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Neighbourhood environment and physical activity in older adults

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Abstract

Rationale.: The neighbourhood socio-physical environment has effects on health in later life including health behaviours, chronic illnesses, mental health and mortality. Few studies have examined the relationship of both physical environmental features and social aspects of neighbourhood with older adults' physical activity.

Objective: This study examined the relationship of neighbourhood physical and social environment with physical activity among older adults.

Methods: A cross-sectional telephone survey was conducted with 434 older adults in eight neighbourhoods in greater Vancouver, Canada and Portland, United States. Data included participants' perceptions of their neighbourhood built and social environment factors and levels of physical activity. A logistic regression analysis was conducted to understand the relationship between these factors.

Results: Participants engaged in physical activity most frequently at home (87.1%) or in close proximity of home (76.5%). Neighbourhood walkability, presence of amenities and accessibility were not significantly associated with meeting physical activity requirements. Participation in a recreational program with friends was associated with increased likelihood of physical activity.

Conclusion: The home and its immediate physical environmental context has potentially important relevance in supporting physical activity in older adults. Also, neighbourhood social aspects have a positive influence on activity levels.

Keywords

Neighbourhood; Built environment; Social environment; Physical activity; Older adults

1. Introduction

The health benefits for older adults who engage in routine moderate-intensity physical activity are widely supported by literature (e.g., Acree et al., 2006; Hamer et al., 2014; Blumenthal and Gullette, 2002; Li et al., 2005). Regular participation in physical activity associated with household, transportation or leisure activities may reduce, delay, or prevent

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the negative effects of chronic conditions (e.g. diabetes, heart disease), depressive illness, cognitive impairment and functional limitations (e.g., Lindwall et al., 2012; Reiner et al., 2013; Schuit, 2006). Built environmental factors (e.g., sidewalks, crosswalks, crossing lights, benches, lighting) are important predictors of physical activity, especially for older adults whose daily activities often contract to more immediate surroundings (e.g., home environment, neighbourhood) due to aging-related functional and mobility challenges (e.g., Carlson et al., 2012; Haselwandter et al., 2014; Rosso et al., 2011; de Melo et al., 2010).

This study is conceptually informed by the social-ecological perspective of the older adult individual having complex interrelations among the intrapersonal, social and physical environment of a neighbourhood in order to understand health behaviour in older adults (e.g., Locher et al., 2011; McLeroy et al., 1988; Sallis and Owen, 1999; Sylvie and Cohen, 2013; Yeom and Colleen, 2008). Intrapersonal factors related to physical activity include age, sex, socioeconomic status, educational level, marital status, chronic illness, functioning level, self-efficacy, lifestyle factors (e.g., physical inactivity, obesity). Chronic conditions in later life are individual risk factors for restrictions in mobility and physical activity levels (e.g. Hinrichs et al., 2015; Pang et al., 2005). Social factors refer to social relationships and social support acting as a facilitator or inhibitor for physical activity in older adults. Social support can potentially act in an informational, instrumental and/or motivational role to initiate and/or maintain both utilitarian and recreational physical activity behavior, e.g., going to a walking club, walking to a neighbourhood destination to meet friends or neighbours. Social relations and support can be measured by frequency of contacts with people in the neighbourhood context (i.e., neighbours, friends, family) and the perceived level of support in physical activity of older adults. Finally, the physical or built environment of the home and neighbourhood environment plays an important role in influencing health behaviour.

The person-environment fit model (e.g., Lawton and Nahemow, 1973) points out that health and well-being are outcomes of optimal match of the person and her/his home environment. Previous research guided by the social ecological approach suggests that there are multiple levels of influence on health promotion in older adults (Locher et al., 2011; Richard and Trudel, 2012; Shumway-Cook et al., 2005; Sylvie and Cohen, 2013). The study by Richard and Trudel (2012) demonstrated the importance of identifying social and political groups or organizations as potential levers in disease prevention and health promotion of older adults. Mahmood et al. (2012) noted the integrated influence of informal social support and physical environmental features in fostering utilitarian and recreational physical activity in older adults. Shumway-Cook et al. (2005) pointed out interventions to improve community-dwelling older adults' mobility levels need to include interpersonal factors (e.g., smoking, sedentary lifestyle, self-efficacy) and interpersonal influencers (e.g., education program fostering lifestyle change), which are potentially modifiable.

The neighbourhood socio-physical environment can have far-reaching effects on health in later life including health behaviours, chronic illnesses, mental health and mortality (Barrett, 2000; Cummins et al., 2007; Deehr and Shumann., 2009; Mendes de Leon et al., 2009; Veenstra et al., 2005: Yen et al., 2009; White et al., 2009). The health of older residents has been associated with subjective (perceived neighbourhood quality) and

objective (neighbourhood disadvantages and affluence) neighbourhood constructs (Bowling and Stafford, 2007; Weden et al., 2008). Also, the importance of social engagement or participation as an important contributing factor for successful aging has been identified and discussed for several decades (e.g., Lowenthal and Haven, 1968; Rowe and Kahn, 1997). Social participation has been associated with mortality, morbidity and quality of life in older adults (Levasseur et al., 2010; Berkman et al, 2000). Research has consistently shown that older adults' engagement in social activities is associated with positive outcomes on a variety of health indicators, including, self-rated health, depression, dementia, cognitive functioning, and health behaviors (e.g., Marquet and Miralles-Guasch, 2015; Patela et al., 2013; Pollack, C.E., von dem Knesebeck, 2004; Tunstall et al., 2014) neighbourhood Accessibility (or lack) of key resources in the neighbourhood, such as facilities to engage in preferred physical activities may be predictive of greater social participation by older adults (Richard et al., 2008, Rosso et al., 2013).

Neighbourhood physical environmental features, characteristics and amenities such as safety and supportive features (e.g., well-maintained pedestrian infrastructure, adequate benches, street lights), low traffic volume and flow, adequate public transportation (e.g., transit routes, physical design of bus stops), enjoyable scenery, can play a role in supporting the mobility of older residents in their neighbourhood (Cauwenberg et al., 2011; Glass and Balfour, 2003; Grant et al., 2010b; Michael et al., 2011; Rosenberg et al., 2013; Rosso et al., 2013). Accordingly, a supportive neighbourhood physical environment is likely to facilitate opportunities to be physically active and socially engaged (e.g., Chaudhury et al., 2012, 2011; Mahmood et al., 2012; Nagel et al., 2008; Phillips et al., 2005; Rosenberg et al., 2012; Yen and Anderson, 2012). Although personal and intrinsic physical capabilities may contribute more to the neighbourhood activity levels of older adults than perceptions of the neighbourhood environment (de Melo et al., 2010), other evidence suggests that the perceived quality and accessibility of the built environment is important for neighbourhood activity engagement in maintaining good health (Grant et al., 2010a; Stathi et al., 2012). Although research examining the relation among physical activity, and neighbourhood physical environment is growing (e.g., Carlson, et al., 2012; Chaudhury et al., 2012; Corey et al., 2008; Frank et al., 2010; Michael et al., 2006; Michael et al., 2009; Michael and Carlson, 2009; Rhodes et al., 2006; Cerin et al., 2008; Villanueva et al., 2014), empirical evidence of the influence of several aspects of the neighbourhood built environment on physical activity in older adults is unclear and inconsistent. Moreover, studies examining the influence of both physical and social environmental aspects of the neighbourhood on older adults' physical activity are scarce (Rosso et al., 2013, 2011). There is a need for empirical research to examine the influence of socio-physical environment on older adults to better understand the neighbourhood-older adult physical activity relation (Rosso et al., 2013; Mahmood et al., 2012; Marjolein and Annemarie, 2014). This will not only advance and deepen our substantive understanding in this area, but will also help make more informed and effective planning and policy decisions.

An accessible and safe home environment can help an older adult's autonomy by supporting maintenance of activities of daily living. A walkable neighbourhood environment with supportive pedestrian infrastructure, such as, safe flow of vehicular traffic, amenities in close proximity, appropriate public transit, can play an enabling role in mobility and physical

activity in all adults, especially for older adults with mobility and functional limitations. All of these levels interact in complex ways in the process of older adults' physical activity behaviours. This social-ecological perspective of neighbourhood-physical activity relations in older adults is a useful conceptualization of the phenomenon as it recognizes the complexity of the multi-faceted nature of physical activity for older adults.

2. Method

This study was part of a larger three-phase, mixed-methods research project conducted in the metropolitan areas of Vancouver, British Columbia (BC), Canada and Portland, Oregon (OR), United States. The overall goal of the larger project was to develop an understanding of the influences of neighbourhood built and social environments on physical activity among older adults utilizing a mixed-methods approach. The broader study focused on two research questions: a) What is the relationship between neighbourhood physical environmental features and physical activity behaviours in older adults? b) What is the relationship between neighbourhood social environment and physical activity behaviours in older adults?

2.1. Data source and collection

Four neighbourhoods in the Metro Vancouver and four neighbourhoods in the Greater Portland areas were the focus of this study. Census Tract data were used to select these eight neighbourhoods based on neighbourhood density and income levels to ensure variation in physical and social environment features important for physical activity (Chaudhury et al., 2011). This paper presents the results from a cross-sectional telephone survey conducted with a random sample of older adults from the eight neighbourhoods. The purpose of this survey was to examine the relationship between neighbourhood physical and social environmental factors, older adults' perceptions of these factors, and physical activity levels among older adults.

2.2. Sample

Eligibility criteria for participants were: a) over 60 years of age at the time of the survey, b) live in one of the selected neighbourhoods, and c) able to understand English. 'Physical activity' was described to participants as any physical movement or mobility carried out for the purpose of leisure (e.g., walk in the park, workout at gym) or transportation (e.g., walking/cycling to a bank or grocery store). In total, 7234 telephone numbers were called, and 434 older adults completed the telephone survey (response rate of approximately 6%). These older adults resided across the eight neighbourhoods, including: Mount Tabor, OR (n = 56), Clackamas, OR (n = 50), Lake Oswego, OR (n = 61), Milwaukie, OR (n = 64), Vancouver, BC (n = 53), Burnaby, BC (n = 51), Surrey, BC (n = 50) and Maple Ridge, BC (n = 49).

2.3. Study measures and variables

Data collected included demographic factors, health status, neighbourhood and housing details, as well as information on physical activity types and levels, neighbourhood spaces where physical activity took place, social and physical environmental motivators for physical

activity and perceptions of neighbourhood environments. The items incorporated into the present study's survey were a combination of concepts from an earlier phase of the larger study supplemented by validated items (i.e., scales) of existing literature focused on physical activity, neighbourhood walkability and social support (e.g., Fisher et al., 2004; Giles-Corti and Donovan, 2002).

There were three sub-scales on the physical environmental variables that are briefly discussed here.

2.3.1. Perception of physical environment motivators—This scale assessed the physical environment as a motivator to engage in physical activity ($\alpha = 0.694$). Participants' were asked to respond (not at all; not much; much; and very much) to the following question: "How much have you been motivated to engage in physical activity by each of the following physical environmental factors: a) Availability of nearby parks; b) Availability of nearby recreation centers and facilities; c) Neighbourhood maintenance and aesthetics; and d) Neighbourhood safety". This variable was recoded into three categories: high-, medium- and low-levels of physical environment motivators.

2.3.2. Neighbourhood walkability scale—This scale was adapted from the widely used Neighbourhood Environment Walkability Scale (NEWS) (Sallis et al., 1997) to assess neighbourhood walkability features ($\alpha = 0.746$). Participants' were asked about their level of agreement (strongly agree, somewhat agree, somewhat disagree, or strongly disagree) in response to the following questions: a) There are sidewalks on most of the streets in my neighbourhood; b) The sidewalks in my neighbourhood are well maintained (paved, even, and not a lot of cracks); c) There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighbourhood; and d) My neighbourhood streets are well lit at night. This variable was recoded into four categories such that there was a relatively equal distribution of responses in each category: low, low-medium, medium–high, and high-perceived neighbourhood walkability.

2.3.3. Perception of neighbourhood safety due to crime and traffic—The neighbourhood safety scale includes seven questions that were adapted from prior research (Fisher et al., 2004; Sallis et al., 1997), and information gained from earlier phases of this study ($\alpha = 0.795$). Participants' were asked about their level of agreement (strongly agree, somewhat agree, somewhat disagree, or strongly disagree) in response to the following statements: a) The crime rate in my neighbourhood makes it unsafe to go on walks during the day; b) Graffiti/vandalism/abandoned buildings are a problem in my neighbourhood; c) Homelessness is a problem in my neighbourhood; d) Alcohol and drug use are a problem in my neighbourhood; e) The traffic along the street I live on makes it difficult or unpleasant to walk in my neighbourhood; f) The traffic along nearby streets makes it difficult or unpleasant to walk in my neighbourhood; and g) Most drivers exceed the posted speed limits while driving in my neighbourhood. This variable was recoded into three categories: low, medium, and high level of perceived risk.

2.3.4. Perception of neighbourhood amenities and accessibility scale—The neighbourhood amenities and accessibility scale includes six items that were adapted from

questions listed in the NEWS (Sallis et al., 1997) ($\alpha = 0.706$). Participants' were asked about their level of agreement (strongly agree, somewhat agree, somewhat disagree, or strongly disagree) in response to the following statements: a) There are many places to go within easy walking distance of my home; b) There are bicycle or pedestrian trails in or near my neighbourhood that are easy to get to; c) There are many alternative routes for getting from place to place in my neighbourhood (I don't have to go the same way every time); d) The distance between intersections in my neighbourhood is usually short (100 yards or less, e.g., the length of a football field); e) Transit stop amenities (e.g., bus shelter, benches, lighting) are functional and helpful; and f) Public transportation, e.g., shelter/bench at stops, are close to home. This variable was recoded into three categories: low, medium and high level of amenities and accessibility features.

2.3.5. Social environment—Variables related to the social environment included: membership in a sports group or recreational organization, and if the older adult had walked or engaged in physical activity with a neighbour in the past 12 months (adapted from Giles-Corti and Donovan, 2002). The social nature of physical activity was also measured as the frequency in which a spouse, close family member, or friend participated in physical activity with the respondent in the past 12 months (adapted from Giles-Corti and Donovan, 2002). In addition, we also assessed the extent to which friends and family motivated the respondent to engage in physical activity (adapted from Stahl et al., 2001).

2.3.6. Physical activity level, type, and location—The Public Health Agency of Canada (2011) and the Center for Disease Control and Prevention (CDC) (2011) both recommend that older adults (≥65 years) participate in a minimum of 150 min (2.5 h) of moderate intensity aerobic activity each week. Preliminary descriptive analysis of the self-reported physical activity levels of the study respondents showed that only 11.3% of our sample did not meet the minimum physical activity requirements outlined by the Public Health Agency of Canada and CDC. This may be due to a tendency of individuals to over-report their physical activity levels (Slootmaker et al., 2009). The CDC has two levels of physical activity recommendations for older adults: a) for "important health benefits," the recommendation is 150 min (2.5 h) of moderate intensity aerobic activity (i.e., brisk walking) plus two or more days of muscle strengthening (weight bearing) activities each week, and b) for "greater health benefits", the recommendation is 300 min (5 h) moderate intensity aerobic activity plus two or more days of muscle strengthening (weight bearing) activities each week (CDC, 2013). Keeping the characteristics of the survey respondents in mind, we chose to classify participants in terms of whether they met the CDC's higher level of recommendation to participate in at least 300 min (5 h) of moderate intensity aerobic activity per week.

2.3.6.1. Physical activity level.—Participants provided information on their weekly physical activity levels when asked, "In a typical week, how many hours in total do you spend participating in physical activity?" Response categories included: 0 h per week (or none), <1 h per week, 1–2 h per week, 3–4 h per week, 5–6 h per week, 7–8 h per week, 9–10 h per week, ≥11 h per week. Responses were dichotomized into the categories of

having met the minimum physical activity requirements (≥5 h per week) or not having met them (<5 h per week).

2.3.6.2. Physical activity type.—Participants were asked about the type of physical activity (or activities) they participated in during the previous four weeks (e.g., heavy and light housework, heavy or light gardening, recreational or utilitarian walking, aerobic machines or classes, yoga or tai chi, calisthenics, weight-lifting, swimming, jogging, dancing, golfing/tennis/pickle ball, cycling, pool or billiard, or other).

2.3.6.3. Physical activity location.—Respondents were asked about the spaces or locations where they performed their physical activity or activities (e.g., home, one to three blocks from home, parks, trails, malls, recreational centers, adult day programs, churches, at a track or school, or others).

2.4. Statistical analysis

All analyses were conducted using IBM SPSS Statistics 19. A purposeful selection procedure was used to identify potential covariates for our logistic regression model (Bursac et al., 2008; Hosmer et al., 2013).

To begin, a univariate logistic regression analysis was conducted for each of the 19 independent variables listed in Tables 1 and 3. Based on the Wald chi-square statistic and *p*-value cut off point of 0.25, we included 11 variables as potential candidates in a preliminary multivariate logistic regression model. These variables included: age, marital status, household income, self-rated health, physical functioning limitations, membership in a sports group or recreational organization, walking with a neighbour, social environment motivator — friends, and participation in physical activity with a spouse, close family member, or friend. Using an iterative process, covariates were removed from the multivariate model, one-at-a-time, if they were not statistically significant at the $p < 0.15$ level, and not considered a confounder. As Bursac et al (2008) suggested, selecting significance levels is arbitrary and selecting inclusion and retention significance levels of $p < 0.25$ and $p < 0.15$, respectively, are reasonable since more traditional Significance levels (e.g., $p < 0.05$) can fail to identify variables known to be important in statistical analyses. Confounding variables were defined as a change greater than 20%, in the coefficient of any independent variable in the reduced model, compared to the larger model. Through this iterative process, one variable was eliminated (walking with a neighbour) because it was non-significant and not considered a confounder. Four study variables (marital status, income, age, and social environment motivator – family) were also non-significant, however, were retained in the logistic regression model as they were determined to be confounding variables. Next, variables that were initially excluded based on univariate analyses were re-introduced to the model, one-at-a-time, to identify those, if any, made an important contribution. Two variables (education and physical environment motivators) were significant at the $p < 0.15$ level and were included in the final multivariate model.

Consequently, logistic regression analysis (odds ratio [OR] and their 95% confidence intervals [*CI*s]) was used to evaluate the association between the dependent variable, meeting physical activity requirements (≥5 h per week), and 12 independent variables

that included: age, marital status, household income, education, self-rated health, physical functioning limitations, physical environment motivators, social environment motivators motivator – friends, membership in a sports group or recreational organization, and participating in physical activity with a spouse, close family member or friend. Independent variables entered into the model were assessed for potential collinearity; tolerance and Eigen values indicated no threat of collinearity among the predictor variables.

2.4.1. Missing data—Likert-type variables with less than 5% item non-response were imputed using mean (*M*) values from valid records. In addition, a comparison of means analysis was used to impute missing values for household income since non-response for this item was greater than 5%. Accordingly, household income was estimated in our sample based on gender, education and home ownership variables. For example, household income was estimated as high if a respondent was male, indicated that they completed a university degree, and owned a home.

3. Results

3.1. Study population characteristics

Information regarding respondents' demographics and health characteristics are presented according to physical activity levels in Table 1. Respondents ($N = 434$) were in large part between 60 and 74 years of age (66.4%), mostly female (64.4%), married (52.3%), had a household income of between $30,000 and $60,000 (53.2%), had completed a university degree (44.0%) and lived with another person (66.1%). Respondents who engaged in physical activity for ≥5 h per week ($n = 314$) more frequently reported that they were in good health (93.0%) and had no limitations in physical functioning (61.5%) compared to those who engaged in physical activity less frequently ($p < 0.001$).

3.2. Physical activity level, type, and location

Overall, respondents in the study were quite physically active. Over 87% of respondents stated that they engaged in physical activity on a regular basis in the past six months since the data were first collected as part of the larger project. In addition, 72.4% of all respondents stated that they engaged in ≥5 h of physical activity each week. This figure is higher compared to other recent studies, e.g., Marjolein and Annemarie (2014), who reported that 56.8% of older adults were meeting the recommended physical activity level. The most likely reason for a higher level of physical activity among our study participants is the operationalization of physical activity to include activities in one's home environment (e.g., housework, gardening). Table 2 summarizes the information regarding the type of physical activity and the location in which respondents performed these activities. Respondents who engaged in ≥5 h of physical activity per week ($n = 314$) reported that walking (88.9%), housework (85.4%), and gardening (52.5%) were their most frequent types of physical activity. A larger proportion of these respondents stated that they often participated in walking that was both recreational (e.g., walking in a park for exercise) (79.6% vs. 60.0%) and utilitarian (e.g., walking to the grocery store) (53.2% vs. 39.4%) compared to individuals who reported <5 h of physical activity per week ($p < 0.05$). Furthermore, a greater proportion of those who met physical activity guidelines (≥5 h per

week) reported participating in heavy housework (e.g., mopping floors) (51.3% vs. 15.0%) and gardening (e.g., digging or planting) (20.7% vs. 7.5%) compared to those who did not meet guidelines ($p < 0.05$). Weightlifting and the use of aerobic machines to exercise were also frequently reported activities across the sample.

Participants reported performing physical activities at various locations in and around their neighbourhoods. Most frequently, respondents engaged in physical activity at home (87.1%) or in very close proximity to home (e.g., within one to three blocks) (76.5%). These values were greater for individuals who met the physical activity guidelines than those who did not (at home: 90.1% vs. 79.2%; close proximity to home: 80.3% vs. 66.7%) (*ps* < 0.05). Other common spaces for physical activity included: nearby parks or trails, the local mall, and recreational centers or gyms.

3.3. Relation between physical and social environmental variables and meeting physical activity guidelines

A descriptive profile of the participants' physical activity levels and their associations with neighbourhood physical and social environment-related variables is provided in Table 3. Older adults reporting ≥5 h of physical activity per week reported higher levels of motivations from friends and family compared to older adults reporting <5 h of physical activity per week (friends: 67.5% vs. 61.7% and family: 69.1% vs. 64.2%). Also, more active respondents rated neighbourhood walkability (rated as *high*: 27.2% vs. 21.8%) and amenities/accessibility higher (rated as *high*: 44.3% vs. 40.0%). There was a higher level of joint physical activity with spouse (*sometimes*: 47.6% vs. 39%), family (*sometimes*: 37.6% vs. 28.3%) and friends (*sometimes*: 50.6% vs. 30.0%) among the more active older adults compared with less physically active group.

The results of the logistic regression analysis are presented in Table 4. Socio-demographic and health related variables were also associated with meeting the required physical activity level, and in the expected direction. Significant associations were observed for age, such that respondents ≥85 years (vs. 60–64 year olds: OR [95% *CI*s] = 0.33 [0.12–0.89]; $p < 0.05$) and individuals who have physical functioning limitations (vs. those who do not = 46 [0.27–0.77]; $p < 0.01$), were less likely to meet physical activity requirements. Similarly, rating health as good (vs. poor) was found to have a strong, positive association with meeting physical activity guidelines (2.89 [1.40—5.98]; $p < 0.01$).

3.3.1. Physical environment motivators and features—After controlling for all other independent variables in the model, respondents who noted that physical environment features motivated them to a large extent were less likely to meet the physical activity recommendations (high = 0.42 [0.23–0.77]; $p < 0.01$) compared to individuals who stated that they were minimally motivated by physical environment features (medium = 0.48 [0.26–0.89]; $p < 0.05$).

3.3.2. Social environment motivators and features—With regards to social environment features, two variables were found to be positively associated with meeting physical activity requirements after controlling for all other independent variables. Compared to individuals who did not belong to a sports group or recreational organization,

those who did were almost two and one half times as likely to meet the physical activity requirements (2.35 [1.35–4.11]; $p < 0.01$). Likewise, there was an increased likelihood of meeting physical activity requirements when respondents indicated that they frequently engaged in physical activity with friends compared to indicating that they rarely participated in physical activities with friends (2.25 [1.32–3.83]; $p < 0.01$).

3.4. Neighbourhoods and meeting required physical activity level

A one-way analysis of variance (ANOVA) was conducted to compare the effect of participants' neighbourhood on meeting physical activity requirements. This analysis showed a statistically significant difference in meeting physical activity requirements across neighbourhoods (F [7426] = 3.53, $p = 0.001$). Specifically, a Games-Howell *post-hoc* test revealed that meeting physical activity requirements was statistically significantly higher in Milwaukie, Oregon ($M = 0.88$, Standard Deviation [SD] = 0.33) compared to other neighbourhoods in the Greater Portland area, including Clackamas ($M = 0.54$, $SD = 0.50$, $p < 0.01$), Lake Oswego ($M = 0.64$, $SD = 0.48$, $p < 0.05$), and Mount Tabor ($M = 0.63$, $SD = 0.49$, $p < 0.05$). There were no statistically significant differences among any of the other neighbourhoods.

4. Discussion

This study explored the older adults' perception of neighbourhood physical and social environmental characteristics and their self-reported physical activity levels. One important finding is the importance of the proximate neighbourhood environment as a setting for supporting physical activity. Physical activity frequently occurred (76.5%) in the immediate neighbourhood at close proximity (i.e., one to three blocks) of home. Traditionally, public health research and policy have focused on older adults' participation in recreational or planned physical activity for healthy living, e.g., exercise programs, walking clubs. However, physical activity as embedded in daily activities, such as walking to the nearby grocery store, bank, shopping, bus stop, is also an important, and likely to be a more sustainable source of exercise for older adults. In this study, 74.2% and 49.3% of all respondents walked regularly for recreational and utilitarian purposes, respectively. Recent research supports the notion that utilitarian types of physical activity are significant sources of exercise as individuals who live within walking distance of shopping areas and public transit and they tend to be more physically active than individuals who are further away (e.g., Sallis et al., 2009; King et al., 2005).

Respondents in this study engaged in physical activity most frequently while at home (87.1%) or in very close proximity (one to three blocks; 76.5%) to their home. Relatively few respondents participated in physical activity at recreation centers (27.5%). This may be due to lack of quality, age-appropriateness and ease of access of structured physical activity programs. However, the availability and quality of physical activity programming at local recreation centers was not examined in this study. Nevertheless, these results suggest that health promotion strategies should consider the relevance of the neighbourhood environment at the block level in providing opportunities for physical activity among older adults. There are a few encouraging initiatives at the policy and planning level that are worth noting.

The city of Victoria in Australia has put forward several recommendations for land-use planning and policies. These include ensuring location of seniors' housing within 1 km of amenities and activities, creation of a safe system for older pedestrians to include safer road environments, safer vehicles, speeds, etc. (Garrard, 2013). The National Complete Streets Coalition is a coalition of non-profit public interest organizations has developed a fairly comprehensive set of guidelines for development of "complete streets" that are safer for people of all ages to walk and bicycle, and streets that reflects local cultures, accessible local shops and restaurants (Smart Growth America, 2014). It will be important for these initiatives to include recommendations for built environmental features sensitive to the needs of older adults (e.g. easy access to benches, public restrooms).

With regards to the physical environmental predictor variables, none of the factors considered in the study were positively associated with meeting physical activity guidelines. One possible explanation is that the neighbourhood physical environmental factors (i.e., walkability, presence of amenities and accessibility) in the study neighbourhoods did not have high enough variability to have any meaningful association with the participants' physical activity levels. Also, the specific variables representing the environmental concepts in the questionnaire developed might need to be refined (e.g., "neighbourhood safety" can be deconstructed with variables such as presence of graffiti or litter, poorly-maintained bus-stops) to be more relevant for older adult participants' lifestyles and preferences in mobility and physical activity. Moreover, a high proportion of the physical activities for these participants were taking place in the home and immediate neighbourhoods, whereas the survey primarily focused on their perceptions of the broader neighbourhood.

Being motivated by the presence of neighbourhood parks was found to have a negative association with one's likelihood to meet physical activity guidelines. One possible explanation of this finding is that the quality of these particular parks may be lacking in supportive features, overriding any benefit of the parks' presence in the neighbourhood. In general, the current evidence on associations between access to a park and level of physical activity in older people is inconsistent, and at best, weak. For example, in a study in Portugal, the distance from parks was found to be negatively associated with physical activity among men and association for women was nonexistent (Ribeiro et al., 2013). Indeed, several studies suggest that this association might be more dependent on park attributes than its proximity (e.g., Aspinall et al., 2010; Inoue et al., 2011; Cohen et al., 2007; Kaczynski et al, 2008; Strath et al., 2012; Sugiyama et al., 2010; Van Cauwenberg et al., 2012). Also, there is some indication that there is a gender difference in usage of green space or park as women are less likely to visit the park due to safety concerns (Ribeiro et al., 2013; Richardson and Mitchell, 2010).

This research has important strengths. The selection of neighbourhoods ensured exposure to diverse social and physical residential environments. By considering social and physical aspects of the environment, this study underscores the importance of the social component associated with physical activity. This importance of the near home environment, as highlighted in the findings of this study, points to the role of this neighbourhood scale to support older adults' levels of mobility and social interaction. Planning issues such as housing density, street infrastructure, and density of amenities at the immediate home

environment potentially hold much promise in active aging. It was also found that individuals who were members of recreational organizations or who frequently participated in physical activity with friends were significantly more likely to meet weekly physical activity requirements. This finding is consistent with other physical activity research that suggests that neighbourhood social support and social cohesion are significantly associated with increased neighbourhood physical activity among older adults (e.g., Booth, et al., 2000; Fisher et al., 2004). One important aspect of social support is the location of the individuals in the support network. It would be worthwhile to examine any association between proximity of individuals in the network and level of support for physical activity and mobility. In any event, this study's findings suggest that developing intervention strategies that support neighbourhood-based social contacts could enrich or support increased levels of physical activity among older adults. Future research should integrate perceived and objective measures of social and built environmental characteristics. A mixed-methods research design will more likely to allow an examination of both objective measures and subjective experience of the socio-physical aspects and characteristics of the neighbourhood environment.

4.1. Limitations

Collectively, the results associated with environmental variables were somewhat surprising, as it was anticipated that the selected neighbourhood design variables would have a positive effect on physical activity levels. Several limitations of the current analysis may have contributed to this. First, our focus in the current analysis was personal perceptions of neighbourhood characteristics. However, prior research suggests a discrepancy between the perception-based insights and actual neighbourhood design features and amenities and suggests that integrating objective and perceived measures may provide a more complete measure of neighbourhood environment (e.g., Christian et al., 2013). Nevertheless, it is important to understand and take into account older adults subjective perceptions of the built environmental features, as those may influence their levels of mobility and physical activity. Second, nuances of variation in environmental features from each of the eight neighbourhoods data may have been suppressed in the analysis of the overall sample. Associations between neighbourhood characteristics and physical activity may differ by neighbourhood density or socioeconomic status (Coogan et al., 2009). Conducting stratified analyses by neighbourhood density and average income levels may tease out some of the unique environmental factors that act as facilitators or barriers for physical activity in each type of neighbourhood. This type of analysis may also provide greater insight into the finding that statistically significantly more participants in the Milwaukie neighbourhood met physical activity requirements compared to other Portland Area neighbourhoods. Third, the absence of significant findings may reflect the lack of variability in our primary physical activity variable of interest, with over 70% of the population meeting the CDC recommendations. Finally, a notable limitation of this study is the absence of participants' objective physical activity data. The findings are related solely on the subjective reports of physical activity level. Self-reported adherence to the physical activity recommendation is generally higher than objectively measured physical activity, e.g., accelerometer-based data (Marjolein and Annemarie, 2014).

5. Conclusion

Physical activity for older adults needs to be conceptualized and approached as a broad spectrum of activities that varies in intensity, formality/informality and associated levels of social interaction. It is important to recognize that both built environment, particularly the close proximity area of one's home, and the social context in a neighbourhood have the potential to influence physical activity in older adults. In order to maximize effectiveness of the neighbourhood environments potential in active aging, we need to have a better understanding of the interrelationship between these two aspects of the neighbourhood, which would in turn, inform more effective interventions to support physical activity behavior in older adults. This study suggests that the immediate home environment is likely an important neighbourhood scale that should be more closely examined for its supportive physical environmental and social aspects to support active aging. From an urban planning and design perspective, this may have implications for residential density, land use and micro-environmental features. From a psycho-sociological perspective, the neighbourly interaction at this scale is worth further investigation. Fundamentally, a social-ecological perspective can provide a more meaningful conceptual understanding of these relationships, which can lead to socially sustainable and environmental supportive physical activity opportunities.

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Table 1

Respondents' intrapersonal factors: Summary of health and socio-demographic characteristics by physical activity level.

Socio-demographic characteristics	Total sample 100% (*N* = 434)	Physical activity level	
		<5 h/week 27.6% (*n* = 120)	≥5 h/week 72.4% (*n* = 314)
Age			
60–64 years	24.1% (106)	22.5% (27)	25.2% (79)
65–69 years	22.3% (98)	20.8% (25)	23.2% (73)
70–74 years	20.0% (86)	17.5% (21)	20.7% (65)
75–79 years	12.2% (53)	12.5% (15)	12.1% (38)
80–84 years	13.9% (60)	14.2% (17)	13.7% (43)
≥85 years	7.2% (31)	12.5% (15)	5.1% (16)
Gender			
Male	35.6% (153)	35.8% (43)	35.0% (110)
Female	64.4% (281)	64.2% (77)	65.0% (204)
Marital status			
Not Married	47.7% (207)	52.5% (63)	45.9% (144)
Married/Common Law	52.3% (227)	47.5% (57)	54.1% (170)
Household income ($)			
Low (<30,000)	22.6% (98)	29.2% (35)	20.1% (63)
Medium (30,000–60,000)	53.2% (231)	51.7% (62)	53.8% (169)
High (>60,000)	24.2% (105)	19.2% (23)	26.1% (82)
Living arrangement			
Alone	33.9% (147)	36.7% (44)	32.8% (103)
With Someone	61.1% (287)	63.3% (76)	67.2% (211)
Education			
High school or less	24.2% (105)	25.8% (31)	23.6% (74)
Some post-secondary	31.8% (138)	30.0% (36)	32.5% (102)
Completed degree	44.0% (191)	44.2% (53)	43.9% (138)
Self-rated health			
Good or Better	89.4% (388)	80.0% (96)	93.0% (292)[a]
Poor	10.6% (46)	20.0% (24)	7.0% (22)[a]
Physical functioning limitations			
No limitations	54.1% (235)	35.0% (42)	61.5% (193)[a]
Some limitations	45.9% (199)	65.0% (78)	38.5% (121)[a]

Note. Statistics indicate the percentage, %, and number (*n*) of participants.

[a] $p < 0.001$.

Table 2

Self-reported physical activity types and locations in the total sample and by physical activity level.

Physical activity variables	Total sample 100% (*N* = 434)	Physical activity level	
		<5 h/week 27.6% (*n* = 120)	≥5 h/week 72.4% (*n* = 314)
Engagement in regular physical activity			
Yes	87.6% (380)	65.8% (79)	95.9% (301)
Most frequently reported types of physical activity [a]			
Walking (all types)	84.1% (365)	71.7% (86)	88.9% (279)
Recreational walking	74.2% (322)	60.0% (72)	79.6% (250)
Utilitarian walking	49.3% (214)	39.4% (47)	53.2% (167)
Both	39.4% (171)	27.5% (33)	43.9% (138)
Housework (all types)	80.2% (348)	66.7% (80)	85.4% (268)
Heavy housework	41.2% (179)	15.0% (15)	51.3% (161)
Light housework	77.6% (337)	65.8% (79)	82.2% (258)
Both	38.7% (168)	14.2% (17)	48.1% (151)
Gardening (all types)	47.2% (205)	33.3% (40)	52.5% (165)
Heavy gardening	17.1% (74)	7.5% (9)	20.7% (65)
Light gardening	42.9% (186)	31.7% (38)	47.1% (148)
Both	12.7% (55)	5.8% (7)	15.3% (48)
Weightlifting	20.0% (87)	11.7% (14)	23.2% (73)
Aerobic Machines	19.8% (86)	10.8% (13)	23.2% (73)
Most frequently reported physical activity location [b]			
At home	87.1% (378)	79.2% (95)	90.1% (283)
Close proximity to home (1–3 blocks)	76.5% (332)	66.7% (80)	80.3% (252)
Parks	58.1% (252)	46.7% (56)	62.4% (196)
Trails	45.6% (198)	24.2% (29)	53.8% (169)
Malls	36.4% (158)	44.2% (53)	33.4% (105)
Recreational centers	27.2% (118)	20.8% (25)	29.6% (93)

Note. Statistics indicate the percentage, %, and number (*n*) of participants.

[a]Top 5 physical activities reported among samples.

[b]Top 6 locations reported among samples.

Table 3

Summary of neighbourhood physical and social environment factors in the total sample and by physical activity level.

Factors	Total sample 100% (*N* = 434)	Physical activity level	
		<5 h/week 27.6% (*n* = 120)	≥5 h/week 72.4% (*n* = 314)
Physical environment motivators			
Low	37.6% (163)	31.7% (38)	39.8% (125)
Medium	27.6% (120)	30.0% (36)	26.8% (84)
High	34.8% (151)	38.3% (46)	33.4% (105)
Neighbourhood walkability scale			
Low	22.0% (95)	21.0% (25)	22.4% (70)
Low-Medium	28.9% (125)	31.9% (38)	27.8% (87)
Medium-High	23.4% (101)	25.2% (30)	22.7% (71)
High	25.7% (111)	21.8% (26)	27.2% (85)
Perception of neighbourhood amenities and accessibility scale			
Low	27.4% (119)	26.7% (32)	27.7% (87)
Medium	29.5% (128)	33.3% (40)	28.0% (88)
High	43.1% (187)	40.0% (48)	44.3% (139)
Perception of neighbourhood safety due to crime and traffic scale			
Low	30.6% (133)	30.8% (37)	30.6% (96)
Medium	31.8% (138)	28.3% (34)	33.1% (104)
High	37.6% (163)	40.8% (49)	36.3% (114)
Social environment motivator – friends			
Not at all	34.1% (148)	38.3% (46)	32.5% (102)
Somewhat	65.9% (286)	61.7% (74)	67.5% (212)
Social environment motivator – family			
Not at all	32.3% (140)	35.8% (43)	30.9% (97)
Somewhat	67.7% (294)	64.2% (77)	69.1% (217)
Membership in recreational organization			
Yes	33.9% (147)	21.7% (26)	38.5% (121)
No	66.1% (287)	78.3% (94)	61.5% (193)
Walking with neighbours			
Never	59.0% (256)	65.0% (78)	56.7% (178)
A little bit	24.7% (107)	25.0% (30)	24.5% (77)
Quite a bit	7.6% (33)	5.0% (6)	8.6% (27)
A great deal	8.8% (38)	5.0% (6)	10.2% (32)
Participant in physical activity – spouse			
Never	54.8% (235)	61.0% (72)	52.4% (163)
Sometimes	45.2% (194)	39.0% (46)	47.6% (148)
Participant in physical activity – family member			
Never	65.0% (282)	71.7% (86)	62.4% (196)
Sometimes	35.0% (152)	28.3% (34)	37.6% (118)

Factors	Total sample 100% (*N* = 434)	Physical activity level	
		<5 h/week 27.6% (*n* = 120)	≥5 h/week 72.4% (*n* = 314)
Participant in physical activity – friend			
Never	55.1% (239)	70.0% (84)	49.4% (155)
Sometimes	44.9% (195)	30.0% (36)	50.6% (159)

Note. Statistics indicate the percentage, %, and number (*n*) of participants.

Table 4

Logistic regression analyses: Variables predicting meeting of minimum physical activity requirement (≥5 h/wk).

Predictor Variables[a]	β	95% *CI*s	
		Lower	Upper
Age (Ref: 60–64)			
65–69 years	1.27	0.63	2.56
70–74 years	0.94	0.45	1.99
75–79 years	1.00	0.43	2.34
80–84 years	0.97	0.42	2.27
≥85 years	0.33	0.12	0.89
Marital status (Ref: not married)			
Married/Common Law	0.86	0.45	1.63
Household income (Ref: low - <$30,000)			
Medium $30,000–60,000	1.49	0.82	2.72
High $60,000+	1.711	0.76	3.87
Education (Ref: high school or less)			
Some post-secondary	1.23	0.66	2.32
Completed degree	0.63	0.34	1.20
Self-Rated Health (Ref: Poor)	2.89	1.40	5.98
Physical Functioning Limitations (Ref: None)	0.46	0.27	0.77
Physical environment motivators (Ref: low)			
Medium	0.48	0.26	0.89
High	0.42	0.23	0.77
Social Environment Motivator – Friends (Ref: Low)	0.72	0.42	1.25
Membership in recreation club (Ref: No)	2.35	1.35	4.11
Participant in physical activity – Spouse (Ref: Never)	1.00	0.54	1.84
Participant in physical activity – Close Family (Ref: Never)	1.52	0.90	2.57
Participant in physical activity – Friend (Ref: Never)	2.25	1.32	3.83

Note.

[a]Reference groups are provided in parentheses for each predictor variable. β = Regression coefficient. CI=Confidence interval.