



## “Socioeconomic inequalities in children's accessibility to food retailing: Examining the roles of mobility and time”



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### ABSTRACT

Childhood overweight and obesity rates in Canada are at concerning levels, more apparently so for individuals of lower socioeconomic status (SES). Accessibility to food establishments likely influences patterns of food consumption, a contributor to body weight. Previous work has found that households living in lower income neighbourhoods tend to have greater geographical accessibility to unhealthy food establishments and lower accessibility to healthy food stores. This study contributes to the literature on neighbourhood inequalities in accessibility to healthy foods by explicitly focusing on children, an understudied population, and by incorporating mobility and time into metrics of accessibility. Accessibility to both healthy and unhealthy food retailing is measured within children's activity spaces using Road Network and Activity Location Buffering methods. Weekday vs. weekend accessibility to food establishments is then compared. The results suggest that children attending lower SES schools had almost two times the density of fast food establishments and marginally higher supermarket densities in their activity spaces. Children attending higher SES schools also had much larger activity spaces. All children had higher supermarket densities during weekdays than on weekend days.

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### 1. Introduction

A large body of work investigates the relationship between neighbourhood environmental features and body weight, specifically by examining determinants of food consumption and physical activity behaviours. Accessibility to food retailing and services is an example of such a neighbourhood feature. Within the context of food environment studies supermarkets and grocery stores have often been assumed to offer accessibility to healthy foods because they offer a wide range of healthy food options at affordable prices, while fast food establishments and restaurants are typically viewed as sources of unhealthy, affordable, and high calorie food (Smoyer-Tomic et al., 2008). Many studies report a positive correlation between accessibility to fast food and poor health indicators such as weight status or high Body Mass Index (BMI) (Davis and Carpenter,

2009; Dubowitz et al., 2012; Jeffery et al., 2006), obesity (Maddock, 2004), unhealthy purchasing behaviour (He et al., 2012), mortality rates (Alter and Eny, 2005), and acute coronary syndrome hospital admissions (Alter and Eny, 2005). Other studies report a positive relationship between accessibility to supermarkets or grocery stores and positive health indicators such as a healthy bodyweight (Dubowitz et al., 2012; Lamichhane et al., 2012; Morland et al., 2006) and increased fruit and vegetable consumption among low-income households (Rose and Richards, 2004). Critically, some studies report the opposite or only a partial relationship between accessibility to healthy or unhealthy food establishments and objectively measured or self-reported health status (Casey et al., 2008; Frank et al., 2009; Inagami et al., 2009; Morland and Evenson, 2009; Rundle et al., 2009).

Research also shows a relationship between socioeconomic status (SES), measured by income, education, and/or occupation, and diet. Evidence of positive correlation between proportion of diets that correspond with current dietary recommendations and socioeconomic status is reported in the literature for adults (Dubois and Girard, 2001) and children (Dubois, 2006). Intersecting food accessibility with class, multiple studies also report greater

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availability of fast food outlets in low-income areas (Blair Lewis et al., 2005; Burns and Inglis, 2007; Cummins et al., 2005; MacDonald et al., 2007; Pearce et al., 2007; Powell et al., 2007; Reidpath et al., 2002). Accessibility to supermarkets has also frequently been found to be poorer in low-income neighbourhoods in Canada and the U.S. (Apparicio et al., 2004; Lamichhane et al., 2013). Socially disadvantaged neighbourhoods with poor access to healthy food have been called 'food deserts' (Cummins and Macintyre, 2002). While most of this food environment research focuses on the household or adults as the behavioural units of analysis, less effort has been directed at studying food accessibility in childhood. Child-specific findings indicate that fast food restaurants have been found more frequently close to low-income schools in Canada (Kestens and Daniel, 2010) and in the US (Walker et al., 2014; Zenk and Powell, 2008). Taken for granted in the food environment literature is the identity of children as autonomous food consumers with increasing power to purchase independent from adults (McNeal, 2002; Valkenburg and Cantor, 2001; Veiga Neto, 2013). The sections below describe in detail how this study contributes to food environment research, namely by embedding mobility and time into a child centred study of accessibility to food retailing and services.

### 1.1. Mobility

Much of the literature examining the relationship between food accessibility, socioeconomic status, and health has been conducted at the neighbourhood scale (Chaix, 2009). While important, many scholars have been critical of the conceptualization and measurement of "environment" and "neighbourhood" in the food access/desert literature (Chaix, 2009; Cummins, 2007; Diez Roux, 2004; Kwan, 2012; Oakes, 2003; and Widener & Shannon, 2014). Specifically, the residential neighbourhood is most commonly measured using a pre-defined administrative area such as a census tract, postal code area, or buffered area around a home address (Chaix, 2009). Everyday life, of course, is not limited to the residential neighbourhood as individuals are exposed to determinants of health both within and beyond their neighbourhoods. Focusing solely on the residential neighbourhood can therefore lead to misleading results; for example, one could live in a food desert but work nearby many sources of healthy and affordable food. The assumption that only the 'local' matters for health and its determinants has been termed the 'local trap' (Cummins, 2007). A promising method to overcome the 'local trap' may be to measure exposure to social and environmental determinants of health within an individual's activity space. Activity spaces are the "locations with which the individual has direct contact as the result of day-to-day activities" (Horton and Reynolds, 1971, p.37). In other words, activity spaces are a spatial representation of individuals' activity and mobility patterns.

Some recent work has considered accessibility to food stores using spatial units of analysis that incorporate mobility. Widener et al. (2013) used a time-geographic approach that generated an accessibility score that incorporated commuting patterns and activity constraints to measure accessibility to healthy foods among residents of Cincinnati, Ohio. Salze et al. (2011) used a potential accessibility index as a method to estimate spatial accessibility to food outlets and sports facilities for regional car commuters in the Bas-Rhin *département* region in Eastern France. Incorporating commuting, as both of these studies have done, improves upon environmental representation. There are, however, many other instances of mobility and activity in everyday life. Horner and Wood (2014) accounted for a broader range of trips when they modelled individual-level food accessibility in Tallahassee, Florida using their eleven participants' activity patterns and time budgets.

Using regional travel survey data, Kestens et al. (2012) assessed food exposure and health in Montréal and Québec city residents' activity spaces and found that models considering both residential and non-residential food exposure better predicted men's risk of overweight than those focusing solely on residential exposure. Zenk et al. (2011) investigated the determinants of physical activity and diet within activity spaces using a food diary and found that fast food outlet density within the activity space was positively associated with poor eating behaviour (i.e., positive association with saturated fat intake and negative association with whole grains). Crawford et al. (2014) compared women's supermarket and farmers' market exposure using a host of non-residential methods, including an activity space metric. They found that different methods result in different exposure results, demonstrating the importance of thinking critically about the scale used in food environment research. Using global positioning system (GPS) data, Shearer et al. (2014) found that adolescents visit food stores outside their residential neighbourhoods more than those within them.

### 1.2. Time

Traditional neighbourhood measurements are not only immobile; they are also atemporal. Research into how food accessibility changes over time, due to the intersection between hours of operation of food establishments (availability in time), and household activity scheduling and patterns can potentially inform policy on the timing of food-related public health interventions. Unfortunately, most studies do not consider the time of day stores are open, when individuals have access to them, and seasonal changes in food retailers' operations and product mix (Chen and Clark, 2013; Widener et al., 2013). For example, individuals may work by a supermarket that is closed when their shift is over, mobile food vendors may sell unhealthy foods outside a high school over lunch periods, and farmers markets may only provide healthy and affordable options to retailers during the harvest season. Incorporating children's mobility patterns into measures of accessibility, as this study does, provides a unique opportunity to consider how accessibility varies with time because children's activity patterns are known to vary on weekdays and weekend days (Buliung et al., 2008; Rowlands et al., 2008). There is no reason to think that the food environment is temporally static. In response, this study investigates how accessibility to food establishments varies over the course of the week (i.e., weekdays vs. weekend days).

### 1.3. Children

This study also addresses a gap in the literature by focusing on children, rather than adults. Children are a population experiencing concerning levels of weight gain (Active Healthy Kids Canada, 2013) and whose eating behaviours are likely influenced by their accessibility to food establishments. Children are also frequently autonomous consumers (Valkenburg and Cantor, 2001; Veiga Neto and Melo, 2013) whose buying capacity has grown sharply in recent years (McNeal, 2002). Children between the ages of 4 and 12 purchased 30 billion US dollars of goods in 2002, one third of which was spent on food items (McNeal, 2002). By the age of eight, children begin purchasing items independently; the majority of these early independent purchases are of sweet and salty snacks bought primarily at convenience stores (McNeal, 2002). Children's mobility patterns also differ from those of adults and adolescents. Therefore, findings from adult or adolescent-centric food accessibility studies that incorporate mobility and their resulting policies may not be applicable to children.

This paper assesses how the accessibility to supermarkets and

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