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Original Article

Socio-environmental disaster: the health conditions of those affected from the perspective of healthcare professionals and managers*

Desastre socioambiental: condições de saúde dos atingidos na perspectiva dos profissionais de saúde e gestores

Desastre socioambiental: condiciones de salud de los afectados desde la perspectiva de los profesionales y gestores sanitarios

Camila da Silveira Santos[I], Alexandra Dias Moreira[I], Kênia Lara da Silva[I], Francisco Carlos Félix Lana[I]

[I] Federal University of Minas Gerais. Belo Horizonte, Minas Gerais, Brazil

***The manuscript originates from preliminary data of the thesis entitled Socio-environmental disaster in Mariana: the implications for the health conditions of the affected population and the work process of healthcare services, which will be presented to the Postgraduate Program of the Nursing School of the Federal University of Minas Gerais.**

Abstract

Objective: to analyze the health conditions of the population affected by the mining dam collapse from the perspective of healthcare professionals and managers. **Method:** this is a qualitative case study, conducted using public domain documents and interviews with healthcare professionals and managers, from March to May 2022, totaling 14 participants. The data were analyzed according to the theoretical propositions strategy based on the Social Determinants of Health. **Results:** the health conditions of this population have worsened in terms of respiratory problems, gastroenteritis, obesity, arboviruses, increased use of alcohol and drugs, and mental illnesses. The loss of employment, home, and community belonging of those affected is highlighted. **Conclusion**: the socio-environmental disaster was a conditioning factor for changes in the health conditions of those affected, exposing them to new scenarios and overlapping risks capable of modifying their quality of life and aggravating their biopsychosocial health conditions.
Descriptors: Health-Disease Process; Social Conditions; Social Determination of Health; Man-Made Disasters; Mining

Resumo

Objetivo: analisar as condições de saúde da população atingida pelo rompimento da barragem de mineração na perspectiva dos profissionais de saúde e gestores. **Método:** estudo de caso qualitativo, realizado por meio de documentos de domínio público e entrevistas com profissionais de saúde e gestores, entre os meses de março a maio de 2022, totalizando 14

participantes. Os dados foram analisados segundo a estratégia de proposições teóricas à luz da Determinação Social da Saúde. **Resultados:** considera-se como piora nas condições de saúde em relação aos problemas respiratórios, gastroenterites, obesidade, arboviroses, intensificação do uso de álcool e drogas, e doenças mentais. Destaca-se a perda do trabalho, da casa, e do pertencimento comunitário dos atingidos. **Conclusão:** o desastre socioambiental foi condicionante para mudanças nas condições de saúde dos atingidos, expondo-os a novos cenários e sobreposição de riscos capazes de modificar a qualidade de vida e agravar as condições de saúde biopsicossociais.
Descritores: Processo Saúde-Doença; Condições Sociais; Determinação Social da Saúde; Desastres Provocados pelo Homem; Mineração

Resumen

Objetivo: analizar las condiciones de salud de la población afectada por el colapso de la presa minera desde la perspectiva de los profesionales y gestores sanitarios. **Método:** estudio de caso cualitativo, realizado por medio de documentos de dominio público y entrevistas a profesionales y gestores de salud, entre marzo y mayo de 2022, con un total de 14 participantes. Los datos fueron analizados según la estrategia de proposiciones teóricas a la luz de la Determinación Social de la Salud. **Resultados:** se considera el empeoramiento de las condiciones de salud en relación con los problemas respiratorios, la gastroenteritis, la obesidad, los arbovirus, la intensificación del consumo de alcohol y drogas, y las enfermedades mentales. Se destacan la pérdida del trabajo, del hogar, y de la pertenencia a la comunidad de los afectados. **Conclusión:** el desastre socioambiental fue un factor condicionante de alteraciones en las condiciones de salud de los afectados, exponiéndolos a nuevos escenarios y riesgos superpuestos capaces de modificar la calidad de vida y empeorar las condiciones de salud biopsicosocial.
Descriptores: Proceso Salud-Enfermedad; Condiciones Sociales; Determinación Social de la Salud; Desastres Provocados por el Hombre; Minería

Introduction

On November 5, 2015, the collapse of Samarco's Fundão dam in Mariana, a town in the state of Minas Gerais, spilled more than 50 million cubic meters of ore tailings that flowed into the Doce River and its tributaries, reaching the Atlantic Ocean.[1-2]

Considered the worst mining disaster nationwide in terms of socio-environmental damage, the dam collapse caused 19 deaths, totally devastated the rural communities of Bento Rodrigues and Paracatu de Baixo, along with the sub districts of Mariana, and several other towns in Minas Gerais and Espírito Santo.[1-3] Its impacts, which are still ongoing, have left their mark on the lives of hundreds of families affected in Mariana, who have sought, over the years, to recover their infringed rights.[3-5]

Disasters are inherently caused by social actions and practices, they are not restricted to natural phenomena and should be considered to be systemic risks.[6-7] They stem

from the lifestyle and production in society, influenced by the production and consumption model consisting of capitalism and mining extractivism.[5,7] The production process rooted in mining, characterized by the excessive exploitation of natural resources, causes environmental, cultural, and economic damage, in addition to situations of risk and vulnerability, and is intrinsically related to the social determinants of health.[1,5]

Mining mega-enterprises and the effects of mineral neo-extractivism advocate for development and economic progress above all else, leading to the dismantling of social and environmental matters.[8] In this sense, the profitability of the enterprise, as opposed to the low investment in dam infrastructure, added to little or no environmental monitoring, is a conditioning factor for the constant mining dam ruptures in the country.[7]

The health-disease process, according to social determinants, is a phenomenon in which biological and social relations, and society and nature, are intertwined dialectically.[9] By articulating the biological and social dimensions, a comprehensive and broad perspective of healthcare is provided in order to explain the relationships between lifestyles in society and health conditions in the context of mining disasters.

The sharp growth of socio-environmental damage, especially due to mining tailings dam ruptures,[8] has caused excessive destruction in the environment, with deleterious repercussions on the health and lifestyles of the affected populations. In this regard, disasters should be considered a serious public health issue that requires actions to prevent, respond to, and recover the health of those affected.[6] In this context, healthcare professionals and managers are identified as key actors in risk management and in the recovery of the living conditions and health of victims.

It is necessary to consider the multiple determinants and singularities of the implications of the mining dam collapse that reverberate in the forms of illness and suffering for the population of Mariana, especially when articulating the biological and social aspects as the essence of the health-disease process, which can outline the multidimensionality of the disaster. Considering that few human health risk assessments have been carried out in Mariana and/or the other affected towns, this study is justified and relevant to the production of knowledge on this phenomenon. In addition, the continuous monitoring of the risks and damage to the health of the affected individuals, not only in the short term, but also for several years following the

onset of the event, is relevant. In this sense, the objective of the present study was to analyze the health conditions of the population affected by the mining dam collapse from the perspective of healthcare professionals and managers.

Method

This is a case study with a qualitative approach, considered an appropriate strategy when addressing issues in which contemporary phenomena of social reality are present and which can be complemented by other exploratory and descriptive inquiries.[10]

This study was carried out in the town of Mariana, the scene of one of the largest socio-environmental disasters involving a mining dam collapse worldwide, when considering the volume of tailings spilled and the distance traveled by the sludge, which was over 600 km until it reached the mouth of the Doce River in the state of Espírito Santo.,[1-2] as shown in Figure 1.

Figure 1 - Path of the Ore Tailings Sludge from the Fundão Dam - Mariana.
Source: Max Vasconcelos, 2017.

This study was carried out at the Local Health Department (LHD) and in the public healthcare units of Mariana, which have been established in the post-disaster period to provide exclusive care to the directly affected population, namely the Basic Health Unit (BHU) of Bento Rodrigues/Paracatu de Baixo and the Psychosocial Care device named *Conviver*. The evidence sources were obtained through public domain documents and interviews with healthcare professionals and managers from Mariana.

The documents have been selected based on their content, relating them to the previously defined objective, aiming to analyze the implications of the socio-environmental disaster and its social determination on the health and disease of the affected population. Designated by the letter D (for document) and by a numerical sequence, they refer to official health information of the city, available in the Update of the City Plan for Planning and Managing Health Recovery Measures following the Samarco Tailings Dam Collapse in Bento Rodrigues, Mariana. — D1; in the human health risk assessment study in locations affected by the Fundão dam collapse — D2; and in the Research on the mental health of families affected by the collapse of the Fundão dam in Mariana — D3, in addition to secondary data from health surveillance systems of the Unified Health System (SUS), such as: the Health Information System for Primary Care and Hospital Information System.

The interviews were carried out between March and May 2022 using a semi-structured script that followed the guiding question: What are the implications of the Mariana socio-environmental disaster on the health-disease process of the affected population? Data collection was carried out by the main researcher who had been previously trained for this purpose, in private spaces in the participants' work environment, individually, with each professional after obtaining their authorization and signing the Informed Consent Form. They were recorded on two digital electronic audio devices, transcribed in full, and with an average duration of forty minutes.

The sample was selected intentionally, with the participation of professionals from the Bento Rodrigues/Paracatu de Baixo BHU, from the *Conviver* device, and health managers from the LHD. The inclusion criteria were the following: healthcare managers who had a vital role in the context of the disaster response; and professionals who had been carrying out healthcare activities for at least six months in healthcare institutions that exclusively provided care to the affected population.

A professional who was on medical leave and three who failed to meet the criterion of time working in the service were excluded. It is noteworthy that two other professionals refused to participate in the study for personal reasons, since both belonged to the community of Bento Rodrigues and did not want to recollect the situations experienced in the disaster. A total of 14 participants were interviewed, including

three managers, three medical doctors, two occupational therapists, two psychologists, a nurse, a social worker, a social educator, and a community health worker.

Data from the Health Information System, documents, and interviews that were used as sources of evidence were analyzed according to the theoretical propositions strategy and the chronological analytical technique[10] according to the Social Determination Theory of the Health-Disease Process.[9] The time series analysis technique through chronology enables tracing the phenomenon over time, considering the sequence of events, contingency, predetermined time interval, and time periods.[10] For this purpose, the data were coded, a structured presentation was carried out in chronological order, and the analysis itself was conducted by analogy, with comparisons with the established theoretical sources.

All ethical precepts regulating research with human beings were complied with, according to Resolutions No. 466/2012 and No. 580/2018 of the Ministry of Health. The study was approved by the Research Ethics Committee of the Federal University of Minas Gerais under opinion No. 5.240.469 on February 13, 2022. The anonymity of the participants was ensured through the use of an identification code represented by the name of the cities affected by the ore tailings sludge from the Mariana disaster, as listed in Figure 1.

Results

Through the analysis of documentary data and interviews with healthcare professionals and managers in Mariana, it became clear that the damage caused from the emergency moment, and the damage that extends in the medium and long term, has become a process of chronic suffering for the affected population, which has lasted for more than seven years since the collapse of the tailings dam.

During the emergency period, following the dam collapse, the damage suffered by the population directly affected was due to the deaths, trauma, and injuries caused to the victims swept away by the wave of tailings sludge.

> *Nineteen lives were lost and dozens of injured people were taken to the city hospital for care. The serious cases were sent directly to the state capital.* (D1)

Health conditions were worsened due to direct contact with the Fundão dam sludge at the time of the disaster, and over time through contaminants present in the air, water, and soil, putting the health team on alert for possible intoxication and its consequences.

> *Contact with heavy metals was a matter for which we've raised lots of questions for the health department, because we needed to understand the health consequences and what signs and symptoms people could present. There were people who had come into direct contact with the sludge. People who had swallowed the sludge. Won't this bring them any harm in the future?*(Conselheiro Pena)
>
> *Complaints such as cough, runny nose, hoarseness, sinusitis, cold, itchy skin, and allergic reactions were common after contact with the tailings sludge from the dam collapse in the affected localities.* (D2)

In the following years after the dam collapse, primary care assistance was higher for respiratory diseases, and hospital admissions increased due to these and other conditions, such as dermatological diseases, as well as clinical and laboratory changes, as shown in Figure 2.

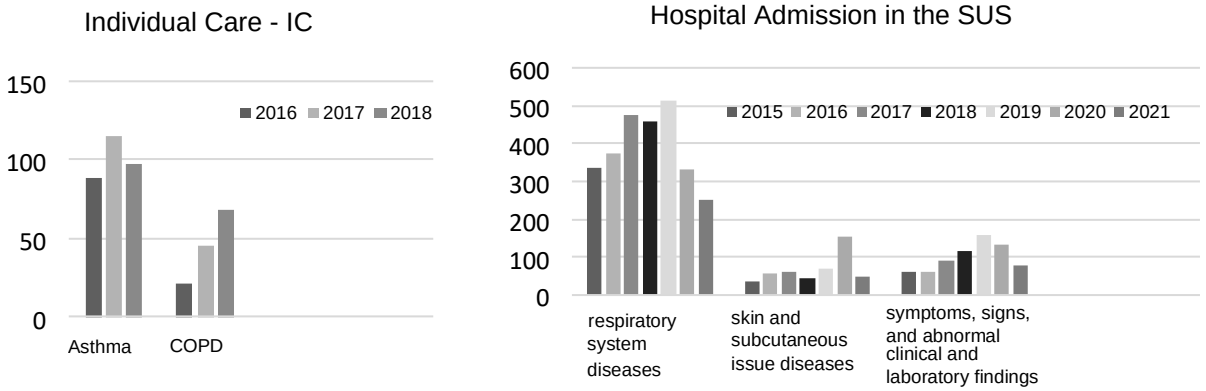

Figure 2 - Individual Care by Conditions Assessed in Primary Care and Hospital Morbidity in the SUS - Mariana.

Source: Health Information System for Primary Care – HISPC; Hospital Information System – HIS/SUS, 2022.

Other problems such as gastroenteritis, intoxication, and conjunctivitis were identified with an increase in the years following the disaster, indicating a possible toxicity of the tailings sludge that triggered the contamination of water, soil, and air with heavy metals.

Regarding arboviruses, there was a surge in dengue cases in 2016 and yellow fever in 2018, as shown in Figure 3.

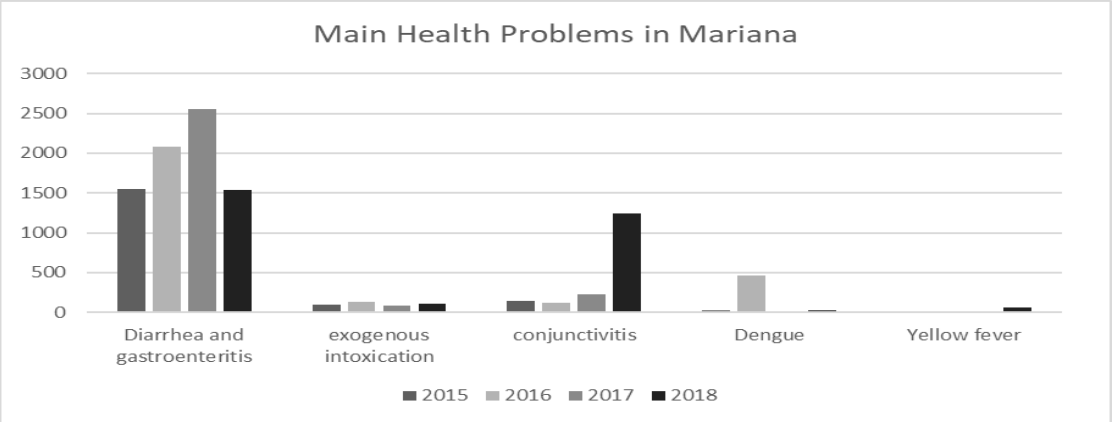

Figure 3 - Main health problems identified in the aftermath of the Mariana disaster.
Source: adapted from Mariana, 2019.

The cause of the increase in arboviruses, according to the report, is related to the environmental devastation as a result of the sludge wave from the dam collapse, which caused changes in the cycles of vectors, hosts, and reservoirs of diseases.

> *With the sludge what changed (not only in my community, but in the city), is that there was an outbreak of yellow fever in 2018. Of course it was due to the sludge, because frogs died, fish died, and the mosquitoes became more prevalent. We've lost a lot of people here! There were very serious impacts that happened post-collapse.* (Conselheiro Pena)

It is also worth noting weight gain as a factor in the changes of the health conditions of the affected population.

> *I've noticed that people in Bento Rodrigues have gained weight.* (Conselheiro Pena)
>
> [...] *People have also become more sedentary. We've realized that the vast majority of people put on weight. Several individuals ended up becoming obese because they no longer exercised, they just stayed indoors.* (Bom Jesus do Galho)

ver the years following the disaster, there was an increase in individual care related to obesity, diabetes, and hypertension, according to Figure 4. As a result of the changes in lifestyle imposed on the affected population, there were significant changes in the health-disease process.

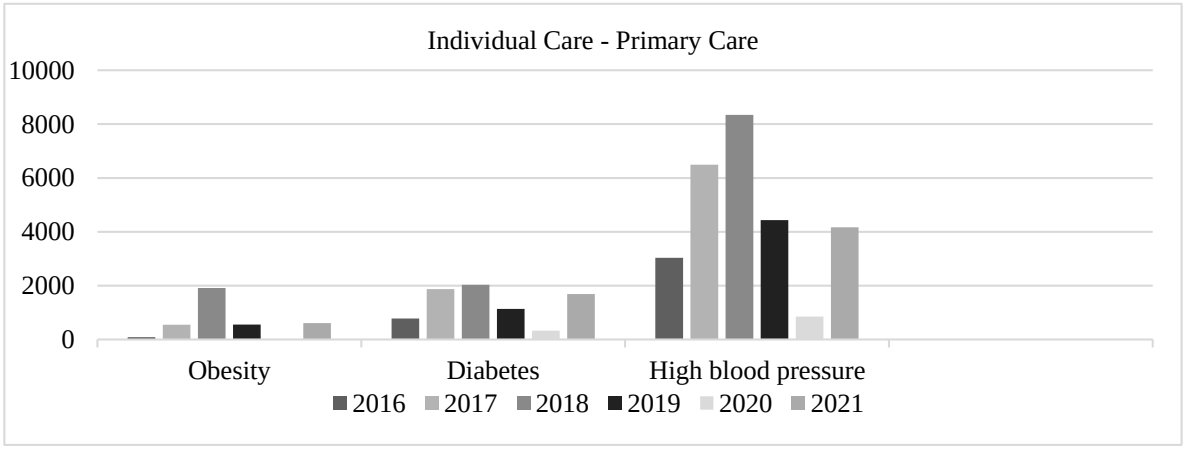

Figure 4 - Individual Care by Conditions Assessed in Primary Care – Mariana.

Source: Health Information System for Primary Care – HISPC, 2022.

> *Many people said: "look, my diet has changed, because before I used to plant and harvest my own food. It was healthier! I didn't have to buy it! Today I have to buy it!" Many people did not have to take medication for blood pressure, anxiety, high cholesterol, and several other conditions. I blame this on the dam collapse. People used to sleep well, today they no longer sleep so well. They had a different quality of life! So when those affected came to Mariana, the health process went through a major change.* (Rio Doce)

The ore tailings sludge spill compromised the health of those affected in several ways, in addition to the biological health complications. There are serious implications that have been present, especially in psychosocial health conditions.

There has been an increase in demand for mental health services, and with this, cases of depression, post-traumatic stress disorder, and anxiety are among the most prevalent disorders.

> *There are many demands that revolve around this disruption, so we have mostly psychosocial issues [...], people who have mental health disorders due to the dam collapse, especially anxiety disorders and depressive disorders. It is important to highlight panic disorder and post-traumatic stress disorder.* (Bom Jesus do Galho)

> *There is a higher prevalence of mental disorders in this population, increased cases of depression, anxiety, attempted self-extermination, and suicidal ideation. If compared to the general population, there is a higher prevalence of these disorders in the affected population.* (Ipatinga)

> *There is a prevalence of depression among those affected of 28.9%, this percentage is five times higher than the average in the Brazilian population in 2015. In the child and adolescent population affected by*

> *the dam collapse, the prevalence of depression is 10 times higher than that of the general population in the same age group.* (D3)

In addition to the profile of users with demands focused on depression and anxiety aspects, cases of post-traumatic stress disorder and extreme cases of self-inflicted violence are common in the affected population, which triggered deaths by suicide after the dam collapse (Figure 5).

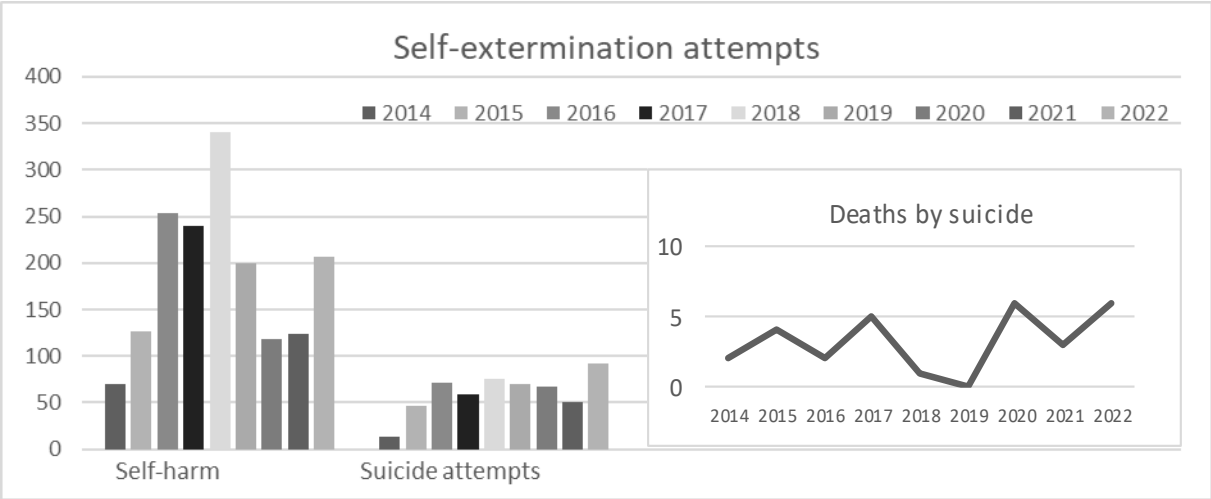

Figure 5 - Notification of self-inflicted violence in Mariana.

Source: Thematic Panel of the Health Surveillance Website of Minas Gerais, 2022.

The health condition of those affected is permeated by multiple and overlapping exposure and risk situations due to the recurrence of socio-environmental disasters nationwide.

> *We've realized that with every tragedy, every crime, every bad thing that happens, there is an impact on the mental health of the people affected. I've seen people who said: "After that dam collapse in Brumadinho, I got depressed again and couldn't go to work anymore!". This did not happen to just a couple of people, it happened to several people. And every year something different happens. At the beginning of the year there was a flood in Rio de Janeiro that brought back memories for the people here.* (Raul Soares)

The use of alcohol and other drugs intensified in the post-disaster period as a result of easier access to these substances following the influx of the affected community to the urban area of the city.

> *Drug use has always existed everywhere, but after the dam collapse I think there was an increase in drug use, because access became easier since we were inside Mariana city.* (Conselheiro Pena)

As a result of the psychosocial problems suffered by the population of Mariana, especially the population directly affected, a considerable increase in the prescription of psychotropic medications was identified, as reported:

> *We have noticed an increase in the use of psychotropic medications and the demand for psychiatric care has increased a lot.* (Colatina)

The health-disease process of the population of Mariana underwent relevant changes in biopsychic conditions following the socio-environmental disaster in 2015, however, it is worth noting that in addition to the disease-centered perspective, individuals and their collectivity receive care from healthcare professionals in their sociocultural, economic, and symbolic needs.

> *For me, the dam collapse has serious consequences, not only for health, but also for matters concerning belonging and bonds (community, social, and family) [...]. People lost their jobs, lost their culture, and lost their history. All this is part of the health-disease process! [...] It is employment, income, food, school, leisure, and culture that were lost, it was an entire community that suffered all this.* (Rio Doce)

The loss of employment, home, community ties, and belonging, among other material and immaterial/symbolic losses for the affected population, reflects a direct impact on the quality of life and the process of illness of the population.

Discussion

Human-made disasters have the potential to trigger damage to physical and mental health, leading to negative consequences for those affected and their families.[11] The collapse of the mining tailings dam in Mariana caused considerable loss to the quality of life of those affected by the sludge, leaving them exposed to the proliferation of diseases, psychological damage, the loss of their homes, unemployment, the rupture of community ties, among other forms of damage.[1,12-13]

The compromised health of those affected by direct contact with the sludge, although fewer in number in the general population of Mariana than in communities that had great exposure to mining tailings, caused respiratory and dermatological

problems. The increase in air pollution from the dust generated by the tailings sludge that has dried up has led to an intensification of respiratory diseases and cases of conjunctivitis in the affected region, and in the long term, may lead to cases of cancer and/or other diseases.[14-15]

On the other hand, cases of diarrhea and gastroenteritis, as well as those of exogenous intoxication, have been noted in the medium term — the period of months following the disaster, can be associated with the contamination of soil and water following the spill of the toxic sludge of the ore tailings.[15] Heavy metals present in mining tailings are indicative of exogenous intoxication in the affected population through waterborne transmission or contact with soil and consumption of contaminated food[8,16-17] in the various territories impacted by the mega-developments imposed by mining companies.

The increase in arboviruses following the collapse of the Fundão dam is noticeable and can be explained by the environmental devastation. The sudden and devastating invasion of the sludge through forests, rivers, and houses caused the reduction of the mosquito's natural predators and its proliferation, contributing to the increase in cases of dengue, yellow fever, and other arboviruses.[18]

As mentioned, the actions of individuals in the environment in which they are inserted, the socioeconomic relationship, the historical context, and the cultural values they hold regarding the space are directly related to the health condition of the population. Thus, the community's health-disease process is related to how it has been appropriating and modifying the surrounding environment. Therefore, regarding the collapse of an ore tailings dam, and the potential devastation that this enterprise can cause, with the imbalance of the ecosystem and, above all, changes in health conditions, the increase in these problems is considered intrinsic to the disaster in Mariana.

Regarding the observed weight gain and obesity, the new reality of life imposed on those affected after they had been forced to move to another region, triggered changes in the habits and customs of an old rural community, altering their lifestyle, diet, work routine, and leisure activities. These consequences add to the health condition caused by obesity, in addition to complications of chronic diseases such as

high blood pressure and diabetes, which are directly related to the occurrence of environmental disasters.[19]

Concerning mental disorders such as depression, anxiety, post-traumatic stress disorder, or aggravation of these existing cases, it is noted that the occurrence of socio-environmental disasters, such as the one that happened in Mariana, and later in Brumadinho, both of which are mining towns where mining is the main economic source, are conditioning factors for these psychopathologies.[20-21]

The increase in self-harm and suicide attempts is eminently evidenced in Mariana, as found in other traumatic contexts.[21-23] The incidence of self-extermination attempts is often observed proportionally to the time post-disaster.[22] Exposure to natural or human-made disasters leads individuals to react in different ways to stress and suffering. Those who suffer the loss of loved ones, loss of employment and/or source of income as a result of events of this magnitude are more susceptible to indiscriminate use of alcohol and other drugs.[24]

With the increase of the demand for mental health care, the demand for medication for the treatment of acute and chronic psychic disorders was considerably higher in Mariana, and in similar situations, the excessive use of psychotropic drugs following a disaster, especially antidepressants, was common in the national and international literature.[25-27] It is understood that mental health is not only analyzed from the perspective of the individual and biological dimension, but, above all, collectively, including cultural, historical, social, economic, political, and environmental aspects, considering that the economic and social disorganization caused by disasters results in negative impacts on the well-being and health of those affected.[25]

The impact on the local economy and the means of survival, which include income, employment, as well as affective losses, housing, disruptions in social networks, education, and health, are intrinsically related to the disaster and interfere in the population's illness process.[21,25] With the collapse of the Fundão dam, there was a reduction in the financial tax collection of the city and a substantial increase in unemployment, due to the closure of the mining company and the removal of those affected from their communities.[1,12]

The violation of the rights for work, housing, the process of rupture of community ties, among other issues, interfere in the health-disease process at different levels and in different ways, intensifying the health inequities and socio-environmental vulnerabilities of the population.[1,28] The central role of employment for individuals goes through multiple variables, among them, the means of income and survival, source of social identification, self-esteem, and above all, it has a constitutive character for individuals, including the psychic dimension, awakening emotions and feelings of belonging or capable of causing illness.[29]

Similarly to the understanding of employment, those affected, the victims of disasters, bring a perspective of the territory beyond the geographical space that permeates the community, but as a place of bonds and belonging, in which social, historical, and affective relationships are essential for the constitution of individuals.[30] Therefore, the forced displacement of the place where the affected communities lived reflects the suffering, the feeling of detachment, of loss of memories and life history of these individuals, thus leading to illness.

Psychic signs and symptoms are often related to the abrupt changes experienced by the affected communities, such as moving to a new house/location, living far away from family members and former neighbors, separation from their pets, and constant concern about the future.[15] Therefore, reflections concerning working conditions, housing, income, and social bonds interfere and constitute the essence of the health-disease process, and that the recovery of these basic rights, lifestyle, and autonomy is essential for the transformation of the health status of the affected population, contributing to a health practice focused on comprehensive care and health promotion.

As a limitation of this study, the lack of a temporal analysis of the health conditions prior to the occurrence of the dam collapse stands out. Given that it was not possible, from the perspective of the healthcare professionals and managers interviewed, to make a comparison of the health conditions of the affected population before and after the triggering event, further studies are recommended.

Regarding the implications for public health practice, it is believed that these findings can subsidize the health sector in addressing future risk scenarios for disasters of this magnitude, contributing to the understanding of the damage caused to human

health and allowing the planning of actions focused on the comprehensive care of the affected population.

Conclusion

The implications of the mining disaster that occurred in Mariana in 2015 caused changes in the health-disease process of the affected population. In the emergency period following the dam collapse, in addition to the numerous fatalities, dozens of individuals were buried by the ore tailings sludge and were poisoned by chemical agents. Over the months, respiratory problems, waterborne diseases such as gastroenteritis and intoxication, and an increase in arboviruses were noticed and had a negative impact on their health.

In the medium and long term, cases of depression and other psychosocial disorders have intensified the chronic suffering of those affected. There is an increase in cases of post-traumatic stress disorder, anxiety, abuse of alcohol and other drugs, use of psychotropic medications, and cases of self-inflicted violence.

The forced displacement to the urban area of the city led to changes in the habits and customs of the formerly rural community, thus resulting in changes in their lifestyle, diet, work and leisure routine, weight gain, obesity, in addition to the intensification of chronic diseases such as diabetes and high blood pressure. It is noteworthy that the health conditions of those affected are determined, above all, by the constant violation of the rights for housing, employment, and fair and timely compensation. This is evidenced by the situation in which the communities of Bento Rodrigues and Paracatu de Baixo find themselves in, which, more than seven years after the disaster, have not yet been definitively resettled in their new land.

The results suggest that the socio-environmental disaster caused by the collapse of the mining dam in Mariana was a conditioning factor for the worsening of the health conditions of those affected, exposing them to new scenarios and overlapping risks capable of modifying their quality of life and worsening their health conditions.

In light of the fact that the mining disasters are not limited to the moment of the dam collapse, but last for as long as the suffering of the victims continues, it is essential to learn from these events and find ways to overcome the current living and health

conditions in these areas. Above all, it is hoped that healthcare professionals and managers can develop new psychosocial support strategies to strengthen social bonds and support networks, so that the suffering of those affected is mitigated and not only medicalized, promoting care that is capable of meeting the health needs of this population.

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Corresponding author

1 – Camila da Silveira Santos
Corresponding author
Nurse, PhD student in Nursing - camilasilveiraufsj@gmail.com
Conception and development of the research, writing of the manuscript, revision and approval of the final version.

2 – Alexandra Dias Moreira
Adjunct Professor, PhD in Nursing - alexandradm84@gmail.com
writing of the manuscript, revision and approval of the final version.

3 – Kênia Lara da Silva
Associate Professor, PhD in Nursing - kenialara17@gmail.com
writing of the manuscript, revision and approval of the final version.

4 – Francisco Carlos Félix Lana

Head Teacher, PhD in Nursing - xicolana@gmail.com
Conception and development of the research, writing of the manuscript, revision and approval of the final version.

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