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Revista Brasileira de Epidemiologia

https://doi.org/10.1590/1980-549720220008.supl.2

ORIGINAL ARTICLE

Food consumption of Brumadinho Health Project participants

Consumo alimentar em participantes do Projeto Saúde Brumadinho

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ABSTRACT

Objective: To analyze the food consumption patterns of residents of Brumadinho, Minas Gerais, Brazil, according to sociodemographic characteristics, neighborhood and area of residence. **Methods:** Cross-sectional study with baseline data from the Brumadinho Health Project, conducted with 2,805 adult individuals. The healthy food consumption markers analyzed were: fruits and vegetables (FV), beans and fish; the unhealthy markers were: sweets and soda/artificial juices, whole-fat milk and red meat with visible fat or chicken with skin. Prevalence values and 95% confidence intervals were calculated for the total sample and according to sociodemographic characteristics, presence of commercial establishments with varieties of FV in the neighborhood and area of residence affected by the dam failure. **Results:** Among the healthy food consumption markers, the most common was beans (81.6%), and among the unhealthy ones, whole-fat milk (68.8%) and red meat with visible fat/chicken with skin (61.1%). Women were more prone to higher consumption of FV, while men, of beans and fish; the prevalence of these markers was higher among individuals with higher education degrees and higher incomes. Unhealthy eating markers were more prevalent among men, younger people, individuals with lower educational level and lower incomes, and residents in an area directly affected by the dam failure or in a mining region. **Conclusion:** Less than half of the participants were considered to follow regular or recommended consumption of healthy eating markers, except for beans. Individual characteristics and area of residence were associated with individuals' food consumption patterns and should be taken into account in actions to promote adequate and healthy eating.

Keywords: Disasters. Food consumption. Eating behavior. Eating habits. Descriptive epidemiology.

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CONFLICT OF INTERESTS: nothing to declare.

HOW TO CITE THIS ARTICLE: Nascimento-Souza MA, Freitas PP, Lopes MS, Firmo JOA, Peixoto SV, Lopes ACS. Food consumption of Brumadinho Health Project participants. Rev Bras Epidemiol. 2022; 25:e220008.supl.2. https://doi.org/10.1590/1980-549720220008.supl.2

Received on: 06/29/2022
Reviewed on: 08/21/2022
Accepted on: 08/23/2022

INTRODUCTION

Adequate and healthy food behavior is essential for the promotion of health and well-being[1] and, in Brazil, it is a right guaranteed by the Federal Constitution[2]. According to the Food Guide for the Brazilian Population, an adequate and healthy diet should be based on in natura or minimally processed foods, or preparations based on them, to the detriment of ultra-processed foods (UPF)[3].

However, studies on the trend of changes in the dietary pattern of Brazilians showed an increase in the consumption of UPF such as soft drinks, cookies and ready meals, and a reduction in the consumption of in-natura and minimally processed foods such as beans, roots and tubers, fruits and vegetables (FV)[4]. These pattern changes seem to come from urbanization and industrialization processes, changes in the organization of families and in food systems, among other factors, affecting different population groups in different ways[5].

Changes in dietary patterns can also be the result of disasters[6], as they may impact on the quality of food[7] and the on the population's quality of life. Families can lose access to land—often the main source of food and income—and have their food choices affected[8] despite remedial measures. Studies conducted with populations affected by disasters have reported a high level of food insecurity and little food diversity[8,9].

On January 25, 2019, a disaster occurred in Brumadinho, Minas Gerais, Brazil: the collapse of the tailings dam of the mine Córrego do Feijão, under the responsibility of mining company Vale S.A. The ore tailings reached nine census sectors, compromising the housing of part of the population, crops and animal husbandry[10], and caused at least 272 deaths[11,12]. In addition, the contamination of the Paraopeba River[13] may have further harmed agricultural activities. All this impacted the population's way of living and, possibly, their feeding patterns.

Despite the lack of previous data on the food consumption patterns of the population of Brumadinho, characterizing it after the disaster is important, especially when considering the need for actions to promote adequate and healthy feeding in the municipality. So, this article aimed to analyze the food consumption of individuals residing in Brumadinho, Minas Gerais, Brazil, according to their sociodemographic characteristics, neighborhood and areas of residence.

METHODS

Study Design and Location

This was a cross-sectional study carried out with baseline data from a longitudinal study called Brumadinho Health Project, conducted in Brumadinho, Minas Gerais, Brazil, with the objective of producing information about the health of the population to ensure the resolution of health care in the municipality[12].

Brumadinho's human development index (HDI) is 0.747 and its population was estimated, in 2021, in 41,208 inhabitants across an area of 639,434 km²[14].

Study Population and Sample

The sample of the Brumadinho Health Project was designed to represent the population aged 12 years and over residing in the municipality in 2019, according to three different estimation domains:

1. Sample from other regions (individuals not directly affected by the dam failure and non-residents in mining areas);
2. Individuals directly affected by the dam failure (residents before or at the time of the survey in areas directly affected by the disaster or by the water from the Paraopeba River, contaminated by the mud); and
3. Individuals residing in mining areas[12].

The sampling plan considered the stratification of the population by census sector, as established by the Brazilian Institute of Geography and Statistics (IBGE) in 2019. A random sample of households was selected in the sectors belonging to the sample domain of other regions (domain 1), while all households in regions considered directly affected (domain 2) or exposed to mining activity (domain 3) that consented to participate were included.

For all estimation domains in each selected household, all residents aged 12 years or older were interviewed, which gave us 3,080 participants and a response rate of 86.4%. For this article, only adult individuals (18 years of age or older) were included, totaling 2,805 respondents.

More details about the research can be found in the project's webpage (http://www.minas.fiocruz.br/saudebrumadinho/), in the article on its methodology[12].

Data Collection Procedures

A questionnaire addressing sociodemographic data, perception of the neighborhood's food setting and food consumption pattern was applied to participants at their households. All interviewers were trained and certified, and conducted the interviews between June and November 2021.

Variables Analyzed

The sociodemographic variables investigated were: sex (male and female), age range (18–24, 25–39, 40–59 and 60 and older), self-reported skin color (white, black, brown, yellow or indigenous), marital status (single, married/living together/stable union and divorced-separated/widowed), education (incomplete elementary school II or less, complete elementary school II, incomplete high school, complete high school, incomplete higher education, higher education or more) and monthly household income per capita (relation between monthly income of household members

by the total number of household residents—categorized into tertiles).

The participants' perception of the region's food context was investigated by asking them to report the presence of commercial food establishments (markets, street markets or other points of sale) with a variety of fresh FV in the neighborhood. This question is part of a self-reported neighborhood scale, which was adapted and validated for the Brazilian population[15]. The variable area of residence was analyzed based on three domains: other regions, region directly affected by the dam failure and mining region.

For the assessment of feeding patterns, healthy eating (FV, beans and fish) and unhealthy eating markers (sweets, soda/artificial juice, whole-fat milk and red meat with visible fat/chicken with skin) were investigated.

The analysis of food consumption patterns was performed according to the Surveillance System of Risk and Protection Factors for Chronic Non-Communicable Diseases by Telephone Survey (Vigitel)[16] (Supplementary Table 1).

Statistical Analysis

For each food marker assessed, the prevalence values and respective 95% confidence intervals (95%CI) were estimated for the total population and per category of variables of interest.

Significant differences between prevalence values were tested by the χ^2 statistical test with Rao-Scott correction. In cases of significant differences between prevalence values of variables with three or more categories, two-by-two comparisons were made, and Bonferroni correction was applied.

Statistical analyses were performed using the Stata® software, version 14.0 (StataCorp LLC, CollegeStation, TX), considering sample weighting and the effect of sample design.

Ethical Considerations

The Brumadinho Health Project was approved by the Research Ethics Committee (20814719.5.0000.5091), and all interviewees signed an informed consent form to participate in the study.

RESULTS

Of the participants, 57.1% were women, 36.2% were aged between 40 and 59 years old, 44.2% reported having brown skin color, 59.6% were married, 29.0% had completed high school, and 37.8% were in the first income tertile (37.8%). Most individuals had commercial establishments with a variety of fresh FV (57.9%) around their homes and lived in other regions of the city (95.5%) (Supplementary Table 2).

The prevalence of regular consumption of FV was 35.0% (95%CI 32.1–38.1), being higher among women (39.4%; 95%CI 35.9–43.0) and those aged 60 years or older (49.3%; 95%CI 43.1–55.5). Married individuals also had a higher prevalence (38.7%; 95%CI 34.9–42.8) compared to single individuals (25.9%; 95%CI 21.2–31.3); as well as those with higher education (66.1%; 95%CI 58.2–73.2) and higher income (48.3%; 95%CI 42.6–54.0) compared to the other categories (Table 1).

The recommended consumption of FV was reported by 21.1% of the participants (95%CI 18.4–24.0), being higher among: women (23.6%; 95%CI 20.1–27.5); individuals aged 60 years or older when compared to those aged 18–24 years (27.2%; 95%CI 21.5–33.7 vs. 13.1%; 95%CI 8.4–19.9); with higher education or more compared to those with complete elementary school II or less (higher education or more: 33.5%; 95%CI 24.7–43.7 vs. complete elementary school II: 16.1%; 95%CI 11, 4–22.1 and fundamental I complete or less 15.6%; 95%CI 12.5–19.3); and individuals in the highest income tertile when compared to those in the lowest tertile (27.5%; 95%CI 22.4–33.4 vs. 16.9%; 95%CI 12.9–21.8) (Table 1).

Most participants (81.6%; 95%CI 79.0–83.9) reported consuming beans regularly, although it was higher among: men (87.2%; 95%CI 84.1–89.8); individuals aged 25 years or older (25–39, 83.9%; 95%CI 79.3–87.6; 40–59, 83.8%; 95%CI 80.0–86.9; 60 and older, 82.4%; 95%CI 77.0–86.8) when compared to younger people (18–24, 68.2%; 95%CI 59.2–76.0); married and widowed (84.5%; 95%CI 81.0–87.4 and 89.4%; 95%CI 81.2–94.3, respectively) when compared to single (75.0%; 95%CI 69, 8–79.6); with complete high school education or less (complete elementary school or less: 87.9%; 95%CI 84.7–90.4; complete elementary school II: 83.6%; 95%CI 77.1–88.5 and high school education: 82.7%; 95%CI 78.5–86.3) when compared to those with higher education or more (64.8%; 95%CI 56.7–72.0); with intermediate income when compared to those with higher income (86.9%; 95%CI 82.4–90.4 vs. 77.7%; 95%CI 72.5–82.1); and whose surroundings did not have commercial establishments with fresh FV varieties (87.8%; 95%CI 84.7–90.4) (Table 1).

Regular consumption of fish was reported by 38.2% of respondents (95%CI 34.8–41.8), being higher among: men (41.5%; 95%CI 37.0–46.2); individuals aged 40-59 years when compared to those aged 18–24 years (42.4%; 95%CI 37.3–47.7 vs. 27.6%; 95%CI 20.2–36.3%); with complete higher education (higher education or more: 52.8%; 95%CI 42.1–63.2) when compared to those with complete elementary school or less and high school (32.9%; 95%CI 28.8–37.4 and 52.8%; 95%CI 42.1–63.2, respectively); higher income (50.8%; 95%CI 44.0–57.6); and who reported the presence of commercial establishments with fresh varieties of FV in their area (43.1%; 95%CI 38.6–47.7) (Table 1).

The prevalence of regular consumption of sweets was 17.7% (95%CI 15.5–20.1), being higher among individuals with complete high school and higher education (21.6%; 95%CI 17.7–26.1 and 23.4; 95%CI 16.5–31.9, respectively) when compared to those with complete elementary school

Table 1. Prevalence (%) and respective confidence intervals (95%CI) of consumption of healthy eating markers according to sociodemographic characteristics and presence of establishments selling fresh fruits and vegetables, Brumadinho (MG), Brazil, 2021.

Variables	Regular consumption of FV*	Recommended consumption of FV†	Regular consumption of beans*	Regular consumption of fish‡
Total population	35.0 (32.1–38.1)	21.1 (18.4–24.0)	81.6 (79.0–83.9)	38.2 (34.8–41.8)
Sex				
Male	29.2 (25.1–33.7)[a]	17.6 (14.5–21.3)[a]	87.2 (84.1–89.8)[a]	41.5 (37.0–46.2)[a]
Female	39.4 (35.9–43.0)[b]	23.6 (20.1–27.5)[b]	77.4 (73.5–80.8)[b]	35.8 (31.8–39.9)[b]
Age range (years)				
18-24	19.6 (13.5–27.7)[a]	13.1 (8.4–19.9)[a]	68.2 (59.2–76.0)[a]	27.6 (20.2–36.3)[a]
25-39	26.0 (20.9–31.9)[a.b]	17.2 (13.0–22.5)[a.b]	83.9 (79.3–87.6)[b]	32.2 (26.6–38.3)[a.b]
40-59	33.3 (28.6–38.4)[b]	20.7 (17.0–25.0)[a.b]	83.8 (80.0–86.9)[b]	42.4 (37.3–47.7)[b]
60 and older	49.3 (43.1–55.5)[c]	27.2 (21.5–33.7)[b]	82.4 (77.0–86.8)[b]	41.6 (34.4–49.1)[a.b]
Self-reported skin color				
White	39.2 (34.7–43.9)	22.4 (18.4–27.0)	78.4 (73.8–82.4)	41.8 (36.4–47.4)
Black	34.9 (27.2–43.5)	23.4 (17.0–31.3)	84.9 (78.3–89.7)	30.7 (23.7–38.8)
Brown	30.6 (26.3–35.3)	18.8 (15.5–22.5)	84.4 (80.8–87.5)	36.6 (32.2–41.2)
Yellow or indigenous	54.7 (26.3–80.4)	34.7 (13.6–64.2)	69.1 (38.8–88.7)	52.5 (25.0–78.5)
Marital status				
Single	25.9 (21.2–31.3)[a]	15.8 (12.0–20.4)	75.0 (69.8–79.6)[a]	34.9 (29.4–40.8)
Married/living together/stable union	38.7 (34.9–42.8)[b]	22.7 (19.1–26.8)	84.5 (81.0–87.4)[b]	39.1 (34.5–43.9)
Divorced/separated	37.4 (27.2–48.9)[a.b]	26.0 (17.8–36.4)	75.3 (63.9–84.0)[a.b]	48.6 (38.1–59.2)
Widow(er)	35.5 (25.8–46.4)[a.b]	21.5 (13.9–31.8)	89.4 (81.2–94.3)[b]	31.8 (23.1–42.0)
Education (years)				
Complete Elementary School I or less	24.3 (20.5–28.5)[a]	15.6 (12.5–19.3)[a]	87.9 (84.7–90.4)[a]	32.9 (28.8–37.4)[a]
Complete Elementary School II	26.8 (20.8–33.7)[a.b]	16.1 (11.4–22.1)[a.b]	83.6 (77.1–88.5)[a]	38.7 (32.1–45.7)[a.b]
Complete High School	34.6 (29.1–40.4) [b]	23.5 (19.2–28.4)[b.c]	82.7 (78.5–86.3)[a]	36.2 (30.4–42.5)[a]
Higher education or more	66.1 (58.2–73.2)[c]	33.5 (24.7–43.7)[c]	64.8 (56.7–72.0)[b]	52.8 (42.1–63.2)[b]
Monthly household income per capita				
1st tertile	25.1 (20.6–30.4)[a]	16.9 (12.9–21.8)[a]	84.2 (79.8–87.8)[a.b]	28.6 (23.5–34.2)[a]
2nd tertile	30.9 (25.0–37.6)[a]	20.4 (15.6–26.2)[a.b]	86.9 (82.4–90.4)[a]	34.6 (28.4–41.4)[a]
3rd tertile	48.3 (42.6–54.0)[b]	27.5 (22.4–33.4)[b]	77.7 (72.5–82.1)[b]	50.8 (44.0–57.6)[b]
Commercial establishments with varieties of fresh fruits and vegetables in the neighborhood				
No	34.8 (30.2–39.6)	22.0 (18.0–26.6)	87.8 (84.7–90.4)[a]	31.3 (26.5–36.5)[a]
Yes	35.4 (31.1–39.8)	20.5 (17.3–24.0)	77.5 (73.5–81.0)[b]	43.1 (38.6–47.7)[b]

FV: fruits and vegetables. Same letters indicate similar prevalence values. Different letters indicate different prevalence values ($p<0.05$). Columns without letters indicate no differences between prevalence values ($p>0.05$). *Regular consumption: any amount at least five days/week; †Recommended consumption: five or more servings at least five days/week; ‡Regular consumption: any amount at least once a week.

I or less. The prevalence of regular consumption of soft drinks/artificial juices was 10.4% (95%CI 8.6–12.5), being higher among: men (13.5%; 95%CI 10.7–16.8); younger individuals (23.8%; 95%CI 17.1–32.2) when compared to those aged 40–59 years (9.1%; 95%CI 6.7–12.3) or 60 years and older (4.7%; 95%CI 3.0–7.4); individuals with self-reported skin color as black (18.8%; 95%CI 12.9–26.4) when compared to white individuals (7.4%; 95%CI 5.2–10.4); single individuals compared to married individuals (15.8%; 95%CI 12.1–20.3 vs. 8.7%; 95%CI 6.8–11.2); individuals with an intermediate level of education (complete elementary school II: 17.8%; 95%CI 12.2–24.5 and high school: 17.8%; 95%CI 12.2–24.5); and with lower income (15.6%; 95%CI 11.8–20.5) (Table 2).

The prevalence of consumption of whole-fat milk was 68.8% (95%CI 65.4–72.0), being higher among individuals with high school education or less (complete elementary school or less: 76.4%; 95%CI 71.6–80.7; complete elementary school II: 72.9%; 95%CI 66.1–78.7 and high school: 69.0%; 95%CI 63.5–74.0) when compared to those with higher education degrees or more (4.2%; 95%CI 2.0–8.6); belonging to the first and second income tertiles (71.4%; 95%CI 66.8–75.5 and 73.1%; 95%CI 66.8–78.6, respectively) compared to those in the highest tertile (61.7%; 95%CI 55.4–67.6); and who did not report presence of commercial establishments selling fresh FV varieties in the neighborhood (72.7%; 95%CI 68.2–76.8).

Table 2. Prevalence (%) and respective confidence intervals (95%CI) of unhealthy eating markers among adults according to sociodemographic characteristics and presence of establishments selling fresh fruits and vegetables, Brumadinho (MG), Brazil, 2021.

Variables	Regular consumption of candy/sweets*	Regular consumption of soda/artificial juice*	Consumption of whole-fat milk	Consumption of red meat with visible fat/ chicken with skin
Total population	17.7 (15.5–20.1)	10.4 (8.6–12.5)	68.8 (65.4–72.0)	61.1 (58.0–64.2)
Sex				
Male	18.2 (15.0–21.8)	13.5 (10.7–16.8)[a]	70.0 (65.5–74.2)	69.3 (65.1–73.3)[a]
Female	17.3 (14.6–20.3)	8.1 (6.3–10.3)[b]	67.9 (63.6–71.8)	55.0 (50.8–59.1)[b]
Age range (years)				
18-24	24.9 (18.1–33.1)	23.8 (17.1–32.2)[a]	68.8 (60.0–76.4)	65.5 (56.8–73.2)[a]
25-39	17.8 (13.6–23.4)	13.6 (9.8–18.5)[a.b]	73.1 (67.4–78.1)	67.2 (61.0–72.9)[a]
40-59	15.7 (12.7–19.3)	9.1 (6.7–12.3)[b.c]	71.5 (66.8–75.8)	65.1 (60.5–69.5)[a]
60 and older	17.1 (13.5–21.4)	4.7 (3.0–7.4)[c]	62.2 (55.2–69.3)	50.4 (44.4–56.4)[b]
Self-reported skin color				
White	16.5 (13.3–20.3)	7.4 (5.2–10.4)[a]	66.2 (61.0–71.1)	57.0 (52.3–61.6)
Black	23.0 (16.2–31.5)	18.8 (12.9–26.4)[b]	68.0 (59.8–75.2)	66.7 (59.7–73.1)
Brown	17.4 (14.2–21.0)	11.0 (8.5–14.0)[a.b]	72.4 (67.7–76.7)	63.7 (58.8–68.2)
Yellow or indigenous	24.9 (8.6–54.0)	13.3 (2.4–49.2)[a.b]	43.7 (19.1–71.9)	61.9 (38.2–81.0)
Marital status				
Single	19.6 (15.4–24.5)	15.8 (12.1–20.3)[a]	69.8 (64.2–74.9)	65.8 (60.0–71.2)
Married/living together/stable union	17.6 (14.9–20.6)	8.7 (6.8–11.2)[b]	68.0 (63.3–72.4)	59.8 (55.6–63.9)
Divorced/separated	16.0 (9.8–25.0)	7.7 (3.5–16.4)[a.b]	70.4 (59.8–79.2)	57.5 (46.0–68.3)
Widow(er)	13.1 (7.5–22.0)	7.5 (3.5–15.5)[a.b]	69.1 (58.0–78.4)	57.6 (46.8–67.8)
Education (years)				
Complete Elementary School I or less	12.8 (10.2–16.0)[a]	7.7 (5.9–10.6)[a]	76.4 (71.6–80.7)[a]	69.9 (65.1–74.3)[a.b]
Complete Elementary School II	15.6 (10.8–22.0)[ab]	17.8 (12.2–24.5)[b]	72.9 (66.1–78.7)[a]	76.8 (70.3–82.3)[a]
Complete High School	21.6 (17.7–26.1)[b]	13.5 (10.2–17.7)[b]	69.0 (63.5–74.0)[a]	60.0 (54.3–65.5)[b]
Higher education or more	23.4 (16.5–31.9)[b]	4.2 (2.0–8.6)[a]	4.2 (2.0–8.6)[b]	34.3 (27.1–42.4)[c]
Monthly household income per capita				
1st tertile	16.0 (12.6–20.0)[a]	15.6 (11.8–20.5)[a]	71.4 (66.8–75.5)[a]	72.1 (67.4–76.4)[a]
2nd tertile	17.8 (13.6–23.0)[a]	8.6 (6.0–12.0)[b]	73.1 (66.8–78.6)[a]	61.3 (54.9–67.9)[b]
3rd tertile	22.0 (17.5–27.3)[a]	6.8 (4.6–10.1)[b]	61.7 (55.4–67.6)[b]	51.7 (45.4–57.9)[b]
Commercial establishments with varieties of fresh fruits and vegetables in the neighborhood				
No	18.8 (15.6–22.4)	11.4 (8.6–15.0)	72.7 (68.2–76.8)[a]	60.2 (55.7–64.6)
Yes	17.0 (14.0–20.4)	9.8 (7.6–12.5)	66.1 (61.6–70.4)[b]	61.9 (57.4–66.3)

Same letters indicate similar prevalence values; different letters indicate different prevalence values ($p<0.05$). Columns without letters indicate no differences between the prevalence values ($p>0.05$). *Regular consumption: any amount of food at least five days/week.

Consumption of red meat with visible fat/chicken with skin was reported by 61.1% (95%CI 58.0–64.2) of the participants, being higher among: men (69.3%; 95%CI 65.1– 73.3); individuals aged up to 59 years (18–24 years: 65.5%; 95%CI 56.8–73.2; 25–39: 67.2%; 95%CI 61.0–72.9 and 40–59: 65.1%; 95%CI 60.5–69.5) when compared to the elderly (50.4%; 95%CI 44.4–56.4); with complete high school or less (complete elementary school or less: 69.9%; 95%CI 65.1–74.3; complete elementary school II: 76.8%; 95%CI 70.3–82.3 and high school education: 60.0%; 95%CI 54.3–65.5) when compared to those with higher education degrees or more (34.3%; 95%CI 27.1–42.4); and belonging to the first income tertile (72.1%; 95%CI 67.4–76.4) compared to those in the second and third tertiles (61.3%; 95%CI 54.9–67.9 and 51.7%; 95%CI 45.4–57.9, respectively) (Table 2).

As for healthy and unhealthy food markers according to area of residence, the prevalence of regular and recommended consumption of FV was lower (25.9%; 95%CI 22.7–29.3; 15.2%; 95CI % 12.8–18.0, respectively) among individuals residing in the region directly affected by the tailings dam failure. This group was also linked to a higher prevalence of consumption of beans (86.7%; 95%CI 83.9–89.1) and sweets (24.2%; 95%CI 21.2–27.4) when compared with people living in other regions. There was also greater regular consumption of soft drinks/artificial juices (29.9%; 95%CI 25.4–34.9) and of red meat with excess fat/chicken with skin (79.2%; 95%CI 74.5–83.1),

as well as lower consumption of whole-fat milk (59.4%; 95%CI 54.3–64.2) among individuals residing in mining regions (Table 3).

DISCUSSION

Less than half of the participants of the Brumadinho Health Project had regular or recommended consumption of healthy eating markers, except for beans, which was reported by most respondents. Among the unhealthy eating markers, the most frequent ones were related to fat consumption, such as whole-fat milk and red meat with visible fat/chicken with skin. Regarding the distribution of markers according to the variables analyzed, women reported higher consumption of FV (regular and recommended), and men, of beans and fish. Higher prevalence values of these markers were observed among individuals with higher education and higher income. In addition, individuals who had access to commercial establishments selling fresh FV varieties in their neighborhood reported higher consumption of beans and fish. On the other hand, unhealthy eating markers were more common among men, younger age groups, individuals with low education and low income, and residing in regions directly affected by the tailings dam failure and with mining activities.

The prevalence values of regular and recommended consumption of FV were similar to those observed in the Brazilian adult population—34.3% and 22.1%[17], respectively. However, among Brazilians, consumption of beans (68.3%)[18] was lower and consumption of fish (46.6%)[18] was higher. Similarly, associations in the Brazilian population with sociodemographic characteristics similar to the ones assessed in this study were also identified, such as higher consumption of FV among women[17,19,20] and married individuals[21], and higher consumption of beans among men[17,19,21].

The prevalence of regular consumption of fish and FV was higher among individuals with high levels of education and higher income, possibly due to the form of access and prices of these foods, which are usually more expensive[19]. On the other hand, consumption of beans was lower in these subgroups. Although beans are a traditional food for Brazilians, their consumption reduces progressively as the income range gets higher[22] and as individuals go through higher education[21,23]. These subgroups possibly experience earlier changes in eating habits, such as the reduction in consumption of home-made food that require more time to prepare, such as rice and beans[22], and the increased consumption of ready-to-eat foods and the habit of having meals away from home[24].

The report of access to commercial establishments with a variety of fresh FV in the neighborhood was associated with higher consumption of beans and fish, as well as with lower intake of whole-fat milk. The food settings, defined as the physical, economic, political and sociocultural environment related to feeding, can influence the choices of food and beverages and, consequently, the nutritional status of individuals[25]. More specifically, food setting built, one of the dimensions of food setting, plays a fundamental role in the quality of diet, affecting the access to food, as well as food availability and suitability in a certain geographic area[26].

Disasters like the one in Brumadinho can affect both the environment and food consumption patterns. The nature of food problems after disasters depends on the type, duration and size of the affected area[27]. Studies that evaluated the repercussions of disasters of different natures have indicated a worsening in eating habits among adult individuals immediately after the disaster; however, it is still unclear whether this association remains in the long term[28]. In the present investigation, there was a lower consumption of FV (regular and recommended) among individuals residing in the region directly affected by the tailings dam

Table 3. Prevalence (%) and respective confidence intervals (95%CI) of consumption of healthy and unhealthy food markers according to area of residence, Brumadinho (MG), Brazil, 2021.

Variables	Other regions	Region directly affected by the dam failure	Mining region
Healthy eating markers			
Regular consumption of fruits and vegetables*	35.3 (32.2–38.5)[a]	25.9 (22.7–29.3)[b]	36.3 (31.6–41.3)[a]
Recommended consumption of fruits and vegetables†	21.1 (18.4–24.2)[a]	15.2 (12.8–18.0)[b]	28.8 (24.2–33.9)[c]
Regular consumption of beans*	81.4 (78.7–83.9)[a]	86.7 (83.9–89.1)[b]	82.2 (78.1–85.6)[a,b]
Regular consumption of fish‡	38.3 (34.8–42.0)	32.9 (29.0–37.1)	42.4 (37.3.47.6)
Unhealthy eating markers			
Regular consumption of candy/sweets*	17.4 (15.1–20.0)[a]	24.2 (21.2–27.4)[b]	21.8 (17.8–26.4)[a,b]
Regular consumption of soda/artificial juices*	9.8 (7.9–12.0)[a]	20.4 (17.5–23.7)[b]	29.9 (25.4–34.9)[c]
Consumption of whole-fat milk	69.0 (65.4–72.4)[a]	67.4 (64.0–70.6)[a]	59.4 (54.3–64.2)[b]
Consumption of red meat with visible fat/chicken with skin	60.8 (57.5–64.0)[a]	61.3 (57.4–65.1)[a]	79.2 (74.5–83.1)[b]

Same letters indicate that the prevalence values did not differ from each other, while different letters indicate differences between variable categories ($p<0.05$). Lines without letters indicate no differences between prevalence values ($p>0.05$). *Regular consumption: consumption of any amount at least five days/week. †Recommended consumption: consumption at least five days/week of five or more servings. ‡Regular consumption: consumption of any amount at least once a week.

failure. Research carried out in Governador Valadares, a city surrounded by river Rio Doce, which was polluted with mining tailings in a disaster similar to that of Brumadinho, reported a reduction or interruption in the consumption of FV and freshwater fish even 17 months after the disaster.

Most respondents reported that public water supply from the river Rio Doce could contaminate crops and preparation of food[7], which could have possible long-term negative repercussions on eating habits and, consequently, on their health. In this sense, as the Brumadinho Health Project is a longitudinal study that aims to monitor dietary patterns of individuals affected by disasters, its contribution is to produce more evidence on the subject.

Regarding the consumption of foods that are markers of unhealthy eating, the prevalence of consumption of candy/sweets and whole-fat milk, similar to the Brazilian population, was 21.7 and 60.6%, respectively, as presented by the National Health Survey of 2013[29]. However, regular consumption of soft drinks/artificial juice was higher (20.4%)[18], while consumption of red meat with fat/chicken with skin was lower (37.2%)[29]. The higher consumption of fatty meats among residents of Brumadinho may be related to cultural aspects, since Minas Gerais is one of the Brazilian states that most consume fatty meat[30]. The prevalence of unhealthy eating markers was higher among males, individuals in younger age groups, with lower educational levels and lower income ranges, as observed in national studies[18,29].

High prevalence of consumption of soft drinks/artificial juice, in turn, was found among individuals who declared themselves to be black and single when compared to those who reported having white skin color and being married, respectively. The few studies conducted so far on unhealthy eating markers corroborate these results, showing that risk markers were associated with being brown and/or black[30,31] and being single[21].

Differences were also identified in the markers of unhealthy food consumption when it comes to individuals' area of residence. Higher regular consumption of soft drinks/artificial juice and red meat with excess fat/chicken with skin was reported by residents of a mining region. We did not find studies in the literature that specifically evaluated food markers in population groups residing in mining regions in Brazil for comparison purposes. However, it is hypothesized that these results may derive from the profile of residents of this region, who are proportionately younger and with low educational level (data not shown). In any case, these findings show the need to better understand regional and local differences in food consumption patterns, as well as to implement actions to promote adequate and healthy eating habits according to the area of residence of individuals[5].

Despite the relevant results, this study has limitations that must be considered. Measuring food consumption according to markers that assess the frequency of food consumption, and not through food frequency questionnaires and 24-hour food recalls—which are more accurate instruments that provide data on the amount of food ingested— is one of them[32]. Consumption markers are simple and quick-to-apply instruments that make it possible to identify dietary inadequacies in large-population studies. Furthermore, they have been used in national surveys[17,19] and by the Food and Nutrition Surveillance System (Sisvan)[33] to monitor food consumption of the Brazilian population with eyes to creating public policies and supporting decision-making on health care[34].

Another limitation is the impossibility of evaluating other food markers that are relevant to the local population, as well as the lack of control of outcomes by potential confounding variables. Since the Brumadinho Health Project is a large longitudinal study, covering different blocks of variables, we had to limit the number of food markers analyzed. However, the markers investigated are those of greatest importance for the Brazilian population and most commonly evaluated in epidemiological studies. As for the control by confounding variables, this was a descriptive study that sought to understand the food consumption pattern of the population according to sociodemographic characteristics, neighborhood settings and area of residence, so that, later on, more robust hypotheses can be elaborated to investigate the multicausality of the outcomes of interest.

The potential of this work should be emphasized, including the fact that it is the first Brazilian population-based study to assess the food consumption pattern of a population affected by a major disaster. This study, therefore, provides important information to support actions that can promote adequate and healthy feeding in the municipal health services, aiming to guarantee health and the human right to adequate feeding. It is noteworthy, however, that these actions must be in line with the economic and social context of the population and respect and value the cultural dimensions of food so it can be feasible and sustainable, while promoting the population's well-being.

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RESUMO

Objetivo: Analisar o consumo alimentar de residentes de Brumadinho, Minas Gerais, Brasil, segundo as características sociodemográficas da vizinhança e a área de residência. **Métodos:** Estudo transversal com dados da linha de base do Projeto Saúde Brumadinho, conduzido com 2.805 indivíduos adultos. Os marcadores de alimentação saudável analisados foram frutas e hortaliças (FH), feijão e peixe; os não saudáveis foram doces e refrigerante/suco artificial, leite com teor integral de gordura e carne vermelha com gordura visível/frango com pele. Prevalências e intervalos de confiança de 95% foram calculados para a amostra total, segundo características sociodemográficas; presença de estabelecimentos comerciais de FH na vizinhança e área de residência, segundo rompimento da barragem. **Resultados:** Entre os marcadores de alimentação saudável, o mais prevalente foi o feijão (81,6%) e, entre os não saudáveis, leite com teor integral de gordura (68,8%) e carne vermelha com gordura visível/frango com pele (61,1%). Mulheres apresentaram maior consumo de FH, e homens, de feijão e peixe, sendo maiores as prevalências desses marcadores entre os indivíduos com maior escolaridade e renda. Os marcadores de alimentação não saudável foram mais prevalentes entre os homens, os mais jovens, indivíduos com menor escolaridade e renda e residentes em área diretamente atingida pelo rompimento da barragem ou região de mineração. **Conclusão:** Menos da metade dos participantes apresentou consumo regular ou recomendado de marcadores de alimentação saudável, exceto o feijão. Características individuais e área de residência foram associadas ao consumo alimentar dos indivíduos, devendo ser consideradas nas ações de promoção da alimentação adequada e saudável.

Palavras-chave: Desastres. Consumo alimentar. Comportamento alimentar. Hábitos alimentares. Epidemiologia descritiva.

ACKNOWLEDGEMENTS: We would like to thank the participants of the project for their cooperation and participation.

AUTHORS' CONTRIBUTIONS: Nascimento-Souza, M.A.: data curation, writing – review & editing, methodology. Freitas, P.P.: writing – review & editing. Lopes, M.S.: writing – review & editing. Firmo, J.O.A.: project administration, writing – review & editing. Peixoto, S.V.: project administration, writing – review & editing, funding acquisition, resources. Lopes, A.C.S.: writing – review & editing.

FUNDING: the Brumadinho Health Project is funded by the Department of Science and Technology, Secretariat of Science, Technology, Innovation and Strategic Inputs in Health (DECIT/SCTIE) of the Ministry of Health (Process 25000.127551/2019-69). SVP and JOAF are productivity fellows from the National Council for Scientific and Technological Development (CNPq).