National Collaborating Centre for Environmental Health

Centre de collaboration nationale en santé environnementale

NOVEMBER 2012

Intersection between the Built and Social Environments and Older Adults' Mobility: An Evidence Review

Heather M. Hanson,[a,b] Maureen C. Ashe,[a,b] Heather A. McKay,[a,b,c] Meghan Winters[a,d]

evidence review

Summary

- Inevitably, an aging population will demand significant health and economic costs at personal and societal levels.
- Emerging evidence highlights that built and social environments both play a role in older adults' mobility, community engagement and health. It may be the interaction between the person, the built environment, and elements of the social environment that encourage or dissuade an older adult to be physically active out of doors and in his or her community.
- However, few studies specifically address the complexity of community participation at the person, neighbourhood, and societal levels. The available evidence suggests that supportive built and social environments are associated with older adults' walking, but the causal mechanisms are less clear. While it appears that poor social and built environments limit community mobility, the extent to which supportive physical surrounds enable community engagement for individuals with existing limitations is unknown.
- Research that seeks to better understand how person-level characteristics interact with street-level and social environment factors would make a valuable contribution to this field. In particular, a better understanding of factors that encourage older adults to remain active in their community could have a substantial impact on individuals, communities, and the health-care system alike.

[a] Centre for Hip Health and Mobility
[b] University of British Columbia Department of Family Practice
[c] University of British Columbia Department of Orthopaedics
[d] Simon Fraser University Faculty of Health Sciences

Introduction

The Canadian population landscape is changing as the number and proportion of older adults grow. An estimated nine million Canadians will be 65 years and older by the year 2036.[1]

Remarkably, this demographic represents about one in four Canadians.[1] The notion of facilitating older adults to age in place at home may be ideal, and if healthy aging was a personal and societal goal, it could lead to enhanced quality of life, decreased risk for developing chronic conditions and, ultimately, reduce the already burgeoning health-care costs associated with aging. Given the expected change in demographics, promoting the health of older adults and encouraging them to remain active and engaged in their communities is warranted. A relatively new area of inquiry within the public health and geography literature is the role that built and social environments might play in enhancing older adults' ability to remain active in their community. Literature highlights that being outside is important to maintain older adults' mobility[2]; a welcoming neighbourhood environment could facilitate opportunities for both physical activity and social interaction. However, it is unlikely that there is but a single reason why people leave their homes to walk in their community. Indeed, it is often the interaction between the person, their physical built and social environments that encourage, impede, or dissuade older adults' community mobility.

In this paper, we highlight key factors associated with community mobility in older adults based on the published literature. We begin with an overview of common terms and definitions within this field. We then present findings on older adults' outdoor community mobility based on a recent review of the relevant published literature and identify key gaps. Finally, we summarize how current evidence might, in future, guide development of effective interventions and policies that encourage and enhance community mobility for older adults.

Defining Key Terms within the Built and Social Environments

As health and the community environment are multi-faceted concepts, utilizing a multi-disciplinary perspective is likely to promote a greater understanding of older adults' community mobility. Further, common definitions provide a platform upon which to integrate knowledge and practice. Definitions also provide a means to synthesize evidence regarding the contribution of the built and social environments to older adults' mobility. For example, in the clinical health domain, older adults' mobility often refers to personal mobility, such as the ability to walk, complete activities of daily living, and participate in the community. However, when searching the geography literature, for example, mobility often refers to transportation (e.g., driving a car, using public transportation, etc.). Thus, we provide definitions for key terms used in this paper.

Person-Level Definitions

Older Adults – We use the term older adults to describe individuals 65 years of age and older.

Mobility – The Canadian Institutes of Health Research[3] and the World Health Organization's International Classification of Functioning Disability and Health (ICF)[4] define mobility as specific activities such as walking, climbing stairs, and engaging in instrumental activities of daily living. It might also refer to community participation (such as using public transportation and driving a car). We define community mobility as the ability of a person to move about and complete physical activities in their community setting, with a focus on non-motorized personal mobility (e.g., walking).

Walking – In the literature, two main types of walking are identified – recreational and utilitarian. Recreational walking refers to physical activity for quality of life and other health benefits; utilitarian walking is personal transportation while completing tasks and/or commuting.[5]

Community Participation – The ICF[4] defines participation as "involvement in a life situation." We define community participation as older adults' interaction and involvement in their neighbourhood outdoor physical environment.

Mobility Disability – Mobility Disability results when a person is not able to move or navigate their environment; it can result from impairments and/or activity restrictions.[6] Mobility Disability is sometimes operationalized in the older adult literature as a self-report measure such as: not able to walk two to three city blocks independently[7]; not able to walk 400 metres in 15 minutes[8]; and/or not able to walk a half-mile or climb stairs independently.[9]

Environment-Level Definitions

Built Environment – The built environment encompasses "urban design, land use and the transportation system".[10] We further differentiate built environment factors according to street-level factors (also called microscale elements, e.g., sidewalks, street crossings, lighting, etc.) or community-level factors (also

known as macroscale elements, e.g., destinations, parks, street networks, land-mix use, etc.).

Social Environment – We define the social environment as, "social relationships and cultural milieus within which defined groups of people function and interact."[11] Key elements of the social environment include: social support, social networks, socioeconomic position, and social cohesion.[11]

Approach for Evidence Review

We conducted a systematic search of the peer-reviewed literature to identify and synthesize the current evidence on the association between the built and social environment and older adults' outdoor community mobility (e.g., walking) and participation. Information related to the search strategy is provided in Appendix A. In brief, articles were included if they used peer-reviewed primary data to address person-level and environment-level factors related to community-dwelling older adults' outdoor mobility. We aimed to review literature that focussed on the person and his/her physical environment and social milieu. We chose, a priori, to include quantitative and qualitative studies as a means to fully appreciate the breadth of the literature. We adopted no geographical restrictions so as to appreciate similarities that might exist among older adults around the world. Due to methodological and geographical differences between studies, our findings reflect a content analysis of results reported in published manuscripts. We neither assessed papers for bias nor made recommendations based on level of evidence. We describe our findings below and summarize key points in Table 1.

Result from Search Strategy

Using our search strategy across five databases, two investigators (HMH, MCA) independently reviewed 1,061 articles by title and abstract. From these, 116 articles were selected for full text review. Two investigators (HMH, MCA) independently reviewed each full text paper, and 33 papers that met the inclusion criteria were selected as relevant. These 33 papers crossed different methodologies and used quantitative (N=28), qualitative (N=4), and mixed methods (N=1) designs. Geographically, we reviewed 19 studies from the US[7,12-29]; two from Canada[30,31]; four from Australia[32-35]; two from Brazil[36,37]; one from Columbia[38]; one from Finland[39]; one from Japan[40]; one from Scotland[41]; and two from Sweden.[42,43] Of note, although our search strategy was focused on health at the person-level, most of the studies we included reported on older adults' walking or physical activity in their environment; only a few studies highlighted direct associations between the built environment and specific health outcomes (e.g., quality of life, mobility, etc.). Table 2 details the characteristics of the studies we included.

Limitations

As researchers adopt a wide range of study designs, we chose to include as wide a range of studies as possible. That is, in this synthesis, we did not try to limit our search by study design. We also did not weight the evidence generated by one method or approach over another. While it is not possible to compare a large-scale quantitative study to a small-scale qualitative study, we felt it was important to include all designs. However, we accept the strengths and limitations of both approaches. Generally, quantitative studies provide population-level findings, are more generalizable, and evaluate relationships between variables. Qualitative methods that use focus groups, interviews, or mixed methods approaches to capture the voices of participants add rich detail and depth of understanding that complement quantitative findings. Similarly, comparing objectively measured characteristics with perceptions of the built environment is a challenge. Together, these equally meaningful and complementary approaches inform and enliven the broad scope of this topic. To enhance clarity for the reader, we refer to specific methods alongside results, wherever possible.

Key Findings

Built Environment

Street-Level Factors

Street-level characteristics were identified by 18 of 33 articles as associated with older adults' community mobility. The condition of sidewalks was most commonly identified as an important feature. Older adults in the state of Santa Catarina, Brazil, were less likely to engage in walking for transportation if their environment did not have sidewalks.[36] Approximately 43% of inactive participants reported having no sidewalks in their neighbourhood compared with 20% of active participants. In Glasgow, Scotland,[41] and Hässleholm, Sweden,[43] uneven sidewalks were identified by older adults as being impediments to their mobility. Clarke and colleagues found that neighbourhood streets in poor condition were

associated with a 4.5 times higher odds of severe mobility disability in Chicago, Illinois.[7] Similarly, in a national study from Australia, being physically active was associated with less difficulty using sidewalks.[33] The surface condition of sidewalks was also identified as an issue for mobility by older adults. Surface materials such as stone finishes and slippery conditions related to weather were perceived as problematic.[42] Other street-level features were mentioned. Appropriate curb height,[41,43] adequate lighting,[34,35] and the presence of benches[41,42] were desirable and thought to encourage walking.

Older adults' perceptions of safety and confidence while walking also affected other aspects of health. Street-level characteristics, specifically the presence of street crossings, were positively associated with mental health and quality of life. In a US survey, older adults reported anxiety about crossing the street, especially in low-light situations such as crossing at dusk or at night.[12] In Finland, authors used a path analysis approach to characterize factors related to quality of life. In general, older adults who reported more barriers in the physical environment had lower quality of life scores. Distances within their community directly explained participants' quality of life score, while hilly terrain, noisy and dangerous traffic, and distances in the community explained quality of life through fear of moving outdoors.[39]

Community-Level Factors

Community level factors were associated with older adults' community mobility in 29 of 33 papers. In all but one study,[24] there was a positive association between some elements of neighbourhood walkability and physical activity of older adults who lived there. Most studies were conducted in the US (N=20), were quantitative in design (N=25), and included large population sizes. Only two studies used both perceived and objective measures of the built environment. For older adults' physical activity (measured either through self-report questionnaires and/or with objective measures [e.g., accelerometry, pedometers]), there were positive associations with some element of neighbourhood walkability such as neighbourhood connectivity or access to services. To illustrate, for older men and women (mean age 78 years) there was a significant association between neighbourhoods with higher composite walkability scores and higher amounts of self-reported physical activity.[14] A study of older adults aged 66+ years conducted in Washington State, Washington, DC, and Baltimore, MD, reported a positive association between self-reported utilitarian walking (for errands) and neighbourhood walkability.[20] Notably, participants who lived in more walkable neighbourhoods walked 38 minutes/week compared with only seven minutes/week of walking for participants who lived in less walkable neighbourhoods. A study conducted in Portland, Oregon, reported similar findings – increased walking in older adults was associated with community-level factors. Specifically, 22% of the variance in neighbourhood walking in older adults (mean age 74 years) was explained by neighbourhood walkability variables (employment density, household density, number of street intersections, and area of green and open spaces).[23]

Associations between community-level built environment features and other health outcomes were also highlighted. For example, older men from King County, Washington State, living in neighbourhoods ranked as more walkable, had a lower risk of depressive symptoms.[13] Further, a slower decline in older adults' leg strength was associated with neighbourhoods that had higher street connectivity in Portland, Oregon.[26] Finally, Clarke and colleagues noted that older adults (75+ years) living in North Carolina neighbourhoods with more car commuters had a higher risk for disability in instrumental activities of daily living[18] and a 1.5 times increased risk for mobility disability, as compared to those in more pedestrian and transit-dependent neighbourhoods.[17]

Destinations

Destinations within the community were highlighted as important factors to encourage walking in many of the papers reviewed (19/33). Studies from across the US identified that specific elements of the community supported increased walking activity. These included streets with more businesses[28]; the presence of malls and trails[25]; parks and green space[16,23]; retail destinations[16,28,29]; and amenities in general.[22,23] The importance of destinations to promote walking was also observed in other countries, although the types of destinations differed between countries. In Sao Paulo, Brazil, older men were more likely to walk if they lived close to soccer fields, whereas older women were more likely to walk if there was a nearby community square or primary health services within a 10-minute walk.[37] In Canada, walking step counts of older adults were associated with perceived access to services.[30] Specifically, walking increased if services were located within a five-minute walking distance.[31] A qualitative study from New South Wales, Australia, found that access to surroundings perceived as attractive supported physical activity in older adults.[34] Finally, in a large study from Tokyo, Japan, five-year survival in

older men was associated with having access to a walkable green space.[40]

Social Environment

Across countries, positive social factors encouraged or increased older adults' participation in walking or outdoor physical activities. The social environment was studied in 19/33 evaluations of older adults' mobility and encompassed the influence of social interactions, a sense of connectedness and belonging, and the presence of social disorder on older adult's physical activity. Interpersonal interactions with friends, neighbours, or family occurred in association with walking. Booth and colleagues found that physical activity was significantly associated with the social reinforcement older adults received from friends or family who commented that walking improved the walker's appearance.[33] Using a case study design from Glasgow, Scotland, Day (2008) reported that physical environments that supported walking also promoted social interactions through greater likelihood of meeting others.[41] This, in turn, generated a sense of community connectedness. Walking to and visiting public locations allowed older adults to feel like part of the broader community or neighbourhood. A study that employed qualitative techniques found that even if older adults had reduced social networks, they still valued simple interactions like sitting on a bench, watching people, and experiencing the informal interactions these locations provided.[42]

Similar to a sense of belonging, having a positive attitude toward the community also had a positive effect on health. A cohort study of older adults in Tokyo, Japan,[40] reported that a positive attitude toward one's own community had a significant impact on older adults' five-year survival. Conversely, social disorder had a negative association with older adults' mobility. A recurrent finding was around the association between fear of crime and violence and fewer social interactions and less physical activity.[19,23,24] Vandalism and graffiti[25] and the presence of litter,[36] specifically, were associated with decreased physical activity. Interestingly, in two studies, older adults reported that sharing the path with cyclists was at times difficult and reduced perceived safety for them as pedestrians.[41,43]

Across studies that addressed the social environment, walking may have occurred because of, or alternatively may have been affected by, a positive social environment. In the first instance, being physically active afforded older adults the opportunity to experience social interactions. Engaging in neighbourhood walking enhanced the social environment by creating a sense of community, such as seeing people on the street and saying hello.[41] In the second instance, engaging in social activities also promoted physical activity. Walking to social or recreational events[37] and the light activity associated with participation in enjoyable leisure tasks provided older adults with a source of physical activity.

Very few studies directly measured the interaction of the built and social environment on community mobility. However, a study by King (2008) that evaluated participants who lived within eight Denver neighbourhoods highlighted the importance of perceived safety and walking, even in higher walkable neighbourhoods.[21] In addition, Lovasi and colleagues from Seattle, Washington, found no statistically significant associations between neighbourhood walkability and older adults' recreational walking.[24] However, in their discussion, the authors note social environment variables (e.g., social capital, social cohesion) and the importance of understanding the complexity of walking in the neighbourhood as important factors to consider. Although emerging evidence suggests a key link between mobility and the social environment, further research is needed to clarify the intersection between specific factors in social and built environments that encourage older adults' community mobility.

Summary of Key Findings

We note that relatively few studies specifically addressed the role of both built and social environments on older adult mobility. Thus, we urge the reader to interpret our findings with this in mind. Conversely, the dearth of research in this emerging field provides an opportunity to seek answers to important questions related to the role of person-level factors, and the interaction between them, on older adults' mobility and ultimately their health. Given these limitations, initiatives that focus on street-level and social environment factors seem important to inform policy decisions. For example, at the street-level, decision-makers might enact policy to maintain the presence and condition of accessible sidewalks and associated usability of street-crossings. This might be especially important in neighbourhoods that are home to a large proportion of older adults. At the social environment level, it may be important to encourage neighbourhood initiatives to instill a sense of safe, inviting communities. It is likely that a multi-pronged approach that encompasses both built and social environment-level initiatives may be key to older adult health and mobility – but more research is needed to discern this interaction.

1) There was a positive association between some elements of neighbourhood walkability (objectively measured and perceived) and older adults' outdoor physical activity. It is not possible to determine the relative importance of the built versus social environment on outdoor mobility. However, it appears that both may play an important role.
2) Emerging evidence from the few studies that used a qualitative approach supports a positive influence of the social environment on older adults' mobility. Elements of the social environment were most often overlooked in large-scale, quantitative studies.
3) The social environment is an important avenue for further investigation. In particular, it is important to better discern the benefits of social interactions that result from a physically active lifestyle and the amount and type of physical activity that stems from social interactions.

Key Gaps in the Literature

1) There are too few studies that investigate person-level factors using, for example, perceived measures of neighbourhood walkability to capture the voice of older adults.
2) Future research might focus on the integration of person-level characteristics with factors related to the built and social environments. A framework that encompasses all of these factors and the relation between them is needed to advance our understanding of how best to encourage older adults to remain active in their communities.

Table 1: *Main findings in eligible papers (n=33) on older adults and the built and social environment*

Environmental Focus	Main Findings
Built Environment	
Street-Level	
	The presence and condition of sidewalks and the construction material used were key issues for older adults
	Other street-level features identified by older adults as important were: curb heights; adequate lighting; safe street crossings; and presence of benches
Community-Level	
	An association between neighbourhood walkability and physical activity in older adults
	Lower risk of depressive symptoms in men living in more walkable neighbourhoods
	Slower decline in leg strength for older adults living in neighbourhoods with greater street connectivity
	Greater risk for disability for older adults living in communities with more car commuters
Destinations	
	Older adults' walking associated with amenities/destinations in the neighbourhood
Social Environment	
	Walking and physical activity offered opportunity for older adults to remain socially connected with other individuals and the broader community
	Social disorder negatively associated with older adults' mobility
	Some older adults voiced concerns about sharing the path with cyclists

Table 2: *Summary of papers included in the evidence review (n=33)*

Author, Year	Study Design	Setting	Sample	Health
USA				
Bailey (1992)[12]	Cross-sectional study	Florida	76 M/F, 56+ yrs.	Older adults are anxious about crossing the street, especially crossing at dusk or at night.
Berke (2007)[13]	Cross-sectional analysis of data from a longitudinal cohort study	Washington	740 M/F, 65+ yrs.	Older men living in neighbourhoods with higher walkability had a lower risk of depressive symptoms.
Berke (2007)[14]	Cross-sectional analysis of data from a longitudinal cohort study	Washington	936 M/F, 65+ yrs.	Neighbourhoods with higher walkability were associated with higher levels of physical activity in older women and men.
Brown (2010)[15]	Cross-sectional study	Alabama	19 M/F, 65+ yrs.	Older adults highlighted that it is important to have amenities located nearby and someone to accompany them on trips.
Carp (1980)[16]	Cross-sectional study	Texas and California	1608 M/F, 65+ yrs.	Older adults more likely to walk if destinations/amenities were within walking distance.
Clarke (2008)[7]	Cross-sectional analysis of data from a longitudinal study	Illinois	Multistage probability sample of 3,105 adults aged 18 or more years restricted to 1195 M/F, 45+ yrs. for this study	Older adults with severe mobility disability had a 4 times greater risk of one street being in fair or poor condition.
Clarke (2009)[17]	Cross-sectional analysis of data from a longitudinal study	United States	Multistage sample of +25 yrs. restricted to 1821 urban M/F, 45+ yrs.	There was a 1.5 times greater risk of mobility disability if older adults lived in a community with more motorized commuters.
Clarke (2005)[18]	Cross-sectional analysis of data from a longitudinal study	North Carolina	First wave of Established Populations for Epidemiological studies of the Elderly (EPESE), 1986, Stratified random sample of 4154 M/F, 65+ yrs.	There was a higher risk of instrumental ADL disability in regions where there were higher proportions of car commuters.
Clarke (2011)[19]	Cross-sectional study	Illinois	Multistage representative sample of 18+yrs, restricted to 1225 M/F, 45+ yrs. (40% of the sample)	For older adults in neighbourhoods with increased social disorder, there was a 25% decrease in personal interaction, except at the neighbourhood block level.
King (2011)[20]	Cross-sectional study	Washington State, Maryland, and Washington, DC	719 M/F, 66+ yrs.	Increased association with walkability and physical activity.
King (2008)[21]	Cross-sectional study	Colorado	190 M/F, aged 65+ yrs.	Increased walking was associated with street level features and the social and community environment.
King (2003)[22]	Cross-sectional study	Pennsylvania	149 F	Physical activity was increased in communities with destinations.
Li (2005)[23]	Cross-sectional study	Oregon	577 M/F, 65+ yrs.	Increased physical activity was associated with safer areas, green space, and amenities.
Lovasi (2008)[24]	Case-control study	Washington	1608 M/F, 30-79 yrs.	No significant association with walking for exercise at the community level or with destinations.

Author, Year	Study Design	Setting	Sample	Health
Michael (2006)[25]	Cross-sectional study	Oregon	105 M/F, 65+ yrs.	Increased physical activity associated with presence of malls and trails; decreased physical activity associated with the presence of graffiti and vandalism.
Michael (2011)[26]	Cohort study (12-14 years follow up)	Oregon	1,671 F, 65+ yrs.	Neighbourhoods with increased connectivity associated with slower decline in dynamic leg strength.
Morris (2008)[27]	Cross-sectional study	Missouri, Illinois, Indiana	Older women: 136 Women with MS: 173	In older women, self-efficacy, functional capacity and street connectivity facilitated physical activity.
Nagel (2008)[28]	Cross-sectional study	Oregon	546 M/F, 65+ yrs. not in formal exercise program, able to walk unassisted, and living in one of 56 included neighbourhoods	Streets with a high volume of traffic and closer distance to retail and parks explained walking activity.
Patterson (2004)[29]	Cross-sectional study	Oregon	133 urban and suburban women 70+ yrs.	Urban neighbourhoods were associated with more frequent walking activity among older women compared with suburban neighbourhoods; more walkable neighbourhood not associated with neighbourhood satisfaction nor quality of life.
AUSTRALIA				
Bird (2009)[32]	Cross-sectional study	Melbourne	72 F (Italian, Vietnamese, Anglo-Celtic), 60+ yrs.	Older women were more likely to be physically active if living alone and less likely to be active if fearful of injury.
Booth (2000)[33]	Cross-sectional study	Australia	449 M/F, 60+ yrs.	Being physically active was associated with higher self-efficacy, access to destinations, less difficulties using footpaths, and friends/social opportunities to encourage activity.
Fuller (2010)[34]	Focus group case study	New South Wales	Compared discussions in two sets of focus groups comprised of 81 M/F 60+ yrs. and 18 M/F 50+ yrs.	Important features for undertaking physical activity include access to facilities, personal safety, weather, footpaths/lighting, transportation.
Humpel (2004)[35]	Cross-sectional study	Australia	399 M/F 40+ yrs. (with 191 >60 yrs.)	Men have significant associations between neighbourhood walking and aesthetics and will still walk even if the weather is inclement. For women, access to walking/exercise and weather were significantly associated with physical activity.

Author, Year	Study Design	Setting	Sample	Health
SOUTH AMERICA				
Corseuil (2011)[36]	Cross-sectional study	Brazil	1656 M/F, 60+ yrs.	Significant associations with low activity levels and presence of garbage and lack of lighting. Respondents were likely to be inactive in the absence of sidewalks, parks, streetlights, and a pet to walk.
Salvador (2010)[37]	Cross-sectional study	Brazil	representative sample of 385 Brazilians 60+ yrs. living at least 6 mo at current address	Men walk because of presence and proximity to soccer fields within 10 minutes; women walk because of presence of a community square and primary health care less than a 10-minute walk away.
Parra (2010)[38]	Cross-sectional study	Columbia	1966 M/F, 60+ yrs.	Residents in areas with higher active park density were more likely to report active park use.
EUROPE				
Day (2008)[41]	Case study	Scotland	45 retired M/F 62-90 yrs. Samples drawn from three different types of urban areas: inner urban, suburban, and small coastal town with rural hinterland	Older adults stated that the following key points were important: clean air / free from pollution; environment that is peaceful and quiet; pavements are important (problematic when there are high curbs, obstacles, uneven surfaces, no benches to sit on, and slopes). Social interaction is important.
Hovbrandt (2007)[42]	Phenomenographic study	Sweden	21 M/F, 80+ yrs. engaged in at least 1 occupation outside the home, selected for maximum variation	Older adults reported that cyclists on the sidewalk can be problematic, or when the weather causes the sidewalks to be slippery (e.g., snow). Other problems included missing benches, pavement stones. Opportunities for social interaction were important.
Wennberg (2010)[43]	Mixed methods before-after study	Sweden	244 M/F, 65+ yrs.	Older residents were more satisfied with the outdoor environment after implementation of accessibility measures. Fewer residents reported physical barriers as a reason to avoid walking outdoors, yet safety and security were still major issues.
Rantakokko (2010)[39]	Cross-sectional study	Finland	589 M/F 75+ yrs. with MMSE >21, able to walk 500m, no contraindications for physical activity	Fear of moving outdoors explained quality of life in older adults. Terrain, traffic, and chronic conditions explained fear of moving outdoors.
CANADA				
de Melo (2010)[30]	Cross-sectional study	Manitoba	60 M/F 65+ yrs., living in neighbourhood for at least 1 year and not using mobility aid	Number of steps associated with perceived access to services and proportion of services within a 5-minute walking time was important.
Richard (2009)[31]	Cross-sectional study	Quebec	Convenience sample of 282 older adults 58+ yrs.	The proximity to older adult-friendly environments and opportunities for social participation were important.

Author, Year	Study Design	Setting	Sample	Health
ASIA				
Takano (2002)[40]	Cohort study	Japan	3144 M/F of the 1992 cohort	Older men had a significant association between 5-year survival and factor of walkable green space. For all participants there was an association between survival and positive attitude towards one's own community.

Appendix A: Literature Search Strategy

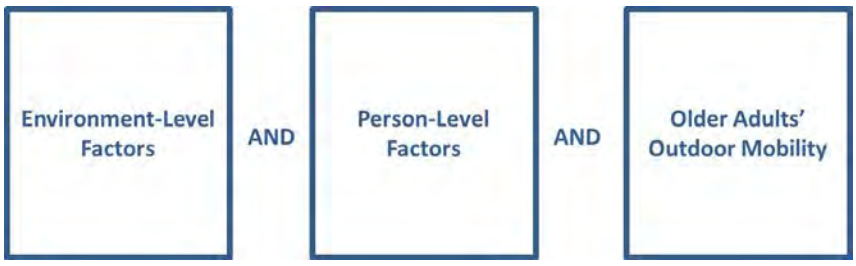
A.1 Databases/Search Tools

We used the following six databases in our systematic search of the literature.

- **AgeLine**: citations from over 600 sources from 1978 to present, with an emphasis on aging issues and the population of 50 years of age and over
- **CINAHL**: citations from over 2,700 journals covering 1982 to present, with a concentration on nursing and allied health literature
- **EMBASE**: with a European focus, citations from over 5,000 international journals covering 1974 to present, with a concentration on biomedical and pharmacological literature
- **OVID Medline**: citations from approximately 5,600 international journals covering 1946 to present, with a concentration on biomedical and life sciences literature
- **PsycINFO**: citations from over 1,300 journals covering 1887 to present, with a concentration on psychology and the psychological aspects of related disciplines
- **TRID**: an integrated database combining approximately 940,000 records covering completed and in-progress research, grey literature, and peer reviewed content from 1960 to present, with a focus on transportation research

The databases were strategically selected to provide disciplinary breadth of the articles searched and included.

A.2 Search Terms and Date Ranges



The search was conceptualized to identify whether there was an association between environment-level and person-level factors and older adults' non-motorized, outdoor mobility. Environment-level search concepts included:

built environment, urban planning, walkability, environmental design, perceived environment, environmental audit, community design, community health planning, city planning, and social planning. Person-level search concepts included: health, physical capacity, physical capability, perceptions, confidence, self-efficacy, physical functioning, well-being, quality of life, and mental health. Mobility was conceptualized to include walking, trips, and participation: walking, motor activity, active transportation, locomotion, mobility, accelerometry, physical activity, pedestrian, trip, GPS, spatial analysis, travel patterns, travel behaviour, travel survey, travel diary, life space, transportation pattern, participation, social inclusion, social exclusion, social interaction, interpersonal relations, social contact, and engagement. The search was optimized for each database, which included matching the search concepts to the equivalent heading or term within the discipline-specific contexts of the six included databases. Standard Boolean operators and wildcard symbols were employed. The search was created and refined in January/February 2012 and conducted in March – June 2012.

A.3 Inclusion Criteria

All records returned by the search were screened for relevance. The first phase involved two investigators independently screening at the title and abstract level. Articles identified as relevant or potentially relevant were then retrieved for full text review; these were also reviewed independently by two investigators who met and agreed on final inclusion of studies for this review. Inclusion criteria used to operationalize relevance were:

- Mean age ≥60 years
- Community-dwelling
- Peer-reviewed articles reporting primary data
- Non-motorized mobility
- Outdoor environment

A.4 Literature Organization/Storage

Electronic copies of all articles considered for full text review were stored in PDF format in an electronic reference manager and collaborative platform (Mendeley, Inc.). Hard copy versions were also used and are maintained at the Centre for Hip Health and Mobility.

Acknowledgements

We gratefully acknowledge the support of the Canadian Institutes of Health Research. We also acknowledge CHHM trainee Anna Chudyk, Dean Giustini, and our librarian scientist for their assistance in the development of the search strategy as well as Michele Wiens, Erna van Balen, Gloria Gutman, and Karen Armstrong for their review of the draft document.

References

1. Statistics Canada. Population projections for Canada, provinces and territories. 2009 to 2036. Ottawa, ON: Ministry of Industry; 2010 Jun. Available from: http://www.statcan.gc.ca/pub/91-520-x/91-520-x2010001-eng.pdf.
2. Simonsick EM, Guralnik JM, Volpato S, Balfour J, Fried LP. Just get out the door! Importance of walking outside the home for maintaining mobility: findings from the women's health and aging study. J Am Geriatr Soc. 2005 Feb;53(2):198-203.
3. Canadian Institutes of Health Research. Mobility in aging – a strategic initiative of the CIHR Institute of Aging. Ottawa, ON: CIHR; 2010; Available from: http://www.cihr.ca/e/29994.html.
4. World Health Organisation. International Classification of Functioning, Disability and Health (ICF). Geneva, Switzerland: WHO; [cited 2012 Sep 6]; Available from: http://www.who.int/classifications/icf/en/.
5. Gauvin L, Riva M, Barnett T, Richard L, Craig CL, Spivock M, et al. Association between neighborhood active living potential and walking. Am J Epidemiol. 2008 Apr 15;167(8):944-53.
6. Patla AE, Shumway-Cook A. Dimensions of mobility: defining the complexity and difficulty associated with community mobility. J Aging Phys Act. 1999;7(1):7-19.
7. Clarke P, Ailshire JA, Bader M, Morenoff JD, House JS. Mobility disability and the urban built environment. Am J Epidemiol. 2008 Sep 1;168(5):506-13.
8. Pahor M, Blair SN, Espeland M, Fielding R, Gill TM, Guralnik JM, et al. Effects of a physical activity intervention on measures of physical performance: results of the lifestyle interventions and independence for Elders Pilot (LIFE-P) study. J Gerontol A Biol Sci Med Sci. 2006 Nov;61(11):1157-65.
9. Guralnik JM, Ferrucci L, Balfour JL, Volpato S, Di Iorio A. Progressive versus catastrophic loss of the ability to walk: implications for the prevention of mobility loss. J Am Geriatr Soc. 2001 Nov;49(11):1463-70.
10. 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(2 Suppl):64-73.
11. McNeill LH, Kreuter MW, Subramanian SV. Social environment and physical activity: a review of concepts and evidence. Soc Sci Med. 2006 Aug;63(4):1011-22.
12. Bailey SS, Jones SA, Stout RJ, Bailey JH, Kass S, Morgan BB. Issues of elderly pedestrians. Transport Res Rec. 1992(1375):68-73.
13. Berke EM, Gottlieb LM, Moudon AV, Larson EB. Protective association between neighborhood walkability and depression in older men. J Am Geriatr Soc. 2007;55(4):526-33.
14. 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(3):486-92.
15. Brown CJ, Bradberry C, Howze SG, Hickman L, Ray H, Peel C. Defining community ambulation from the perspective of the older adult. J Geriatr Phys Ther. 2010 Apr-Jun;33(2):56-63.
16. Carp FM. Environmental effects upon the mobility of older people. Environ Behav. 1980 Jun 1;12(2):139-56.
17. Clarke P, Ailshire JA, Lantz P. Urban built environments and trajectories of mobility disability: findings from a national sample of community-dwelling American adults (1986–2001). Soc Sci Med. 2009;69(6):964-70.
18. Clarke P, George LK. Understanding and addressing the challenges of disability. The role of the built environment in the disablement process. Am J Public Health. 2005;95(11):1933-9.
19. Clarke PJ, Ailshire JA, Nieuwenhuijsen ER, de Kleijn – de Vrankrijker MW. Participation among adults with disability: the role of the urban environment. Soc Sci Med. 2011;72(10):1674-84.
20. King AC, Sallis JF, Frank LD, Saelens BE, Cain K, Conway TL, et al. Aging in neighborhoods differing in walkability and income: associations with physical activity and obesity in older adults. Soc Sci Med. 2011 Nov;73(10):1525-33.
21. King D. Neighborhood and individual factors in activity in older adults: results from the Neighborhood and Senior Health Study. J Aging Phys Act. 2008;16(2):144-70.
22. King W, Brach J, Belle S, Killingsworth R, Fenton M, Kriska A. The relationship between convenience of destinations and walking levels in older women. Am J Health Promot. 2003;18(1).
23. Li F, Fisher KJ, Brownson RC, Bosworth M. Multilevel modelling of built environment characteristics related to neighbourhood walking activity in older adults. J Epidemiol Community Health. 2005;59(7):558-64.
24. Lovasi G, Moudon A, Pearson A, Hurvitz P, Larson E, Siscovick D, et al. Using built environment characteristics to predict walking for exercise. Int J Health Geog. 2008;7(1):10.
25. 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(3):302-12.
26. Michael YL, Gold R, Perrin NA, Hillier TA. Built environment and lower extremity physical performance:

prospective findings from the study of osteoporotic fractures in women. J Aging Health. 2011 Dec;23(8):1246-62.
27. Morris KS, McAuley E, Motl RW. Self-efficacy and environmental correlates of physical activity among older women and women with multiple sclerosis. Health Educ Res. 2008 Aug;23(4):744-52.
28. Nagel CL, Carlson NE, Bosworth M, Michael YL. The relation between neighborhood built environment and walking activity among older adults. Am J Epidemiol. 2008;168(4):461-8.
29. Patterson PK, Chapman NJ. Urban form and older residents' service use, walking, driving, quality of life, and neighborhood satisfaction. Am J Health Promot. 2004;19(1):45-52.
30. de Melo LL, Menec V, Porter MM, Ready AE. Personal factors, perceived environment, and objectively measured walking in old age. J Aging Phys Act. 2010 Jul;18(3):280-92.
31. Richard L, Gauvin L, Gosselin C, Laforest S. Staying connected: neighbourhood correlates of social participation among older adults living in an urban environment in Montréal, Québec. Health Prom Int. 2009 Mar 1;24(1):46-57.
32. Bird S, Kurowski W, Feldman S, Browning C, Lau R, Radermacher H, et al. The influence of the built environment and other factors on the physical activity of older women from different ethnic communities. J Women Aging. 2009;21(1):33-47.
33. Booth ML, Owen N, Bauman A, Clavisi O, Leslie E. Social-cognitive and perceived environment influences associated with physical activity in older Australians. Prev Med. 2000 Jul;31(1):15-22.
34. Fuller BG, Stewart Williams JA, Byles JE. Active living—the perception of older people with chronic conditions. Chronic Illn. 2010 Dec 1;6(4):294-305.
35. Humpel N, Owen N, Iverson D, Leslie E, Bauman A. Perceived environment attributes, residential location, and walking for particular purposes. Am J Prev Med. 2004;26(2):119-25.
36. Corseuil MW, Schneider IJ, Silva DA, Costa FF, Silva KS, Borges LJ, et al. Perception of environmental obstacles to commuting physical activity in Brazilian elderly. Prev Med. 2011 Oct;53(4-5):289-92.
37. Salvador EP, Reis RS, Florindo AA. Practice of walking and its association with perceived environment among elderly Brazilians living in a region of low socioeconomic level. Int J Behav Nutr Phys Act. 2010;7:67.
38. Parra DC, Gomez LF, Fleischer NL, David Pinzon J. Built environment characteristics and perceived active park use among older adults: results from a multilevel study in Bogotá. Health Place. 2010;16(6):1174-81.
39. Rantakokko M, Iwarsson S, Kauppinen M, Leinonen R, Heikkinen E, Rantanen T. Quality of life and barriers in the urban outdoor environment in old age. J Am Geriatr Soc. 2010 Nov;58(11):2154-9.
40. Takano T, Nakamura K, Watanabe M. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. J Epidemiol Community Health. 2002 Dec;56(12):913-8.
41. Day R. Local environments and older people's health: dimensions from a comparative qualitative study in Scotland. Health Place. 2008 Jun;14(2):299-312.
42. Hovbrandt P, Fridlund B, Carlsson G. Very old people's experience of occupational performance outside the home: possibilities and limitations. Scand J Occup Ther. 2007 Jun;14(2):77-85.
43. Wennberg H, Hydén C, Ståhl A. Barrier-free outdoor environments: Older peoples' perceptions before and after implementation of legislative directives. Transport Policy. 2010;17(6):464-74.

This document was produced by the National Collaborating Centre for Environmental Health at the British Columbia Centre for Disease Control, November 2012.

Production of this document has been made possible through a financial contribution from the Public Health Agency of Canada through the National Collaborating Centre for Environmental Health.

Photo Credit: northlightimages; licensed through iStockphoto

ISBN: 978-1-926933-41-2

400 East Tower
555 W 12th Avenue
Vancouver, BC V5Z 3X7
Tel.: 604-707-2445
Fax: 604-707-2444
contact@ncceh.ca

National Collaborating Centre for Environmental Health

Centre de collaboration nationale en santé environnementale

To provide feedback on this document, please visit www.ncceh.ca/en/document_feedback

www.ncceh.ca