

Food Availability in Homes with Children and Adolescents: Associated Factors During the COVID-19 Pandemic

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Abstract The COVID-19 pandemic aggravated food insecurity mainly among the most vulnerable populations. Food availability is an important tool for monitoring food security, as it allows the quality of food consumed to be assessed. We investigated food availability in households with children and adolescents during the suspension of school meals during the COVID-19 pandemic and its associated factors. A cross-sectional study was conducted with a representative sample of public-school students ($n = 611$). Socioeconomic factors, food insecurity, and food availability were investigated through telephone interviews with those responsible for purchasing and/or cooking foods in households. Multiple linear regression was used to verify the associations between food availability, Socioeconomic factors, and food insecurity. Of those interviewed, 92.2% were females, 80.2% declared themselves brown or black, and 50.7% were unemployed. Of the households, 82.0% experienced food insecurity, and 64.9% had a low socioeconomic classification. A negative correlation was identified between availability of healthy food and food insecurity ($r=-0.64$; $p<0.001$) and negative association with not married marital status ($p=0.004$), a higher number of children ($p=0.020$), low socioeconomic status ($p<0.001$), a drop in family income ($p=0.001$), and household food insecurity ($p<0.001$). Households with children and adolescents had unsatisfactory food availability associated with social vulnerability.

Keywords: Food Security, Student Health, Food availability, Schoolchildren

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1. Introduction

During the COVID-19 pandemic, one of the main preventive actions to minimize the spread of SARS-CoV-2 was restricting social contact, with stricter measures depending on the location. By reducing social interactions, preventive measures have changed the population's lifestyle habits, such as food access [1].

In Brazil, one measure adopted was the suspension of face-to-face classes in schools, which interrupted the provision of school meals. The offer of food to all students in basic public education takes place through the National School Feeding Program (Programa Nacional de Alimentação Escolar - PNAE) [2]. School feeding contributes to a greater energy supply and quality of meals for students experiencing food insecurity (FI) [4], thereby contributing to the realization of a human right to

adequate food (HRAF).

For low-income children living in unfavorable socioeconomic conditions, the suspension of school meals can mean experiencing food and **nutrition** insecurity [3]. To minimize the impact of the suspension of the supply of school meals, basic food baskets or food kits were made available to those responsible for students [5].

However, the **Food and Nutrition Security (FNS)** situation is not guaranteed solely by access to food baskets/kits because food must be available to all family members depending on the vulnerability conditions of students' families. Therefore, it is needed to verify the food availability – a dimension of food security - in households with children and adolescents and the quality of food available [6,7]. Thus, this study aimed to evaluate food availability and its associated factors in the homes of schoolchildren during the suspension of face-to-face classes due to the COVID-19 pandemic.

2. Material and Methods

This was a cross-sectional study involving a representative sample of households of students enrolled in public schools of the municipalities of Mariana and Ouro Preto, Minas Gerais, Brazil. Baseline data from the Longitudinal Study of Food and **Nutrition** Security in the COVID-19 Pandemic (ESANP) were analyzed.

Mariana has an estimated population of 62,258 inhabitants, an average monthly salary of formal workers of 2.5 national minimum wages, and a municipal human development index (MHDI) of 0.742 [8,9]. The municipality of Ouro Preto has an estimated population of 73,498 inhabitants, an average monthly salary of formal workers of 3.1 minimum wages, and an MHDI of 0.741 [9,10].

According to data from the Municipal Departments of Education, during face-to-face classes, one to four meals are served in the school units, depending on the teaching modality, and length of stay of the students. Meals offered in school feeding programs comprise non-perishable foods, meat, fruits, vegetables, eggs, milk and dairy products. During the suspension of face-to-face classes due to the pandemic, the two municipalities in the study distributed basic baskets or food kits to students' families [11]. The kits were distributed monthly in Mariana and every four months in Ouro Preto.

Participants and data collection

The study population was surveyed in April and May 2020 through the Municipal Departments of Education, which supported the study and consented to data availability.

Students from the following teaching modalities participated in the study: kindergarten, early childhood, and elementary education. For sample planning, a proportional stratification representative of the teaching modalities in the municipal network of each city was used. A sample size of 374 individuals was obtained with a 5% margin of error and 95% reliability. Because the ESANP is a longitudinal study that naturally includes a percentage of losses, a recomposition of 60.0% was added to the sample, totaling 611 households interviewed.

Eligible individuals were responsible for purchasing and/or preparing meals in households, that were 18 years old or older and residing in the same household as the students. Contacts with permanently busy telephone lines, with a fax signal or answering machine, or with the impossibility of contact were excluded.

Data collection was conducted by interviewers trained to use the instruments and conduct interviews under the supervision of the researchers from June to July 2020. According to the research protocol, five attempts were made to contact the participants via telephone on alternate days and times (morning, afternoon, and evening). When the attempts were unsuccessful, contacts were excluded, and new raffles were carried out until the sample was completed (N=611).

Outcome variable - household food availability

Household food availability was assessed using questions about the availability of 14 foods and food groups in homes, adapted from the National Child Food and Nutrition Study (Estudo Nacional de Alimentação e Nutrição Infantil - ENANI) [12], and based on regional

habits and the components of the food baskets: rice, pasta, corn soup, meat, milk, eggs, sardines, frozen foods, and sausages [13,14,15].

The following question was asked for each of the list components: "In the last 30 days, how often were the following foods available in your home?". Possible answers included "never," "rarely," "sometimes," "almost always," and "always" [12].

Among the foods and/or food groups investigated, seven were categorized as healthy (fruits, vegetables, beans, milk and dairy products, meat, eggs, and sardines), and another seven were categorized as unhealthy (sausages, frozen foods, industrialized cookies, packaged snacks, sweets, sweet drinks, and industrialized juices), according to the Food Guide for the Brazilian Population [14].

To assess food availability in households, a scoring system was used, considering the frequency of availability of each food/group, on a scale from zero to four points. The maximum score (4 points) was attributed to the 'always' availability of healthy foods, or the absence of unhealthy food. The minimum score (0 points) was attributed to the 'never' availability of healthy foods, and 'always' availability of unhealthy foods (Table 1).

Three availability scores were created from the sum of the scores: healthy food availability score (0 to 28 points), unhealthy food availability score (0 to 28 points), and total food availability score, resulting from the sum of the two previous scores (0 to 56 points). The higher quality of food available in households was indicated by higher scores in the three cases.

Table 1. Score to the frequency of food availability in households according to the category of food markers. ESANP Study, 2023

Frequency of Food Availability					
Healthy eating marker foods	Never	Rarely	Sometimes	Almost always	Always
Fruits	0	1	2	3	4
Vegetables	0	1	2	3	4
Beans	0	1	2	3	4
Milk and dairy products	0	1	2	3	4
Meat	0	1	2	3	4
Eggs	0	1	2	3	4
Sardines	0	1	2	3	4
Unhealthy eating marker foods	Never	Rarely	Sometimes	Almost always	Always
Sausages	4	3	2	1	0
Frozen foods	4	3	2	1	0
Industrialized cookies	4	3	2	1	0
Packaged snacks	4	3	2	1	0
Sweets	4	3	2	1	0
Sweet drinks	4	3	2	1	0
Industrialized juices	4	3	2	1	0

Note: Sweets included chocolate and candies.

Explanatory variables

Sociodemographic and economic characteristics, aspects related to the pandemic, and the food security **status** of households were investigated.

Sociodemographic variables included student age (0-3 years old/4-5 years old/6-17 years old), respondent's gender (female/male), respondent's marital status (not married/married), referred respondent's skin color (yellow;

white; black; brown), respondent's education (illiterate/incomplete elementary I; complete elementary school/incomplete elementary II; complete elementary school II/incomplete high school; complete high school/incomplete university; university), area of residence (urban/rural), number of people in the household ($2-4 \geq 5$) and number of children in the household ($1-2 \geq 3$).

The economic variables were respondents' employment status (unemployed/employed), receipt of benefits from government social programs (not receiving/receiving), and socioeconomic classification [high/low level]. The pandemic-related variables were access to the basic food basket (no/yes), receipt of government emergency aid (not receiving/receiving), income reduction (no/yes), and the effect of this income reduction (very large, large/small, very small).

The food security **status** of the households was assessed using the Brazilian Food Insecurity Scale (EBIA). EBIA evaluates the family's self-perceived food access for the last 3 months through 14 closed questions (yes/no) and presents degrees of severity (0 to 14 points): food security (0 points); mild food insecurity (1 to 5 points); moderate food insecurity (6 to 9 points); and severe food insecurity (10 to 14 points) [17].

Data analysis

Data was tabulated, and consistency was evaluated using Microsoft Office Excel® (2013). Statistical analyses were performed using the STATA® program version 13.0, and a significance level of 5.0% was considered for all statistical tests.

Descriptive analyses were performed using frequency calculations. Simple linear regression analyses were then performed to investigate the relationship between sociodemographic and economic characteristics, variables related to the pandemic, and the food security **status** with food availability. Additionally, correlation analyses were conducted between the food insecurity scale and food availability scores.

The association between the food availability scores (outcome variables) and explanatory variables was analyzed using a multiple linear regression model. The explanatory variables were included in the model in blocks, according to plausibility in the literature, $p\text{-value} \leq 0.20$ in the bivariate analysis, and performance of collinearity analysis. The first block consisted of sociodemographic and economic variables, followed by variables related to the pandemic and food security **status**. Variables with less significance were analyzed and removed one by one from the model (backward stepwise elimination); variables with $p < 0.05$ were kept in the model. In all models, the normality

of residuals was tested.

3. Results

The study included 611 adults responsible for purchasing food in the homes of children and adolescents aged 1 to 17 years. Of these, 92.2% were female, 59.6% were married, 80.2% were self-declared black or brown, 50.7% were unemployed, and 49.0% had completed high school. Of the households, 80.4% had one to two children, 64.9% had low socioeconomic status, 64.7% had a member receiving emergency aid from the federal government, and 66.5% reported a drop in family income during the pandemic. Concerning basic food baskets provided by municipalities, 46.8% of households reported access. The prevalence of food insecurity in households was 82.0%, with 16.3% having severe or moderate food insecurity (Table 2).

The mean of the healthy food availability score in households was 20.7 points (95% CI: 20.3; 21.1), for the unhealthy food availability score 16.2 points (95%CI: 15.9; 16.6), and for the total food availability score 37.0 points (95%CI: 36.6; 37.4) (Table 2).

A negative correlation was observed between the healthy food availability score (-0.64 ; $p < 0.001$) and the total availability score (-0.28 ; $p < 0.001$) with food security scores. Conversely, a positive correlation was identified between the unhealthy food availability score (0.39 ; $p < 0.001$) and food security scores (Figure 1).

In Table 3, using the final model of multiple linear regression, it is observed that not married marital status ($\beta = -1.02$; 95%CI: -1.71 ; -0.33), the highest number of children ($\beta = -1.02$; 95%CI: -1.87 ; -0.16), low socioeconomic status ($\beta = -1.92$; 95%CI: -2.66 ; -1.19), the highest effect of the drop in family income ($\beta = -1.26$; 95%CI: -1.98 ; -0.55) and the food insecurity **status** of households, mild ($\beta = -2.30$; 95%CI: -3.20 ; -1.40) and moderate/severe ($\beta = -6.61$; 95%CI: -7.85 ; -5.38), had a negative association with the healthy food availability score.

Regarding the unhealthy food availability score, there was a positive association with female respondents ($\beta = 1.75$; 95%CI: 0.39 ; 3.11), low socioeconomic status ($\beta = 1.64$; 95%CI: 0.86 ; 2.42) and a greater effect of a drop in income ($\beta = 2.15$; 95%CI: 1.39 ; 2.91). A greater number of children ($\beta = -0.99$; 95%CI: -1.96 ; -0.02), access to the basic food basket ($\beta = -0.78$; 95%CI: -1.54 ; -0.02), and food insecurity, mild ($\beta = -1.32$; 95%CI: -2.33 ; -0.31) and moderate/severe ($\beta = -3.25$; 95%CI: -4.58 ; -1.92), were negatively associated with the total food availability score.

Table 2. Sociodemographic, economic, pandemic-related, and food security according to household food availability scores (N=611), 2020

Variables		Availability scores		
		Healthy food (0 to 28)	Unhealthy food (0 to 28)	Total food (0 to 56)
	%	Mean and 95CI%		
Total scores		20.7 (20.3; 21.1)	16.2 (15.9; 16.6)	37.0 (36.6; 37.4)
Gender				
Male	7.8	22.2 (21.0; 23.5)	14.0 (12.6; 15.4)	36.2 (34.8; 37.7)
Female	92.2	20.6 (20.2; 21.0)	16.4 (16.0; 16.8)	37.0 (36.6; 37.4)
Marital status				
Married	59.6	21.7 (21.2; 22.1)	15.8 (15.3; 16.3)	37.5 (37.0; 37.9)
Not married	40.4	19.4 (18.8; 20.1)	16.9 (16.2; 17.5)	36.3 (35.7; 36.9)

Variables		Availability scores		
		Healthy food (0 to 28)	Unhealthy food (0 to 28)	Total food (0 to 56)
		%	Mean and 95CI%	
Skin color				
White	15.3	22.2 (21.4; 23.1)	16.1 (15.1; 17.0)	38.3 (37.2; 39.4)
Yellow	4.5	18.4 (16.0; 20.8)	18.0 (16.3; 19.8)	36.4 (34.4; 38.4)
Brown	54.0	21.0 (20.4; 21.5)	15.9 (15.4; 16.4)	36.8 (36.3; 37.3)
Black	26.2	19.7 (18.9; 20.6)	16.9 (16.1; 17.7)	36.6 (35.9; 37.4)
Employment status				
Employed	49.3	21.2 (20.7; 21.8)	15.5 (15.0; 16.1)	36.8 (36.2; 37.3)
Unemployed	50.7	20.3 (19.7; 20.9)	16.9 (16.4; 17.4)	37.2 (36.7; 37.7)
Education level				
University	9.8	23.8 (23.0; 24.5)	15.4 (14.0; 16.8)	39.2 (37.9; 40.5)
Complete high school	49.0	21.8 (21.3; 22.3)	15.7 (15.2; 16.2)	37.5 (36.9; 38.0)
Complete elementary school II	20.7	18.6 (17.7; 19.6)	17.4 (16.5; 18.3)	36.1 (35.3; 36.8)
Complete elementary school I	9.8	18.2 (17.0; 19.4)	16.5 (15.4; 17.6)	34.7 (33.5; 35.9)
Illiterate	10.7	19.6 (18.2; 21.0)	17.0 (15.7; 18.3)	36.6 (35.4; 37.9)
Number of people in the household				
2-4	69.3	21.0 (20.5; 21.5)	16.2 (15.8; 16.6)	37.2 (36.7; 37.7)
≥ 5	30.7	20.2 (19.4; 20.9)	16.3 (15.5; 17.1)	36.5 (35.8; 37.2)
Number of children in the household				
1-2	80.4	21.3 (20.8; 21.7)	16.0 (15.6; 16.5)	37.3 (36.9; 37.7)
≥ 3	19.6	18.6 (17.6; 19.6)	17.0 (16.1; 18.0)	35.7 (34.8; 36.5)
Socioeconomic classification				
High level	35.1	23.1 (22.6; 23.6)	14.9 (14.3; 15.6)	38.0 (37.4; 38.7)
Low level	64.9	19.5 (19.0; 20.0)	17.0 (16.5; 17.5)	36.5 (36.1; 37.0)
Benefits (social programs)				
Receiving	48.2	20.1 (19.5; 20.6)	16.6 (16.1; 17.2)	36.7 (36.1; 37.2)
Not receiving	51.8	21.4 (20.9; 21.9)	15.9 (15.3; 16.4)	37.2 (36.7; 37.8)
Government emergency aid				
Not receiving	35.3	21.0 (20.4; 21.7)	15.9 (15.2; 16.5)	36.9 (36.2; 37.5)
Receiving	64.7	20.6 (20.1; 21.1)	16.5 (16.0; 16.9)	37.0 (36.6; 37.5)
Income reduction				
No	33.5	21.7 (21.1; 22.4)	15.2 (14.5; 15.9)	36.9 (36.2; 37.6)
Yes	66.5	20.3 (19.8; 20.8)	16.8 (16.3; 17.2)	37.0 (36.6; 37.5)
Effect of income reduction				
Small/very small	62.4	21.9 (21.4; 22.3)	15.3 (14.8; 15.8)	37.2 (36.7; 37.6)
Large/very large	37.6	18.9 (18.2; 19.6)	17.8 (17.2; 18.4)	36.7 (36.1; 37.3)
Access to the basic food basket				
No	53.2	21.2 (20.7; 21.8)	16.3 (15.7; 16.8)	37.5 (37.0; 38.0)
Yes	46.8	20.3 (19.6; 20.9)	16.1 (15.6; 16.7)	36.4 (35.9; 37.0)
Food security status				
Food security	18.0	24.3 (23.8; 24.8)	14.3 (13.4; 15.2)	38.6 (37.8; 39.5)
Mild food insecurity	65.7	21.0 (20.6; 21.5)	16.0 (15.6; 16.5)	37.1 (36.6; 37.5)
Moderate/severe food insecurity	16.3	15.6 (14.6; 16.6)	19.2 (18.2; 20.1)	34.8 (33.8; 35.7)

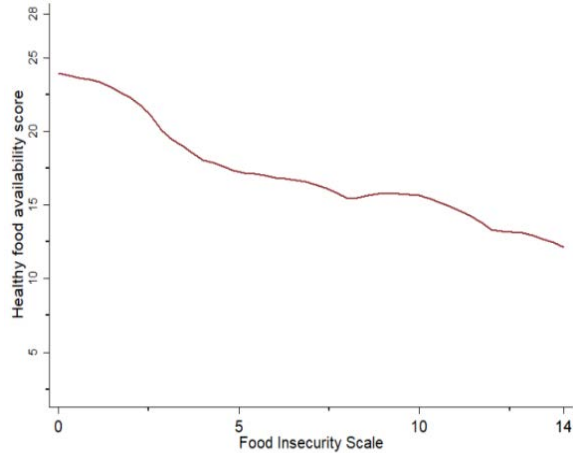
Note: ¹ CI, confidence interval.

Table 3. Factors associated with food availability scores in schoolchildren's homes during the COVID-19 pandemic (N=611). Mariana and Ouro Preto, Minas Gerais, 2020

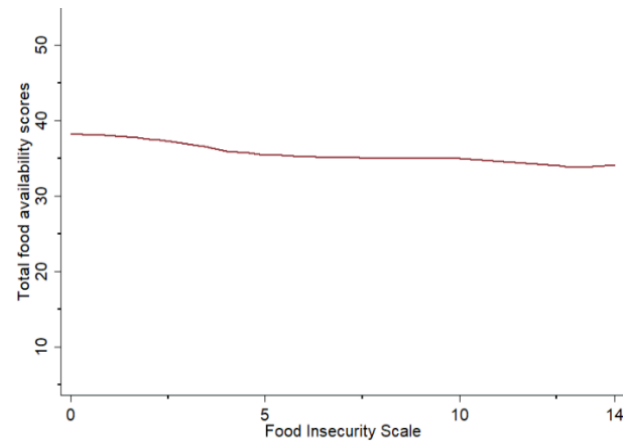
	Final model	
	β (95%CI)	P Value
Healthy food availability score		
Respondent's marital status		
Married	Ref	
Not married	-1.02 (-1.71; -0.33)	0.004
Number of children in the household		
1-2	Ref	
≥ 3	-1.02 (-1.87; -0.16)	0.020
Socioeconomic classification		
High level	Ref	
Low level	-1.92 (-2.66; -1.19)	<0.001
Effect of income reduction		
None/small	Ref	

Final model		
	β (95%CI)	P Value
Large/very large	-1.26 (-1.98; -0.55)	0.001
Food security status		
Food security	Ref	
Mild food insecurity	-2.30 (-3.20; -1.40)	<0.001
Moderate/severe food insecurity	-6.61 (-7.85; -5.38)	<0.001
Unhealthy food availability score		
Respondent's gender		
Male	Ref	
Female	1.75 (0.39; 3.11)	0.012
Socioeconomic classification		
High level	Ref	
Low level	1.64 (0.86; 2.42)	<0.001
Effect of income reduction		
Small/very small	Ref	
Large/very large	2.15 (1.39; 2.91)	<0.001
Total food availability score		
Number of children in the household		
1-2	Ref	
≥ 3	-0.99 (-1.96; -0.02)	0.046
Access to the basic food basket		
No	Ref	
Yes	-0.78 (-1.54; -0.02)	0.045
Food security status		
Food security	Ref	
Mild food insecurity	-1.32 (-2.33; -0.31)	0.011
Moderate/severe food insecurity	-3.25 (-4.58; -1.92)	<0.001

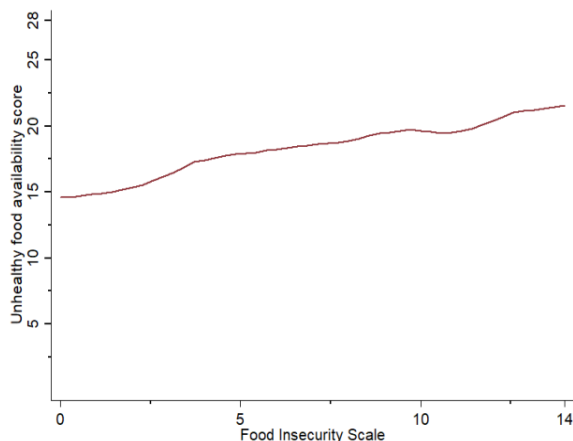
Notes: ¹ CI, confidence interval; ² ref, reference.



(A). Healthy food availability score ($r=-0.64$; $p<0.001$) and food security



(C). Total food availability score ($r=-0.28$; $p<0.001$) and food security scores



(B). Unhealthy food availability score ($r=0.39$; $p<0.001$) and food security

Figure 1. Correlations between Food Availability Scores (healthy, unhealthy, total) and the Brazilian Food Security Scale

4. Discussion

Households of children and adolescents during the interruption in the supply of school meals during the COVID-19 pandemic showed compromised food availability.

In this context, a survey on the availability of food carried out with the participation of several countries showed that, during the pandemic, 32.7% of the participants had problems purchasing food, 50.4% had access to a smaller variety of food, 30.2% found lower quality food, and 39.2% had a smaller amount of food [18].

The adoption of measures to prevent the spread of COVID-19 added to existing conditions, would reflect on food systems with a decrease in food availability in some regions of the world, mainly those with economic vulnerability. Low availability of food in households can have direct consequences for food security [6]. In this study, by analyzing the means of healthy and unhealthy food availability scores, median and low values were found.

Data from the National Survey on Food Insecurity in the Context of the COVID-19 Pandemic in Brazil demonstrated a tendency towards a decrease in the availability of fresh or minimally processed foods in Brazilian households. Moreover, for families that reduced the purchase of these foods, severe FI was present in almost half of the households [24].

Regarding the unhealthy food availability score, there was less availability of processed and ultra-processed foods in households where women were responsible for food preparation since responsibility for family food is still determined by gender [27]. The literature also demonstrates that motherhood plays a key role in healthy decision-making processes that shape domestic food environments and protect children's health through practical planning and budgeting strategies [28].

Most of the observed associations revolved around economic conditions. There are inverse relationships between food insecurity, family income, and the number of children in the households, being that a greater number of economic dependents can limit or reduce food availability, especially healthy food [24,26,29,31,32]. Furthermore, low socioeconomic status and the drop in income may suggest the overall difficulty in purchasing food families faced during the pandemic, since increases in food prices higher than the rates of inflation have been registered in Brazil since the first year of the pandemic [33,34].

Consumers were largely affected by the rise in food prices, especially foods such as cereals, legumes, tubers, roots, and vegetables, in addition to meats and fruits [34]. This made it more difficult to cope with the months of social restrictions and decreased income caused by increased unemployment and the closure of businesses, leading to decreased purchasing power among families, especially those with low incomes [33].

Thus, the drop in family income associated with the rise in prices during the pandemic may have triggered a lower acquisition of food groups in general [35], since the total food availability score did not show a high mean in this study. Furthermore, receiving basic food baskets does not seem to be enough to guarantee the availability of food. An American study conducted with schoolchildren who received a backpack with three meals each day on the weekend did not demonstrate improvement in food security in the participants' homes [25]. Another study with public education students' homes, during the suspension of face-to-face classes in Brazilian schools, showed that households that received baskets or kits were more likely to experience FI [26].

Given the above, our results corroborate the findings that inequalities in access to income, goods, services, and public policies are the conditions with the greatest capacity to explain inequities related to the guarantee of the FNS and HRFA [24].

The study was limited to the use of telephone interviews, which may imply participation bias, as only people with an active telephone line could participate. In addition, only students receiving public education were analyzed, so the results may not generalize to all students in the municipalities. However, most students in the teaching modalities in the present study are served by public education in Brazil: early childhood education (74.7%) and elementary education (82.0%) [38]. Despite this, it is understood that studies on food and nutrition security and its dimensions are important and necessary with the participation of students from all socioeconomic contexts.

The strengths of the study were the use of a representative sampling process for the student population of public schools in the two municipalities studied and the pioneering approach in assessing the availability of food for this population during the COVID-19 pandemic.

Municipalities must promote policies that remove households from vulnerable situations, with support for small local producers and the promotion of access to fresh and healthy food in sufficient quantities at an affordable price so that the basic needs of the population are guaranteed. Furthermore, surveillance of household food security needs to be permanent to prevent the HRAF of these individuals from being jeopardized in emergencies, such as the suspension of face-to-face classes.

These findings highlight the urgent need for public policies aimed at social protection programs and the strengthening of local food systems. The long-term effects of the pandemic on food security need to be investigated in order to evaluate the effectiveness of the interventions adopted to mitigate these impacts. Additionally, studies focusing on the role of governmental institutions and community organizations in supporting food security during crises can provide valuable insights for policy development.

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List of Abbreviations

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Authors contributions: Priscila Pena Camargo: Conceptualization; Methodology; Formal analysis; Writing original draft; review; editing and finalizing. Erica Costa Rodrigues: Data curation/Data management; Literature review. Mariana Carvalho de Menezes, and Natália Caldeira de Carvalho: Survey management, Review; editing, and finalizing. Adriana L Meireles and Raquel D Mendonça: Project administration; Supervision; Resources; Review and editing.

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