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ORIGINAL ARTICLE

Unhealthy eating markers and associated factors among school adolescents in Montes Claros (MG)

Marcadores de alimentação não saudável e fatores associados entre adolescentes escolares de Montes Claros (MG)

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ABSTRACT This article aims to analyze the consumption of unhealthy eating markers among school adolescents and explore their association with sociodemographic variables and health-related behaviors. This is a population-based cross-sectional study involving 1,616 students from public state schools in the municipality of Montes Claros, Minas Gerais, conducted between 2022 and 2023. Data collection was carried out using a self-administered individual questionnaire. After adjusted analysis, it was observed that among the unhealthy eating markers, salty ultra-processed industrialized foods (30.5%) and sweets (26.1%) were the most consumed. Female sex was associated with a higher regular consumption of these markers. Regular consumption of soft drinks was positively associated with the habit of eating meals in front of the TV or while studying (PR = 1.34), having breakfast (PR = 1.33), as well as to higher family income (PR = 1.36). Smartphone use and dependence were associated with a higher consumption of salty ultra-processed industrialized foods (PR = 1.62) and sweets (PR = 1.69). It is inferred that the consumption of unhealthy foods among adolescents may be associated with social, economic, and cultural factors. Therefore, the adoption of healthy eating practices should be encouraged, given their beneficial effects on health.

KEYWORDS Adolescents. Diet. Healthy eating habits. Feeding behavior.

RESUMO *Este artigo analisa o consumo de marcadores de alimentação não saudável entre adolescentes escolares e explora sua associação com variáveis sociodemográficas e comportamentos relativos à saúde. Trata-se de um estudo populacional com delineamento transversal, envolvendo 1.616 estudantes de escolas da rede pública estadual do município de Montes Claros, Minas Gerais, em 2022 e 2023. A coleta de dados ocorreu mediante questionário autoaplicado individual. Após análise ajustada, observou-se que, entre os marcadores de alimentação não saudável, alimentos industrializados ultraprocessados salgados (30,5%) e guloseimas (26,1%) foram os mais consumidos. O sexo feminino mostrou-se associado ao maior consumo regular desses marcadores. O consumo regular de refrigerantes foi positivamente associado ao hábito de realizar refeições em frente à TV ou estudando (RP = 1,34), de tomar café da manhã (RP = 1,33), bem como à renda familiar mais alta (RP = 1,36). O uso e a dependência de smartphones associaram-se ao maior consumo de alimentos industrializados ultraprocessados salgados (RP = 1,62) e guloseimas (RP = 1,69). Infere-se que o consumo de alimentos não saudáveis entre adolescentes pode ser associado a fatores sociais, econômicos e culturais. Por conseguinte, a adoção de práticas alimentares saudáveis deve ser encorajada, haja vista seus efeitos benéficos à saúde.*

PALAVRAS-CHAVE *Adolescentes. Dieta. Comportamento alimentar.*

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Introduction

Adolescence is a transition between childhood and adulthood, marked by major biological, psychological, and social changes. During this time of rapid growth, adolescents seek identity and autonomy, shaped by cultural, family, and socioeconomic factors. These factors directly impact their food choices, increasing vulnerability to unhealthy habits[1].

In this context, inadequate eating habits have become a growing concern, often linked to consuming processed and ultra-processed foods, such as sweets, snacks, and fast food. These foods are energy-dense, high in sugar, fat, and sodium, but low in essential nutrients like vitamins, minerals, and fiber. Excessive consumption is linked to an increase in Non-Communicable Chronic Diseases (NCDs), such as type 2 diabetes, cardiovascular diseases, and some cancers, usually associated with adulthood but rooted in adolescence[1-4].

For adolescents, school is a key environment for promoting healthy eating, directly influencing eating habits[5]. The observed nutritional transition, shifting toward more processed and ultra-processed foods over unprocessed or minimally processed foods emphasizes the need to understand the dietary patterns of this age group[6].

Nationwide research with a representative sample has revealed concerning eating behavior patterns among Brazilian adolescents. The 2019 National School Health Survey (PeNSE)[7] found that about 39.4% of schoolchildren regularly consume ultra-processed foods, compared to only 32.5% who consume fruits and vegetables daily. These findings highlight nutritional vulnerability in this age group, influenced by social, economic, and cultural factors. The results underscore the need for investigations to better understand these determinants and their implications for adolescent health[7].

Besides social, economic, and cultural factors, digital behavior is also relevant to understanding food consumption among adolescents. Excessive smartphone use is increasingly common in this age group. It has been linked with inadequate eating habits, whether through frequent exposure to advertisements for ultra-processed foods or through quick, less healthy food choices[9]. In this sense, it is essential to understand the relationship between smartphone use and the consumption of unhealthy food markers. This knowledge can help support targeted adolescent health promotion and nutrition education strategies[8,9].

This study analyzed adolescents' consumption of unhealthy food markers and their association with sociodemographic variables and health-related behaviors. It aims to better understand the factors shaping food choices and to identify strategies promoting healthier diets.

Material and methods

This study is nested in the ELCAS Project: 'Longitudinal Study on Adolescent Behavior in Physical Activity and Health'. ELCAS has two stages: an epidemiological, cross-sectional, analytical baseline study, and a longitudinal, prospective follow-up study two years later. This study employed baseline data collected from first-year High School students of both genders in the state public education system in Montes Claros, Minas Gerais, Brazil, during 2022 and 2023.

In 2022, Montes Claros had 43 public schools offering High School education, according to a stratified list from the Minas Gerais State Education Secretariat (SEE/MG). These schools enrolled 3,765 first-year High School students. Sample size parameters included 50% prevalence for maximum sample size and, consequently, greater inferential power for different variables, 95% confidence level, 3% error; deff of 1.5, and 10% margin to account for potential losses. Thus, a minimum sample size of 1,373 adolescents was estimated to ensure representativeness.

The inclusion criteria encompassed adolescents of both genders enrolled in the first year of High School in public schools in Montes Claros (MG) in 2022 and 2023, who had parental consent through the Informed Consent Form and who had read, agreed to, and signed the Informed Assent Form. The exclusion criteria included students absent during data collection in the selected classroom who did not participate in the study, as well as adolescents who were entitled to specialized educational services, whose condition prevented them from providing information about their daily life habits.

The sample selection followed a two-stage cluster sampling: first, 20 schools were selected using probability proportional to size; second, classes were selected randomly. All students in chosen classes were invited to participate.

Data were collected after obtaining permission from the Montes Claros 22nd Regional Superintendence of Education. Researchers contacted school administrators, presented the research, and requested written authorization for data collection. After receiving permission, they requested a list of all relevant classes. Researchers were trained for standardized and uniform data collection. They then approached the adolescents in the selected classes, explained the objectives, invited participation, and clarified that participation was voluntary.

After getting parental or guardian authorization, students completed the self-administered questionnaire individually in the classroom, without the teacher present, and at times set by the school. Researchers were available to help and answer questions, ensuring informed participation and confidentiality. A pilot study in one school identified possible discrepancies in the research instrument and estimated the mean response time at around 40 minutes.

Regarding the study variables, diet quality was assessed through questions about food consumption over the past seven days of the week, a satisfactory method and a valid indicator of eating habits[7]. Adolescents could respond that they did not consume food or indicate a frequency ranging from one to seven days. The groups of unhealthy eating markers evaluated were soft drinks, fast food, sweets (e.g., candies, sweets, chewing gum, and chocolates), and salty ultra-processed foods (such as hamburgers, sausages, packaged snacks, and instant noodles)[10,11]. Consumption frequencies were grouped into weekly consumption of zero, one to three days, four to six days, and every day. Based on the responses, food consumption was categorized, for each group, into > 3 times/week and ≤ 3 times/week. Each group of unhealthy eating markers (soft drinks, fast food, sweets, and ultra-processed salty foods) was addressed as an independent variable in the analysis of this study.

The association variables were gender (male; female), age group in full years (≥ 16; ≤15), skin color (non-white; white), household income (C1, C2, DE; A1, B1, B2), guardian's schooling level (< 12 years; ≥ 12 years), physical activity level (active; insufficiently active/inactive), has breakfast (yes; no), has lunch with parents (yes; no), eats while watching TV or studying (no; yes) and smartphone dependence (non-problematic users; problematic users).

Household income was verified using the Brazilian Economic Classification Criteria (CCEB)[12]. Data on ownership of consumer goods (cars, bathrooms, microcomputer, washing machine, dishwasher, refrigerator, freezer, clothes dryer, microwave, DVD, and motorcycle) and the schooling level were considered, and not declared household income, with a score assigned to each item according to the application of the instrument.

The CCEB analyzes socioeconomic issues because it is a price classification system for the Brazilian public. It does not classify the population in terms of social classes, but rather divides the market exclusively into economic classes based on the ownership of goods, not on household income. Each item has a score, and classes are defined by total scores. Classes

are defined based on the instrument's score, estimating the mean household income as follows: A (BRL 20,888), B1 (BRL 9,254), B2 (BRL 4,852), C1 (BRL 2,705), C2 (BRL 1,625), DE (BRL 768). The family head's schooling level was also determined by the CCEB instrument.

Physical activity levels were assessed using the short version of the International Physical Activity Questionnaire (IPAQ)[13], validated and translated for Brazilian adolescents. Adolescents with at least 300 minutes of activity per week were classified as active, following WHO guidelines[14].

The variables 'has breakfast', 'has lunch with parents' and 'eats while watching TV or studying' had the same response options: yes, every day; yes, 5 to 6 days; yes, 3 to 4 days; yes, 1 to 2 days; rarely; no. These variables were recategorized into yes and no.

Smartphone addiction was assessed using the validated Smartphone Addiction Inventory (SPAI-BR)[15]. The scale includes 26 dichotomous items (1=Yes; 0=No), classifying adolescents, after the final score, into two groups according to the total score of the instrument (up to 26 points): non-problematic smartphone users (≤ 8) and problematic users (≥ 9).

The collected data were double-entered, checked, and analyzed using the Statistical Package for the Social Sciences – SPSS® version 22.0. Data were submitted to a descriptive analysis using absolute and relative frequencies. Subsequently, bivariate analyses were performed between the outcome variable and each independent variable using a Poisson regression model with robust variance. Crude Prevalence Ratio (PR) values were estimated, with a 95% confidence interval. Variables with a descriptive level of $p \leq 0.20$ were selected for multiple analysis.

The dependent variable was the consumption of unhealthy food markers, and the independent variables were grouped into two levels: demographic and socioeconomic variables (level 1); and behavioral variables (level 2). In the adjusted analyses, a hierarchical conceptual model strategy was followed at both levels mentioned. Variables were included level by level in the model through backward selection. At all levels, only those variables with a descriptive level $p < 0.05$ remained in the model after adjustment for the variables of the previous levels. Adjusted PRs with their respective 95% Confidence Intervals (95% CI) were estimated.

The Research Ethics Committee of the State University of Montes Claros (Unimontes) approved the research project in March 2022, through the substantiated Opinion N°5.287.269 and the Certificate of Presentation for Ethical Appraisal (CAAE) 56165122.0.0000.5146. It was funded by Fapemig APQ – 00711-22, Universal Demand. It was formally institutionalized by Unimontes in August 2022 under CEPEx Resolution N°103. The adolescents received detailed information about the study methodology, objectives, and the importance of the accuracy of the information provided. The study also followed the guidelines established in Resolution N°466/2012 of the National Health Council[16], which regulates human research.

Results

Table 1 presents the characteristics of the 1,616 participating adolescents. Most were young people up to 15 years of age (64.9%) and were non-whites (73.3%). Regarding household income, 62% belonged to economic classes C1, C2, and DE. Approximately 65.4% of the adolescents were physically active. Among the adolescents, 49.3% regularly had breakfast, 55.6% reported having lunch with their parents, and 45.4% stated that they ate while watching television or studying.

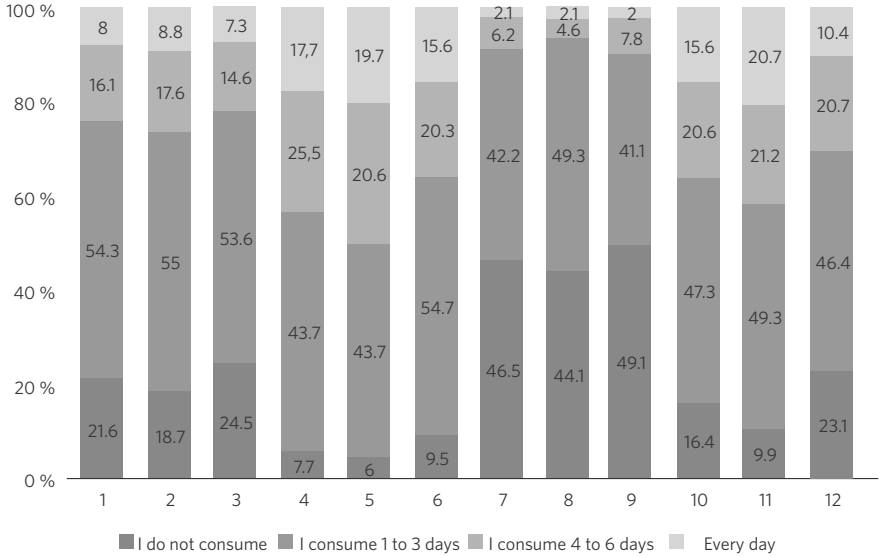
Table 1. Descriptive analysis of independent variables among school adolescents. Montes Claros, Minas Gerais, Brazil, 2022/2023 (n=1,616)

Variables	Total (n = 1,616) n (%)	Male (n = 801) n (%)	Female (n = 815) n (%)
Age group (full years)			
≥ 16	464 (35.1)	254 (40.1)	210 (30.5)
≤ 15	858 (64.9)	379 (59.9)	479 (69.5)
Skin color			
Non white	1,184 (73.3)	597 (75.3)	587 (72.5)
White	419 (25.9)	196 (24.7)	223 (27.5)
Household income			
C1 C2 and DE	826 (62.0)	365 (56.0)	461 (67.8)
A1 and B1 B2	506 (38.0)	287 (44.0)	219 (32.2)
Guardian's schooling			
< 12 years	265 (17.1)	650 (84.7)	631 (81.0)
≥ 12 years	1,281 (82.9)	117 (15.3)	148 (19.0)
Physical activity level			
Active	1,004 (65.4)	534 (72.3)	470 (59,0)
Insufficiently active/inactive	532 (34.6)	205 (27.7)	327 (41.0)
Has breakfast			
Yes	791 (49.3)	461 (58.0)	330 (40.7)
No	814 (50.7)	334 (42.0)	480 (59.3)
Has lunch with parents			
Yes	893 (55.6)	477 (60.1)	416 (51.2)
No	713 (44.4)	317 (39.9)	396 (48.8)
Eats while watching TV or studying			
No	877 (54.6)	427 (53.8)	450 (55.4)
Yes	729 (45.4)	367 (46.2)	362 (44.6)
Smartphone use or dependence			
Non-problematic users	596 (45.1)	334 (52.3)	262 (38.4)
Problematic users	726 (54.9)	305 (47.7)	421 (61.6)

Source: Prepared by the authors.

Figure 1 shows the frequency of consumption of healthy eating markers by the total study population by gender. Among adolescents, consumption more than three times a week was 24.1% (387) for soft drinks, 43.1% (693) for ultra-processed salty foods, 8.3% (132) for fast food and 36.2% (435) for sweets.

Figure 1. Frequency distribution of consumption of unhealthy food markers in the week before the survey among school adolescents. Montes Claros, Minas Gerais, Brazil, 2022/2023 (n=1,616)



Source: Prepared by the authors.

Soft drinks: 1- Total; 2-Female; 3-Male. Processed: 4-Total; 5-Female; 6-Male. Fast-food: 7-Total; 8-Female; 9-Male. Sweets: 10-Total; 11-Female; 12-Male

Table 2 presents the results of the crude analysis of the association between demographic, socioeconomic, and behavioral factors and the regular consumption of unhealthy food markers. After adjustment, according to the conceptual model (*table 3*), being female was associated with higher regular consumption of ultra-processed salty foods (PR=1.33; 95% CI 1.1;1.6) and sweets (PR=1.54; 95% CI 1.2;1.9); however, female adolescents reported lower regular consumption of fast food (PR=0.64; 95% CI 0.4;0.9) than boys. The age group of 15 years or younger displayed the highest consumption of sweets (PR=1.24; 95% CI 1.0;1.5). Being white was associated with lower regular consumption of soft drinks among adolescents (PR=0.92; 95% CI 0.7;1.3) and higher regular consumption of ultra-processed salty foods (PR=1.23; 95% CI 1.0;1.5). Household income was positively associated with the consumption of soft drinks (PR=1.36; 95% CI 1.06;1.74) and sweets (PR=1.36; 95% CI 1.06;1.74).

The habit of having breakfast was associated with the consumption of soft drinks (PR=1.33; 95% CI 1.0;1.8) and fast food (PR=1.75; 95% CI 1.1;2.9). Adolescents who reported eating meals in front of the TV or while studying showed a higher frequency of regular consumption of soft drinks (PR=1.34; 95% CI 1.0-1.8), ultra-processed salty foods (PR=1.40; 95% CI 1.2;1.7) and sweets (PR=1.28; 95% CI 1.0;1.6). Smartphone use and dependence was positively associated with the consumption of ultra-processed salty foods (PR=1.62; 95% CI 1.3;2.0) and sweets (PR=1.69; 95% CI 1.3;2.1).

Table 2. Crude factor analysis associated with the consumption of healthy eating markers in the week before the survey among school adolescents. Montes Claros, Minas Gerais, Brazil, 2022/2023 (n=1,616)

	Soft drinks	Processed foods	Fast food	Sweets
Variable	**PR (95% CI)**	**PR (95% CI)**	**PR (95% CI)**	**PR (95% CI)**
First level: demographic variables and socioeconomic variable				
Gender				
Male	1.00	1.00	1.00	1.00
Female	1.23 (0.9-1.6)	1.32 (1.1-1.5)[c]	0.66 (0.4-1.1)	1.48 (1.2-1.7)[c]
Age group (full years)				
≥ 16	1.00	1.00	1.00	1.00
≤ 15	1.0 (0.8-1.4)	0.92-(0.8-1.1)	1.38 (0.8-2.3)	1.28 (1.0-1.7)[c]
Skin color				
Non white	1.00	1.00	1.00	1.00
White	0.93 (0.7-1.2)	1.22 (1.0-1.4)[c]	0.97 (0.6-1.6)	1.16 (0.9-1.4)
Household income				
C1, C2, and DE	1.00	1.00	1.00	1.00
A1, B1, and B2	1.25 (0.9-1.6)	1.19 (1.0-1.4)[c]	1.24 (0.8-1.9)	1.03 (0.8-1.2)
Guardian's schooling				
≥ 12 years	1.00	1.00	1.00	1.00
< 12 years	1.11 (0.8-1.5)	0.92 (0.7-1.1)	0.80 (0.4-1.5)	1.18 (0.9-1.4)
Second level: behavioral variables				
Physical activity level				
Active	1.00	1.00	1.00	1.00
Insufficiently active/inactive	1.33 (1.0-1.7)[c]	1.14 (0.9-1.3)	0.81 (0.5-1.3)	1.1-(0.9-1.3)
Has breakfast				
Yes	1.00	1.00	1.00	1.00
No	1.32 (1.0-1.7)[c]	1.22 (1.1-1.4)[c]	1.84 (1.2-2.9)[c]	1.33 (1.1-1.6)[c]
Has lunch with parents				
Yes	1.00	1.00	1.00	1.00
No	1.19 (0.9-1.5)	1.22 (1.1-1.4)[c]	1.45 (0.9-2.2)	1.30 (1.1-1.5)[c]
Eats while watching TV or studying				
No	1.00	1.00	1.00	1.00
Yes	1.51 (1.2-1.9)[c]	1.56 (1.3-1.8) [c]	1.59 (1.0-2.4)[c]	1.42 (1.2-1.7)[c]
Smartphone use or dependence				
Non-problematic users	1.00	1.00	1.00	1.00
Problematic users	1.60 (1.2-2.1)[c]	1.62 (1.4-1.9)[c]	1.60 (0.9-2.7)	1.74 (1.4-2.1)[c]

Source: Prepared by the authors.

a) PR: Prevalence Ratio; and b) 95% CI: 95% Confidence Interval. Estimated by Poisson regression adjusted for robust variance. [c] p-value < 0.05.

Table 3. Adjusted analysis of factors associated with the consumption of healthy eating markers in the week before to the survey among school adolescents. Montes Claros, Minas Gerais, Brazil, 2022/2023 (n = 1,616)

	Soft drinks	Processed foods	Fast food	Sweets
Variables	**PR (95% CI)**	**PR (95% CI)**	**PR (95% CI)**	**PR (95% CI)**
First level: demographic variables and socioeconomic variable				
Gender				
Male	1.00	1.00	1.00	1.00
Female	1.24 (0.9-1.67)	1.33 (1.1-1.6)[c]	0.64 (0.4-0.9)[c]	1.54 (1.2-1.9)[c]
Age group (full years)				
≥ 16	1.00	1.00	1.00	1.00
≤ 15	0.96 (0.7-1.3)	0.93 (0.8-1.1)	1.23 (0.7-2.1)	1.24 (1.0-1.5)[c]
Skin color				
Non white	1.00	1.00	1.00	1.00
White	0.92 (0.7-1.3)[c]	1.23 (1.0-1.5)[c]	0.78 (0.4-1.4)	1.18 (0.9-1.5)
Household income				
C1, C2, and DE	1.00	1.00	1.00	1.00
A1, B1, and B2	1.44 (1.1-1.9)[c]	1.21 (1.0-1.4)[c]	1.17 (0.7-1.9)	1.20 (0.9-1.5)
Guardian's schooling				
< 12 years	1.00	1.00	1.00	1.00
≥ 12 years	1.30 (0.9-1.9)	0.90 (0.701.2)	0.51 (0.2-1.3)	1.19 (0.9-1.5)
Second level: behavioral variables				
Physical activity level				
Active	1.00	1.00	1.00	1.00
Insufficiently active/inactive	1.39 (0.9-1.8)	1.10 (0.9-1.3)	1.03 (0.6-1.8)	1.03 (0.8-1.3)
Has breakfast				
Yes	1.00	1.00	1.00	1.00
No	1.33 (1.0-1.8)[c]	1.10 (0.9-1.3)	1.75 (1.1-2.9)[c]	1.01 (0.8-1.3)
Has lunch with parents				
Yes	1.00	1.00	1.00	1.00
No	1.13 (0.8-1.5)	1.10 (0.9-1.3)	1.29 (0.8-2.1)	1.14 (0.9-1.4)
Eats while watching TV or studying				
No	1.00	1.00	1.00	1.00
Yes	1.34 (1.0-1.8)[c]	1.40 (1.2-1.7)[c]	1.41 (0.8-2.3)	1.28 (1.0-1.6)[c]
Smartphone use or dependence				
Non-problematic users	1.00	1.00	1.00	1.00
Problematic users	1.29 (0.9-1.8)	1.62 (1.3-2.0)[c]	1.61 (0.9-2.7)	1.69 (1.3-2.1)[c]

Source: Prepared by the authors.

a) PR: Prevalence Ratio; and b) 95% CI: 95% Confidence Interval. Estimated by Poisson regression adjusted for robust variance. c p-value < 0.05.

Discussion

The results of this study reinforce the importance of understanding nutrition as a multifactorial event. Excessive consumption of unhealthy foods – soft drinks, fast food, processed products, and sweets – has become a growing concern in several parts of the world, especially among adolescents. This dietary pattern is related to several factors, including changes in eating habits, the influence of advertising, and the availability and accessibility of low-cost, high-calorie products. Due to the process of identity shaping and the search for social acceptance, adolescents are especially vulnerable to the influence of media and consumer culture, which favors the excessive consumption of low nutritional value foods[17–19]. This situation contributes to the growing increase in childhood and adolescent obesity, a global public health problem[4,6].

In their study, Machado-Rodrigues et al.[20], when investigating the association between the consumption of Ultra-Processed Foods (UPF), behavioral and emotional factors and the risk of overweight among Portuguese adolescents, emphasized a positive relationship between UPF consumption and increased sedentary time, especially with watching TV, playing video games and using smartphones, which confirms the intricate etiology of pediatric obesity.

This dietary profile represents a challenge for the promotion of health and the prevention of chronic diseases in this life cycle, even more so when considering that Brazil has policies and programs that aim to encourage adequate food choices in the school and community environment, among which the National Food and Nutrition Policy (PNAN), the Dietary Guidelines for the Brazilian Population and the School Health Program (PSE) stand out[7,21,22]. There is a perceived need for intersectoral efforts between the health and education sectors for the effective implementation of these programs toward developing educational practices, improving the school food environment, and strengthening adolescents' autonomy to make healthier choices, so as to reverse inadequate dietary patterns and promote healthy habits throughout life[21,23].

In this context, the National School Meals Program (PNAE), consolidated after the promulgation of the 1988 Federal Constitution is a progress in that it guarantees the right to school meals, considering nutritional guidelines and sociocultural differences. The program offers healthy meals daily to students in basic education in the public school system, promoting food and nutritional security and thus ensuring the Human Right to Adequate Food[24]. However, the obesogenic environment of many adolescents and their families hinder the adoption of healthy and safe eating habits, which can impact their growth and development, as well as influence eating behavior in later stages of life[20,24].

The prevalence of regular consumption of ultra-processed foods, such as savory snacks and sweets, was higher among female adolescents. A study conducted in Santo Antônio de Jesus, Bahia, Brazil, with 139 young women, observed a high prevalence of ultra-processed foods, reflecting changes in Brazilian dietary patterns over the last 30 years[25]. Similarly, research conducted in Teresina, Piauí, revealed higher consumption of these foods among girls[26]. Data from PeNSE 2009 indicate that girls consume sweets, biscuits, and processed meats more frequently than boys[27].

Despite the association with higher consumption of ultra-processed foods, females showed lower regular intake of fast food compared to males. This may be explained by the fact that women largely play the role of health promoters in the home environment[28], often being responsible for preparing family meals.

Thus, to reconcile the several activities of daily life and save time, they may opt for ultra-processed foods that require less preparation. Men, on the other hand, less involved in preparing home-cooked meals, tend to prefer the convenience of quick and ready-made meals offered by fast food chains. However, analyses

in the United States of America (USA) indicate that women tend to be more sensitive to positive changes in diet, such as increased consumption of fruits and vegetables, while men are more influenced by negative factors[29].

The highest prevalence of elevated sugar consumption levels was observed among adolescents aged 15 or younger. A study conducted in Campinas, São Paulo, Brazil, with 924 adolescents found that the consumption of added sugars was significantly lower among young people aged 15-19. This situation may be attributed to behavioral changes typical of adolescence, such as the growing aesthetic concern with body weight and skipping meals[30].

Studies conducted with European adolescents indicated that total sugar intake represented 23.6% of total daily calories, while in the US, added sugars accounted for approximately 16% of total calories consumed by children and adolescents[31,32]. Data from the 2012 and 2015 PeNSE editions showed a high prevalence of ultra-processed food consumption among adolescents, with about 75% reporting frequent consumption of these products[33]. However, although some regional studies indicate slightly higher consumption of sugary drinks among boys, the 2019 national PeNSE report did not identify statistically significant differences between genders regarding the consumption of sweets[34,35].

Regarding ethnicity, white adolescents showed the lowest consumption of soft drinks, but the highest intake of ultra-processed salty foods. Data from the 2017-2018 Family Budget Survey (POF) revealed that white individuals consumed more ultra-processed foods (20.1%) than Blacks (16.6%)[36], which can be explained by cultural and socioeconomic factors that influence dietary patterns.

Differences were found in the participation of unprocessed and minimally processed foods and ultra-processed foods in the diet of the Brazilian population, which are associated with the socioeconomic position of individuals in society, being, in general, unfavorable for Blacks, browns and Indigenous people. In the US, however, studies have shown an increase in the consumption of ultra-processed foods among young non-Hispanic blacks, contrasting with young non-Hispanic whites[37]. However, the study does not separate the data by age group of the participants.

European literature on ethnic differences in sugary drink consumption among adolescents is limited and has heterogeneous results. A previous study show variations between ethnic groups in the determinants of consumption (such as parenting practices and availability), but do not show a systematic difference between white and non-white adolescents regarding the frequency of soft drink intake[38].

Household was positively associated with the consumption of soft drinks and sweets, as there has been an increase in the consumption of these ultra-processed foods with growing income and education levels of individuals. Analyzing data from the 2008-2009 and 2017-2018 POF surveys in Brazil revealed that the intake of ultra-processed foods tends to be higher among those with higher purchasing power and education level[39].

In 2017-2018, ultra-processed foods accounted for approximately 20% of total energy intake. Although their consumption is significantly higher among individuals with higher income and education levels, the temporal analysis of the POF indicates a trend towards national standardization at high levels, which implies increased health risks for the population. This situation is due to the lower relative prices of these products, their expanded availability in the market, and the growing presence of the food industry throughout the country[39].

From the 2000s onwards, the prices of ultra-processed foods have declined continuously, becoming more accessible to a portion of the population[40]. Still, these foods are not within everyone's reach. In Brazil, low-income households face financial barriers to acquiring these products, preferring to consume cheaper foods, such as cereals, tubers and roots, which are still the main sources of energy for these populations[41].

This consumption pattern is also observed in other countries. In Mexico, for example, studies have shown that high schooling and income levels are directly associated with increased consumption of ultra-processed foods, which reinforces the idea that financial availability and access to processed foods are determining factors in the dietary patterns of populations, reflecting socioeconomic inequalities that directly impact nutrition[42].

The lack of breakfast intake was associated with higher consumption of soft drinks and fast food by adolescents, highlighting its role in promoting balanced eating habits[43]. Regular breakfast intake is related to several health benefits, such as lower body fat and better cardiovascular parameters[44]. A study with 1,232 adolescents from state schools in Curitiba showed that the regular intake of breakfast was linked to lower consumption of instant noodles and soft drinks. Furthermore, these young people had healthier sleep and eating routines[45]. Investigations in Greece and Spain corroborate these findings, revealing that regular breakfast intake is inversely related to body adiposity among children and adolescents[46,47].

Eating meals in front of screens, especially TVs, or during study sessions was associated with higher consumption of soft drinks, salty ultra-processed foods, and sweets. Consistent with these findings, a study of 8- to 12-year-olds from Brazilian public schools evidenced that this habit is associated with increased consumption of ultra-processed foods, excess weight, and decreased satiety perception. This behavior is explained by the convenience of choosing easy-to-prepare foods, which are often low in nutrients and high in empty calories[48].

Longer weekly hours of TV viewing were correlated with higher consumption of sweets and sugary drinks among adolescents. A study with adolescents seen at a nutrition clinic in São Luís, Maranhão, Brazil, revealed that the habit of eating in front of the TV is a significant risk factor for the consumption of sweets[49]. Furthermore, a study conducted with 815 adolescents from public schools in Piracicaba, São Paulo, Brazil, also revealed that excessive time spent watching television is related to increased consumption of sweets, sugars, and soft drinks[50]. A possible explanation for this association may be linked to parenting style. Parents who are less effective at controlling their children's screen time may also have limitations in managing other family behaviors, such as dietary ones[51]. In addition, advertisements for ultra-processed foods can adversely affect the food choices of this audience, since these advertisements influence teenagers to consume more high-calorie foods[52,53].

This study identified a positive relationship between smartphone use dependence and high consumption of ultra-processed salty foods and sweets. A similar result was found in a previous study with Korean adolescents aged 12-18, in which smartphone addiction was associated with unhealthy eating patterns[54]. Another study pointed out that screen time is inversely proportional to the consumption of vegetables and fruits, although it is directly related to the consumption of ultra-processed foods, such as sweets and fast food. Teenagers tend to eat while connected to their smartphones, resulting in inattention and changes in eating habits. We should also consider that, due to the typical characteristics of this developmental stage, they may be more vulnerable to the persuasive marketing and advertising strategies adopted by the food industry on digital platforms. This population has a higher risk of unbalanced diets, food addiction, skipping meals, and low intake of healthy foods. Thus, the development of negative outcomes, such as obesity, sleep disorders, and declining healthy parameters in these adolescents is favored[55].

The findings highlight the importance of healthy eating promotion activities, combined with nutritional education, through interdisciplinary interventions, fostering a receptive and trusting environment and regular monitoring of adolescents. The involvement of

health professionals, parents, teachers, and public administrators is essential to streamline interventions and develop programs tailored to identified needs and with realistic goals, leading to greater empowerment and engagement of adolescents in self-care.

Health education strategies focused on developing socio-emotional skills are fundamental for preventing risky behaviors, including those related to inadequate nutrition. Strengthening skills such as emotional regulation, intrinsic motivation for healthy food choices, and self-confidence to resist social pressure and the stimuli of food marketing is essential.

Although the data presented provide important insights into unhealthy food consumption among adolescents, this study has some limitations. Initially, the data collected rely on self-reports, which may introduce recall or social desirability biases. Furthermore, the variables analyzed do not encompass all possible external influences, such as family and social factors, which can significantly impact eating habits. Future studies could consider a more comprehensive approach, with more diverse samples and longitudinal methodologies, to explore changes in food consumption over time.

Conclusions

Excessive intake of unhealthy foods among adolescents is a multifaceted event influenced by individual, social, economic, and cultural factors. The increasing prevalence of diseases associated with these dietary patterns highlights the urgency of prevention strategies, including nutritional education, regulation of food advertising, and the promotion of healthier environments in schools and communities, as advocated by the National Intersectoral Policy for Adolescent and Youth Health Care (PNAISA). Public policies aimed at improving access to healthy food and reducing socioeconomic inequalities are fundamental to addressing this public health problem. Continuous monitoring and investigation of new risk factors, such as the use of mobile devices and the consumption of digital media, are essential for a broader understanding of adolescents' eating habits and the development of more effective interventions.

By revealing these relationships, the study provides input for the formulation of intersectoral guidelines and strategies that integrate the areas of health, education, and social assistance. These findings can contribute to the improvement of the PNAISA and to the development of specific actions to promote healthy eating in this age group, especially in contexts of social vulnerability.

Based on the reflections of this study, we recommend strengthening intersectoral actions aimed at promoting healthy eating among adolescents. We also suggest expanding food and nutrition education activities to the school community – adolescents, teachers, and families. Health teams and schools should be integrated, with continuous nutritional monitoring, dietary guidance, and early identification of risk behaviors.

We propose to include planning and evaluating public policies that encourage initiatives to reduce the availability and consumption of ultra-processed foods, promote healthy food environments, and foster sustainable access. Finally, we recommend to integrate digital and media literacy initiatives into food education, promoting the critical use of social media and the recognition of unhealthy food marketing strategies targeting adolescents.

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Authorship contributions

Pinho L (0000-0002-2947-5806)* contributed to the conception, analysis, and interpretation of data, preparation of preliminary versions, critical review of intellectual content, and final approval of the manuscript. Dias MCAO (0009-0003-2283-5754)* contributed to the conception, analysis, and interpretation of data, discussion, and preparation of preliminary versions. Carneiro LC (0009-0006-4583-3921)* contributed to writing and critical review of the manuscript. Brito MFSF (0000-0001-5395-9491)* contributed to the design of the research project, data interpretation, and critical review for intellectual content. Figueiredo RC (0009-0000-4489-4649)* contributed to the analysis and interpretation of data, and writing and critical review of the manuscript. Silva NSS (0000-0002-8420-0821)* contributed to the design of the research project, data interpretation, and writing and approval of the final version of the manuscript. Silva RRV (0000-0003-3329-8133)* contributed to the design of the research project, data interpretation, and critical review for intellectual content. ■

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