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Local food environment and fruit and vegetable consumption: An ecological study

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ABSTRACT

Ecological studies are essential for understanding the environment-diet relationship. The purpose of this study was to describe environmental conditions and their relationship with fruit and vegetable (FV) consumption among Brazilian public health service users in the city of Belo Horizonte. We evaluated food stores contained within 1600 m buffer zones at 18 Health Academy Programme sites, from 2013 to 2014. Variables at the community (density, proximity and type) and the consumer (sectional location of FV; availability, quality, variety, price and advertising of FV and ultra-processed foods) nutrition environment were measured by direct observation, while aggregate data from users (income and FV consumption) were obtained by interview. Data were analysed using the Kernel intensity estimator, average nearest neighbour value and Local Moran's Index for local spatial autocorrelation. We interviewed 3414 users and analysed 336 food stores. Major geographical variations in the FV consumption were identified. Average consumption was higher (site 2A: 410.5 ± 185.7 g vs. site 4B: 311.2 ± 159.9 g) in neighbourhoods with higher income and concentration of food stores, and better index of access to healthy foods. Sites with poor FV consumption had the most stores with poor access to healthy foods (index in the first tertile, ≤10). In conclusion, negative characteristics of the food environment, as seen in the present study, may contribute to low FV consumption, suggesting the need for the development and consolidation of public policies aimed at creating healthy environments through built environment interventions that increase access to and consumption of healthy foods like FV.

1. Introduction

Fruit and vegetables (FV) are considered an important proxy for healthy eating and determinant of health. A diet low in fruit was found to be the most important dietary contributor to mortality and lost years of healthy life, and a diet low in vegetables the forth contributor (Forouzanfar et al., 2015). Despite its importance to health, FV consumption worldwide is still far below the recommended levels. Brazil is in line with this global panorama, where just 24.1% of population present an adequate intake (BRASIL, 2015).

Evidence about the relationship between environmental conditions and food consumption is increasing. Ecological models and literature suggest that the driving force for the increasing prevalence of poor eating habits is an obesogenic environment, rather than metabolic defects or genetic mutations in individuals (Pessoa et al., 2015; Hawkes et al., 2015).

The built environment can influence on opportunities or barriers to healthy behaviour, such as FV consumption (Kirkpatrick et al., 2014; Ni Mhurchu et al., 2013; Caspi et al., 2012). Food environment characteristics that can favour FV consumption opportunities include type, location and geographic access to food stores as well as the quality, price and diversity of products (Caspi et al., 2012; Robinson et al., 2013; Duran et al., 2015a). Income inequalities are also a major factor in explaining food disparity, determining differences in food availability, access and consumption. Several studies have shown that individuals with favorable socioeconomic status enjoyed in their neighbourhoods higher access of healthy foods as FV (Duran et al., 2015a; Story et al., 2008; Duran et al., 2015b; Lee et al., 2013).

Despite the growing use of the ecological approach for understanding food consumption, a review revealed that most of the investigations (88.9%) explore the relationship of FV consumption with only one or two environmental measurements (Richard et al., 2011). However, food intake is a highly complex phenomenon resulting from the interaction between multiple influences in different contexts, which require a broad understanding on how individuals are embedded in their environments (Story et al., 2008).

Abbreviations: FV, Fruit and vegetables; HAP, Health Academy Programme; HFSI, Healthy Food Store Index.

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Other studies that consider different aspects of the environment and their relationship with behaviour are necessary. Therefore, this study aimed to conduct a descriptive analysis of the characteristics of the food environment and their relationship with FV consumption among the users of Brazilian public health care services, i.e. the Health Academy Programme (HAP).

The HAP was selected as the research setting because it is a key part of the Brazilian Primary Health Care System, which aims to overcome structural barriers to practice physical activity and to adopt healthy habits, especially among vulnerable populations. The program operates according to the health promotion concept, encouraging community participation in dealing with the social determinants of health and the construction of a healthy environment (BRASIL, 2013).

2. Methods

2.1. Study design and the Health Academy Programme

This is an ecological epidemiological study about built environment and its relation to FV consumption in the neighbourhoods of HAP centres in Belo Horizonte. The city is divided into nine administrative regions and is the sixth most populous in Brazil, with a population of 2,375,15. It has an uneven distribution of wealth with a Gini index of 0.611 (BRASIL, 2011). The Gini index is an economic metric used to assess the distribution of income among nation's residents: an index of 0 represents perfect equality, while an index of 1 implies perfect inequality.

The HAP are public spaces constructed for the promotion of healthy living by offering opportunities for regular physical exercise classes, healthy eating and community education activities at no cost (BRASIL, 2013). Group-education activities regarding nutrition can be provided by professionals of Primary Care. The centres are spaces with infrastructure, equipment and human resources, which are located primarily in vulnerable areas.

The profile of HAP users reveals important vulnerabilities, mostly in women with low education and income, who present with relevant dietary inadequacies (such as low consumption of FV, and high consumption of sweets, sugar-sweetened beverages, sausages and processed meats) and high prevalence of overweight and other chronic diseases (Mendonça et al., 2015). Investigations that described how similar or different HAP users were from non-HAP users have identified that those exposed to HAP were more active (Reis et al., 2010). Meanwhile, non-HAP users had a higher proportion of self-rated health as fair or poor. Among HAP users, 98.9% reported that the program achieves its goals; 73% and 23% reported high and medium satisfaction with the program, respectively (Hallal et al., 2010).

2.2. Study sample

The study selected a representative sample of the HAP units. 42 centres were found to be eligible out of the 50 HAP centres operating at the time of study. Eighteen centres were selected for the study via simple conglomerate sampling stratified by the nine administrative regions of the city. These centres were representative of the HAP units with 95% confidence and <1.4% error based on an estimation of the population proportion (Costa et al., 2015).

To define the neighbourhood of HAP centres, we used their geographical position and created buffers with 1 mile (1600 m) around each centre (Robinson et al., 2013; Laska et al., 2010; Hattori et al., 2013). All commercial FV food stores contained within these buffer zones were included in the study (Costa et al., 2015).

All HAP centre users aged 20 years or older were interviewed. Out of a total of 3763 individuals listed as users, 3414 individuals participated in this study (refusals = 6.3%, exclusions = 3.0%). All participants interviewed in the present study provided written informed consent. The study was conducted according to the guidelines laid down in the Declaration of Helsinki and was approved by the Ethics Research Committee of the University and City Hall.

2.3. Data collection

Data were obtained using two procedures: face-to-face interviews with HAP users; and direct observation of the food environment, which consisted of FV food store audits.

Data used through face-to-face interviews included gender, age, education level, monthly income per capita, home addresses and FV consumption. Those measures were aggregated in order to describe HAP participants.

Daily FV consumption was investigated via questions adapted from International Surveillance Systems (CDC, 2013; WHO, 2016). These questions addressed the frequency and quantity of FV consumption as well as the FV preparation method. In order to analyse consumption, the frequency of intake was calculated as daily consumption. We quantified intake in grams considering 80 g as the standard portion size (FAO/WHO, 2004). Consumption adequacy was evaluated considering the World Health Organization recommendation of at least 400 g FV intake per day (FAO/WHO, 2004).

The following food stores were included: establishments registered in geo-referenced databases of the Municipal Joint Taxation Secretariat, open-air food markets listed at the municipality City Hall site, and stores not registered in public databases but identified on site by field staff. The stores not registered in the list provided included informal stores, with recent activity or under implementation, between others. Such findings suggest the need for changes in data monitoring and updating, by encouraging regularization of commercial stores with the Municipal Government (Costa et al., 2015).

Data collected for the community nutrition environment (or macro-level) included location, proximity, density and type of commercial food store. Consumer nutrition environment variables (or micro-level) were assessed using the Food Store Observation Tool (ESAO-S). This instrument is a reliable tool adapted to the Brazilian context from several measures as the Nutrition Environment Measures Survey in Stores (NEMS-S) (Duran et al., 2015b). Besides ESAO-S components, analysis of consumer nutrition environment included investigation of price and quality of food (Costa et al., 2015; Duran et al., 2015b).

Based on the ESAO-S instrument, the healthy food store index (HFSI) provided summarized information on better quality of food stores at the micro-level, allowing an easier comparison between areas using a single food environment score. HFSI ranged from 1 to 16 and included variables concerning the availability, variety and advertising of FV and ultra-processed products. An HFSI higher value indicated better access to healthy food and lower access to ultra-processed products.

The instrument assessed the 10 most frequently purchased fruits (banana, orange, papaya, watermelon, apple, mango, pineapple, tangerine, grape and melon) and vegetables (pumpkin, chayote, tomato, carrot, lettuce, zucchini, cabbage, beetroot, kale and okra) in the municipality in addition to the five most frequently consumed ultra-processed products in Brazil, including sugar-sweetened beverages (soda and juices), cookies and salty snacks (The Brazilian Institute of Geography and Statistics (IBGE), 2010).

The food store audit also included the following measures: The location of the FV section was investigated by its close presence at the store's main entrance. The availability was evaluated by the presence of at least one unit of each purchasable item. In order to assess variety, we determined the number of different types within each item, e.g., Iceberg lettuce, Green-leaf lettuce, Red-leaf lettuce. The average price of analysed foods was expressed per kg for FV and per unit for ultra-processed food. The FV quality was rated as acceptable or unacceptable depending on whether most of the food was withered, bruised, overripe or old looking. Advertising was analysed by checking signs or advertisements in the stores that encouraged the purchase of FV or ultra-processed