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Association between childhood obesity and environmental characteristics: Testing a multidimensional environment index using census data

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ABSTRACT

Childhood obesity is increasing worldwide and evidence suggests that it might be partially explained by environmental characteristics namely social and built features. This study main goal was to create a multidimensional environment index comprising both social and built environment features and to examine if there were differences in children's weight status regarding the characteristics of the place they live in. Overall, the proportions of boys with overweight/obesity were significantly higher in the Socioeconomic Vulnerable Areas which comes in line with previous evidence. We consider that the territorial categorization proposed is an added value for the so-called "healthy urban planning", once it identifies priority areas to tackle health inequalities.

1. Introduction

Childhood Obesity is a major public health issue (Broyles et al., 2015) due to its high and increasing prevalence rates worldwide despite the efforts, mostly at the individual level (Caballero, 2007; James, 2008), to reverse this tendency. At the beginning of the century, childhood obesity prevalence in Portugal was very high (31.5%) (Padez, Fernandes, Mourao, Moreira, & Rosado, 2004) and more recent data shows that Portugal has one of the highest prevalence of childhood obesity among European countries (32.2%) (Rito et al., 2012).

Studies about obesity have focused on the individual determinants such as genetics, family characteristics and individual sedentary and physical activity behaviours. However, evidence suggests that the rising prevalence of obesity cannot be solely explained at the individual level but that the socio-environmental characteristics likely also promote weight gain. (Pearce & Witten, 2010; Smith & Cummins, 2009). Therefore, childhood obesity might be best understood as the product of a complex interaction between individual, interpersonal and environmental factors (Bonney et al., 2015; Pearce & Witten, 2010). From a geographic perspective, it is important to define what exactly is meant by "environmental factors" and the respective study scale, in order to delineate methodologic approaches and tools to measure it and fully assess its impacts in children's weight status. The Social-Ecological Model poses as a helpful framework in such task. This model categorizes health determinants in different levels: individual, interpersonal, institutional, community and, structures and systems (state) (CDC, 2013).

In short, obesity environment determinants are considered as all factors not included in the individual level, such as the environment social and built features (Pearce & Witten, 2010) and might be studied at different scales namely, neighbourhood, city, municipality or country (Colls & Evans, 2014; Smith & Cummins, 2009). For example, Pearce and Witten (2010) state that food availability and eating habits are determined at a larger scale by national/international policies and trade agreements that impact food costs, and at a smaller scale by local supermarkets marketing strategies that might influence individuals' food choices towards higher caloric food.

Since the late 1990's, when the concept of "obesogenic environment" arose, many studies assessing the impact of environmental features in body status have been developed at the neighbourhood scale (Guthman, 2013; Townshend & Lake, 2017). The latter concept implies that a certain area foments high caloric food consumption and discourage physical activity, simultaneously (Reidpath, Burns, Garrard, Mahoney, & Townsend, 2002). In other words, areas where no quality food predominate and with many barriers to engage in physical activities, promote obesity (Garfinkel-Castro, Kim, Hamidi, & Ewing, 2017; Guthman, 2013).

In 2010, a systematic review about the built environment and obesity conducted by Feng, Glass, Curriero, Stewart, and Schwartz (2010) retrieved from PubMed 738 articles published until 2008. More recently, in 2014, another systematic review about obesogenic environments retrieved over 5600 articles from five electronic databases published between 1995 and 2013 only, which illustrates the increase of evidence about this subject published over time (Mackenbach et al., 2014). The 2010 review concluded that the methods and approaches from different studies were so heterogeneous that the comparison

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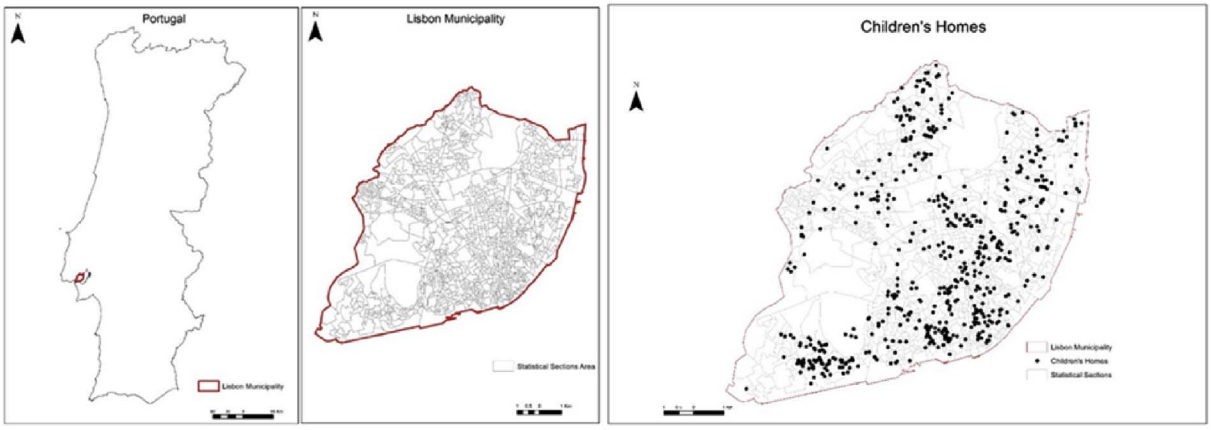

Fig. 1. Study area and children's homes localization.

between evidence from different studies was challenging (Feng et al., 2010). Four years later, studies continue to show great heterogeneity in the definition of physical environment, in the methods and measures used or even in the contexts and locations studied causing an inconsistency in the findings (Mackenbach et al., 2014). For instance, all studies analysed in the 2014 review, that tested if green space was associated with obesity used different definitions of green space. From those, only one of the European studies found a positive association between green space and lower Body Mass Index (BMI) (Mackenbach et al., 2014). Another example is the proximity to food outlets which has been considered as determinant in weight status however, according to both reviews, no robust evidence supports this hypothesis (Feng et al., 2010; Mackenbach et al., 2014). In fact, only urban sprawl and land use mix proved to be associated with weight status in North America (Feng et al., 2010; Mackenbach et al., 2014).

Another important issue to highlight is that studies specifically about childhood obesity usually focus in either the social (Kinra, Nelder, & Lewendon, 2000) or built environment features (Jennings et al., 2011) separately, neglecting the fact that the contexts in which children (and all individuals) live in are a combination/interaction of both dimensions (Reidpath et al., 2002; Smith & Cummins, 2009).

While some researchers believe that environmental features determine individuals weight status (Townshend & Lake, 2017) despite the inexistence of evidence of a causality effect (Garfinkel-Castro et al., 2017), others remain sceptic and cautious about such matter (Feng et al., 2010). The lack of consensus in this subject is implicit in the heterogeneity of definitions, methods and measures of the built environment as well as in the inconsistent evidence about the environmental drivers of obesity. Thus, in this study the typical indicators were not used nor new definitions or measures were created. Data about physical activity and food environment was not used once many of the measures used have no plausible justification (Feng et al., 2010) and, it was not intended to assess the territory obesogenic level. Instead, basic census data was used to achieve this study main goal.

In sum, it was intended to create an index that could classify the territory according to its residents' sociodemographic (social environment) and buildings characteristics (built environment) regardless of its obesogenic proneness, test the index for spatial autocorrelation and examine if there were differences in children's weight status considering the characteristics of the place they live assessed/measured by the index.

2. Material and methods

This study presents a Multidimensional Environment Index (MEI) based in census data at the section level (census statistical areas of approximately 300 dwellers) that integrates the social and built environment dimensions into a single construct. This index considers that all neighbourhoods have intrinsic characteristics that result from its own combination of social and built features as well as its neighbours'. Social environmental aspects were considered as the household income, the educational level and employment status among others (Broyles et al., 2015; Drewnowski, Rehm, & Solet, 2007) and as built environment the living conditions (Caballero, 2007) namely buildings characteristics, their age and typology (residential or other). According with the available literature, buildings features are considered as surrogates of the built environment construct, like parks, sidewalks or bicycle paths (Garfinkel-Castro et al., 2017; Sallis, Floyd, Rodriguez, & Saelens, 2012). After testing the MEI for spatial autocorrelation, its association with childhood obesity was examined.

2.1. Study design and setting

This is a cross-sectional study performed in Portugal's capital, more specifically Lisbon municipality area, which has 85 Km^2 and a population of 547 773 individuals resulting in a population density of approximately 6444 individuals per square kilometre. Lisbon is the most populated city in Portugal and Lisbon municipality is essentially urban.

Environment data was collected at the statistical section level from the Census 2011 in the National Statistics Institute's (INE) website.

Height and weight of 929 children were measured by trained people in 24 private and public schools and kindergartens in 2009. Using self-reported questionnaires, children's parents provided their homes' postal code and other sociodemographic characteristics of the family (see Fig. 1).

2.2. Environmental features

Environmental data was grouped in two major dimensions: built environment (BE) and socioeconomic environment (SE). BE is measured by 14 variables about the buildings' construction date and materials, buildings' main function, type of occupation, dimension, number of divisions and amenities such as parking. SE is constituted by 20 variables about family dimension, residents' age, individuals schooling level,[1] individuals' employment status and employment sector and ownership status of residencies (Fig. 2.).

2.3. Anthropometric measures

Children's height and weight were objectively measured and BMI

[1] Schooling level: don't read or write, 1st schooling cycle (1–4 years), 2nd schooling cycle (5–6 years), 3rd schooling cycle (7–9 years), secondary schooling (10–12 years), superior schooling (academic degree).