

Classification of commercial food establishments: comparison between methods

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FREE THEME ARTICLE

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Abstract *The aim is to compare the classification of commercial food establishments obtained by the index of access to food in establishments sold for consumption at home (HFSI) with the classification of food acquisition recommended by the technical study "Mapping of Food Deserts in Brazil". Investigated commercial food establishments present in the food environment (circular buffer) of areas with and without Public Food and Nutritional Safety Equipment (EPSAN) in Belo Horizonte. An on-site audit was carried out to evaluate the HFSI, which was organized into tertiles to classify the establishment. Comparison was made between the classifications of establishments observed by HFSI and those proposed by the technical study. Grocery stores, bakeries/confectionery shops were classified as ultra-processed food purchasing establishments by the HFSI while the technical study defines them as mixed establishments. There was a difference in the classification of commercial food establishments according to HFSI and technical study, which may compromise the associations of the community food environment in studies with nutrition and health outcomes.*

Keywords *Access to healthy food, Feeding in the urban context, Food*

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Introduction

The food environment is defined as the opportunities and conditions present in physical, economic, political, and sociocultural environments that influence food choices and the nutritional status of individuals. It is the consumer's interaction with the food system and encompasses the availability, accessibility, convenience, promotion, quality, and sustainability of food ^{1,2}.

Among the different perspectives, the food environment can be investigated at the level of the community, in which the distribution of commercial food establishments is observed (density, type, location, proximity, and convenience), and at the level of the consumer, in which a set of indispensable elements of the food is evaluated, which can influence the purchase, such as quality, price, promotion, availability, and variety ^{3, 4, 5, 6}.

Different approaches can be used to define the types of food outlets, including government coding systems ^{7, 8}, food chain trade names, economic activity classification codes ⁹, or the researcher's exclusive approach (based on audits or marketing dynamics such as the predominance of purchased food) ^{4, 10, 11}. In this way, the diversity of methodologies for assessing the food environment can lead to divergent and inconsistent definitions and classifications of commercial food establishments ^{12, 13, 14}.

It should also be noted that the availability of healthy and unhealthy foods varies considerably according to the type of food outlet and location - countries, regions, cities ^{15, 14}. One example is supermarkets, which in high-income countries are identified as healthy commercial establishments due to the greater availability of nutritious foods ^{16, 17, 18, 19, 20, 21}. However, in middle- and low-income countries supermarkets have made more ultra-processed foods available ^{10, 22, 23}.

In Brazil, supermarkets are classified as healthy establishments (greater access to *natura* foods) in all the states of the North and Midwest regions⁷, and in the states of the South region they are considered mixed, i.e., with similar access to healthy and unhealthy foods ⁷ according to the technical study "Mapping Food Deserts in Brazil". This study serves as a reference for classifying commercial food establishments in various other food environment studies carried out in the country ^{24, 25, 7}. However, depending on the social, cultural, economic,

political, and regulatory context of the location and considering that the same type of establishment offers different foods (availability, quality, variety), it is hypothesized that this classification is generalized and does not reveal the real food context ^{26, 27}. Barriers and facilitators to acquiring healthy food differ according to the type of commercial establishment ¹¹, which highlights the need for a more detailed analysis beyond purchasing patterns. This study aimed, therefore, to compare the classification of food outlets in a Brazilian capital city, obtained by the index of access to food in outlets for consumption at home, with the classification of food acquisition recommended by the technical study "Mapping Food Deserts in Brazil". The comparison between the two classification methodologies will make it possible to understand the importance of evaluating the community food environment in conjunction with aspects related to the consumer environment to adequately describe the food context.

Methods

This is a cross-sectional study of commercial establishments in the city of Belo Horizonte-MG (Brazil), approved by the Research Ethics Committee (CAAE 84707818.3.0000.5149). Belo Horizonte is the capital of the state of Minas Gerais, located in the southeast of Brazil, with an estimated population of 2.5 million in 2021. The municipality's Municipal Human Development Index (MHDI), constituted of education, longevity, and income indicators, was 0.810 in 2010 (IBGE, as in Portuguese).

The units of analysis were the commercial food establishments in the food environment of areas with and without Public Food and Nutrition Security Equipment (EPSAN, as in Portuguese), including EPSAN, so that the administrative regions were represented by sectors with and without EPSAN. The areas with EPSANs were selected based on the equipment installed and operating in Belo Horizonte in May 2019, which sold food for consumption at home. The areas without EPSANs were selected from census tracts that did not have an EPSAN and were in the same administrative region as the corresponding EPSAN, respecting a radius of 1000m from the equipment.

The food environment of the areas with and without EPSAN was defined from a circular buffer with a radius of 500m around the EPSAN and the centroid of the selected census

tract, respectively. The 500m radius was adopted because it is a measure of short distance²⁸, considered easily accessible^{29, 30}, and used in studies correlating the built environment and the presence or absence of establishments within this radius³¹.

The areas were selected based on simple random sampling, through consecutive draws, stratified by the nine administrative regions. Due to the greater concentration of EPSAN and commercial establishments in the central area of the city, to guarantee the proportionality of the sample, two facilities, and two census sectors were selected in the Central-South region, totaling twenty units (ten areas with EPSAN and ten areas without EPSAN). Further information on the sampling process can be found in Cordeiro et al., 2022; Jardim et al., 2023; Paiva et al., 2023^{32, 33, 34}.

Data was collected using a structured questionnaire³⁵ from August to October 2019, from Monday to Friday, between 9 am and 3 pm, to avoid the time of day interfering with food variability.

To rate access to food in commercial establishments the Healthy Food Store Index (HFSI) was used. This index includes variables for the availability, variety, and advertising/promotion of healthy foods (fruit and vegetables) and unhealthy foods (ultra-processed foods - sugary drinks, corn snacks, and chocolate cookies). This index has been validated for the Brazilian context and ranges from 0 to 16 (the higher the score, the better the availability of healthy foods) (Chart 1).

Concerning the HFSI value resulting from the on-site assessment of food stores, it was organized into tertiles to classify access to and acquisition of the store. Commercial food establishments in the 1st tertile (lower score ranging from 0 to 1; lower access to healthy foods and higher access to unhealthy foods) were defined as establishments purchasing ultra-processed foods. Food stores in the 2nd tertile (median score ranging from 2 to 11; similar access to healthy and unhealthy foods) were classified as mixed stores. Food stores in the 3rd tertile (highest score ranging from 12 to 16; greater access to healthy foods and less access to unhealthy foods) were defined as stores for purchasing in natura foods.

In terms of type, the establishments identified on site were classified as organic fairs, open-air fairs, direct from the farm, fruit and vegetable markets, hypermarkets, local or neighborhood

markets, bakeries, municipal greengrocers, private chain greengrocers, convenience stores, supermarkets and atacarejos (wholesale and retail food sales), large chain supermarkets^{35, 36}. To make it possible to compare the classification of the establishments in this study with that in the “Technical Study Mapping Food Deserts in Brazil”⁷, the establishments were reclassified into the following categories: fruit and vegetable stores, grocery stores, bakeries and confectioneries, supermarkets, hypermarkets and convenience stores⁷.

This classification was compared with the specification recommended by the Interministerial Chamber for Food and Nutritional Security, through the Technical Study Mapping Food Deserts⁷. To identify the establishments, this technical study used the Annual Social Information Report (RAIS), which is a socioeconomic information report requested annually by the Brazilian Ministry of Labor and Employment from legal entities and other employers. For identifying street markets, it used the municipality’s own mapping. The RAIS database includes the National Classification of Economic Activities (CNAE)⁹ for each establishment, which allows the definition of the type of activity carried out. The categorization into “In natura food purchasing establishments,” “Mixed establishments,” and “Ultra-processed food purchasing establishments” was made according to the NOVA classification of foods (based on the extent and purpose of food processing: in natura or minimally processed, processed, and ultra-processed)²² that were purchased from the commercial establishments identified by the Household Budget Survey data. According to the technical study, for the state of Minas Gerais, convenience stores are defined as ultra-processed food purchasing establishments, while grocery stores, bakeries/pastry shops, supermarkets, and hypermarkets are classified as mixed establishments, and fruit and vegetable stores are classified as in natura food purchasing establishments⁷.

The description of the establishments took into account the absolute and relative participation of each type of establishment in the total number of identified establishments. The evaluation of the classification of establishments according to the HFSI was compared to the classification proposed by the Interministerial Chamber for Food and Nutritional Security. Statistical analyses were conducted using Stata software, version 14.2, and the maps were pro-

Chart 1. Scoring system for the Healthy Retail Food Store Index (HFSI).

Variable	Score
Fresh fruits and vegetable availability	0 points if not available; 1 point if available
Fresh fruits and vegetable located near the entrance of the store	0 points if not located near the entrance of the store; 1 point if located
Different types of fruits	0 points if not available; 1 point if 1–7 types of the 10 most purchased fruits are available; 2 points if 8–10 of the 10 most purchased fruits are available
Fruits variety	0 points if not even 1 fruit variety is available; 1 point if up to 14 varieties are available; 2 points if 15 or more varieties are available
Different types of vegetables	0 points if not available; 1 point if 1–7 types of the 10 most purchased vegetables are available; 2 points if 8–10 of the 10 most purchased vegetables are available
Vegetables variety	0 points if not even 1 vegetable variety is available; 1 point if up to 14 varieties are available; 2 points if 15 or more varieties are available
Fruits and vegetable signage/promotion	0 points if not available; 1 point if available
Soft drinks availability	0 points if not available; 1 point if available
Sugar-sweetened nectar/juice availability	0 points if not available; 1 point if available
Chocolate filled cookies availability	0 points if not available; 1 point if available
Corn chips availability	0 points if not available; 1 point if available
Highly processed foods signage/advertising	0 points if not available; 1 point if available

Source: DURAN et al., 2013.

duced using QGIS 2.10.1 and 2.18.0, and ArcGIS 10.5 software.

Results

A total of 253 food retail establishments for home consumption were identified. Of these, 18 (5.0%) were outside the unit of analysis and 87 (24.3%) did not agree to participate in the survey. Thus, 148 (41.3%) establishments took part in the study. About the type of commercial establishment, the majority were fruit and vegetable stores (39.9%), followed by bakeries/confectioners (23.6%) and grocery stores (21.6%) (Table 1).

The average Healthy Food Store Index (HFSI) was 7 (ranging from 0 to 16). Fruit and vegetable shops had higher indices (HFSI=13;

ranging from 7 to 16) when compared to other types of stores. The lowest access rates were found in convenience stores (HFSI=1; 0-2) and bakeries/confections (HFSI=1; 0-9). According to the classification, fruit and vegetable stores were the only establishments defined as selling in natura foods. Supermarkets and hypermarkets were classified as mixed and grocery stores, bakeries, and convenience stores as ultra-processed food stores (Table 1).

A comparison of the classification of commercial food establishments according to the result obtained by the HFSI and the proposal of the Technical Study Mapping Food Deserts in Brazil is shown in Table 2. There was a discrepancy between the classifications of grocery stores and bakeries. These establishments were classified as purchasing ultra-pro-

cessed foods, according to the access assessment index (HFSI). And, with the classification of the Technical Study Mapping Food Deserts in Brazil, these establishments were defined as mixed. Figure 1 shows the spatial distribution of commercial food establishments categorized according to the HFSI classification and according to the Technical Study “Mapping Food Deserts in Brazil.”

Discussion

This study found a discrepancy in the classification of commercial food establishments according to the HFSI and the Technical Study “Mapping Food Deserts in Brazil”. Grocery stores and bakeries were classified as ultra-processed food stores by the HFSI, while the Technical Study “Mapping Food Deserts in Brazil” defines them as mixed stores. Establishments such as supermarkets and hypermarkets remained as mixed establishments in both classifications, convenience stores remained as ultra-processed

food purchasing establishments and fruit and vegetable stores remained as in natura food purchasing establishments.

Bakeries usually offer food products, mostly ultra-processed, in addition to traditional bakery products ¹¹. The availability of ultra-processed foods is also common in medium-sized stores such as grocery stores and neighborhood markets, which in addition to offering them use different types of advertising to encourage the purchase of products with low nutritional value ^{37, 38}. The reclassification of these establishments increased the prevalence of establishments purchasing ultra-processed foods in the areas analyzed, revealing a different scenario, only evidenced by the on-site audit.

The use of pre-existing data sets is common in studies of the food environment ^{10, 39, 24} due to their convenience, efficiency, and suitability for initial exploratory studies on large scales, such as the Technical Study “Mapping Food Deserts in Brazil”. However, physical access to a type of commercial establishment, when these are clas-

Table 1. Description of commercial establishments according to type and classification of the index of access to food in food sales establishments. Belo Horizonte, 2019.

Type of establishment	Absolute frequency (n)	Relative frequency (%)	HFSI* Median (min-max)	HFSI* classification (tertile)
Fruit and vegetable stores	59	39,9	13 (7-16)	In Natura
Grocery stores	32	21,6	2,5 (0-12)	Ultra-processed
Bakeries and confectioneries	35	23,6	1 (0-9)	Ultra-processed
Supermarkets	16	10,8	9 (1-11)	Mixed
Hypermarkets	2	1,3	9,5 (9-10)	Mixed
Convenience stores	4	2,7	1 (0-2)	Ultra-processed

*HFSI = Healthy Food Store Index

Table 2. Comparison of the classification of commercial food establishments according to HFSI and Technical Study Mapping of Food Deserts in Brazil Belo Horizonte, 2019.

Type of establishment	HFSI* classification	Classification Technical Study Mapping of Food Deserts in Brazil
Fruit and vegetable stores	In Natura	In Natura
Grocery stores	Ultra-processed	Mixed
Bakeries and confectioneries	Ultra-processed	Mixed
Supermarkets	Mixed	Mixed
Hypermarkets	Mixed	Mixed
Convenience stores	Ultra-processed	Ultra-processed

*HFSI = Healthy Food Store Index

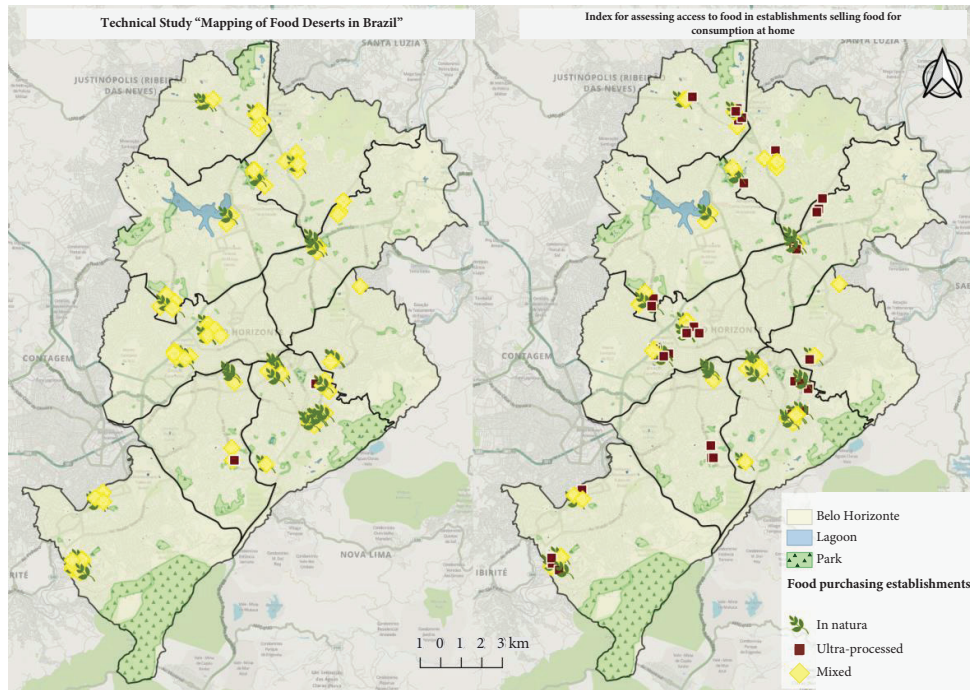


Figure 1. Spatial distribution of commercial food establishments categorized according to the HFSI classification and according to the technical study Mapping Food Deserts in Brazil.

sified by the kind of food it sells (for example: bakery), does not guarantee that there will be the same availability, variety, quality, and price of food in other commercial establishments of the same type^{27, 40, 41, 42}.

The categorization of commercial establishments based on type is widespread and represents a methodological limitation that limits the credibility of food environment studies, since the identification of commercial establishments according to the type or predominance of the food they sell, without an evaluation of key elements of the food available for sale, can generate erroneous conclusions about the food environment^{12, 13, 42}.

It is also necessary to reconsider the classification of mixed commercial establishments, as evidence shows that exposing consumers to a simultaneous offering of in natura, minimally processed, and ultra-processed foods usually leads to the purchase and consumption of unplanned foods, which are generally ultra-processed^{43, 10}. It is known that supermarkets and hypermarkets, classified as mixed establishments, offer price promotions and convenience features that lead to greater consumption of

ultra-processed foods¹⁰. In this sense, more studies into consumer behavior are needed.

It is worth noting that efforts to standardize a taxonomy of commercial establishments can facilitate their use by researchers and public policymakers¹⁴. The methods used to define the types of commercial food establishments vary and most authors do not fully describe the methods used^{4, 10}. Therefore, researchers need to address common methodological issues and provide clear, theoretically grounded operational definitions of the types of food outlets under investigation¹⁰.

It should be noted that the use of information on the types of stores from the Technical Mapping Study may lead to conclusions that differ from the actual food context. Therefore, efforts to understand and explore the potential influence of the food environment on food availability in a given population need to be investigated locally⁴⁴. Empirical research into the types of stores is recommended¹⁴ and, above all, on-site investigation of the food environment through audits with the application of indices or numerical scores, since the availability, quality, variety, and cost of available food can be identified²⁷,

⁴². On-site investigations tend to be more reliable and allow for a better understanding and monitoring of the food environment in different scenarios ¹³.

Some limitations of this study need to be clarified. The consumer food environment data (availability, variety, and promotion) that comprised the index of access to food in retail outlets were assessed in combination due to the cross-sectional study design. Therefore, the temporal variability in the availability and variety of food could not be measured. However, considering that the availability of fresh produce (fruit, vegetables, meat, and dairy products) tends to be consistent over two weeks, a single observation is sufficient to reflect the commercial activities in the selected establishments ¹⁷.

Conclusion

The differences found in the classification of grocery stores, bakeries/confectioneries according to the HFSI classification compared to the classification of the Technical Study Mapping Food Deserts in Brazil may compromise the associations of the community food environment in studies with nutrition and health outcomes. The HFSI identified grocery stores and bakeries/confections as establishments that purchase ultra-processed foods, while the Technical Study Mapping Food Deserts in Brazil defines them as mixed establishments. It is suggested that the classification of commercial food establishments take place through studies that investigate the community food environment concomitantly with aspects related to the consumer environment, such as the availability of food on the spot, the acquisition of food, price, and consumer behavior, to advance the debate on the potential associations of these commercial food establishments with the outcomes evaluated.

Contributions

Nayhanne G. Cordeiro contributed to data collection, analysis and interpretation of data, and preparation of the article; Larissa L Mendes contributed to data interpretation, writing and review of the article; Mariana Z Jardim contributed to data collection, analysis and interpretation of data, and preparation of the article; Gabriela G Paiva contributed to data interpretation, writing and review of the article; Fernanda CS Ribeiro contributed to data interpretation, writing and review of the article; Gabriela MR Vieira contributed to data interpretation, writing and review of the article; Bruna VL Costa worked on the conception and design of the study, interpretation and structuring of the data, and final review of the article.

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