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Social inequities in the food retail patterns around schools in Recife, Brazil

Desigualdades sociais no padrão do varejo de alimentos no entorno de escolas em Recife, Brasil

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Abstract *This study aimed to describe the community food environment surrounding schools and its association with territorial socio-environmental vulnerability in the city with the highest intraurban social inequity index in Brazil. Methods: this ecological observational study includes data on the presence and type of food retail in a 400 m buffer surrounding public and private schools in Recife. We have also described the Health Vulnerability Index (HVI) of census tracts and conducted multivariate analyses. Results: through factor analysis, we observed two grouping patterns of food retail. The "diverse food outlets" pattern was positively associated with middle HVI (β 0.14, 95% confidence interval [CI] – 0.11; 0.16) and higher HVI areas (β 0.15, 95%CI – 0.11; 0.17), while "the large food retail chains" pattern was inversely associated with middle HVI (β -0.42, 95% CI – 0.53; -0.30) and high HVI areas (β -0.32, 95%CI – 0.45; -0.18) and positively associated with private schools (β 0.15, 95%CI – 0.030; 0.27). Conclusion: the greatest variety in food retail is in high HVI areas, and large food retail chains prevail around private schools, especially in low HVI areas.*

Key words *School food environment, Supermarkets, Child and adolescent health, Socioeconomic status*

Resumo *Este trabalho objetivou descrever o ambiente alimentar comunitário no entorno das escolas e sua associação com a vulnerabilidade socioambiental territorial na cidade com maior índice de desigualdade social intraurbana do Brasil. Métodos: estudo ecológico observacional, inclui dados sobre a presença e o tipo de varejo de alimentos em uma área de 400 m no entorno de escolas públicas e privadas de Recife. Descrevemos o Índice de Vulnerabilidade à Saúde (IVS) dos setores censitários e realizamos análises multivariadas. Resultados: por meio da análise fatorial, observamos dois padrões de agrupamento de estabelecimentos. O padrão "Diversos pontos de venda de alimentos" foi associado positivamente com IVS médio (β 0,14; intervalo de confiança [IC] 95% – 0,11; 0,16) e áreas de IVS mais alto (β 0,15; IC95% – 0,11; 0,17), enquanto o padrão "Grandes redes varejistas de alimentos" foi inversamente associado às áreas de IVS médio (β -0,42; IC95% – 0,53; -0,30) e alto IVS (β -0,32; IC95% – 0,45; -0,18) e positivamente associado com escolas particulares (β 0,15; IC95% – 0,030; 0,27). Conclusão: a maior variedade de estabelecimentos está em áreas de alto IVS, e grandes redes varejistas de alimentos predominam no entorno de escolas particulares, especialmente em áreas de baixo IVS.*

Palavras-chave *Ambiente alimentar escolar, Supermercados, Saúde da criança e do adolescente, Status socioeconômico*

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Introduction

The food environment can be characterized by the physical and perceived availability of food outside the home and access to it and represents the mediating scenario of food consumption[1,2], where the effects of the physical, constructed, and social context condition the individual's eating behavior and the health of the population[2-4]. The school food environment includes the spaces, infrastructure, information, and nutritional and commercial conditions, where food is available for obtention and consumption within and beyond the school[5,6]. In order to explore the external (static) dimension of the community food environment[7], it is necessary to comprehend the factors determining food retail in the territory shared by the population around schools, such as availability, density, quantity, accessibility, and location[8-10]. These aspects of food retail enable and encourage the school community to make food choices that contribute to a healthy or unhealthy diet[5].

Beyond the limits of location and permanence at home, the food environment becomes more complex when it includes commuting routes considering work, study, and leisure activities of individuals[11,12]. Of these, the school, on the community level, brings together social determinants of the individual outside the home in the food context[4,13-15]. Studies have investigated environmental characteristics of school surroundings in different countries such as Mexico[16] and the USA[17], for example, where the massive presence of street food vendors and kiosks was associated with excess weight among students. In Brazil, these studies are concentrated in the South and Southeast regions, and they identified a higher density of retail selling mostly foods of low nutritional value[8,18,19].

Some studies have also claimed possible social inequities in the structure of school and community food environments[3,9,17,20]. A cohort carried out in the Netherlands revealed that poor children were surrounded by more unhealthy food outlets over the years, in a fast process of deterioration of the neighborhood's food environment with repercussions in a slight increase in body mass index (BMI) only among socially vulnerable children after the introduction of fast-food restaurants[20]. Socioeconomic aspects of the school neighborhood[8,21,22] and the school's sector (public or private)[10,16,19,23] are associated with the quality of the school food environment[4,24,25].

Exposure to spaces filled with unhealthy food outlets in contexts of financial stress and lower maternal education may contribute to the deepening of health inequities by limiting the consumer's ability to handle an unhealthy food environment[13,20]. On the other hand, evidence specifically on the association between socioeconomic inequities and the school food environment is still unclear[4]. Therefore, this work aims to describe the food environment in the surroundings of public and private schools of the state capital with the highest intraurban social inequity index in Brazil, Recife, as well as its association with the socioeconomic and environmental vulnerability of the territory.

Methodology

Study design and characteristics

This is an ecological observational study performed with secondary data from preschools, elementary/middle schools, and/or high schools, as well as food retail and socioeconomic variables of the population of the city of Recife, state of Pernambuco, Brazil.

Study area

The study was carried out in the city of Recife, state capital of Pernambuco, with an estimated population of 1,537,704 inhabitants in 2020 and a demographic density of 7,039,64 inhabitants per square kilometer[26]. Recife is the Brazilian state capital with the highest intra-urban social inequality index, with a Gini coefficient of 0.612 (higher than the national coefficient), and is located in the state with the third highest income inequality in the country according to the Summary of Social Indicators 2020[27].

Variables

Outcome: food environment in school surroundings

For assessing the food environment, we used the 2019 database from the Pernambuco State Department of Finance. This database contained the following information: retail name, address, and National Classification of Economic Activities (CNAE) (available at: https://doi.org/10.48331/scielodata.J4JHY9). CNAE is an instrument developed by the National Classification Commission (CONCLA) that aims to characterize the economic activities performed by companies[28].

We included the following food retail: butcher shops, street vendors, bars, prepared meal delivery services, hypermarkets, grocery stores,

cafeterias, dairies, corner stores, minimarkets, bakeries, fish markets, restaurants, supermarkets, and food, beverage, and candy retailers.

Retails were georeferenced through the Geographic Information System (GIS) using addresses available in the database. The unit of analysis adopted in this study was the 400 m Euclidean buffer surrounding schools, corresponding to a possible daily path taken by students in 5-minute walks[29,30].

Exposures

School characteristics

Secondary data of public and private schools from all over Recife were collected from the National Institute for Educational Studies and Research "Anísio Teixeira" (INEP), referring to 2019. Schools were georeferenced using their addresses and the GIS.

Variables included in the analyses were: the school sector (public or private) and educational stage offered by the school (preschool only; elementary/middle school only; high school only; preschool and elementary/middle school; elementary/middle school and high school, or all stages).

Socioeconomic characteristics

The Health Vulnerability Index (HVI), a synthetic indicator, was used for categorizing census tracts according to socioeconomic and environmental deprivation variables[31]. The HVI was developed to represent life conditions of the population and has been applied as a proxy for socioeconomic vulnerability[32-34].

Indicators forming the HVI were selected according to their discriminatory power for spatial inequities in a way that, the higher their value, the higher the expected vulnerability. These are water supply; sanitation; solid waste management; ratio of residents per household; number of illiterate persons and per capita income of up to a minimum wage per household; average monthly nominal income of responsible individuals; and black, mixed-race, or indigenous residents[31]. All information was extracted from the 2010 demographic census[26] (last Brazilian census).

The enumeration area was used as the neighborhood unit, functioning as the minimal political-administrative unit used by IBGE for collecting statistical data of interest to the population[27]. This way, the food environment of school surroundings was defined from where the school was located and its respective enumeration area.

After calculating the HVI, each sector was classified according to the number of standard deviations (SD) from the overall mean, with a good index when presenting negative deviations, according to the following categorization: low risk – values lower than the mean HVI; middle risk – HVI values within 0.5 SD of the mean (mean ± 0.5 SD); high risk – values higher than the mean HVI[31].

Statistical analysis

For collecting school location data, we applied the addresses available at the INEP listing to the online Google Street View tool for obtaining geographic coordinates. Latitude and longitude values for each address were collected from the WGS84 Coordinate System and, by using the QGIS 2.10.1 software, transformed to the Universal Transverse Mercator (UTM) projected coordinate system, zone 23S, SIRGAS datum 2000.

School and HVI characteristics were described by means of absolute frequencies, and their associations were tested using the chi-squared test. Food retail types were analyzed by median values and interquartile ranges since they did not present normal distributions. Their associations with the covariables were verified through a Kruskal Wallis test and Dunnett's *post-hoc* test.

A choropleth map was constructed for presenting the distribution of grouping factors according to the buffers. In order to graphically demonstrate the distribution of food retail in the city of Recife, a Kernel density map was created. All maps were built with QGIS 2.14.9 software.

Starting from the presence of food retail within the buffer surrounding schools, we explored possible grouping patterns according to food retail type by using Principal Component Analysis (PCA). Firstly, we assessed the method's applicability through a Kaiser-Meyer-Olkin test (KMO > 7) and Bartlett's test of sphericity ($p < 0.05$). For identifying patterns to be retained, we used the Kaiser criterion, that is, eigen values greater than 1. We also analyzed the eigenvalue graph for each factor (scree plot) and the theoretical plausibility of factors themselves. With the aim of generating a pattern structure that would be more easily interpretable, we performed an orthogonal rotation by maximizing higher factor loadings and minimizing lower loadings via the Varimax method. The food retail pattern composition grouped components with the highest factor loadings. Food retail with factor loadings greater than 0.5 was retained in the matrix.

The generated factor scores were analyzed as a continuous variable. Multiple linear regression was employed for testing the association between the school sector, HVI, and grouping patterns of food retail, adjusting for the unit number within the buffer. In all association analyses, we considered a significance level of 5%. Statistical analyses were conducted using SPSS 15.0.

Results

Out of 1511 schools, four were excluded because they were not located within the Recife geographic field, 34 were excluded due to being an adult and vocational schools, 448 for stating that their activities were suspended, and 18 because they were in 15 sectors with no HVI information; altogether, the study was performed considering 1,007 schools.

The spatial distribution of schools per sector and the HVI of census tracts are represented in Figure 1. We verified a higher concentration of schools, of both private and public sectors, in more central areas of low and middle HVI, whereas less schools were verified in the outskirts to the North, West, and East of the city. In areas with high HVI, we verified a lower density of schools.

Table 1 shows that most schools were in areas with middle HVI (39.5%). These areas concentrated the high proportions of public and private schools: 38.9% and 40%, respectively. Those with low and middle HVI presented a higher proportion of private schools 40.4%. Moreover, in areas with low and middle HVI, we observed a higher availability of diverse educational stages, especially complete secondary education (high school and all stages).

Table 2 illustrates the food environment in school surroundings according to HVI, enumeration area, and school sector. Higher median numbers of total food retail, cafeterias, restaurants, bars, food retailers, and supermarkets were found around schools located in low HVI areas, while a higher median number of minimarkets, beverage shops, and street vendors was found in middle HVI sectors. Cafeterias, prepared meal delivery services, restaurants, and bars presented higher median values around private schools.

Table 3 describes the composition of patterns identified by the PCA. The assumption for conducting analyzes was satisfied (KMO = 0.939; Bartlett $p < 0.001$). Pattern 1 comprised a greater diversity of food retail (50.81% of explained variance). Food retail with higher factor loadings was prepared meal delivery services, beverage retailers, restaurants, cafeterias, bars, and minimarkets, but also included those who commercialized unprocessed or minimally processed foods for preparing meals, such as grocery stores, dairies, butcher shops, and fish markets. Pattern 1 was renamed as "diverse food outlets", referring to the diversity of traditional food retailers[35] at outlets[35,36]. Pattern 2 (explained variance of 9.34%) grouped food retail belonging to large retail corporations and transnational brands (super and hypermarkets and convenience stores) and was, therefore, identified as "large food retail chains"[35].

After adjusting for the density of food retail within the buffer, we verified that the diverse food outlets pattern was positively associated with middle (β 0.14, 95%CI 0.11; 0.16) and high HVI areas (β 0.15, 95%CI 0.11; 0.17) with a discrete linear trend, whereas the large food retail chains pattern was inversely associated with middle (β -0.42 95%CI -0.53; -0.30) and high HVI areas (β -0.32, 95%CI -0.45; -0.18) and positively associated with private schools (β 0.15, 95%CI 0.030; 0.27) (Table 4).

Discussion

This study revealed 2 different grouping patterns of food retail surrounding schools. One of them included diverse food outlets, mostly commercializing food for consumption after little or no preparation, which was associated with census tracts of high HVI. Meanwhile, the other pattern comprised stores belonging to large retail chains and was inversely associated with census tracts of higher HVI and positively associated with private schools.

Within the diverse food outlet pattern, the presence of a kind of establishment selling food for consumption after little or no preparation was related to the presence of similar food retail around schools. There appears to be a trend of accumulation of various food outlets in cities[36,37]. Although a diverse pattern may allow the physical availability of healthy and unhealthy foods, the ultra-processed food consumption pattern may prevail in a more vulnerable population since socioeconomic inequities may compromise their ability to handle an environment with healthy and unhealthy food options[4,13,20]. In Belo Horizonte[8] and Niterói[18], in the Southeast region of Brazil, cafeterias were the most frequent food outlets surrounding schools.

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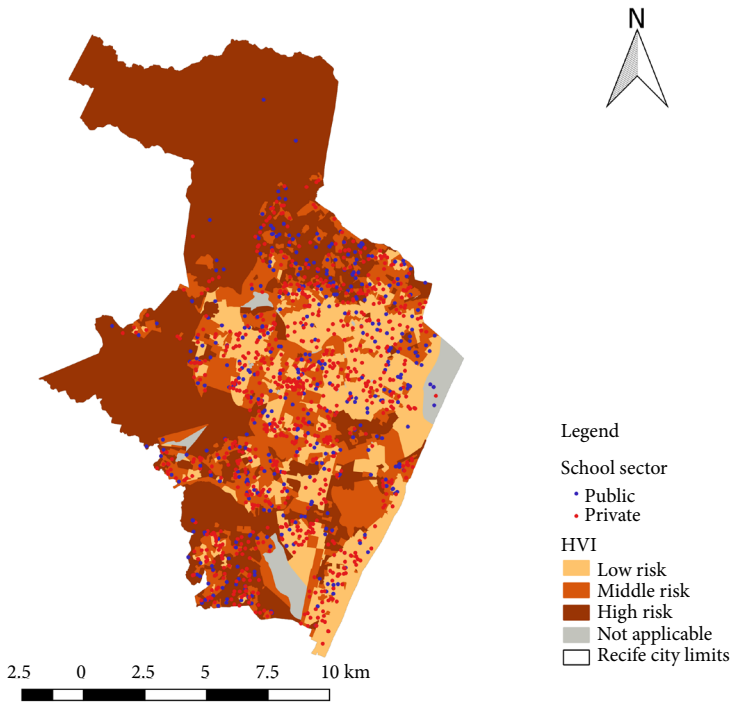

Figure 1. Spatial distribution of schools per sector and the HVI of census tracts.

Source: Authors.

Table 1. School characteristics (sector and educational stage)* according to the Health Vulnerability Index (HVI) of census tracts. Recife, 2019.

	Total		Low HVI		Middle HVI		High HVI		
	n	%	n	% (CI)	n	% (CI)	n	% (CI)	p-value
Total	1007	-	356	35.4	398	39.5	253	24.8	
Sector									
Public school	452	45	132	29.2 (25.0-33.3)	176	38.9(34.5-43.4)	144	31.9(27.5-36.1)	< 0.001
Private school	555	55	224	40.4 (36.3-44.4)	222	40.0(35.9-44.1)	109	19.6(16.3-23.9)	
Educational stage									
Preschool	190	18.9	59	31.1(24.4-37.6)	78	41.1(34.4-48.0)	53	27.9(21.5-34.2)	< 0.001
Elementary/middle school	170	16.9	54	31.8(24.7-38.7)	75	44.1(36.6-51.5)	41	24.1(17.7-30.5)	
High school	68	6.8	37	54.4(42.5-66.2)	22	32.4(21.2-43.4)	9	13.2(5.1-21.2)	
All stages	61	6.1	36	59.0(46.7-71.3)	19	31.1(19.5-42.8)	6	9.8(2.3-17.3)	
Preschool and elementary/ middle school	446	44.4	135	30.2(26.0-34.)	180	40.3(35.8-44.9)	131	29.4(25.1-33.6)	
Elementary/middle school and high school	69	6.9	33	47.8(36.0-59.6)	23	33.3(22.2-44.4)	13	18.8(10.0-28.0)	
Unspecified	3	0.3	2	66.7(0.1-1)	1	33.3 -	0	0.0 -	

*Sector is a dichotomous variable. Educational stage is a categorical variable. P-value for chi-square test.

Source: Authors.

Table 2. Food environment in school surroundings (400 m buffer) according to HVI and sector. Recife, 2019.

	Total		Low HVI		Middle HVI		High HVI			Public		Private		
	Median	IQR	Median	IQR	Median	IQR	Median	IQR	p-value*	Median	IQR	Median	IQR	p-value*
Cafeteria	13	12	16ab	11	13.5ac	11	9bc	8	< 0.001	12	11	15	12	< 0.001
Meal delivery	12	10	13a	9	13b	9	8ab	8	< 0.001	11	10	13	8	< 0.001
Restaurant	9	9	13ab	1	9ac	7	6bc	6	< 0.001	8	8	10	9	0.001
Beverage shop	8	7	8a	5	10ab	8	8b	8	< 0.001	8	7	9	8	0.189
Minimarket	8	9	5ab	6	10ac	8	8bc	9	< 0.001	8	9	8	9	0.688
Street vendor	8	7	8a	6	9ab	6	7b	7	< 0.001	8	6	8	7	0.354
Bar	7	7	8.5ab	7	6ac	6	4bc	5	< 0.001	6	7	7	6	< 0.001
Food retailer	5	5	6a	6	5b	5	4ab	4	< 0.001	5	5	5	5	0.008
Grocery store	2	3	2a	2	3a	3	2	3	0.017	2	2	2	3	0.001
Dairy	2	2	2a	2	2b	3	1ab	3	< 0.001	1	3	2	2	0.138
Bakery	2	2	2a	2	2b	2	1ab	2	< 0.001	1	2	2	2	0.032
Candy store	1	2	2	2	1	2	1	2	0.463	1	2	1	2	0.277
Butcher shop	1	2	1	2	1a	2	1a	2	0.009	1	2	1	2	0.431
Fish market	0	1	0a	1	1b	1	0ab	1	< 0.001	0	1	0	1	0.052
Supermarket	0	0	1ab	1	0a	1	0b	1	< 0.001	0	1	0	1	0.019
Hypermarket	0	0	0ab	0	0b	0	0a	0	< 0.001	0	0	0	0	0.635
Corner store	0	0	0ab	0	0a	0	0b	0	< 0.001	0	0	0	0	0.100
Total	85	53	90.5a	48b	90	57	65ab	48.5	< 0.001	80	59	89	47.7	0.001

IQR: interquartile range. * Kruskal Wallis test (Dunnett's post-hoc test). abc: same letters denote statistically significant difference between the groups.

Source: Authors.

Table 3. Grouping patterns of the identified food retailers. Recife, 2019.

	Factor loading	
	Diverse food outlets	Large food retail chains
Meal delivery	.923	
Beverage retailer	.916	
Restaurant	.888	
Cafeteria	.880	
Bar	.880	
Minimarket	.871	
Food retailer	.859	
Grocery store	.857	
Dairy	.830	
Street vendor	.827	
Bakery	.821	
Butcher shop	.629	
Fish market	.567	
Hypermarket		.650
Supermarket		.646
Candy retailer	.509	.523
Corner store		.390
Explained variance (%)	50.81	9.34

Source: Authors.

In our study, this pattern was associated with census tracts of higher socio-environmental vulnerability (high HVI). This food outlet pattern including street vendors, cafeterias, and kiosks has been described as prevalent around schools and representative of the sale of unhealthy foods in this environment[8,16,17]. This was also observed in Madrid[9], where the diversity of unhealthy food outlets in a 400 m buffer surrounding schools revealed that less favored areas had 62.0% more unhealthy food outlets around schools than more favored areas. This is concerning because, among adolescents of low socioeconomic status, the presence of cafeterias surrounding the school demonstrates an association with the accumulation of irregular eating habits and excess weight[17,22].

Considering the second identified pattern (large food retail chains), although these retailers have a wide variety of foods, they have been shown to be large enterprises of massive ultra-processed food supply[9,17,35]. The diversity of products within sole food retail does not result in the preference for healthy foods: A study indicates that 60.4% of the energy content of foods purchased in this food retail comes from ultra-processed items[37]. This pattern was more

Table 4. Multiple linear regressions* for the associations between school sector, HVI, and grouping patterns of food retailers. Recife, 2019.

	Diverse food outlets			Large food retail chains		
	Beta	**95%CI**	**p-value**	**Beta**	**95%CI**	**p-value**
HVI						
Low risk	-		< 0.001	-		< 0.001
Average risk	**0.14**	0.11; 0.16		**-0.42**	- 0.53; -0.30	
High risk	**0.15**	0.11; 0.17		**-0.32**	- 0.45; -0.18	
Sector						
Public school	-		0.102	-		
Private school	-0.02	-0.04; 0.01		**0.15**	0.030; 0.27	< 0.015

* Adjusted for the number of establishments in the buffer. 95%CI: 95% confidence interval. HVI is a categorical variable. Sector is a dichotomous variable.

Source: Authors.

present around private schools and less present in areas of higher socio-environmental vulnerability (middle and high HVI). The "large food retail chains" pattern is a symbol of the nutrition transition and represents the inclusion of ultra-processed foods in the diet of the population[17,35]. Other studies corroborate our findings, researchers have described higher concentrations of large food retail chains in areas of lower socioeconomic vulnerability[38,39], as well as high consumption of ultra-processed foods among Brazilian students at private schools, with higher chances of purchasing snacks at the school cafeteria or surrounding retail[40].

In Brazil, the technical study of mapping food deserts[41] established a typology, according to the predominance of acquisition of unprocessed, ultra-processed, or mixed foods, attributed to food retailing depending on regional aspects such as the level of development and food culture. According to this classification[41] for the territory we studied, food retailers of the Diverse food outlets pattern represent establishments of different nature that sell food for immediate consumption or little preparation, predominantly unprocessed and mixed foods, although only in cafeterias and bars, ultra-processed products predominate. While in the Large food retail chains pattern, mixed and ultra-processed foods predominate, in addition to maintaining a commercial profile strongly committed to the dissemination of the consumption of ultra-processed foods[17,19,35,39].

In agreement with reports by studies performed in the South[38] and Southeast regions of Brazil[8,32,42,43], our results indicate that large supermarket chains aim to provide for the richest population in Recife, in the Northeast region, and their location in socioeconomically privileged regions and near private schools may be intentional. Being more present around private schools, hypermarkets do not represent an advantage for students because they promote an obesogenic food environment through their predominantly ultra-processed product profile[24].

In this same social stratum of supermarket target consumers, we find the highest prevalence of excess weight in children of the Northeast region, with lower percentage values than the South region[44-46]. This higher prevalence is found among students with higher family incomes[47] when compared to those with less access to goods and services in the Northeast region of Brazil. However, nutritional implications to students from more favored areas are frequently described under the light of the ostensive supply of ultra-processed foods among a wide variety of foods available at super and hypermarkets[24]. Meanwhile, for students from high HVI areas, the social inequity component determines that they will be exposed to a higher density of food retail but with scarce diversity and unhealthy options in each of the various retailers in the neighborhood[9,20,22].

Limitations and potentialities

Some limitations of this work should be mentioned, such as the control of confounding variables when conducting an ecological study, which prevents the analysis of each individual within the studied universe. For minimizing errors, we chose the city territory as the unit of analysis in order to obtain variable homogeneity associated with the determination of environments. The use

of secondary data for assessing socio-environmental vulnerability and geographically locating schools and food retail may lead to imprecise or outdated information. For reducing interferences of data temporality, we used the most recently available demographic and school census. Due to the absence of a budget for updating the decennial census, the 2010 edition remained the most recent. To reliably assess the data, we also checked the coordinates virtually. Another limitation in measuring the food environment is related to the special restriction imposed by choosing the Euclidean buffer, although this boundary delimitation technique is frequently adopted for analyzing the community food environment around schools[8,14,29,30].

Nevertheless, we proposed an innovative analysis for studying the community food environment when compared to analyses that are primarily based on food processing levels[37,48] and the classification of food retail regarding the health benefits of the commercialized products[8,32,38]. Through factor analysis, we first analyzed not only the occurrence of food commercialization of some kind but of commercial retail and how they interact with each other within the territorial distribution. This allowed the analysis of components that are effectively implicated in the correlation between food retail patterns and how the presence of a store may attract or repel other stores. Although the PCA-derived variable for the second pattern represents less than 10% of the variation at points of sale compared to 50% for the result of different exits and implies a lower strength indicative of a linear trend. Factor analysis as an analytic axis of this study is justified by the thesis that commercialization happens according to the consumption demand and consumer profile, but also to the characteristics of competitors in the area[36,39,49].

Implications to school health

The results of this research demonstrate that the types and grouping patterns of food retail surrounding schools are associated with the sector (public or private) of schools nearby and the socioeconomic characteristics of the enumeration area. After observing these associations and probable impacts on the pattern of food purchase and consumption by the school community, we suggest that laws and public policies considering food outlets within schools should be extended to the school surroundings. This would also expand the positive impacts already observed after the regulation of cafeterias and dining halls[50,51] that collaborate with the construction of food environments with restricted exposure to abusive marketing[52] and ultra-processed foods.

Considering the purchase of food and beverages as an exercise of autonomy by schoolchildren that allows a certain escape from the control exercised by adults (guardians and school)[13], interventions that lend themselves to changing the context of decision-making, through regulation of local commerce, for example, tend to be more effective when reaching society widely[53] and not just the internal territory of schools. It should be kept in mind that regulating food retail in school surroundings is a more complex matter than doing so with school cafeterias and dining halls, considering that neighboring retail provides food for the population and not exclusively for the school community. On a local level, restrictions to ultra-processed food marketing aimed at children with ludic characteristics; incentives to the supply of unprocessed or minimally processed foods through attractive product placement and favorable prices for socio-environmentally vulnerable populations; and a responsive relationship between actions that promote healthy eating within schools and the external environment where students navigate are initial actions that may favor a healthier food environment for students.

Conclusions

This study described the community food environment surrounding private and public schools and its association with socio-environmental vulnerability conditions. Our main result revealed a higher diversity of food retail in areas of higher vulnerability, whereas the presence of large chain stores predominated in census tracts of less vulnerable, mainly surrounding private schools. Based on these findings, the coexistence of food retailers around schools is configured not only by commercial relations but in association with the social and economic aspects of the community that shares a certain territory. Future research should advance from the NOVA classification of foods to explore the types of retail grouped in the same neighborhood. Understanding the commercial scenario should enable the promotion of education for realistic practice of better food choices, whether in the diversity of foods or of the retailers, for the various social groups distributed throughout the city.

Collaborations

SGF Clark contributed to study conceptualization, curation and data analysis, writing, and review. LL Mendes, OS Honório and JS Oliveira contributed to the writing and review of the study. R. Canuto contributed with study conceptualization, methodology, curation and data analysis, and review.

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