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ORIGINAL ARTICLE

Laboratory profile after mining dam breach: Brumadinho Health Project results

Perfil laboratorial após rompimento de barragem de mineração: resultados do Projeto Saúde Brumadinho

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ABSTRACT

Objective: To evaluate changes in selected laboratory tests in the population included in the Brumadinho Health Project, according to the exposure to the dam failure. **Methods:** Cross-sectional study carried out on representative sample of residents (≥12 years) in Brumadinho, Minas Gerais, including: 1) non-exposed; 2) directly affected by tailings sludge; 3) residents in mining area. The prevalence of abnormal results of blood count, total, HDL and LDL cholesterol, triglycerides, aspartate aminotransferase, alanine aminotransferase, creatinine, urea, estimate of glomerular filtration rate (eGFR) and high-sensitivity C-reactive protein (hs-CRP) were estimated. The Prevalence Ratios (PR) and 95% Confidence Intervals (95%CI) of having an abnormal laboratory finding were estimated using Generalized Linear Models with Poisson probability distribution. Crude and adjusted models were estimated for age range, gender, diabetes, body mass index, smoking, hypertension. **Results:** After adjusting, there was no difference in PR between the three populations for most tests, with the exception of the population residing in an area with mining activity and not directly affected by the mud, with a lower chance of having altered total cholesterol (PR: 0.84; 95%CI 0.74–0.95) and a higher chance of having altered HDL cholesterol (PR: 1.26; 95%CI 1.07–1.50), hs-CRP (PR: 1.19; 95%CI 1.04–1.37), and eGFR <60mL/min/1,73 m^2 (PR: 1.51; 95%CI 1.05–2.19). **Conclusion:** No significant differences were found in the prevalence of biochemical and hematological alterations between the populations directly exposed and not exposed to tailings. Only the group residing in the mining area had a higher prevalence of alterations related dyslipidemia, renal disease, and inflammation.

Keywords: Man-made disasters. Mining. Laboratory tests. Brazil.

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CONFLICT OF INTERESTS: nothing to declare

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INTRODUCTION

Disasters caused by man, such as technological (chemical and radioactive) or natural disasters, like floods, droughts, and landslides, can generate human, environmental or material impacts in the short, medium or long term[1].

Disasters with mining dams have already been reported around the world[2], but in Brazil, specifically in the state of Minas Gerais, two major events of this type have recently occurred[3-5]. A disaster of great magnitude occurred on January 25th, 2019, with the rupture of the tailings dam at the Córrego do Feijão mine, owned by mining company Vale S.A., in Brumadinho, Minas Gerais, affecting a considerable territorial extension and causing dozens of deaths and disappearances. About 12 million m^3 of wet iron ore tailings leaked and traveled along the Ribeirão Ferro-Carvão bed, reaching the Paraopeba River, heading toward São Francisco River[6].

Various consequences are associated with disasters, such as increased incidence of cardiovascular, respiratory, and obesity diseases, in addition to mental disorders, increased consumption of alcohol, tobacco, and other drugs[7-9].

Identifying and evaluating the impacts on the health of the population surrounding these disasters is important and include, in addition to environmental contamination, unfavorable outcomes for physical and mental health, as well as possible economic destabilization[10]. Producing this knowledge is essential for the planning of preventive actions and for facing possible new events, reducing the impact on the affected populations[11]. Assessing selected laboratory parameters can contribute to the identification of early or late changes in health and produce important evidence on the impacts on the health conditions of these populations.

The present study aimed to evaluate the existence of hematological changes, renal function, liver function, carbohydrate metabolism, lipid profile, and inflammation through laboratory tests carried out in three different groups of Brumadinho residents in relation to exposure:

Unexposed population, considered not directly affected by the dam failure or not residing in an area with active mining;

- Population directly affected by the tailings sludge;
- Population residing in an area with mining activity that was not directly affected by the mud.

METHODS

Population

The Brumadinho Health Project (*Projeto Saúde Brumadinho*) is a prospective cohort study started in 2021, coordinated by Fundação Oswaldo Cruz de Minas Gerais (Fiocruz Minas) in partnership with Universidade Federal do Rio de Janeiro (UFRJ), with the objective of evaluating the living conditions and health of residents in the city of Brumadinho.

The research sampling plan was designed to represent the population residing in the municipality of Brumadinho aged 12 years old and older, in three estimation domains, formed by different groups of residents in relation to exposure:

- Population not directly affected by the dam failure or not residing in an area with active mining, considered non-exposed or reference population (n=1,562);
- Population directly affected by the tailings mud or by the water from the Paraopeba River, contaminated by the mud, residing in the areas at the time of the survey or at the time of the dam failure — Córrego do Feijão/Parque da Cachoeira/Pires (n=981);
- Residents of the region with mining activity who were not directly affected by the mud — Tejuco (n=537).

This design involved a random sample of existing households in the region not directly affected, in addition to a census in the two other domains, allowing a representative sample of the municipality's population to be estimated. In the selected households, all residents in the age group considered were invited to participate in the survey, and 86.4% of the eligible ones participated in it.

The Brumadinho Health Project was approved by the Research Ethics Committee of Fiocruz Minas (20814719.5.0000.5091), and all participants agreed to provide information for the study by signing the informed consent (adults) or assent (adolescents).

Variables

The collection of biological material took place at the participants' homes between 7 am and 3 pm, without the need for fasting, between September and November 2021. Two tubes of blood were collected from each participant, one containing separator gel and clot activator, without anticoagulant, with a capacity of 5 mL, and another, ethylenediamine tetraacetic acid dipotassium (EDTA K2) with a capacity of 4 mL, to obtain serum and whole blood, respectively. The samples were stored in thermal boxes with reusable ice and kept at a temperature of 4-8°C for a maximum period of 24 h until analyzed. Samples that remained outside the established temperature parameters were rejected. Some participants did not have all tests performed because of insufficient sample volume.

Laboratory tests were performed by the laboratory of Associação Fundo de Incentivo à Pesquisa (AFIP — Medicina Diagnóstica), using widely validated methods and included blood count, glycated hemoglobin (HbA_{1c}), total cholesterol (Total-C), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), aspartate aminotransferase (AST), alanine

aminotransferase (ALT), creatinine, urea and high-sensitivity C-reactive protein (hs-CRP). The glomerular filtration rate (eGFR) was estimated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) 2021 equation[12]. The laboratory has an accreditation certification with excellence III from the National Accreditation Organization (*Organização Nacional de Acreditação* – ONA)[13].

The tests had their precision monitored daily by the use of own controls and/or commercial controls, following the recommendations by the current legislation[14]. Reagent systems, methods, analytical coefficients of variation of controls, and reference values and ranges used are available in supplementary material (Tables S1 and S2). Results different from the intervals or reference values were considered altered, thus defining the outcomes of this analysis.

Participant information, including gender, age, weight, height, smoking, diabetes *mellitus* (DM) and hypertension, was obtained through the questionnaires.

DM was defined as a self-reported disease and/or HbA1c ≥6.5%, and hypertension, based on the report of a previous medical diagnosis for this condition. The body mass index (BMI) was calculated by dividing weight (kg) by height (meters) squared, based on self-reported measurements, and categorized as normal (≤25 kg/m^2), overweight (>25 kg/m^2 and <30 kg/m^2), and obesity (≥30 kg/m^2). Smoking was categorized into never smoked, former smoker, and current smoker. Age was categorized into the following age groups: 12 to 17 years, 18 to 59 years, and ≥60 years.

Statistical analysis

At first, the sample was characterized according to sociodemographic and behavioral variables and the diagnosis of chronic diseases, and the differences were tested using the Rao-Scott test[15]. Laboratory test results were described based on their continuous distributions, through summary measurements, median, and interquartile range (1st–3rd quartile), for population groups, and stratification by gender and age range. Differences between groups were tested using the Kruskal-Wallis test[16].

The prevalence of abnormal tests was estimated according to the study region, gender and age range, and the differences were tested by Rao-Scott. Prevalence ratios (PR) and 95% confidence intervals (95%CI) of altered tests were also estimated, using generalized linear models with Poisson probability distribution[17]. As adjustment variables, age, gender, DM, BMI, smoking, and hypertension were used. For each test, the modeling strategy consisted initially of fitting univariate models (model 1=no fit) and, subsequently, of multiple models with chained input of fit variables, which are pre-analytical factors known to influence the results of the analyzed tests (model 2=model 1 adjusted by age range and gender; model 3=model 2+DM; model 4=model 3+BMI+smoking+hypertension).

All point and interval estimates, tests of differences in proportions, and regression models considered the sample weights and correction for design purposes, through the survey[18] package of the statistical R software[19].

RESULTS

Of the 3,080 subjects sampled in the study, 2,782 participants (90.3%) had results from at least one laboratory test. As shown in Table 1, the population studied was predominantly female (56.6%), aged 18–59 years (64.8%), who had never smoked (68%), and were overweight or obese (54.4%). The prevalence of alterations in the serum levels of Total-C, HDL-C, LDL-C, and TG was 54, 26.5, 30.6, and 39.3%, respectively. About a quarter of the total population had anemia, and a third had abnormal hs-CRP (Table 1).

In the evaluation of the distribution of laboratory tests, according to gender and different age groups — adolescent (12 to 17 years old), adult (18 to 59 years old), and aged (60 years old or more) — it was observed that, for most parameters analyzed, there is no difference between the three populations studied; differences occurred for lipid profile, eGFR and hs-CRP (Tables S4 and S5).

In assessing the prevalence of alterations in biochemical (Table S6) and hematological (Table S7) parameters, according to geographic stratum, age range, and gender, it was found that women aged between 18 and 59 years, from the population considered not directly affected by the dam failure, showed a higher prevalence of increased Total-C (57.9%) and LDL-C (33.7%) (Table S6). The prevalence of high hs-CRP was higher in the population of residents of the region located in an area with mining activity, aged 60 years old or older and of both genders (Table S6). There was no difference in the prevalence of hematological alterations among the three population strata, except for eosinophils in women aged 12 to 17 years (Table S7).

Tables 2 and 3 show the results of the raw and adjusted models for the association between the altered parameters and the region of residence. The estimated PR and 95%CI were verified for residents in regions directly affected by the mud and residents in communities with active mining activity, compared to the unexposed population. There was no difference between the PR adjusted for the results of the hematological tests among the three population strata (Table 2 and Table S8). According to Table 3, in the population of residents of the area with mining activity, the prevalence of altered Total-C was lower (PR=0.83; 95%CI 0.74–0.94), and of altered HDL-C (PR=1.31; 95%CI 1.12–1.54), altered hs-CRP (PR=1.26; 95%CI 1.09–1.44), and eGFR <60 mL/min/1.73 m^2 (PR=1.50; 95%CI 1.04–2.16) was higher when adjusted for age, gender, and DM (model 3).

These findings persisted after additional adjustment for BMI, hypertension, and smoking (model 4) for variables Total-C and HDL-C, eGFR <60 mL/min/1.73 m^2, and hs-CRP (Table 3).

DISCUSSION

In this study, laboratory tests that assess renal function, liver function, carbohydrate metabolism, lipid profile, inflammation, and blood cell counts were measured in strata of the population of the Brumadinho region. The results showed that the population directly affected by the tailings mud or by the water from the Paraopeba River contaminated by the mud did not present a significant difference in the prevalence of altered laboratory test results, when compared to the unexposed population, regardless of the adjustments made. On the other hand, the population of residents of the region located in an area with mining activity had a higher prevalence of low HDL-C, high hs-CRP, and low eGFR (<60 mL/min/1.73 m^2) when compared to the unexposed population.

The data analyzed in the present study do not allow us to conclude about this instigating finding; however, considering that this population was not directly affected by the dam failure, but lives in an area with active mining, it is possible to assume that the changes in the results of laboratory tests may have been observed due to prolonged contact with mining activity. Individuals who work for long periods in a mining environment are at greater risk of developing chronic diseases such as high blood pressure, overweight/obesity, dyslipidemia, and high blood glucose[20]. Additionally, studies show that not only acute exposure, but also prolonged exposure to concentrations of some heavy and essential metals, can cause damage to various human organs and tissues[21,22].

When analyzing the results of laboratory tests from the population of Brumadinho, there was a higher prevalence of abnormal results for some laboratory tests compared to

Table 1. Demographic and clinical characterization and prevalence of altered test results in the total population and according to different geographic strata. Brumadinho Health Project (2022)*.

Characteristics	Total population n=3,080 (95%CI)	Not directly affected n=1,562 (95%CI)	Directly affected n=981(95%CI)	With mining activity n=537 (95%CI)	p-value†	Missing
Gender						
Male	43.35 (41.10–46)	43.16 (40.79–45.54)	48.27 (46.05–50.48)	45.09 (41.99–48.18)	0.006	
Female	56.65 (54.40–59)	56.84 (54.46–59.21)	51.73 (49.52–53.95)	54.91 (51.82–58.01)		
Age range (years)						
12 to 17	6.75 (5.40–8)	6.54 (4.97–8.11)	10.18 (8.25–12.11)	12.31 (9.43–15.19)	<0.001	
18 to 59	64.79 (61.70–68)	64.51(61.35–67.67)	69.41 (66.35–72.48)	72.58 (68.69–76.47)		
60+	28.46 (25.40–32)	28.95 (25.68–32.21)	20.40 (17.32–23.49)	15.11 (11.39–18.83)		
Diabetes	14.01 (12.10–16)	14.06 (12.10–16)	11.18 (9.08–14)	16.45 (13.10–20)	0.102	300
Hypertension	28.16 (25.60–31)	28.20 (25.50–31)	27.96 (25.20–31)	26.39 (22.60–31)	0.749	3
BMI						
Average	45.58 (42.50–49)	45.67 (42.50–49)	46.56 (43.20–50)	38.19 (33.70–43)	0.003	272
Overweight	36.59 (33.90–39)	36.73 (33.90–40)	31.69 (28.80–35)	37.32 (33–42)		
Obesity	17.83 (15.50–20)	17.60 (15.20–20)	21.75 (18.90–25)	24.50 (20.50–29)		
Smoking						
Never smoked	68 (64.80–71)	67.81 (64.40–71)	70.77 (67.40–74)	74.10 (69.80–78)	0.009	4
Former smoker	16.65 (14.60–19)	16.88 (14.70–19)	13.40 (11.30–16)	9.65 (7.38–13)		
Smoker	15.35 (13.20–18)	15.32 (13.10–18)	15.83 (13.30–19)	16.25 (13–20)		
Total cholesterol	53.97 (50.80–57)	54.31 (51.03–57.60)	49.31 (45.90–52.72)	43.58 (38.92–48.24)	<0.001	299
HDL cholesterol	26.49 (23.80–29)	26.15 (23.26–29.04)	30.24 (27.07–33.41)	38.39 (33.91–42.87)	<0.001	299
LDL cholesterol	30.63 (27.70–34)	30.81 (27.67–33.96)	27.69 (24.73–30.64)	25.69 (21.55–29.84)	0.075	407
Triglycerides	39.32 (36.10–43)	39.34 (35.86–42.82)	36.83 (33.37–40.30)	42.78 (38.01–47.54)	0.302	299
Creatinine	8.06 (6.59–10)	8.05 (6.37–9.73	6.95 (5.25–8.66)	10.44 (7.60–13.28)	0.217	298
Urea	14.96 (13–17)	14.97 (12.77–17.17)	14.04 (11.67–16.42)	16.16 (12.87–19.46)	0.681	299
HbA_{1c}	24.83 (22.20–28)	24.89 (22.08–27.70)	22.07 (19.22–24.91)	26.66 (22.38–30.95)	0.284	318
AST	6.27 (5.03–8)	6.22 (4.79–7.66)	7.30 (5.63–8.96)	6.93 (4.66–9.19)	0.514	298
ALT	11.14 (9.54–13)	11.02 (9.22–12.81)	14.13 (11.86–16.41)	12.21 (9.46–14.96)	0.066	298
hs-CRP	33.75 (30.90–37)	33.56 (30.53–36.60)	35.11 (32.12–38.11)	41.72 (36.99–46.45)	0.017	298
Erythrocytes	6.56 (5.22–8)	6.52 (4.96–8.08)	7.39 (5.67-9.11)	7.54 (5.23–9.86)	0.557	488
Hemoglobin	25.13 (22.40–28)	25.04 (22.11–27.98)	25.64 (22.65-28.63)	29.10 (24.92–33.28)	0.304	488
Hematocrit	27.47 (24.80–30)	27.38 (24.51–30.24)	28.60 (25.48-31.73)	30.54 (26.17–34.90)	0.421	488
Total leukocytes	11.01 (9.19–13)	11.10 (9.03–13.17)	8.98 (7.09-10.87)	9.78 (7.05–12.52)	0.245	488

*the prevalence of altered test results for leukocyte types is found in supplementary material (Table S3); †Rao-Scott independence test; 95%CI: 95% confidence interval; BMI: body mass index; HDL: high-density lipoprotein; LDL: low-density lipoprotein; HbA1c: glycated hemoglobin; AST: aspartate aminotransferase; ALT: alanine aminotransferase; hs-CRP: high-sensitivity C-reactive protein.

other populations, indicating a higher prevalence of anemia, dyslipidemia, renal dysfunction, and inflammation. The prevalence of high Total-C (>200 mg/dL) and hypertriglyceridemia (TG >175 mg/dL) was 53.9 (95%CI 50.8–57) and 39.3% (95%CI 36.1–43), respectively. These values are higher than those found in studies in the Brazilian adult population, whose prevalence of high Total-C is 32.7% and of hypertriglyceridemia, 21%[23-25].

The prevalence of elevated creatinine (>1.3 mg/dL among men and >1.02 mg/dL among women) in the total population analyzed was 8.1% (95%CI 6.6–10), being higher than the values indicated in population surveys in two Brazilian cities, with prevalences varying between 3.13 and 3.46%[26]. The prevalence of anemia (hemoglobin <13.5 g/dL among men and <12 g/dL among women) was 25.1% (95%CI 22.4–28) in the total population of Brumadinho and is higher than the prevalence of 9.9% observed in Brazilians aged over 18 years old[27]. Finally, the prevalence of high hs-CRP (≥0.3 mg/dL) was 33.75% (95%CI 30.9–37). Hs-CRP is a marker of inflammation, and is remarkably increased in diseases such as DM, obesity, metabolic syndrome, atherosclerosis in addition to being associated with a higher risk of cardiovascular disease and death[28,29].

Taken together, these findings may be related to mining activity, which is intense throughout the municipality of Brumadinho, since acute or chronic exposure to concentrations of some heavy and essential metals, present in mining activity, can cause damage to various human organs and tissues, such as anemia, leukopenia, liver and kidney damage, endothelial dysfunction, among others[22,23].

Table 2. Prevalence ratios of altered hematological test results according to geographic strata adjusted by different models considering the population not directly affected as a reference. Brumadinho Health Project (2022)*.

Tests	Models	Directly affected PR (95%CI)	With mining activity PR (95%CI)
Erythrocytes	1[a]	1.13 (0.81–1.58)	1.16 (0.78–1.71)
	2[b]	1.03 (0.74–1.43)	1.09 (0.75–1.60)
	3[c]	1.08 (0.78–1.49)	1.19 (0.81–1.74)
Hemoglobin	1[a]	1.02 (0.87–1.21)	1.16 (0.97–1.40)
	2[b]	0.99 (0.84–1.17)	1.14 (0.95–1.38)
	3[c]	1.01 (0.86–1.19)	1.17 (0.97–1.41)
Hematocrit	1[a]	1.04 (0.90–1.22)	1.12 (0.93–1.33)
	2[b]	1.06 (0.91–1.23)	1.13 (0.94–1.34)
	3[c]	1.07 (0.92–1.25)	1.14 (0.95–1.36)
Total leukocytes	1[a]	0.81 (0.61–1.07)	0.88 (0.63–1.23)
	2[b]	0.81 (0.61–1.08)	0.88 (0.63–1.24)
	3[c]	0.81 (0.61–1.09)	0.89 (0.63–1.26)
Platelets	1[a]	0.92 (0.65–1.31)	0.69 (0.44–1.10)
	2[b]	0.91 (0.64–1.30)	0.69 (0.43–1.09)
	3[c]	0.91 (0.64–1.30)	0.69 (0.43–1.10)

*the prevalence ratios of altered results of leukocyte counts are found in supplementary material (Table S8); 95%CI: 95% confidence interval; PR: prevalence ratio; [a]model 1: no adjustment; [b]model 2: adjusted for gender; [c]model 3: adjusted by age range and gender;

On the other hand, disasters are known to have a direct impact on health, including imbalance of the autonomic system, hemodynamic disorders, activation of the sympathetic system and renin angiotensin, oxidative stress, as well as inflammation and atherosclerosis, which can be explained, at least partly, by exposure to particulate matter and harmful substances. After natural

Table 3. Prevalence ratios of altered laboratory test results according to geographic strata adjusted by different models considering the population not directly affected as a reference. Brumadinho Health Project (2022).

Tests	Models	Directly affected PR (95%CI)	With mining activity PR (95%CI)
Total cholesterol	1[a]	0.91 (0.83–1)	0.80 (0.71–0.91)
	2[b]	0.93 (0.85–1.02)	0.82 (0.73–0.93)
	3[c]	0.93 (0.84–1.02)	0.83 (0.74–0.94)
	4[d]	0.92 (0.84–1.02)	0.84 (0.74–0.95)
HDL cholesterol	1[a]	1.16 (0.99–1.35)	1.47 (1.25–1.72)
	2[b]	1.07 (0.91–1.24)	1.34 (1.14–1.57)
	3[c]	1.07 (0.92–1.25)	1.31 (1.12–1.54)
	4[d]	1.09 (0.93–1.27)	1.26 (1.07–1.50)
LDL cholesterol	1[a]	0.90 (0.78–1.04)	0.83 (0.69–1.01)
	2[b]	0.89 (0.77–1.03)	0.81 (0.67–0.98)
	3[c]	0.88 (0.75–1.03)	0.83 (0.68–1.01)
	4[d]	0.88 (0.75–1.03)	0.83 (0.68–1.02)
Triglycerides	1[a]	0.94 (0.82–1.07)	1.09 (0.94–1.25)
	2[b]	0.94 (0.82–1.07)	1.10 (0.95–1.27)
	3[c]	0.94 (0.82–1.06	1.08 (0.93–1.24)
	4[d]	0.94 (0.82–1.06)	1.02 (0.89–1.18)
eGFR60	1[a]	0.74 (0.52–1.06)	1.09 (0.73–1.61)
	2[b]	0.95 (0.68–1.34)	1.68 (1.16–2.36)
	3[c]	0.96 (0.69–1.34)	1.50 (1.04–2.16)
	4[d]	0.79 (0.55–1.13)	1.51 (1.05–2.19)
Urea	1[a]	0.94 (0.75–1.17)	1.08 (0.84–1.39)
	2[b]	0.97 (0.78–1.22)	1.15 (0.89–1.48)
	3[c]	0.98 (0.78–1.23)	1.12 (0.87–1.45)
	4[d]	0.95 (0.75–1.20)	1.14 (0.84–1.54)
ALT	1[a]	1.17 (0.85–1.62)	1.11 (0.75–1.66)
	2[b]	1.06 (0.77–1.46)	1 (0.67–1.50)
	3[c]	1.06 (0.77–1.46)	0.94 (0.63–1.42)
	4[d]	1.05 (0.76–1.45)	0.92 (0.61–1.40)
AST	1[a]	1.28 (1.02–1.61)	1.11 (0.84–1.46)
	2[b]	1.24 (0.99–1.55)	1.10 (0.83–1.45)
	3[c]	1.24 (0.99–1.55)	1.10 (0.83–1.45)
	4[d]	1.18 (0.93–1.49)	1 (0.75–1.34)
hs-CRP	1[a]	1.05 (0.92–1.18)	1.24 (1.08–1.44)
	2[b]	1.10 (0.97–1.24)	1.29 (1.11–1.48)
	3[c]	1.10 (0.97–1.24)	1.26 (1.09–1.44)
	4[d]	1.04 (0.92–1.18)	1.19 (1.04–1.37)

PR: prevalence ratio; 95%CI: 95% confidence interval; HDL: high-density lipoprotein; LDL: low-density lipoprotein; eGFR60: glomerular filtration rate with reference value >60 mL/min/1.73 m^2; ALT: alanine aminotransferase; AST: aspartate aminotransferase; hs-CRP: high-sensitivity C-reactive protein; [a]model 1: no adjustment; [b]model 2: adjusted by age range and gender; [c]model 3: model 2+diabetes *mellitus*; [d]model 4: model 3+body mass index+smoking+hypertension.

disasters, increased frequencies of post-traumatic stress disorder, depression, and other mental disorders have been reported[8-10]. Disasters are also related to increased hypertension, increased BMI, smoking, alcohol abuse, high blood glucose, high-sodium diets, and worsening socioeconomic status[7-9]. In addition, infrastructure is compromised and access to public health services is reduced, which can contribute to worsening of health conditions of the affected population[11].

In any case, the data analyzed in the present study do not allow us to state the cause of the higher prevalence of laboratory alterations, since anemia, dyslipidemia, renal dysfunction, and inflammation can occur in different conditions. Longitudinal follow-up of this population may provide more accurate information to justify this finding.

Among the limitations of the present study, its sectional nature is highlighted, which does not allow establishing temporal relationships between the variables investigated. Tests were performed on 90.3% of study participants. In addition, due to the absence of information prior to the disaster, it is not possible to understand the impact of this event for the values described here. Finally, the exams were carried out two and a half years after the dam rupture, and the time required for this exposure to have an impact in these parameters is still unknow.

On the other hand, this is the first population-based study conducted in a region that suffered a disaster of this magnitude, which will constitute the baseline of a cohort. The identification of risk factors associated with the development of anemia, dyslipidemia, subclinical inflammation, and decreased eGFR, especially in individuals from areas with mining activity, can provide subsidies for the early identification of diseases and increased risk of illness, and the proposition of public health measures aimed at mitigating these risk factors should be considered. The results of the present study will serve as a reference for the longitudinal assessment of the health condition of the inhabitants of the different geographic strata of Brumadinho, more specifically the development of diseases that may be related to mining activities, exposure to mining mud tailings or the disaster *per se*.

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RESUMO

Objetivo: Avaliar alterações em parâmetros laboratoriais na população do Projeto Saúde Brumadinho, segundo exposição ao rompimento da barragem. **Métodos:** Estudo transversal realizado em amostra representativa de residentes (≥12 anos) em Brumadinho, Minas Gerais, incluindo: não expostos (grupo referência); diretamente atingidos pela lama de rejeitos; e residentes em área de mineração. Foram estimadas as prevalências de resultados alterados de hemograma, colesterol total, colesterol lipoproteína de alta densidade (HDL), colesterol lipoproteína de baixa densidade (LDL), triglicérides, aspartato aminotransferase, alanina aminotransferase, creatinina, ureia, estimativa da taxa de filtração glomerular (TFGe) e proteína C-reativa ultrassensível (PCRus). As razões de prevalência (RP) e os intervalos de confiança de 95% (IC95%) de ter o exame alterado foram estimados por meio de modelos lineares generalizados com distribuição de probabilidade Poisson. Estimaram-se modelos brutos e ajustados por faixa etária, sexo, diabetes, índice de massa corporal, tabagismo, hipertensão. **Resultados:** Após ajustes, não se observou diferença nas RP entre as populações estudadas para a maioria dos testes, com exceção da população residente em área com atividade de mineração e não diretamente atingida pela lama, com menor chance de ter colesterol total alterado (RP=0,84; IC95% 0,74–0,95) e maior chance de ter colesterol HDL (RP=1,26; IC95% 1,07–1,50) e PCRus (RP=1,19; IC95% 1,04–1,37) alterado e TFGe<60 mL/min/1,73 m2 (RP=1,51; IC95% 1,05–2,19). **Conclusão:** Não foram encontradas diferenças significativas na prevalência de alterações bioquímicas e hematológicas entre a população diretamente exposta aos rejeitos e a população não exposta. Apenas o grupo residente em área de mineração apresentou maior prevalência de alterações relacionadas com dislipidemia, disfunção renal e inflamação.

Palavras-chaves: Desastres provocados pelo homem. Mineração. Testes laboratoriais. Brasil.

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