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Travel behavior of low income older adults and implementation of an accessibility calculator

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ABSTRACT

Given the aging demographic landscape, the concept of walkable neighborhoods has emerged as a topic of interest, especially during the last decade. However, we know very little about whether walkable neighborhoods promote walking among older adults, particularly those with lower incomes. Therefore in this paper we: (i) examine the relation between trip distance and socio-demographic attributes and accessibility features of lower income older adults in Metro Vancouver; and, (ii) implement a web-based application to calculate the accessibility of lower income older adults in Metro Vancouver based on their travel behavior. We use multilevel linear regression to estimate the determinants of trip length. We find that in this population distance traveled is associated with gender, living arrangements, and dog ownership. Furthermore, significant geographical variations (measured using a trend surface) were also found. To better visualize the impact of travel behavior on accessibility by personal profile and location, we also implemented a web-based calculator that generates an Accessibility (A)-score using Google Maps API v3 that can be used to evaluate the accessibility of neighborhoods from the perspective of older adults.

1. Background and objectives

The world's population is aging at a rapid rate. In 2010, people aged >65 years accounted for eight percent of the world's population; by 2050 this figure is expected to double to 16% (United Nations Department of Economic and Social Affairs). In Canada, the proportion of people aged >65 years is projected to rise from 14% in 2010, to 25% by 2050 (United Nations Department of Economic and Social Affairs); this is largely a result of the aging baby boomer generation, declines in fertility rates and an increased life span (Certified General Accountants Association of Canada, 2005). Aging of the population highlights the need for interventions that maximize health and well-being in later life as a way to decrease strains on the health care system and to maximize the quality of life of a growing segment of our population.

Walking is an ideal activity among the older adults as it is safe, does not require any training, and can be undertaken in different settings throughout the year (Morris and Hardman, 1997; Mutrie and Hannah, 2004; U.S. Department of Health and Human Services, 2008; US Department of Health and Human Services, 1999). Walking for transportation, in particular, is highly promising and, if incorporated in daily life, can contribute towards physical activity guidelines among aging people (Cauwenberg et al., 2012; Frank et al., 2010; Moniruzzaman et al., 2014; Morabia and Costanza, 2010). Walkable neighborhoods where walking is encouraged through supportive community design features, is a popular research topic (Glazier et al., 2014; Sugiyama et al., 2012; TRB and Institute of Medicine, 2005). Past studies show that built environments are important determinants of walkable neighborhoods (Cervero, 2002; Frank and Engelke, 2001; Frank and Pivo, 1995; Frank et al., 2006; Saelens et al., 2003). Cervero and Kockelman (1997) used "3D" (density,

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diversity, and design) model to express built environment which was recently extended by Cervero et al. (2009) into a "5Ds" model with two additional "Ds" as destination accessibility and distance to transit.

Walkable neighborhoods, with compact and mixed land uses, connected streets, and pedestrian oriented retail, are more conducive to walking than suburban, residential only neighborhoods as destinations (e.g. shops) in the walkable neighborhoods are closer to residents and have direct access to them (Badland et al., 2013; Duany et al., 2000; Frank et al., 2004; Frank et al., 2006; Frank et al., 2009; Jackson, 2011; Owen et al., 2007; Saelens and Handy, 2008). The term "complete neighborhood" refers to a walkable neighborhood with easy and safe access to goods and services without the use of car and fulfills the necessities of all ages and abilities (Leyden, 2003). Residents of complete neighborhoods are more likely to know each other, engage in social activities together, and be politically active all of which have health and community benefits for its residents (e.g. prevention of crime) (Leyden, 2003; Putnam, 2000). These neighborhoods also support residents' physical activity (King et al., 2003) as amenities are located within a short distance (e.g. groceries, coffee shops, restaurants, banks) and residents are able to access them by walking, cycling, and/or public transit. On the other hand, car-dependent neighborhoods demand that people travel longer distances to avail of daily necessities that are relatively difficult to access without a car. Although driving a car represents independence to most older adults (Burkhardt, 1998), it imposes a sedentary lifestyle on its users (Frank et al., 2004) and creates a health concern as residents of the car-dependent neighborhoods become older and forced to stop driving due to medical conditions (Burkhardt, 1999; Burkhardt and McGavock, 1999). Participation in out-of-home activity significantly reduces among the older adults in the car-dependent neighborhoods who can no longer drive their car and therefore are at higher risk of social exclusion (Burkhardt, 1998; Farber et al., 2011). It has also been found that car users tend to lose mobility as they age (Mercado and Páez, 2009). Using a three year longitudinal data, Marottoli et al. (2000) showed that older adults who had lost their license participated in fewer than one third of the out-of-home activities than those who continued to drive, with consequences on psychological well-being and physical health status (Bassuk et al., 1999; Marottoli et al., 2000; Zimmer et al., 1995). Hence, living in walkable neighborhoods with pedestrian-oriented design may better support older adults' health and independence (Owen et al., 2007).

The last two decades have marked an evolution of different indices designed to assess walkability of communities and neighborhoods (Maghelal and Capp, 2011). The popularity of walkability scores has escalated recently and they are now used by urban and social planners to inform decision making, by individuals who are considering a move to a new and potentially more suitable neighborhood, and by realtors to market neighborhoods. Walk Score[1], for example, is a popular measure used to identify walkable neighborhoods. It is a publicly available walkability index that measures the walkability of an address based on distances to nearby destinations. The Walk Score algorithm also takes into consideration population density and road metrics such as block length and intersection density. Frank et al. (2009) and Kuzmyak et al. (2005) also developed a walkability index and a walk opportunity index, respectively, to quantify neighborhood walkability (see for detail about these measures: Páez et al., 2013). While these measures are based on neighborhood built environments or opportunities within a given distance, they provide only a single result for any address. In other words, these measures do not account for how mobility may differ by an individual's socio-demographic characteristics (e.g. age, socioeconomic status) and therefore do not provide unique scores relevant at the individual level. Páez et al. (2013) developed of a web-based accessibility calculator that estimates accessibility for all age cohorts and income groups based on their travel behavior. However, we know that travel behaviors and needs of older adults are different than for a younger demographic (Cao et al., 2010; Rosenbloom, 2001; Tacken, 1998). Therefore, we perceived a need to implement and evaluate an age specific web application (*accessibility calculator*) that could be used by low income older adults to locate walkable neighborhoods in the Metro Vancouver region. Similar to the online accessibility calculator of Páez et al. (2013), our calculator in this study goes beyond walkability to generate an accessibility score (*A-score*) and also identifies different opportunities in the neighborhoods that are considered important to older adults, specifically. Thus, the *A-score* can be used to understand the accessibility of neighborhoods for older people.

The objective of this study is to examine the relation between trip distance, socio-demographic, and attitudinal characteristics of lower income older adults who live in Metro Vancouver. While the travel behavior of people with low income has been the subject of some study (Azmi and Karim, 2012; Azmi et al., 2012; Caspi et al., 2013; Hearst et al., 2013; Millward et al., 2013; Morency et al., 2011; Roorda et al., 2010; Sundquist et al., 2011), there has been less specific attention to older adults' walking. Residents of low income housing are at high risk of not achieving adequate physical activity because of their limited access to recreational facilities (Gordon-Larsen et al., 2006). Furthermore, lower income older adults might not afford maintaining a car due to high cost of car insurance in Canada. Thus, walking for transportation could be a viable alternative among these older adults and can help to achieve physical activity without additional time demands. Although there are different measures of travel behavior, for instance trip distance or vehicle kilometer traveled, mode choice, trip frequency, we primarily use trip length to assess neighborhood walkability in this study because it is an indicator of everyday competence, as noted by Mercado and Páez (2009) in their study of older adults' trip distance in Hamilton, Ontario. It is also an indicator of quality of life and provides indirect measures of independence to explore one's neighborhood (Mercado and Páez, 2009; Rowe and Kahn, 1997; Schaie et al., 2005).

Our paper is organized into five Sections. Section 2 presents our methods, including sampling techniques, data collection, and geocoding. Section 3 presents results of the trip distance model estimated in this paper. Section 4 presents a case-study and describes the process of developing the web-based application (*Accessibility calculator)*. Finally, in Section 5 we discuss the model results, provide a brief summary, and direction for future research.

2. Material and methods

2.1. Travel diary

In order to analyze the travel behavior of lower income older adults we collected information by means of a travel diary survey. Below we explain in detail the procedure used for sampling and collecting socio-demographic and travel behavior information.

[1] www.walkscore.com