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Perceptions of neighborhood environments and their association with overweight in children, adolescents, and caretakers in a medium-sized city in Brazil

Maria Alvim Leite[1], Maíra Macário de Assis[1], Bruna Pires Luz Silva[2], Fernanda Penido Matozinhos[3], Cristina Padez[4], Ana Paula Carlos Cândido[2] and Larissa Loures Mendes[5*]

Abstract

Background: Previous studies conducted in developed countries have suggested associations between perceptions of neighborhood characteristics and weight gain. However, there are few studies regarding the adult perception of the residential environment and overweight in children and adolescents in countries with low and medium income. The aim of the study was to assess the associations between caretakers' perceptions of environmental characteristics and overweight in themselves and in their children, in a medium-sized city in Brazil.

Methods: Cross-sectional study was performed with 708 children and adolescents and their caretakers. Anthropometric measurements and a structured questionnaire filled out by caretakers concerning child and family characteristics were completed. For environmental assessment, 408 caretakers answered the Portuguese version of the "Neighborhood Environment Walkability Scale" by telephone call. A 95% confidence interval (95%CI) was used in the analysis. Unadjusted prevalence ratios (PR) were calculated, as were PR adjusted for age, gender, family income, and total time of exercise the children or adolescents practiced (from Poisson regression models predicting children's and adolescents' overweight), and for age and family income (from Poisson regression models predicting caretakers' overweight). Statistical significance was defined as a p value <0.05.

Results: Adult perceptions about the absence of sidewalks on most streets (PR = 0.49, 95%CI = 0.42–0.98) and the absence of interesting things to look at (esthetics) in the neighborhood (PR = 0.65, 95%CI = 0.44–0.90) were inversely associated with the prevalence of overweight in the children and adolescents after adjustment. The absence of hills in the neighborhood (PR = 1.24, 95%CI = 1.05–1.45) and the perception of heavy exhaust fumes (PR = 1.26, 95%CI = 1.02–1.56) were directly associated with the prevalence of overweight in the caretakers. Finally, the high speed of traffic on the street (PR = 0.76, 95%CI = 0.63–0.92) was inversely associated with the prevalence of adult overweight.

Conclusions: The results showed, in Brazil, the importance of understanding aspects related to obesogenic environment in the context of medium-sized Brazilian cities.

Keywords: Adolescent, Child, Environment, Overweight, Perception

* Correspondence: larissa.mendes@gmail.com
[5]Department of Nutrition, Universidade Federal de Minas Gerais (UFMG), Av. Alfredo Balena, Número 190, Bairro Funcionários, Belo Horizonte, Minas Gerais CEP 30130-100, Brazil
Full list of author information is available at the end of the article

Background

The high prevalence of overweight in children and adolescents and its associations with metabolic complications is considered a serious public health problem [1, 2]. In Brazil, data from a national survey on families' budgets in 2008–2009 showed that 33.5% of children aged 5 to 9 years are overweight and 14.3% of them are obese. Among adolescents, the prevalence of overweight was 20.5% and of obesity was 4.9% [3]. Unhealthy eating habits, such as greater consumption of processed and ultra-processed foods and sedentary activities, are immediately related factors of weight gain [4, 5].

In addition, recent studies have focused attention on how neighborhood built environments affect individuals' participation in physical activity (PA) and ultimately their BMI. The evidence suggests an association between individual health outcomes, like weight gain, and characteristics of the environment where families live [6]. Access to sports facilities, parks, and green areas; paved streets in good condition; existence of sidewalks and bike paths; availability of establishments that sell healthy foods and safety of the neighborhood are some of the aspects that can change behaviors related to food consumption and PA in children and adolescents, as well as adults and seniors [7–9].

When it comes to children, because they have less autonomy than adults, there is a dependence factor on caretakers' perceptions of these characteristics, which results in a particular impact on their weight status and PA [10–13]. The caretakers have an important role related to children and adolescents [14], and therefore, it is possible that their perceptions of neighborhood environments and safety may affect the behaviors of this group [15]. However, the relationship between environmental factors and overweight in medium-sized cities in medium-income countries, like Brazil, is still not fully clarified.

In countries with low and medium income, studies of urban areas that investigate aspects related to weight status in childhood and adolescence are still scarce and questions remain about the applicability of surveys constructed in developed countries to local contexts. Most of the evidence was found in developed countries, which have social, cultural, and environmental factors different from the reality of countries like Brazil [16, 17]. Therefore, the aim of this study was to assess the associations between caretakers' perceptions of environmental characteristics and overweight in themselves and in their children, in a medium-sized city in Brazil.

Methods

Participants

A cross-sectional study was conducted in children, adolescents, and their caretakers in the city of Juiz de Fora, Minas Gerais, Brazil. Data collection took place from 2011 to 2014. The study was performed with children and adolescents, ages 6–16 years, of both genders, from public elementary and high schools in the city's suburban area.

According to the school census [18], in 2009, the total number of children and adolescents enrolled in public schools in Juiz de Fora was 71,671 students. To estimate the sample size, a comparative analysis between the proportions (chi-square) was made. The statistical power calculated was 95%, considering an alpha of 5%, an effect size of $w = 0.15$ and $df = 1.5$. Based on these criteria, a minimum sample of 687 students was established. For these calculations, the G*Power software, version 3.1.9.2, was used.

A total of 708 students were selected. At first, a casual sampling stratification was considered, so the number of schools was proportional to the total number of students in each class. Subsequently, the selection of the students, by schools, was made from a simple random drawing by class, using a table of random numbers, which was filled to complete the required number of students per school.

Instrumentation and procedure

The anthropometric measurements of height and weight of children, adolescents, and their caretakers were taken, at schools, without shoes and wearing light clothes, by trained researchers using a calibrated digital weighing-machine (weight per kilogram) and a portable stadiometer (height per meter).

For children and adolescents, the body mass index (BMI) was calculated based on the height and weight (kg/m^2) and, subsequently, the *z*-score was considered based on the growth reference data of the World Health Organization (WHO). Children's and adolescents' weight status were classified as normal < +1SD and overweight > + 1SD [19]. For adults, BMI was categorized as normal ($18.5\ kg/m^2 \leq BMI < 25\ kg/m^2$) and overweight ($BMI \geq 25\ kg/m^2$), according to the values proposed by the WHO [20].

Additionally, a questionnaire developed by this study's researchers was used. Its variables were kinship with the caretaker, gender (for caretaker and students), ethnicity (for students), age (for caretakers and students), date of birth (for students), practice of PA (for students), food consumption (for students), income (for caretakers), and education (for caretakers).

To analyze the perception of residential environment, a subsample of 408 caretakers (57% of the initial sample) who agreed to answer a telephone interview conducted by trained researchers was made. The subsample did not differ statistically in relation to socio-demographic characteristics of the total sample.

The perception of the neighborhood physical environments was assessed using the Brazilian version of the Neighborhood Environment Walkability Scale (NEWS), originally developed by Saelens et al. [21], translated and validated in Portuguese by Malavasi [22]. For this study, a reduced version of the scale was used, contemplating the items of proximity and access of general establishments and social structures, facilities for walking and cycling, road characteristics, surrounding neighborhood characteristics, traffic safety, security against crime, and satisfaction with the neighborhood. The item related to residential density was not used.

The associations between the scale's questions and the study outcomes were analyzed, and the answers were dichotomized into "agree" (considering the options "agree" and "strongly agree") and "disagree" (considering the options "disagree" and "strongly disagree").

Data analysis

Continuous variables, which were skewed, were described in terms of median and interquartile range (IQR). The Wilcoxon test was used to analyze the differences between gender and children's and adolescents' ages, total time of exercise in which the child or adolescent engaged, and household income. Categorical variables were presented as relative frequencies and percentages, and chi-square was used to analyze the differences. Stata (Statistical Software for Professionals) version 13.0 was used for all the statistical analyses.

Poisson regression models were constructed to quantify the relationships between perceived environment and child, adolescent, and caretaker overweight. Crude prevalence ratios (PR) were calculated, and the criterion used for selection of variables in the bivariate analysis was $p \leq 0.20$. After the bivariate analysis, the association was verified between overweight and the perceived environment variables adjusted for potential confounding factors.

For the child or adolescent, the PRs were adjusted by age, gender, household income, and total time of exercise the child or adolescent practiced, and for caretakers, the PRs were adjusted for age and household income. A 95% confidence interval (95%CI) was used to guide interpretation of Poisson models. Statistical differences were evaluated according to the likelihood ratio (LR) and the Wald test. In the bivariate and multivariate analyses, the measure of association was prevalence ratio (PR), calculated with the aid of Poisson regression with an estimator of robust variance [23]. Due to the extent of the scale, the tables were organized into groups according to the NEWS.

This study was approved by the Ethics Committee on Research in Humans at the Universidade Federal de Juiz de Fora (UFJF), case number 522.694.

Results

Among the participants in the current study, 46.6% were boys and 53.4% girls, 6 to 16 years old. The median age was 11.0 years (IQR = 9–13), the median total time of exercise the child or adolescent practiced was 195.6 min daily (IQR = 113–248), and the median household income was R$1300 (IQR = 933–2005) (Table 1).

The Wilcoxon test showed significant differences in the total time of exercise the child or adolescent practiced between genders ($p < 0.001$). The predominant prevalence of the caretaker's education in total was 4 to 7 years (38.4%). In this sample, 33.6% of the children and adolescents were overweight (95%CI = 0.29–0.38). The prevalence of overweight in caretakers was 67.8% (95%CI = 0.62–0.73) (values not shown in the tables).

Table 2 shows the unadjusted and adjusted prevalence rates of individuals overweight (children, adolescents, and their caretakers), in Juiz de Fora, according to the perceived environment variables. In the unadjusted analysis, the environmental perception variables associated with children's and adolescents' overweight were the places for walking and cycling domain ("There are sidewalks on most of the streets") and the neighborhood surroundings domain ("There are many interesting things to look at while walking").

After adjusting for age, gender, family income, and total time of exercise that children or adolescents practiced, significant associations between children's and adolescent's overweight and the following perceptions of the residential environment were found. The caretaker's perception about lack of sidewalks on most streets (PR = 0.50, 95%CI = 0.28–0.90) and the neighborhood surroundings/esthetics (PR = 0.69, 95%CI = 0.49–0.96) were significantly and inversely associated with the prevalence of children's and adolescents' overweight (Table 2).

For caretakers, perceived absence of hills (i.e., flat terrain) in the neighborhood (PR = 1.24, 95%CI = 1.07–1.42) and heavy exhaust fumes (such as from cars, buses) when walking (PR = 1.26, 95%CI = 1.02–1.56) were directly associated with the prevalence of caretakers' overweight in the sample. High traffic speed on the streets (PR = 0.82, 95%CI = 0.70–0.96), in contrast, was inversely associated with caretakers' overweight. Both factors were found even in unadjusted data and after adjusting for age and family income (Table 2).

Discussion

The present study evaluated the associations of the adult-perceived environment with overweight in themselves and in their children, in a medium-sized city in Brazil. This is one of the few studies with this theme conducted in a medium-sized city in Brazil. The results may be important for urban planning, connecting associations of a city's characteristics and health status.

Table 1 Descriptive statistics for children, adolescents, and caretakers, by gender

Variables	Boys (46.6%)		Girls (53.4%)		Total (100%)	
	Median	IQR	Median	IQR	Median	IQR
Children and adolescents age (years)	11.0	9–13	11.5	10–13	11.0	9–13
Total time of exercise that children or adolescents practiced daily (min)	180.5	113–248	113	113–180.5	195.6	113–248
Household income (R$)	1244	800–2000	1400	1000–2500	1300	933–2005
1st tercile income (R$400–1200)	800	622–900	800	622–100	800	622–933
2nd tercile income (R$1044–1800)	1300	1200–1500	1300	1200–1500	1300	1200–1500
3rd tercile tncome (R$1866–8500)	2900	2000–4000	3000	2500–4000	3000	2177–4000
Age group	*N* (%)		*N* (%)		*N* (%)	
6–9 years[a]	49 (25.8)		54 (24.8)		103 (25.3)	
10–16 years	141 (74.2)		164 (75.2)		305 (74.7)	
Caretakers' education	*N* (%)		*N* (%)		*N* (%)	
11 or more years	54 (36.5)		63 (38.9)		117 (37.7)	
8–10 years	21 (14.2)		22 (13.6)		43 (13.9)	
4–7 years	54 (36.5)		65 (40.1)		119 (38.4)	
0–3 years	19 (12.8)		12 (7.4)		31 (10.0)	
Caretakers' weight status	*N* (%)		*N* (%)		*N* (%)	
Normal weight[a]	48 (34.3)		44 (29.5)		92 (31.8)	
Overweight	92 (65.7)		105 (70.5)		197 (68.2)	
Children's and adolescents' weight status	*N* (%)		*N* (%)		*N* (%)	
Normal weight[a]	117 (61.6)		151 (69.3)		268 (65.7)	
Overweight	73 (38.4)		67 (30.7)		140 (34.3)	

n = sample
IQR interquartile range
[a]Reference category

Despite the scarcity of similar studies in this country, for a comparison with the results of this paper, there is increasing discussion in developed countries about aspects of neighborhood-related subjective indicators and health issues.

Studies have shown that parental perceptions are associated with the weight status of children and adolescents, who are under the responsibility of an adult and do not have autonomy over their decisions [24, 25]. In addition, walking and cycling for transportation by youth have been associated with objective measurements of community design and transportation attributes such as distance to destinations, sidewalks, and traffic safety [26, 27].

On environmental perception, as a rule, it has been found that subjects with more positive impressions are more likely to be physically active [28, 29]. An Australian study [30], for example, examining perceptions and behaviors of adults, found that improved perceptions of accessibility to destinations and esthetics were associated with increased walking levels, which impact directly on weight status. However, in this research, most of the results showed different associations with other studies' results about environmental perceptions and their associations with child, adolescent, and adult overweight. This demonstrates the necessity of conducting other studies, due to the differing aspects of neighborhood perceptions in medium-sized cities in Brazil. A similar situation has been found in a systematic review: only 30% of the associations between parents' perceptions of the environment and children's activities were significant in the anticipated directions [31].

This study suggested that when caretakers disagree that their neighborhood has sidewalks on most of the streets, and many interesting things to look at while walking there, the association with the prevalence of overweight in their children was inverse. A possible reason for this finding may be the urban design of the city under study, which is unplanned, and the absence of sidewalks and the "bad" esthetics that are realities in most of the neighborhoods. However, previous studies have shown that the absence of sidewalks and bicycle lanes—or their poor maintenance—limit the active mobility and place at risk the safety of those who decide to use them. This situation may result in decreased PA

Table 2 Prevalence rates from Poisson regression models predicting children's and adolescents' overweight and caretakers' overweight

Variables	Unadjusted PR (95%CI)	Adjusted PR[a] (95%CI)
	Children's and adolescents' overweight	
Places for walking or cycling (reference = agree)		
There are sidewalks on most of the streets.	*0.64 (0.42–0.99)*	*0.50 (0.28–0.90)*
The sidewalks are well maintained (paved, even, and not many cracks).	0.94 (0.72–1.23)	0.91 (0.67–1.24)
There are bicycle or pedestrian trails in or near my neighborhood that are easy to access.	0.98 (0.74–1.30)	0.84 (0.62–1.15)
Neighborhood surroundings (reference = agree)		
There are trees along the streets.	1.06 (0.81–1.40)	1.11 (0.81–1.51)
Trees give shade for the sidewalks.	1.02 (0.76–1.37)	1.07 (0.76–1.50)
There are many interesting things to look at while walking.	*0.69 (0.51–0.93)*	*0.69 (0.49–0.96)*
My neighborhood is generally free from litter.	0.92 (0.69–1.23)	0.96 (0.68–1.35)
There are many attractive nature landscapes.	1.05 (0.77–1.44)	1.07 (0.74–1.54)
There are many attractive buildings/homes.	1.05 (0.80–1.38)	1.03 (0.74–1.43)
There are parks or other locations for physical activity or walking.	1.08 (0.80–1.46)	1.07 (0.75–1.50)
	Caretakers' overweight	
Access to services (reference = agree)		
I can do most of my shopping at local stores.	0.98 (0.88–1.08)	0.95 (0.81–1.10)
Stores are within easy walking distance of my home.	1.07 (0.96–1.18)	1.04 (0.90–1.20)
Parking is difficult in local shopping areas.	1.03 (0.93–1.15)	1.02 (0.88–1.19)
Many places to go within easy walking distance of my home.	0.99 (0.85–1.16)	0.96 (0.77–1.19)
It is easy to walk to a bus stop (train, subway) from my home.	1.17 (0.94–1.44)	1.05 (0.59–1.87)
The streets are hilly, making my neighborhood difficult to walk in.	1.04 (0.94–1.16)	1.09 (0.94–1.27)
Many canyons/hillsides limit the number of routes for getting from place to place.	*1.13 (1.02–1.25)*	*1.24 (1.07–1.42)*
Traffic safety (reference = agree)		
So much traffic along the street I live on that it makes it difficult or unpleasant to walk.	1.00 (0.90–1.11)	0.97 (0.83–1.13)
So much traffic along nearby streets that it makes it difficult or unpleasant to walk.	1.01 (0.90–1.14)	0.99 (0.83–1.17)
The speed of traffic on the street I live on is usually slow (30 mph or less).	*0.86 (0.77–0.96)*	*0.82 (0.70–0.96)*
Most drivers exceed the posted speed limits while driving.	0.98 (0.88–1.09)	0.94 (0.81–1.08)
Crosswalks and pedestrian signals to help walkers cross busy streets.	1.02 (0.92–1.14)	1.08 (0.93–1.25)
The crosswalks help walkers feel safe crossing busy streets.	1.03 (0.92–1.16)	1.11 (0.94–1.32)
When walking, there are heavy exhaust fumes (such as from cars, buses).	*1.18 (1.01–1.38)*	*1.26 (1.02–1.56)*

$p < 0.05$ (Poisson regression)
PR prevalence ratio, *95%CI* 95% confidence interval
[a]Adjusted for children's and adolescents' overweight: age, gender, family income, and total time of exercise that children or adolescents perform; or adjusted for caretakers' overweight: age and family income
Note: Italic values represent significant associations in which the confidence interval does not pass by 1.00

and, consequently, in the weight gain of the local population [24, 25, 32].

About neighborhood esthetics, Mota et al. [32] found that more physically active adolescents are the ones who care about the recreational opportunities and beauty of the neighborhood. Nogueira et al. [24] studied the environmental perception of parents and the nutritional status of their children. They found that neighborhoods with better access to destinations and interesting things to look at were associated with lower BMI in Portuguese girls. Thus, it is important to conduct further studies to better understand the aspects of neighborhood surroundings in medium-sized cities in developing countries because these aspects may have different perceptions compared with cities in developed countries.

For caretakers, the perception of neighborhoods without canyons/hillsides was associated with a higher prevalence of overweight adults. It is noteworthy that in the city of Juiz de Fora, many neighborhoods are located in hilly areas, consequently influencing walkability. For traffic safety, when caretakers disagree with the perception of lower traffic speeds on the street, this was

associated with a lower prevalence of overweight. Other studies show consistent results that traffic safety is an important attribute related to a better PA profile and weight of individuals [33–35]. The association of perceived traffic speed and overweight was inverse in this study, and the authors believe it was because Brazilian urban environments are different from those in developed countries. Most Brazilian urban neighborhoods have infrastructure, transportation, and road designs that may not be adequately captured by measures constructed in the developed countries, and this may explain the fact that a different association was found about the perception of traffic safety.

Also for caretakers, the perception of heavy exhaust fumes when walking was associated with a higher prevalence of overweight adults. The perception of polluted air may inhibit people from walking or cycling, leading to weight gain for those subjects [36]. In polluted environments, people also feel less comfortable practicing PA, because of the difficulty in breathing caused by some fume components [37].

For domains related to perceived safety from crime, stores, facilities, and other things in neighborhood, and neighborhood satisfaction, no associations were found with the prevalence of overweight in children, adolescents, and their caretakers.

Some limitations of this research should be acknowledged. First, this is a cross-sectional study that can reveal associations, but not causalities. Second, this study was based on a subsample of the caretakers' reports about environmental characteristics, rather than on direct observation. In this analysis, the focus was only on subjective perceptions of safety and the subjective presence of environmental features. Although there is evidence that perceptions of the environment may not match objective measures [38], it is unclear whether perceived safety corresponds with concrete safety, and whether perceived or actual barriers play a more important role in the context of caretaker decisions.

Conclusions

These findings suggest that the built and social environment, and the associations with overweight and PA, have complex patterns according to the type of city studied. This reinforces the importance of conducting more studies to try to understand the real aspects related to the perception of environment and its relationship to overweight in Brazil. This was the first study known by the authors to be done in this country that evaluated perceptions of caretakers and their relation with overweight in children and adolescents, and comparisons were limited, since they were conducted with the results found in other countries, which have different environmental characteristics.

The results emphasize the importance of understanding the aspects related to the obesogenic environment in the context of medium-sized Brazilian cities and that they may differ from larger cities.

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Availability of data and materials

The datasets and/or material analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' contributions

MAL and MMdeA worked on the study design, data analysis, writing, editing, and article's final version. BPLS worked on the data collection, data analysis, writing, editing, and article's final version. FPM worked on the study design, data analysis, writing, and article's final version. CP worked on the data analysis, on the discussion, and on the article's final version. APCC and LLM worked on all stages, from the study design to the review of the article's final version. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

All participants of the study signed a consent form.

Ethics approval and consent to participate

This study was approved by the Ethics Committee on Research in Humans of the Universidade Federal de Juiz de Fora (UFJF), case number 522.694.

Author details

[1]School of Medicine, Universidade Federal de Juiz de Fora (UFJF), Rua José Lourenço Kelmer, s/n, Bairro São Pedro, Juiz de Fora, Minas Gerais CEP: 36036-900, Brazil. [2]Department of Nutrition, Universidade Federal de Juiz de Fora (UFJF), Rua José Lourenço Kelmer, s/n, Bairro São Pedro, Juiz de Fora, Minas Gerais CEP: 36036-900, Brazil. [3]Department of Maternal and Child Nursing and Public Health, School of Nursing, Universidade Federal de Minas Gerais (UFMG), Av. Alfredo Balena, Número 190, Bairro Funcionários, Belo Horizonte, Minas Gerais CEP 30130-100, Brazil. [4]Department of Life Sciences, Research Center for Anthropology and Health, University of Coimbra, Calçada Martim de Freitas, Coimbra 3000-456, Portugal. [5]Department of Nutrition, Universidade Federal de Minas Gerais (UFMG), Av. Alfredo Balena, Número 190, Bairro Funcionários, Belo Horizonte, Minas Gerais CEP 30130-100, Brazil.

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