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Analysis of health indicators among Brazilian schoolchildren using PeNSE data (2009–2019)

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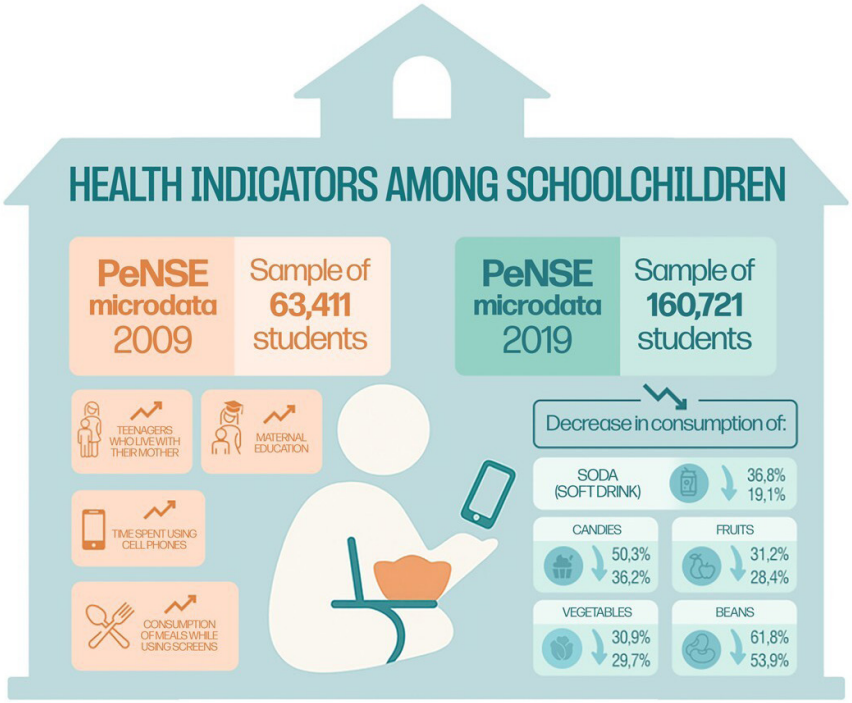
Graphical Abstract



Highlights

- *Increased mobile phone use among schoolchildren, particularly in public schools.*
- *More meals consumed while using screens over the decade.*
- *High consumption of ultra-processed foods among adolescents.*
- *Reduced consumption of fruits, legumes, vegetables, and beans.*

Abstract

The present study aimed to comparatively analyze health indicators among Brazilian 9th-grade students based on microdata from the National School Health Survey (PeNSE) for the years 2009 and 2019. This is a quantitative, cross-sectional study with a sample of 63,411 students in 2009 and 160,721 in 2019. Variables related to dietary intake, family arrangement, mobile phone use, and maternal education were evaluated. A significant increase was observed in mobile phone ownership (from 73.7% to 86.7%) and in the habit of consuming meals concomitantly with other activities (from 62.2% to 77.5%), a behavior that may be associated with distraction and reduced attention to satiety during meals. An improvement in maternal educational level was identified, along with an increase in the proportion of adolescents living only with their mother (from 31.0% to 37.6%). Conversely, a reduction was observed in the consumption of fruits (from 31.2% to 28.4%), vegetables (from 30.9% to 29.7%), beans (from 61.8% to 53.9%), sweets/confectionery (from 50.3% to 36.2%), and soft drinks (from 36.8% to 19.1%). These findings indicate changes in dietary patterns, characterized by reduced consumption of traditional foods and the persistence of practices associated with the media and digital environment. It is concluded that, despite the reduction in specific ultra-processed foods, dietary behaviors remain influenced by socioeconomic and cultural factors, requiring intersectoral public policies to promote healthy eating and strengthen the actions of the National School Feeding Program (PNAE) and the Dietary Guidelines for the Brazilian Population.

Keywords: Health Indicators. Student Health. Dietary Patterns. Adolescents. Diet.

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INTRODUCTION

Diet is one of the main determinants of health conditions throughout the life course. In this context, the assessment of dietary intake should not be restricted to the isolated analysis of nutrients or food groups, but rather should consider the totality, simultaneous combination, and complex synergy of each component influencing dietary interactions, which may result in significant health impacts[1,2]. However, this comprehensive perspective extends beyond what is directly consumed, encompassing how social, cultural, environmental, and lifestyle determinants shape the set of factors that influence individual and population food choices, enabling the evaluation of diet from a global perspective[1,3,4,5,6,7].

Inadequate dietary habits, such as high consumption of ultra-processed foods (UPFs) and low intake of fruits and vegetables, are associated with poor academic performance, difficulties in concentration and behavior, reduced levels of motivation and energy, as well as several adverse health outcomes, including growth deviations, obesity, cardiovascular diseases, and cognitive decline in children and adolescents[8,9,10,11,12,13].

School feeding plays a strategic role in this context, as the school environment is recognized as a privileged setting for health promotion and the formation of healthy eating habits. The Health-Promoting Schools approach, proposed by the World Health Organization (WHO), emphasizes the importance of integrating food and nutrition education, food security, and community participation[2,14].

In Brazil, the Food and Nutrition Surveillance System (Sisvan) collects data on the nutritional status and dietary patterns of the Brazilian population, aligning with the Dietary Guidelines for the Brazilian Population, which, together with the National School Feeding Program (PNAE), constitute public policies that guide the provision of meals based on fresh and minimally processed foods and discourage the consumption of UPFs[10,15,16].

Adolescence is a stage marked by physical and emotional transformations, the construction of autonomy, and the consolidation of health-related behaviors — especially dietary habits — that tend to persist into adulthood[17,18]. However, studies indicate that the dietary transition observed in recent decades has been characterized by a marked increase in the consumption of UPFs, a phenomenon that has intensified among school-aged populations[19,20]. In the Brazilian context, a similar pattern is observed, with diets characterized by high energy density, excessive fat and sugar intake, and low fiber consumption[1].

Many adolescents consume UPFs, with prevalence rates of 42% for soft drinks and 46% for fast food at least once per week[21,22]. Similarly, data from 200 countries indicate that the benefits of urbanization for child growth and development have diminished, with repercussions on both the food and school environments[23].

It has also been observed that the intake of soft drinks, snacks, sweets, and fast food often occurs at the expense of complete meals and breakfast, which are important moments associated with better cognitive performance and daily energy balance[16,21,24].

Thus, the study hypothesizes that among Brazilian schoolchildren, at least two distinct and prevalent dietary patterns can be identified over the past decade: one characterized by high consumption of ultra-processed foods (sweets, soft drinks, savory snacks), along with frequent intake of fried foods, and another marked by higher consumption of fresh and traditional foods (fruits, vegetables, legumes, and beans). In this context, the study aims to comparatively analyze evidence on health indicators among Brazilian schoolchildren using microdata from the National School Health Survey (PeNSE) for 2009 and 2019.

METHODOLOGY

A quantitative, cross-sectional study was conducted using microdata from the National School Health Survey (PeNSE) 2019, carried out by the Brazilian Institute of Geography and Statistics (IBGE) in partnership with the Ministry of Health and with support from the Ministry of Education. PeNSE is a population-based survey conducted periodically since 2009, investigating aspects related to the health of children and adolescents[3,25].

The PeNSE-2009 and PeNSE-2019 editions included 63,411 and 160,721 schoolchildren, respectively[3,25]. Based on filters applied to the microdata, the variables of interest related to dietary habits included sex, age, race/ethnicity, family arrangement, breakfast consumption, and frequency of consumption of fast food, foods, and ultra-pro-

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cessed beverages.

This study used exclusively secondary, publicly available data from the 2009 and 2019 editions of PeNSE, provided by IBGE[3,25]. As these are public datasets, individual participant identification is not possible, ensuring full protection of privacy. Thus, the authors report the data as presented by IBGE without applying statistical tests.

The 2009 and 2019 PeNSE editions were approved by the National Research Ethics Commission (CONEP), the highest authority within the CEP/CONEP system. The 2009 edition was approved under Amendment Opinion No. 005, dated June 10, 2009, referring to Research Protocol CONEP No. 11.537, in which CONEP considered the study clearly designed and compliant with national and international regulations for research involving adolescents. The 2019 edition was approved under Opinion No. 3,249,268, issued by CONEP in April 2019[3,25]. Therefore, the present study is exempt from evaluation by a Research Ethics Committee, as it uses anonymized, publicly available data, in accordance with Brazilian guidelines for research using secondary data.

RESULTS

The sample of schoolchildren showed a slight predominance of females (2009: 90.7% and 2019: 92.6%) compared to males (2009: 87.0% and 2019: 87.4%). The predominant age group was 13 to 15 years (2009: 89.1% and 2019: 92.3%). Regarding self-reported race/ethnicity, participants identified as mixed-race (2009: 38.6% and 2019: 41.1%), White (2009: 39.6% and 2019: 35.5%), Black (2009: 12.7% and 2019: 14.7%), Asian (2009: 3.7% and 2019: 4.4%), and Indigenous (2009: 4.0% and 2019: 3.9%). These data are presented in Table 1.

Table 1 - General characteristics of students who participated in PeNSE, Brazil, 2009 and 2019.

Percentage of 9th-grade students	2009	2019
Number of girls aged 13–15 years	90.7	92.6
Number of boys aged 13–15 years	87.0	87.4
White race	39.6	35.5
Black race	12.7	14.7
Asian race	3.7	4.4
Mixed race (Brown)	38.6	41.1
Indigenous	4.0	3.9
Mobile phone ownership	73.7	86.7
Mobile phone ownership among public school students	69.4	83.4
Mobile phone ownership among private school students	89.9	95.0
Mother with no schooling or incomplete primary education	25.6	15.2
Mother with complete secondary education or incomplete higher education	25.4	27.4
Mother with complete higher education	16.0	23.5
Living with both mother and father	58.0	52.3
Living only with the mother	31.0	37.6

Source: Table adapted from data extracted from PeNSE 2009 and 2019[3,25].

Mobile phone use among the surveyed students showed a significant increase (2009: 73.7; 2019: 86.7). However, this phenomenon was more pronounced among students from public schools (2009: 69.4; 2019: 83.4) than among those from private schools (2009: 89.9; 2019: 95.0), as shown in Table 2. Maternal education was characterized by a reduction in the proportion of mothers with no formal education or incomplete primary education (2009: 25.6; 2019: 15.2) and an increase in those with complete higher education (2009: 16.0; 2019: 23.5). Regarding family structure, students reported living with both parents (2009: 58.0%; 2019: 52.3%) and living only with their mother (2009: 31.0%; 2019: 37.6%).

Only the 2019 survey reported on the habit of eating breakfast daily (54.7%), of which 53.8% were students from public schools and 57.2% from private schools; although a substantial proportion reported doing so rarely (23.6%). Similarly, the proportion of students who consumed meals or school food provided by public schools was 43.4%, while 23.8% reported not consuming these foods at all.

Table 2 - Dietary habits of students surveyed in PeNSE, Brazil, 2009 and 2019.

Dietary indicator	2009	2019	Observations
Eating meals concomitantly with other activities on one or more days per week	62.2	77.5	Marked increase regardless of sex or type of school
Usually having lunch or dinner with parents or guardians on five or more days in the same week	62.0	64.9	Increase observed regardless of sex or type of school
Consumption of healthy food marker (vegetables and/or greens) on five or more days in the seven days prior to the survey	30.9	29.7	Decrease observed regardless of sex or type of school
Consumption of healthy food marker (beans) on five or more days in the seven days prior to the survey	61.8	53.9	Public school students: 65.0 in 2009 to 56.5; private schools: 49.8 to 47.2
Consumption of healthy food marker (fresh fruits or fruit salad) on five or more days in the seven days prior to the survey	31.2	28.4	Decrease regardless of sex or type of school
Consumption of unhealthy food marker (sweets/confectionery) on five or more days in the seven days prior to the survey, by sex and school administrative dependency	50.3	36.2	Substantial decrease regardless of sex or type of school
Consumption of unhealthy food marker (soft drinks) on five or more days in the seven days prior to the survey	36.8	19.1	Substantial decrease regardless of sex or type of school

Source: Table adapted from data extracted from PeNSE 2009 and 2019[3,25].

Reports of eating meals concomitantly with other activities, such as screen use, increased from 62.2% in 2009 to 77.5% in 2019. However, in the 2019 survey, 46.6% of students reported eating meals while watching television or using a mobile phone every day, whereas 27.5% denied this behavior.

According to the 2019 survey, the variable referring to foods consumed on the day prior to the survey was investigated: 48.0% of students consumed savory snacks or salty biscuits, and 45.4% reported intake of sweet biscuits or packaged cakes. Margarine consumption was reported by 39.5% of schoolchildren, and 39.0% consumed processed meats such as sausages or mortadella. Other processed foods were also frequently consumed: 44.5% reported eating industrialized bread, 37.7% industrialized desserts, 30.7% ready-made sauces, and 18.0% frozen or instant foods.

Among the evaluated schoolchildren, a decrease in the consumption of vegetables and/or greens (2009: 30.9; 2019: 29.7) and beans (2009: 61.8; 2019: 53.9) was reported. Regarding bean consumption, it was observed that among public school students, consumption decreased from 65.0% in 2009 to 56.5% ten years later, whereas the decline was more modest among private school students (2009: 49.8; 2019: 47.2).

The consumption of healthy food markers (fresh fruits or fruit salad) on five or more days in the seven days preceding the survey decreased from 31.2% in 2009 to 28.4% in 2019. Finally, a marked reduction was observed in the consumption of sweets/confectionery (2009: 50.3; 2019: 36.2) and soft drinks (2009: 36.8; 2019: 19.1).

DISCUSSION

The National School Health Survey (PeNSE), whose first edition took place in 2009 and the fourth in 2019, constitutes one of the most relevant surveys on adolescent health and behavior in Brazil. Its data enable the monitoring of risk and protective factors associated with non-communicable chronic diseases (NCDs), supporting public policies aimed at health promotion and food and nutrition security[3].

In the present study, no substantial changes were observed in relation to age group, sex, and race/ethnicity, suggesting that the variations identified between the analyzed periods reflect real transformations in behaviors and dietary patterns rather than demographic changes in the sample. However, among sociodemographic variables, improvements in maternal educational level and an increase in the proportion of adolescents living only with their mother were noteworthy, indicating changes in the family and social profile of Brazilian schoolchildren. Previous research indicates that parental educational level, particularly maternal education, is associated with better dietary practices, greater nutritional knowledge, and more favorable attitudes toward the adoption of healthy habits[26,27].

These findings reinforce that family and social interactions play a determining role in shaping dietary habits, reflecting cultural and affective values

that directly influence adolescents' food choices[1,28]. However, the growing influence of the digital and media environment has been reshaping these dynamics.

The use of mobile phones and screens during meals, reported by nearly half of students in 2019, represents a relevant behavioral change. This habit is associated with distracted eating, reduced perception of satiety, and automatic consumption of ultra-processed foods[6,29]. Moreover, the increase in the habit of eating meals concomitantly with other activities, identified in 77.5% of schoolchildren in 2019, reinforces the transition toward less mindful eating practices and greater susceptibility to external stimuli[7,30].

This phenomenon is embedded in a context in which eating is increasingly mediated by screens and convenience, where time dedicated to meals is replaced by multitasking behaviors, often associated with the consumption of easily accessible industrialized foods. Such patterns, widely documented in national and international studies, contribute to increased total caloric intake and a decline in dietary quality, favoring the emergence of overweight, obesity, and metabolic disorders[5,6].

PeNSE data revealed a substantial increase in the consumption of ultra-processed foods (UPFs), such as snacks, biscuits, industrialized cakes, processed meats, and ready-made sauces, accompanied by a reduction in the consumption of fruits, vegetables, legumes, and beans. These findings confirm the trend of replacing traditional foods with industrialized products, a phenomenon already reported in other national dietary surveys[4,30]. The reduction in the intake of fresh foods, combined with the increased consumption of ultra-processed products, represents a risk for adequate intake of micronutrients, fiber, and bioactive compounds essential for maintaining health.

The decline in bean consumption, a food historically central to the Brazilian diet, is particularly concerning. The more pronounced reduction among public school students may reflect economic inequalities and the influence of food prices, which underwent significant increases during the analyzed period, making fresh foods less accessible to lower-income populations[31]. National media reported that in 2010, due to inflation, carioca beans became 76.76% more expensive, and in 2019 this food, regardless of type, remained at a high price[32,33]. These findings highlight the need for policies that encourage the consumption of traditional foods and strengthen the National School Feeding Program (PNAE), an important instrument for promoting healthy and equitable diets.

The reduction in the consumption of soft drinks and sweets/confectionery observed between 2009 and 2019 represents, on the other hand, a positive finding. This trend may be associated with public campaigns aimed at reducing sugar consumption, increased access to nutritional information, and regulation of food sales within schools[3,17]. Nevertheless, a substantial proportion of schoolchildren continue to consume these products regularly, underscoring the need for continuous interventions and integrated educational strategies to consolidate these changes and expand their reach.

Although economic and sociocultural transformations exert strong influence on dietary patterns, the persistence of inadequate eating habits among adolescents highlights the limitations of current strategies. The frequent consumption of UPFs and low adherence to healthy foods reinforce the determining role of the food environment and marketing directed at young populations. Aggressive advertising strategies and easy access to industrialized products contribute to the consolidation of high-energy-density, low-nutritional-value dietary patterns, negatively impacting school health and cognitive performance[28,34].

The findings also confirm the relationship between inadequate diet and increased risk of obesity, indicating that the prevalence of this condition among adolescents has risen substantially in the last decade, surpassing undernutrition rates[10,35]. This scenario underscores the urgency of intersectoral policies integrating health, education, and food security actions.

Promoting healthy eating habits during adolescence requires a multifactorial approach involving not only the school environment but also family and community contexts. Schools should be recognized as strategic settings for health promotion, capable of integrating food education initiatives, the provision of balanced meals, and encouragement of shared meals without the presence of screens[2,15].

In summary, the comparative data from PeNSE 2009 and 2019 reveal both progress and persistent challenges: on one hand, there are positive signs in the reduction of sugary beverages and sweets; on the other, inadequate dietary patterns persist, along with a progressive loss of traditional eating habits. This duality reflects the complexity of the contemporary food environment, shaped by economic, technological, and cultural factors influencing adolescents' dietary behaviors.

Although the decline in soft drink and sweets consumption is a positive trend, concerns remain due to the alarming increase in obesity indicators and other chronic diseases, given that a significant proportion of adolescents continue to consume these products regularly. This consumption must be

addressed through food education and effective interventions, particularly considering the aggressive and appealing marketing strategies of food industries.

Furthermore, healthy eating habits are essential for cognitive development, as adolescents' dietary patterns impact both physical and mental development[13,28,34]. Additionally, combating hunger and aligning with the concept of nutritional well-being represent challenges for families, society, and public authorities[36].

CONCLUSION

By analyzing food consumption choices among 9th-grade schoolchildren based on PeNSE 2009 and 2019 data, a significant increase was observed in the habit of eating meals alongside other activities, as well as a slight increase in shared meals with parents. However, there was a reduction in the regular consumption of healthy foods (vegetables, greens, beans, and fruits) and a marked decrease in the consumption of unhealthy foods, such as sweets and soft drinks, regardless of sex or type of school.

The limitations of this study include the lack of more recent data, which would allow analysis of behaviors in a post-pandemic context. Nonetheless, the need to examine socioeconomic changes in relation to dietary habits over a decade is evident. The use of self-reported data may be subject to recall bias and social desirability bias, and the assessment of intake based on "the previous day" may reflect interindividual variability not representative of habitual consumption.

The results indicate the need for a multifaceted approach: (1) strengthening and improving school meals aligned with the Dietary Guidelines for the Brazilian Population, avoiding ultra-processed foods and increasing the availability of fruits, vegetables, and legumes; (2) regulation and monitoring of food availability in school canteens and surrounding vendors; (3) food education strategies involving families and communities to encourage shared meals without screens and the restoration of traditional dietary habits; (4) public policies aimed at reducing the cost of nutritionally valuable foods.

Unhealthy food preferences may lead to chronic health conditions in the medium and long term, affecting adolescent health and raising important discussions regarding the reorientation of policies and programs, as well as the regulation and implementation of economic measures targeting ultra-processed foods in Brazil.

CRediT author statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the workreported in this paper.

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