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Understanding differences in the local food environment across countries: A case study in Madrid (Spain) and Baltimore (USA)

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ABSTRACT

Places where we buy food influence dietary patterns, making local food environments a good example of a mass influence on population diets. Cross-cultural studies, using reliable methods, may help understanding the relationship between food environments and diet-related health outcomes. We aimed to understand cross-national differences in the local food environment between Madrid and Baltimore by comparing an average neighborhood in each city in terms of food store types, healthy food availability, and residents' pedestrian access.

During 2012–2013, we assessed one neighborhood (~15,000 residents) in each city selecting median areas in terms of socio-demographic characteristics (segregation, education, aging, and population density). We collected on-field data on (a) number and types of all food stores, (b) overall healthy food availability and (c) specific availability of fruits & vegetables. Throughout a street network analysis (200 m, 400 m and 800 m) of food stores with high healthy food availability, we estimated residents' pedestrian accessibility.

We found 40 stores in Madrid and 14 in Baltimore. Small food stores carrying fresh foods in Madrid contrasted with the high presence of corner and chain convenience stores in Baltimore. In Madrid, 77% of the residents lived within less than 200 m from a food store with high healthy food availability. In contrast, 95% of Baltimore's residents lived further than 400 m from these stores.

Our results may help promoting interventions from local city agencies to allocate resources to existing small-sized food stores, and to improve walkable urban environments. These actions may influence food choices, especially for those residents lacking access to private vehicles.

1. Introduction

Obesity is a global public health problem linked to several health conditions, such as cardiovascular diseases, hypertension and diabetes. The worldwide prevalence of obesity nearly doubled between 1980 and 2014. In 2014, 11% of men and 15% of women worldwide were obese (WHO, 2014). In high income countries, as the United States or Spain, the prevalence of obesity is around 34% and 23.7%, respectively (WHO, 2014).

The study of contextual factors in relation to obesity and diet remains an important piece in the field of diet-related disease prevention. Dietary behaviors are socially constrained by different economic and contextual factors. The retail food environment is a contextual factor considered a mass influence acting on individual dietary behaviors, body weight and diet-related health outcomes (Holsten, 2009; Townshend and Lake, 2009; Moore et al., 2008; Feng et al., 2010). The retail food environment refers to the *community food environment* (quantity and type of food retailers available) and to the *consumer food environment* (availability, quality, price and marketing of food products within stores) (Franco et al., 2016; Glanz et al., 2005).

Over the last two decades several studies mostly conducted in the US have looked at the associations between the retail food environment and diet/obesity (McKinnon et al., 2009; Powell et al., 2007; Ni Mhurchu et al., 2013). Nonetheless, studies looking at this association in other contexts other than the US are scarce (Macdonald et al., 2011; Thornton et al., 2013). If we aim to study the influence of local food environments on diet, we should look for mass influences, as Geoffrey Rose highlighted when studying health phenomena (Rose, 1985). Therefore, if the local food environment is a mass influence acting on all neighborhoods as a whole, and subsequently on populations´ diet, we should understand different food environments in different cultural settings. Thereby, we would be able to detect shifts in average

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neighborhoods that shift the entire distribution of neighborhoods. However, these are rarely studied when looking at local food environments, missing the mass influences that shift the entire distribution of neighborhoods. Cross-national studies are thus warranted considering the large international differences in the patterning of the retail food environment (Flavian et al., 2002; Thornton et al., 2013).

Systematic reviews focusing on the effect of local food environments on dietary behaviors have shown consistent evidence for existing inequalities regarding food access in the US, but also highlighted several limitations (Black et al., 2014; Cobb et al., 2015; Feng et al., 2010; Gamba et al., 2015; Holsten, 2009). The comparability of previous studies may be limited for several methodological and theoretical reasons: (1) a lack of consistency in the operationalization of retail food environment measures; (2) a scarcity of direct data collection on healthy food availability (Black et al., 2014); and (3) upstream influences as population density and mobility patterns (Cummins and Macintyre, 2006).

In the present paper we aim to understand cross-national differences in the local food environment between Madrid and Baltimore, by comparing an average neighborhood in each city in terms of food store types, healthy food availability, and residents´ pedestrian access.

2. Methods

2.1. Study setting and sample

This study involved an international collaboration organized by local research teams working at the European project "Heart Healthy Hoods" at the University of Alcala in Madrid and the Center for a Livable Future at the Johns Hopkins University in Baltimore, respectively.

Madrid is the most populous city in Spain, with approximately 3.2 million residents (Municipal Registry, 2014). Baltimore City is the largest city in the state of Maryland in the United States, with an estimated population of 622,104 residents (Census Projection 2011). Regarding contextual factors (poverty, diversity, employment and health) related to healthy food access, Madrid and Baltimore are two ethnically, economically and geographically diverse cities. In Madrid, 15.2% of the population was in 2014 at risk of poverty or social exclusion, compared with the 42.1% of residents that live at or below 185% of the Federal Poverty Level in Baltimore City. Madrid's population is made up of a 19.6% of foreign-born residents, whereas Baltimore's population is much more diverse (68.3%). Unemployment remained close to 15.1% in Madrid (2014), and by a 13.9% in Baltimore. Adult obesity rates in Madrid (14.28%) are also lower than the reported in Baltimore City (33.8%).

In order to select average areas, that were representative of city-median socio-demographic characteristics, we constructed a summary index (the Median Neighborhood Index or MNI) for both cities. This is a summary index that averages Euclidean variable distances of several socio-demographic (aging, education level, racial/ethnic composition) and urban form (population density) features to the median neighborhood for each variable. For Madrid, we used % population aged 65 or above as the demographic indicator, % adults over 25 with less than 8–9 years of education as the socioeconomic indicator, % foreign-born as the segregation indicator, and population density (in km^2) as the urban form indicator. For Baltimore, we used % population aged 65 or above as the demographic indicator, % adults over 25 with less than 8–9 years of education as the socioeconomic indicator, % non-white as the segregation indicator, and population density (in km^2) as the urban form indicator. As shown in Table 1, we obtained data from the municipal registry in Madrid (*Padron*) and from the American Community Survey 5-year averages (2007–2011) in Baltimore, at census section and census tract levels, respectively. These geographical units are the smallest ones in both settings, for which Census Bureau data were publicly and readily provided.

Lower values of the MNI represent areas closer to the average neighborhood in each city. To obtain areas of the desired size and population, we looked for clusters of low MNI areas using Kulldorf's Spatial Scan Statistic (Kulldorff et al., 1997) with a maximum area of 12 census sections and 3 census tracts in Madrid and Baltimore, respectively (~12,000–15,000 pop.). Table 1 shows how these two areas represent average neighborhoods, as compared to the average value of each variable in each city. We also included a statistical comparison between the median value of each variable in each city and the value of the same variable in the selected neighborhood in each city. For this, we used the Kruskal-Wallis Rank Sum test that essentially performs a comparison of medians between two samples (see Table 1). Appendix 1 provides a more detailed graphical description of how the selected areas in Madrid and Baltimore are the ones closest to the median area (census section or census tract) of each city for the selected variables and how different they are from extreme areas.

2.2. Data collection

During the summer of 2012 (Baltimore) and April 2013 (Madrid), we conducted field observations in both settings. We assessed all food stores present by ground-truthing and classified them by retailer type. Following previously published criteria (Glanz et al., 2007; Buczynski and Buzogany, 2015; Glanz et al., 2005), we defined food store types in Madrid and Baltimore as: a) supermarkets; b) grocery stores; c) specialty stores (including bakeries, butchers, fishmongers, or greengrocers); d) chain convenience stores (including chain, discount and gas stations); e) corner stores (including behind-glass stores, where all of the goods for sale and the storeowner are physically behind plexiglass) (Franco et al., 2008). We geocoded and mapped all food stores for in-store surveying.

To characterize healthy food availability, we conducted in-store audits for all food stores in in both areas. We used an abbreviated version of the Nutrition Environment Measures Survey in Stores (NEMS-S), a standardized observational tool developed and validated by Glanz et al. (Glanz et al., 2007). This NEMS-s measure has demonstrated to be feasible, have strong face and content validity, and have both high inter-rater kappas (0.84 to 1.00) and high test–retest reliability (0.73 to 1.00) (Glanz et al., 2007).

Table 1
Sociodemographic and urban form characteristics of average neighborhoods in Madrid and Baltimore.
We obtained data from the municipal registry in Madrid (*Padron*) and from the American Community Survey 5-year averages (2007–2011) in Baltimore, at census section and census tract levels, respectively.

Variables	Madrid (entire city)	Madrid (median neighborhood)	p-Value[a]	Baltimore (entire city)	Baltimore (median neighborhood)	p-Value[a]
Aging	20.2%	23.8%	0.24	12.0%	15.4%	0.25
Education	20.5%	21.3%	0.83	4.0%	2.6%	0.57
Segregation[b]	15.0%	21.1%	0.71	69.6%	82.5%	0.73
Population density	5237.8	35,097.0	0.33	2481.8	5344.3	0.27
Source of data	Municipal Registry (2014)			American Community Survey (2009–2014)		
Geographical unit definition	Census Section (~1500 people)			Census Tract (~4000 people)		
Number of units	2420	12		200	3	
Total population	3,166,310	14,840		617,443	10,923	

[a] Kruskal-Wallis test of comparison of medians of each variable in each city vs. the median neighborhood selected through the MNI.
[b] % Foreign-born in Madrid or % non-white in Baltimore.