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Food environment, income and obesity: a multilevel analysis of a reality of women in Southern Brazil

Ambiente alimentar, renda e obesidade: uma análise multinível da realidade de mulheres no Sul do Brasil

Entorno alimentario, renta y obesidad: un análisis multinivel de la realidad de mujeres en el Sur de Brasil

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Abstract

The objective of this study was to explore relationships between the neighborhood food environment and obesity in urban women living in São Leopoldo, Rio Grande do Sul State, Brazil. A cross-sectional survey was carried out. This study was conducted with 1,096 women. Structured interviews were conducted using a standard pre-tested questionnaire. Obesity was defined as body mass index (BMI) ≥ $30kg/m^2$. Circular buffers of 400m in radius were created based on the centroid of the women's houses who participated, in the 45 census tracts inhabited by them. Neighborhood food establishments were identified through systematic survey of all streets in the study areas and geographical coordinates of shops were collected. Establishments were evaluated using the NEMS tool. The prevalence of obesity was 33% among the women participants. After adjusting for individual variables, supermarkets and healthy food establishments were positively associated with obesity, PR = 1.05 (95%CI: 1.01-1.10), PR = 1.02 (95%CI: 1.00-1.04), respectively, while mean buffer income was negatively associated, PR = 0.64 (95%CI: 0.49-0.83). Neighborhood food environment factors were associated with obesity even after controlled for individual variables, as socioeconomic variables, behavioral and food purchase.

Feeding; Obesity; Women

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Introduction

The prevalence of obesity has increased in the world in the last decades [1]. The growing increase in obesity is influenced by contextual issues, since lifestyle, diet and physical activity practices are influenced by economic growth [2,3,4,5,6,7,8]. There is much evidence that family and contextual income influence obesity [9,10,11]. In Brazil, low-income women have a higher prevalence of obesity when compared to high-income women but the causal relationship is not well established [12,13].

Interventions focused on people changing their eating behaviors to improve their nutritional status have had limited success [2]. Although the individual approach is necessary, it is not sufficient and changing the contextual determinants of healthy eating also needs to be considered.

Recently, the interest in the potential impact of the neighborhood on individual health and healthy diet components has increased. The food environment refers to physical, economic, political and sociocultural characteristics, opportunities and conditions that influence food behaviors [14,15]. The food environment can influence food acquisition practices and whether people make healthy food choices or not, because besides being influenced by the individuals' preferences and knowledge about food, food behavior is influenced by the location of food stores and the price of available foods [15,16,17,18,19,20,21,22]. These characteristics, among other factors, may lead to the development of obesity and related conditions [23,24].

Types of food stores have been considered proxies for healthy or unhealthy diets. In Brazil, supermarkets offer many different types of ultraprocessed foods, but, on the other side, they also offer healthy foods to consumers [18,25]. This is different from grocery stores which predominantly sell ultraprocessed foods and few healthy foods, fruits and vegetables [26]. A Brazilian study with children shows that the availability of natural foods was associated with an increase of these foods consumption and a decrease of ultraprocessed food consumption [22]. In addition to the quality of food available in the neighborhood, the density of establishments is also a factor associated with nutritional status: in neighborhoods where there is a high diversity of food stores, residents tend to have a normal nutritional status [27,28].

Neighborhood social disadvantage is another contextual characteristic related to obesity. Socially disadvantaged neighborhoods tend to have a lower availability of healthy foods when compared to more advantaged neighborhoods [29,30,31,32,33,34,35,36,37]. Menezes et al. [35], when evaluated Brazilian adults found that average consumption of fruits and vegetables was higher in neighbourhoods with higher income and concentration of food stores. Furthermore, studies exploring the relationship between the food environment and obesity suggest that higher access to healthy food is associated with better diet quality and lower rates of obesity [26,29,38,39,40].

Although the relationship between the food environment and obesity has been studied in developed countries [41,42], few studies have focused on low and middle-income countries [28,42,43]. The objective of this study was to explore the relationship between the neighborhood food environment and obesity in women living in São Leopoldo, Rio Grande do Sul State, Brazil. We also assessed if relationships differed by income group. We hypothesized that living in a neighborhood with more supermarket and healthy food stores would protect residents from being obese, while living in areas with more grocery stores and convenience stores would increase the risk of being obese.

Materials and methods

This study was part of the larger project *Living Conditions and Health of Adult Women: A Population-based Study in Vale do Rio dos Sinos – Evaluation after 10 Years, Rio Grande do Sul, Brazil*. The present investigation had two stages of data collection. First, a cross-sectional population-based study of a representative sample of 1,096 women living in the urban area of São Leopoldo. Second, gathering information on the neighborhoods in which participants resided. The county of São Leopoldo is located in the Sinos River Valley, Porto Alegre Metropolitan Area, and in 2010, it had a population of 214,087 inhabitants [44].

Individual-level data collection

Individual data were collected by structured interviews with women aged 20-69 years using a standardized and pre-tested questionnaire, validated to ensure questions were understood correctly. A pilot study in a census tract, not included in the final sample, was conducted to test the methods and logistics of the research and if the questionnaire was adequate. The sample size for the overall study was estimated from the different outcomes predicted in this project, choosing the one with the largest sample size required to perform a cross-sectional analysis. Based on sample size calculations for identifying a risk ratio of 2.0 for a 95% confidence level and statistical power of 80%, with the ratio of 1 unexposed to 2 exposed, a total of 1,335 households were required to be visited in 45 census tracts. Cluster-based sampling was carried out, where 45 census tracts were drawn among the 371 in the urban area of São Leopoldo, using the "Value of the monthly nominal income of persons aged 10 years and over (with or without yield)" [44]. For each census tract, 36 households were selected. Pregnant women were excluded from the study.

Environmental-level data collection

We evaluated the neighborhood environment (stores, schools, parks, food stores, among others) of the 45 census tracts in which participants resided at the same period as when the individual-level data were collected in 2015. The geographical coordinates (latitude and longitude) of participants' residences were collected with GPS units (Etrex/Hcx/Garmin) when first visited for the individual-level data collection.

For each census tract, the centroid of the participants' residential locations was identified and used as an anchor to define a 400m radius buffer. Circular buffers have previously been used to geographically approximate individuals' neighborhood [45,46,47,48]. A 400m buffer was used since 400m is a reasonable distance for an individual to walk to a point of interest [49].

Researchers visited each buffer on foot to identify food stores and record their geographical coordinates by GPS. After the identification, formal and informal food stores were visited and assessed using an adapted version of the *Nutrition Environment Measure – Stores* (NEMS) tool [50,51]. This questionnaire evaluates the in-store availability and price of food, as well as the quality of fruits and vegetables available. The questionnaire allowed to distinguish three food groups: healthy, intermediate and unhealthy, according to the nutritional composition and the price of the food. Unhealthy foods received a negative score and healthy foods received a positive score. For the analyses, the stores considered healthy were those that had an overall positive score, meaning that they carried more healthy than unhealthy foods.

Measures

• **Individual variables**

The obesity outcome was evaluated at the individual level by means of the body mass index (BMI: ratio of weight in kilograms to the square of the height in meters). Women with a BMI ≥ 30kg/m² were considered obese [52].

Demographic variables included age (in 10-year groupings), skin color (self-identified and categorized as white vs. non-white), and marital status (married vs. unmarried, separated or widowed). Individual socioeconomic variables were household income (in tertiles), years of schooling (continuous), and paid employment status (in paid employment vs. not). A food frequency questionnaire (FFQ) was used to assess the daily consumption of fruits, vegetables, and sugary drinks. Women reported how many days per week or month they consumed each of 14 types of fruits, 11 types of vegetables and 2 types of sugar drinks in the 3 months prior to interview. In each category (fruits, vegetables and sugar drinks), items were summed to obtain the intake frequency per day [53]. Food frequency questionnaires may refer to different timeframes depending on the research objective [54]. In our study, we assessed intake 3-months prior to interview in order for the timing of the food intake and food environment measurements to be consistent.

Variables describing food purchasing practices included: the number of stores that women accessed to buy each of eight food items (rice, beans, milk, bread, meat, fruit, vegetables and industrialized products) and the number of food establishments that women accessed in the neighborhood where they lived (a subjective definition of neighborhood), both analyzed as continuous variables and transport mode used to purchase food (on foot and/or bicycle, car, motorcycle and/or bus).

• **Contextual variables**

Four variables related to the food environment were studied, namely the number of supermarkets, grocery stores (local food store), convenience stores (shop at gas station), and healthy stores (categorized through the NEMS score) in each of the 45 buffers.

The mean buffer-level income was also used to explore potential moderation of the association between food store availability and obesity. The mean buffer-level income was defined as the mean household income of the census tracts, calculated using official census data [44]. In cases where buffers overlapped multiple census tracts, income information for the different census tract was combined.

Data collection stages had quality control. First, we administered a control questionnaire, including variables that should not change over a short time frame, to 10% of the sample, 2 months after their first interview. This was done by telephone or home visits. Different interviewers also reviewed 20% of the buffers 15 to 40 days after the first environmental-level data collection by recording the coordinates of all food stores found. The intraclass correlation coefficient (ICC) was calculated and the value found for the food stores was 0.81 which is considered excellent [55].

• **Statistical analyses**

Data entry was performed in EpiData, version 3.1 (http://www.epidata.dk/). Double entry and subsequent comparison allowed to eliminate errors due to typing mistakes. Data analysis was conducted with Stata, version 12.0 (https://www.stata.com). We used Poisson regression with robust standard error to estimate crude and adjusted prevalence ratios (PR) and 95% confidence intervals (95%CI) controlling for the hierarchical study design (with 8 to 37 participants in each buffer) [56]. Poisson regression was used due to the high prevalence of the outcome in the sample [57].

We first assessed the association between individual variables only, and then examined the relationship between obesity and food environment variables. Variables that were significantly associated with the outcome at a 0.05 significance level were considered possible confounding factors and included in the adjusted models. Multilevel analyses for each of the food environment variables and neighborhood-level income controlled for sociodemographic and economic characteristics, variables related to the purchase of food, and for fruit and vegetable intake. We tested the interaction between income and types of food stores and all presented p < 0.05. Therefore, we used Poisson analysis to assess the relationship between the availability of specific types of food stores and obesity stratified by family income.

The research protocol was approved by the Ethics Research Committee of the University of Vale dos Sinos River (UNISINOS; CEP 653,394). Participants provided informed consent prior to data collection and were guaranteed complete confidentiality.

Results

From the 1,281 women in the full study sample, 153 refused to participate, 4 could not provide weight and height measurements, and 28 resided outside the buffer defined for their neighborhood. These were excluded from the analyses for a final analytical sample of 1,096 women. Despite exclusions, the analytical sample was representative, in terms of its demographic characteristics, to IBGE (Brazilian Institute of Geography and Statistics) data.

Table 1 shows socioeconomic, demographic and food purchase characteristics for the complete sample and according to obesity status. Women in the sample were white skin color (74.3%), married or in union (63.8%), aged 50 years or more (34.6%), had completed higher education (41.5%) and

Table 1

Socioeconomic, demographic and food purchase characteristics of the total sample and according to obesity (n = 1,096). São Leopoldo, Rio Grande do Sul State, Brazil, 2015.

Variables	n	%	Obesity			
			%	PR	95%CI	p-value
Age (years)						**< 0.001**
20-29	211	19.3	12.2	-	-	
30-39	238	21.7	21.0	1.54	1.11-2.13	
40-49	267	24.4	24.3	1.59	1.16-2.18	
≥ 50	380	34.6	42.5	1.95	1.46-2.61	
Skin color						0.346
White	815	74.3	32.3	-	-	
Not white	281	24.7	35.3	1.09	0.90-1.31	
Marital status						**0.002**
Single	223	20.4	15.5	-	-	
Married + union	700	63.8	64.6	1.34	1.04-1.72	
Divorced + widow	173	15.8	19.9	1.66	1.24-2.21	
Education (years)						**< 0.001**
≥ 11	455	41.5	32.7	-	-	
8-10	196	17.9	18.6	1.36	0.89-2.06	
5-7	247	22.6	26.0	1.67	1.09-2.57	
0-4	198	18.0	22.7	1.94	1.30-2.89	
Family income (BRL)						**0.024**
1st tertile (≤ 190.71)	352	33.3	35.8	1.28	1.03-1.59	
2nd tertile (190.72-345.81)	348	32.9	35.8	1.29	1.04-1.61	
3rd tertile (≥ 345.82)	358	33.8	28.4	-	-	
Employed						**0.042**
Yes	614	56.1	30.6	-	-	
No	482	43.9	36.4	1.19	1.00-1.40	
Transport used to purchase foods						0.88
On foot/Bicycle	442	40.3	40.6	-	-	
Car/Moto/Bus	654	59.7	59.4	0.98	0.83-1.17	
Nutritional status						
Normal	371	33.9				
Overweight	361	33.0				
Obesity	362	33.1				

	Mean	SD		PR	95%CI	p-value
Fruits and vegetables (consume/day)	6.34	2,90		1.03	1.00-1.06	**0.013**
Sweet drink (consume/day)	0.46	0.40		1.15	0.93-1.41	0.175
Number of stores *	1.69	0.70		1.15	1.04-1.27	**0.005**
Number of food items bought inside the neighborhood **	4.18	3.52		0.99	0.97-1.01	0.58

95%CI: 95% confidence interval; PR: prevalence ratio; SD: standard deviation.

* Number of types of establishment that women access;

** Number of items that women buy inside their neighborhood.

worked at the time of the interview (56.1%). In relation to food intake, they consumed on average 6.34 (SD: 2.90) fruits and vegetables per day, and drank sugar drinks 0.46 (SD: 0.40) times per day. In relation to food purchases, women reported accessing an average of 1.69 (SD: 0.70) types of food establishments, relying on their neighborhood to purchase, on average, 4.18 (SD: 3.52) food items

out of the 8 enquired, and 59.7% of women reported making the majority of their purchases by car, motorcycle or bus (Table 1).

The prevalence of obesity in the sample was 33.1%. Table 1 shows the crude prevalence ratios for obesity with the characteristics of the sample. Compared to their respective reference category, a higher obesity prevalence was found in the higher age groups (PR = 1.95; 95%CI: 1.46-2.61), among those divorced, separated and widowed (PR = 1.66; 95%CI: 1.24-2.21), those with a lower schooling level (PR = 1.94; 95%CI: 1.30-2.89) and in the second tertile level of income (PR = 1.29; 95%CI: 1.04-1.61), as well as among women who were not working (PR = 1.19; 95%CI: 1.00-1.40). The frequency of consumption of fruits and vegetables and the number of stores accessed by women to purchase food were associated with obesity, with PRs of 1.03 (95%CI: 1.00-1.06; p = 0.013) and 1.15 (95%CI: 1.04-1.27; p = 0.005), respectively.

Concerning the food environment, 279 food stores were identified, of which 95 were supermarkets (34.1%), 95 grocery stores (34.1%), 17 (6.1%) convenience stores, 37 (13.3%) bakeries, 11 (3.9%) butchers, 19 (6.8%) fruit producers and 5 (1.8%) others (data not shown).

Table 2 shows the relationship between environmental-level variables (availability of four different types of food establishments and income) and obesity. The associations were not substantially different when using absolute compared to relative measures. Results for absolute measures are presented here, while those for relative measures can be found in the Supplementary Material (http://cadernos.ensp.fiocruz.br/site/public_site/arquivo/supl-e00144618_6899.pdf). In the crude analysis, women living in neighborhoods where supermarkets were available presented a 6% higher prevalence of obesity, when compared to those without this food establishment in their neighborhood (PR = 1.06; 95%CI: 1.01-1.10). After controlling for individual variables (age, marital status, family income, education, employment, consumption of fruits and vegetables and food purchasing behaviors), the association between supermarket exposure and obesity was maintained (PR = 1.05; 95%CI: 1.01-1.10). The direction of the association between availability of healthy establishments in the neighborhood and obesity was the same. After adjusting for demographic, socioeconomic, food intake and food purchase variables, obesity and healthy establishments were associated (PR = 1.02; 95%CI: 1.00-1.04). There was an inverse association between the mean income of the buffer and obesity, meaning that the higher the neighborhood-level income, the lower the prevalence of obesity, even after adjusting for potential confounders. A 36% lower prevalence of obesity was observed in women living in areas with a higher mean income, when compared to those living in more disadvantaged areas. (Table 2). Grocery stores and convenience stores were not associated with obesity in the multilevel Poisson regression analysis.

Table 3 shows the mean number of each type of food store for the full analytical sample and stratified by individual-level income tertile. The highest mean was found for healthy establishments (6.44; SD: 0.83), followed by supermarkets (2.98; SD: 5.41), grocery stores (2.57; SD: 2.89), and convenience stores (0.33; SD: 0.67). As income tertiles increased, there was an increase in the mean number of convenience stores.

Table 3 also shows results for the assessment of the interaction between type of food store and individual-level income (in tertiles). There was a significant interaction for the 1st tertile (lowest income) with supermarket and healthy stores, that low income women with access to these stores had a 7% and 2% higher obesity risk compared to those without access (PR = 1.07; 95%CI: 1.03-1.12 and PR = 1.02; 95%CI: 1.00-1.05, respectively). A significant interaction was also found among women in the 3rd income tertile but for supermarkets only (PR = 1.03; 95%CI: 1.00-1.07).

Discussion

We explored the association between the characteristics of the food environment and obesity in women living in a midsize Brazilian city, thus contributing to the literature on neighborhood effects on obesity in a middle-income country. We found that obesity was positively associated with the availability of supermarket and healthy food establishments in the neighborhood and inversely associated with the average income of the neighborhood.

Table 2

Multilevel Poisson regression models for the association between the neighborhood food environment and obesity (n = 1,096). São Leopoldo, Rio Grande do Sul State, Brazil, 2015.

Variable	Supermarket		Grocery store		Convenience store		Healthy store *		Mean income **	
	PR	95%CI	PR	95%CI	PR	95%CI	PR	95%CI	PR	95%CI
Crude	1.06	1.01-1.10 ***	1.01	0.98-1.05	0.86	0.72-1.03	1.02	1.00-1.04 #	0.64	0.49-0.84 ***
Model 1	1.05	1.01-1.10 ***	-	-	-	-	-	-	-	-
Model 2	-	-	1.0	0.97-1.04	-	-	-	-	-	-
Model 3	-	-	-	-	0.86	0.72-1.02	-	-	-	-
Model 4	-	-	-	-	-	-	1.02	1.00-1.04 #	-	-
Model 5	-	-	-	-	-	-	-	-	0.64	0.49-0.83 ***

95%CI: 95% confidence interval; PR: prevalence ratio.

Note: Crude: effect of the types of foods stores without ajustment; Model 1: supermarket controlling for individual variables (age, marital status, family income, education, employment, consumption of fruits and vegetables and food purchasing behaviors); Model 2: grocery store controlling for individual variables; Model 3: convenience store controlling for individual variables; Model 4: healthy store controlling for individual variables; Model 5: mean income controlling for individual variables.

* Stores with more healthy and intermediate items than unhealthy items, from *Nutrition Environment Measure – Stores* (NEMS);

** Total monthly income of individuals 10 years of age or older (Brazilian Institute of Geography and Statistics) within the buffer divided by 1,000;

*** $p < 0.01$;

# $p < 0.05$.

Table 3

Descriptive statistics for the neighborhood food environment, full sample and by family income (individual variable) and the association between availability of specific types of food establishments and obesity, stratified by family income.

Variable	Total		1st tertile (≤ BRL 190.71)		2nd tertile (BRL 190.72-345.81)		3rd tertile (≥ BRL 345.82)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Supermarket	2.98	5.41	3,28	2,47	3.13	2.47	2.55	2.28
Convenience store	0.33	0.67	0.21	0.49	0.24	0.47	0.53	0.90
Grocery store	2.57	2.89	3.02	3.23	2.74	3.10	1.98	2.12
Healthy stores *	6.44	0.83	6.90	4.83	6.65	4.71	5.83	4.28
	PR	95%CI	PR	95%CI	PR	I95%CI		
Supermarket	1.07	1.03-1.12 **	1.06	1.02-1.11 ***	1.03	1.00-1.07 #		
Convenience store	0.88	0.74-1.05	0.85	0.71-1.02	0.95	0.77-1.16		
Grocery store	1.01	0.97-1.04	1.03	1.00-1.06 #	1.00	0.97-1.03		
Healthy stores *	1.02	1.00-1.05 ***	1.02	1.00-1.05 ***	1.01	0.99-1.03		

95%CI: 95% confidence interval; PR: prevalence ratio; SD: standard deviation.

Note: Poisson analysis. The interaction between type of food store and income was tested before the Poisson analysis and all presented $p < 0.05$.

* Stores with more healthy and intermediate items than unhealthy items, from *Nutrition Environment Measure – Stores* (NEMS);

** $p < 0.001$;

*** $p < 0.01$;

# $p < 0.05$.

This is consistent with the literature which shows that contextual characteristics are associated with obesity in men and women [1], however, no studies have been found that highlight the relationship between food environment and obesity in women specifically. Importantly, in our study 76% of the women interviewed were responsible for purchasing food in their homes, and this reinforces the importance of studying the relationship between the food environment and obesity among women since they are responsible for making purchasing decisions in their households. The obesity prevalence of 33.1% among participating women, as well as obesity being positively associated with age and inversely related to family income and schooling are in line with previous research [7,9,10,11,58]. One of the possible explanations for the relationship between the neighborhood and obesity, especially in poor economic communities, is due to the high exposure to unhealthy foods and limited access to healthy foods [59]. Although economically disadvantaged populations have a good density of establishments [60,61], the quality of the foods provided may inhibit a healthy eating behavior among the residents who depend on this trade [62]. Evidence suggests that the neighborhood socioeconomic status, both in developing and developed countries, can influence the health of individuals and still affect many of the factors associated with the prevalence of obesity by environmental factors, such as access to healthy food stores, healthy restaurants, places for physical activity and parks, and price and availability of healthy food [29,38,42,58,63,64,65].

We hypothesized that being exposed to a supermarket would reduce the prevalence of obesity, since women would have greater diversity in choice and thus greater opportunities for buying healthy foods, but our findings did not support this hypothesis. In our study supermarket availability was positively associated with obesity, whereas the majority of previous research, which was conducted in different social contexts, for it occurred in developing countries, has reported an inverse relationship [18,25,29]. However, two previous studies reported results similar to ours. In one study, the relationship between obesity and living in a "food desert" (i.e., areas without healthy foods available), in adults in Detroit (United States), Budzynska et al. [66], found that people who shopped at supermarkets had higher BMIs compared to those who bought groceries from other food stores. Similarly, Chaparro et al. [67] found that in Los Angeles (United States), residents who had a supermarket in their neighborhood had twice the risk of being obese when compared to those without supermarket access (OR = 2.02; 95%CI: 1.44-2.83), however, the neighborhood density of unhealthy food outlets did not modify this association. One possible explanation for this association is that supermarkets sell different types of foods, both healthy and unhealthy, and that the proportion of the latter to the former is often higher [67,68]. In addition ultraprocessed foods of low nutritional quality are usually less expensive than fresh healthy foods, so although both can be bought in supermarkets, cheaper foods might be more popular [36,68,69,70].

We also found that obesity was positively associated with the access to a healthy food establishment. This relationship needs to be studied in more depth, but one avenue of research might be to understand if the price of healthy food is one of the possible factors that explains this result. There is evidence suggesting that healthier diets tend to be more expensive and that when food prices increase, the quality of diet decreases [68,71,72]. Making healthy foods cheaper is one way to encourage people to buy these foods, and this is only possible through monetary policies. A promising way to improve food intake is through food taxation [73]. This is already evident in the scientific literature, demonstrating that both subsidies and taxes influence food purchasing behaviors, and consequently, food intake, but none of the evidence is from Brazil specifically [74,75].

In this study we used the NEMS score to classify food establishments. In the literature different measurement methods can be used to evaluate the food environment, both at the community level, through the location and density of food retailers, as well as at the consumer level, to assess in-store food availability, variety, price, and quality and to qualify stores as healthy or unhealthy [76]. In one study on adults from Philadelphia (United States), that has used the same method to describe the food environment, people were more likely to shop at food stores closest to home if the store had higher NEM-S scores, and to travel for shopping if stores had lower scores [62]. Many studies, however, classify the environment into healthy or unhealthy based on commercial classifications only, such by categorizing "supermarkets" as "healthy stores" [25,77]. This classification presents limitations, and one is that stores usually offers both healthy and unhealthy foods [36]. A combination of methodologies as

we used here may enable a more comprehensive assessment of the relationship between the environment and obesity [30].

The results of the present study should be interpreted in light of methodological limitations. First, the cross-sectional design does not allow to establish causal relationships and reverse causality cannot be excluded. For example, an unfavorable food environment could lead to a behavioral change that would influence obesity, but, on the other hand, it is possible that the food environment would have adapted to the demand of obese customers. Considering the current Brazilian food policy, a second limitation is the classification of establishments according to the NEMS classification which considers the nutritional composition of foods but not the level of industrial processing, which is being recognized as an important determinant of health [78,79]. The third limitation is our focus on the residential neighborhood since women can buy food near their workplace or travel to shop in different areas. This is especially important considering that participants reported buying only half of the staple items in establishments located in what they considered to be their neighborhood. Finally, the timeframe for assessing food intake (i.e., 3 months prior to interview), differs from the 12-month period often used in other studies. Nonetheless, the timeframe chosen was consistent with timing of food environment.

Worldwide, changes in the political landscape related to nutrition are occurring, with an increasing number of countries taking regulatory action to improve the food environment to promote healthy and quality foods and Brazil is no different. Important public policies have been proposed, including some that acknowledge that the environment can benefit the population's health by reinforcing the contextual approach to obesity prevention and promoting healthy eating [80,81,82,83].

This paper adds to the literature from elsewhere that suggests residential neighborhood may be an important contextual factor for obesity but that understanding it properly, and within country-specific settings, is likely to be an important part of ensuring that obesity prevention strategies are effective.

Contributors

V. Backes and M. T. A. Olinto contributed to the data collection, data analysis, and writing. F. Bairros and C. B. Cafruni contributed to the data collection. S. Cummins, M. Shareck, and K. Mason contributed to the data analysis and writing. J. S. Dias-da-Costa cotnributed to the data collection and data analysis.

Additional informations

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Resumo

O estudo teve como objetivo explorar as relações entre o ambiente alimentar da vizinhança e obesidade em mulheres na área urbana de São Leopoldo, Rio Grande do Sul, Brasil, através de um inquérito transversal. O estudo teve uma amostra de 1.096 mulheres. Foram realizadas entrevistas estruturadas com um questionário padronizado e previamente testado. A obesidade foi definida como índice de massa corporal (IMC) ≥ 30kg/m². Foram criadas zonas-tampão com raio de 400m em torno do centroide das residências das participantes nos 45 setores censitários. Os estabelecimentos varejistas com venda de alimentos na vizinhança foram identificados através de uma pesquisa sistemática das áreas do estudo, e foram coletadas as coordenadas geográficas dessas lojas. Os estabelecimentos foram avaliados com a ferramenta NEMS. A prevalência de obesidade foi 33% entre as participantes. Depois de ajustar para as variáveis individuais, os supermercados e os estabelecimentos com alimentos saudáveis mostraram uma associação positiva com a obesidade, RP = 1,05 (IC95%: 1,01-1,10), RP = 1,02 (IC95%: 1,00-1,04), respectivamente, enquanto que a renda média da zona-tampão mostrou associação negativa, RP = 0,64 (IC95%: 0,49-0,83). Os fatores de ambiente alimentar da vizinhança estiveram associados à obesidade, mesmo depois de controlar para as variáveis individuais, socioeconômicas, comportamentais e de compra de alimentos.

Alimentação; Obesidade; Mulheres

Resumen

El objetivo de este estudio fue investigar las relaciones entre el entorno alimentario del vecindario y la obesidad en mujeres que viven en áreas urbanas de São Leopoldo, Rio Grande do Sul, Brasil. Se llevó a cabo un estudio transversal. Este estudio se realizó con 1.096 mujeres. Se realizaron entrevistas estructuradas, usando un cuestionario estándar probado previamente. La obesidad se definió como un índice de masa corporal (IMC) ≥ 30kg/m². Se crearon amortiguadores circulares en un radio de 400m, basados en el centroide de las casas de las mujeres que participaron, en los 45 distritos censales donde residían. Los establecimientos de comida del vecindario fueron identificados mediante un estudio sistemático de todas las calles en las áreas de estudio y también se recabaron las coordenadas geográficas de las tiendas. Los establecimientos fueron evaluados usando el instrumento NEMS. La prevalencia de obesidad fue de un 33% entre las mujeres participantes. Tras el ajuste de las variables individuales, los supermercados y los establecimientos de comida sana estuvieron positivamente asociados con la obesidad, RP = 1,05 (IC95%: 1,01-1,10), RP = 1,02 (IC95%: 1,00-1,04), respectivamente, mientras que un promedio de renta media estuvo negativamente asociado, RP = 0,64 (IC95%: 0,49-0,83). Los factores del vecindario en el entorno alimentario estuvieron asociados con la obesidad incluso después de ser controlados por variables individuales como: socioeconómicas, comportamentales y de compra de comida.

Alimentación; Obesidad; Mujeres