

Aspects of the built environment associated with obesity in children and adolescents: A narrative review

Aspectos do ambiente construído associados à obesidade em crianças e adolescentes: revisão narrativa

Elizabeth Nappi CORRÊA¹
Bethsáida de Abreu Soares SCHMITZ²
Francisco de Assis Guedes de VASCONCELOS¹

ABSTRACT

Objective

To perform a narrative literature review to describe the availability of food retailers (groceries and eateries) and their association with obesity in schoolchildren and adolescents.

Methods

The review included studies published from 2003 to 2013 listed in three databases with data on the child's school and/or home surroundings.

Results

There was a higher concentration of fast foods near the schools, especially high schools, public schools, or schools located in low-income regions. Moreover, children and adolescents living in areas further from convenience stores had better diets.

Conclusion

Acknowledging the relationship between built environment and obesity by establishing scientific evidence is necessary for developing specific strategies that help to control the spread of obesity in this age group, aiming to construct healthier spaces.

Keywords: Built environment. Child. Obesity.

¹ Universidade Federal de Santa Catarina, Departamento de Nutrição, Programa de Pós-Graduação em Nutrição. Campus Universitário, Sala 207, Caixa Postal 476, Trindade, 88040-900, Florianópolis, SC, Brasil. *Correspondência para/*Correspondence to: EN CORRÊA. E-mail: <nutrinappi@bol.com.br>.

² Universidade de Brasília, Faculdade de Ciências da Saúde, Departamento de Nutrição. Brasília, DF, Brasil.

RESUMO

Objetivo

Realizar revisão narrativa da literatura, procurando descrever as características da disponibilidade de locais de comercialização de alimentos (pontos de venda de alimentos e pontos de alimentação) e sua associação com obesidade entre crianças em idade escolar e adolescentes.

Métodos

Foram identificados os estudos publicados entre 2003 e 2013 em três diferentes bases de dados que apresentaram resultados relacionados ao ambiente no entorno escolar e/ou residencial de crianças e adolescentes.

Resultados

No entorno das escolas, encontrou-se maior concentração de estabelecimentos do tipo fast food, em especial nas escolas de ensino médio, públicas ou localizadas em regiões de menor poder aquisitivo. Também foi identificado que crianças e adolescentes que residem em áreas mais distantes de lojas de conveniências apresentam dieta de melhor qualidade.

Conclusão

O reconhecimento da relação entre ambiente construído e obesidade, por meio do estabelecimento de evidências científicas, é necessário para a elaboração de estratégias diferenciadas que contribuam para o controle do crescimento da obesidade nesse grupo etário, com um novo olhar para a construção de espaços mais saudáveis.

Palavras-chave: Ambiente construído. Criança. Obesidade.

INTRODUCTION

The risk of obesity is not randomly distributed in the population. Some individuals or groups are more vulnerable to obesity than others. The reasons behind this inequality are not yet fully known, but they can stem from a combination of biological, cultural, and environmental factors¹. The role of environmental factors in individuals' food behavior and intake, and consequently, in their nutritional status, has been the object of various studies²⁻⁷. Neighborhoods with specific environmental characteristics are related to different health-related behaviors of children and adolescents and to their Body Mass Index (BMI)⁸⁻¹³.

According to Brug *et al.*⁵, environmental influences can be analyzed from two dimensions: 1) one related to the access to foods consumed at home or family environment (bought at groceries, supermarkets, bakeries, farmer's markets, butcheries, and other retailers) and 2) one related to the access to ready-to-eat foods consumed away from home (restaurants, snack bars, canteens, street food vendors). In this article,

Food Outlet (FO) refers to food retailers that sell foods prepared at home, and Food Service (FS) refers to establishments that sell ready-to-eat foods consumed away from home (including street food vendors).

The existence of food service and food outlet in a neighborhood can influence nutritional status^{3,6,7,10}. In a narrative review Brug *et al.*⁵ systematically reviewed six articles from high-income countries about the environment and health behavior and found that the availability and access to healthy foods are important factors that influence the food behavior of children, adolescents, and adults⁵. However, these authors believe that studies using objective and validated instruments are needed to investigate more thoroughly the associations between food behaviors and environmental opportunities⁵.

An environment with good availability of nutritious foods nearby is necessary for children and adolescents to adopt healthy eating behaviors⁴. In this sense, investigations involving children and adolescents should be comprehensive and include their work, leisure¹⁴, home, and school¹⁵ neighborhoods.

Given the importance of the theme and the scarcity of pertinent Brazilian studies, the objective of this article was to make a narrative literature review to describe the availability of food retailers (groceries and eateries) and their association with schoolchild and adolescent obesity. The following questions were posed to guide the discussion and describe the characteristics of the studies: How does the environment influence child and adolescent food intake? What methodological procedures were used by studies on environmental influence? Which environmental characteristics in the home and school neighborhoods are associated with child and adolescent food intake and obesity?

METHODS

The following databases were not systematically searched for articles published between 2003 and 2013: SciVerse Scopus, Pubmed, and the virtual health library Bireme.

Descriptor selection relied on the official terms listed in the Medical Subject Headings (MeSH) and the non-indexed terms most often cited in publications about the environment and its relationship with obesity. The following structuring was used for combining the descriptors: (built environment OR residence characteristics OR social environment) AND (child OR adolescen OR students) AND (obesity OR childhood obesity) AND (food OR nutrition). The search tools available in each database required variations in this combination.

As an additional criterion, we also searched for the references cited in the initially selected articles, a technique called "snowball." This was due to the vast amount of descriptors used in publications on this theme and not indexed by MeSH, hindering the combination of terms for the systematic search. Some examples of not indexed descriptors found in the publications are: food environment, school environment, neighborhood, neighborhood environment, environmental health, obesogenic

environments, environmental assessment, local food environmental. Publications with the following descriptors were also found: food outlet, foodscape, convenience store, supermarket, retail food outlets.

The articles were screened by reading their title and abstract. Studies with preschoolers or adults and those that covered only aspects related to commuting, physical activity, and/or environmental recreation were excluded. After excluding the repeated articles from different databases, 90 studies in English and Portuguese were selected, but only 28% were original research articles analyzed in this study.

The narrative review was used for exposing the results: data were presented in summary tables and the main findings relating the characteristics of the built environment (FO and FS) in school and home neighborhoods in the discussion.

The tables contain the selected articles' authors/publication year, the study objective and environment, the variables, and the main results in chronological order.

Influence of the built environment on the food intake and behavior of children and adolescents

An individual's environment may promote or inhibit the adoption of obesity-related life practices¹⁶. Despite the existence of indicators that environmental factors can influence energy intake and expenditure, and consequently, BMI, there is no empirical evidence of the relationship between environmental exposures and obesity¹⁷.

Studies of the relationship between environment and nutrition are becoming increasingly frequent, especially those with children and adolescents⁵. Pieces of evidence suggest that obesity can be influenced by the built environment¹⁸, represented by work and group living conditions, and this environment is a key determinant of food intake opportunities and

restrictions¹⁹. Environmental opportunities and conditions that encourage life habits that promote the development of obesity¹⁶ can be called an obesogenic environment²⁰.

This environment is characterized by great availability and access to energy-dense foods, great social pressure for consuming these foods, in addition to opportunities to minimize physically active behavior at work, commuting, or leisure time⁵. The relationship between these environmental factors and obesity has been analyzed, but understanding of the individual and environmental mechanisms that produce it still needs improvement²¹.

Urbanization-related environmental changes promote more opportunities for increasing food intake since they facilitate food acquisition and make foods more attractive to an increasing number of consumers. People now consume more foods of different types²², so it is important to distinguish the location and type of purchased food²³.

Most studies in this area are cross sectional, necessary for understanding how environmental factors relate to the population's demographic characteristics and health-related results⁸. Environmental description helps to identify the availability of healthy foods and intervention points for improving population access¹⁴. However, in these studies it is difficult to establish causality and directionality between the variables and outcome²⁴.

Although many studies have focused on analyzing the home neighborhood, the numerous FO and FS near urban schools suggest that not only the home, but also the school neighborhood, should be included in more comprehensive assessments of child and adolescent exposure²⁵.

Fifty-two percent of the selected articles involving schoolchildren and adolescents directly or indirectly assessed the school neighborhood (Chart 1); the home neighborhood was investigated by 24% of the studies (Chart 2); and

six studies (24%) assessed both the home and school neighborhoods (Chart 3).

Fifty-two percent of the selected studies were conducted in the United States of America (USA), and a similar proportion was identified in other publications^{14,26}. Six studies (24%) were conducted in Europe, four (16%) in Canada, and only one in Latin America (Brazil). This prevalence of American studies reflects the need to increase the number of such studies in other countries and hinders extrapolation of the findings to other populations.

Studies on the relationship between the environment and food intake and/or nutritional status of children and adolescents have received greater emphasis after the first decade of the XXI century, as reflected by this review, with 80% of the studies having been published in or after 2010.

Methodological procedures used in the studies on home and school neighborhood characteristics

The variety of methodological procedures used in the study articles shows the difficulty of selecting a gold standard for environmental assessment. A well accepted methodological option is the identification of FO and FS by conducting a walking survey using the Global Positioning System (GPS). However, this collection systematics and database construction is very expensive and lengthy⁴⁷. This is clear in 25 of the selected studies, where only 16%^{10,34,35,40} used field recognition for identifying the FO and FS; the other studies preferred to work with secondary data.

Despite the limitations associated with using secondary data, this type of methodological procedure can and has been used frequently. Secondary data are collected from external sources and include administrative data (census), commercial data (market survey companies), internet resources (Google Earth and Google

Chart 1. Studies that assessed the availability of food retailers (groceries and eateries) in school surroundings.

Authors/year	Study objective	Study environment	Study variables	Main results
Austin <i>et al.</i> (2005) ²⁷	1,292 schools in Chicago (USA)	Buffer of 0.4 and 0.8 km	Presence of fast food restaurants (secondary data).	- Mean distance between school and fast food restaurant: 0.52 km. - 78% of the schools had at least one fast food restaurant in the 0.8 km buffer.
Simon <i>et al.</i> (2008) ²⁸	1,684 schools in Los Angeles (USA)	Buffer of 0.4 and 0.8 km	Presence of fast food restaurants (secondary data).	- 23.3 and 64.8% of the schools had one or more fast food restaurants in the 0.4 km and 0.8 km buffers, respectively.
Sturm (2008) ²⁹	31,622 schools in the USA	Buffer of 0.4 and 0.8 km	Food retailers (secondary data).	- High schools had fewer food retailers nearby than elementary schools. - Larger schools had fewer food retailers nearby than smaller schools.
Day & Pearce (2011) ³⁰	406 schools in New Zealand	Buffer of 0.4, 0.8, and 1.5 km	Presence of fast food restaurants and convenience stores (secondary data).	- Elementary and middle schools had 19.3 food retailers <i>per</i> 1,000 students and high schools had 6.6 retailers <i>per</i> 1,000 students in the buffer.
Kestens & Daniel (2010) ³¹	1,168 schools in Montreal (Canada)	Buffer of 0.75 km	Presence of fast food restaurants and produce retailers (secondary data).	- The number of food retailers in the school surroundings was inversely related to the neighborhood income.
Kwate & Loh (2010) ³²	2,096 schools in New York (USA)	Buffer of 0.4 km	Presence and concentration of fast food restaurants (secondary data).	- 25% had a fast food restaurant in the 0.4 km buffer. - High schools had more grouped fast food restaurants than elementary schools. - Public schools had more grouped fast food restaurants in their surroundings.
Gebauer & Laska (2011) ³³	25 schools in Minnesota (USA)	Buffer of 0.8 km	Presence of convenience stores and types of food (secondary data).	- Low availability of healthy beverages and snacks. - Fresh fruits and vegetables available in 51 and 49% of the stores, respectively.
Harris <i>et al.</i> (2011) ³⁴	522 high school students from 11 schools in Maine (USA)	Buffer of 2 km	Presence of food retailers; (walking survey) Nutritional status (BMI); Food intake.	- Ten schools had \geq one store selling soda and eight schools had \geq one fast food restaurant in the 1 km buffer. - Store proximity to school or density in school surroundings was not related to risk of obesity in students.
Leite <i>et al.</i> (2012) ³⁵	3 schools in Santos (São Paulo)	Buffer of 0.5 km	Presence of groceries and food processing (walking survey).	- Ultraprocessed foods closer to schools. - Ultraprocessed foods were more common in low-income areas than minimally processed foods.
Black & Day (2012) ³⁶	1,392 public schools in Canada	Buffer of 0.8 km	Grocery and eatery presence and distance (secondary data).	- Presence of at least one food retailer in the 0.8 km buffer. Larger schools >exposed to food retailers. - Schools in low-income neighborhoods had more access to food retailers.
Ellaway <i>et al.</i> (2012) ³⁷	29 schools in Glasgow (Scotland)	Buffer of 0.4 and 0.8 km	Presence of groceries and eateries (secondary data).	- An average of 35 food retailers within a 0.8 km high school buffer.
Seliske <i>et al.</i> (2013) ³⁸	6,971 students aged 13-16 years from 158 schools in Canada	Buffer of 1 km	Presence of cafés, fast food restaurants and convenience stores (secondary data).	- Students attending schools near eateries were more likely to eat at these establishments than those attending schools without nearby eateries.
Smith <i>et al.</i> (2013) ³⁹	1,382 students aged 15-16 years from 29 schools in London	Buffer 0.4 and 0.8 km	Presence of groceries (in 2001 and 2005); (secondary data) Food intake during two data collection periods.	- Food deliveries and groceries in the 0.4 km buffer increased from 2001 to 2005. Positive relationship between diet quality (healthy) and distance between school and groceries.

Note: BMI: Body Mass Index; USA: United States of America.

Chart 2. Studies that assessed the availability of food retailers (groceries and eateries) in the home surroundings of schoolchildren and adolescents.

Authors/year	Study objective	Study environment	Study variables	Main results
Jago <i>et al.</i> (2007) ⁹	204 scouts aged 10 to 14 years from Texas (USA)	Buffer of 1.6 km	<ul style="list-style-type: none"> - Distance from small food retailers and fast food restaurants; (secondary data). - Intake of fruits and vegetables. - Nutritional status (BMI). 	<ul style="list-style-type: none"> - Association between living further from convenience stores ↑ intake of fruits and juices ↓ intake of vegetable fat. - Living close to a fast food restaurant was associated with higher intake of vegetable fat, fruits, and juices.
Galvez <i>et al.</i> (2009) ¹⁰	323 children aged 6 to 8 years from New York (USA)	Postal code of the students' homes	<ul style="list-style-type: none"> - Presence of groceries and eateries; (walking survey). - Nutritional status (BMI). 	<ul style="list-style-type: none"> - Convenience stores and fast food restaurants present in 55 and 41% of the blocks (postal code). - Children living in blocks with one or more convenience stores were more likely to have higher BMI than those who did not live in such blocks.
Skidmore <i>et al.</i> (2010) ⁴⁰	1,721 students aged 9 to 10 years from 92 schools in Norfolk (England)	Buffer of 0.8 km	<ul style="list-style-type: none"> - Presence and density of groceries; (walking survey). - Food intake. 	<ul style="list-style-type: none"> - Living further from a supermarket was associated with >weekly fruit and vegetable servings. - Living closer to convenience stores >intake of potato chips, chocolate, and white bread. - Supermarket density was associated with higher intake of vegetables and unhealthy foods.
Leung <i>et al.</i> (2011) ¹¹	353 girls aged 6 to 7 years from California (USA)	Buffer of 0.4 and 1.6 km	<ul style="list-style-type: none"> - Presence of food retailers on two occasions (2005 and 2008); (secondary data). - Nutritional status (BMI). 	<ul style="list-style-type: none"> - Availability of convenience stores was associated with higher risk of overweight/obesity and higher BMI (buffer of 0.4 km). - Presence of fresh produce inversely associated with overweight/obesity (buffer of 1.6 km). - Significant trend between the availability of fresh produce retailers and lower risk of overweight/obesity after a three-year study.
Jilcott <i>et al.</i> (2011) ⁴¹	744 patients aged 8-18 years from North Carolina (USA)	Buffer of 0.4, 0.8, 1.6, and 8 km	<ul style="list-style-type: none"> - Proximity to groceries and eateries; (secondary data). - Nutritional status (BMI). 	<ul style="list-style-type: none"> - Negative associations between BMI and farmers' markets coverage (buffer of 0.4 and 0.8 km). - Positive association between BMI and fast food restaurant and pizzeria coverage (buffer of 0.4 km). - Proximity to convenience stores was negatively associated with BMI. Proximity to farmers' markets was positively associated with BMI percentile.
Wall <i>et al.</i> (2012) ¹²	2,682 teenagers (mean age 14.5 years) from 20 schools in Minnesota (USA)	Buffer of 0.4, 0.8, 1.2, and 1.6 km	<ul style="list-style-type: none"> - Presence of food retailers; (secondary data). - Nutritional status (BMI). 	<ul style="list-style-type: none"> - Homes close to convenience stores and restaurants was associated with higher BMI in girls.

Note: BMI: Body Mass Index; USA: United States of America.

Street View), and telephone directories (listing commercial and nongovernmental companies)⁴⁸.

The use of an omnidirectional image, for example, Google Street View, provides a permanent visual

record of an area and allows observing many characteristics of the built environment; however, the temporal relationship between image captures and outcome assessment in the studies can be a problem⁴⁹.

The use of a single source to identify FO and FS is a limited option; the use of different sources reduces the risk of 'losing' information and provides a more viable alternative than a walking survey in many situations^{50,51}.

Chart 3. Studies that assessed the availability of food retailers (groceries and eateries) in the home and school surroundings of children and adolescents.

Authors/year	Study objective	Study environment	Study variables	Main results
Laska <i>et al.</i> (2010) ⁴²	349 teenagers aged 11 to 18 years from Minnesota (USA)	Buffer of 0.8, 1.6, and 3 km	- Presence of food retailers; (secondary data). - Food intake. - Nutritional status (BMI).	- Intake of beverages with added sugar was associated with home proximity to fast food restaurants, restaurants, convenience stores, supermarkets, and other groceries within a 0.8 and/or 1.6 km buffer. - BMI positively associated with the presence of a convenience store within a 1.6 km buffer.
Harrison <i>et al.</i> (2011) ⁴³	1,995 students aged 9 to 10 years from 92 schools in Norfolk (United Kingdom)	Buffer of 0.8 km	- Access to groceries; (secondary data). - Nutritional status (fat mass index).	- Among girls, homes closer to healthy food retailers (supermarkets and groceries) was associated with lower fat mass index; and homes and schools closer to unhealthy food retailers (deliveries and convenience stores) was associated with higher fat mass index.
An & Sturm (2012) ⁴⁴	8,226 children aged 5 to 11 years and 5,236 teenagers aged 12 to 17 years from California (USA)	Buffer of 0.15, 0.8, 1.6, and 2.4 km	Presence of groceries (convenience stores and supermarkets) and eateries (fast food restaurants); (secondary data). - Food intake.	- No relationship found between the environment (presence and density of eateries and groceries) and food intake.
He <i>et al.</i> (2012a) ⁴⁵	810 students aged 11 to 14 years from 21 schools in Ontario (Canada)	Buffer of 1 km	Presence of fast food restaurants, convenience stores, and supermarkets; (secondary data). - Food intake.	- Students living further than 1 km from the closest convenience store had higher healthy diet indices. - Students attending schools further than 1 km from convenience stores and fast food restaurants had higher healthy diet indices.
He <i>et al.</i> (2012b) ⁴⁶	810 students aged 11 to 13 years from 21 schools in London (England)	Buffer of 1 km	- Presence of fast food restaurants and convenience stores; (secondary data). - Purchasing behavior.	- 65% reported buying foods at fast food restaurants and convenience stores. - Proximity to such stores increased the probability of buying their products at least once a week. - High density of fast food restaurants in the home and school surroundings was associated with more fast food purchases.
Buck <i>et al.</i> (2013) ¹³	384 students aged 6 to 9 years and German schools	Buffer of 1.5 km	- Presence of groceries and eateries-Sales of unhealthy foods; (secondary data). - Food intake. - Nutritional status (BMI).	- Groceries and fast food restaurants were not significantly grouped around schools. - The food retail index was not associated with BMI or food intake variables.

Note: BMI: Body Mass Index; USA: United States of America.

Another observation regarding the methodological procedures used in the studies is the amount of assessed individuals and/or schools. Studies that investigated the presence of FO and FS in school neighborhoods included different numbers of schools, varying from three³⁵ to 31,622 schools²⁹. The same occurred with the number of children and/or adolescents included in the studies, varying from 204⁹ to 13,562 students⁴⁴. This sample size variability can be a reflection of the different methodologies used in the studies, a fact that hinders comparisons between studies.

Different buffers (influence areas) are considered in environmental investigations. They correspond to the construction of zones with specific radii around specific points. Studies that assessed school surroundings most commonly used buffers of 0.4 km (54%) and 0.8 km (62%). Studies that assessed both school and home surroundings varied greatly with respect to the analyzed areas, which varied from 0.15 km to 3 km. Again, the methodological variability of the studies, especially the size of the analyzed areas, impairs direct comparisons between the studies.

The appropriate buffer may vary with age group, population composition, and study objective¹⁵. To consider an area close to home or school, it is interesting to make inferences regarding the distance and time walking. On average it takes an adult five minutes to walk 0.4 km²⁷, and an adolescent, walking quickly, fifteen minutes to walk 1.6 km¹². In case of children, one must consider the restrictions associated with walking in a given area and the types of resources available in the neighborhood⁵².

The use of very large buffers can mask variations within areas¹⁵ and the use of very small buffers can leave out important information regarding the type and presence of FO and FS in the students' home and school surroundings.

In addition to buffers, the neighborhoods or territories delimited by a postal code can also be used as a unit of analysis in environmental studies. Neighborhoods (or more broadly,

residential areas) have been used in health studies because of the routine data availability (such as census data) that can be used to characterize the neighborhood⁵³. When defining these neighborhoods, researchers take into account their area, the specific local history or culture, the natural boundaries, and/or the manmade boundaries⁵⁴.

In the present study none of the reviewed articles considered neighborhoods as a unit of analysis, which is positive because the area that someone considers a neighborhood may not correspond to the neighborhood established by the city⁵³. Resident perception of neighborhood boundaries, important to assess the social interactions in the environment, is an option to investigate the areas of influence of the environment on the individual⁵⁴.

Characteristics of the school surroundings, food intake, and obesity in children and adolescents

Few studies have assessed environments outside of the home neighborhood; however, many activities and food intake occur in work and school surroundings⁵². Despite the few studies on child movement within a territory, the general focus is school commuting. Decreasing distance between home and school⁵⁵ and increasing population density and infrastructure⁵⁶ increases physically active commuting (walking or bicycling), which also increases the child's exposure to environmental influences⁵⁷. Student exposure to food retailers can vary depending on the location of these establishments in the home-school path⁵⁸.

In the reviewed articles (Chart 1), public schools or schools located in low-income neighborhoods had more FO in their surroundings^{31,36}. Public schools also had more fast food restaurants in their surroundings³².

Individuals are not randomly distributed in the neighborhoods. In reality they are located in

neighborhoods according to their income, lifestyle, health conditions, work proximity, and predisposition towards certain behaviors^{24,59}. In economically or socially disadvantaged neighborhoods, inappropriate access to healthy foods has a negative impact on diet quality, possibly because of limited access to stores that sell healthy foods at reasonable prices^{60,61}. Carrol-Scott *et al.*⁸ studied fifth and sixth graders in Connecticut (USA) and found that the concentration of wealth in the neighborhood promoted the intake of healthy foods and inhibited the intake of unhealthy foods.

Poor people pay more for food because companies find it more risky to their assets and personnel to operate in low-income communities, so they increase their prices to compensate for this situation². This factor may be related to food deserts.

There is no consensus regarding the term food desert, but the term has been employed to designate areas with limited access to supermarkets and other food retailers¹. Another approach defines food desert as areas with very limited access to nutritious foods⁴.

It is important to consider the difference in the profile of FO and FS in the proximity of elementary (children) and high (adolescents) schools. Children may have less autonomy in their food choices⁶². However, when they grow and become adolescents, they gain more autonomy to choose their lifestyle³, and become fully autonomous to make food choices⁶³.

This adolescent territorial autonomy may explain the higher number of fast food restaurants near high schools³². Buck *et al.*¹³ did not find a significant number of fast food restaurants near elementary schools, which are frequented by younger students. However, FO related results are contradictory, with studies finding more³⁷ or fewer^{29,30} establishments near high schools than elementary schools.

Changes in youth's eating behavior are commonly attributed to environmental

characteristics, which encourage excessive calorie intake⁶⁴; the types of food sold near schools have also been investigated. Fruits and vegetables are more scarce³³ than soda and fast foods³⁴. Austin *et al.*²⁷ assessed school surroundings in Chicago and found that almost 80% had at least one fast food restaurant in the 800 m buffer.

Students attending schools further from fast food restaurants, convenience stores⁴⁵, and groceries³⁹ had healthier diets. In Canada a positive relationship was found between the distance of a fast food restaurant from a school and consumption of fast foods by the students⁴⁶. Also in Canada students attending schools with eateries in their surroundings tend to eat between classes in these establishments³⁸ instead of consuming school meals. In the United Kingdom (UK) easier access to convenience stores resulted in higher student Fat Mass Indices (FMI)⁴³, a potential indicator of body fat.

Most of these studies (Chart 1 and Chart 3) were conducted in the USA and UK, where the distribution and cost of meals in fast food restaurants make them accessible to most people, which is not true in Brazil. Additionally, associations between the environment and food intake/nutritional status found in metropolitan areas cannot be generalized. The results and interventions must be understood and adapted to the local reality⁵².

In Brazil Leite *et al.*³⁵ conducted a study in Santos (SP) with children and the built environment. The objective was to scan the surroundings of three public schools in Santos (SP) for the presence of FO and the degree of food processing proposed by Monteiro *et al.*⁶⁵ using two classifications: ultraprocessed foods and minimally processed foods. The study found that FO selling ultraprocessed foods were closer to the schools than groceries with less processed foods. These ultraprocessed foods are frequently consumed throughout the day, substituting the main meals, fruits, milk, and water, resulting in excessive calorie intake and consequently, obesity⁶⁶.

Characteristics of the home surroundings, food intake, and obesity of schoolchildren and adolescents

Health may be influenced by restriction or access to environmental resources through different mechanisms⁵⁹, such as the presence and distribution of food retailers. Residents of communities with easy access to healthy foods (presence of supermarkets near the homes) tend to have healthier diets⁶ because in such environments choosing a healthy diet may be easier⁶⁷. The availability of inexpensive good-quality foods in neighborhood stores can encourage healthy food habits and walks to the local establishments⁶⁸.

The presence of a supermarket can be seen as a strength, as it provides a wide range of fresh, healthy foods with competitive prices⁶⁹. On the other hand, supermarkets also offer a wide variety of sodas, packaged snacks, and frozen dinners at lower prices and in larger packages⁷⁰. This dual role of supermarkets is reflected in the results that follow.

Skidmore *et al.*⁴⁰ found that students living in areas with a higher supermarket density consumed more vegetables and some unhealthy foods. However, living further away from a supermarket resulted in higher weekly intake of fruits and vegetables⁴¹. Adolescents who lived close to fast food restaurants, convenience stores, restaurants, and supermarkets consumed more beverages with added sugar⁴². On the other hand, a study of children and adolescents from California did not find a relationship between environment (presence and density of FO and FS) and food intake⁴⁴.

Some studies (Chart 2 and Chart 3) show that the presence and/or access to convenience stores near children's homes were associated with a higher risk of obesity^{10,11,42} and higher BMI^{12,41}. Some findings also showed that living closer to restaurants (including fast food restaurants and pizzerias) was positively associated with higher BMI percentiles in children and adolescents^{12,41}.

On the other hand, living near places that sell fruits and vegetables was associated with a lower risk of obesity¹³ and lower BMI^{41,43}. In the UK better access to supermarkets was also related to lower FMI⁴³.

Adolescents living in areas further from convenience stores presented higher intake of fruit juice and lower intake of vegetable fats³⁴. Moreover, adolescents who lived further from these establishments also had healthier diets⁹. On the other hand, children who lived closer to convenience stores consumed more potato chips, chocolate, and bread⁴⁰.

Traditionally people buy fewer items in small groceries and convenience stores so it is possible to walk home carrying the purchase. People buy more items in supermarkets so they are less likely to walk there and back home⁶⁷, which promotes the use of a motor vehicle for purchases further away⁶⁸.

Convenience stores usually charge significantly higher prices than conventional groceries and supermarkets. However, they usually work longer hours, make quick transactions, and are located in many places⁷¹. In Brazil convenience stores are franchised and dedicate a significant area to display refrigerated beverages and frozen foods; dairy products; newspapers and magazines; bazaar, tobacco, and candy products; and a snack bar. Traditionally these stores are located in gas stations to attract new customers and increase the revenue of these establishments⁷².

Children who lived in densely populated areas or areas close to fast food restaurants consumed more vegetable fat, juices, fruits⁹, and fast foods⁴⁶. However, these findings should be interpreted with caution because they should not be generalized to other realities.

FINAL CONSIDERATIONS

According to the present literature review, most studies indicate a higher concentration of

fast food restaurants in school surroundings, especially near high schools, public schools, or school located in low-income neighborhoods. The presence of fast food restaurants was associated with worse diets and higher FMI in students. These studies were conducted in high-income countries. In Brazil the number of studies is still small, so it is not possible to affirm that the presence of fast food restaurants in the neighborhood can influence the diet quality of children and adolescents.

Home surroundings with a higher concentration of convenience stores and fast food restaurants were associated with higher BMI percentiles. Furthermore, children and adolescents living further away from convenience stores presented healthier diets.

Generally, the pieces of evidence exposed herein reflect the reality of North American and European countries and it may be a mistake to generalize these results to all populations and situations. Standardized methodological procedures were not found between the reviewed articles because different objectives required different strategies. Hence, the studies could not be directly compared.

The presence of FO and FS in home and school surroundings must be identified. Recognizing the distribution profile of these establishments in the territory and their relationship with food intake is important to establish evidence that contribute to strategies that improve the availability of healthy foods, especially in middle-income countries such as Brazil, which still lacks studies in this area.

The formulation of public policies that encourage the construction of establishments that sell healthy foods in areas where they are not available can be one more strategy to motivate people to change their eating habits. This initiative, along with other initiatives that aim to prevent disease and promote healthy diets, already exists in Brazil and can help to reduce the prevalence of obesity in children and adolescents.

CONTRIBUTORS

EN CORRÊA structured and wrote the manuscript. BAS SCHMITZ and FAG VASCONCELOS reviewed the manuscript.

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