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RESEARCH ARTICLE

Mental and Psychosocial Predictors of Toothache in Brazilian Dam Rupture: A Cross-Sectional Study

Paula Carolina Mendes Santos[1*], Marco Antonio Valente Roque[2], Andre Augusto Correa de Freitas[1], Brian Sabato[1], Ana Cristina Borges-Oliveira[3], Frederico Duarte Garcia[4], Maila de Castro Lourenco das Neves[4]

[1]Instituto de Ciências Biológicas. Universidade Federal de Minas Gerais,Brazil
[2]Núcleo de Pesquisa e Vulnerabilidade em Saúde da Universidade Federal de Minas Gerais, Brazil
[3]Departamento de Odontologia Social e Preventiva, Faculdade de Odontologia, Universidade Federal de Minas Gerais, Brazil
[4]Departamento de Saúde Mental, Faculdade de Medicina, Universidade Federal de Minas Gerais, Brazil

*Corresponding author: Paula C.M. Santos: paulamendespne@yahoo.com.br

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Abstract:

The burst of Fundão's dam in Mariana, Brazil, was one of the most significant technological disasters and, for instance, may be associated with negative consequences in oral and mental health. Objective: The present study aimed to investigate the toothache prevalence and the associated factors in disaster survivors. Method: This research is an observational, cross-sectional study carried out as a health household survey with the Mariana dam rupture survivors. Results: the study included 225 adults; age mean 45.5±17.8 years. In univariate analysis, the prevalence of toothache was 16.9% and was higher in women (20.1% versus 11.1%, p= 0.097) subjects with generalized anxiety disorders (GAD) (57.9% versus 25.8%, p≥0.0001), major depressive disorder (MDD) (50 versus 24.6%, p=0.003), post-traumatic stress disorder (PTSD) (26.3 versus 9%, p=0.006), a lower social support satisfaction (SSSS). Multivariate Data Analysis (MVA) results reveal how individuals dissatisfied with their oral appearance were 3.2 times more likely to present with toothaches (p=0.004, 95% CI-1.46-7.02). Of those affected by the disaster, survivors diagnosed with GAD were 2.5 times more likely to present tooth aches (p=0.019, 95% CI=1.16-5.48). Ultimately, the likelihood of an individual presenting with toothaches after the disaster rose to 4% to each point in the SSSS (p.=0.026,95% CI=1.005-1.081). Conclusion: We found that post-disaster survivors in Brazil presented with an elevated prevalence of toothache, and this oral symptom correlated with other dental impairments, anxiety disorder, and social support.

Keywords: Oral health, mental health, disaster survivors

Introduction

Technological disasters became prevalent in the twenty-first century[1]. The International Strategy for Disaster Reduction (ISDR), characterized disasters as "A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" [2]. Technological disasters can be a complex sum of natural hazards and human action. Disasters yield both immediate and long-lasting negative consequences on the health and the wellbeing of people, communities, and economies [3]. People exposed to disasters may develop direct and indirect consequence1, such as personal losses, grief, and traumas[4]. The measure of the damage produced by a disaster correlates to the degree of exposition to the traumatic event, to some personal characteristics such as resilience, previous history of mental disorders; to social characteristics, such as the social support, and the availability of mental health care system [1]. After a disaster, a fast and efficient response from the mental health care system should be warranted to prevent negative consequences.

Individuals affected by disasters are more likely to develop psychological disorders and oral health issues [5]. While the oral condition can increase the suffering of vulnerable populations, it has been little investigated. Self-perception has been studied in developed and underdeveloped countries and, considering the difficulty of performing clinical examination, these subjective indicators have become the only measure of oral health condition with the possibility of establishing the need for treatment [6]. Bivariate analyses showed that there are associations between self-perception of oral health in vulnerable populations, and socioeconomic variables such as drug use, tooth cavity index and self-reported oral health status [7,8].The evidence suggests a multidirectional overlap between oral, mental, and somatic health [5]. Subjects affected by disasters are more prone to develop mental disorders and oral diseases [9]. To the best of our knowledge, four cross-sectional studies investigated oral health in disaster survivors. Sato et al., in 2015, evaluated the prevalence of denture loss after a natural disaster and examined its consequences. The authors reported that 17.2% of participants lost their dentures after the disaster. In this study, denture loss produced a significant impairment in eating and speaking capabilities and discouraged speaking with others [10]. The authors found that participants of upper-middle age, who received dental treatment before the disaster, had lost or fractured denture and those presenting clinical oral health problems were more prone to present lower levels of oral health-related quality of life (OHRQoL). Tsuchiya et al. investigated a toothache prevalence among the disaster survivors and the association with post-disaster distress in health survey [10]. Tsuchiya et al. concluded that participants living in temporary housing presented an increased odds ratio (OR) for toothache than those living in their house [10]. In another study, Tsuchiya et al (2015) associating insomnia and periodontal diseases, reported a significant association between insomnia and periodontal disease and suggested that oral health care should be a need for disaster's victims [11].

One of the most significant technological disaster of the twenty-first century occurred in November 5, 2015, in the Brazilian city of Mariana, as reported by the

Environment Brazilian Institute (IBAMA) and several international institutions [1]. At 4 P.M., a dam from the open-pit mining company Samarco burst, flooding the nearby communities and enveloping homes and cars in the sludge. More than 62 million cubic meters of mud and ore tailings went down through the valley contaminating rivers basins and the lands in three states. Nineteen people died, and thousands remained homeless [1]. Two years after Mariana's disaster, the subjects displaced by the disaster remained in temporary housing, and the perception of the community cohesion remained broken. Legal and political measures taken to repair the damage were not efficient to reallocate the subjects in their original communities and to restore broken social ties.

Previous research, out of the disaster context, with health vulnerabilities, found that risk factors for poor OHRQoL are: proxies of dental impairments [14], upper-middle age 12, female sex 15, social status such as "low income" 16 and "low education levels" 14, low self-rating of general health 14,16 and psychological distress 15.

The assessment of aspects related to health is a need after a disaster. Useful data may lead to and adapt to the health care system needs and approaches provided to the population exposed to a disaster [18]. The American College of Emergency Physicians states that data collection and research are critical for future disaster preparedness and response [19].

Oral health is essential for eating, communication, and comfort, aspects of particular importance in disaster survivors [12]. Toothache is the most prevalent acute experience in the orofacial region affecting teeth and surrounding tissues [20]. In management of oral health after a disaster, toothache prevalence associates with distress after the acute phase 21. This study is an arm of the cross-sectional study named 'Research on the Reality of Mental Health in Mariana - Health diagnosis of families affected by the disruption of the dam in Mariana'(PRISMMA), available for download at www.crr.medicina.ufmg.br/artigos. The present study aimed to investigate the toothache prevalence and the associated factors in disaster survivors. The authors hypothesize that toothache is associated with sociodemographic characteristics (i.e., female gender, upper-middle age, low income), traumatic event exposition, mental health diseases (depression, generalized anxiety disorder, post-traumatic stress disorder) and social support in the Mariana dam rupture survivors.

Methods

This research is an observational, cross-sectional study carried out as a health household survey with the Mariana dam rupture survivors. Data were collected in November 2017, two years after the dam rupture. The Ethics Committee of the Federal University of Minas Gerais (UFMG) assessed and approved the study protocol under the term CAAE 32520314.1.0000.5149. All participants signed an informed consent form.

The field research team consisting of two psychiatrists, two study coordinators, one psychologist, one field coordinator, four team coordinators, one oral surgeon, and sixty four trained researchers.

Sample

The PRISMMA study included adult subjects (aged 18 years or higher), living in the districts directly affected by the mud from the rupture of the Mariana dam (i.e., Bento Rodrigues, Paracatu de Baixo, Paracatu de Cima, Borba, Campinas, Pedras and Ponte do Gama). The exclusion criteria comprised the refusal to participate, severe visual, auditive, or mental impairment that precluded the comprehension of the questionnaire and subjects presenting signs of intoxication by drugs of abuse. The present study included a subsample of the PRISMMA study that accepted to perform a complimentary oral health assessment.

Data collection

Measures

The structured interview questionnaire comprised the assessment of demographics characteristics (i.e., gender, age, educational level, family income), medical history and current clinical disease treatments adapted from the questionnaire used at the Fukushima study 22, the diagnostic of mental health disorders, the social support perception, the impact of the event, and oral health assessment.

The sections of the Brazilian version of the Mini International Neuropsychiatric Interview (MINI) 5.0.0 diagnosed major depressive disorder (MDD), suicide, generalized anxiety disorder (GAD), post-traumatic stress disorder (PTSD) and substance use disorder (SUD) [23].

The Brazilian version of the Social Support Satisfaction Scale (SSSS) assessed social support. The SSSS developed and validated by Ribeiro comprises 15 Likert-type questions that assess four dimensions of social support (i.e., satisfaction with friends; intimacy; satisfaction with family; and social activities). SSSS scores range from 15 to 75 points, with higher scores indicating increased social support 24. The present study used SSSS scores as a continuous variable.

The Impact of Events Scale-Revised (IES-R) [25] evaluated specific stressors related to the dam rupture. Impact of Event Scale-Revised (IES-R) is a 22-item, self-report measure that assesses distress caused by traumatic events. Respondents were requested to identify a specific stressful life event and then indicate how they were distressed during the past seven days. For the analysis, we used the IES-R score as a continuous variable. We asked the Mariana dam rupture survivors about the actual presence of toothache [26,27].

The oral health questionnaire was developed for the present study based on previous studies by Oliveira et al., (2008) and Teixeira et al., (2015), having the variables related to oral heath based on the National Oral Health Survey 2010 [28]. The questionnaire containing 15 dichotomous questions to evaluate satisfaction with oral appearance, toothache, bruxism, daily teeth brushing, daily flossing, perception of halitosis, dentist consultation every six months, oral hygiene habits and access to dental service.

Statistical analysis

In the descriptive analysis, we calculated mean, standard deviation (SD), median, and range for continuous variables; and absolute, relative frequencies, and proportions for categorical variables. We assessed data normality using the Kolmogorov-Smirnov test; all the continuous variables presented a non-normal distribution. Chi-square test to compared categorical variables. To calculate the odds ratio (OR) of the factors associated with a toothache, we conducted multiple logistic regression with a stepwise backward selection. The model assessed all variables presenting a $p \leq 0.2$ in the univariate analysis. Statistical analyses considered a $p \leq 0.05$ as significant. Nagelkerke's R square test assessed the predictive capacity of the logistic model obtained. The Statistical Package for the Social Sciences (SPSS), version 24 (IBM, NY) performed the analysis. A prevalence of toothache was found in 16.9% of those affected.

Characteristics associated with a toothache in univariate analysis

Toothache was significantly more prevalent in women ($\chi2 = 3.01$, $p = 0.097$), subjects with depressive disorder ($\chi2 = 9.919$, $p=0.003$), or generalized anxiety disorder ($\chi2 = 14.9$, $p\geq0.0001$), or post-traumatic stress disorder ($\chi2 = 8.873$, $p=0.006$). Subjects with toothache presented a lower social support satisfaction (40.6 ± 10.5 versus 33.43 ± 9.9, $p<0.0001$, Student t-test), and a higher oral appearance dissatisfaction ($\chi2=16.5$, $p\geq0.0001$), a and a more prevalent perception of halitosis ($\chi2 = 9.556$, $p= 0.002$) (Table 1).

Table 1- Factors associated with a tooth in the univariate analysis (n=225).

		Toothache		No toothache				Total	
Characteristic		N	%	N	%	Qui-square- $\chi2$	p	n	%
Sex	Male	9	23.7	72	38.5	3.01	0.097	81	36.0
	Female	29	76.3	115	61.5			144	64.0
Race	White	32	84.2	147	78.6	0.609	0.514	179	79.6
	Non-white	6	15.8	40	21.3			46	20.4
Marital status	Married	14	36.8	80	42.8	0.458	0.589	94	41.8
Education	Less than eight years	21	55.3	112	59.9	0.280	0.593	133	59.1
	More than eight years	17	44.7	75	40.1			92	40.9
Current clinical diseases		34	89.5	151	80.1	1.645	0.249	185	82.2
Substance use disorder		5	13.2	13	7	1.65	0.198	18	8.0
Depressive disorder		19	50	46	24.6	9.919	0.003	65	28.9
Generalized anxiety disorder		22	57.9	50	25.8	14.9	≥0.001	72	32.0
Post-traumatic stress disorder		10	26.3	17	9	8.873	0.006	27	12.0
Satisfaction with oral appearance		12	31.6	125	66.8	16.5	≥0.001	137	60.9
Bruxism		10	26.3	29	15.5	0.354	0.55	39	17.3
Daily toothbrushing		37	97.3	177	94.6	0.87	0.76	214	95.1
Daily flossing		23	60.5	109	58.4	0.065	0.85	132	58.7

Perception of halitosis	15	39.4	32	17.1	9.556	0.002	47	20.9
Dentist consultation every six months	19	50	69	36.9	2.28	0.147	88	39.1
	Mean±S.D.		Mean±S.D.		P	95% C.I.	Mean±S.D.	
Social support satisfaction scale	40.6±10.5		33.43±9.9		≤0.001*	3.6-10.6	36.64±10.3	
IES-R	45.5±19.8		35.5±19.6		0.005*	3.0-16.8	37±19.9	

IES-R: Impact of Events Scale-Revised; S.D.: Standard deviation; 95% C.I.: 95% confidence interval. * Student t-test.

Multivariate analysis

Including the variables presenting a p>0.2, the multivariate analysis yield a proper fit of the model, according to the Hosmer-Lemeshow goodness of fit test (p = 0.944). The Nagelkerke coefficient of determination explained 21,0% of the model (R^2 = 0.210). Table 2 shows the results of the multivariate analysis

Table 2- Factors associated with toothache in multivariate analysis

Characteristic	Odds Ratio	Std. Err.	p	95% C.I.	
Unsatisfaction with oral appearance	3.20	0.40	0.004	1.46	7.02
Generalized anxiety disorder	2.53	0.39	0.019	1.16	5.49
Social support dissatisfaction scale	1.04	0.02	0.026	1.005	1.081
Constant	0.005	0.90	<0.001		

Toothache rates are found to be higher among the disaster survivors, and were associated with oral appearance dissatisfaction, diagnosis of generalized anxiety disorder, and dissatisfaction with social support satisfaction in the multivariate analysis. Individuals unsatisfied with the appearance of their teeth were 3.2 times more prone to present toothache (p=0.004, 95%CI=1.46-7.02). Dam rupture survivors with GAD were 2.5 times more prone to present toothache (p=0.019, 95%CI=1.16-5.48). Finally, the chance of presenting toothache after the disaster increased 4% for each point increase in SSSS (p=0.026, 95%CI=1.005-1.081).

The quality of the regression adjustment, that is, the ability of this multivariate model to infer about the odds of the events studied, was given by the Hosmer-Lemeshow test (p+0.944), which demonstrated a good effectiveness of the adjustment in these associations. The Nagelkerke Coefficient showed that the multilevel model was able to explain about 21% of the variations in toothache reports in people who survived the Mariana dam failure.

Discussion and conclusion

This study assessed the prevalence and associated factor of toothache in Mariana's dam rupture survivors, two years after the disaster. In parallel with the initial hypothesis, the results suggest that low satisfaction with dental appearance, the presence of GAD, and a high level of dissatisfaction with social support associated with a greater chance of reporting toothache among dam rupture survivors.

The overall prevalence of toothache observed was 16.9% in the dam rupture survivors. This prevalence is higher than the 15.2% found by Peres et al., using the Telephone Survey Surveillance System for Risk and Protective Factors for Chronic Diseases (VIGITEL) in 2009, among adults living in Brazil's State capitals [28] and higher than the 13.9% found in south-eastern Brazil, the region of the dam disaster [28]. This finding reinforces the need for dental care after a disaster.

The prevalence of toothache found in the present study is 2,5 fold higher than the prevalence found by Tsuchiya and colleagues in 2018 after the Great East Japan Earthquake survivors in 2016 [21]. Albeit, the Brazilian studies show an increased prevalence of toothache, when compared to the Japanese 15.2% versus 1.8% point prevalence in the general population, in both populations exposed to disasters present a much higher prevalence (i.e., 16.9% X 7.9%, respectively) when compared to the general population. Toothache is directly associated with low socioeconomic status, oral health deterioration, poor dental hygiene habits, and low or lack of access to health services [16,29]. Moreover, the differences between the Brazilian and Japanese populations may be due to individual's human development index, as reported in the study of Ardila et al. [30].

The present study found that individuals with oral appearance dissatisfaction were 3.2 times more prone to toothache. Tessarollo et al., in 2018, found that the severity of malocclusion interfered with the satisfaction of dental appearance [31]. Besides, malocclusion could be associated with a need for orthodontic treatment [32] and bruxism [33]. Bruxism causes pain because of the overloading of the musculoskeletal tissue, and craniofacial pain, on the other hand, triggers more bruxism [34]. Thus, one possible hypothesis is that the association between oral appearance dissatisfaction and toothache is mediated by malocclusion and bruxism. Besides that, toothache also has been associated with oral health deterioration [32], and this deterioration may be associated with oral appearance dissatisfaction.

We found that 32% of survivors of dam rupture had GAD, and these subjects were 2.5 times more prone to had toothache. The prevalence of GAD found is three times higher than the reported in the general Brazilian population, which is 9.3% [1]. Besharat et al. [35] also found that individuals diagnosed with GAD are more prone to have toothache compared to those who do not have this diagnosis. Anxiety disorders is a significant risk factor for bruxism, an essential cause of toothache [36]. Thus, the vulnerability to toothache in the studied population may be related to an increase in the prevalence of anxiety. Further studies are needed to investigate whether this relationship between anxiety and toothache can be mediated by bruxism in disaster survivors. Based on our findings, oral health professionals caring for patients who have gone through situations of high stress, should consider the possibility of anxiety disorders comorbid in patients experiencing toothache.

Finally, the study results suggest that low social support was associated with toothache. In parallel to our results, previous pain research demonstrated that the perception of social support was associated with a reduction of pain perception [37,38,39]. In a recent systematic review and meta-analysis, Che et al., found that clearly expressed social support (e.g. verbal communication, handholding) decrease pain [40]. In post-disaster research, a review assessing forty-one studies investigating different facets of post-disaster supportive interactions reported that exists a salutary effect of supportive behaviors on psychological distress [41]. Social support is also related to a protective factor for the recovery and coping of post-disaster [42]. Social support may provide supportive resources from others (e.g., emotional, economical, informational), increase individual resilience, and the perception that supportive resources are available if they are needed [43,44]. All

the studies reported above are in agreement with our finding and point out that social support can offer health protection to individuals affected by major stressful events.

Some drawbacks limit the generalization of the results of this study. Due to the cross-sectional nature of the investigation hindered the likelihood to recognize any cause-effect relationship. Oral Health was not assessed by a validated instrument for the Brazilian population making data comparison limited. Finally, the sample comprised more adults and elderly subjects, populations with higher risk to present toothache than the general population.

To the best of our knowledge, this is the first study to demonstrate an association between satisfaction with dental appearance, generalized anxiety disorder, social support, and toothache two years after a disaster in survivors.

In summary, we found that post-disaster survivors in Brazil presented an elevated prevalence of toothache, and this oral symptom correlated with other dental impairments, anxiety disorder, and social support. Three points are important to highlight from our findings: the possibility of medium and long-term oral health impacts on disaster survivors, the complex and intimate relationship between mental and oral health, and the need for dentists to set up assistance teams for post-disaster individuals. Thus, in the medium and long term, public policies after disasters must include comprehensive assistance to individuals, including oral health. Longitudinal studies are necessary to assist in the evaluation of such policies and contribute to the knowledge between the relationships between oral and mental health and their psychosocial determinants.

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