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Social determinants of health associated with the experience of hunger among Brazilian adolescents

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Abstract *The aim of this study was to identify social determinants of health associated with the experience of hunger among school-age adolescents in Brazil. We conducted a cross-sectional study with a sample of 16,526 adolescents using data from the 2015 National School-based Student Health Survey. Experience of hunger was determined based on the answer to the question "In the last 30 days, how often have you been hungry because there wasn't enough food at home?" The social determinants of health were analyzed using Poisson regression with robust variance. The prevalence of the experience of hunger was 22.8% (95%CI: 21.9-23.7). The experience of hunger was directly associated with being male (PR = 1.12; 95%CI: 1.07-1.16); not being overweight (PR = 1.08; 95%CI: 1.04-1.13); irregular consumption of beans (PR = 1.20; 95%CI: 1.13-1.26), vegetables (PR=1.16; 95%CI: 1.09-1.22) and fruit (PR = 1.19; 95%CI: 1.13-1.24); body dissatisfaction (PR = 1.26; 95%CI: 1.18-1.35); and not regularly eating lunch or dinner with parents or guardians (PR = 1.41; 95%CI: 1.32-1.52). An inverse association was found between the experience of hunger and maternal education level and living in the Mid-West, Southeast and South. The findings show that the experience of hunger among Brazilian adolescents coexists with risky eating behaviors, body dissatisfaction, and social inequality.*
Key words *Hunger, Adolescents, Social determinants of health*

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Introduction

Adolescence is a period of physical and psychological development characterized by changes in the body and peer group relations[1-6]. In Brazil, despite the creation of the Child and Adolescent Statute[7] (Law 8069/90) to protect the rights of this group, problems during this phase of health vulnerability are aggravated by the socioeconomic inequalities facing a large proportion of adolescents[8]. One way of recognizing these unequal and unfair realities, which constitute social determinants of health, is to identify the experience of hunger or difficulty accessing adequate food among this group[9,10], otherwise known as food and nutrition insecurity[11].

The concept of food and nutrition insecurity gained greater visibility after the creation of the Organic Law on Food and Nutrition Security, which sets out strategies to guarantee the right to adequate food[12]. Food insecurity among adolescents is associated with poor infrastructure and low levels of human capital, income, employment, social support and education[10,13-15], which are categorized as structural and intermediary determinants of health[16,17].

Researchers began to investigate the denial of the right to food in Brazil from the perspective of food and nutrition insecurity in the 1990s. At the beginning of the twentieth century, the problem was assessed using different categories of hunger. However, hunger was normalized and it was only later that the condition was assigned the status of a social problem by researchers such as Josué de Castro, author of *Geography of Hunger*, published in 1946[18]. Maria do Carmo Freitas[19] discussed hunger as a public health problem in her work *Agonia da Fome* (The Agony of Hunger), highlighting that it was caused by processes of social exclusion and revealed "in every context of political and economic domination". Hunger is a complex and multifactorial social phenomenon and should therefore be monitored in different contexts in Brazil, especially considering that the situation is worsening due to increasing social vulnerability caused by the current sociopolitical context[20].

Given the urgency of developing actions to tackle this problem in Brazil, it is important to investigate how hunger manifests itself in different contexts (individual, household and regional) and the relationship with behavioral, physical and social factors[21]. It is important to highlight that in recent studies hunger is described as severe food insecurity, which negatively affects nutrition and food outcomes[22,23].

The prevalence of severe food insecurity in Brazilian households dropped from 9.5% in 2004 to 4.2% in 2013. However, the rate has begun to rise again, reaching 9% in 2020[20]. The prevalence of severe food insecurity and its social and physical effects is higher among structurally vulnerable groups, such as children, adolescents, women and older persons[24]. The findings of the 2017-2018 national household budget survey illustrate different levels of vulnerability across Brazil, showing that the prevalence of severe food insecurity was higher in households with children and/or adolescents[25].

Hence, it is evident that adolescents are one of the most vulnerable groups in Brazil and therefore more likely to experience hunger. This is confirmed by the literature, including a study with adolescents living in municipalities with a low human development index in Brazil's semi-arid region conducted in 2005 showing that the prevalence of severe food insecurity among this group was between 34.0% and 48.8%[26]. In addition, a survey of state capitals conducted between 2011 and 2012 estimated that prevalence of severe food insecurity was 2.6% among adolescents and 13.9% among those whose mothers were illiterate[27].

The evidence of food insecurity among adolescents warrants further research at national level to inform food and nutrition surveillance[28] aimed at identifying the most vulnerable groups and associations between hunger and different factors, such as nutritional status, behavior and living standards. These studies can generate quality data to inform policies and actions to address food insecurity and guarantee the right to adequate food among this age group. The aim of this study was therefore to identify social determinants of health associated with the experience of hunger among school-age adolescents.

Methods

Study design and data

We conducted a cross-sectional study using microdata[29] from Sample 2 of the 2015 National School-based Student Health Survey (PeNSE 2015). The questionnaire-based survey was performed by the Brazilian Institute of Geography and Statistics (IBGE) in conjunction with the Ministry of Health and Ministry of Education.

The sample consisted of students regularly attending private and public schools in urban

and rural areas between the sixth year of junior high school and third year of high school. A total of 16,608 questionnaires were completed, 16,556 of which were considered valid. Sample 1 permitted comparisons with national and international indicators for this age group, unlike Sample 1, which only represented students in the ninth year of junior high school[30].

The survey used a cluster sampling approach involving the following stages: 1) division of the sample area into strata; 2) random selection of schools in each strata (primary sampling unit); and 3) random selection of classes in each school (secondary sampling unit). All students in the selected classes were invited to participate in the survey. The sample size for each stratum was calculated using the following parameters: sampling error of 3% at a 95 percent level of confidence, estimated prevalence of 50%, and sample design effect of "3" in the first stage. This made it possible to estimate the population parameters for each of the country's five regions (North, Northeast, Southeast, South and Mid-West) and Brazil as a whole[30].

The data were collected between April and September 2015 using a self-administered electronic questionnaire. Further details on the methodology and sample design can be found in the survey report published by the IBGE[30].

The present study used data obtained from the IBGE database on 16,526 students who answered the dependent variable question, representing only 30 losses (0.18%) in relation to the original survey sample.

Study variables

The dependent variable was the experience of hunger, derived from the question "In the last 30 days, how often have you been hungry because there wasn't enough food at home?" The possible answers were: (a) "never", (b) "rarely", (c) "sometimes", (d) "most of the time", and (e) "always". Outcome (0), "Hasn't experienced hunger in the last month", was derived from the answer "never" and the answers b, c, d, e were grouped together to provide the outcome (1), "Experienced hunger in the last month".

In order to gain a better understanding of the inherent complexity of adolescence[31], the independent variables represented dimensions of the social determinants of health model adapted to adolescent dietary patterns and nutrition, which encompasses eating behaviors and body dissatisfaction[31] (Chart 1).

For the variables food consumption and eating routines, "regular" was defined as at least five days a week. Nutritional status was assessed based on weight and height, measured by trained interviewers using an electronic scale and portable stadiometer in a private room after the respondent has completed the questionnaire. These data were not collected from students who were unable or refused to undergo anthropometric measurements. Weight and height were measured twice and when the second measurement was different, a third measurement was taken. Only one measurement was recorded for each variable[32].

Nutritional status was classified based on the BMI-for-age percentile for 10 to 19 years, 11 months and 29 days. Body mass index (BMI) was calculated using the following formula: [weight (kg)/height^2 (m)]. Excess weight, thinness and short stature were assessed based on weight, height, age and sex using the WHO AnthroPlus software[33] to calculate z-scores. We adopted the WHO Child Growth Standards[34] as the reference for BMI-for-age (BMI/A) and height-for-age (H/A). Nutritional status was classified according to the thresholds for individuals aged between 10 and 19 years, 11 months and 29 days recommended by Brazil's Food and Nutritional Surveillance System (SISVAN)[35].

Ethical aspects

The PeNSE 2015 was approved by the National Research Ethics Committee (CONEP) on 30 March 2015 (code 1.006.467). Just like the other editions (2009 and 2012), the survey provided valuable data for studies investigating risk factors for non-communicable chronic diseases[30]. The present study used data made available by the IBGE and was conducted in accordance with ethical norms and standards for research involving human subjects set out in National Health Council Resolution 510 (April 7 2016)[36].

Data analysis

The descriptive statistics (prevalence ratios and their respective 95% confidence intervals) were analyzed using SPSS version 20[37]. The statistical significance ($p < 0.05$) of differences in the frequencies of the experience of hunger was determined using Pearson's chi-square test.

The association between the experience of hunger and the independent variables was tested by performing Poisson regression using Sta-

ta 13.0 (StataCorp LP, College Station, United States)[38]. The answer "Hasn't experienced hunger in the last month" was the reference category for the dependent variable in the Poisson regression models.

First, we performed bivariate Poisson regression (Model 1), estimating crude prevalence ratios (PR) and their respective 95% confidence intervals (95% CI). Only variables with a p-value of < 0.02 were retained in the multivariate Pois-

Chart 1. Independent variables included in the model to test factors associated with the experience of hunger among Brazilian adolescents, based on the dimensions of social determinants of health model adapted to adolescent dietary patterns and nutrition.

Dimension/characteristic/variable	Description
Socioeconomic status and individual and family characteristics	
Sociodemographic	
Sex	Male or female
Color/race	Self-declares white or non-white (black, yellow, brown or indigenous).
Age group	10-14 years or 15-19 years at the time of data collection.
Work	Working at the time of data collection.
Family	
Maternal education level	Maternal education level at the time of data collection: no basic qualifications, literate, junior high, high school, higher education.
Number of people living in the household	Living in a household with five or more people, or up to four people.
Sociopolitical and economic context	
Sample area	
Macro region	Region of residence at the time of data collection: North, Northeast, Southeast, South, Mid-west.
Physical, behavioral and psychosocial factors	
Nutritional status	
Thinness	Thinness or extremely thin (BMI/A < Z-score -2)[35].
Excess weight	Overweight and obese (BMI/A ≥ Z-score +1) [35].
Short stature	Short or very short stature-for-age or extremely thin (H/A < Z-score -2) [35].
Food consumption	
Regular consumption of beans	Eats beans at least five days a week.
Regular consumption of legumes and vegetables	Eats legumes or vegetables at least five days a week. Examples: lettuce, squash, broccolis, onion, carrots, kale, spinach, cucumber, tomato etc. Potatoes and cassava not included
Regular consumption of fruit	Eats fresh fruit or fruit salad at least five days a week.
Regular consumption fried savory snacks	Eats fried savory snacks at least five days a week. Examples: French fries (not including chips) or fried savory snacks such as chicken thighs, fried kibbeh, fried pasty, been fritter, etc.
Regular consumption of sweets	Eats sweets (candy, chocolate, gum, bonbons or lollipops) at least five days a week.
Regular consumption soft drinks	Eats soft drinks at least five days a week.
Regular consumption of savory ultra-processed foods	Eats industrialized/ultra-processed foods (hamburger, ham, mortadella, salami, sausage, hotdog, instant noodles, packaged savory snacks, and crackers) at least five days a week.

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son regression model with robust variance. This approach was adopted based on the recommendations for this type of modelling[39-41] to ensure a best-fitting final model (Model 2). Only variables with a p-value of < 0.05 were retained in the final adjusted model (Model 2). The adjusted prevalence ratios of the variables retained in this model were calculated together with their respective 95% confidence intervals.

The analyses were performed taking into account PeNSE 2015's complex sampling design using the SPSS Complex Samples module and Stata 13.0 survey data analysis command (svy) to incorporate the post-stratification weights in order to correct for the effect of clustering the primary sampling units (design effect).

Results

Most of the adolescents were male, non-white, aged between 15 and 19 years, not working, did not know their mother's education level, lived in households with up to four people, and were from the Southeast. The prevalence of the experience of hunger among the sample was 22.8% (95%CI: 21.9-23.7%) (Table 1).

Prevalence of the experience of hunger was higher among respondents who were non-white (23.6%); whose mothers had no basic qualifications (30.4%); who lived in the North (27.0%); who did not eat beans, legumes and vegetables, and fruit regularly (27.0%, 25.4%, and 25.1%, respectively); who did not eat lunch or dinner regularly with parents or guardians (30.4%); and who were indifferent to or dissatisfied with their bodies (28.9% and 26.9%, respectively) (Table 1).

The following variables maintained their association with the experience of hunger in the bivariate Poisson regression model (Model 1): region representative of the sociopolitical and economic context; markers of socioeconomic status and individual and family characteristics (sex, maternal education level); and physical, behavioral and psychosocial factors (excess weight, regular consumption of beans, regular consumption of legumes and vegetables, regular consumption of fruit, regularly eating lunch or dinner with parents or guardians, and body dissatisfaction) (Table 2).

In the multivariate model (Model 2), the likelihood of the experience of hunger was associated with socioeconomic status and individual and family characteristics, being 12% higher in males than in females and 33% lower among individuals whose mothers had completed higher education than in those whose mothers had no basic qualifications. The latter reveals an inversely proportional relationship between maternal education level and the experience of hunger. With regard to sociopolitical and economic context, students living in the North were more likely to experience hunger than those living in other regions.

Chart 1. Independent variables included in the model to test factors associated with the experience of hunger among Brazilian adolescents, based on the dimensions of social determinants of health model adapted to adolescent dietary patterns and nutrition.

Dimension/characteristic/variable	Description
Eating routines	
Regularly eats breakfast	Eats breakfast at least five days a week.
Regularly eats lunch or dinner with parents or guardians	Eats lunch or dinner with mother, father or guardian at least five days a week.
Eats while watching television or studying	Eats while watching TV or studying at least five days a week.
Ate fast food in the last week	Eats in fast food restaurants (diners, hotdog stands, pizza parlor, etc.) at least five days a week.
Body image	
Body satisfaction	Satisfaction with their body at the time of data collection: satisfied/very satisfied, indifferent, dissatisfied/very dissatisfied.

Source: Authors.

Table 1. Prevalence of the experience of hunger among Brazilian adolescents (n = 16,526) according to selected variables. National School-based Student Health Survey, 2015.

Variables	Population	Prevalence of the experience of hunger			
	%	n	%	95%CI	p-value
Socioeconomic status and individual and family characteristics					
Sociodemographic					
Sex					0.099
Female	49.2	8,258	22.0	20.7-23.3	
Male	50.8	8,268	23.5	22.2-24.9	
Color/race					0.018
White	36.4	6,565	21.3	19.9-22.8	
Non-white	63.6	9,940	23.6	22.4-24.8	
Age group					0.343
10-14 years	46.1	9,376	22.3	21.1-23.5	
15-19 years	53.9	7,150	23.2	21.8-24.6	
Working					0.734
No	82.0	14,056	22.7	21.7-23.7	
Yes	18.0	2,465	23.1	20.9-25.5	
Family					
Maternal education level					< 0.001
No basic qualifications	5.9	748	30.4	25.6-35.6	
Literate	20.0	2,734	25.3	23.2-27.7	
Junior high	13.1	2,000	21.8	19.5-24.2	
High school	22.5	3,765	21.5	19.7-23.5	
Higher education	13.4	3,098	20.0	17.9-22.3	
Don't know	25.3	4,160	22.0	20.3-23.8	
Number of people living in the household					0.109
5 or more	40.1	6,348	23.7	22.2-25.3	
Up to 4	59.9	10,171	22.1	21.0-23.3	
Sociopolitical and economic context					
Region					0.008
North	9.5	3,186	27.0	24.8-29.3	
Northeast	29.5	3,462	23.0	21.2-24.9	
Southeast	40.2	3,267	21.7	20.1-23.4	
South	13.2	3,201	23.1	21.5-24.8	
Mid-west	7.7	3,410	21.4	19.8-23.2	
Brasil		16,526	22.8	21.9-23.7	
Physical, behavioral and psychosocial factors					
Nutritional status					
Thinness					0.27
No	97.3	16,132	22.7	21.8-23.6	
Yes	2.7	393	26.2	20.3-33.1	
Excess weight					0.258
Yes	26.6	4,825	21.9	20.2-23.7	
No	73.4	11,700	23.1	22.0-24.2	
Short stature					0.076
No	97.6	16,273	22.6	21.7-23.5	
Yes	2.4	253	29.6	22.0-38.5	

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Table 1. Prevalence of the experience of hunger among Brazilian adolescents (n = 16,526) according to selected variables. National School-based Student Health Survey, 2015.

Variables	Population	Prevalence of the experience of hunger			
	%	n	%	95%CI	p-value
Food consumption					
Regular consumption of beans					< 0.001
Yes	58.1	9,167	19.7	18.5-20.9	
No	41.9	7,335	27.0	25.5-28.4	
Regular consumption of legumes and vegetables					< 0.001
Yes	37.9	6,636	18.4	17.1-19.8	
No	62.1	9,871	25.4	24.2-26.6	
Regular consumption of fruit					< 0.001
Yes	32.3	5,591	17.9	16.4-19.5	
No	67.7	10,914	25.1	23.9-26.3	
Regular consumption of fried savory snacks					0.966
Yes	13.5	2,171	22.8	20.5-25.4	
No	86.5	14,332	22.8	21.8-23.8	
Regular consumption of sweets					0.288
Yes	38.4	6,097	22.1	20.7-23.7	
No	61.6	10,407	23.2	22.0-24.4	
Regular consumption of soft drinks					0.183
Yes	26.1	4,214	23.9	22.0-25.8	
No	73.9	12,297	22.4	21.4-23.5	
Regular consumption of savory ultra-processed foods					0.068
Yes	30.2	4,980	21.5	19.9-23.1	
No	69.8	11,514	23.3	22.2-24.5	
Eating routines					
Regularly eats breakfast					0.092
Yes	53.5	7,231	23.6	22.2-25.0	
No	52.1	9,291	22.0	20.8-23.3	
Regularly eats lunch or dinner with parents or guardians					< 0.001
Yes	69.6	11,913	19.7	18.7-20.8	
No	30.4	4,599	29.8	27.9-31.7	
Regularly eats while watching TV or studying					0.092
No	52.1	9,291	22.0	20.8-23.3	
Yes	47.9	7,231	23.6	22.2-25.0	
Regularly eats fast food					0.194
No	53.5	8,709	23.3	22.1-24.7	
Yes	46.5	7,798	22.1	20.8-23.5	
Body image					
Satisfied with their body					< 0.001
Satisfied/very satisfied	71.1	11,521	20.7	19.7-21.8	
Indifferent	10.6	1,806	28.9	26.0-32.1	
Dissatisfied/very dissatisfied	18.3	3,038	26.9	24.7-29.2	

Source: Authors.

Associations were also found between the experience of hunger and physical, behavioral and psychosocial factors. The likelihood of experiencing hunger was 8% higher in respondents who were not overweight, 20% higher in those who did not eat beans regularly, 16% higher

Table 2. Crude and adjusted prevalence ratios (PR) and confidence intervals (95% CI) for the experience of hunger among Brazilian adolescents (n = 16,526) according to selected variables. National School-based Student Health Survey, 2015.

Variables	Model 1		Model 2	
	Crude PR	p-value	Adjusted PR	p-value
Socioeconomic status and individual and family characteristics				
Sociodemographic				
Sex				
Female	Ref		Ref	
Male	1.07 (1.01-1.12)	0.026	1.12 (1.07-1.16)	< 0.001
Color/race				
White	Ref			
Non-white	1.11 (0.99-1.23)	0.065		
Age group				
10-14 years	Ref			
15-19 years	1.04 (0.92-1.17)	0.515		
Working				
No	Ref			
Yes	1.02 (0.93-1.12)	0.696		
Family				
Maternal education level				
No basic qualifications	Ref		Ref	
Literate	0.83 (0.75-0.93)	0.002	0.84 (0.76-0.92)	0.001
Junior high	0.72 (0.57-0.91)	0.006	0.73 (0.59-0.90)	0.004
High school	0.71 (0.62-0.81)	< 0.001	0.70 (0.62-0.80)	< 0.001
Higher education	0.66 (0.56-0.77)	< 0.001	0.67 (0.58-0.77)	< 0.001
Don't know	0.72 (0.64-0.82)	< 0.001	0.75 (0.66-0.84)	< 0.001
Number of people living in the household				
5 or more	Ref			
Up to 4	0.93 (0.86-1.02)	0.126		
Sociopolitical and economic context				
Region				
North	Ref		Ref	
Northeast	0.85 (0.78-0.0.93)	0.001	0.82 (0.76-0.87)	< 0.001
Southeast	0.80 (0.74-0.87)	< 0.001	0.85 (0.77-0.94)	0.003
South	0.86 (0.80-0.92)	< 0.001	0.86 (0.79-0.92)	< 0.001
Mid-West	0.79 (0.74-0.85)	< 0.001	0.86 (0.79-0.93)	< 0.001
Physical, behavioral and psychosocial factors				
Nutritional status				
Thinness				
No	Ref			
Yes	1.15 (0.85-1.57)	0.354		
Excess weight				
Yes	Ref		Ref	
No	1.05 (1.00-1.10)	0.042	1.08 (1.04-1.13)	<0.001
Short stature				
No	Ref			
Yes	1.31 (0.98-1.75)	0.069		

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among those who did not eat legumes and vegetables regularly, 19% higher in those who did not eat fruit regularly, and 41% higher among adolescents who did not Regularly eats lunch or

Table 2. Crude and adjusted prevalence ratios (PR) and confidence intervals (95% CI) for the experience of hunger among Brazilian adolescents (n = 16,526) according to selected variables. National School-based Student Health Survey, 2015.

Variables	Model 1		Model 2	
	Crude PR	p-value	Adjusted PR	p-value
Food consumption				
Regular consumption of beans				
Yes	Ref		Ref	
No	1.27 (1.22-1.32)	< 0.001	1.20 (1.13-1.26)	< 0.001
Regular consumption of legumes and vegetables				
Yes	Ref		Ref	
No	1.27 (1.22-1.32)	< 0.001	1.16 (1.09-1.22)	< 0.001
Regular consumption of fruit				
Yes	Ref		Ref	
No	1.29 (1.24-1.33)	< 0.001	1.19 (1.13-1.24)	< 0.001
Regular consumption of fried savory snacks				
Yes	Ref			
No	1.00 (0.89-1.09	0.959		
Regular consumption of sweets				
Yes	Ref			
No	1.04 (0.98-1.11)	0.199		
Regular consumption of soft drinks				
Yes	Ref			
No	0.93 (0.83-1.03)	0.185		
Regular consumption of savory ultra-processed foods				
Yes	Ref			
No	1.08 (1.01-1.14)	0.026		
Eating routines				
Regularly eats breakfast				
Yes	Ref			
No	0.93 (0.86-1.01)	0.072		
Regularly eats lunch or dinner with parents or guardians				
Yes	Ref		Ref	
No	1.51 (1.40-1.63)	<0.001	1.41 (1.32-1.52)	< 0.001
Eats while watching TV or studying				
No	Ref			
Yes	1.07 (0.99-1.16)	0.072		
Ate fast food in the last week				
No	Ref			
Yes	0.95 (0.87-1.03)	0.196		
Body image				
Satisified with body				
Satisfied/very satisfied	Ref		Ref	
Indifferent	1.40 (1.25-1.56)	< 0.001	1.33 (1.18-1.49)	< 0.001
Dissatisfied/very dissatisfied	1.30 (1.20-1.41)	< 0.001	1.26 (1.18-1.35)	< 0.001

Ref (reference category) = did not experience hunger/Model 1: crude Poisson regression/Model 2: adjusted Poisson regression.

Source: Authors.

dinner with parents or guardians. The experience of hunger was also associated with level of *body satisfaction*, being higher among those who reported being indifferent (PR = 1.33; 95%CI 1.18-1.49) and those who were dissatisfied or very dissatisfied (PR = 1.26; 95%CI 1.18-1.35) (Table 2).

Discussion

The prevalence of the experience of hunger among Brazilian adolescents in 2015 (22.8%) was approximately ten times higher than the rate of severe food insecurity (classified as hunger) found by a study with adolescents living in state capitals and the Federal District (2.6%) conducted between 2011 and 2012[27]. This rate is also higher than the rates of severe food insecurity found in households with people aged 5-17 years between 2017 and 2018[25] and in Brazilian households in 2020[42] (7.3% and 9.0%, respectively).

These differences should be interpreted with caution as each study used different methods. The present study used the answer to a specific question as a marker of the experience of hunger, while the other studies used the Brazilian Food Insecurity Scale[23]. These comparisons were chosen because we were only able to identify studies of adolescents from state capitals[27] or specific regions[26]. Despite these limitations, the findings of the present study confirm increased vulnerability among this age group.

The association between the experience of hunger and a set of characteristics that increase social vulnerability, such as living in the North (sociopolitical and economic context), being male and low maternal education level (socioeconomic status and individual and family characteristics) corroborate the findings of other studies with adolescents in state capitals. In the present study, the prevalence of severe food insecurity was higher among boys, students with mothers without any basic qualifications and those living in the North[27]. The relationship between hunger and being male warrants further investigation, as explanations for this association were not found in the literature. The lack of studies for comparison purposes may be explained by the fact that studies of food insecurity usually assess hunger at household level and the variable sex tends to refer to the head of the household and is related to occupation and family income[42].

With regard to sociopolitical context, the findings suggest that heightened levels of social inequality in the North contribute to increased food insecurity in this region, which is made up of states with the lowest human development index[43]. The region is characterized by poor sociopolitical and economic conditions, which have a negative impact on health outcomes, despite improvements between 2000 and 2016[44].

The coexistence of hunger along with low maternal education level highlights the effect of this variable as a key marker, as shown by studies of social determinants of health[45]. Another study in Brazil shows that, in addition to hunger, adolescents with mothers with a low level of education – which is a proxy for low socioeconomic status – are more prone to the co-occurrence of risk factors for non-communicable chronic diseases (regular consumption of ultra-processed foods, irregular consumption of fruit and legumes, insufficient physical activity, smoking and drinking)[46]. These findings demonstrate the need to strengthen policies that address the structural causes of hunger and improve the education and living standards of women, focusing on eating patterns, nutrition and family health.

The following physical, behavioral and psychosocial factors were associated with the experience of hunger among the adolescents from our sample: not being overweight, irregular consumption of beans, fruit, legumes and vegetables, not regularly eating lunch or dinner with parents or guardians, and indifference to or dissatisfaction with their bodies.

The lack of association between hunger and anthropometric markers of malnutrition (thinness and short stature) corroborate the findings of other Brazilian studies investigating the relationship between these outcomes and different levels of food insecurity (absence of hunger and hunger)[26,47]. However, a meta-analysis with 55,173 individuals from 21 studies in 12 countries found that household food insecurity increased the risk of stunting[48]. Our findings suggest that using anthropometric indicators of malnutrition alone is not the best option for identifying adolescents experiencing hunger.

It is worth highlighting that the lack of association between hunger and nutrition outcomes (thinness, excess weight and short stature) may be the result of the economic and social development witnessed in Brazil in the years leading up to the PeNSE 2015. This period saw large-scale investments in actions to address food and nutrition insecurity, such as the National School Lunch Program and the family benefit program *Programa Bolsa Família*. These actions improved access to adequate dietary energy intake, correcting nutritional deficiencies in most of the population. However, some studies have reported an increase in the consumption of foods of high energy density and minimal nutritional value, which is related to excess weight and obesity[49].

Another important finding is irregular consumption of fruit, legumes, vegetables (FLV) and beans among adolescents who experienced hun-

ger. It is worth highlighting that households experiencing moderate or severe food insecurity tend to give preference to high energy density foods, resulting in lower availability of low energy density foods, such as fruit, legumes and vegetables[50]. The findings therefore indicate that food consumption is associated with nutritional risk due to the low intake of vitamins, minerals, fiber and bioactive compounds, which coexists with the experience of hunger. This situation results in poor nutritional intake caused by food consumption patterns that are restricted to certain food groups[51].

Similar results were found by a study with adolescents living in the Amazon, which showed that the prevalence of household food and nutrition insecurity was related to low consumption of vegetables, fruit and legumes[52]. In addition, a systematic literature review examining the relationship between food insecurity and dietary indicators also reported lower consumption of food builders and regulators and sources of iron, which include FLV and beans, in people experiencing food insecurity[53].

Irregular consumption of beans (despite being a staple food for poorer populations) may be explained by a general reduction in the consumption of this food by the Brazilian population. The annual per capita consumption of beans dropped by half between 2008 and 2018 (12.4 kg in 2002-2003, 9.12 kg in 2008-2009, and 5.91 kg in 2017-2018). The share of beans in daily calorie intake also fell over the same period: 5.8% in 2002-2003, 4.8% in 2008-2009, and 4.3% in 2017-2018[54]. The results of the food consumption component of the household budget survey show that the consumption of beans fell between the periods 2008-2009 and 2017-2018 across all regions, income strata and age groups. The frequency of consumption among adolescents dropped from 71.7% (2008-2009) to 58.2% (2017-2018)[55].

The association between the experience of hunger and indifference and body dissatisfaction is noteworthy. It is known that body dissatisfaction among adolescents increases the risk of developing eating disorders, such as compensatory behavior to prevent weight gain[56]. In addition to food and nutrition insecurity, this aspect poses a risk to physical and mental health. Worrying about one's body from an aesthetic rather than health perspective when linked to dissatisfaction with self-image amounts to a social construction influenced by the media and appears to have a greater impact on more vulnerable groups[57].

Adolescents who worry about their bodies tend to create multiple needs (supplements, clothes, cosmetic interventions, etc.) that take precedence over food consumption and interfere with other basic needs and aspects of development, such as education and social interaction. Body dissatisfaction is one of the main factors associated with risk behaviors for eating disorders and emerging evidence indicates that food insecurity is cross-sectionally associated with these disorders[58].

Another interesting association identified in the adjusted model was that between the experience of hunger and behavioral aspects of eating routines (frequency of eating lunch or dinner with parents or guardians). The relationship between this variable and lower socioeconomic status was identified by a study using data from Sample 1 of the PeNSE 2015. The findings showed that the prevalence of regularly eating lunch or dinner with parents or guardians was higher among adolescents from more advantaged groups (white, higher goods and services scores, from the South)[59].

Regularly eating together as a family is a positive marker of dietary patterns, nutrition and health and is consistently emphasized in guidance about eating a healthy, balanced diet, such as the Dietary Guidelines for the Brazilian Population[60]. It is during meals that families share food knowledge and experiences, creating bonds and developing eating habits[61]. This is why we chose to test eating behavior variables in the statistical models. Future research should investigate factors associated with low frequency of family meals among socially vulnerable populations in Brazil.

Dallacker *et al.*[62] suggest four possible types of association between family meal frequency and health: (1) these meals are a causal factor in improving adolescent eating behaviors and nutritional health; (2) health-conscious families eat together more frequently; (3) the link between meal frequency and nutritional health are explained by other variables, such as socioeconomic status or family functioning; and (4) there is reciprocal relationship between meal frequency and nutritional health, where healthy families have more regular family meals and, at the same time, more regular family meals promote family nutritional health[62].

Frequency of family meals therefore appears to be a marker of food consumption and nutrition quality of diets and may be linked to socioeconomic status. In this sense, Gomes and Pereira[63] suggest that not eating meals together regularly illustrates the ambivalence of poor families towards senti-

ments of "bringing together/pushing apart"[63]. In practice, poor families with exhausting study and workloads find it difficult to eat together, which in turn hampers the construction of spaces to share mealtimes as health promoters.

Study limitations include the fact that we did not examine economic factors such as family income, which could have resulted in a model with a better fit. In addition, we used the answer to a specific question as a marker of the experience of hunger rather than a validated psychometric scale for assessing food insecurity. We suggest that the dependent variable question about the experience of hunger is modified for future studies to make it clear whether the participant experienced hunger because there was not enough food at home or because there was not the food that the participant likes to eat. This observation is important in relation to the comparison of results.

Despite these limitations, our findings present innovative and valid measures for assessing hunger among adolescents in different contexts in Brazil, using appropriate estimates that take into account the effect of PeNSE's complex sampling design. Another important strength of this study is that we used a wide range of variables to assess food and nutrition security, illustrating the complementarity of markers of hunger and multi-factorial nature of this phenomenon[53]. This type of study offers a good alternative for screening severe food insecurity in a given population, especially considering the sampling method and representativeness of the data used.

Our findings reveal an important association between the experience of hunger among adolescents in Brazil and social determinants of health related to the sociopolitical and economic context, socioeconomic status, individual and family characteristics, and behavioral and psychosocial factors, such as food consumption, eating routines and body dissatisfaction. These factors create a context of vulnerability, posing a worrying risk of food insecurity and negative health and nutrition outcomes.

This complex context should therefore be monitored and taken into account in the planning of policies and actions to tackle food insecurity and promote health among this group. Focusing on nutritional care and health promotion, these initiatives should foster improvements in living standards and encompass individual and family behaviors, emphasizing food and nutrition education and the promotion of food environments that promote health and access at all times to adequate food. Finally, it is important to highlight that adolescents' rights should be protected in accordance with the legislation so that they are able to develop their full potential as Brazilian citizens.

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Collaborations

D Vale: study conception and design, data analysis and interpretation, drafting the article and revising it critically for important intellectual content, and approving the final version to be published. TT Santos: data interpretation; revising the article critically for important intellectual content, and approving the final version to be published. RD Fernandes: data interpretation, revising the article critically for important intellectual content, and approving the final version to be published. NLA Cabral: data interpretation, revising the article critically for important intellectual content, and approving the final version to be published. CO Lyra: data interpretation, revising the article critically for important intellectual content, and approving the final version to be published. AGRC Oliveira: study conception and design, data analysis and interpretation, drafting the article and revising it critically for important intellectual content, and approving the version to be published.

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