

## ORIGINAL

## Collective Health

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# Breakfast irregularity among Brazilian adolescents: coexistence with other risk behaviors and associated factors

## *Irregularidade do desjejum entre adolescentes brasileiros: coexistência com outros comportamentos de risco e fatores associados*

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### ABSTRACT

#### Objective

To assess the prevalence of breakfast irregularity among Brazilian adolescents and its co-occurrence with other risk behaviors.

#### Methods

Cross-sectional study based on data from the National School Health Survey, 2019. Breakfast irregularity ( $\leq 4$  days/week) was the dependent variable, whose co-occurrence with excessive screen time ( $> 3$ h/day), regular consumption of sugar-rich foods ( $\geq 5$  days/week), and irregular consumption of fruit, greenery, and beans (FV -  $\leq 4$  days/week) was investigated. The Chi-Square and Multiple Logistic Regression tests were used to analyze the factors associated with breakfast irregularity and its co-occurrence ( $p < 0.05$ ).

#### Results

Approximately 40.7% of adolescents reported breakfast irregularity. The four risk behaviors coexisted in 8.1% of students, with 86.0% higher likelihood of co-occurrence among girls. The most frequent combination of three risk behaviors included excessive screen time, irregular fruit and greenery consumption, and irregular breakfast (8.9%).

#### Conclusion

Four in every ten adolescents ate breakfast irregularly, with a marked coexistence with other risky behaviors, especially among girls. It is, therefore, essential to encourage, propose, and implement intervention strategies based on multicomponent approaches, with multi-professional and intersectoral support, to achieve greater effectiveness.

**Keywords:** Adolescent nutrition. Breakfast. Feeding behavior. Nutrition surveys. Risk factors.

## RESUMO

### Objetivo

Avaliar a prevalência de irregularidade do desjejum entre adolescentes brasileiros e sua coocorrência com outros comportamentos de risco.

### Métodos

Estudo transversal baseado em dados da Pesquisa Nacional de Saúde do Escolar, 2019. A irregularidade da realização do desjejum ( $\leq 4$  dias/semana) foi a variável dependente, cuja coexistência com tempo de tela excessivo ( $> 3h/dia$ ), consumo regular de alimentos ricos em açúcar ( $\geq 5$  dias/semana) e consumo irregular de frutas, hortaliças e feijão (FH -  $\leq 4$  dias/semana) foi investigada. Utilizou-se o teste Qui-Quadrado para analisar os fatores associados à irregularidade do desjejum e sua coocorrência, além da Regressão Logística Múltipla ( $p < 0,05$ ).

### Resultados

A irregularidade do desjejum foi relatada por 40,7% dos adolescentes. A coexistência dos quatro comportamentos de risco ocorreu em 8,1% dos estudantes, com chances de ocorrência 86,0% superiores entre as meninas. A combinação mais frequente de três comportamentos de risco abrangeu o tempo de tela excessivo, o consumo irregular de FH e a irregularidade do desjejum (8,9%).

### Conclusão

Quatro a cada dez adolescentes realizavam o desjejum irregularmente, sendo verificada marcante coexistência com outros comportamentos de risco, especialmente entre as meninas. Assim, torna-se essencial o incentivo, a proposição e a implementação de estratégias de intervenção pautadas em abordagens multicomponentes, e que contem com apoio multiprofissional e intersetorial, de forma a obter maior efetividade.

**Palavras-chave:** Nutrição do adolescente. Desjejum. Comportamento alimentar. Inquéritos nutricionais. Fatores de risco.

## INTRODUCTION

Adolescence is a transition period between childhood and adulthood, corresponding to the age range of 10-19 [1]. It is a phase of rapid individual physical, cognitive, social, emotional, and sexual development, often marked by risk or protective behaviors that begin or are consolidated at this stage. These behaviors have important effects on current health and in adult life [2].

During this period, diet is influenced by multiple sociocultural, economic, and environmental factors, making adopting a healthy diet that meets the specific nutritional needs of this phase even more relevant [3]. However, inadequate eating habits are prevalent in this age group, emphasizing the preference for Ultra-Processed Foods (UPF) and irregular intake of essential meals, such as breakfast [4-6]. This morning meal stands out as one of the three most important meals of the day, along with lunch and dinner, corresponding to approximately 25% of daily energy intake [7].

A multicenter study on European adolescents indicated that irregular breakfast was the dominant behavior associated with global and abdominal obesity [8]. This relationship was justified by the negative impact of skipping this meal on dietary balance, related to irregular consumption of Fruits and Greenery (FG), with consequent lower intake of micronutrients and higher UPF consumption [8]. These factors can chronically lead to health risks, including the emergence of chronic Non-communicable Diseases (NCDs), reduced growth rate, development, and progression of puberty [8-9].

At a national level, irregular breakfast consumption has been systematically assessed by the *Pesquisa Nacional de Saúde do Escolar* (PeNSE, National School Health Survey) since 2012 and was found among 38.1% of Brazilian adolescents in this first year and 35.6% in 2015 [6]. A study developed based on data from PeNSE 2012 revealed that irregular breakfast consumption increased by 41%

the likelihood of adolescents showing a higher number of risk behaviors for being overweight, such as regular consumption of fried and sugar-rich foods, irregular consumption of FG, and sedentary behavior [10].

Despite the impact of these aspects on adolescence, there are notable gaps in actions and studies aimed at this stage of life [2], notably, the incipience of studies that delve into the analysis of the coexisting behaviors [10]. In this context, the present study aimed to assess the prevalence of irregular breakfast among Brazilian adolescents participating in the PeNSE 2019 and its co-occurrence with the regular consumption of sugar-rich foods, irregular intake of FG, and excessive screen time to identify groups to be mainly focused on in actions to promote adequate and healthy eating and health and indicate factors that these actions should target.

## METHODS

### Study design

This cross-sectional study analyzed data from the PeNSE 2019, conducted by the Instituto Brasileiro de Geografia e Estatística (IBGE, Brazilian Institute of Geography and Statistics). This is the fourth edition of the research, which aims to identify and monitor risk and protective factors for the health of Brazilian adolescents [11].

### Participants and variables analyzed

In PeNSE 2019, data were collected from 4,253 schools and 125,123 students from all over the country, including urban and rural areas, and public and private education networks. Only students from classes that met the minimum requirements for their data to be used were considered, including consent to participate in the research and the provision of data on gender and age. Furthermore, records from classes with less than 60% of valid questionnaires against the number of students attending were disregarded. More information about the sampling and data collection process can be found in the PeNSE 2019 report [11].

For the present study, only data from students aged 13 and 17 were analyzed [11]. The association between irregular breakfast, the frequency of consumption of sugar-rich foods, FG, and excessive screen time was investigated.

The outcome variable of the study consisted of irregular breakfast consumption, estimated by the question: "Do you usually eat breakfast?". The response options were: "Yes, every day"; "5 to 6 days a week"; "3 to 4 days a week"; "1 to 2 days a week"; "Rarely"; "No". The variable was recategorized as regular breakfast consumption ( $\geq 5$  days a week) or irregular breakfast consumption ( $\leq 4$  days a week) [11]. Because this was the primary variable of interest, the sample of this study considered only the data related to adolescents who had validly answered the question about breakfast consumption ( $n=124,551$ ). However, because respondents could skip questions, varying sample values were observed throughout the results, depending on the variable analyzed.

The consumption of three healthy eating markers (beans; vegetables and greens; and fresh fruits) and three unhealthy eating markers (sweets and treats; soft drinks; and fast food) in the previous week was assessed, also categorized as regular ( $\geq 5$  days/week) or irregular ( $\leq 4$  days/week). For the healthy eating marker groups, irregular consumption was considered inadequate or at risk, while for the unhealthy eating marker foods, inadequacy referred to regular consumption. This is the categorization officially adopted by IBGE in analyzing food consumption markers found

in PeNSE reports [11,12] and is used consistently in works derived from the research [6,10]. The joint variable “Fruits and Greenery” was generated from the original variables “Fruits” and “Vegetables”, and the combination of the original variables “Sweets and Treats” and “Soft Drinks” resulted in the variable “Sugar-rich foods”.

Regarding excessive screen time, the daily hours the adolescent remained seated, watching television, playing video games, using a computer, cell phone, or tablet, or doing other activities were considered. The responses were recategorized as excessive (>3 hours/day) or adequate screen time (≤3 hours/day) [13].

Regarding eating habits and practices, the consumption of food the school offers, the purchase of food or drinks at the school cafeteria, and food or drinks from vendors at the school gate (0-2/≥3 days/week) were analyzed. The socioeconomic variables included age (13-15/16-17 years), gender (male/female), maternal schooling (≤8/8-11/≥12 years), ethnicity/skin color (White/Black, Brown or Other – Asian or Indigenous origin), whether the adolescent lived with his/her parents (Yes/No), and the number of people in the household (1-4/≥5).

### Data analysis

The analyses were performed using IBM®SPSS® (version 25.0), considering the complex sampling design (Complex Samples Module). Absolute and relative frequency calculations were performed to describe the variables and their respective 95% confidence intervals (95% CI). In the bivariate analysis, the Chi-square test was adopted. In the multivariate analysis, Multiple Logistic Regression ( $p<0.05$ ) was employed to assess the associated factors and the coexistence of irregular breakfast with other risk behaviors. The adjusted logistic regression model considered the inclusion of all independent variables associated with irregular breakfast in the bivariate analysis together, and only the variables significantly associated with the outcome remained in the final model after adjustment for the variables gender, age, ethnicity/skin color, number of people in the household, living with parents, and maternal schooling.

Rectangular Venn Diagrams were built [10,14] to graphically represent the coexistence of behaviors and irregular breakfast in the general population of adolescents and stratified by gender. The relative frequencies of each coexistence group were generated from the combination of the variables of interest, identifying adolescents without risk behaviors and who had one, two, three, or four simultaneous behaviors. Odds Ratio (OR) and 95% CI were calculated to estimate possible differences between boys and girls regarding the likelihood of not having all four risk behaviors investigated.

## RESULTS

Most of the students evaluated were female (50.8%), aged 13-15 (64.7%), self-declared black, brown or other ethnicity/skin color (64.0%) and lived with up to four people (62.2%), including the mother and father (55.5%). Regarding maternal schooling, 71.0% of them had less than 12 study years (Table 1).

Regarding eating habits and practices, 40.7% of the students had an irregular breakfast, with a higher prevalence among girls (46.7% vs. 34.4%;  $p<0.001$ ). Less than half of the adolescents consumed the food the school offered three or more days a week (43.4%). Furthermore, 13.9% and 9.1% reported purchasing food or drinks from the school cafeteria and street vendors three or more days a week, respectively, with a significant difference only for cafeteria products ( $p=0.024$ ) (Table 2).

**Table 1** – Sociodemographic characteristics of Brazilian adolescents, according to sex. Brazil, PeNSE, 2019. (n=124,551).

Variables	Gender				Total	
	Male		Female		%	95% CI
	%	95% CI	%	95% CI		
Age group (years)						
13-15	64.7	62.4-66.9	64.7	62.2-67.1	64.7	62.4-66.9
16 or 17	35.3	33.1-37.6	35.3	32.9-37.8	35.3	33.1-37.6
Skin color/ethnicity						
White	36.8	35.6-37.9	35.2	34.3-36.2	36.0	35.1-36.8
Black, brown, or other	63.2	62.1-64.4	64.8	63.8-65.7	64.0	63.2-64.9
Number of residents in the household						
1-4	62.3	61.4-63.2	62.2	61.2-63.1	62.2	61.5-63.0
5 or above	37.7	36.8-38.6	37.8	36.9-38.8	37.8	37.0-38.5
Living with parents						
Yes	57.6	56.6-58.6	53.4	52.3-54.4	55.5	54.6-56.3
No	42.4	41.4-43.4	46.6	45.6-47.7	44.5	43.7-45.4
Maternal schooling						
≤8 years	35.4	34.1-36.7	38.4	37.0-39.8	36.9	35.8-38.1
8 a 11 years	33.4	32.3-34.4	34.8	33.8-35.9	34.1	33.3-35.0
≥12 years	31.3	30.3-32.2	26.8	25.8-27.9	28.9	28.1-29.8

Note: CI: Confidence interval.

**Table 2** – Food practices and consumption of Brazilian adolescents, by gender, Brazil. PeNSE. 2019. (n=124,551).

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Variables	Gender				Total	
	Male		Female		%	95% CI
	%	95% CI	%	95% CI		
Habits and practices						
Breakfast ( $p<0.001$ )						
Regular	65.6	64.5-66.6	53.3	52.2-54.3	59.3	58.5-60.2
Irregular	34.4	33.4-35.5	46.7	45.7-47.8	40.7	39.8-41.5
Eats food offered by the school ( $p=0.772$ )						
≥3 days	43.6	41.8-45.3	43.3	41.5-45.1	43.4	41.9-44.9
0-2 days	56.4	54.7-58.2	56.7	54.9-58.5	56.6	55.1-58.1
Purchase of food or drinks in the school cafeteria ( $p=0.024$ )						
≥3 days	14.4	13.6-15.2	13.4	12.6-14.2	13.9	13.2-14.6
0-2 days	85.6	84.8-86.4	86.6	85.8-87.4	86.1	85.4-86.8
Purchase of food or drinks from street vendors at the school gate ( $p=0.775$ )						
≥3 days	9.1	8.6-9.7	9.0	8.4-9.7	9.1	8.6-9.6
0-2 days	90.9	90.3-91.4	91.0	90.3-91.6	90.9	90.4-91.4
Sedentary screen time ( $p<0.001$ )						
≤3 hours	47.2	46.1-48.4	44.7	43.8-45.7	46.0	45.1-46.9
>3 hours	52.8	51.6-53.9	55.6	54.3-56.2	54.0	53.1-54.9
Consumption frequency in the previous seven days						
Fruits ( $p=0.070$ )						
Regular	27.5	26.7-28.4	26.4	25.5-27.3	26.9	26.3-27.6
Irregular	72.5	71.6-73.3	73.6	72.7-74.5	73.1	72.4-73.7
Vegetables or greens ( $p=0.001$ )						
Regular	29.8	29.0-30.6	28.0	27.0-29.0	28.9	28.2-29.5
Irregular	70.2	69.4-71.0	72.0	71.0-73.0	71.1	70.5-71.8
Fruits and greenery* ( $p=0.008$ )						
Regular	42.6	41.7-43.6	40.7	39.6-41.8	41.7	40.9-42.4
Irregular	57.4	56.4-58.3	59.3	58.2-60.4	58.3	57.6-59.1
Treats and sweets ( $p<0.001$ )						
Irregular	72.5	71.6-73.3	61.9	61.0-62.9	67.1	66.4-67.8
Regular	27.5	26.7-28.4	38.1	37.1-39.0	32.9	32.2-33.6

**Table 2** – Food practices and consumption of Brazilian adolescents, by gender, Brazil. PeNSE. 2019. (n=124,551).

Variables	Gender				Total	
	Male		Female		%	95% CI
	%	95% CI	%	95% CI		
Soft drinks ( $p=0.001$ )						
Irregular	81.9	81.0-82.7	83.7	83.0-84.4	82.8	82.1-83.4
Regular	18.1	17.3-19.0	16.3	15.6-17.0	17.2	16.6-17.9
Sugar-rich foods** ( $p<0.001$ )						
Irregular	63.6	62.6-64.6	55.9	55.0-59.9	59.7	59.0-60.5
Regular	36.4	35.4-37.4	44.1	43.1-45.0	40.3	39.5-41.0
Beans ( $p<0.001$ )						
Regular	64.8	63.7-66.0	53.4	52.2-54.6	59.0	58.0-60.1
Irregular	35.2	34.0-36.3	46.6	45.4-47.8	41.0	39.9-42.0
Fast-foods ( $p=0.023$ )						
Irregular	93.2	93.3-94.2	94.5	94.0-94.9	94.1	93.8-94.5
Regular	6.2	5.8-6.7	5.5	5.1-6.0	5.9	5.5-6.2

Note: \*Group of the variables Fruits, Vegetables or greens; \*\*Group of the variables: Treats, sweets, and soft drinks. Regular consumption: 5 days or above per week; Irregular consumption: 4 days or less per week. CI: Confidence Interval.

Regarding foods that indicate an unhealthy diet, regular consumption of sweets and treats was reported by 32.9% of students, soft drinks by 17.2%, and fast food by 5.9%. Furthermore, irregular consumption of groups that indicate a healthy diet was notable, such as fruits (73.1%), vegetables (71.1%), and beans (59.0%). Girls had a higher prevalence of regular consumption of sweets and treats ( $p<0.001$ ) and irregular consumption of vegetables ( $p=0.001$ ) and beans ( $p<0.001$ ), besides lower percentages of regular intake of soft drinks ( $p=0.001$ ) and fast food ( $p=0.023$ ), compared to boys (Table 2).

The most significant proportion of adolescents who ate breakfast irregularly were in the 13-15 age group (62.8%;  $p<0.001$ ) and self-declared Black, brown, or other ethnicity/skin color (62.3%;  $p<0.001$ ). Regarding the students who ate breakfast irregularly, 65.9% lived with up to four people ( $p<0.001$ ), and 50.9% lived with their parents ( $p<0.001$ ). The highest prevalence of irregular breakfast was observed among adolescents whose mothers had 8-11 schooling years ( $p<0.001$ ).

Regarding habits and practices, there was a lower frequency of consumption of food provided by the school ( $p<0.001$ ), as well as a higher prevalence of purchasing food or drinks in the school's vicinity ( $p=0.004$ ), excessive screen time ( $p<0.001$ ), irregular consumption of FG ( $p<0.001$ ) and beans ( $p<0.001$ ), and regular consumption of sugar-rich foods ( $p<0.001$ ) among students who had irregular breakfast (Table 3).

The graphical representation of the coexistence of the selected risk behaviors can be seen in the Venn Diagrams (Figure 1). In the total population, 27.0% of the students had one risk factor; 32.3% two factors; 23.1% three factors; and 8.1% all four behaviors simultaneously, a condition more prominent among girls (OR=1.86; 95% CI 1.69-2.04). On the other hand, 9.5% of adolescents did not have any of the evaluated behaviors, which was mainly observed among boys (OR=1.34; 95% CI 1.23-1.45). For the total population, the most prevalent combination of two risk behaviors was the coexistence of irregular FG consumption and excessive screen time (9.1%); and three risk behaviors consisted of the co-occurrence of irregular breakfast, irregular FG consumption, and excessive screen time (8.5%). Only 3.7% of the students with irregular breakfast did not show other risk behaviors (Figure 1).

**Table 3** – Relationship between nutritional and behavioral characteristics of Brazilian adolescents, stratified per breakfast frequency. Brazil. PeNSE. 2019. (n=124,551).

Variables	Breakfast			
	Regular		Irregular	
	%	95% CI	%	95% CI
<b>Sociodemographic data</b>				
Age group (years) ( $p=0.001$ )				
13-15	66.0	63.8-68.1	62.8	59.9-65.6
16 or 17	34.0	31.9-36.2	37.2	34.4-40.1
Skin color/ethnicity ( $p<0.001$ )				
White	34.8	33.8-35.8	37.7	36.5-38.9
Black, brown, or other	65.2	64.2-66.2	62.3	61.1-63.5
Number of residents in the household ( $p<0.001$ )				
1-4	59.7	58.7-60.6	65.9	65.0-66.9
5 or above	40.3	39.4-41.3	34.1	33.1-35.0
Living with parents ( $p<0.001$ )				
Yes	58.6	57.7-59.5	50.9	49.7-52.0
No	41.4	40.5-42.3	49.1	48.0-50.3
Maternal schooling ( $p<0.001$ )				
$\leq 8$ years	39.2	37.8-40.5	33.8	32.5-35.1
8-11 years	32.5	31.5-33.5	36.4	35.3-37.6
$\geq 12$ years	28.3	27.4-29.3	29.8	28.7-31.0
Eats food offered by the school ( $p<0.001$ )				
$\geq 3$ days	45.4	43.8-47.0	40.6	38.7-42.6
0-2 days	54.6	53.0-56.2	59.4	57.4-61.3
Purchase of food or drinks in the school cafeteria ( $p=0.813$ )				
$\geq 3$ days	13.9	13.2-14.7	13.8	12.9-14.7
0-2 days	86.1	85.3-86.8	86.2	85.3-87.1
Purchase of food or drinks from street vendors at the school gate ( $p=0.004$ )				
$\geq 3$ days	9.5	9.0-10.2	8.4	7.8-9.1
0-2 days	90.5	89.8-91.0	91.6	90.9-92.2
Sedentary screen time ( $p<0.001$ )				
$\leq 3$ hours	51.3	50.2-52.3	38.2	37.1-39.2
$> 3$ hours	48.7	47.7-49.8	61.8	60.8-62.9
<b>Consumption frequency in the previous seven days</b>				
Fruits ( $p<0.001$ )				
Regular	30.3	29.5-31.1	22.1	21.2-23.0
Irregular	69.7	68.9-70.5	77.9	77.0-78.8
Vegetables or greens ( $p<0.001$ )				
Regular	32.0	31.2-32.9	24.3	23.4-25.2
Irregular	68.0	67.1-68.8	75.7	74.8-76.6
Fruits and greenery* ( $p<0.001$ )				
Regular	45.7	44.8-46.7	35.7	34.7-36.7
Irregular	54.3	53.3-55.2	64.3	63.3-65.3
Treats and sweets ( $p<0.001$ )				
Irregular	69.3	68.5-70.1	63.9	62.9-64.9
Regular	30.7	29.9-31.5	36.1	35.1-37.1
Soft drinks ( $p<0.001$ )				
Irregular	84.7	84.0-85.4	80.0	79.1-80.9
Regular	15.3	14.6-16.0	20.0	19.1-20.9
Sugar-rich foods** ( $p<0.001$ )				
Irregular	62.6	61.7-63.5	55.6	54.6-56.6
Regular	37.4	36.5-38.3	44.4	43.4-45.4
Beans ( $p<0.001$ )				
Regular	62.9	61.7-64.2	53.3	52.1-54.5
Irregular	37.1	35.8-38.3	46.7	45.5-47.9
Fast-foods ( $p<0.224$ )				
Irregular	5.7	5.3-6.2	6.1	5.6-6.5
Regular	94.3	93.8-94.7	93.9	93.5-94.4

Note: \*Group of the variables Fruits, Vegetables or greens; \*\*Group of the variables: Treats, sweets, and soft drinks. Regular consumption: 5 days or above per week; Irregular consumption: 4 days or less per week. CI: Confidence Interval.

Figure 1a - Coexistence of behaviors - Total Population (%)

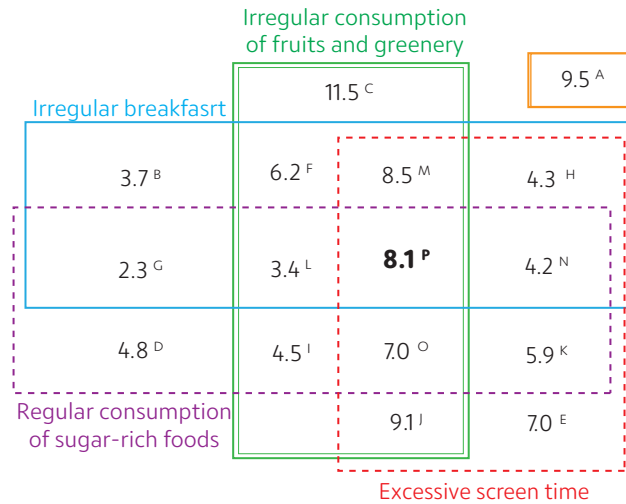


Figure 1b - Coexistence of behaviors - Boys (%)

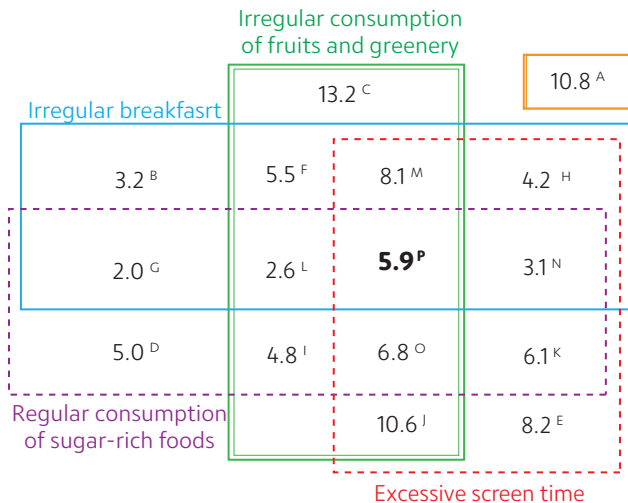
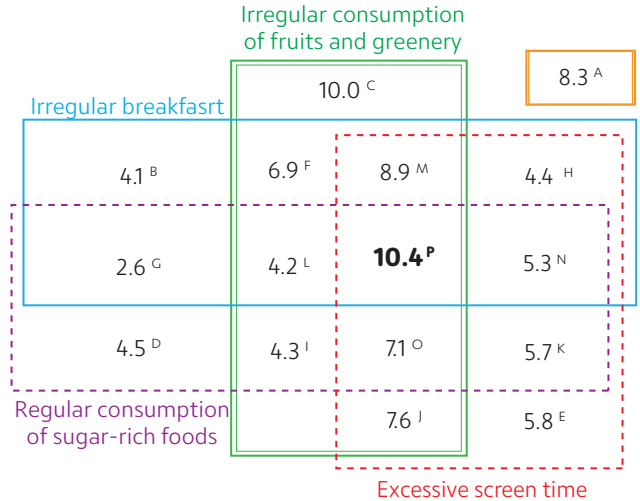


Figure 1c - Coexistence of behaviors - Girls (%)



—— Irregular breakfast     
 —— Irregular consumption of fruits and greenery     
  No risk factors  
- - - - Excessive screen time     
 - - - - Regular consumption of sugar-rich foods

Figure 1 – Coexistence of irregular breakfast and other risk behaviors among Brazilian adolescents. Brazil, PeNSE, 2019. (n=124,551).

Note: Regular: 5 days or above/week; Irregular: 4 days or less/week. <sup>A</sup> No risk factor; <sup>B</sup> Irregular breakfast (Breakfast), only; <sup>C</sup> Irregular consumption of Fruits and Greenery (FG) only; <sup>D</sup> Regular consumption of sugar-rich foods (Açúcar) only; <sup>E</sup> Screen time >3 hours (Screen), only; <sup>F</sup> Breakfast + FG; <sup>G</sup> Breakfast + Sugar; <sup>H</sup> Breakfast + Screen; <sup>I</sup> FG + Sugar; <sup>J</sup> FG + Screen; <sup>K</sup> Sugar + Screen; <sup>L</sup> Breakfast + FG + Sugar; <sup>M</sup> Breakfast + FG + Screen; <sup>N</sup> Breakfast + Sugar + Screen; <sup>O</sup> FG + Sugar + Screen; <sup>P</sup> All four risk factors.

In the multivariate analysis, excessive screen time was associated with a greater likelihood of having an irregular breakfast (OR=1.50; 95% CI 1.40-1.61), irregular consumption of FG (OR=1.50; 95% CI 1.40-1.61) and beans (OR=1.31; 95% CI 1.21-1.42), and regular consumption of sweets and treats (OR=1.13; 95% CI 1.05-1.21) and soft drinks (OR=1.28; 95% CI 1.16-1.43). The likelihood of having an irregular breakfast was also higher among adolescents who consumed the food offered by the school less frequently (OR=1.14; 95% CI 1.06-1.24) and who bought food or drinks from street vendors two or fewer days a week (OR=1.23; 95% CI 1.09-1.39) (Table 4).

**Table 4** – Factors associated with the coexistence of irregular breakfast associated with other risk behaviors. Brazil, PeNSE, 2019. (n=124,551).

Variables	Irregular breakfast			
	Crude		Adjusted**	
	OR	95% CI	OR	95% CI
<b>Habits and practices</b>				
Eats food offered by the school				
≥3 days	1.00		1.00	
0-2 days	1.21	1.12-1.30	1.14	1.06-1.24
Purchase of food or drinks from street vendors at the school gate				
≥3 days	1.00		1.00	
0-2 days	1.15	1.04-1.28	1.23	1.09-1.39
Screen time				
Adequate	1.00		1.00	
Excessive	1.61	1.52-1.70	1.50	1.40-1.61
<b>Consumption frequency in the previous seven days</b>				
Fruits and greenery*				
Regular	1.00		1.00	
Irregular	1.54	1.45-1.63	1.50	1.40-1.61
Treats and sweets				
Irregular	1.00		1.00	
Regular	1.18	1.11-1.25	1.13	1.05-1.21
Soft drinks				
Irregular	1.00		1.00	
Regular	1.37	1.26-1.48	1.28	1.16-1.43
Beans				
Regular	1.00		1.00	
Irregular	1.38	1.30-1.47	1.31	1.21-1.42

Note: \*Group of the variables Fruits, vegetables, or greens; \*\*Adjusted by gender, age, and ethnicity/skin color. Number of residents in the household. Living with mother and/or father and maternal schooling; All p-values were less than 0.01. Regular consumption: 5 days or above per week; Irregular consumption: 4 days or less per week; Adequate screen time: ≤3 hours per day; Excessive: >3 hours per day. CI: Confidence Interval; OR: Odds Ratio.

## DISCUSSION

Irregular breakfast was observed in four out of ten Brazilian adolescents. This behavior was associated with different sociodemographic aspects, habits and practices, and the frequency of consumption of healthy and unhealthy eating markers. The coexistence of the four risk behaviors assessed affected more than 8.0% of the students, and the likelihood of showing all the behaviors investigated was 86.0% higher among girls.

The high prevalence of irregular breakfast is consistent with other studies and is higher than that observed in the two previous editions of PeNSE [5-6,12,10]. Several factors may be involved in irregular breakfast during adolescence, including lack of time to prepare or consume meals, limited knowledge about nutrition and health, unavailability of food, lack of habit, lack of appetite in the morning, adoption of fad diets or beliefs and myths about food, concern or dissatisfaction with body image, and risk practices linked to eating disorders [4].

Furthermore, the choice of foods to make up breakfast significantly affects health, making this an opportunity to improve nutrient intake. Current recommendations for the composition of a balanced breakfast include fiber-rich whole grains, fresh fruits, low-fat dairy products, and foods that are sources of protein and unsaturated fats [4,15]. Thus, irregular breakfast among adolescents may be linked to a lower daily intake of energy and nutrients, especially vitamins D and B complex, besides calcium, iron, zinc, and potassium [16].

Breakfast irregularity is particularly troubling because it is one of the day's main meals, accounting for approximately 17.7% of the daily calories consumed by Brazilian adolescents [17]. Furthermore, skipping this meal has been associated with outcomes such as an increased risk of developing obesity and other NCDs, having lower levels of attention, memory, and motivation, mood instability, and, consequently, worse school performance [17]. This scenario is due, among other factors, to the frequent adoption of diets with poorer nutritional quality among adolescents who do not eat breakfast regularly, characterized by higher consumption of energy from UPF rich in sugar, fat, and sodium, besides lower consumption of FG and foods that are calcium and vitamin D sources [17,18].

This study identified a higher prevalence of irregular breakfast among female students, which reiterates the results of the Health Behavior in School-Aged Children (HBSC 2017-2018) [19], a health surveillance system for adolescents in Europe and Canada, in which 45.0% of female students aged 11-15 skipped breakfast, in contrast to 39.0% among boys [19]. These results may reflect the more significant concern and dissatisfaction of girls regarding their image and body weight, besides media influence on these issues, which leads to irregular meals and the adoption of restrictive diets without professional guidance [4,20].

Age was another determinant related to breakfast irregularity, with older adolescents skipping breakfast more frequently than younger ones. This finding is also consistent with the results of the HBSC [19]. This may be due to increased autonomy throughout adolescence, often resulting in less balanced food choices. Furthermore, as age increases, aspects such as lack of time and appetite, prioritizing sleep time over morning meals, and adopting dietary restrictions tend to be more prevalent [20].

Regarding ethnicity/skin color, adolescents who self-declared Black/brown or other ethnicity/skin color had irregular breakfast more frequently. This result is similar to a study based on the North American National Health and Nutrition Examination Survey (NHANES 2015–2018), in which 67.1% of Black adolescents had this meal the previous day, compared to 75.0% of white adolescents. These data possibly reflect racial, social, and economic disparities, which, acting intersectionally, can adversely affect health and nutrition, placing Black and brown individuals, in particular, at greater risk of exposure to behaviors and factors that are harmful to health [21].

Also, maternal schooling was associated with irregular breakfast, corroborating previous studies [22,23]. In a study conducted with data from the *Estudo de Riscos Cardiovasculares em Adolescentes* (ERICA, Study of Cardiovascular Risks in Adolescents), always or almost always eating breakfast was more prevalent among adolescents whose mothers had completed at least high school [19]. However, the direction of the relationship between maternal schooling and adolescents' food choices is not unanimous among studies since better socioeconomic conditions can, on the one hand, facilitate access to information and income, and consequently, access to natural and minimally processed foods, but can also facilitate access to UPF [10,24].

Adolescents who lived with both parents had breakfast more regularly. This relationship may be because, when living with parents, the likelihood of exercising commensality, that is, eating together as a family, is maximized, and this is closely associated with healthier food choices [25].

Furthermore, adolescents who had an irregular breakfast consumed the food offered by the school less frequently. This result is consistent with a study derived from PeNSE 2012, in which the likelihood of adhering to school meals was more significant among students who had breakfast. These behaviors possibly reflect more frequent eating practices and more adequate and healthy eating routines [23].

Therefore, it is important to identify and intervene in the determinants of adherence to school meals and, consequently, the adoption of healthy eating behaviors, including breakfast. Previous studies indicate that the preference for foods sold at school points of sale results in lower acceptance of the food the school offers [26]. A study conducted with data from adolescents participating in ERICA indicated that the lower frequency of purchasing snacks in school cafeterias was associated with higher consumption of school meals [27]. Furthermore, the fear of acquiring “poverty status” when consuming school meals has been reported in the literature, which could contribute to their irregular consumption [28].

This study found an association between irregular breakfast and a lower frequency of food purchases in the school vicinity. This relationship may not be a reflection of a lower interest or habit of purchasing these foods but instead of the lower availability of points of sale since these were not frequently found in schools where students reported greater irregular breakfast (50.5% vs. 53.9% among those with regular breakfast consumption;  $p=0.004$  – Data not shown), reiterating the importance of regulating food sales in the school vicinity to minimize the overlap of unhealthy eating practices and behaviors [10,27].

This concern is justified by the observation that these points of sale tend to have a low supply of natural or minimally processed foods, with a predominance of UPF, mainly soft drinks and processed and fried snacks [11]. Thus, their presence in the school vicinity restricts choices and favors the adoption of unhealthy eating patterns [29].

Regarding the simultaneous occurrence of risk behaviors, the number of publications investigating the overlap of factors related to diet and sedentary behavior has expanded in recent years. However, studies evaluating the co-occurrence of risk behaviors among adolescents in developing countries and their associated factors are less frequent. Considering that the simultaneous presence of risk behaviors is a strong predictor of overweight and NCDs in adolescence and adulthood, with increased risks of adverse health outcomes as the number of risk behaviors increases, it becomes crucial to expand discussions on the topic [10,22,24].

The relationship between excessive screen time and irregular breakfast may be directly related to the consumption of UPF, which, due to their practicality and because they can be consumed quickly and simultaneously with other activities, may replace complete meals, such as breakfast, with lower consumption of foods that are healthy diet markers [30,31]. Additionally, sleep deprivation caused by excessive screen time may lead to fatigue, thus reducing the perception of restorative sleep and the willingness to get up in the morning, resulting in a lower likelihood of having breakfast regularly [31].

A significant proportion of adolescents with irregular breakfasts also showed other risk behaviors, such as irregular consumption of FG and regular consumption of sugar-rich foods, which was also found in the literature [10,21]. In this sense, a study conducted with data from PeNSE 2015 revealed an association between eating breakfast and a lower score for UPF consumption [32].

Implementing appropriate and comprehensive intervention strategies that act at the individual, collective, and environmental levels is relevant to encouraging the adoption of healthy habits among adolescents, including regular breakfast consumption. To achieve a holistic and effective approach, professionals should be aware of the connections between the different behaviors that affect students’ health and nutrition. Guidelines should not be limited to nutrition alone but comprehensively cover health aspects to achieve more positive results, ensuring adolescents have the necessary support for a healthy and whole life [12].

Since this is a cross-sectional study, we should underscore that the associations observed here do not imply a cause-and-effect relationship but rather a hypothesized association that should be investigated a posteriori. The data analyzed represent adolescents who attend educational institutions and may not adequately represent those outside the educational system [11]. Furthermore, it would be interesting for new studies to evaluate the coexistence of other factors, such as psychological aspects and consumption of other food groups.

This study stands out for investigating factors associated with irregular breakfast in a representative sample of Brazilian students, contributing to understanding risk behaviors associated with irregular breakfast and the influence of sociodemographic, family, and behavioral factors. Venn Diagrams were used to expose the simultaneity of factors visually. These graphic resources allowed comparing and visualizing data sets in the general population of adolescents and separately in boys and girls, which is a significant differential of the present study.

## CONCLUSION

Irregular breakfasts were observed in four out of ten Brazilian students; 63.5% had two or more behaviors and 8.1% had all four risk behaviors, where girls were more likely to have irregular breakfasts. The likelihood of having irregular breakfasts was higher among adolescents with excessive screen time, irregular consumption of FG and beans, and regular consumption of soft drinks, sweets, and treats. These results are particularly of concern when considering the potential synergistic risks arising from overlapping exposures, leading to adverse effects on the health and nutrition of adolescents now and throughout their lives. Therefore, it is essential to encourage, propose, and implement intervention strategies based on multicomponent approaches with multidisciplinary and intersectoral support to achieve greater effectiveness in actions to promote healthy and adequate nutrition and healthy lifestyle habits.

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