

Food environment surrounding public and private schools: an opportunity or challenge for healthy eating?

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Abstract *The study analyzed and compared the types of food sold in the surroundings of 30 private and 26 public elementary schools in the city of Niterói, Rio de Janeiro. Data were collected by audit using a checklist instrument to characterize establishments (formal or informal) and identify the types of food and beverages sold, which were classified by processing level (fresh, processed, and ultraprocessed). Mann-Whitney statistical tests were used to verify the difference in the type of trade outlets and the categories of food sold between schools. The Kruskal-Wallis test was used to verify the difference in the amount of food traded between the categories. The amount of ultraprocessed food in the surroundings of public and private schools was statistically higher ($p=0.0001$) than the other categories. Some culinary preparations had a high rate of energy contribution from ultraprocessed foods (above 15%). There was no statistically significant difference ($p = 0.478$) in the categories of food sold between public and private schools. The sale of ultraprocessed products predominates around public and private schools, favoring the exposure of children to an environment that encourages the consumption of these products.*

Key words *School environment, School food, Healthy eating*

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Introduction

Adequate nutrition in childhood contributes to child growth and development¹, a crucial phase for the formation of healthy eating habits and maintenance in adulthood. However, conditioning factors related to the physical and social environment interfere with the children's food choices, sometimes with adverse consequences for health². In this sense, the standardization of eating practices, expansion of the advertising market, and lifestyle changes have favored the greater access to processed and ultraprocessed foods, affecting the population's health profile. Most of these foods have a high concentration of sugar, fats and sodium, and a high energy density³⁻⁷.

The food environment can be described as a microenvironment that includes the individuals' locations, such as home, work, neighborhood, school, whose particularities of access to food (availability, quality, and price) guide their consumption choices. In turn, this environment is related to the food macroenvironments established by policies, food industries, advertising, and marketing companies, among others, that indirectly influence the population's purchase decision and condition consumption profiles^{8,9}.

In the case of children, the school is one of the main components of the food environment, where children remain for long periods, thus being considered a favorable space for the development of healthy eating practices¹⁰. Studies have shown that students, whether from public or private institutions, are exposed to environments that mostly sell ultraprocessed foods¹⁰⁻¹⁴, which can impact health if consumed in excess and frequently.

In Brazil, food in public schools is regulated through the National School Food Program (PNAE), which guarantees the supply of healthy meals and establishes guidelines for Food and Nutrition Education (EAN) in schools.

Some legal provisions for the promotion of healthy eating in schools are in place, such as Interministerial Ordinance n° 1010 of May 8, 2006, which establishes guidelines for the promotion of healthy eating in early childhood, elementary and secondary schools of the public and private networks nationwide¹⁵, the Manual of healthy school canteens, which aims to help owners transform their canteens into places for the promotion of healthy eating¹⁶, and Law n° 13.666/2018, of the President of the Republic, which determines the cross-sectional inclusion of the EAN theme in the school curriculum¹⁷.

Some Brazilian states and municipalities have already published legislation to regulate the sale of food in school cafeterias^{18,19}. However, there is still no Federal Law regulating the sale of food in these environments^{11,20,21}, and there is no inspection or punitive actions for irregularities.

Despite the existence of legal provisions, it is worth considering that the surroundings of schools are convenient places to sell foods of interest to children (candies, chocolates, and other treats) that can hinder the promotion of healthy eating even in schools where education programs are implemented or in those with healthy eating-oriented canteens²². Thus, considering that students already have the autonomy to buy food in canteens and in commercial establishments around schools, which do not always have healthy snack options^{23,24} and that few studies explore the analysis of the food environment in the school environment, this study aimed to analyze and compare the types of food sold around public and private schools in the city of Niterói-RJ.

Methods

This is an observational and descriptive research conducted by the Education, Extension, and Research Group on Food and School Health (GE-PASE/UFF). This study considered all formal and informal commercial establishments located within a radius of 500 meters from the primary access school's gate^{11,25} to delimit the food environment of the school's surroundings.

Initially, a search was made on the Niterói's Municipal website to select public schools, and a total of 120 municipal school units were found (community daycare centers, early childhood education, elementary education, and youth and adult education). Forty-nine elementary schools were selected, composed of students aged 7-15 years, who already have decision-making power over their food choices²⁶. Fourteen schools in risk areas were excluded due to urban violence, which resulted in a final sample of 35 municipal school units.

A search was carried out on "Google Maps" to select private schools and locate the units closest to the municipal schools previously selected, also totaling 35 schools. After this stage, schools whose surroundings did not identify food establishments, formal or informal, were excluded, leaving 30 private schools and 26 public schools.

Data were collected from August 2017 to June 2018, through an audit, which corresponds to

the assessment of the food environment by direct observation of the place²⁷. Information was registered with a checklist instrument elaborated by researchers and pre-tested in the school surroundings of a neighboring municipality, containing two topics: 1) characterization of establishments (formal or informal) and 2) availability and types of food and beverages sold.

Subsequently, the foods sold around public and private schools were classified by processing level (fresh or minimally processed, processed, and ultraprocessed) according to the Food Guide for the Brazilian Population, namely:^{28,29}

Fresh and minimally processed foods: include those that can be consumed without undergoing any modification after leaving nature or those that are subjected to cleaning, removal of inedible parts, portioning, freezing, and other processes that do not add any other substance that alters its original form;

Culinary ingredients: include substances taken from fresh foods that are used as items of culinary preparations, such as oils, vinegar, sauces, salt, and sugar;

Processed foods: include those manufactured with salt or sugar, oil, or other processed ingredients over fresh or minimally processed food;

Ultraprocessed foods: include processed products, usually made with more than five ingredients that provide high palatability and longer duration, where these ingredients used are additives, antioxidants, stabilizers, and preservatives;

Culinary preparations: defined as recipes consisting of natural or processed foods³⁰ and culinary ingredients²⁸. They were characterized by the determination of the per capita number of food/culinary ingredients present in each preparation according to the "Table for assessing food consumption in home measures"³¹.

The number of kilocalories of each food/ingredient was calculated from the characterization of culinary preparations, as per the "Brazilian food composition table"³². Finally, the energy contribution rates of each food/ingredient of the culinary preparation according to the classification of the processing level of the food guide^{28,29}.

Culinary preparations were classified according to the ingredient contribution rate and categorized as per the predominance of fresh/minimally processed, processed, and ultraprocessed foods). Teo and Monteiro⁴ affirm that the recommended participation of ultraprocessed foods in the diet should not exceed 15% of the total meal energy. In the case of this study, the

energy contribution of ultraprocessed foods was limited to 15% of the total energy of the culinary preparation.

Data statistical analysis

The normality distribution of the variables was verified using the Kolmogorov-Smirnov test. Considering that all variables had a non-parametric distribution, the Mann-Whitney test was used to verify the difference in the type of trade between public and private schools, the Kruskal-Wallis test to verify the statistical difference in the amount of food traded among the categories (fresh/minimally processed, processed or ultraprocessed) and the Mann-Whitney test to verify the statistical difference of the different categories of food sold between public and private schools considering the level of significance at 5%. The SPSS (Statistical Package for Social Sciences) program, version 13.0, was used to perform the statistical analysis. Data are presented in median and percentile distribution [P25; P75].

Results

The study identified a total of 285 establishments around the 56 public and private elementary schools, of which 80% were formal establishments (48% around private schools and 32% around public schools, $p=0.230$), and 20% were informal establishments (8% around private schools and 12% around public schools, $p=0.553$). As for the characteristic of the existing trade, there was a predominance of snack bars (15% in both surroundings) and restaurants in public and private schools (14% and 15%, respectively) and a smaller number of markets/corner stores and grocery stores, with 5% and 4% in public schools and 7% and 6% in private schools, respectively.

Table 1 shows that the sale of ultraprocessed foods was higher than 65%, regardless of the type of schools, and was statistically higher ($p=0.0001$) than the other categories. Twenty-five types of ultraprocessed foods were identified, with the highest rate of sweets (candies, chewing gum, chocolates, and chocolates), cookies (salty and sweet), popsicles, processed drinks and soft drinks in both environments.

The high supply of processed cake and ice cream was identified around the private schools and processed popcorn around the public ones. Regarding fresh or minimally processed foods,

Table 1. Absolute (n) and relative (%) distribution of foods sold in the surroundings of public and private schools as per the classification of the Food Guide for the Brazilian Population, Niteroi-RJ, 2018.

Food categories	Private schools	Public schools
	(n=34)	(n=36)
	n (%)	n (%)
Fresh or minimally processed	76 (10.7)	57 (9.5)
Açaí	13 (38.2)	10 (27.8)
Water	26 (76.5)	23 (63.9)
Coconut water	4 (11.8)	1 (2.8)
Fresh fruits	11 (32.4)	9 (25.0)
Boiled corn	0 (0.0)	0 (0.0)
Popcorn	6 (17.6)	5 (13.9)
Fresh fruit juice	16 (47.1)	9 (25.0)
Processed	15 (2.0)	12 (2.0)
Processed coconut water	15 (44.1)	12 (33.3)
Ultraprocessed	493 (69.7)	434 (72.2)
Salted peanuts	23 (67.7)	22 (61.1)
Candy and gum	28 (82.4)	26 (72.2)
Cereal bar	20 (58.8)	13 (36.1)
French fries (frozen)	7 (20.6)	9 (25.0)
Processed fruit drinks (nectar, soy)	21 (61.8)	19 (52.8)
Guarana-based processed drinks	23 (67.6)	20 (55.6)
Dairy drinks	17 (50.0)	13 (36.1)
Stuffed sweet biscuit	23 (67.6)	21 (58.3)
Sweet biscuit without filling	22 (64.7)	21 (58.3)
Whole Biscuit	13 (38.2)	10 (27.8)
Processed cake	20 (58.8)	12 (33.3)
Bonbons/chocolates	27 (79.4)	22 (61.1)
Morning cereal	8 (23.5)	4 (11.1)
Ready-to-drink tea	19 (55.9)	14 (38.9)
Peanut candy	22 (64.7)	23 (63.9)
Milk sweet	22 (64.7)	22 (61.1)
Isotonic/Energetic	16 (47.1)	11 (30.6)
Popsicle	22 (64.7)	18 (50.0)
Microwave popcorn	4 (11.8)	6 (16.7)
Industrialized popcorn	18 (52.9)	22 (61.1)
Lollipops	28 (82.4)	25 (69.4)
Soft drinks	27 (79.4)	25 (69.4)
Packet snack	25 (73.5)	24 (66.7)
Salty flaky pastry	17 (50.0)	16 (44.4)
Ice cream	21 (61.8)	16 (44.4)

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the highest rates sold were mineral water and fruit juice around private schools and mineral water in the vicinity of public schools. As for processed products, only coconut water was identified in both environments.

There was a more significant offer of culinary preparations composed of processed and

ultraprocessed foods in the surroundings of public and private schools. Of the preparations made up of fresh/minimally processed foods, fruit milkshake/smoothie had a higher supply. The most available preparations, composed of processed foods, were salty (fried and roasted) and fruit refreshment. There was a greater variety

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Food categories	Private schools	Public schools
	(n=34)	(n=36)
	n (%)	n (%)
Culinary preparations		
With a predominance of fresh/minimally processed	20(2.8)	10 (1.6)
Fruit milkshake/smoothie	10 (29.4)	6 (16.7)
Fruit salad	6 (17.6)	3 (8.3)
Tapioca	4 (11.8)	1 (2.8)
With a predominance of processed	70 (10.0)	55 (9.1)
Cheese bread	13 (38.2)	9 (25.0)
Fruit refreshment *	21 (61.8)	10 (27.8)
Salty pastry (fried and baked)	36 (105.8)	36 (100.0)
With a predominance of ultraprocessed	33 (4.6)	33(5.5)
Hot dog	6 (17.6)	2 (5.6)
Hamburger	7 (20.6)	10 (27.8)
Cheese and ham sandwich	9 (26.5)	12 (33.3)
Natural sandwich	11 (32.4)	9 (25.0)

* Dilution from processed concentrated juices was considered.

Source: Author's elaboration.

of preparations composed with a predominance of ultraprocessed foods and the natural and ham and cheese sandwich in a higher number of areas in private schools, and ham and cheese sandwich, and hamburgers in the surroundings of public schools (Table 1).

Some culinary preparations such as hot dogs, natural ham and cheese sandwiches, and salty pastry (fried and roasted) presented a high rate of energy contribution from ultraprocessed foods (above 15%). On the other hand, tapioca, fruit salad, fruit refreshment, and fruit milkshake/smoothie did not show an ultraprocessed energy contribution (Table 2).

The sale of food according to the different categories was not statistically different between public and private schools ($p > 0.05$) (Table 3). However, considering all schools ($n = 56$), the number of ultraprocessed foods sold (18 [12;21]) was statistically higher than the number of fresh/minimally processed foods (2 [1;4]) and processed foods sold (0 [0;1]) ($p = 0.0001$).

Discussion

In this study, there was no significant difference in public and private schools' surroundings as to the type of food sold. It was shown that both had

a significant number of trade outlets that sold, predominantly, foods of low nutritional value, with high levels of critical nutrients and additives in their composition. These foods are known for several attributes, such as, for example, hyperflavor, which compromise satiety and control appetite, favoring involuntary consumption, and increasing the risk of obesity³³. Therefore, their sale represents a challenge for the promotion of healthy eating habits and requires the development of public policies that regulate the food supply and promote environments conducive to healthier choice options, especially for developing children.

As for the type of formal establishment, there was a predominance of snack bars. This type of trade outlet favors greater access to high energy density food. Therefore, the territories analyzed are characterized by an insufficiency of desirable establishments for healthier food choices, considering that places with a more significant presence of markets and fruit and vegetables are food environments less conducive to obesity^{8,34,35}.

Since 2009, the municipality of Niterói has a Law that prohibits the sale and advertising of products contributing to childhood obesity in canteens and snack bars installed in school units that are part of the municipal education system³⁶. However, as in other States and Municipalities

Table 2. Distribution of the rate of the energy of culinary preparations sold in the surroundings of public and private schools as per the level of food processing, Niterói-RJ, 2018.

Preparations	Processing level				
	Preparation	Fresh/ minimally processed	Processed	Ultraprocessed	Culinary ingredients
		Kcal	Kcal (% kcal)	Kcal (% kcal)	Kcal (%kcal)
Hot dog	252.6	4.4(2.0)	0 (0)	221.2(87.0)	27.0(11.0)
Hamburger*	278.2	37.2 (13.0)	24.2 (9.0)	171.9 (62.0)	45.0 (16.0)
Fruit milkshake/smoothie	193.3	133.6 (69.0)	0 (0)	0(0)	59.7(31.0)
Cheese and ham sandwich	277.2	0 (0)	61.0 (22.0)	216.2 (78.0)	0 (0)
Cheese bread	443.3	208.3 (48.0)	45.1(10.0)	0(0)	180.0(42.0)
Fruit refreshment	63.5	0(0)	3.8(6.0)	0(0)	59.7(94.0)
Fruit salad	120.0	60.3(50.0)	0 (0)	0 (0)	59.7 (50.0)
Baked salty pastry	455.1	181.6(40.0)	52.8(12.0)	220.6(48.0)	0 (0)
Fried salty pastry	440.5	240.1(55.0)	0 (0)	110.3(25.0)	90(20.0)
Natural sandwich	280.7	63.9 (23.0)	17.5 (6.0)	172.4 (61.0)	27.0 (10.0)
Tapioca	460.6	460.6 (100)	0 (0)	0 (0)	0 (0)

*The version sold in supermarkets was considered.

Source: Author's elaboration.

with legal provisions, the challenge concerns street vendors who sell treats around public and private schools.

A study carried out in the city of Santos-SP observed a predominance of informal establishments in the vicinity of public schools that were characterized by the exclusive sale of processed and ultraprocessed foods¹¹. Similar studies that evaluated the proximate surroundings of schools in New Zealand³⁷ and New York³⁸ identified an agglomeration of businesses characterized by the sale of high-calorie foods such as fast-food and convenience stores, reinforcing the findings of this study.

The analysis of food preparations according to the level of processing in the Food Guide's perspective is a complex task for researchers, when ultraprocessed, processed and fresh foods/ingredients are used in the same preparation. In this study, food preparations were evaluated according to the rate of energy in each category, of which preparations with a high rate of ultraprocessed foods (above 15%) were identified. Moreover, even fresh foods can be added with ultraprocessed foods, evidenced in this study by tapioca stuffed with ham and by popcorn seasoned with condensed milk.

The excessive use of culinary ingredients, such as sugar and oils, opposes the recommendations of the food guide and mischaracterizes

preparations that are considered healthy a priori, such as the case of sugar-added fruit juice and fruit milkshake/smoothie, also identified in this study. The use of this ingredient stood at increasing levels throughout Brazil³⁹, exceeding the recommendations of the World Health Organization (WHO), which advises that the contribution of daily added sugar should not exceed 10% in total calories⁴⁰.

Strategies for implementing public policies to regulate the sale of ultraprocessed foods and beverages, known as competitive foods, have been attempted in different developed countries⁴¹. In Brazil, some of them have been discussed and implemented with varying degrees of success, such as nutrition labeling, the regulation of food advertising, and the agreements between the Brazilian Food Industry Association and the Ministry of Health to reduce sodium, trans fats, and sugar. A significant achievement in this regard was the recent publication by the National Health Surveillance Agency (ANVISA) of RDC n° 332, of December 23, 2019, which defines the requirements for hydrogenated fats and prohibits the production, import, use and supply of partially hydrogenated oils and fats for use in foods and foods formulated with these ingredients⁴².

Another significant regulatory advance for the promotion of healthy eating was the Public Consultation (CP) addressing the proposed

Resolution of the Collegiate Board on nutrition labeling to facilitate the consumer's understanding of the nutritional information⁴³. Food advertising regulation should gain prominence in the government's public agenda considering the advances and setbacks obtained, due to the conflicts of interest on this topic in Brazil⁴⁴.

Another strategy that can encourage better choices is subsidizing healthy foods and taxing unhealthy foods based on the proportion of sugar, fat, and calories⁴⁵. In this regard, the WHO recommends increasing taxes on soft drinks and sugary drinks to combat the growth in overweight and obesity rates worldwide⁶.

Modifying the food environment through regulatory measures is not the only way to reduce the consumption of ultraprocessed foods. Educational strategies are equally important and necessary as the training of canteen owners and continuous EAN actions that must be included in the schools' educational project. Activities that arouse the reflection of the participants, such as workshops for the development of culinary practices and the use of vegetable gardens as a learning aid, can help to face the current scenario of replacing fresh foods with highly processed foods, enabling the understanding of food as social practice, promoting increased recognition of the relevance of fruit and vegetable consumption by students, and increasing their motivation to try out these foods⁴⁶⁻⁴⁹.

A study that evaluated the school environment's influence on the nutritional status of schoolchildren found that schools with a more significant number of snack bars and food advertisements in the territory had a higher proportion of children with obesity⁵⁰. Some studies call the environment "obesogenic" when the availability of healthy foods is scarce or nonexistent, when it has an ample supply of ultraprocessed foods and advertising exposure, besides discouraging physical activity^{11,51-54}. In this sense, it is difficult to adopt and maintain dietary recommendations for the prevention and control of obesity in an environment conducive to habits and attitudes contrary to these practices.

Therefore, the regulation of the school food environment is a strategy for the promotion of a healthy diet, considering that the foods that underlie this environment may have a protective or promoting effect on obesity^{55,56}. Nevertheless, health promotion and healthy eating actions cannot do without recognizing the food environment, as they support the individual on strategies to make better choices in these environments.

Table 3. Medians and percentiles [25; 75] of the amount of food sold in the surroundings of public and private schools grouped by level of processing, Niterói-RJ, 2018.

Food categories	Schools		p-value*
	Publics	Private	
Fresh or minimally processed	2 [1; 2.5]	2 [2; 4]	0.164
Processed	0 [0; 1]	1 [0; 1]	0.270
Ultraprocessed	16 [11; 21.5]	20 [12.8; 21.2]	0.478

*Mann-Whitney Test.

Source: Author's elaboration.

The WHO Commission for the End of Childhood Obesity has published a report recognizing that many children live in environments that promote excessive weight gain and inadequate eating practices. They recommend the promotion of healthy school environments as one of the main actions to reduce childhood obesity and health problems associated with this disease⁶. The Strategic Action Plan for Coping with Chronic Non-Communicable Diseases 2011-2022, published by the Ministry of Health of Brazil, also recognizes the school as favorable equipment for the promotion of healthy eating and physical activity in the recommendations geared to children⁵⁷.

The sale of foods with high energy value and high sugar, sodium and fat content in canteens and the school environment, can discourage the acceptance of school meals and affect the possible impacts of the EAN actions proposed by the PNAE in public schools. Likewise, in private schools, these foods compete with healthy eating protective factors, such as efforts to regulate canteens and the inclusion of healthy eating in the school's educational project.

The choice for fresh foods depends on availability and accessibility. Therefore, there is a need to develop strategies to promote the protection of the school environment concerning the sale of ultraprocessed foods and, notably, to support the actions to promote healthy eating already implemented in schools. The strengthening of programs such as the PNAE can expand the reach of equipment that promote the triggering of positive changes in the food system, considering the greater access to healthy foods⁴⁶.

Changes in dietary practices demand considering each case's singularities and the specificities

of the child development process that involves the construction of decision-making skills. On the other hand, the indiscriminate sale of ultraprocessed products around public and private schools indicates the relevance of public policies that make environments more conducive to the adoption of healthy choices, primarily State regulatory actions. Moreover, it warns about the relevance of assessing the environment in order to learn more about the school food environment, mainly because the topic is rarely addressed in the literature and can subsidize public policymakers to regulate the food environment of educational institutions to support, encourage and protect healthy eating habits and reduce the risk of childhood obesity. However, it has limitations arising from the lack of a validated instrument for assessing the school environment.

The reconfiguration of institutional environments requires joint action by several governmental spheres, intersectoral articulation, and social engagement to have a lasting impact on the transformation of dietary practices since they are socially constructed and integrated with sociocultural structures, systems, policies and standards⁹. It also requires the challenge of sensitizing school principals, canteen owners, and street

vendors located near school entrances about the effects of their sold food on the health of children, who still do not have the critical capacity to make more healthy choices.

Conclusion

This study's findings showed no significant difference between the foods sold around public and private schools. The food environment around the schools surveyed is characterized by the full availability of establishments that mainly sell ultraprocessed foods, favoring children's exposure to an environment that encourages the consumption of these products, reinforcing the need for regulatory strategies. This indicates the widespread sale of ultraprocessed products in different urban spaces and social strata demanding universal public policies that affect this context. On the other hand, the school space is fundamental for establishing environments that promote healthy eating practices that enhance the integration of stimulating, supportive and protective actions in the light of the recommendations of the food guide for the Brazilian population.

Collaborations

P Henriques, CRT Alvarenga, DM Ferreira, PC Dias, DSB Soares and RMS Barbosa participated in the conception and design of the research, analysis and interpretation of data, review and approval of the final version of the article.

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