



Do perceptions of the neighbourhood food environment predict fruit and vegetable intake in low-income neighbourhoods?



Ellen Flint^{a,*}, Steven Cummins^a, Stephen Matthews^b

^a Department of Social and Environmental Health Research, London School of Hygiene and Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH, UK

^b Department of Sociology, The Pennsylvania State University, 211 Oswald Tower, University Park, PA 16802-6211, USA

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ABSTRACT

The aim of this study is to investigate the extent to which perceptions of the quality, variety and affordability of local food retail provision predict fruit and vegetable intake. Secondary analysis of baseline data from the Philadelphia Neighbourhood Food Environment Study was undertaken. This study investigating the role of the neighbourhood food environment on diet and obesity comprised a random sample of households from two low-income Philadelphia neighbourhoods, matched on socio-demographic characteristics and food environment. The analytic sample comprised adult men and women aged 18–92 ($n=1263$). Perception of the food environment was measured using five related dimensions pertaining to quality, choice and expense of local food outlets and locally available fruits and vegetables. The outcome, portions of fruits and vegetables consumed per day, was measured using the Block Food Frequency Questionnaire. Results from multivariate regression analyses suggest that measured dimensions of perceived neighbourhood food environment did not predict fruit and vegetable consumption. Further investigation of what constitutes an individual's 'true' food retail environment is required.

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1. Background

A diet rich in fruits and vegetables provides satiety and hydration without excessive energy intake, protecting against obesity (Drewnowski, 2004). Increasing the proportion of fruits and vegetables in the diet also protects against CVD and a number of cancers, as vegetable matter is low in saturated fats (Van Duyn and Pivonka, 2000). However socioeconomic inequalities in fruit and vegetable consumption have been widely reported, with deprived individuals reporting lower intake of fruits and vegetables compared to their more affluent counterparts (Centers for Disease Control and Prevention (CDC), 2010). Researchers have also long reported neighbourhood-level variations in diet, with neighbourhood deprivation independently predicting food consumption (Forsyth et al., 1994). In order to account for these variations, it has been suggested that differences in the structure of the built food environment between deprived and affluent neighbourhoods exist, and that exposure to poor quality food environments in deprived areas amplifies individual-level risk factors for poor diet (Macintyre, 2007). The relationship between the food environment and diet has been hypothesised as the

primary mechanism through which obesogenic settings operate (Caspi et al., 2012b). Understanding this relationship is therefore important for population health improvement.

Previous work in this field has sought to describe and quantify local food environments, and investigate the ways in which their characteristics predict fruit and vegetable intake. These studies can broadly be divided into two groups: (i) those which have used Geographic Information Systems (GIS) and/or store audits to objectively measure dimensions of the food environment (e.g., Glanz et al., 2007; Bodor et al., 2008; Thornton et al., 2010); and (ii) those which have used survey data to capture respondents' perceptions of their local food environments (e.g. Williams et al., 2010; Inglis et al., 2008; Blitstein et al., 2012). Only a few studies have used a combination of these approaches (e.g. Gustafson et al., 2011; Sharkey et al., 2010; Zenk et al., 2009). In their systematic review of work on the relationship between the food environment and diet, Caspi et al. (2012b) noted that those using perceived measures of the food environment were very low in number, compared to those using objective/GIS-based methods. However, these approaches are complementary and both are informed by a strong theoretical framework which has emerged from the literature, dividing the food environment into *community* and *consumer* dimensions (Glanz et al., 2005). Charriere et al., (2010) advocated the appropriation of Penchansky and Thomas's five health-care access dimensions to encapsulate the characteristics of the food environment: availability, accessibility, affordability, acceptability and accommodation (Penchansky and Thomas, 1981). As described by

* Corresponding author. Tel.: +44 20 7927 2742; fax: +44 20 7927 2701.

E-mail addresses: ellen.flint@lshtm.ac.uk (E. Flint),

steven.cummins@lshtm.ac.uk (S. Cummins), sxm27@psu.edu (S. Matthews).

(Caspi et al., 2012b), evidence of a relationship between these dimensions and fruit and vegetable intake is mixed. Most studies which have measured perceptions of food *availability* found a significant association between perceived high availability of fruits and vegetables, and intake (Inglis et al., 2008; Moore et al., 2008; Sharkey et al., 2010; Blitstein et al., 2012). In contrast, evidence for an association between perceived *accessibility* and fruit and vegetable intake has been mixed, with both positive (Blitstein et al., 2012) and null (Inglis et al., 2008; Gustafson et al., 2011; Lucan and Mitra, 2012) associations reported. Evidence of an association between perceived *affordability* of fruits and vegetables and intake is also inconclusive, with some studies showing an association with increased intake (Zenk et al., 2005) and others reporting null (Sharkey et al., 2010; Blitstein et al., 2012) or counterintuitive (Inglis et al., 2008) findings. Stronger evidence has been found for an association between perceived *acceptability* and fruit and vegetable intake (Inglis et al., 2008; Sharkey et al., 2010; Zenk et al., 2005; Blitstein et al., 2012), although null findings have also been reported (Dean and Sharkey, 2011; Lucan and Mitra, 2012). Findings from studies which used objective measures to quantify these dimensions of the food environment, such as store audits and GIS methods, are even more heterogeneous and inconclusive.

The present study aims to contribute to the evidence base by assessing the extent to which perceived availability, affordability and acceptability of the neighbourhood food environment predict fruit and vegetable consumption in two ways. Firstly, we investigate whether perceptions related to the general food retail environment (perceived quality of grocery stores in the neighbourhood; perceived level of choice of different types of grocery stores in the neighbourhood) are associated with fruit and vegetable intake. Secondly, whether perceptions directly related to fruit and vegetable consumption (perceived quality of fruits and vegetables available in the neighbourhood; perceived variety of fruits and vegetables available in the neighbourhood and perceived expense of fruits and vegetables available in the neighbourhood) are associated with fruit and vegetable intake.

2. Methods

2.1. Study background

Baseline data from the Philadelphia Neighbourhood Food Environment Study were used. This was a prospective quasi-experimental study in two Philadelphia neighbourhoods investigating the effects of a supermarket intervention and the role of the neighbourhood food environment on diet and obesity. For the present study, only cross-sectional data from the 2006 pre-intervention baseline were used. The study neighbourhoods were selected for the purpose of matched comparison based on race/ethnicity, socioeconomic characteristics and food environment characteristics. The two site boundaries (intervention and control) were based on aggregations of contiguous census tracts (9 and 10 tracts). For the intervention site, the selection was based on a 1-mile radius around a proposed intervention store with all full and part census tracts falling within the radius constituting the study neighbourhood. For the control neighbourhood selection was based on a 1-mile radius based around a potential site of a store. The neighbourhoods are 3–4 miles apart and both lie within Philadelphia County, approximately equidistant from the downtown area. Both sites were similar on race/ethnic structure, age structure, and other demographic indicators. Moreover, at the time of the study (2006), both neighbourhoods were considered 'food deserts' as there was relatively limited full-service food retail available. Data from a Nutrition Environment Measure Survey (NEMS) undertaken as part of the fieldwork showed that at

baseline, both sites had two grocery stores and 55/56 convenience stores (Glanz et al., 2007). The accessibility of these food retail outlets is described in detail by Fuller et al. (2013). The mean distance from participants' homes to their primary food store was 3.6 km ($\pm$ SD 3.1 km) (Fuller et al., 2013). The baseline telephone survey of residents in these two neighbourhoods was conducted in 2006. This consisted of a random directory-listed and random-digit dialled telephone survey of a representative sample of residents of households in each of the two neighbourhoods. Respondents were contacted with a pre-notification letter and \$1 cash incentive. Following this letter, a telephone survey was completed by the household primary food shopper and questions relating to diet, perceptions of the neighbourhood food environment, and a range of socio-demographic data were collected. To be eligible, households had to be located in either of the two neighbourhoods and to have one primary food shopper aged 18 years of age or older residing within the home. Respondents received \$20 for participation. The sample size at baseline was 1440, representing a 47.2% screener response rate (response rate 2 defined by the American Association for Public Opinion Research (AAPOR, Version 7)). This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Pennsylvania State University's Office of Research Protection (IRB #34283). Verbal informed consent was obtained from all subjects. This was witnessed and formally recorded.

2.2. Variables

The baseline questionnaire contained five statements designed to capture respondents' perceptions of their neighbourhood food retail environment, each addressing a distinct dimension. These measures were adapted from those used in the Perceived Availability of Health Foods Scale in the Multi Ethnic Study of Atherosclerosis (MESA) study (Mujahid et al., 2007). Two pertained to the general food retail environment and three specifically to environmental factors related to fruit and vegetable consumption. Respondents were asked to state the extent to which they agreed or disagreed with these statements, with five possible responses: *strongly disagree*; *disagree*; *no preference*; *agree*; *strongly agree*. The five statements were as follows: (1) there is a good choice of different types of grocery stores in my neighbourhood; (2) the quality of grocery stores in my neighbourhood is good; (3) the choice of fresh fruit and vegetables to purchase in my neighbourhood is good; (4) the quality of fresh fruit and vegetables to purchase in my neighbourhood is good; (5) fresh fruit and vegetables in my neighbourhood are expensive. These five continuous variables were used as five separate exposure variables in the analyses. Perception of fruit and vegetable expense was reverse-coded so that 'agreement' indicated the most desirable situation for all five dimensions. The outcome, fruit and vegetable consumption, was operationalized as the number of fruit and vegetable portions consumed per day and was derived, using standard algorithms (Centers for Disease Control (CDC), 2005–2006), from responses to the Block Food Frequency Questionnaire (Block FFQ), which measures the intake of 10 fruits and 12 vegetables over the past month (Block et al., 1986). Consistent with past research, and to limit the influence of outliers, the Block FFQ was truncated at 15 items per day in these analyses (Michels et al., 2006).

2.3. Statistical analysis

For the purposes of this study, the baseline sample was restricted to those who provided complete information on all analytic variables, yielding a study sample size of 1263. Descriptive analysis was performed to determine the distribution of responses for each of the food retail environment exposure variables and for

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