Promoting Active Living Among People with Physical Disabilities

Evidence for Neighborhood-Level Buoys

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Background: People with physical disabilities are more likely to be sedentary than the general population, possibly because they have an accrued sensitivity to environmental features.

Objectives: This paper describes the relationship between neighborhood-level active living buoys and the active living practices of adults with physical disabilities living in a large urban area.

Methods: A sample of 205 people with physical disabilities was recruited via a local rehabilitation center and its adapted fitness center. Telephone interviews were administered by senior occupational therapy students. The interview included a modified version of the Physical Activity and Disability Survey, a validated instrument that includes questions on physical activity, active transportation, and other activities of daily living. Individuals were geocoded within their census tract of residence (n=114) using their postal codes. Data on neighborhood active living potential were gleaned from systematic social observation.

Results: Multilevel logistic regression analyses showed that the association between the presence of environmental buoys and leisure activity was significant (OR=4.0, 95% CI=1.1–13.8) despite adjustments for individual difference variables while the association with active transportation became nonsignificant (OR=2.9, 95% CI=0.7–7.7) following adjustment for these variables.

Conclusions: People with physical disabilities who live in neighborhoods with more environmental buoys are more likely to report involvement in leisure-time physical activity.
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Introduction

In response to increasing rates of sedentary behavior and related illnesses, a growing body of literature pertaining to neighborhood-level determinants of physical activity has emerged in the public health literature.[1–19] Specific consideration has been given to population subgroups such as children,[8,9,20–23] adolescents,[24,25] older adults,[2,4,26] and people of various ethno-cultural and racial backgrounds.[27,28] Conspicuously absent from this list are people with physical disabilities. In fact, only limited data exist regarding environmental determinants of physical activity among people with physical disabilities,[29,30] despite the fact that these people are less active than other members of the population[31] and likely encounter more environmental barriers than the general population in their pursuit of an active lifestyle.[29,30] This paper contributes by examining the association among one specific type of environmental feature, neighborhood-level active living buoys, and the active living practices of people with physical disabilities.

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Conceptualizing Neighborhood-Level Active Living Buoys

Neighborhood active living buoys for people with physical disabilities are conceptualized as facilitating elements of the environment that can support a person's involvement in physical activities despite the presence of functional limitations.[29] The notion of buoys originated from Lawton and Nahemow's[32] ecologic model of aging and was recently reiterated by Glass and Balfour.[33] This later model posited that the health and functioning of an individual in any given neighborhood is a function of the balance between personal competencies and environmental pressors and buoys. Environmental pressors are barriers in the environment that interact with personal functional limitations and

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have the effect of hindering activity. An environmental buoy, on the other hand, is defined as a facilitating element of the environment that serves to support a person's activities despite the presence of functional limitations. Examples of such buoys could be physical adaptations in surroundings (e.g., access ramps) or the availability of resources (e.g., adapted transport).

Although the notions of barriers and facilitators are not new, their influence on individuals with differing functional limitations rarely has been examined at the neighborhood level. In a previous investigation conducted by Spivock et al.,[29] active living buoys were subdivided into three main categories: quality of the walking surface (e.g., surface of path, topography); adaptation of signage (e.g., auditory signals at crosswalks, sufficient time to cross); and accessibility of elements that surround the walking network (e.g., destinations and transport). In addition, an observational tool was devised for assessing the presence of buoys in urban settings. In the one urban setting examined, few environmental buoys were present to support active living among people with disabilities. Furthermore, the presence of environmental buoys was associated with average-to-high levels of activity-friendliness; average-to-higher safety from crime and traffic congestion and collisions; average-to-high number and variety of destinations; and higher proportions of people with disabilities and of low income.

Similar observations have been made by others.[30,34] For example, using cross-sectional data, Rimmer et al.[30] found that built environments including supports were more conducive to activity among people with disabilities, and Shumway-Cook et al.[34] observed that the presence of environmental buoys supported mobility in the community. Despite these initial findings, there are limited data that address environmental influences on the likelihood of adopting active transportation practices and maintaining involvement in leisure-time physical activity (LTPA) among people with physical disabilities. This paper is part of a larger investigation[35] and describes the relationship between the presence of neighborhood-level active living buoys and the active living practices of people with physical disabilities living in a large urban area.

Methods

Sample

Given interest in examining active living and the fact that few people with disabilities are physically active (only 8% report engaging in any LTPA, according to at least one study[36]), the recruitment strategy was purposeful and aimed at sampling substantial numbers of both physically active and physically inactive people with physical disabilities. As a first step, during regular activity classes at the center during the fall of 2004, members of an adapted fitness center affiliated with a rehabilitation facility in Montreal, Canada, were invited to participate in a research project pertaining to lifestyle and health. The adapted fitness center, the only one of its kind in Montreal, offers a gym with accessible fitness equipment, pool facilities, and programming to enable people with physical disabilities to take part in LTPA. Eligibility was determined at this time, and the person's name and telephone number were recorded. Informed consent was obtained over the telephone at the time of the initial phone contact.

In a second step, another group of participants was recruited who were likely to be inactive but comparable in terms of age and type of disability. Potential participants for this group were originally determined between January and August 2005 by an exhaustive search of the archives and current patient lists of the rehabilitation center that housed the adapted fitness center. For each participant who had been recruited from the adapted fitness center, a person affiliated with the rehabilitation center in the same age group and with a similar disability was identified. Within each of these strata, the person having been discharged most recently was chosen to match the active person and invited to participate. If this individual declined, an invitation was made to another.

All participants met the following inclusion criteria: They were aged 18–75; had a physical disability according to the Quebec Study on Activity Limitations criteria (i.e., any reduction in their ability to carry out daily activities resulting from a physical impairment[37]); and had resided on the island of Montreal in a non-institutional setting at the same address for at least 12 months. Exclusion criteria included being unable to understand or speak French (because this was a French-language institution) or exhibiting a cognitive impairment limiting the ability to complete an interview. Individuals were considered to have a cognitive impairment after a total of three questions had to be repeated three times before a coherent response could be obtained during the initial telephone interview, which was conducted by occupational therapy students. This protocol resulted in the exclusion of one individual.

Data Collection of Individual-Level Information

Data on individual-level determinants and outcomes were collected through telephone interviews for 201 of the study's 205 participants. Because of physical impairments restricting their use of a telephone, four participants were interviewed in person in their homes or at the rehabilitation center. Of these four, two participants were interviewed with a family member present to assist in interpreting speech. All interviews were performed by senior occupational therapy students following a 2-hour training session. Interviewers entered the data directly into a database using Microsoft Office's Access interface, version 11.6 SP1, in real-time. The interview was built around a modified and translated (from English to French) version of the Physical Activity and Disability Survey of Rimmer et al.[38]

This survey included questions on physical activity involvement (e.g., Do you presently participate in physical activities with the goal of improving or maintaining your physical fitness or for leisure purposes?) and active transport (e.g., Do you regularly perform physical activity for transport purposes, such as walking to work or propelling your wheelchair to school?). If a participant answered yes to either of these questions, he or she was then asked to provide information on frequency, intensity, duration, and type of activity. The number of minutes per week spent in each reported activity were totaled and then categorized as no activity, less than 30 minutes per day, or more than 30 minutes per day. For the purposes of analyses, responses were then dichotomized as yes (pooling responses of less than 30 minutes with those of more than 30 minutes) or no. This was done primarily because nearly half of the sample (41.0%) reported no physical activity at all. Similarly, responses to the question on transport physical activity were summed into a total number of minutes per week and then categorized in the same way as LTPA. These answers were then dichotomized as either yes or no for the multilevel logistic regression analysis because 74.6% of respondents reported engaging in absolutely no active transport.

Participants were also asked about their perceptions of the presence of the three aspects of neighborhood buoys (i.e., walking surface, adaptation of signage, and accessibility of elements that surround the walking network) using a 3-point scale: 1=little or no presence of feature, 2=moderate presence of feature, 3=large presence of feature. Responses to each item were dichotomized, with a value of 1 being ascribed to a response indicating a large presence of the feature and 0 otherwise. Subsequently, responses to the three items were summed and then resulting scores were divided into tertiles. Postal codes of participants were also recorded.

Finally, participants provided information about age, gender, disability, household income, and highest level of education completed. For age, they were asked to provide their birth year, and a variable representing their age in 2005 was created and eventually dichotomized into a group aged 18–44 and a group aged 45–75. Level of disability was self-reported by the participants, and these self-reports were then categorized into mobility, sensory, neuromuscular, balance/agility, and other. Mobility disability was chosen as the referent. For total gross household income, the interviewers provided categories of "less than (CAD$) 20,000" up to a top category of "(CAD$) 100,000 and higher" ([CAD$] 0–19,999; 20,000–39,999 . . . 100,000+). In analyses, participants earning (CAD$) 80,000–99,999 ($n$=12) were included in the highest income category along with those earning (CAD$) 100,000 or more. The question about the highest level of education included response choices of elementary school, high school, junior college, and university. The corresponding number of years of education for each category was also provided to assist participants educated outside the province of Quebec in understanding equivalent education levels. Dummy variables were created to operationalize response categories. Data collection procedures were approved by the Human Research Ethics committee of the CRIR (Centre de Recherche Interdisciplinaire en Réadaptation du Montréal Métropolitain).

Collection of Neighborhood-Level Data

Neighborhood-level data about active living buoys were obtained through observation. Following matching through postal code information, the 205 participants were found to live in 114 different census tracts. In a large urban area such as the Island of Montreal, residents' postal codes often correspond to a block-face or an apartment building. Census tracts are small, relatively stable geographic areas that have a population ranging in size from 2500 to 8000 inhabitants.[39] On the Island of Montreal, 2001 census tracts covered an average of 0.96 km^2 (SD=1.98) with an average population of 3554 (SD=1647); there were on average 92 distinct postal codes per 2001 census tract.

Data on neighborhood-level active living buoys were available for a subset of 56 census tracts from a previous investigation conducted in the summer of 2003[29] in which a total of four pairs of observers (n=8, four men and four women) were recruited to perform systematic social observation of neighborhoods using an observation grid.[33] Collected data included active living buoys for people with disabilities, as well as three dimensions pertaining to neighborhood active living potential for the general population: activity-friendliness, density of destinations, and safety. Activity-friendliness refers to physical characteristics of the neighborhood such as the interconnectedness of the street network, the presence of park benches and water fountains, and the presence of bicycle and walking paths. Density of destinations refers to the number and variety of destinations for engaging in meaningful personal or collective pursuits such as shopping, working, and participating in local community events. Safety describes the degree of threat presented by crime and by volume and speed of automobile traffic.

As reported elsewhere, the validity and reliability of the neighborhood active living buoys for people with physical disabilities[29] and the active living potential measures for the general population[35] are in the satisfactory to high range. In previous studies, mean scores for active living buoys (as assessed by observers on a 10-point scale)—walking surface (M=4.5, SD=1.0); signage (M=2.4, SD=0.7); and surroundings (M=3.3, SD=1.1)—were found to be significantly lower (all $p<0.001$ in one-sample t-tests)[29] than means for the three dimensions of neighborhood active living potential (activity-friendliness, 6.0; density of destinations, 5.3; safety, 6.4).[35]

An observer who had performed the systematic social observations in 2003 underwent re-training to minimize observational drift, and then performed systematic social observation in the 58 remaining tracts during the summer of 2005. Summary scores for the buoys and for the other dimensions of neighborhood active living were obtained through application of multilevel modeling procedures (for a full explanation of dimensions and their calculation, please see Spivock et al.[29] and Gauvin et al.[35]). Independent sample t-tests on the two subsets of census tract data showed no significant differences in mean levels of active living buoys between the different data collection procedures. The average dimensional scores for buoys and other dimensions of neighborhood active living potential were then categorized into tertiles, using the middle tertile as the referent. Mean values in the lowest, middle, and highest tertiles were 4.2 (minimum, 3.8; maximum, 4.5); 4.8 (minimum, 4.5; maximum, 5.2); and 5.6 (minimum, 5.3; maximum, 6.0), respectively.

Statistical Analysis Strategy

Following computation of descriptive statistics using SPSS version 12 software (Chicago IL, 2003), two separate series of multilevel logistic regression analyses were performed with HLM version 6.04 software (Lincolnwood IL, 2007), using active transport and LTPA as dichotomous dependent variables. That is, participants (n=205) were conceptualized as being nested within census tracts (n=114). Multilevel analyses were conducted to control for possible effects of this clustering. Each of the two resulting sets of multilevel analyses included six incremental models. Model 1 included the highest and lowest tertiles of active living buoys (the main exposure variable); Model 2 included control dummy variables for age (dichotomized at 45 years) and gender; Model 3 added dummy variables for gross household income (referent was [CAD$] <20,000; entered dummy variables were [CAD$] 20,000–39,999; [CAD$] 40,000–59,999; [CAD$] 60,000–79,999; and [CAD$] 80,000+); Model 4 added dummy variables for type of primary disability (the referent was mobility impairments; entered variables were sensory, balance/agility, neuromuscular disease, and other impairment/disability); Model 5 added the highest and lowest tertiles of the other three dimensions of neighborhood active living potential. Finally, Model 6 added participants' perception of the presence of neighborhood active living buoys.

Results

The final sample of participants with complete data in the telephone interview portion of the study included 94 men and 111 women (n=205). Although 206 participants met the criteria for inclusion, one was unable to finish the interview and was eventually excluded from the analyses due to a large amount of missing data. The average age of participants was 41 years (SD=11.4). Primary disabilities were mobility (n=95, 46.3%); neuromuscular disease (n=48, 23.3%); balance/agility (n=28, 13.7%); sensory (n=8, 3.9%); and other (n=25, 12.2%) (Table 1).

Of the participants, 106 were recruited from the adapted fitness center (304 people were approached; 221 agreed to speak with the research associate; 113 met age and residency requirements and agreed to give their telephone numbers; 107 were reached by the interviewers; and 106 completed the interview, for a response rate of 34.9%). Participants from the rehabilitation center came from an original list of 413 potential participants. Of those, 270 received information packages in the mail or (having already been prescreened for age, residency, and type of disability) from their clinicians; 100 participants contacted the research team; and 99 were successfully interviewed (response rate=36.7%).

Individuals recruited from the adapted fitness center had higher incomes ($\chi^2(5)=31.9$, $p<0.001$) than those from the rehabilitation center. There was no significant difference between the education levels of individuals in the two groups. There was no significant difference in the ages of participants of the two groups. As expected, members recruited in the adapted physical activity center were significantly more active than participants recruited from the rehabilitation center ($\chi^2(1)=85.0$, $p<0.001$).

As for the observed neighborhood data, a positive correlation was found between safety and activity-friendliness (Pearson $r=0.36$, $p<0.001$), and a negative correlation was found between safety and density of destinations (Pearson $r=-0.61$, $p<0.001$). All other correlations in the matrix had values below 0.2.

Table 1. Participant (n=205 individuals) and neighborhood characteristics (n=114 census tracts)

Participant characteristics	Categories	% (n)
Age (years)		
<45		39.5 (81)
≥45		60.5 (124)
Gender		
Men		45.9 (94)
Women		54.1 (111)
Average household income (CAD$)		
0–19,999		37.6 (77)
20,000–39,999		38.8 (78)
40,000–59,999		13.7 (28)
60,000–79,999		4.9 (10)
80,000+		5.8 (12)
Highest level of education attained		
Primary school (years 1–6)		6.8 (14)
High school (years 7–11)		28.8 (59)
Junior college (years 13–14)		22.4 (46)
University (year 14 and higher)		37.6 (78)
Primary impairment/disability		
Sensory total:		3.9 (8)
Hearing		1.8 (4)
Visual		2.9 (6)
Mobility total:		46.3 (95)
Post-stroke		9.8 (20)
Para/quadriplegic		6.8 (14)
Musculoskeletal		5.4 (11)
Mobility—other		24.4 (50)
Balance/agility		13.7 (28)
Neuromuscular disease		23.4 (48)
Other		12.2 (25)
Use of legs		
Full		17.6 (36)
Partial		69.8 (143)
None		11.7 (24)
Use of arms		
Full		55.6 (114)
Partial		42.4 (87)
None		1 (2)
Physical activity involvement		
None		41.0 (84)
Some		59.0 (121)
1–29 min./day		33.7 (69)
>29 min./day		25.4 (52)
Active transport		
None		74.6 (153)
Some		25.4 (52)
1–29 min./day		14.6 (39)
>29 min./day		6.3 (13)
Neighborhood characteristics (average score and proportion across 114 census tracts)	M	SD
Score on buoys scale	5.0	0.6
Proportion (%) of people with disabilities	17.8	1.1
Proportion (%) of people of low income	29.4	13.6
Proportion (%) of people with low education	15.7	8.5

CAD$, Canadian dollars; Min., minutes.

Results of the two series of multilevel logistic regression analysis appear in Tables 2 and 3 for LTPA and active transportation, respectively. Results indicate that greater presence of buoys is a significant predictor of involvement in LTPA (OR=6.79, 95% CI=2.87–16.05) even when all confounding variables are included in the model (OR=4.27, 95% CI=1.19–15.35). Greater presence of buoys was also related to use of active transportation in bivariate analyses (OR=3.09, 95% CI=1.31–7.30), and when individual-level variables were controlled (i.e., age, gender, income, disability [Model 4]). When other dimensions of active living potential were added (Model 5), this relationship was attenuated to nonsignificance (OR=2.50, 95% CI=0.57–10.95).

Discussion

The relationship between neighborhood-level active living buoys and the active living practices among people with physical disabilities living in a large urban area was the focus of this analysis. The presence of buoys was associated with LTPA even after controlling for numerous individual and neighborhood characteristics. Although there is little research in the literature with which to compare this information, the finding is congruent with some analogous studies. According to Rimmer et al.,[30] the level of accessibility in the built environment is a self-reported determinant of LTPA for people with physical disabilities, although the current investigation showed that environmental determinants acted in addition to perceptions. Although the presence of buoys was associated with active transport in bivariate analyses, this association seems to be confounded with other dimensions of the environment. More specifically, adjusting for activity friendliness, density of destinations, and safety (Model 5) attenuated the association between active living buoys and active transport, suggesting that these neighborhood features share variance with active living buoys. This is not altogether surprising in that, according to Berke et al.,[2] features of community-level walkability for the general population (e.g., mixed land use, grid-like street patterns) have a positive influence on the walking practices of older people (aged 65–97), many of whom would be likely to exhibit some type of physical impairments/disabilities.

Overall, one of the strengths of this study is that it provides a well-characterized environmental assessment that links the environment to estimates of leisure-time and transportation physical activity. The recruitment strategy, which utilized an archive search as well as current fitness center member solicitation, allowed for sufficient statistical power to describe associations in this understudied, yet important, population. The results suggest that the two dimensions of active living (LTPA and transportation physical activity) are differentially associated with neighborhood active living buoys. It is therefore important that future studies consider these outcomes separately.

Limitations

Some limitations exist. First, the measures of physical activity were self-reported. The usual practice of validating this information with the use of pedometers or accelerometers was made difficult by the fact that nearly 30% of the study participants used a wheelchair as their primary mode of mobility. Nevertheless, the Physical Activity and Disability Survey,[38] from which the questions were taken, is a validated and widely used tool, and it was deemed the most appropriate for the population under investigation. Second, because this was a cross-sectional study, a causal effect of buoys on active living cannot be claimed: The case may simply be that already-active people opt to live in neighborhoods that support their lifestyle. Future research involving natural experiments or investigator-driven experiments is warranted to overcome this limitation. Given the supportive evidence in the current study, longitudinal studies of active living practices and natural experiments involving retro-fitting environments with active living buoys are warranted. The fact that the observational data were collected over a 2-year period could also be a limitation, although analyses showed no statistical differences among these scores.

Next, logistic analyses are commonly used for dichotomous outcomes, but ORs are easily misinterpreted in the setting of common outcomes. Odds ratios for common outcomes, like the activity outcomes studied here, will be inflated relative to the corresponding prevalence ratio or relative risk.[40] Additional research with more nuanced differences are required for future research. Finally, despite the rather involved and exhaustive participant recruitment strategy, the relatively small sample size may have limited the statistical power of detecting associations. For example, although income would be expected to be strongly associated with physical activity participation, this effect was observed only in descriptive analyses and not in multivariate analyses.

Conclusion

People with physical disabilities who live in neighborhoods with more active living buoys are more likely to report involvement in LTPA as well as in active transportation. The association of buoys to active transportation, however, is confounded with other dimensions of the environment. These results underscore the importance of addressing the needs of people with physical disabilities when considering built-environment influences on active living, especially when dealing with an aging population that is likely to exhibit an

Table 2. Associations between active living buoys and likelihood of involvement in LPTA[a]

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)	Model 6 OR (95% CI)
Neighborhood characteristics						
Buoys						
Highest tertile	6.79 (2.87–16.05)***	6.76 (2.83–16.15)***	6.04 (2.47–14.73)***	6.45 (2.60–16.04)***	4.09 (1.16–14.38)*	4.27 (1.19–15.35)*
Middle tertile (Ref)	1.00	1.00	1.00	1.00	1.00	1.00
Lowest tertile	0.64 (0.321–1.29)	0.65 (0.32–1.32)	0.59 (0.28–1.24)	0.57 (0.27–1.23)	0.50 (0.21–1.19)	0.49 (0.21–1.17)
Activity-friendliness						
Highest tertile					1.02 (0.37–2.81)	1.07 (0.38–3.02)
Middle tertile (Ref)					1.00	1.00
Lowest tertile					0.52 (0.20–1.41)	0.52 (0.19–1.42)
Density of destinations						
Highest tertile					1.02 (0.40–2.61)	0.99 (0.39–2.54)
Middle tertile (Ref)					1.00	1.00
Lowest tertile					1.40 (0.56–3.51)	1.49 (0.59–3.75)
Safety						
Highest tertile					0.68 (0.24–1.90)	0.69 (0.24–1.95)
Middle tertile (Ref)					1.00	1.00
Lowest tertile					1.35 (0.48–3.84)	1.29 (0.45–3.73)
Individual characteristics						
Age (years)						
<45 (Ref)		1.00	1.00	1.00	1.00	1.00
≥45		1.92 (1.01–3.65)*	2.00 (1.01–3.95)*	2.12 (1.05–4.27)*	2.10 (1.03–4.29)*	2.14 (1.04–4.39)*
Gender						
Men (Ref)		1.00	1.00	1.00	1.00	1.00
Women		0.82 (0.43–1.56)	0.74 (0.38–1.46)	0.73 (0.37–1.46)	0.76 (0.38–1.53)	0.79 (0.39–1.61)
Income (CAD$)						
<20,000 (Ref)			1.00	1.00	1.00	1.00
20,000–39,999			0.98 (0.48–2.02)	1.00 (0.48–2.073)	1.02 (0.49–2.16)	1.01 (0.47–2.15)
40,000–59,999			6.05 (1.74–21.06)**	6.70 (1.86–24.15)**	6.27 (1.70–23.10)**	6.90 (1.80–26.45)*
60,000–79,999			1.00 (0.20–5.10)	0.84 (0.16–4.39)	0.76 (0.14–4.11)	0.76 (0.14–4.05)
≥80,000			2.60 (0.46–14.66)	2.50 (0.44–14.22)	2.44 (0.41–14.58)	2.38 (0.40–14.23)
Disability						
Mobility (Ref)				1.00	1.00	1.00
Sensory				0.99 (0.17–5.64)	0.91 (0.15–5.41)	0.82 (0.14–4.87)
Agility/Balance				0.64 (0.23–1.81)	0.66 (0.23–1.87)	0.57 (0.20–1.68)
Neuromuscular				1.09 (0.47–2.53)	0.95 (0.39–2.33)	0.91 (0.37–2.25)
Other				0.46 (0.16–1.32)	0.42 (0.14–1.26)	0.36 (0.12–1.13)
Perception of neighborhood						
Highest tertile						1.52 (0.72–3.22)
Middle tertile						1.00
Lowest tertile						0.60 (0.26–1.36)

Note: Model 1 includes only the main exposure variable of active living buoys. Model 2 includes the main exposure variable of active living buoys and controls for age and gender. Model 3 includes the main exposure variable of active living buoys and controls for age, gender, and income. Model 4 includes the main exposure variable of active living buoys and controls for age, gender, income, and type of primary disability. Model 5 includes the main exposure variable of active living buoys and controls for age, gender, income, type of primary disability, and three dimensions of active living potential (density of destinations, activity–friendliness, and safety). Model 6 includes the main exposure variable of active living buoys and controls for age, gender, income, type of primary disability, three dimensions of active living potential (density of destinations, activity-friendliness, and safety), and perception of the presence of active living buoys.

[a]Controlling for individual and neighborhood variables among 205 people with physical disabilities living within 114 census tracts in Montreal, Canada.

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

LTPA, leisure-time physical activity.

Table 3. Associations between active living buoys and likelihood of involvement in active transport[a,***]

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)	Model 6 OR (95% CI)
Neighborhood characteristics						
Buoys						
Highest tertile	3.09 (1.31–7.30)*	3.19 (1.34–7.61)*	3.35 (1.30–8.59)*	3.40 (1.30–8.91)*	2.54 (0.62–10.49)	2.50 (0.57–10.95)
Middle tertile (Ref)	1.00	1.00	1.00	1.00	1.00	1.00
Lowest tertile	0.82 (0.30–2.21)	0.79 (0.29–2.15)	0.77 (0.26–2.26)	0.77 (0.25–2.37)	0.83 (0.25–2.82)	0.80 (0.23–2.84)
Activity-friendliness						
Highest tertile					0.96 (0.30–3.06)	0.88 (0.26–3.01)
Middle tertile (Ref)					1.00	1.00
Lowest tertile					0.72 (0.21–2.53)	0.71 (0.19–2.63)
Density of destinations						
Highest tertile					0.63 (0.20–2.02)	0.65 (0.19–2.17)
Middle tertile (Ref)					1.00	1.00
Lowest tertile					1.51 (0.52–4.39)	1.57 (0.52–4.77)
Safety						
Highest tertile					0.48 (0.13–1.82)	0.48 (0.12–1.94)
Middle tertile (Ref)					1.00	1.00
Lowest tertile					0.61 (0.19–1.95)	0.71 (0.21–2.44)
Individual characteristics						
Age (years)						
<45 (Ref)		1.00	1.00	1.00	1.00	1.00
≥45		0.93 (0.46–1.88)	1.07 (0.50–2.29)	1.02 (0.47–2.24)	1.02 (0.46–2.30)	0.98 (0.43–2.24)
Gender						
Men (Ref)		1.00	1.00	1.00	1.00	1.00
Women		1.32 (0.66–2.68)	1.14 (0.54–2.44)	1.16 (0.53–2.50)	1.18 (0.53–2.65)	1.09 (0.47–2.51)
Income (CAD$)						
<20,000 (Ref)			1.00	1.00	1.00	1.00
20,000–39,999			1.87 (0.78–4.52)	1.85 (0.76–4.52)	2.08 (0.81–5.36)	2.14 (0.80–5.75)
40,000–59,999			5.26 (1.78–15.53)**	5.22 (1.74–15.69)**	5.49 (1.72–17.52)**	5.44 (1.64–18.04)**
60,000–79,999			0.78 (0.12–5.12)	0.86 (0.13–5.89)	0.87 (0.12–6.60)	0.74 (0.09–6.32)
≥80,000			0.26 (0.03–2.55)	0.25 (0.03–2.53)	0.23 (0.02–2.48)	0.21 (0.02–2.46)
Disability						
Mobility (Ref)				1.00	1.00	1.00
Sensory				1.79 (0.29–11.18)	1.84 (0.28–12.21)	2.21 (0.31–15.87)
Agility/Balance				1.02 (0.33–3.18)	1.02 (0.32–3.26)	1.26 (0.37–4.24)
Neuromuscular				0.90 (0.33–2.45)	0.83 (0.29–2.43)	0.92 (0.30–2.80)
Other				1.50 (0.48–4.71)	1.45 (0.44–4.79)	1.76 (0.52–6.02)
Perception of neighborhood						
Highest tertile						0.73 (0.30–1.80)
Middle tertile (Ref)						1.00
Lowest tertile						2.02 (0.81–5.06)

Note: Model 1 includes only the main exposure variable of active living buoys. Model 2 includes the main exposure variable of active living buoys and controls for age and gender. Model 3 includes the main exposure variable of active living buoys and controls for age, gender, and income. Model 4 includes the main exposure variable of active living buoys and controls for age, gender, income, and type of primary disability. Model 5 includes the main exposure variable of active living buoys and controls for age, gender, income, type of primary disability, and three dimensions of active living potential (density of destinations, activity-friendliness, and safety). Model 6 includes the main exposure variable of active living buoys and controls for age, gender, income, type of primary disability, three dimensions of active living potential (density of destinations, activity-friendliness, and safety), and perception of the presence of active living buoys.

[a]Controlling for individual and neighborhood variables among 205 individuals with physical disabilities living in 114 census tracts in Montreal, Canada.

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

increased number of disabilities over the coming years.

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References

1. McGinn AP, Evenson KR, Herring AH, Huston SL, Rodriguez DA. Exploring associations between physical activity and perceived and objective measures of the built environment. J Urban Health 2007;84:162–84.
2. Berke EM, Koepsell TD, Moudon AV, Hoskins RE, Larson EB. Association of the built environment with physical activity and obesity in older persons. Am J Public Health 2007;97:486–92.
3. McCormack GR, Masse LC, Bulsara M, Pikora TJ, Giles-Corti B. Constructing indices representing supportiveness of the physical environment for walking using the Rasch measurement model. Int J Behav Nutr Phys Act 2006;3:44.
4. Michael Y, Beard T, Choi D, Farquhar S, Carlson N. Measuring the influence of built neighborhood environments on walking in older adults. J Aging Phys Act 2006;14:302–12.
5. Lopez RP, Hynes HP. Obesity, physical activity, and the urban environment: public health research needs. Environ Health 2006;5:25.
6. Librett JJ, Yore MM, Schmid TL, Kohl HW III. Are self-reported physical activity levels associated with perceived desirability of activity-friendly communities? Health Place 2006;3:767–73.
7. Giles-Corti B. People or places: What should be the target? J Sci Med Sport 2006;9:357–66.
8. Davison KK, Lawson CT. Do attributes in the physical environment influence children's physical activity? A review of the literature. Int J Behav Nutr Phys Act 2006;3:19.
9. Sallis JF, Glanz K. The role of built environments in physical activity, eating, and obesity in childhood. Future Child 2006;16:89–108.
10. Day K, Boarnet M, Alfonzo M, Forsyth A. The Irvine-Minnesota inventory to measure built environments: development. Am J Prev Med 2006;30:144–52.
11. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the built environment underlies key health disparities in physical activity and obesity. Pediatrics 2006;117:417–24.
12. Trayers T, Deem R, Fox KR, et al. Improving health through neighbourhood environmental change: Are we speaking the same language? A qualitative study of views of different stakeholders. J Public Health (Oxf) 2006;28:49–55.
13. Leslie E, Coffee N, Frank L, et al. Walkability of local communities: using geographic information systems to objectively assess relevant environmental attributes. Health Place 2007;13:111–22.
14. Rutt CD, Coleman KJ. Examining the relationships among built environment, physical activity, and body mass index in El Paso, TX. Prev Med 2005;40:831–41.
15. Frank LD, Schmid TL, Sallis JF, Chapman J, Saelens BE. Linking objectively measured physical activity with objectively measured urban form: findings from SMARTRAQ. Am J Prev Med 2005;28(Suppl 2):117–25.
16. Brownson RC, Chang JJ, Eyler AA, et al. Measuring the environment for friendliness toward physical activity: a comparison of the reliability of 3 questionnaires. Am J Public Health 2004;94:473–83.
17. Satariano WA, McAuley E. Promoting physical activity among older adults: from ecology to the individual. Am J Prev Med 2003;25(Suppl 2):184–92.
18. Maibach EW. Recreating communities to support active living: a new role for social marketing. Am J Health Promot 2003;18:114–9.
19. Handy SL, Boarnet MG, Ewing R, Killingsworth RE. How the built environment affects physical activity: views from urban planning. Am J Prev Med 2002;23(Suppl 2):64–73.
20. Timperio A, Salmon J, Telford A, Crawford D. Perceptions of local neighbourhood environments and their relationship to childhood overweight and obesity. Int J Obes 2005;29:170–5.
21. Zhang X, Christoffel KK, Mason M, Liu L. Identification of contrastive and comparable school neighborhoods for childhood obesity and physical activity research. Int J Health Geogr 2006;5:14.
22. Anderson PM, Butcher KE. Childhood obesity: trends and potential causes. Future Child 2006;16:19–45.
23. Dehghan M, Khtar-Danesh N, Merchant AT. Childhood obesity, prevalence and prevention. Nutr J 2005;4:24.
24. Babey SH, Brown ER, Hastert TA. Access to safe parks helps increase physical activity among teenagers. Policy Brief UCLA Cent Health Policy Res 2005;(PB2005–10):1–6.
25. Carver A, Salmon J, Campbell K, et al. How do perceptions of local neighborhood relate to adolescents' walking and cycling? Am J Health Promot 2005;20:139–47.
26. Cunningham GO, Michael YL, Farquhar SA, Lapidus J. Developing a reliable senior walking environmental assessment tool. Am J Prev Med 2005;29:215–7.
27. De Bourdeaudhuij I, Teixeira PJ, Cardon G, Deforche B. Environmental and psychosocial correlates of physical activity in Portuguese and Belgian adults. Public Health Nutr 2005;8:886–95.
28. McNeill LH, Wyrwich KW, Brownson RC, Clark EM, Kreuter MW. Individual, social environmental, and physical environmental influences on physical activity among black and white adults: a structural equation analysis. Ann Behav Med 2006;31:36–44.
29. Spivock M, Gauvin L, Brodeur JM. Neighborhood-level active living buoys for individuals with physical disabilities. Am J Prev Med 2007;32:224–30.
30. Rimmer JH, Riley B, Wang E, Rauworth A. Accessibility of health clubs for people with mobility disabilities and visual impairments. Am J Public Health 2005;95:2022–8.
31. CDC. Health-related quality of life and activity limitation—eight states, 1995. MMWR Morb Mortal Wkly Rep 1998;47:134–40.
32. Glass TA, Balfour JL. Neighbourhoods, aging and fuctional limitations. In: Kawachi I, Berkman LF, editors. Neighborhoods and health. New York: Oxford University Press, 2003.
33. Lawton MP, Nahemow L. Ecology and the aging process. In: Eisdorfer C, Lawton MP, editors. The psychology of adult development and aging. Washington DC: American Psychological Association, 1973.
34. Shumway-Cook A, Patla AE, Stewart A, et al. Environmental demands associated with community mobility in older adults with and without mobility disabilities. Phys Ther 2002;82:670–81.
35. Gauvin L, Richard L, Craig CL, et al. From walkability to active living potential: an "ecometric" validation study. Am J Prev Med 2005;28(Suppl 2): 126–33.
36. Rimmer JH, Rubin SS, Braddock D, Hedman G. Physical activity patterns of African-American women with physical disabilities. Med Sci Sports Exerc 1999;31:613–8.
37. Noreau L, Cantin R, Trépannier S. Activité physique. In: Institut de la statistique du Québec, editor. Enquête québécoise sur les limitations d'activités. Québec: Institut de la statistique du Québec 2001:122–48.
38. Rimmer JH, Riley BB, Rubin SS. A new measure for assessing the physical activity behaviors of persons with disabilities and chronic health conditions: the physical activity and disability survey. Am J Health Promot 2001; 16:34–42.
39. Statistics Canada. 2001 Census Dictionary. www12.statcan.ca/english/census01/Products/Reference/dict/geo013.htm.
40. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. JAMA 1998;280:1690–1.