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Concept mapping applied to the intersection between older adults' outdoor walking and the built and social environments ☆

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ABSTRACT

Objective. For older adults, the ability to navigate walking routes in the outdoor environment allows them to remain active and socially engaged, facilitating community participation and independence. In order to enhance outdoor walking, it is important to understand the interaction of older adults within their local environments and the influence of broader stakeholder priorities that impact these environments. Thus, we aimed to synthesize perspectives from stakeholders to identify elements of the built and social environments that influence older adults' ability to walk outdoors.

Method. We applied a concept mapping approach with the input of diverse stakeholders (N = 75) from British Columbia, Canada in 2012.

Results. A seven-cluster map best represented areas that influence older adults' outdoor walking. Priority areas identified included sidewalks, crosswalks, and neighborhood features.

Conclusion. Individual perceptions and elements of the built and social environments intersect to influence walking behaviors, although targeted studies that address this area are needed.

Introduction

Outdoor mobility is central to enabling older adults' independence and social engagement within their broader community; it dictates connectedness with both social and physical, or built, environments (Gagliardi et al., 2010). In particular, walking (an element of mobility), either on its own or in combination with public transportation, and/or the use of private vehicles, are key modes of transport. Importantly, using public transit and walking for active transport are associated with increased physical activity (Davis et al., 2011). For older adults who are able to walk outdoors, a combination of a poor neighborhood design and physical decline presents challenges to moving about in the community. A lack of fit between the person and the environment exacerbates even minor mobility limitations (Patla and Shumway-Cook, 1999; Verbrugge and Jette, 1994). This, in turn, leads to a loss of independence and the inability for older adults to remain in their home (Yen and Anderson, 2012).

Older adults engage in walking for a variety of purposes, including recreation and utilitarian walking as a mode of transportation to complete daily tasks (Gauvin et al., 2008; Joseph and Zimring, 2007). Yet, if walking is to be encouraged among older adults a safe, socially inviting, and physically accessible environment may optimize uptake and adherence to walking and other forms of physical activity. The relationship between outdoor mobility and the environment is not yet fully understood, however, Vita et al. (1998) argue that encouraging walking among older adults provides an opportunity for physical activity and plays a part in postponing disability (Pahor et al., 2006). Further, a recent review by Kerr et al. (2012) highlights the essential role of built environment design to foster older adults' physical activity. Therefore, communities planned with walking in mind provide positive health behavior opportunities.

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Social environments "*encompass the immediate physical surroundings, social relationships, and cultural milieus within which defined groups of people function and interact.*" (page 465) (Barnett and Casper, 2001). The social environment, and perceptions of whether a community is recognized as friendly for walking, might meet or exceed the role played by objectively defined built environment neighborhood features (Montemurro et al., 2011). For example, although signage serves the distinct purpose of wayfinding, it can also contribute to whether pedestrians perceive their neighborhood environment as safe and inviting. Thus, individual perceptions and elements of the social environment also intersect to influence walking behaviors.

However, there is limited evidence that addresses both built and social environments and their interaction with older adult mobility. Although, Carlson et al. (2012) fostered this line of investigation by evaluating the psychosocial and built environment correlates of older adults' outdoor activity, we propose to extend this work by including the social environment using concept mapping, a novel mixed methods approach, that was successfully utilized in other health-related projects (Brennan et al., 2012; Groenewoud et al., 2008; Kelly et al., 2007; Lebel et al., 2011; Reis et al., 2012; Trochim and Kane, 2005). Our aim was to synthesize perspectives from a diverse group of stakeholders to identify elements of the built and social environments that influence older adults' ability to walk outdoors. Second, we aimed to determine the relative importance and feasibility to implement elements that could be used to support current policies, or inform future policy direction.

Methods

Design

We used concept mapping, a mixed methods approach, as outlined by Kane and Trochim (2007) that is based on both qualitative and quantitative data, and offers the potential for a greater understanding of the data than could either approach alone (Kane and Trochim, 2007). Traditionally, concept mapping is used for planning and evaluation, and specifically can be used to identify strategies that may be useful for future planning. For example, Trochim and Kane discuss the use of concept mapping to identify strategic planning for public health; and more recently Reis et al. (2012) used online concept mapping to synthesize expert opinion on policies related to the built environment and promotion of physical activity, with the goal of developing a research agenda. For this project we chose to use online concept mapping, rather than other in-person qualitative approaches, such as focus groups and interviews, because we wanted to reach across a large spectrum of stakeholders to obtain a broad perspective to answer our primary research question, while removing geographical and scheduling barriers to respondents' participation. By using this online method, we could engage more stakeholders in this discussion, and the novel tools associated with this method (idea generation, ranking, and sorting) was facilitated by the use of technology. The independent and anonymous completion of the task online allowed participants to complete idea generation and/or ranking without being influenced by other participants or the interviewer, and therefore potentially reducing social desirability bias. Therefore, the online concept mapping process was an ideal mechanism to achieve our study objective. As part of the concept mapping process we employed three main steps: i) statement generation; ii) statement sorting and rating; and iii) analysis of concept maps (Fig. 1) (Kane and Trochim, 2007; Trochim, 1989). We define key terms in Table 1.

Participants

Prior to undertaking the concept mapping process, we developed a framework to identify stakeholders invested in the area of the built and social environments and older adults' mobility (Schiller et al., 2013). We defined stakeholders as individuals and organizations with relevant interest or expertise, notably those who were either affected by or who could affect (Freeman, 1984) at least one component of the interaction between the built and social environments and older adults' mobility. Relevant expertise was conceptualized as employment at a relevant agency or organization, reputation within the research

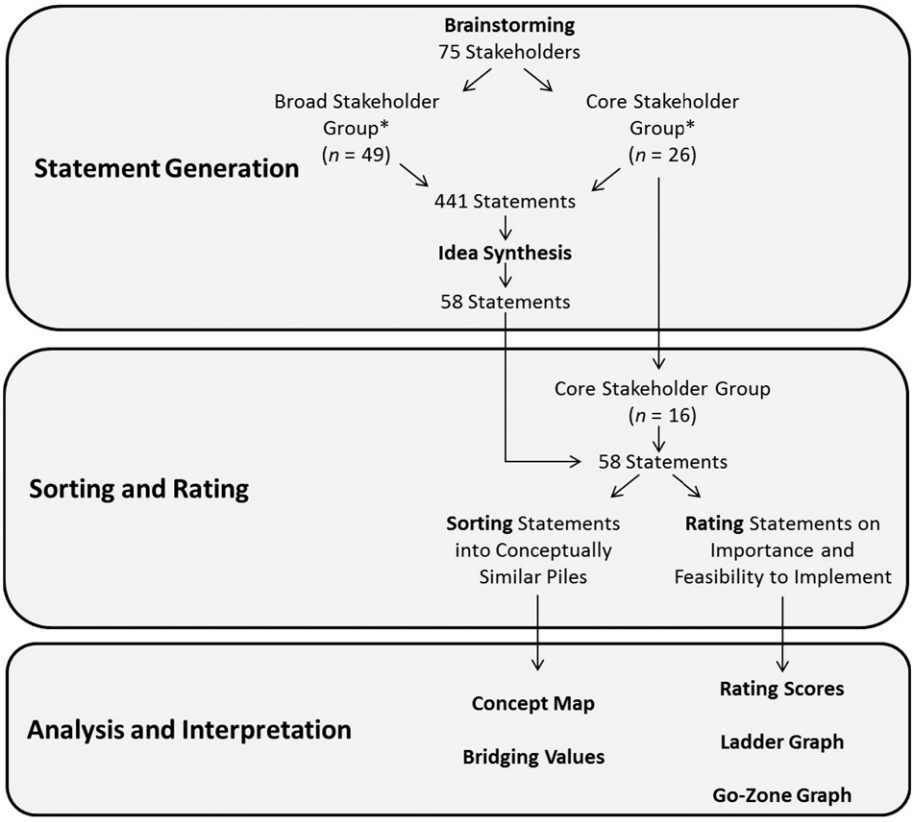

Fig. 1. Flow diagram of the Concept Mapping process utilized to understand elements of the built and social environments that influence older adults' outdoor walking. Data were collected in British Columbia, Canada in 2012.

Table 1
Definition of key concept mapping terms.

Term	Definition
Stakeholder	Individuals and organizations with relevant interest and/or expertise
Brainstorming stage	Generation of multiple statements by participating stakeholders in response to a single question/focal prompt
Idea synthesis	Cleaning and reduction of the brainstormed statements in preparation for the sorting and rating tasks
Sorting and rating stage	Grouping of statements into conceptually similar piles and rating of each statement on a given construct(s)
Concept map	A visual representation of the sorting data generated through multidimensional scaling and hierarchical cluster analyses
Stress index	A measure of how well a concept map reflects the data, with lower values indicating better fit
Bridging index	Proprietary calculation describing the degree to which a statement was sorted by participants with other statements in the vicinity; a high bridging value indicates the statement bridges areas of the map while a low bridging value indicates that a given statement anchors an area of the map
Go-Zone Graph	A graph displaying the rating data for each statement. Each axis contains one rating construct, statements rating above average on both rating constructs create a 'go-zone' in the top right quadrant of the graph

community as a content expert, the first-hand experience from older adults, or on recommendation as an appropriate stakeholder. We believed that all invited stakeholders would have insights into the needs of older adults so we did not restrict participation by age. Thus, based on our preliminary work developing a framework for identifying relevant individuals and organizations (Schiller et al., 2013), we recruited stakeholders from seven categories, including: policy/government; researchers; health practitioners/professionals; health and social service providers; not-for-profit organizations; private business, and older adults. Following the development of our framework, we invited two target groups: a broad group of stakeholders heavily targeting older adults to gather their perspectives during the initial brainstorming task, and a smaller representative group of core stakeholders who participated in both the initial brainstorming and the subsequent sorting and rating tasks (Kane and Trochim, 2007). For our older adult participants, we used an email-based recruitment strategy sent to chapters of an organization for retired persons. To populate the other six categories of key stakeholders, we used email to invite stakeholders via known experts and listservs for content area specializations and professional organization. As part of this recruitment strategy we targeted groups from the planning sector, health care sector as well as academia. We aimed for diverse perspectives to inform this project, and although responses were anonymized, we were able to capture some information on respondents (e.g., self-identified primary and secondary stakeholder group, location, occupation and age).

We recruited a diverse group of stakeholders to participate; and seventy-five participants completed the brainstorming phase (including 49 participants from the broad group and 26 participants from the core group). Data from the brainstorming component were collected between May 23, 2012 and June 10, 2012. The mean age of participants was 65.1 (10.4) years (range 35–81 years); and they all resided in British Columbia, Canada, with N = 56 from Metro Vancouver, N = 10 from smaller urban centers outside of Metro Vancouver and N = 9 from rural communities. Participants self-identified their primary stakeholder affiliation as follows: 40 older adults (53%); 12 not-for-profit organizations (16%); 9 health practitioners/professionals (12%); 7 researchers (9%); 5 private business (7%); and 2 health and social service providers (3%). While no participants identified their primary affiliation as a policymaker or government representative, 7% of participants ($n = 5$) defined their second stakeholder category as policy/government. This study was approved by the university research ethics board at the University of British Columbia and all participants provided informed consent.

Concept mapping method

The first step of the concept mapping method included a brainstorming session to generate the initial statements or ideas. At a time and place of convenience, participants accessed a web-based platform (Enterprise Feedback Management; Vovici Corporation, Herndon, VA) to participate in this initial asynchronous task. Participants completed the five demographic questions then responded to a single question or focal prompt. The foreword statement and focal prompt for participants included: "There may be many aspects of the built environment (i.e., sidewalks, street connectivity, etc.) and the social environment (i.e., community connectedness, social supports, etc.) that impact older adults' outdoor walking. These could include aspects that promote or limit walking.

> "*From your perspective, aspects of the built environment and social environment that influence older adults' outdoor walking are…*"

We refined the scope and wording of our focal prompt after pilot testing with our project team; and concluded that the prompt resulted in responses that were either facilitators or barriers to outdoor walking. In the full protocol, we did not limit the number of responses participants could contribute to process. Three authors HH, CS, MA synthesized the responses in preparation for sorting and rating tasks; this included breaking down complex responses into their component parts, and clarifying the language used to ensure understanding across stakeholder groups. We removed duplicate statements, or statements reflecting very similar content.

The second step of the concept mapping method is sorting and rating of the brainstormed statements. The core stakeholder group completed the sorting and rating tasks using the Concept Systems Global software (Concept Systems, Inc., Ithaca, NY). Participants electronically sorted synthesized statements into groups they perceived to conceptually relate; they could create as many groups as best represented statements. We asked participants to rate each statement on two constructs, importance and feasibility to implement; on a scale from 1 (low) to 5 (high) and scored relative to the other statements.

Statistical analyses

After sorting and rating, we used the Concept Systems Core software to analyze data using multidimensional scaling and hierarchical cluster analysis. We used the agglomerative method (Kane and Trochim, 2007) of merging statements together at each stage of analyses. We reviewed the merging at each stage to observe how the statements were clustered and stopped the analyses when agglomeration best represented the data. We used the maximum and minimum numbers of clusters created by stakeholders during the sort and rate task (range = 14 to 4) as the start and end point for investigating the cluster merging as the analyses progressed. We generated a stress value to measure how well the final concept map represented data; the target was a value between 0.21 and 0.37 (Kane and Trochim, 2007). Two investigators MW, MA then independently applied a name to clusters based on the statements that fell within each cluster; consensus on the final cluster name was reached through discussion. Following this, we created the final concept map; and go-zones, which comprised statements that rated above average on both perceived importance and feasibility to implement.

Results

Statement generation

From the brainstorming phase participants generated 441 statements, which we synthesized to 58 statements. Sixteen stakeholders (N = 16) from the core representative group participated in the sorting and rating phase (two participants completed the sorting task only, one completed the rating task only, and 13 completed both the sorting and rating task).

Concept map

The point map generated from the multidimensional scaling analysis yielded a stress value of 0.23, which acceptably represented the data and fell within typical concept mapping values (Kane and Trochim, 2007; Rosas and Kane, 2012). Each statement was represented by a point, with similar ideas represented by points located closer together. The statements were then statistically partitioned or clustered into like ideas or concepts through cluster analysis. We identified a 7-cluster solution that best represented the data (Fig. 2). Smaller clusters, those with less shaded area inside the cluster border, or clusters with a high density of statement reflected a closely related concept whereas larger clusters with fewer statements reflected a broader concept. For example, clusters 1, 2, and 3 had a high density of statements within the cluster border. This indicated that participants commonly placed

these statements together and shared a common theme. Clusters contained between 4 and 16 statements (Table 2) and are presented in the order grouped by the cluster analysis. We provide bridging values, a measure of the degree to which a statement was sorted with its neighbors, along with mean values for each cluster. The average cluster bridging values for clusters 1, 2, and 3 were low (range = 0.08 to 0.16). Thus, the statements in these clusters were commonly sorted together and reflected a shared concept.

Rating scores

We present rating scores for each statement, grouped by cluster as per their order in the hierarchical cluster analysis (Table 2). Participants scored each statement on two constructs related to implementation; (1) relative *importance*, and (2) *feasibility* to implement. We note the five statements that were most highly rated on a 5-point scale on these two constructs in Table 2. For relative *importance*, the most highly rated cluster was Personal Ability (cluster average = 4.21). For *feasibility* to implement, the most highly rated cluster was Sidewalks and Crosswalks (cluster average = 3.66).

The Go-Zone map (Fig. 3) compared statement ratings from low to high for both relative *importance* and *feasibility* to implement. The top right quadrant is the 'Go-Zone' for action and reflects statements rated as both important and feasible. Rating scores placed 18 statements within the Go-Zone for action. Twelve of these eighteen statements arose from the sidewalks/crosswalks (n = 7) and neighborhood features (n = 5) clusters.

Discussion

We used a novel approach, concept mapping, to identify elements of the built and social environments that are perceived to influence older adults' outdoor walking. Our findings are important for three reasons: older adults command an increasing proportion of the global population (World Health Organization, 2011); decisions regarding neighborhood attributes have implications for older adult mobility; and we reside within an increasingly constrained fiscal environment of public accountability that must prioritize scarce resources. Therefore, our findings are timely and important as they guide decision makers regarding priority areas of investment in the built environment that promote mobility of an increasingly aging population. Our findings also highlight areas of enquiry for further research.

What emerged as a clear priority for participants was both the presence and the characteristics of sidewalks and crosswalks. About half of all statements within this cluster were considered both important and feasible to implement; and this is consistent with the literature related to walking outdoors and older adults' pedestrian mobility. Safely navigating sidewalks and streets is vital for older adults' outdoor mobility; and walking is impeded if sidewalks are absent or poorly maintained (Corseuil et al., 2011) or if pedestrian crossing times are too short to allow older adults sufficient time to cross the street (Grant et al., 2010). We deemed statements considered both important and feasible to implement as particularly relevant targets for new or renewed policy efforts. For example, building sidewalks on at least one side of the street was important to participants and is already required for new developments in many major municipalities. Thus, some of our findings reinforce what is already known, validating existing and new policies, and priority areas for investment by local and provincial government.

Public transportation and pedestrian routes were also identified as highly important and feasible to implement; and accessible private vehicle parking fell just outside the 'go-zone' cut-off. Even short walks to access public transportation or private vehicles provide older adults a means to be engaged in physical activity (Rissel et al., 2012) and within their neighborhoods. Heckler and colleagues highlighted that their study participants combined recreational and utilitarian walking (e.g., active transportation) to meet physical activity guidelines (Hekler et al., 2012). Therefore the use of public transport may encourage more physical activity (Rissel et al., 2012). Of note, after the introduction of a UK national free bus pass program for adults 60 years + there was an increase in use of public transportation and therefore, associated increased opportunities for walking (Coronini-Cronberg et al., 2012). Thus, municipal and provincial decision makers must take into account the importance of public transportation to enhance walking opportunities for older adults.

Yang and Matthews (2010) noted that the built environment is more obvious than the social environment. Despite this, our participants made statements during the brainstorming session that spoke to aspects of the social environment. Many of these (perceptions of neighborhood safety, community events/activities, and social capital) were considered both important and feasible and fell within the 'go-zone' for action. The mechanism might be that social factors increase the desire and willingness of older adults to navigate their neighborhoods. Importantly, socialization encourages activity (Fried et al., 2004) and reduces the risk of disability (Buchman et al., 2010; de Leon et al., 1999; Unger et al., 1999) and the development of dementia (Rovio et al., 2005). How communities and local governments may best harness the potential of the social environment to encourage outdoor walking is still to be evaluated.

The decision to walk outdoors is also influenced by older adult's assessment of his/her physical capacity and perceived self-efficacy to safely complete the task. Older adults can 'disengage' from an activity if they feel unable to overcome the demands of challenging environments (Gagliardi et al., 2010) and when there are no other transportation options. During brainstorming, stakeholders generated responses related to individual attributes or characteristics that might influence older adult walking, including physical stamina, strength, and/or sense of mastery/control. Although we did not anticipate comments on person-

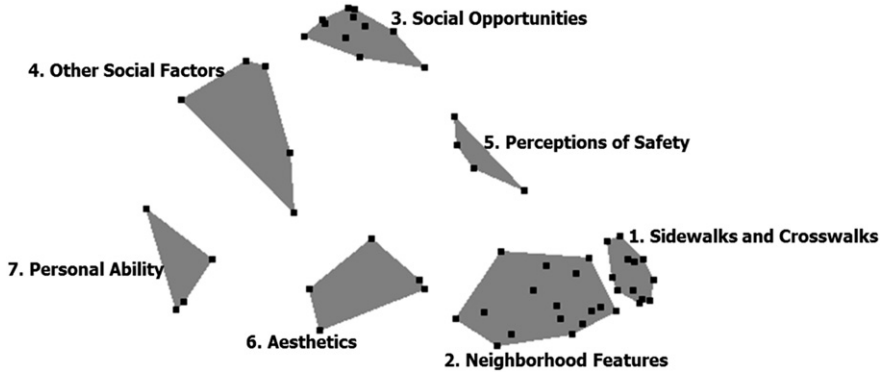

Fig. 2. A concept map representing aspects of the built and social environments that influence older adults' outdoor walking, as determined by contributing stakeholders. Each point represents one statement with the gray clusters indicating the partitioning of the statements through hierarchical cluster analysis into seven concepts. Statements in the same cluster share a common concept and a high density of statements within a cluster indicates a more focused concept. Data were collected in British Columbia, Canada in 2012.

Table 2
Cluster and statement bridging index and rating scores for relative importance and feasibility to implement, as grouped by cluster analysis for the 7-cluster concept mapping solution. Data were collected in British Columbia, Canada in 2012.

Statement		Rating score[b]	
	Bridging index[a]	Importance	Feasibility
Cluster 1: sidewalks and crosswalks[c]	**0.08**	**3.80**	**3.66**
Sidewalk quality including slope, continuity, maintenance, width, material	0.00	4.21	4.00
Curb cuts	0.00	3.71	4.07*
Angle of ramps	0.00	3.71	3.71
User-friendly crosswalks with good visible/audible signals	0.02	4.14	4.07
Presence of handrails	0.02	3.93	4.07*
Clearly marked changes in surfaces and heights	0.03	4.00	4.00
Presence of steps/stairs	0.08	3.50	2.64
Obvious and appropriate signage with color contrast	0.09	3.50	3.50
Uneven sidewalks and paths	0.10	3.93	3.57
Business signs and other obstacles along a sidewalk	0.11	2.64	3.36
Presence of heavy doors	0.13	3.36	2.86
Pedestrian traffic lights that do not give enough time to clear the intersection	0.20	4.07	4.00
Sidewalks on at least one side of the street for safety	0.24	4.64*	3.71
Cluster 2: neighborhood features	**0.16**	**3.82**	**3.49**
Presence of benches	0.04	4.29	4.14*
Accessible parking	0.05	3.64	4.14*
Width of steps and doors	0.06	3.36	2.71
Formal crosswalks in the middle of long blocks	0.08	3.50	3.50
Overhead shelters e.g. along commercial shopping areas	0.10	3.71	3.86
Bridges, too long, narrow, poor surfaces	0.12	3.14	2.50
Well lit streets and roads, parks, and buildings	0.13	4.43*	4.07
Accessible and clean toilets	0.14	3.50	3.36
Minimize stairs to increase accessibility	0.14	3.86	3.00
Traffic calming features (e.g., speed bumps, roundabouts, etc.)	0.15	3.14	4.00
Streets and sidewalks cleared of snow, ice, sand, gravel	0.18	4.79*	4.50*
Street connectivity	0.22	3.93	3.00
Levels of traffic on roads and at intersections	0.24	3.93	2.79
Mixed land-use	0.28	3.57	3.00
Access to public transportation	0.32	4.50*	4.00
Availability and safety of walking paths away from main thoroughfares	0.38	3.86	3.29
Cluster 3: social opportunities	**0.15**	**3.57**	**3.12**
Intergenerational activities	0.00	2.93	3.07
Availability of events/programming/activities/clubs	0.00	3.79	4.00
Presence of other people	0.02	3.57	3.21
Family and friends nearby	0.03	3.93	2.14
Advertisements of social opportunities available in different languages	0.06	3.07	3.57
Senior focused activity programs	0.12	3.43	3.71
Having someone compatible to walk with	0.13	4.14	3.14
Cost of social activities	0.16	3.86	3.00
Generalized societal impatience with being impeded in any way	0.28	3.00	2.36
Places to go to meet or socialize with people e.g., urban square, senior/community centers, fitness centers	0.34	4.43*	4.00
Disrespect for those with slow or erratic strides	0.50	3.14	2.07
Cluster 4: other social factors	**0.54**	**3.49**	**2.97**
Care giving obligations	0.36	3.14	2.36
Perception of connectedness to community	0.36	3.86	3.14
Owning a dog promotes walking	.056	2.50	2.29
Neighborhood safety	0.70	4.07	3.50
Walking routes that include both esthetically pleasing locations and practical service destinations	0.72	3.86	3.57
Cluster 5: perceptions of safety	**0.56**	**3.21**	**3.07**
Whether pathways are shared with bicycles or other vehicles	0.45	3.79	3.71
Walking in crowded spaces	0.56	3.29	2.29
Loose dogs on town sidewalks or tied in front of a doorway	0.58	2.71	2.86
Police presence	0.65	3.07	3.43
Cluster 6: esthetics	**0.63**	**3.96**	**2.74**
Busy street traffic noise that reverberates, disorients/distracts	0.44	3.57	2.29
Proximity of places to walk to (groceries, parks, etc.)	0.49	4.43	3.00
Walking in residential neighborhoods with good sidewalks and gardens to enjoy	0.58	3.93	3.14
Physical pleasantness of area (low graffiti, litter, poorly maintained lots, etc.)	0.68	3.86	3.71
Weather/climate restrictions	0.96	4.00	1.57
Cluster 7: personal ability	**0.96**	**4.21**	**2.71**
Sense of mastery or control over one's environment	0.90	4.36	2.79
Perceived personal safely	0.95	4.43	3.07
Stamina to navigate uneven surfaces and hills	1.00	4.07	2.36
Poor strength or balance	1.00	4.00	2.64

[a] Low bridging index values indicate statements that were commonly sorted with other statements in the same area of the point map and therefore reflect a shared concept.
[b] Asterisk (*) identifies the top 5 highest rated statements (scale from 1 [low] to 5 [high]) for the rating constructs of importance and feasibility.
[c] Average cluster rating for bridging index, importance rating, and feasibility rating are in bold.

level characteristics, during sorting and rating we chose to retain these responses and included them in the Personal Ability cluster and also in our analyses. These findings highlight the interaction of the person within their environment and this is a key component of the social ecological model. Further, while statements in this cluster were rated as highly important, stakeholders considered them not as feasible to

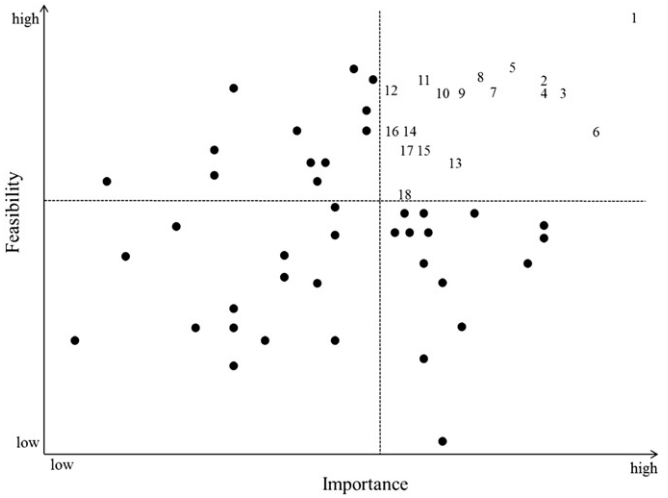

Fig. 3. Go-Zone map of importance and feasibility ratings, with the upper right quadrant indicating statements that rated high on both rating constructs. Data were collected in British Columbia, Canada in 2012. Notes: Hatched lines mark the location of the mean for each rating construct.
The numbered points correspond to the following Go-Zone statements:

1. streets and sidewalks cleared of snow, ice, sand, gravel
2. well lit streets and roads, parks, and buildings
3. access to public transportation
4. places to go to meet or socialize with people e.g., urban square, senior/community centers, fitness centers
5. presence of benches
6. sidewalks on at least one side of the street for safety
7. sidewalk quality including slope, continuity, maintenance, width, material
8. user-friendly crosswalks with good visible/audible signals
9. pedestrian traffic lights that do not give enough time to clear the intersection
10. clearly marked changes in surfaces and heights
11. presence of handrails
12. availability of events/programming/activities/clubs
13. neighborhood safety
14. physical pleasantness of area (low graffiti, litter, poorly maintained lots, etc.)
15. uneven sidewalks and paths
16. whether pathways are shared with bicycles or other vehicles
17. walking routes that include both aesthetically pleasing locations and practical service destinations
18. availability and safety of walking paths away from main thoroughfares

implement. This surprise finding recognizes that often behavior change is difficult to initiate and many people encounter challenges with maintaining positive health behaviors, such as outdoor walking. Although there are many self-management programs that exist to encourage a physically active lifestyle, there is a need for further research to identify and evaluate behavioral interventions that target modifiable personal attributes related to older adult outdoor mobility (Forsyth and Krizek, 2010). One such potential intervention is the use of utilitarian physical activity, such as the use of public transportation as mentioned previously and/or walking to close destinations (such as grocery stores, banks, libraries etc.) to encourage more physical activity. Thus, a safe, walkable neighborhood with destinations in close proximity may be the "ideal" intervention to encourage older adults to adopt a more active way of life.

Strengths and limitations

We adopted a standardized concept mapping research approach (Kane and Trochim, 2007), and endeavored to include stakeholders from varied backgrounds with different disciplinary perspectives. As the concept mapping process accommodates diverse perspectives by generating a group aggregate map (Trochim, 1989) we believe that the diversity of participants was a strength of this project.

Despite the comprehensiveness of the concept mapping project, we acknowledge some limitations. First, we had a smaller number of participants that contribute to the sorting and rating tasks than were present for the brainstorming task; and this may limit the generalizability of the results. Second, participants required some computer literacy to complete sorting and rating tasks. Some older adult participants found the computer-based sorting and rating tasks challenging. Not surprisingly, electronic modes of concept mapping may not be suitable for all research questions or stakeholder groups. However, as diverse stakeholder groups participated in all three phases (brainstorming, sorting, and rating) we believe that computer literacy did not substantially influence the outcome of the project. Finally, the built and social environments may be concepts that were new to some participants. While prompts were provided for clarification, it may be that the participant's understanding of these concepts, especially perhaps the less-studied concept of the social environment, affected the number and the ranking of these responses.

Conclusion

Concept mapping can be used to engage stakeholders from diverse backgrounds and as a means to better understand factors that influence older adults' outdoor walking. Given the interactions between elements of the built and social environments, both factors should be considered by decision makers who are investing in changes to promote older adult walking. Sidewalks and crosswalks and neighborhood features are key areas for policy development; but there is a need for further research to identify and evaluate behavioral interventions that target modifiable personal attributes related to older adult outdoor mobility. Finally, individual perceptions and elements of the social environment intersect to influence walking behaviors, and suggest the importance of more targeted studies to address this gap.

Conflict of interest

The authors declare that there are no conflicts of interests.

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