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Original/*Otros*

Availability of food stores and consumption of fruit, legumes and vegetables in a Brazilian urban area

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Abstract

Background: The food environment can have an important influence on the availability of and access to food, which plays a significant role in the health of individuals. The goal of this study was to compare the consumption of fruits, legumes and vegetables (FLV) by adults and the availability of food stores in the context of socioeconomic and geographic space connected to basic health units in a Brazilian capital city.

Methods: The study was developed from information obtained through the Risk Factors Surveillance for Non-Communicable Diseases Prevention by Telephone Survey (VIGITEL), using samples from Belo Horizonte from the years 2008 to 2010. A total of 5611 records were geocoded based on the postal code. A score was created based on the weekly and daily frequency of FLV intake of individuals. The coverage area of basic health units was used as a neighborhood unit. Georeferenced data on food stores in the city and neighborhood income were used.

Results: As neighborhood income increased, there was an increase in the distribution of food establishments for all of the studied categories. The highest FLV intake scores were observed in areas with higher income levels.

Conclusion: The highest concentration of food stores, regardless of supply quality, was observed in geographic areas with higher purchasing power and in those where there was a greater concentration of other types of businesses and services, a different pattern from that found in other countries.

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Key words: *Diet. Fruit Vegetables. Environment and public health. Income.*

LA DISPONIBILIDAD DE LAS TIENDAS DE ALIMENTOS Y EL CONSUMO DE FRUTAS, LEGUMBRES Y VERDURAS EN UN ÁREA URBANA DE BRASIL

Resumen

Antecedentes: El ambiente alimentar puede tener una influencia importante en la disponibilidad y el acceso a ellos, éste desempeña un papel importante en la salud de las poblaciones. El objetivo de este estudio fue comparar el consumo de frutas, legumbres y hortalizas (FLV) de adultos y la disponibilidad de las tiendas de alimentos en el contexto del espacio socioeconómico y geográfico en el territorio de las unidades básicas de salud en una capital brasileña.

Métodos: El estudio se desarrolló a partir de la información obtenida a través de la Vigilancia de Factores de Riesgo para Enfermedades no Transmisibles Prevención de Encuesta Telefónica (VIGITEL), utilizando muestras de la ciudad de Belo Horizonte en los años de 2008 a 2010. Un total de 5.611 registros fueron geo-codificados usando el código postal. Una puntuación fue creada en base a la frecuencia semanal y diario del consumo de FLV . El área de las unidades básicas de salud se utilizó como unidad vecinal. Se utilizaron los datos geo-referenciados de los comercios de venta de comida en la ciudad y el barrio.

Resultados: A medida que aumentaba la renta del barrio, hubo un aumento en la distribución de los establecimientos de comida e bebidas para todas las categorías estudiadas. Se observaron las puntuaciones más altas de consumo FLV en zonas con niveles de ingresos más altos.

Conclusión: La mayor concentración de tiendas de alimentos e bebidas e mayor puntuación de consumo, independientemente da calidad de los productos ofrecidos, fue observado en las áreas geográficas con mayor poder adquisitivo.

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Palabras clave: *Dieta. Frutas. Hortalizas. Medio ambiente y la salud pública. Ingresos.*

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Introduction

The consumption of fruits, legumes and vegetables (FLV) is part of healthy eating patterns associated with chronic non-communicable diseases (NCDs) prevention[1].

Recent evidence supports hypotheses about a relationship between environment and health, proposing an ecological approach to explain this relationship[2,3]. This link can also be applied to understand how environmental factors can act on issues related to the food consumption. The food environment can have an important influence on the availability and access to food[4,5,6,7].

In Brazil, few studies have evaluated the food environment of neighborhoods. National household surveys based on probability samples showed low consumption of FLV in the Brazilian population[8], which was also found in other analyzes using telephone interviews[9,10]. In addition, a separate study[11] in a large Brazilian city showed that there are significant differences in the availability of food stores and restaurants in the context of neighborhoods. However, there is no information on the individual level of healthy consumption.

The social environment, the built environment and the macro-environment are included in the environmental contexts related to eating behaviors[12]. Considering the built environment, for example, it was observed in several American populations that evidence points to differences in the trade and food distribution in addition to racial and socioeconomic segregation in the occupation of the urban space. Studies also show that neighborhoods with greater miscegenation and socioeconomically disadvantaged occupants tend to have a higher concentration of food stores with little food variety[13,14], and therefore, some healthy foods, such as fruits, legumes and vegetables, are less available or have poorer quality in lower-income areas[14].

The present study aimed to compare the consumption of FLV by adults and the availability of food establishments within the socioeconomic context and geographic area attached to the basic health units in a Brazilian city.

Methods

The present study was developed from the Risk Factors Surveillance for Non-Communicable Diseases Prevention by Telephone Survey (VIGITEL) using samples obtained in Belo Horizonte, Brazil, from the years 2008, 2009 and 2010[15].

For the present study, 6,034 registries were considered eligible, geocoded using the postal code. The geographic coordinates (latitude and longitude) corresponding to the centroid of the postal code rather than the residential address were georeferenced for 5,826 (96.5%) points. Of the 5,826 points to be georeferenced, 215 did not have complete information, resulting in a final sample of 5,611 participants.

For the analysis of FLV consumption, a score was created based on the weekly and daily consumption frequency of these foods, as reported by the respondents. The score of FLV consumption ranged from zero (when the individual reported no consumption of fruits, legumes and vegetables on any day of the week) to 12 points (when fruits, legumes and vegetables were consumed five or more days of the week and 2-3 times a day).

Georeferenced environmental data were obtained from databases provided by the Municipal Secretariat of Health and the Information Technology Company of the municipality of Belo Horizonte, whose information was related to the coverage area of the basic health units (territorially delimited set of census tracts) comprising 148 subdivisions of the nine Sanitation Districts of the municipality of Belo Horizonte. The coverage areas were defined by administrative and health criteria. This method of organisation is used by the public system for the delivery of health services and defined by basic health units (BHU). In these BHU, the local government provides health measures and policies, including basic health care services. The average coverage area was 2.5 km^2, with the smallest area being 0.3 km^2 and the largest being 14.7 km^2. On average, 7,000 households and 21,000 inhabitants were observed per coverage area.

To characterize the built environment factors, a database was created with information on the food establishments in Belo Horizonte, based on the National Classification of Economic Activities from 2011. This database is the national standardization instrument of the economic activity codes and the eligibility criteria used by the various tax administration organizations of Brazil.

The databases from municipal public facilities of food security and nutrition, such as fruits and vegetables subsidized by the city and restaurants with accessible prices focused on offering nutritionally balanced, ready meals, were also included. Moreover, data such as the sum of the monthly nominal income of individuals aged 10 years or older in the coverage areas, named the overall yield of the coverage area, were obtained from the databases of the Brazilian Institute of Geography and Statistics[16].

A geographic information system was used for the preliminary spatial analysis to stratify the geocoded data in information layers and to develop data maps. The crossings of the spatial information layers were translated into variables for the analysis using MapInfo software, version 8.5.

Thematic grid maps, generated from the inverse distance weighted interpolation method using the MapInfo Professional 8.5 software, were used to describe the spatial distribution of the FLV-consumption scores and neighborhood income. The categories of FLV-consumption scores were defined by calculating the mean and standard deviation values corresponding to quintiles of the overall income of the coverage areas. Geo-

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graphical areas without residences and green areas of 2 km² or more were also identified on the maps.

Variance analysis and Bonferroni correction for multiple comparisons were used to compare the average number of food establishments according to the quintiles of the overall income of the coverage areas. The STATA 12.0 program was used for the analysis. The significance level was set at 0.05.

The VIGITEL implementation project was approved by the National Ethics Committee on Human Research. The present study was also approved by the Ethics Committee, according to the Opinion No. 25447414.1.0000.5149.

Results

In 2008, the average FLV consumption score was 6.0 (95% CI 5.85 - 6.24); in 2009, the score was 6.1 (95% CI 5.94 - 6.25); and in 2010, the score was 6.2 (95% CI 6.11 - 6.41). The mean score among men was 5.9 (95% CI 5.73 - 6.01), and the mean score among women was 6.3 (95% CI 6.22 - 6.49).

Table I shows the descriptive measures of the environmental variables. There was a high number of restaurants, bars and eateries in the city. On average, the food establishments with the lowest presence in the coverage areas were supermarkets and hypermarkets. In Belo Horizonte, there were 17,984 registered food establishments in total. The average number of food establishments per coverage area was approximately 154. Only one neighborhood had no food establishment. There is high variability of the total average in-

come among the coverage areas, shown by a standard error value higher than the average, which emphasizes high inequity compared to income in the municipality.

Table II shows a comparison of the availability of food establishments according to quintiles of the total income of the coverage areas. As neighborhood income increased, there was also an increase in the distribution of food establishments of all categories. Based on the multiple comparison test, there were differences in the distribution of food establishments in almost all the quintiles of overall income of the coverage areas for the analyzed categories of establishments. That is, there are more establishments in higher income areas, regardless of the type of establishment.

Thematic maps were prepared to verify the spatial distribution of the FLV-consumption score and to describe the overall income quintiles of the coverage areas of the basic health unit in Belo Horizonte (Fig. 1). Based on the maps, higher FLV consumption scores were observed in areas with higher income levels.

Discussion

In the present study, the mean FLV consumption score for the adult population of the municipality of Belo Horizonte was 6, which represents the combination of fruit and vegetables, fruits and legumes, or legumes and vegetables in 5 or more days of the week, considering 1-2 daily servings of fruits and only one serving of vegetables and legumes. This level of consumption can be considered low and is lower in males, a finding consistent with what has been widely obser-

Table I

Description of environmental variables according to the coverage areas of basic health units in Belo Horizonte - MG – Brazil. 2008-2010

Variables	Mean (SD)	Median	Minimum	Maximum	Total number of establishments
Monthly overall income of CA (in reals)	34,200.0 (42,300.0)	15,700.0	1,423.8	204,000.0	Not applicable
Population density (Inhabitants/km²)	9,706.7 (3,719.58)	9,530.2	519.4	26,165.2	Not applicable
Supermarkets and hypermarkets	3.3 (0.05)	2	0	22	332
Mini-markets, grocery stores and warehouses	14.2 (0.15)	14	0	51	1,846
Shops and open-air markets specializing in selling produce	5.9 (0.11)	5	0	53	723
Restaurants	33.00 (0.90)	16	0	373	3,566
Bars	17.8 (0.31)	14	0	86	2,077
Eateries	30.3 (0.83)	18	0	413	3,446
Mobile food shops	4.2 (0.08)	4	0	33	534
Total number of food establishments[a]	153.6 (9.07)	122	0	1,215	17,984

Abbreviation: SD, standard deviation; CA, Coverage area of basic health unit aTotal number of food establishments: Included all the food establishments in the city of Belo Horizonte, in addition to those already described in the table, such as bakeries and pastry shops; dairy and cold cuts retail businesses; sellers of sweets, candies, chocolates and similar; beverage vendors; butcher shops; fish markets; pharmacies and drug stores that sell food and department stores that sell food.

Table II

Establishments that sell food according to the overall income quintiles of the coverage areas of basic health units in Belo Horizonte - MG – Brazil. 2008-2010

Food establishment	1st Mean Quintile (SD)	2nd Mean Quintile (SD)	3rd Mean Quintile (SD)	4th Mean Quintile (SD)	5th Mean Quintile (SD)	p value
Number of supermarkets and hypermarkets	0.8 (0.03)	1.7 (0.05)[a]	1.9 (0.04)[a]	3.4 (0.07)	6.7 (0.12)	< 0.001
Number of mini-markets, grocery stores and warehouses	8.4 (0.11)	13.6 (0.17)	15.2 (0.14)	17.9 (0.24)	19.9 (0.31)	<0.001
Number of shops and open-air markets specialized in selling produce	2.5 (0.05)	4.8 (0.10)	5.5 (0.07)[a]	6.2 (0.11)[a]	15.2 (0.36)	<0.001
Number of restaurants	4.3 (0.14)	9.9 (0.22)	17.8 (0.37)	43.3 (0.68)	158.9 (3.65)	<0.001
Number of bars	5.3 (0.09)	11.0 (0.14)	16.8 (0.19)	24.7 (0.42)	51.9 (0.84)	<0.001
Number of eateries	4.6 (0.11)	12.9 (0.30)	21.0 (0.43)	36.1 (0.47)	133.1 (3.55)	<0.001
Number of mobile food shops	1.8 (0.06)	3.6 (0.05)	5.1 (0.09)[a]	5.2 (0.09)[a]	8.3 (0.24)	<0.001
Total number of food establishment	43.6 (0.54)	91.5 (1.02)	127.2 (1.41)	198.8 (2.16)	523.0 (10.13)	<0.001

Abbreviation: SD - standard deviation. Bonferroni ANOVA test showed significant differences in multiple comparisons between the groups. a - p-value > 0.05 for Bonferroni test.

ved in national studies, such as household budget surveys[8] and telephone interviews[9,10,15]. However, the results must be assessed with caution because the intake was measured only using an indication of consumption and not the amount consumed.

A positive relation was observed between the socioeconomic level of the areas and higher FLV consumption scores. The average FLV consumption was below the desired level reinforced by the findings of other studies[8,9,10,15]. More quantitatively equipped geographic areas were observed. The highest concentration of food establishments, regardless of supply quality, was observed in geographic areas inhabited by individuals with higher purchasing power and where there was a greater concentration of other types of businesses and services.

Studies conducted in another Brazilian city have shown that areas with lower economic deprivation have a higher density of all types of food businesses in addition to better public transport structure and a higher density of parks and public places for the practice of sports. This finding suggests that the installation of supermarkets and other retail food establishments in a given area is largely determined by the economic market. These types of establishments tend to aggregate in regions with higher purchasing power[17]. That is, the supply and number of food establishments increases proportionally with the income of the neighborhood, not only for establishments that sell FLV but also for all types of establishments. In the present study, the characterization of the availability of food establishments does not allow analytical approaches that discriminate the characteristics of stores with respect to the quality of the food offered within the geographic areas under study, particularly regarding the availability of

certain healthy foods, such as fresh meat, low-fat milk and nutritionally healthy drinks, as well as competitive prices. This type of information can only be obtained using other methodological approaches, such as direct on-site observation[18].

In a more detailed investigation in the city of São Paulo, it was found that the access to healthy foods varied according to the type of food establishment and according to the socioeconomic status of vicinal small geographic areas. Fast-food restaurants were more often located in low socioeconomic neighborhoods, and supermarkets and restaurants that offer full meals were more often located in neighborhoods with higher socioeconomic status[11].

Likewise, in some developed countries, it is possible to qualitatively distinguish the distribution of types of food establishments according to the socioeconomic status of the neighborhood. In American urban areas, for example, in addition to racial and socioeconomic segregation and occupation of the urban space, there is evidence of differences in business and food distributions (food environment). Neighborhoods with greater miscegenation and more individuals with lower income tend to have a higher concentration of commercial establishments with little food variety than of supermarkets, considered by several authors, in this specific context, as places with a greater variety of food and, generally, with the lowest prices[13,19,20,21,22,23].

In relation to individual consumption, based on the comparison of maps, the higher FLV consumption scores occurred in more socioeconomically advantaged areas. It is known that in addition to individual factors, neighborhood socioeconomic factors may influence the choice of food. Material conditions, including the financial situation (e.g., family income), social depri-
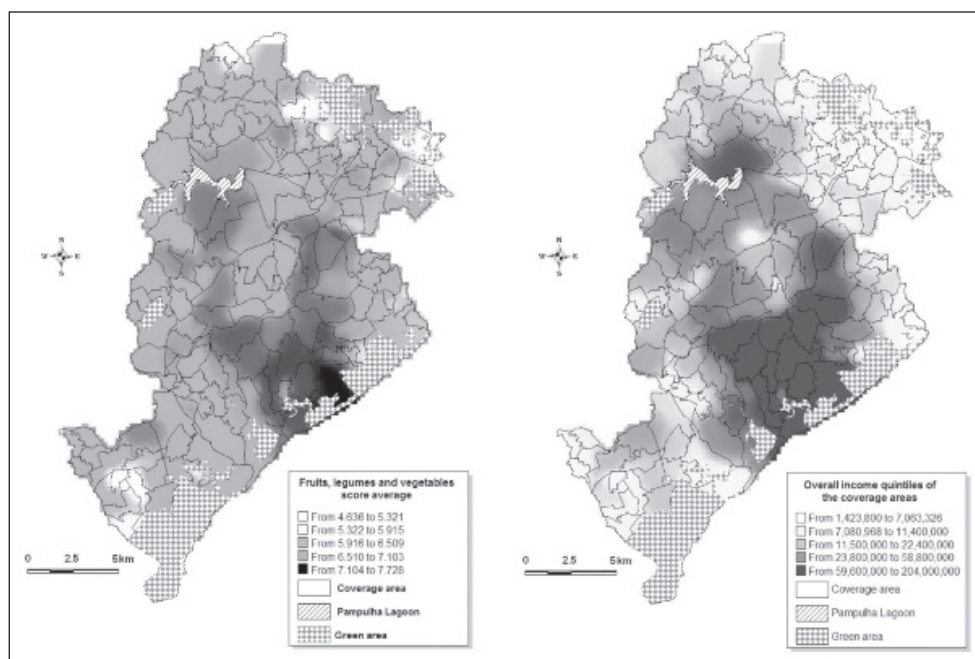
Fig. 1.—Mean score of fruits, legumes and vegetables according to the coverage area and overall income quintiles (in reals) of the coverage areas in Belo Horizonte - MG - Brazil.

vation and unfavorable working, housing and neighborhood conditions, can affect feeding behavior. The income of an individual, in part, can determine his/her access to various products and even certain food stores, hindering the purchase of healthy foods[14, 24].

Increased FLV consumption is an important factor in coping with NCDs and should be understood not only in the scope of individual decisions but also from the perspective of increased supply, increased production, lower prices, availability and food quality, factors that affect public policies. In 2013, the Ministry of Health launched a plan for coping with NCDs, providing increased FLV consumption in the next decade[25,26]. The current study may support local planning to expand the availability of healthy foods and reduce health inequities based on such availability.

However, we can highlight some limitations of the present study. One of the limitations concerns the geo-referenced data used to describe the characteristics of the environment, which are secondary and derived from government and commercial sources and, therefore, may be subject to inaccuracies. An additional limitation can also be recognized regarding the impossibility of analysis of food prices, the perceived environment, the possible concomitance of the sale of fruits, legumes and unhealthy foods, and access to food establishments rather than only their availability, as analyzed in the present study. Studies including those factors would provide more consistent results regarding the analysis of the food environment in Belo Horizonte.

The present study advances the hypothesis of the correlation between healthy eating and the availability of foods and services, presented by the income in urban areas whose historical process of conformation is diametrically opposed to developed countries. In addition, there is a need to reduce the geographical area to better discern the intra-urban differentials (although there has been great advancement in the use of the coverage areas) or to compare homogeneous geographic areas. It should also be noted that surveillance systems are important tools in this type of research and with the aid of environmental information become relevant tools for the planning of actions to promote healthy eating in urban spaces.

Acknowledgments

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