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Original Research

Do people really know what food retailers exist in their neighborhood? Examining GIS-based and perceived presence of retail food outlets in an eight-county region of South Carolina

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ABSTRACT

Measures of neighborhood food environments have been linked to diet and obesity. However, the appropriate measurement methods and how people actually perceive their food environments are still unclear. In a cross-sectional study of 939 adults, the perceived presence of food outlets was compared to the geographic-based presence of outlets within a participant's neighborhood, utilizing percent agreement and Kappa statistics. Perceived presence was based on survey-administered questions, and geographic-based presence was characterized using 1-, 2-, 3- and 5-mile (1-mile = 1.6 km) Euclidean- and network-based buffers centered on each participant's residence. Analyses were also stratified by urban and non-urban designations. Overall, an individual's perceived neighborhood food environment was moderately correlated with the geographic-based presence of outlets. The performance of an individual's perception was most optimal using a 2- or 3-mile geographic-based neighborhood boundary and/or when the participant lived in a non-urban neighborhood. This study has implications for how researchers measure the food environment.

1. Introduction

It has been suggested that neighborhood food environment, measured either objectively or subjectively, is associated with dietary intake (Caspi et al., 2012a). To date, geographic information systems (GIS) have been the most-utilized objective method to characterize neighborhood food environments (McKinnon et al., 2009; Charreire et al., 2010; Van Meter et al., 2011; Thornton et al., 2011). However, it is unknown whether GIS-based measures are the most appropriate means of defining an individual's food environment (Caspi et al., 2012a,b; Mujahid et al., 2007). There are currently no standardized methods for characterizing a food environment, and thus

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assessment and development of appropriate food environment measures is warranted (Caspi et al., 2012b; Lytle, 2009).

Perception measures based on surveys and self-report have been used increasingly to characterize food environments (Moore et al., 2008a,b; Sharkey, 2009; McKinnon et al., 2009). Such measures have included an individual's perception of the availability of healthy food items in his/her neighborhood (Moore et al., 2008a,b; Freedman and Bell, 2009; Zenk et al., 2009; Gustafson et al., 2011; Williams et al., 2011; Moore et al., 2012), as well as information on the individual's perceived presence of different retail food outlets (Zenk et al., 2009; Gustafson et al., 2011; Williams et al., 2011; Caspi et al., 2012b). In a recent review by Caspi and colleagues, studies using measures of perceived food environments have shown significant associations with dietary outcomes (Caspi et al., 2012a; Sharkey et al., 2010; Moore et al., 2009, 2008b; Inglis et al., 2008), whereas studies utilizing GIS-based measures of retail outlet presence or density have shown mixed and varying relationships (Caspi et al., 2012b).

Methodological decisions regarding how to define food environments, including geographic boundaries and contexts, could have a significant role in deciphering inconsistent findings among studies. Using GIS, food environments have typically been characterized by geographic "neighborhood" boundaries defined as census tracts, block groups and/or Euclidean or network buffers centered on some point of reference (e.g., population-weighted centroids or home addresses) (Charreire et al., 2010; Van Meter et al., 2011; Thornton et al., 2011). However, the use of such boundaries has notable limitations, including the modifiable areal unit problem, which can bias research findings based on the choice (i.e., number, size and shape) of boundaries for areal units (Openshaw, 1983; Christian, 2012). In addition, one cannot assume that all individuals conceptualize and/or interact within their environments similarly. For instance, in neighborhood perception studies utilizing mental maps, researchers found that an individual's perceived neighborhood can cover many different spaces and produce different boundaries based on age, race, class, gender and various other factors (Coulton et al., 2001, 2012). In a recent activity-based food environment study, researchers found that individuals encountered very different food environments in their daily travels compared to those located within or near their residential-defined neighborhood (Christian, 2012). Thus, how a person may operationalize and perceive his/her neighborhood food environment could vary based on that person's daily routine and sociodemographic factors.

Despite challenges in defining and characterizing a food environment, only a handful of studies have examined differences in perceived and objective environments (Caspi et al., 2012a; Moore et al., 2008a,b, 2012; Zenk et al., 2009; Gustafson et al., 2011; Williams et al., 2011; Giskes et al., 2007; Freedman and Bell, 2009). Of these studies, only two directly compared perceived and GIS-based presence (availability) of retail food outlets (Caspi et al., 2012a; Williams et al., 2011); the primary focus of these studies was the identification of traditional food outlets (i.e., supermarkets) within a pre-specified neighborhood boundary.

In this study, we sought to provide an in-depth comparison of GIS-based and perceived presence of retail food outlets in a sample of adults living in an eight-county region of South Carolina. In doing so, we aimed to determine what retail food outlets are available in an individual's neighborhood, as defined by field-validated GIS (as the gold standard), and to what extent individuals are aware of the presence of these food outlets via survey. Aims of our analyses included: (1) to examine whether the objective presence of retail food outlets within a standard 1-mile (~1.6 km) buffer used to define an individual's GIS-based neighborhood is accurately reflected in the perceived presence of retail food outlets within a 1-mile or a 20-min walk from an individual's home; (2) to conduct sensitivity analyses by varying defined GIS-based neighborhoods, utilizing 2-, 3- and 5-mile buffers to examine changes in agreement (i.e., percent agreement and Kappa statistics) while keeping the perception buffer the same (1 mile or a 20-min walk); and (3) to examine the accuracy between perceived and GIS-based presence by a sociodemographic factor, specifically urban or non-urban neighborhood designation.

Findings from this study could contribute to exploring whether measures of perceived availability of food retail outlets are viable alternative measures to GIS-based measures in food environment studies. In addition, this work could contribute to refining methods that researchers and policymakers use to describe a person's perception of his/her food environment and whether an individual's perceptions are adequate to detect changes in the retail food environment resulting from food access interventions, policy initiatives and associations with diet and weight outcomes.

2. Methods

This was a cross-sectional, non-experimental research study utilizing survey responses from 939 primary household food shoppers conducted in the spring of 2010, along with corresponding GIS-based measures of the respondents' food environments, within an eight-county region in South Carolina. This was a supplemental study related to a larger research effort focused on developing measures of the built nutritional environment (Liese et al., 2010, 2013a) and examining perceptions, shopping behaviors and diet among residents of the eight-county study region (Ma et al., 2013; Liese et al., 2013b). This study was approved by the University of South Carolina (USC) Institutional Review Board.

2.1. Study region

The study area consisted of a contiguous geographical region encompassing eight counties (seven non-urban and one urban) in South Carolina (Fig. 1). The one urban county, Richland, contains the state capital, Columbia. The seven non-urban counties (Calhoun, Chester,