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## The COVID-19 pandemic and changes in eating habits of Brazilian adolescents



Crizian Saar Gomes<sup>a,\*</sup>, Nathália Mota Mattos Santi<sup>a</sup>, Danilo Rodrigues Pereira da Silva<sup>b</sup>, André Oliveira Werneck<sup>c</sup>, Célia Landmann Szwarcwald<sup>d</sup>, Marilisa Berti de Azevedo Barros<sup>e</sup>, Deborah Carvalho Malta<sup>f</sup>

<sup>a</sup> Universidade Federal de Minas Gerais, Faculdade de Medicina, Programa de Pós Graduação em Saúde Pública, Belo Horizonte, Minas Gerais, Brazil

<sup>b</sup> Universidade Federal de Sergipe, Departamento de Educação Física, São Cristóvão/SE, Brazil

<sup>c</sup> Universidade de São Paulo (USP), Escola de Saúde Pública, Departamento de Nutrição, São Paulo, Brazil

<sup>d</sup> Instituto de Comunicação e Informação Científica e Tecnológica em Saúde da Fundação Oswaldo Cruz, Rio de Janeiro, RJ, Brazil

<sup>e</sup> Universidade Estadual de Campinas, Faculdade de Ciências Médicas, Departamento de Saúde Coletiva, Campinas, SP, Brazil

<sup>f</sup> Universidade Federal de Minas Gerais, Escola de Enfermagem, Departamento de Enfermagem Materno Infantil e Saúde Pública, Belo Horizonte, Minas Gerais, Brazil

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### ABSTRACT

**Introduction:** The social distancing imposed by the COVID-19 pandemic influenced lifestyle and modified dietary patterns. Our objective was to evaluate the consumption of fruits and vegetables (FV), and ultra-processed foods (UPF), before and after the COVID-19 pandemic, as well as to identify the sociodemographic factors associated.

**Methods:** This study used data from the “Convid Adolescents”, a survey on health behaviors that were collected through an online questionnaire self-completed by 9.470 adolescents between 12 and 17 years of age during the pandemic in Brazil in 2020. Individuals were invited to participate through a chain-sampling procedure called “virtual snowballing”. Information about FV, and UPF consumption before and during the pandemic period were reported. The independent variables used were sex, age group, race/color of skin, kind of school, education level of the mother, region of Brazil, financial difficulties during the pandemic, food insecurity, and social restrictions. Logistic regression models were used.

**Results:** There was a reduction in the low consumption of FV (83.5% to 80.3%) and there was no significant difference in the high consumption of UPF (38.9% to 38.1%) before and during the pandemic. The incidence of low consumption of FV and high consumption of UPF during the pandemic was 20% and 13.8%, respectively. Girls, private school adolescents, who reported having food insecurity and financial difficulties during the pandemic were the most affected subgroups.

**Conclusions:** Despite little change in the prevalence of FV and UPF consumption before and during the pandemic, the incidence of high consumption of UPF and low FV consumption was high, and it identified in specific population subgroups.

### 1. Introduction

The COVID-19 pandemic was declared by the World Health Organization (WHO) on March 11th, 2020, and in Brazil, the first case was registered on February 26th of the same year [1,2]. Since then, several public health measures have been taken to control the transmission rate of the virus, including personal protection measures, such as hand sanitizing, the use of masks, and social distancing [3].

Although it is undeniable that social distancing is necessary to control the pandemic, it did cause the interruption of most daily activities and

influenced the lifestyle of Brazilian adults [4,5]. Some studies have associated the period of social distancing with modifications in eating habits, mainly related to the consumption of unhealthy foods and drinks [4,5]. This type of change in behavior may increase the risk of noncommunicable diseases, such as obesity, diabetes, cardiovascular disease and cancer, which are risk factors for mortality COVID-19 [6,7]. Studies on eating and nutrition during the pandemic indicated that the quality of food is associated with health and can consequently aid in the prevention and treatment of the disease [8,9]. Therefore, a well-balanced and diversified diet, rich in antioxidant nutrients, including fruits and vegetables (FV), is recommended.

\* Corresponding author at: Universidade Federal de Minas Gerais, Faculdade de Medicina, Programa de Pós Graduação em Saúde Pública, Av. Alfredo Balena, 190 – Santa Efigênia, Belo Horizonte, MG 30130-100, Brazil.

E-mail addresses: [criziansaar@gmail.com](mailto:criziansaar@gmail.com) (C.S. Gomes), [nathaliampff@hotmail.com](mailto:nathaliampff@hotmail.com) (N.M.M. Santi), [daniilorpsilva@gmail.com](mailto:daniilorpsilva@gmail.com) (D.R.P. da Silva), [andreowerneck@gmail.com](mailto:andreowerneck@gmail.com) (A.O. Werneck), [celia.szwarcwald@icict.fiocruz.br](mailto:celia.szwarcwald@icict.fiocruz.br) (C.L. Szwarcwald), [marilisa@unicamp.br](mailto:marilisa@unicamp.br) (M.B. de Azevedo Barros), [dcmalta@uol.com.br](mailto:dcmalta@uol.com.br) (D.C. Malta).

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The issue is even more alarming regarding adolescents, since it is a period of many social and psychological changes and intense growth, and it is a phase when new lifestyle habits are acquired, which will be key for present and future health. Evidence of the impacts of social isolation on eating habits in adolescents is limited, especially in Brazil. However, the existing evidence indicates that, regardless of an increase in consumption of healthy foods, the consumption of unhealthy foods has increased as well (sweets and chocolate, fried food), indicating a clear change in eating habits in this segment of the population [10,11]. For example, a narrative review identified an increase in carbohydrate consumption (pizza, bread, cake and sweets), snacks and FV, except in studies that evaluated changes in the Polish population [12]. A study conducted in Italy identified that during the pandemic there was an increase in the consumption of desserts, high-calorie snacks and in home-cooked meals, and an unchanged consumption of fresh foods [13]. Research carried out in Brazil revealed that during the period of social distancing, there was an increase in the consumption of vegetables, frozen foods, chocolates, and sweets) [10].

An increase in inequality and vulnerability throughout this period is also relevant. The National Survey on Unsafe Eating in the context of the COVID-19 pandemic in Brazil, conducted with a probability sample of 2180 households, indicated that 19.1 million people are starving in the country, and approximately 116.8 million are affected by food insecurity at some level, which results in a worsening of eating habits [14]. Therefore, identifying the population groups that are most affected is essential in order to direct efficient actions and public health policies, as well as allows government health officials to create recommendations for future periods of social distancing.

Thus, the present study aimed to evaluate the consumption FV, and ultra-processed foods (UPF), before and after the COVID-19 pandemic, as well as to identify the sociodemographic factors associated.

## 2. Methodology

### 2.1. Sample

This study used data from the “Convid Adolescents - Behavior Survey” conducted by the Fundação Oswaldo Cruz (FIOCRUZ, in Portuguese) in partnership with Universidade Federal de Minas Gerais (UFMG) and Universidade Estadual de Campinas (Unicamp). “Convid - Adolescents” is a cross-sectional study which evaluated the behavior of Brazilian adolescents between 12 and 17 years of age during the COVID-19 pandemic in Brazil.

Data collection for the study was carried out through the Internet between June 27, 2020, and September 17, 2020. This period refers to the first wave of COVID-19 in Brazil, in which there was a rapid advance of the disease across the country and the adoption of social distancing measures, such as the closing of schools, workplaces, and some types of commerce.

The individuals were invited to participate through a chain-sampling procedure called “virtual snowballing”. To begin the process, the leading researchers chose other researchers from different states of Brazil, with previous experience in studies with adolescents. Those researchers sent the link to the research to parents of adolescents. Furthermore, the coordination team entered in contact with private and public schools, as well as with state and municipal education authorities, through an institutional email. The institutions which chose to participate in the survey sent the digital questionnaires to the students. The questionnaires were filled out by the adolescents on the cell phone or laptop/computer with Internet access, after the consent the parents and the consent of the adolescents themselves. All the answers were anonymous, with no identification of the participants. Additional information about this survey is available at the survey site (<https://convid.fiocruz.br/>). All the procedures were approved by the National Research Ethics Committee (Decision number: 4,100,515). Since the sampling by networks is not probabilistic, post-stratification procedures were used to obtain the same distribution of the adolescents for region of

residency, sex, age group (12–15; 16–17), and kind of school (public or private), using data from the 2015 National Adolescent School-based Health Survey (PeNSE 2015, in Portuguese) by the Brazilian Institute of Geography and Statistics, in a partnership with the Ministry of Health [15].

This study included 9470 adolescents, 12 to 17 years of age, from every Brazilian state. However, the survey excluded individuals with missing data for the UPF ( $n = 108$ ) and FV ( $n = 44$ ) from the analysis. For the incidence analyses, individuals who had a high consumption of UPF before the pandemic ( $n = 3702$ ; weighted prevalence: 38.9%) and a low consumption of FV ( $n = 7866$ ; weighted frequency: 83.5%) were excluded. Therefore, the final sample was 5660 and 1560, respectively, for the analyses related to the consumption of UPF and FV.

### 2.2. Variables

The questionnaire used is available at the survey site (<https://convid.fiocruz.br/>) and is based on validated questions used in health surveys, as 2019 National Health Survey [16] and monitored by the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey [17]

#### 2.2.1. Eating habits

The intake of FV was defined by the weekly frequency of consumption of these foods, whereas the intake of UPF was defined by the consumption of sugary foods (chocolate, cookies, candy), chips, ready to eat frozen foods, embedded foods (ham, salami, sausage, hamburgers), chocolate milk, and soda. The questions seeking to identify the consumption of each kind of food presented the following structure: “Usually, before the pandemic, how many times a week did you eat these foods? During the pandemic, how many times a week did you eat these foods?”. The answer options were: never eat them; once a week or less; twice to four times a week; five times a week or more.

A “low intake” of FV was considered when the adolescents reported to eating FV less than five times a week, and as a “high intake” of UPF, the consumption of at least one kind of UPF in five days or more a week, according to the NOVA classification [18].

#### 2.2.2. Independent variables

The independent variables chosen in this study were: sex (male, female); age group (12 to 15; 16 to 17 years of age); race/color of skin (white, black, brown, and other); kind of school (public; private); education level of the mother (incomplete high school; complete high school; complete college education); region of Brazil where they live (North; Northeast; Southeast; Midwest; South); financial difficulties during the pandemic (“During the pandemic, is your family facing financial difficulties?”(yes; no); food insecurity (“Was there ever a concern that the family will run out of food before your parents have money to purchase more food?” (yes; no); social restrictions (little strict; very strict;). We considered it to be “little strict” when the adolescent answered “I had no restrictions, lived a normal life” or “I tried to take some precautions, avoided contact with others a little, tried to not visit elderly people, but continued to go out as usual”; and “very strict” when the answers were “Stayed home most of the time, leaving only to visit close relatives, go to the drugstore or to the grocery store” and “stayed home all the time, leaving only for medical needs”.

#### 2.2.3. Statistical analysis

The characteristics of the sample were described by frequencies and 95% confidence intervals (95% CI). Initially, the prevalence (95% CI) of outcomes was calculated before and during the pandemic for the total sample and according to the independent variables. The differences between the prevalence before and during the pandemic were considered significant when there was no overlap of the 95% CI of the prevalence being considered. Next, the incidence of outcomes was estimated. To accomplish this, adolescents who reported a low consumption of FV and a high consumption of UPF before the pandemic were excluded. To verify the possible factors associated with the incidence of outcomes, this study applied logistic

regression models with a significance level of 5%. The odds ratio (OR) was used as an associated measurement. All the analyses were carried out in the State 15.1 software and considered the post-stratification weights.

### 3. Results

Table 1 shows the characteristics of the total sample and the stratification for a consumption of FV and UPF. A total of 9470 adolescents were evaluated, considering that 50.2% were girls; 67.7% were between 12 and 15 years of age; 46.6% were brown skinned; 85.9% attended a private school; and 41.2% lived in the Southeast region. Concerning the food insecurity and financial difficulties during the pandemic, 26.1% and 33.9%, respectively, reported such conditions, while 71.5% reported having followed very strict restrictions (Table 1).

When analyzing the prevalence of low consumption of FV and high of UPF before and after the pandemic (Table 2), a reduction in the low consumption of FV was observed, decreasing from 83.5% to 80.3%, with this pattern being observed only among girls, adolescents between 16 and 17 years of age, race/color of skin white, who attended a public school, who did not report a food insecurity and financial difficulties, who adhered to very strict social restrictions, and whose mothers had an intermediate level of education. In terms of the high consumption of UPF, there were no significant differences before (38.9%) and after (38.1%) the pandemic.

Tables 3 and 4 show the incidences of low consumption of FV and a high consumption of UPF, respectively, during the pandemic. About 20% of the adolescents began to consume a low amount of FV during the pandemic. The girls (ORaj: 1.50; 95% CI: 1.05; 2.16), students of private schools (ORaj: 1.48; 95% CI: 1.02; 2.16), those who reported having food insecurity (ORaj: 2.40; 95% CI: 1.59; 3.63), and financial difficulties during the pandemic (ORaj: 1.71; 95% CI: 1.18; 2.51) showed a higher incidence of a low consumption of FV during the pandemic (Table 3).

**Table 1**  
Characteristics of the sample.

Variables	Total (n = 9470)	Analyses of FV consumption* (n = 1560)	Analyses of UPF consumption* (n = 5660)
	% (95% CI)	% (95% CI)	% (95% CI)
<b>Sex</b>			
Boys	49.8 (48.1;51.4)	51.4 (47.7;55.1)	50.5 (48.4;52.6)
Girls	50.2 (48.6;51.9)	48.6 (44.9;52.3)	49.5 (47.4;51.6)
<b>Age group</b>			
12–15 years	67.7 (66.3;69.1)	70.7 (67.5;73.7)	67.6 (65.8;69.3)
16–17 years	32.3 (30.9;33.7)	29.3 (26.3;32.5)	32.4 (30.6;34.2)
<b>Race/color of skin</b>			
White	40.1 (38.5;41.7)	35.4 (32.2;38.8)	37.7 (35.8;39.7)
Black	9.7 (8.8;10.7)	7.4 (5.5;9.8)	10.5 (9.25;11.9)
Brown	46.6 (44.9;48.3)	53.9 (50.2;57.6)	48.3 (46.2;50.4)
Other	3.6 (3.0;4.37)	3.3 (2.2;4.8)	3.5 (2.7;4.5)
<b>Kind of school</b>			
Public	85.9 (85.1;86.7)	85.1 (83.2;86.9)	86.9 (85.9;87.8)
Private	14.1 (13.3;14.9)	14.9 (13.1;16.8)	13.1 (12.2;14.1)
<b>Mother's education</b>			
Incomplete High School	32.6 (30.9; 34.2)	30.8 (27.1;34.9)	36.7 (34.6;38.9)
Complete High School	33.8 (32.1; 35.5)	32.1 (28.6;35.7)	32 (29.9;34.1)
Complete College	33.6 (32.1; 35.2)	37.1 (33.6;40.8)	31.3 (29.3;33.3)
<b>Food insecurity</b>			
No	73.9 (72.4;75.4)	74.5 (71.0;77.8)	74.2 (72.3;76.0)
Yes	26.1 (24.6;27.6)	25.5 (22.2;29.0)	25.8 (24.0;27.7)
<b>Financial difficulties during the pandemic</b>			
No	66.1 (64.5;67.7)	70.0 (66.5;73.3)	65.7 (63.7;67.7)
Yes	33.9 (32.3;35.5)	30.0 (26.7;33.5)	34.3 (32.3;36.3)
<b>Region</b>			
North	9.1 (8.6; 9.7)	8.4 (7.2;9.7)	9.2 (8.5;9.9)
Northeast	28.4 (26.4; 30.4)	20.5 (16.5;25.1)	27.2 (24.7;29.7)
Southeast	41.2 (39.7; 42.8)	51.1 (47.4;54.9)	43.7 (41.7;45.7)
South	13.6 (13.0; 14.2)	12.3 (11.0;13.7)	13.1 (12.3;13.9)
Midwest	7.7 (7.1; 8.4)	7.7 (6.3;9.5)	6.8 (6.1;7.7)
<b>Social restriction</b>			
Little strict	28.5 (27.2;30.0)	30.3 (27.0;33.9)	29.8 (27.9;31.7)
Very strict	71.5 (70.0;73.0)	69.7 (66.1;73.0)	70.2 (68.3;72.0)

95% CI: 95% confidence interval \* Samples of incidence analyses.

In terms of a high consumption of UPF, 13.8% began to have this habit during the pandemic, and female adolescents (ORaj: 1.70; 95% CI: 1.33; 2.19), those who attend private schools (ORaj: 1.56; 95% CI: 1.15; 2.10), with mothers who have a higher education level (complete high school - ORaj: 1.41; 95% CI: 1.06; 1.88 / complete college - ORaj: 1.70; 95% CI: 1.19; 2.44), and those who reported having financial difficulties during the pandemic (ORaj: 1.40; 95% CI: 1.10; 1.79) showed higher incidences of a high consumption of UPF during the pandemic (Table 4).

A Summary Figure of Findings are illustrated in Figs. 1.

### 4. Discussion

The current study shows that during the COVID-19 pandemic the consumption of UPF remained stable, while that of FV increased. The incidence of high consumption of UPF and low consumption of FV were 13.8% and 20.3%, respectively. Higher incidences of low consumption of FV were observed among girls, adolescents from private schools, those who reported having food insecurity, and those who had financial difficulties during the pandemic. The highest incidences of a high consumption of UPF were observed among girls, students of private schools, who reported financial difficulties during the pandemic and those whose mothers have a higher education level.

The reduction in the low consumption of FV found in the present study is in accordance to other studies development in Brazil [4,11], Italy [11,19], Chile [11], Spain [11], Colombia [11], Greece [20] and Croatia [21] and can be explained by the greater availability of those foods during the pandemic [22], more time to cook at home and a consequent increase in the consumption of homemade meals [23,24], monitoring by the parents of what their children eat at home due to an increased concern with overweight children and adolescents [20,25]. The higher proximity with family, including the preparation of meals at home, can improve the relationship

**Table 2**

Consumption of fruits and vegetables and of ultra-processed foods before and during the COVID-19 pandemic among Brazilian adolescents according to sociodemographic characteristics.

Variables	Low consumption of FV		High consumption of UPF	
	Before (%; 95% CI)	During (%; 95% CI)	Before (%; 95% CI)	During (%; 95% CI)
<b>Total</b>	83.5 (82.3;84.6)	80.3 (79.0;81.6)	38.9 (37.3;40.6)	38.1 (36.5;39.7)
<b>Sex</b>				
Boys	83.1 (81.1;84.9)	80.5 (78.3;82.5)	38.1 (35.4;40.8)	35.7 (33.0;38.4)
Girls	83.8 (82.4;85.1)	80.2 (78.6;81.7)	39.7 (37.9;41.6)	40.5 (38.7;42.4)
<b>Age group</b>				
12–15 years	82.7 (81.1;84.2)	79.8 (78.1;81.5)	39.0 (36.8;41.2)	38.4 (36.3;40.6)
16–17 years	85.0 (83.2;86.6)	81.4 (79.5;83.1)	38.8 (36.5;41.0)	37.4 (35.3;39.7)
<b>Race/color of skin</b>				
White	85.4 (83.9;86.8)	81.9 (80.2;83.5)	42.5 (40.2;44.8)	42.6 (40.3;44.9)
Black	87.8 (83.8;91.0)	85.8 (81.6;89.2)	33.8 (29.0;38.9)	29.4 (25.2;34.0)
Brown	80.7 (78.6;82.6)	77.7 (75.4;79.8)	36.6 (34.0;39.2)	35.9 (33.3;38.6)
Other	85.0 (78.3;89.9)	82.9 (76.0;88.1)	42.1 (33.1;51.6)	38.9 (30.8;47.8)
<b>Kind of school</b>				
Public	83.7 (82.3;85.0)	80.4 (78.8;81.8)	38.3 (36.4;40.1)	36.8 (35.0;38.6)
Private	82.1 (80.0;84.0)	80.3 (78.1;82.3)	42.8 (40.2;45.5)	46.2 (43.6;48.9)
<b>Mother's education</b>				
Incomplete High School	84.1 (81.6;86.3)	83.0 (80.5;85.3)	30.1 (27.2;33.0)	29.7 (27.0;32.6)
Complete High School	84.0 (81.9;85.9)	79.0 (76.3;81.4)	41.4 (38.3;44.6)	39.4 (36.3;42.5)
Complete College	81.3 (79.3;83.2)	78.4 (76.2;80.4)	42.3 (39.5;45.0)	44.2 (41.5;47.0)
<b>Food insecurity</b>				
No	83.3 (81.9;84.6)	79.4 (77.9;80.9)	38.5 (36.6;40.4)	38.1 (36.2;39.9)
Yes	83.9 (81.4;86.1)	83.0 (80.3;85.4)	39.6 (36.2;43.0)	38.1 (34.8;41.5)
<b>Financial difficulties during the pandemic</b>				
No	82.5 (80.9;83.9)	79.0 (77.4;80.6)	39.2 (37.2;41.2)	37.5 (35.5;39.5)
Yes	85.4 (83.4;87.1)	83.0 (80.6;85.1)	38.2 (35.4;41.0)	39.4 (36.6;42.2)
<b>Region</b>				
North	84.9 (82.8;86.8)	80.7 (78.4;82.8)	38.4 (35.7;41.1)	38.5 (35.8;41.3)
Northeast	88.1 (84.8;90.8)	82.2 (78.4;85.5)	41.4 (36.9;46.1)	40.0 (35.4;44.6)
Southeast	79.4 (77.7;81.1)	78.3 (76.5;80.0)	35.3 (33.3;37.3)	34.1 (32.2;36.1)
South	85.0 (83.6;86.3)	83.6 (82.2;85.0)	41.0 (39.1;42.9)	42.3 (40.4;44.2)
Midwest	83.3 (79.8;86.3)	78.4 (74.5;81.8)	45.9 (41.6;50.3)	44.6 (40.3;49.0)
<b>Social restriction</b>				
Little strict	82.4 (80.1;84.5)	80.9 (78.5;83.1)	36.1 (33.1;39.3)	33.3 (30.3;36.3)
Very strict	83.9 (82.5;85.2)	80.1 (78.5;81.7)	40.1 (38.1;42.0)	40.1 (38.2;42.1)

95% CI: 95% confidence interval.

with food, increase knowledge and abilities, thus allowing for a better quality of food [26,27]. A narrative review also found an increase in the consumption of legumes, FV, as well as the habit of cooking meals at home during the pandemic [12].

Concerning the prevalence of consumption of UPF, although there was no significant alteration for the total sample during the pandemic, it can be observed that the consumption is high among adolescents (approximately 40% consume at least one UPF at 5 times a week or more per week). The consumption of UPF is associated with a high calorie intake and higher risk of obesity and non-communicable chronic diseases [28]. In contrast, other studies found an increase in the consumption of UPF during the time of confinement [11,19,29]. For instance, a survey conducted with children and adolescents in Saudi Arabia identified that 46% of the interviewees had difficulties following a healthy diet during the confinement, due to an increase of the consumption of fast food, sweets, pasta, and fizzy drinks [29]. Farello et al. (2022) [13] also observed an increase in consumption of high-calorie sweets, desserts and snacks among Italian adolescents during the pandemic.

In relation to the analyses of incidence, it was observed that approximately 20% of the adolescents stopped consuming FV regularly, and 13.8% began to consume UPF five times a week or more, in other words, the food consumption worsened during the pandemic. Such results are worrisome, since adolescence is a phase of development when the individual acquires abilities and life habits that are the foundations for future health.

It is known that food consumption is influenced by several factors, ranging from biological issues to the family and physical environment in which the individual participates [30,31].

The higher incidence of a low consumption of FV and high consumption of UPF observed in the girls corroborates with other studies

[32–34] and emphasizes the importance of different strategies according to gender. One possible explanation for this fact may be related to the emotional behavior associated with eating, in other words, the use of food as a means of comforting oneself, as a means through which to respond to the feelings of anxiety, sadness, and depression. One study indicated that there is a gender difference in relation to “emotional hunger”, characterized by the wish to eat as a reaction to negative feelings of stress [35]. Women showed more food anxiety in comparison to men during the period of social confinement, and that may be connected to female physiology, which is more prone to emotional and psychic alterations and anxiety [36–38].

The current study confirmed the influence of socioeconomic conditions on eating. Usually, inadequate eating patterns are more often associated to situations of more socioeconomic vulnerability [32]. In the current study, the adolescents who referred to food insecurity had a greater incidence of low consumption of FV, while those who referred to financial difficulties during the pandemic showed a greater incidence of a low consumption of FV and a high consumption of UPF.

The association between worse socioeconomic conditions and worse eating habits is consistent with previous results [39,40] and may be explained by the greater difficulty that people in worse socioeconomic conditions have to access information that could possibly enable them to choose healthier foods; a lesser availability of food stores which sell fresh and wholesome foods in poorer parts of town; the lack of public policies towards the promotion of healthy eating habits among poorer families; the higher cost of nutrient-rich foods, like fresh FV, in contrast to foods that are rich in calories; and higher caloric density, practicality, and satisfaction provided by UPF [39,41,42].

**Table 3**

Incidence of low consumption of fruits and vegetables during the COVID-19 pandemic according to sociodemographic characteristics.

Variables	% (95% CI)	Univariate model	Multivariate model
		OR (95% CI)	ORaj (95% CI)
Total	20.3 (17.8;23.2)		
<b>Sex</b>			
Boys	17.0 (13.3;21.4)	1	1
Girls	23.7 (20.4;27.4)	1.52 (1.07;2.15)	1.50 (1.05;2.16)
<b>Age group</b>			
12–15 years	18.9 (16.0;22.2)	1	1
16–17 years	23.7 (18.9;29.3)	1.33 (0.94;1.90)	–
<b>Race/color of skin</b>			
White	21.6 (18.0;25.8)	1	1
Black	28.9 (17.7;43.5)	1.47 (0.75;2.90)	–
Brown	18.5 (15.0;22.6)	0.82 (0.52;1.16)	–
Other	16.4 (6.5;35.7)	0.71 (0.24;2.06)	–
<b>Kind of school</b>			
Public	19.9 (17.0;23.2)	1	1
Private	22.6 (18.1;27.8)	1.17 (0.83;1.64)	1.48 (1.02;2.16)
<b>Mother's education</b>			
Incomplete High School	21.2 (16.1;27.3)	1	1
Complete High School	19.6 (15.2;24.9)	0.91 (0.58;1.43)	–
Complete College	21.8 (17.7;26.6)	1.04 (0.68;1.59)	–
<b>Food insecurity</b>			
No	15.2 (12.7;18.1)	1	1
Yes	35.5 (28.8;42.8)	3.07 (2.12;4.44)	2.40 (1.59;3.63)
<b>Financial difficulties during the pandemic</b>			
No	15.0 (12.4;18.0)	1	1
Yes	32.9 (27.3;39.1)	2.79 (1.97;3.95)	1.71 (1.18;2.51)
<b>Region</b>			
North	16.5 (11.8;22.6)	1	1
Northeast	13.0 (7.5;21.6)	0.75 (0.36;1.56)	–
Southeast	24.0 (20.2;28.2)	1.59 (1.01;2.49)	–
South	24.6 (20.7;29.0)	1.65 (1.05;2.58)	–
Midwest	12.9 (7.7;20.7)	0.74 (0.37;1.49)	–
<b>Social restriction</b>			
Little strict	17.5 (13.2;22.8)	1	1
Very strict	21.7 (18.5;25.2)	1.30 (0.89;1.91)	–

Note. Only adolescents with an adequate consumption of FV before the pandemic were included in the analysis of incidence.

By contrast, when we consider the mother's level of education and the kind of school the adolescent attends as proxies of socioeconomic conditions, it could be observed that private school adolescents presented a greater incidence of a high consumption of UPF and a low consumption of FV, whereas adolescents whose mothers had a higher level of education presented a higher incidence of the consumption of UPF. This apparent contradiction is explained by the coexistence of healthy and unhealthy choices for individuals with better socioeconomic conditions [43–46]. A recent systematic review shows that individuals with higher incomes have a mixed eating pattern, consisting of more diverse and nutrient-rich foods, including several *in natura* foods (meat, dairy products, FV) which have a higher cost, but they tend to have a higher consumption of UPF (soda, for example) and ready-to-eat foods. On the other hand, individuals with lower incomes have an eating pattern closer to the Brazilian eating standard, which is more monotone, with a lower cost and less nutritional value [47].

It is important to emphasize that poverty in Brazil has increased due to austerity policies, unemployment, a lack of investments in social protection policies [48–51], and those problems have worsened with the pandemic. A survey conducted by PNAD COVID during the pandemic indicated an increase in unemployment and worsening inequalities [52]. Moreover, 19.1 million people were affected by hunger in 2020, which represents a portion of the 116.8 million Brazilians who had to deal with some degree of food insecurity - a number that corresponds to 55.2% of the homes, according to data from the Brazilian Research Network on Food and Nutritional Sovereignty and Security (Penssan, in Portuguese) [14]. These factors intensify the interest in UPF, which are cheaper, provide high satisfaction and are quick to prepare. The increase in the price of cooking gas has made it difficult for a large portion of the population in financial difficulties to afford. It

**Table 4**

Incidence of high consumption of ultra-processed foods during the COVID-19 pandemic according to sociodemographic characteristics.

Variables	% (95% CI)	Univariate model	Multivariate model
		OR (95% CI)	ORaj (95% CI)
Total	13.8 (12.5;15.2)		
<b>Sex</b>			
Boys	10.8 (8.9;12.1)	1	1
Girls	16.9 (15.2;18.8)	1.68 (1.32;2.14)	1.70 (1.33;2.19)
<b>Age group</b>			
12–15 years	13.2 (11.5;15.0)	1	1
16–17 years	15.1 (13.2;17.2)	1.17 (0.94;1.46)	–
<b>Race/color of skin</b>			
White	16.3 (14.4;18.5)	1	1
Black	9.4 (6.5;13.3)	0.52 (0.35;0.80)	–
Brown	12.8 (10.8;15.0)	0.75 (0.59;0.96)	–
Other	13.5 (7.7;22.6)	0.80 (0.42;1.53)	–
<b>Kind of school</b>			
Public	12.6 (11.2;14.2)	1	1
Private	21.5 (18.8;24.4)	1.89 (1.52;2.34)	1.56 (1.15;2.10)
<b>Mother's education</b>			
Incomplete High School	10.8 (8.9;13.0)	1	1
Complete High School	14.6 (12.4;17.2)	1.41 (1.06;1.88)	1.41 (1.06;1.88)
Complete College	18.4 (15.5;21.6)	1.85 (1.40;2.49)	1.70 (1.19;2.44)
<b>Food insecurity</b>			
No	14.1 (12.5;15.8)	1	1
Yes	13.1 (11.0;15.6)	0.92 (0.72;1.18)	–
<b>Financial difficulties during the pandemic</b>			
No	12.7 (11.1;14.4)	1	1
Yes	16.0 (13.8;18.5)	1.31 (1.04;1.65)	1.40 (1.10;1.79)
<b>Region</b>			
North	13.7 (11.2;16.5)	1	1
Northeast	13.9 (1.5;18.3)	1.02 (0.69;1.52)	–
Southeast	12.7 (11.2;14.5)	0.92 (0.70;1.20)	–
South	16.3 (14.5;18.2)	1.22 (0.94;1.60)	–
Midwest	15.7 (12.0;20.4)	1.18 (0.80;1.74)	–
<b>Social restriction</b>			
Little strict	11.1 (9.0;13.6)	1	1
Very strict	15.0 (13.4;16.8)	1.41 (1.09;1.84)	–

Note. Only adolescents with an adequate consumption of UPF before the pandemic were included in the analysis of incidence.

should also be emphasized that the UPF had less variation in price than basic foods, making them more desirable by more affluent portions of the population.

Finally, the results of the present study point to a significant level of social inequality in terms of food consumption by adolescents. People with better socioeconomic conditions have a greater possibility of choice, whereas the most vulnerable individuals seem to be conditioned to the consumption of a more basic and accessible diet.

The limitations of this study should also be mentioned. The collection of data via Internet may not reach every population segment, since many do not have access to this means of communication, which may lead to an overestimation of the proportion of the indicators. However, such a limitation was minimized by the calibration of the sample with data from PeNSE. Moreover, the period of data collection (from June 27 to October 12, 2020) represents a singular moment of social distancing, subjected to changes throughout the pandemic. Moreover, the retrospective design may have a memory bias in questions related to eating before the pandemic. Furthermore, the questionnaire on eating does not evaluate the amount and the size of the servings.

On the other hand, it is important to emphasize that this is the first nationally representative study aimed at quantifying the incidence of inadequate eating habits in adolescents and at identifying the population groups that were more affected by the COVID-19 pandemic, which may aid in the promotion of healthier lifestyles when facing the current and future pandemics.

The present study concluded that social isolation may influence adolescents' eating habits. Although there was little change in the consumption of FV and UPF before and after the pandemic, the incidence of a high consumption of UPF and a low consumption of FV was high (20.3% and

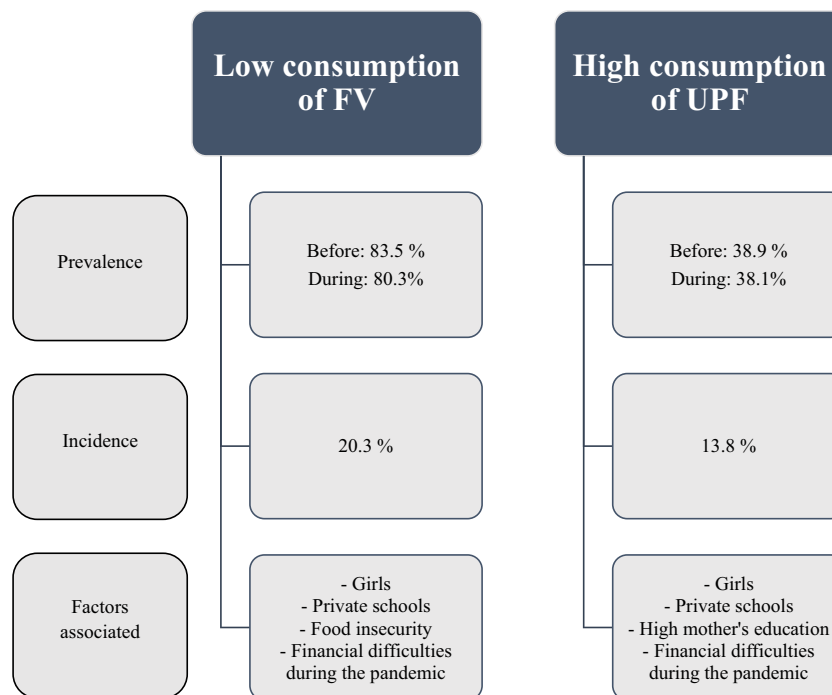


Fig. 1. Summary Figure of Findings.

13.8%, respectively). Girls, private school adolescents, who reported having food insecurity and financial difficulties during the pandemic were the most affected subgroups. Therefore, efforts focused on these subgroups are useful and necessary to minimize the negative effects of isolation on the eating habits of Brazilian adolescents.

Considering that eating habits play a key role in protecting individuals from the more severe consequences of COVID-19 and other diseases and considering that adolescence is a period of development of eating habits, health authorities must reinforce campaigns of strategic nutrition aimed to this age group, especially in conditions of the suspension of activities and social isolation.

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#### Ethics Statement

The study design was approved by the National Research Ethics Committee (Decision number: 4,100,515).

#### Data availability statement

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

#### Declaration of Competing Interest

The authors declare that there are no conflict of interests.

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