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Food deserts? Healthy food access in Amsterdam

Marco Helbich [a,*], Björn Schadenberg [b], Julian Hagenauer [c], Maartje Poelman [a]

[a] Department of Human Geography and Spatial Planning, Utrecht University, Utrecht, The Netherlands
[b] Mulier Institute, Centre for Research on Sports in Society, Utrecht, The Netherlands
[c] Leibniz Institute of Ecological Urban and Regional Development, Dresden, Germany

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ABSTRACT

Healthy food environments are imperative for public health. Access to supermarkets that offer wholesome food products at low prices varies across space and over socioeconomic status and ethnic neighborhoods. This research examined food inequalities in Amsterdam, the Netherlands. Supermarket accessibility was calculated and linked to property prices and the share of native Dutch people on a geographic micro-scale with a spatial resolution of 100 meters. Mann–Whitney tests and Spearman correlations were used to test differences and associations between accessibility, property prices, and the share of natives per area. The spatially explicit contextual neural gas approach was used for data clustering. The results show access differences in supermarkets in favor of areas with high property prices and those areas with a large share of native Dutch people. The correlations indicate that low-priced areas and those with a low share of native Dutch people have a lower supermarket density, but the results are the opposite when proximity to and variety of supermarkets are examined. The clustering revealed no evidence of undersupplied areas. Pronounced inequalities in access to healthy food could not be confirmed. On the basis of this analysis, there is no urgent need for policymakers to intervene in the geographies of supermarkets.

1. Introduction

Overweight and obesity have become pandemic and are considered global health challenges (Ng et al., 2014): 1.9 billion adults are now overweight, and 600 million of these adults are obese (WHO, 2015). These figures have doubled since the 1980s. The Netherlands is no exception to this trend: The proportion of overweight people increased between 1981 and 2013 from 22.9% to 31.5% (CBS, 2015), and that of obese people from 4.4% to 10.1%. This is alarming, because both overweight and obesity are closely associated with non-communicable diseases (e.g., diabetes, musculoskeletal disorders, and cardiovascular diseases) (Rubenstein, 2005).

Although the causes are complex and multifactorial, there are two major viewpoints concerning the epidemic pathway to overweight and obesity (Ball, Timperio, & Crawford, 2006). First, individuals are responsible for their own weight gain, food intake, and energy consumption. Second, it is assumed that external factors such as an obesogenic food environment[1] affect people's consumption behavior and diet (Ball et al., 2006; Glanz, Sallis, Saelens, & Frank, 2005). From the latter perspective, overweight and obesity are a normal response to an abnormal environment. Empirical results for the association between the physical food environment – here defined as the accessibility/availability of places that sell healthy food (i.e., supermarkets) in the local environment – and individual dietary intake or weight status are inconsistent (Black, Moon, & Baird, 2014; Caspi, Sorensen, Subramanian, & Kawachi, 2012; Cobb et al., 2015). Reviews (Beaulac, Kristjansson, & Cummins, 2009; Hilmers, Hilmers, & Dave, 2012) suggest that limited access to healthy food partially explains dietary inequalities across urban neighborhoods. Findings show that people living in neighborhoods with low socioeconomic status and those living in ethnic minority neighborhoods are more prone to unhealthy diets, compared to those living in high

* Corresponding author.
E-mail addresses: m.helbich@uu.nl (M. Helbich), bjorn_schadenberg@hotmail.com (B. Schadenberg), j.hagenauer@ioer.de (J. Hagenauer), M.P.Poelman@uu.nl (M. Poelman).
URL: http://www.uu.nl/staff/MHelbich

[1] Food environments refer to "the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations" (Swinburn, Egger, & Raza, 1999, p. 564).

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socioeconomic status neighborhoods (e.g., Ball, 2015; Cummins & Macintyre, 2006; Moore & Diez-Roux, 2006; Van Lenthe & Mackenbach, 2002; Walker et al., 2011; Zenk et al., 2005).

Those areas with inadequate access to food outlets offering affordable and healthy nutrition (i.e., supermarkets), while being socially distressed, are metaphorically labeled “food deserts” (Cummins & Macintyre, 2002; USDA, 2016). Supermarkets serve as suppliers of healthy and fresh food, offering them at more competitive prices than smaller grocery stores (Zenk et al., 2005). In contrast, convenience stores and corner stores offer more low-nutrient food and a limited range of healthy and fresh products (e.g., fruits and vegetables) at higher prices. People living in food deserts increasingly consume the energy-dense nutrition that is readily available in smaller convenience stores, which influences their dietary choices (Cummins & Macintyre, 2002; Morland, Wing, & Diez-Roux, 2002; Walker et al., 2011). Areas with a disproportionately high number of convenience stores are labeled as “food swamps” (Hager et al., 2016; Taylor & Ard, 2015).

Studies dealing with the identification of food deserts typically rely on analytics supported by geographic information systems (GIS; McKinnon et al., 2009; Peng et al., 2017). The concept of accessibility (Guagliardo, 2004) is central in such analyses and refers to the ease of access from an origin to a destination. The origins are primarily represented as centroids of administrative units (e.g., census tracts; Leete, Bania, & Sparks-Ibanga, 2012; McCracken, Sage, & Sage, 2013; Sadler, Gilliland, & Arku, 2013; Lu & Qiu, 2015). As administrative units vary in size and shape, area-based approaches are under debate (Ver Ploeg, Dutko, & Breneman, 2015). Accessibility measures vary greatly in complexity and their selection has proven to be challenging (Burgoine, Alvanides, & Lake, 2013; Charreire et al., 2010; McKenzie, 2014).

Because there are myriad ways of operationalization, a single measure is rarely sufficient to represent supermarket accessibility holistically (Charreire et al., 2010). Thus, Apparicio, Cloutier, and Shearmur (2007) call for a multidimensional perspective obviating an oversimplification of people's access to retailers of healthy food as, for example, in McCracken et al. (2013), through a single measure. Such multidimensional indicators are based on a combination of proximity to, and density and variety of, supermarkets (Apparicio et al., 2007; Russell & Heidkamp, 2011; Wang, Qiu, & Swallow, 2014, 2016). For each measure, ad-hoc and less theory-driven decisions need to be made, such as whether to employ Euclidean or street network distances (Charreire et al., 2010). Oliver, Schuurman, and Hall (2007) and Apparicio, Abdelmajid, Riva, and Shearmur (2008) showed that the latter represent actual distances more precisely. Similarly, buffers based on straight-line distances tend to overestimate food store availability and do not impose mobility restrictions where man-made features (e.g., railways) serve as impediments (Oliver et al., 2007). There is no agreement in terms of buffer width, but distances of around 1000 meters are common (e.g., Apparicio et al., 2007; Charreire et al., 2010; Cushon, Creighton, Kershaw, Marko, & Markham, 2013).

Besides accessibility, food deserts are frequently discussed in tandem with vulnerable population groups (Beaulac et al., 2009; McCracken et al., 2013). Yet, studies show that ethnic minorities and/or low income groups have insufficient access to healthy food (Gordon et al., 2011; Morland & Filomena, 2007; Powell, Auld, Chaloupka, O'Malley, & Johnston, 2007; Zenk et al., 2005). In order to identify food deserts, both the accessibility and neighborhood characteristics (e.g., income levels; Shavers, 2007) are frequently grouped by means of descriptive approaches (e.g., quartiles), although conceptually this is overly simple (Leete et al., 2012). A statistically more sound analytical procedure is clustering. This analytical procedure groups multivariate data into smaller groups that have similar accessibility and neighborhood characteristics (Hagenauer & Helbich, 2013a).

Taken together, while empirical evidence for food deserts in U.S. urban landscapes is extensive (Beaulac et al., 2009; Taylor & Ard, 2015; Walker et al., 2011), findings for Canada are mixed (Larsen & Gilliland, 2008; Lu & Qiu, 2015; Smoyer-Tomic, Spence, & Amrhein, 2006). For example, Apparicio et al. (2007) and Gould, Apparicio, and Cloutier (2012) found that socioeconomically deprived neighborhoods have in fact better access to affordable and healthy food, while Larsen and Gilliland (2008) found the opposite for Montreal. Others, including Cushon et al. (2013) and Smoyer-Tomic et al. (2006), did not confirm an accessibility–socioeconomic association. Cultural, economic, and regulatory differences or the provision of affordable and wholesome food make it difficult to transfer results from North America to Europe (Cummins & Macintyre, 2006). Shaw (2012), for instance, identified some areas in Nantes, France, that have both poor access to food outlets and low socioeconomic profiles. For the UK, Clarke, Eyre, and Guy (2002) found food deserts in Leeds/Bradford and Cardiff in neighborhoods with low socioeconomic status; in contrast, Macdonald, Ellaway, and Ball (2011) concluded that no population groups are significantly disadvantaged in British cities as a result of the spread and densification of food outlets. Križan, Bilková, Kita, and Horňák (2015) confirmed these findings of satisfactory access to healthy food across the residents of Bratislava, Slovakia.

Even though these studies contributed significantly to our understanding of food deserts, several shortcomings remain. First, although there is compelling evidence for food deserts in North American cities (e.g., Apparicio et al., 2007; Larsen & Gilliland, 2008), investigations for continental Europe are scarce (e.g., Križan et al., 2015; Shaw, 2012). Yet, to date, there is no research for the Netherlands. This is surprising for cities such as Amsterdam, where significant health disparities across neighborhoods are documented (GGD Amsterdam, 2013). Second, from a methodological point of view, studies largely remain at a coarse analytical level (e.g., census tracts) (e.g., Clarke et al., 2002; Cushon et al., 2013; Smoyer-Tomic et al., 2006). Inconsistencies in empirical findings might be caused by the way that geographic boundaries for neighborhood definitions are chosen (Barnes et al., 2016), whereas scale and zoning effects can be significantly reduced by employing at least aggregated data (Openshaw, 1984). Thus, local variations in food accessibility within a spatial unit call for micro-geographic analyses at a grid level. Third, with few exceptions (e.g., Apparicio et al., 2007), food deserts are rarely identified based on multivariate cluster analyses that group data objectively and coherently. Fourth, the review by Lamb et al. (2015) emphasized methodological flaws in most food desert studies (Wang et al., 2016). The fact that adjacent spatial units share similar attributes (i.e., are spatially dependent) is usually ignored, even though this has serious consequences for non-spatial statistical analysis, including clustering (Hagenauer & Helbich, 2013a). This calls the validity of the findings partially into question.

This research addressed the aforementioned shortcomings and was the first to investigate the associations between, on the one hand, the accessibility of supermarkets and, on the other hand, property prices and the share of native Dutch people (i.e., persons whose parents were born in the Netherlands) in Amsterdam, on a spatial micro-scale with a spatial resolution of 100 meters. Specifically, while also utilizing multivariate statistics, we used an innovative and spatially explicit clustering approach, namely contextual neural gas (CNG). An understanding of local food environments is an important first step toward combatting the increasing prevalence of population overweight and obesity (Ng et al., 2014). Our findings are essential for decision-makers to promote food equity and to formulate policies toward healthy food environments.