

Association between parental perceptions of residential neighbourhood environments and childhood obesity in Porto, Portugal

Maria M. Ferrão^{1,2}, Augusta Gama^{2,3}, Vitor R. Marques^{2,4}, Larissa L. Mendes⁵, Isabel Mourão⁶, Helena Nogueira^{2,7}, Gustavo Velásquez-Melendez⁵, Cristina Padez^{1,2}

1 Department of Life Sciences, University of Coimbra, Coimbra, Portugal

2 CIAS—Research Centre for Anthropology and Health, University of Coimbra, Coimbra, Portugal

3 Department of Animal Biology, Faculty of Sciences, University of Lisbon, Lisbon, Portugal

4 Center of Anthropobiology, Tropical Research Institute, Lisbon, Portugal

5 Departamento de Enfermagem Materno-infantil em Saúde Pública, Escola de Enfermagem, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

6 Department of Sports, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal

7 Department of Geography, University of Coimbra, Coimbra, Portugal

Correspondence: Larissa Loures Mendes, Departamento de Enfermagem Materno-infantil em Saúde Pública, Escola de Enfermagem, Universidade Federal de Minas Gerais, Av. Alfredo Balena, 190, CEP 30130-100, Belo Horizonte/MG, Brazil, tel: +553134099868, e-mail: larissalouresmendes@gmail.com

Background: Portugal has one of the highest rates of childhood obesity in Europe. Few studies have explored the relationship between parents' perceptions of their residential neighbourhood (safety concerns and amenities of the built environment) and their children's weight status. This study aims to examine the associations between parents' perceptions of their residential neighbourhood and overweight/obesity among their children. **Methods:** Anthropometric measures of height and weight were taken for 2690 children in preschools and elementary schools in Porto. Body mass index (kg/m^2) was calculated, and the International Obesity Taskforce (IOTF) cut-offs were used. Parents completed the 'Environmental Module' standard questionnaire of the International Physical Activity Prevalence Study. Chi-square tests and the logistic regression model adjusted for age, gender, maternal education and school cluster were used to examine the associations between parents' perceptions of their residential neighbourhood and overweight/obesity among their children. **Results:** In this sample, 31.8% of the children were overweight (including obese). Significant associations were found between child obesity and the following residential environmental characteristics: the odds of children being obese were lower if their parents believed that it was safe (low/no crime rate) to walk/cycle at night (OR = 0.65, 95% CI = 0.54–0.79) and during the day (OR = 0.70, 95% CI = 0.55–0.86) and that it was easy and pleasant (pedestrian safety) to walk in their neighbourhoods (OR = 0.73, 95% CI = 0.58–0.90) and when local sidewalks were well maintained and unobstructed (OR = 1.18, 95% CI = 1.01–1.40). **Conclusion:** Parental perceptions of neighbourhood safety and the quality of local sidewalks are significantly associated with obesity values.

Introduction

The prevalence of childhood obesity is increasing globally, making this a serious social and health problem. In recent decades, Southern Europe, in line with the rest of the world, has experienced a rapid increase in childhood obesity, and Portuguese children have one of the highest rates of overweight/obesity among European countries (31.5%).¹

Environment has been thought to contribute to the current epidemic of obesity by encouraging poor dietary habits, including the consumption of dense high-energy foods, and by discouraging regular physical activity in favour of sedentary activities, such as watching television, using computers and playing electronic games.²

Other studies suggest that there is a relationship between children's weight status and neighbourhood infrastructures. For example, children who live in neighbourhoods with good access to supermarkets, parks, playgrounds and recreational facilities tend to have healthier diets, to be less sedentary and to have a reduced risk of being overweight.^{2–8} Moreover, unsafe neighbourhoods and residential environments with limited access to sport facilities, parks and public transport options and non-existent or damaged/obstructed sidewalks and bike paths may affect childhood obesity by restricting or discouraging children's outdoor activities, such as playing, walking and cycling, and their ability to take advantage of nearby recreational or sport facilities.^{2,8–16} Parents make decisions for their

children regarding the places in which they can spend time and the activities in which they can participate.^{17–21} It is commonly believed that children's mobility is restricted compared with children's mobility in previous generations. For instance, in Australia, Veitch et al.⁷ found that 12% of children aged 8–12 years were not allowed to walk or cycle without adult supervision, and one-third of the sample (32%) was restricted from travelling >100 m alone.

As highlighted by some researchers, parental concerns about perceived crime and traffic safety in local neighbourhoods, regardless of actual crime rates or traffic accidents, may be an important influence on children's physical activity levels^{5,10,13–15,18,22} and, consequently, on children's weight status.¹⁸ However, the extent to which adults' perceptions of their residential area mediate neighbourhood effects on their children's physical activity levels and weight status is unclear. In this study, we hypothesized that parents who perceived their neighbourhood as unsafe or lacking the features of the built environment that promote walking and cycling would be more likely to have obese (including overweight) children because these parents may limit their children's access to outdoor activities or active transportation.

Methods

Anthropometric measurements of height and weight were taken for 2690 children aged 3–10 years in 27 preschools and 30 elementary

Table 1 Descriptive statistics for children, mothers and fathers by child's sex

Variables	Boys (48.8%)			Girls (51.2%)			Total (100%)		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Child age (years)	1314	6.7	2.3	1376	6.6	2.2	2690	6.7	2.2
Age group	n (%)			n (%)			n (%)		
3 years	153 (11.8)			170 (12.6)			323 (12.2)		
4 years	213 (16.5)			222 (16.4)			435 (16.5)		
5 years	201 (15.6)			216 (16.0)			417 (15.8)		
6 years	120 (9.3)			138 (10.2)			258 (9.8)		
7 years	147 (11.4)			158 (11.7)			305 (11.6)		
8 years	189 (14.6)			179 (13.3)			368 (13.9)		
9 years	179 (13.9)			193 (14.3)			372 (14.0)		
10 years	89 (6.9)			74 (5.5)			163 (6.2)		
Mother education	n (%)			n (%)			n (%)		
Less than high school ^a	550 (43.4)			602 (45.5)			1152 (44.5)		
High school	294 (23.2)			269 (20.4)			563 (21.8)		
Higher education	423 (33.4)			450 (34.1)			873 (33.7)		
Father education	n (%)			n (%)			n (%)		
Less than high school ^a	659 (55.5)			703 (55.9)			1362 (55.7)		
High school	238 (20.1)			243 (19.4)			481 (19.7)		
Higher education	290 (24.4)			311 (24.7)			601 (24.6)		
Children's weight status	n (%)			n (%)			n (%)		
Normal weight	916 (70.0)			913 (66.4)			1829 (68.2)		
Overweight	272 (20.8)			307 (22.3)			579 (21.5)		
Obese	120 (9.2)			155 (11.3)			275 (10.3)		

a: Reference category.

schools in Porto (urban area) between March and December 2009. Measurements were taken privately at the children's schools using a calibrated digital scale (weight/kg) and a portable stadiometer (height/m). Measurements were taken without shoes and with light clothing. Body mass index (BMI = kg/m²) was calculated, and the International Obesity Taskforce (IOTF) age- and sex-specific cut-off points were used to define overweight and obesity. These cut-off points are linked to the widely accepted adult BMI cut-off points of 25 kg/m² (overweight) and 30 kg/m² (obesity).²³ For the statistical analysis, overweight and obese children were analysed as the same group, 'obese'.

Additionally, to assess perceptions of the neighbourhood environment, the parents completed the 'Environmental Module' standard questionnaire of the International Physical Activity Prevalence Study.²⁴ This questionnaire was designed to assess the perceived environmental factors that prevent or limit the opportunity to walk and cycle in residential neighbourhoods. Parents were asked to agree or disagree with 17 statements on a 4-point scale ranging from 'strongly agree' to 'strongly disagree' and 'don't know/not sure'. From the questionnaire, we selected the 14 statements related to perceived access to destinations, street connectivity, the existence and quality of sidewalks and bike paths, accessibility to public transport systems, parks and recreation facilities, and pedestrian safety and crime (table 2). For the statistical analysis, responses to the statements were collapsed into two categories: (i) agree ('strongly agree' and 'somewhat agree') and (ii) disagree ('strongly disagree' and 'somewhat disagree').

This questionnaire has been used in previous Portuguese physical activity studies and has shown good reliability and validity.^{15,25} A study developed by Mota et al.¹⁵ using the same questionnaire in the same city of Porto found that intraclass correlation coefficients ranged from ICC = 0.36–0.79.

Data analysis

The Chi-square test was used to determine differences in proportions of children across weight status and levels of perceived neighbourhood environmental characteristics. Then, logistic regression models were constructed to examine the effect of each perceived environmental characteristic using childhood obesity as the

dependent variable. These models were adjusted for the variables that were significant in the individual models, namely, age, sex, maternal education and school clusters. Significance was set at $P < 0.05$. The analyses were performed using Stata 9.0, StataCorp, College Station, TX, USA.

Results

The participants in this study were 2690 children (48.8% boys and 51.2% girls) aged 3–10 years old. In this sample, 31.8% of the children were obese (including overweight); specifically, 10.3% of the children were obese and 21.5% were overweight. The prevalence of overweight/obesity in boys was 30% and the prevalence in girls was 33.6% ($P < 0.001$). On average, mothers were more educated than fathers in this sample (table 1). Table 2 shows that some perceptions of the local neighbourhood were associated with children's obesity. These associations were confirmed by a multivariate analysis (table 3). After adjusting for age, gender, maternal education and school cluster, a significant association was found between childhood obesity (including overweight) and the following perceptions of the residential environment: when parents believed that it was safe (low crime rate) for their children to walk/cycle at night (OR = 0.65, 95% CI = 0.54–0.79) and during the day (OR = 0.70, 95% CI = 0.55–0.86) and when parents believed that it was safe to walk in their neighbourhood (low traffic rate) (OR = 0.73, 95% CI = 0.58–0.90). A significant association was also found between child obesity and a negative parental perception of the quality/absence of barriers on sidewalks (OR = 1.18, 95% CI = 1.01–1.40).

Discussion

Our results suggest that when parents perceive their neighbourhood as unsafe for their children to walk during the day and after dark, as having a high traffic load and as having poor sidewalk conditions that create barriers to walking safely, children are more likely to be obese. These results suggest that parents may restrict their children's active transportation or outdoor play based on safety concerns and the perceived physical conditions of the local facilities for walking.

Table 2 Parents' perceptions of their neighbourhood according to their child's weight status in Porto, Portugal

Statements	Nutritional status		P-value
	Normal n (%)	Obesity n (%)	
Many shops/places are within easy walking distance of my home			
Agree	1257 (69.1)	563 (30.9)	0.986
Disagree	378 (69.1)	169 (30.9)	
It is a 10–15-min walk to a transit stop from my home			
Agree	1126 (69.3)	499 (30.7)	0.070
Disagree	491 (68.0)	231 (32.0)	
There are sidewalks on most of the streets in my neighbourhood			
Agree	1462 (69.2)	650 (30.8)	0.388
Disagree	184 (66.7)	92 (33.3)	
There are facilities to bicycle in or near my neighbourhood			
Agree	380 (71.8)	149 (28.2)	0.102
Disagree	1192 (68.1)	559 (31.9)	
My neighbourhood has several free or low-cost recreation facilities/parks			
Agree	884 (70.7)	366 (29.3)	0.135
Disagree	713 (67.8)	338 (32.2)	
The crime rate in my neighbourhood makes it unsafe to go on walks at night (reverse)*			
Agree	665 (63.6)	380 (36.4)	0.000
Disagree	902 (73.4)	326 (26.6)	
There is so much traffic on the streets that it makes it difficult or unpleasant to walk (reverse)*			
Agree	515 (63.6)	294 (36.4)	0.000
Disagree	1107 (71.6)	438 (28.4)	
I see many people being physically active in my neighbourhood			
Agree	1039 (70.4)	437 (29.6)	0.157
Disagree	543 (67.5)	261 (32.5)	
There are many four-way intersections in my neighbourhood			
Agree	1171 (68.6)	536 (31.4)	0.694
Disagree	420 (70.5)	176 (29.5)	
The sidewalks are well maintained and not obstructed			
Agree	1084 (70.7)	449 (29.3)	0.079
Disagree	532 (67.2)	260 (32.8)	
Places for bicycling in and around my neighbourhood are well maintained and not obstructed**			
Agree	400 (73.1)	147 (26.9)	0.022
Disagree	984 (67.8)	467 (32.2)	
There is so much traffic on the streets that it makes it difficult or unpleasant to ride a bike (reversed)			
Agree	825 (68.2)	385 (31.8)	0.143
Disagree	757 (71.0)	309 (29.0)	
The crime rate in my neighbourhood makes it unsafe to go on walks during the day (reverse)*			
Agree	237 (60.9)	152 (39.1)	0.000
Disagree	1355 (71.2)	547 (28.8)	
There are many places to go within easy walking distance of my home			
Agree	1363 (69.5)	599 (30.5)	0.430
Disagree	261 (67.4)	126 (32.6)	

*P < 0.001 (Chi-square test).

**P < 0.05 (Chi-square test).

Table 3 Unadjusted and adjusted odds ratio (OR) and 95% confidence interval (95% CI) from logistic regression models predicting children's obesity in Porto, Portugal

Statements	Unadjusted OR (95%CI)	Adjusted OR (95%CI)
Many shops/places are within easy walking distance of my home		
Agree	1.00	1.00
Disagree	0.99 (0.82–1.21)	1.09 (0.89–1.36)
It is a 10–15-min walk to a transit stop from my home		
Agree	1.00	1.00
Disagree	1.06 (0.85–1.32)	1.01 (0.81–1.25)
There are sidewalks on most of the streets in my neighbourhood		
Agree	1.00	1.00
Disagree	1.12 (0.87–1.45)	1.18 (0.89–1.56)
There are facilities to bicycle in or near my neighbourhood		
Agree	1.00	1.00
Disagree	1.19 (0.97–1.47)	1.09 (0.89–1.34)
My neighbourhood has several free or low-cost recreation facilities/parks		
Agree	1.00	1.00
Disagree	1.14 (0.96–1.36)	1.04 (0.88–1.22)
The crime rate in my neighbourhood makes it unsafe to go on walks at night*		
Agree	1.00	1.00
Disagree	0.63 (0.52–0.77)	0.65 (0.54–0.79)
There is so much traffic on the streets that it makes it difficult or unpleasant to walk*		
Agree	1.00	1.00
Disagree	0.69 (0.56–0.85)	0.73 (0.58–0.90)
I see many people being physically active in my neighbourhood		
Agree	1.00	1.00
Disagree	1.14 (0.95–1.36)	1.10 (0.92–1.33)
There are many four-way intersections in my neighbourhood		
Agree	1.00	1.00
Disagree	0.92 (0.76–1.10)	0.88 (0.72–1.06)
The sidewalks are well maintained and not obstructed**		
Agree	1.00	1.00
Disagree	1.18 (0.99–1.39)	1.18 (1.01–1.40)
Places for bicycling in and around my neighbourhood are well maintained and not obstructed		
Agree	1.00	1.00
Disagree	1.29 (1.04–1.61)	1.13 (0.91–1.40)
There is so much traffic on the streets that it makes it difficult or unpleasant to ride a bike		
Agree	1.00	1.00
Disagree	0.87 (0.73–1.04)	0.91 (0.75–1.09)
The crime rate in my neighbourhood makes it unsafe to go on walks during the day*		
Agree	1.00	1.00
Disagree	0.63 (0.50–0.79)	0.70 (0.55–0.86)
There are many places to go within easy walking distance of my home		
Agree	1.00	1.00
Disagree	1.09 (0.86–1.39)	1.16 (0.90–1.48)

Note: All models were adjusted for age, gender, maternal education and schools clusters.

*P < 0.001 (logistic regression).

**P < 0.05 (only adjusted logistic regression).

This situation may contribute to the epidemic of childhood obesity by increasing sedentary time with indoor activities.

Previous studies of parental perceptions focusing on safety reports have concluded that road safety or traffic, violence and fear of crime in urban environments are concerns for parents.^{8,10,14,26} Furthermore, studies of the built environment have shown the importance of sidewalks (both their existence and the safety of their physical infrastructure) for creating good environments for walking and playing outdoors.^{27,28}

Our findings are in line with previous research on 10- to 12-year-old Australian children suggesting that parental perceptions of heavy traffic on local streets and concerns about safe walking and cycling conditions are related to children's overweight and obesity status. However, parental perceptions of the local neighbourhood were not associated with weight status among 5- to 6-year-old children.⁸ This may be because these children are very young, and their mobility is restricted and dependent on parental supervision.

Other studies have shown that busy neighbourhoods seem to be perceived as unsafe. Studies conducted in the USA have confirmed that urban parents with higher levels of concern for safety (heavy

traffic and crime) were less likely to allow their children to play outside.^{14,18} Furthermore, limited access to safe recreation in residential areas was significantly associated with less activity among children in urban Chicago.²⁹ Recently, Bacha et al.³⁰ showed that mothers from Michigan living in neighbourhoods that were perceived as unsafe had a higher risk of having obese daughters, but not sons. The situation in Europe seems to be similar. Mullan³¹ found that parents from Wales who reported that the road outside or nearest their home was busy with traffic were less likely to perceive their neighbourhood as a safe place for children to play outside and to walk alone after dark. Another study by Miles,³² which combined data from eight studies in European cities based on the WHO LARES study (Large Analysis and Review of European housing and health Status), reported that the neighbourhood physical environment and perceived safety influence adults' readiness to encourage children's physical activity. However, there are contradictory findings. Veitch et al.¹⁶ used data from the longitudinal study Children Living in Active Neighborhoods (CLAN) in Melbourne, Australia, and found no association between parental perceived social neighbourhood factors (high crime rate, stranger danger, social trust and social cohesion) and the time that their children spent at sedentary behaviours. Carson et al.³³ also observed no substantial association between perceived neighbourhood safety and the active transport behaviours of elementary school children in Alberta (Canada). Furthermore, Burdette and Whitaker³⁴ reported that neither the physical nor the social environment seemed to be important to children's weight status. Our results are quite different, perhaps because we used parental perceptions rather than objective measurements of the local neighbourhood.

Finally, regarding the conditions of the infrastructure and barriers to walking, some indicators of sidewalk conditions have been shown to be related to weight status. In general, the literature suggests that more walkable areas are associated with a reduced risk of overweight and obesity. For instance, more children walk to school in neighbourhoods with sidewalks.²⁸ Spence et al.³ found an inverse relationship between the walkability of a neighbourhood and weight status for preschool-aged girls (but not boys). Davidson et al.³⁵ found that parental perceptions of the neighbourhood characteristics that provide the physical means for children to be active, such as sidewalks, influence children's self-efficacy for being physically active and, consequently, influence their body weight. Other study has found that weight status is reduced in areas where sidewalks or trails are present or are in good condition.³⁶ Parental concerns about safe walking and cycling conditions are related to children's local walking and cycling,⁸ as transportation to other recreational sites³⁷ or to and from school.²⁸ Together, these results suggest that pedestrian-friendly (or cycling-friendly) environments should be recognized as important for health. Nevertheless, the evidence is mixed.

A small number of studies have explored the relationship between parents' perceptions of their residential neighbourhood (safety concerns and the existence or inexistence of certain amenities of the built environment) and their children's weight status. As far as we know, this is the first Portuguese study to focus on the association between parental perceptions of their residential neighbourhood and childhood obesity.

Several limitations of this study should be acknowledged. First, this is a cross-sectional study than can reveal associations but not causalities. Second, the questionnaire used in this study was designed to assess the extent to which parents' perceptions of their local neighbourhood affect their children's physical activity levels. However, in this study, only children's weight status was measured, not their physical activity levels. Third, this study was based on parental reports rather than on direct observation (objective measures of the environment to establish their validity). In this analysis, we focused only on subjective perceptions of safety and

the subjective presence/quality of environmental features rather than objective measures, such as crime rates, traffic loads,

neighbourhood physical disorders and the actual existence of equipment. 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 parental decisions. Finally, it is generally accepted that the built environment influences not only physical activity but also nutrition and affects children's weight by shaping their eating habits. This fact was not considered into account in this study.

In conclusion, this study emphasises the importance of increased and effective cooperation among urban planning, urban security and public health. Public health efforts to reduce childhood obesity may benefit from policies directed towards the improvement of actual and perceived neighbourhood safety (slowing and reducing traffic and minor crime threats) and providing pedestrian and cycling infrastructures. These may be key strategies for encouraging parents to allow their children to be active outdoors, to play freely and to actively reach destinations in their neighbourhoods. Safe and walkable neighbourhoods in Porto are elements of the urban environment that can promote physical activity and can ultimately reduce the risk of childhood obesity.

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Key point

What is already known on this subject?

The prevalence of childhood obesity is increasing globally, making this a serious social and health problem.

Portugal has one of the highest rates of obesity compared with other European countries.

Perceived neighbourhood safety and perceived neighbourhood physical disorders are mechanisms through which neighbourhood characteristics may influence obesity.

What does this study add?

In this survey, parental safety perceptions of residential neighbourhoods (crime safety and pedestrian safety) were associated with children's weight status; safer, non-violent and transit-friendly environments protect children from obesity.

Physical disorder in neighbourhoods, such as barriers and damaged sidewalks, were associated with children's obesity. Parents identified good walking paths as an essential physical element in their children's use of active transport.

Further research is required to identify the factors that mediate or moderate the effects of the built or social environment on childhood obesity.

Public health efforts may benefit from policies directed towards improving both actual and perceived neighbourhood safety. This study stresses the need for increased and effective cooperation between urban planning and health.

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