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Neighbourhood walkability and physical activity among family members of people with heart disease who participated in a randomized controlled trial of a behavioural risk reduction intervention

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ABSTRACT

This study adds to the current literature investigating the relationship between individuals' physical activity (PA) and the built environment. Self-reported PA from a prospective behavioural risk reduction intervention was explored in the context of objectively measured Walk Score® and neighbourhood walkability in Ottawa, Canada. Participants in the intervention arm had significantly higher odds of meeting PA guidelines at 12-weeks compared to the standard care control group. This was not influenced by Walk Score® or walkability. This individual-level intervention was effective in assisting participants to overcome potential structural barriers presented by their neighbourhood to meet PA guidelines at 12-weeks.

1. Introduction

The benefits of physical activity (PA) are extensive and well documented (Bauman, 2004), including decreased morbidity and mortality associated with numerous chronic diseases (Blair et al., 1996; Meyerhardt et al., 2006; Smith et al., 2007; Heitmann et al., 2009), greater longevity (Leitzmann et al., 2007; Hakim et al., 1998) and improved functioning in old age (Van Gelder et al., 2004; Vogel et al., 2009; Seguin and Nelson, 2003). Despite these benefits, physical inactivity continues to present a serious challenge for public health. In 2005, almost half (48%) of Canadians were considered inactive (equivalent to less than 30 min of walking per day) in their leisure time (Gilmour, 2007).

Physical inactivity is an independent risk factor for the development of coronary heart disease (CHD) (Paffenbarger et al., 1978; Manson et al., 1999; Rodriguez et al., 1994; Kannel and Sorlie, 1979; Leon and Connett, 1991). Family history is another risk factor: first-degree relatives of those with CHD have a 1.5- to two-fold increase in risk (Sivapalaratnam et al., 2010; Yarnell et al., 2003; Nasir et al., 2007; Andresdottir et al., 2002; Hopkins et al., 1988). Family members of people with CHD may be a key group to target with interventions to increase PA since they carry an excessive burden of CHD risk associated with both a positive family history and physical inactivity. Even in the presence of a family history of CHD, participation in at least moderate-level PA can significantly decrease the odds of developing CHD compared to remaining sedentary (Chen and Millar, 2001).

Interventions to increase PA are essential components of health promotion strategies. A Cochrane systematic review of randomized controlled trials of interventions to encourage PA among sedentary individuals with a minimum of six months of follow-up found that the evidence supports a positive, moderate sized effect on increasing self-reported PA (Foster et al., 2005). This suggests that PA is amenable to improvements with appropriate intervention.

It is important to understand PA behaviour change in terms of a social ecological perspective, which permits the exploration of PA in the context of personal, behaviour-specific, socio-environmental and physical environmental factors (Giles-Corti et al., 2005). Social ecological theory considers the various levels of influence on health behaviours, including individual, interpersonal, organizational, community and public policy factors that facilitate or impede behaviour change (Sallis and Owen, 2002). PA interventions need to be examined from a social ecological perspective to gain a better

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understanding of the broader context in which PA behaviour change is achieved.

A substantial body of research has examined the attributes of the built environment that are conducive to PA; several reviews have demonstrated the relationship between neighbourhood characteristics and PA outcomes (Mccormack and Shiell, 2011; Saelens et al., 2003; Wendel-Vos et al., 2007; Saelens and Handy, 2008). Higher density, greater connectivity, greater land use mix, accessibility of recreational facilities and local destinations, safety and visual quality are associated with greater self-reported walking and cycling (Saelens et al., 2003). Similarly, land use mix, connectivity, population density and overall neighbourhood design are significant determinants of PA (Mccormack and Shiell, 2011). Social support, connectivity of trails, and availability of recreation facilities have also demonstrated associations with PA (Wendel-Vos et al., 2007). Density, distance to non-residential destinations and land use mix were positively associated with walking for transport, but findings for route/network connectivity, parks and open space, and personal safety were less consistent (Saelens and Handy, 2008). These reviews highlight some of the important characteristics of neighbourhoods that are associated with PA; however, the majority of the existing research is largely based on cross-sectional or longitudinal research. An examination of how neighbourhood characteristics influence PA outcomes in the context of an individual-level behavioural risk reduction intervention is warranted.

Walkability is a commonly measured characteristic in studies examining neighbourhood influences on health outcomes (Berry et al., 2010; De Greef et al., 2011; Frank et al., 2008, 2010, 2005; Hoehner et al., 2011; Sundquist et al., 2011; Van Dyck et al., 2011, 2010a, 2010b). In general, walkability indices incorporate measures of several neighbourhood characteristics (e.g. land use mix, residential density, etc.) into one scale and use geospatial mapping techniques to link walkability to individual areas (e.g. the area surrounding an individual's home address). One of the most commonly used walkability indices is that proposed by Frank and colleagues (2010), which incorporates measures of intersection density, residential density, retail floor area ratio and land use mix (Frank et al., 2010). A simpler, readily available, cost-free approach for measuring neighbourhood walkability is Walk Score (available at walkscore.com), which uses data from multiple sources to estimate the walkability of the local area based on distance to amenities (e.g. grocery stores, restaurants, parks, libraries, fitness centres, retail establishments) and two pedestrian-friendly metrics, intersection density and average block length (Walk Score Advisory Group, 2011). Walk Score has recently been validated as a neighbourhood measurement tool (Carr et al., 2010, 2011; Duncan et al., 2011); however, it has not been applied in the context of a PA behaviour change intervention.

Few studies have examined whether or not the neighbourhood environment influences the effectiveness of interventions to increase PA. The purpose of the current study was to (1) create a walkability index using an existing built environment dataset from the Ottawa Neighbourhood Study (ONS), (2) compare walkability to Walk Score®, and (3) to link both walkability and Walk Score® to PA outcomes from the Family Heart Health: Randomized Controlled Trial (FHH-RCT). The analyses examined (1) whether or not FHH-RCT participants met the PA guidelines ($\geq$150 min moderate-vigorous PA per week); (2) the effect of the intervention arm (family risk reduction (FRR) vs. standard care (SC)), (3) individual level Walk Score® (high vs. low) and aggregate walkability of participants' home residential neighbourhood (high vs. low) on the dichotomous PA outcome (met PA guidelines vs. not) at baseline and at the end of the intervention period (12-weeks); (4) and the interaction between these conditions. It was hypothesized that (1) participants living in high walkability neighbourhoods would be more likely to meet PA guidelines at baseline compared to participants living in low walkability neighbourhoods and (2) that participants in the FRR intervention arm living in high walkability neighbourhoods would be most likely to meet PA guidelines at 12-weeks.

2. Methodology

2.1. Participants

To be included in the current analysis, participants were required to (i) be enroled in the FHH-RCT, (ii) live in an Ottawa neighbourhood and (iii) provide verbal informed consent for the data linkage. The University of Ottawa Heart Institute (UOHI) Human Research Ethics Board approved the FHH-RCT and this data linkage study.

Between January 2008 and October 2010, 423 participants were recruited for the FHH-RCT through a hospital-based prevention and wellness centre. In addition to being the spouse, offspring or sibling of a patient hospitalized at UOHI within the past 5 years for CHD, eligible participants were required to have at least one modifiable CHD risk factor (i.e. physical inactivity, smoking, poor nutrition, abdominal obesity or medication nonadherence), to speak English or French, be 20 to 80 years of age, be willing to provide informed consent, and be geographically available for assessment, intervention and follow-up. Exclusion criteria for the FHH-RCT was as follows: (1) unable to understand English or French; (2) history of diabetes mellitus or any atherosclerotic disease; (3) fasting glucose $\geq$7.0 mmol/L at screening; (4) presence of life threatening illness; (5) chronic kidney disease and/or undergoing dialysis; (6) active liver disease; (7) pregnant or planning to become pregnant within the next year; (8) cognitive impairment; or (9) other family member already participating in the study.

2.2. Intervention

Briefly, the FHH-RCT was a prospective, 1-year, randomized, controlled trial to evaluate the effects of a 12-week telephone-based risk reduction intervention provided to individuals at risk for CHD. Participants in the FHH-RCT were randomized to one of 2 arms: FRR intervention or SC control. FRR participants received one in-person counselling session with a heart health educator to identify their risk reduction goals and create a personalized behaviour change plan followed by 12 weekly telephone counselling sessions. The weekly sessions began with a discussion of progress toward stated goals and were structured using principles from the Theory of Planned Behaviour (41) and ecological models (Sallis and Owen, 2002). Each coaching session for those needing to increase their PA was designed to accomplish five goals: (1) to strengthen intentions to engage in physical activity; (2) to maintain and develop positive attitudes towards lifestyle change to support increased physical activity; (3) to provide social support and reinforcement; (4) to increase perceived control over physical activity (by identifying facilitators to change and assisting participants to overcome barriers), and (5) to help participants identify resources in the home, neighbourhood and community that could support long-term physical activity behaviour change and facilitate links to these resources. SC participants received a printed package containing general information about PA, nutrition, smoking and medications and CHD risk reduction and did not receive any further intervention.

2.3. Measures

2.3.1. Physical activity

Physical activity was measured using a modified version of the Godin Leisure-Time Exercise Questionnaire (Godin and Shephard,