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Factors Associated with Outdoor Winter Walking in Older Adults: A Scoping Review

Kyle Bergen[1], Megan Jubenvill[1], Kyle Shaw[1], Erin Steen[1], Hal Loewen[2], Sophia Mbabaali[3], Ruth Barclay[1], On behalf of the Winter Walk Team

[1]Department of Physical Therapy, College of Rehabilitation Sciences, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada., [2]Neil John Maclean Health Science Library, University of Manitoba, Winnipeg, Manitoba, Canada and [3]Faculty of Kinesiology and Recreation Management, University of Manitoba, Winnipeg, Manitoba, Canada

Article

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Corresponding author:
La correspondance et les demandes de tirés-à-part doivent être adressées à : / Correspondence and requests for offprints should be sent to: Ruth Barclay PhD, Department of Physical Therapy, College of Rehabilitation Sciences, Rady Faculty of Health Sciences, University of Manitoba, R106-771 McDermot Ave/, Winnipeg, Manitoba R3E0T6, Canada (ruth.barclay@umanitoba.ca)

Résumé

Le but de cette étude était d'identifier les facteurs internes et externes associés à la marche extérieur en hiver chez les personnes âgées. Douze bases de données ont été consultées dans le cadre de cet examen de la portée. Les critères d'inclusion comprenaient les publications en anglais, l'accent mis sur des adultes de 65 ans ou plus et l'évaluation de facteurs associés à la marche hivernale en plein air. Deux auteurs ont examiné les titres et les résumés ainsi que le texte intégral. Les désaccords ont été résolus par consensus. Les données ont été extraites, organisées en tableaux et résumés selon les catégories suivantes : obstacles, facilitateurs, facteurs internes et externes associés à la marche hivernale en plein air. Parmi les 6,843 articles répertoriés, 1,898 doublons ont été retirés, 4,789 ont été exclus lors de la sélection des titres et des résumés, et 148 lors de l'analyse du texte intégral. Huit études ont été incluses. Quatre catégories de facteurs affectant la marche à la marche hivernale en plein air chez les personnes âgées sont ressorties : les conditions météorologiques défavorables, l'environnement physique, la fonction physique et la perception des conditions de marche hivernale.

Les professionnels de la réadaptation et de l'exercice physique peuvent utiliser ces résultats pour éduquer leurs clients et mettre en œuvre des alternatives et des solutions tenant compte des facilitateurs et des obstacles associés à la marche à la marche hivernale en plein air.

Abstract

The purpose of this study was to identify internal and external factors associated with outdoor winter walking in older adults. In this scoping review, 12 databases were searched. Inclusion criteria included English language, focus on adults 65 years of age or older, and evaluation of factors associated with outdoor winter walking. Two authors screened titles/abstracts and full text. Conflicts were resolved by consensus. Data were extracted, organized into tables, and summarized as pertaining to barriers/facilitators and internal/external factors associated with outdoor winter walking. A total of 6,843 articles were identified, 1,898 duplicates were removed, 4,789 were excluded during title/abstract screening, and 148 were excluded during full-text review. Eight studies were included. Four categories of factors affecting outdoor winter walking in older adults were identified: adverse weather conditions, physical environment, physical function, and perceptions relating to winter walking conditions. Rehabilitation and exercise professionals can use the results to educate their clients and implement the facilitators of and alternatives and solutions to barriers to outdoor winter walking.

Introduction

Importance of Physical Activity in Aging

The importance of regular physical activity as a person ages is well known; it is associated with improved health, function, and quality of life (Anokye, Trueman, Green, Pavey, & Taylor, 2012; Fletcher, et al., 2018; Manini & Pahor, 2009). Having an active lifestyle decreases one's risk for cardiovascular disease, type 2 diabetes, and many types of cancer (Bushman, 2020). Improved cognition, decreased risk for dementia, reduced anxiety and depression, and improved sleep are also benefits associated with physical activity (Bushman, 2020). Remaining active while aging, which can be contributed to by walking regularly, has many benefits. It helps maintain and increase bone density, allowing older adults to maintain physical function and independence as they age; it also decreases the risk for falls and injuries associated with these falls (Bushman, 2020). As a result of the many benefits of active aging that can be achieved through walking, it is important to consider what the facilitators or barriers are to walking in older adults.

Older adults may choose to walk for many reasons. Krogstad, Hjorthol, & Tennoy (2015) identified three main categorical reasons why older adults may choose to walk: to accomplish necessary activities, because they have the ability to, and because they find it to be an enjoyable leisure activity. As a result, walking plays a role in accomplishing daily living activities, expressing and maintaining independence, and improving physical and mental functioning for older adults (Krogstad et al., 2015). Warm summer months evidently provide good conditions for walking, but seasonal changes can bring many environmental challenges to winter walking for older adults. In the winter months social isolation can occur if walking outdoors becomes limited, as older adults use walking as a means of transportation (Krogstad et al., 2015; Choi & DiNitto, 2016). An older adult may normally walk to a local drop-in centre once a week, but this may be reduced or limited as a result of factors affecting their ability to walk outdoors in the winter. This may decrease their engagement and participation in their social community.

Seasonal changes impact gait speed (Montufar, Arango, Porter., & Nakagawa, 2007). Assessed in real life conditions, walking speeds of both younger and older adults were reduced in winter compared with summer (Montufar et al., 2007). This is an important factor, as increased gait speed in older adults is related to survival (Studenski et al., 2011). A reduction in gait speed is a risk factor for a variety of outcomes such as falls, cognitive impairment, institutionalisation, and death (Abellan van Kan et al., 2009). Understanding more clearly the factors facilitating or preventing outdoor winter walking among older adults could help develop better strategies to deliver the benefits that walking, as a type of physical activity, can provide during the winter months. Factors may be described as internal to the person, such as physical function, perceptions, or beliefs; or external, which refers to factors outside of the person such as neighbourhood or environment.

Winter and Reduced Activity

The geographical lens of this scoping review is the climate conditions experienced by residents of Winnipeg, Manitoba in Canada. Canadian winters are some of the most severe in the world (Government of Canada, 2013). For example, in Winnipeg, Manitoba, the average ambient temperature between December and February is -14.2 degrees Celsius and the extreme minimum temperature is -45.0 degrees Celsius (Government of Canada, 2019a). Wind chill greatly amplifies the cold weather that Canadians experience. In Winnipeg, the average number of days per year with a wind chill below -20 degrees Celsius is 85.1, with 43.9 of these days being below -30 degrees Celsius and 12.1 of these days being below -40 degrees Celsius (Government of Canada, 2019a). The snow, ice, wind, decreased daylight hours, and cold weather experienced during Canadian winters can make outdoor winter walking challenging for older adults.

Environmental factors have been identified as both facilitators and barriers in relation to activity and participation (Schneidert, Hurst, Miller, Ustun, 2003). For example, snow-covered sidewalks could be a barrier to walking outdoors, whereas snow clearing and sanding could be a facilitator of outdoor walking. The model developed by Patla and Shumway-Cook (1999) identifies ambient conditions and terrain characteristics as two of eight factors that may limit mobility in older adults. They discuss two aspects in regard to ambient conditions: weather conditions and light level. In the winter months, Canada has decreased daylight hours and snowfall that can reduce visibility, wind that can affect balance, and cold weather, which requires warmer, bulkier clothing (Government of Canada, 2013; 2019a, 2019b). Terrain characteristics associated with winter, such as ice and snow, add to the complexity of winter walking for older adults in addition to the usual obstacles such as curbs and inclines (Patla & Shumway-Cook, 1999). Environmental factors can pose challenges to mobility for older adults, and if they have difficulty overcoming these challenges, inactivity can result (Patla & Shumway-Cook, 1999).

In order to address the barriers to walking outdoors in winter and the resultant influence on physical activity, mobility, and safety, we need to have a comprehensive understanding of the associated factors that appear in the literature. As a result of the review, we hope to develop a basis for further research and strategies that will identify barriers as well as the factors that could facilitate participation in safe winter walking.

Objective

The purpose of this study was to identify the internal and external factors associated with outdoor winter walking in older adults. The protocol for this scoping review was published in Open Science Framework (https://osf.io/xebgd/).

Methods

Approach

Scoping reviews provide an avenue to comprehensively map areas of interest and do so in a clear and transparent way so that it may be replicated by others (Arksey & O'Malley, 2005). By consolidating many study designs, the scoping review has the advantage of retrieving all literature that is pertinent to the research (Arksey & O'Malley, 2005). Through this method of knowledge synthesis, scoping reviews can summarize research, identify current gaps, inform future directions, and be a source of information for programs and policies (Arksey & O'Malley, 2005). Our review followed the foundational steps of the methodological framework produced by Arksey and O'Malley (2005) in conducting a scoping review as well as following the recommendations proposed by Levac, Colquhoun, and O'Brien (2010) to enhance each stage. Covidence was used to manage search results, develop a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart, and manage article screening and data extraction (Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia, available at www.covidence.org). The PRISMA extension for scoping reviews checklist was used in planning the review (www.equator-network.org/reporting-guidelines/prisma-scr/).

The research topic was created by the 11 members of the "Winter-Walk" team. This team included: seven researchers encompassing professional backgrounds of physical therapy, occupational therapy, kinesiology, geography, and library sciences. The team also included two older adult members of the community from the Manitoba Association of Seniors Centres and Active Aging in Manitoba, and two graduate student trainees. These members had diverse and unique experiences in areas of older adults, physical activity, and winter walking. The team had two, 5-hour meetings in which there were presentations from all the team members, roundtable discussions, and two rounds of voting to determine the team research priorities related to older adults and outdoor winter walking. The team identified and voted on 14 topics. The topic with the highest priority was "identifying internal and external factors associated with outdoor winter walking for older

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adults". This review will add to the literature of outdoor winter walking barriers and facilitators for older adults and assist as a basis for future winter walking studies.

Study Eligibility

The scoping review included all study designs and all years published within the utilized databases. To be included, studies had to evaluate one or more factors associated with outdoor winter walking and be written in the English language, and the study population had to be 65 years of age or older or contain a sub-group analysis of adults 65 years of age or older. Studies that contain mixed ages were included if 80 per cent or more of the study sample was over 65 years old.

Articles were excluded if participants did not walk outdoors (e.g., used wheeled mobility) or if the study population examined was homogenous of a specific health condition.

An eligibility checklist was developed based on these criteria within Covidence and applied to the articles during the screening process to exclude those that did not meet the criteria for inclusion.

Search Strategy

The search was conducted using the subject headings: Geriatrics, Aging, Aged, Retirement, Walking, and Cold Temperature; along with appropriate keywords and free-text words. Databases searched included Ovid MEDLINE® 1946–August 21, 2020; Cumulative Index to Nursing and Allied Health Literature (CINAHL) 1937–August 21, 2020; Scopus 2004–August 21, 2020; AgeLine 1978– August 21, 202; Embase 1947–August 21, 2020; Sportdiscus 1937–August 21, 2020; Cochrane Central 1996–August 21, 202; ClinicalTrials.gov 2000–August 21, 2020; the International Clinical Trials Registry Platform 2004–August 21, 2020, and the Joanna Briggs Institute Evidence-Based Practice Database 1996–August 21, 2020. Grey literature was not included in this scoping review. The reference list of included articles was examined to identify other relevant literature. Deduplication and references were managed in EndNote. Further deduplication was additionally completed in Covidence. The initial search strategy was conducted in Ovid MEDLINE and then applied within the other databases. See Table 1 for the full search strategy conducted on Ovid MEDLINE.

Study Selection

The health sciences librarian (H.L.) aided in the development of the search and offered search strategy suggestions. After conducting the search, titles and abstracts were screened and then selected using the inclusion and exclusion criteria checklist, which is available in Covidence. This involved each title and abstract being assessed by two authors for eligibility (K.B., M.J., K.S., E.S., S.M.). Lack of agreement on titles and abstracts at this stage resulted in carrying the study forward to the next stage. Two authors then applied the same inclusion and exclusion criteria to each full text article that passed the first stage. Lack of agreement between reviewers resulted in further analysing the article until a consensus was reached. Once this was completed, the reference lists of included studies were analysed to determine if any additional studies met the inclusion and exclusion criteria that were not covered by the databases. Covidence was used for citation management and the screening process.

Data Extraction and Data Charting

Data was extracted in Covidence independently by the first four authors, ensuring that at least two authors addressed each source and compared results. After extracting data from two articles, minor revisions were made to the extraction chart format based on team member experience and discussion. In cases for which there was a lack of agreement, the two individuals who had extracted the data of the study met and formed a consensus on the final data extracted. Data were exported from Covidence to Microsoft Excel. Tables were created from the following information that was extracted: author, title, publication year, country, study design, study purpose, age, sex, health conditions or physical function, number of participants in the study, statistical methods used, outcome measures used, how the study measured winter walking, the factors described in the study, and the factors that are associated with winter outdoor walking or are predictors of winter outdoor walking.

Synthesis of Results

The first four authors and R.B. of the "Winter-Walk" team analysed the results of the final studies included. For each study, the factors associated with outdoor winter walking in older adults were classified as either facilitators or barriers and then categorized as either internal or external in nature. Furthermore, the factors identified were classified into body functions, activity, or participation, according to the *International Classification of Functioning Disability and Health* (ICF) (World Health Organization, 2002). Once the factors affecting outdoor winter walking from all the studies were organized together in tables, factors were grouped into categories.

A stage of consultation occurred to offer additional knowledge and perspectives, as well as relevance and applicability to the scoping review (Levac et al., 2010). A consultation occurred with the two older adult community members of the "Winter-Walk" team, who represented two community organizations which support senior centres and active aging. Scoping review results were shared with these team members, and their impressions of the results and next steps are included in the discussion.

Results

The database searches resulted in 6,843 studies, with 1,893 duplicates removed via EndNote. The remaining 4,950 studies were imported to Covidence for screening. Further deduplication occurred in Covidence where five more studies were removed. After reviewing the titles and abstracts of 4945 studies, 4,789 were excluded for reasons including being unrelated to the review topic or because the study focused on a specific health condition. This resulted in 156 full-text studies that were assessed for eligibility. We excluded 148 of these, with the main reason for exclusion being that the study did not evaluate factors associated with outdoor winter walking. Other reasons for exclusion can be seen in Figure 1. Following full-text screening, eight studies were included in the scoping review.

Study Characteristics

As seen in Table 2, the largest number of studies (three) came from Canada (Clarke et al., 2017; Li, Hsu, & Fernie, 2013; Schmidt, Rempel, Murray, McHugh, & Vallance, 2016). The remainder were

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Table 1. Search Strategy Ovid MEDLINE(R) and Epub ahead of print, in-process, and other non-indexed citations

#	Searches
1	exp Geriatrics/
2	elder*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
3	senior*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
4	exp Aging/
5	exp Aged/
6	exp Retirement/
7	("65 and up" or "65 and older" or "65 or older" or "65+" or "65 plus" or "65plus" or "sixty-five plus" or "sixty five and up" or "sixty five and older" or "sixty five or older").mp.
8	((old or older) adj5 (person* or people* or female* or woman or man or men or males*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
9	geriatric*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
10	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11	exp Walking/
12	walk*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
13	ambulat*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
14	"physical* activ*".mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
15	(trek* or running or jog* or runner or hiking or hiker*).mp.
16	11 or 12 or 13 or 14 or 15
17	exp Cold Temperature/
18	winter.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
19	icy.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
20	exp Snow/
21	snow*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
22	slush*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
23	freez*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
24	exp Freezing/
25	ice.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
26	frozen.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
27	(melt* or thaw*).mp.
28	((severe or inclement or cold or bad or poor or harsh or adverse) adj3 (weather or condition* or temperature* or climate* or environment*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
29	17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28
30	10 and 16 and 29

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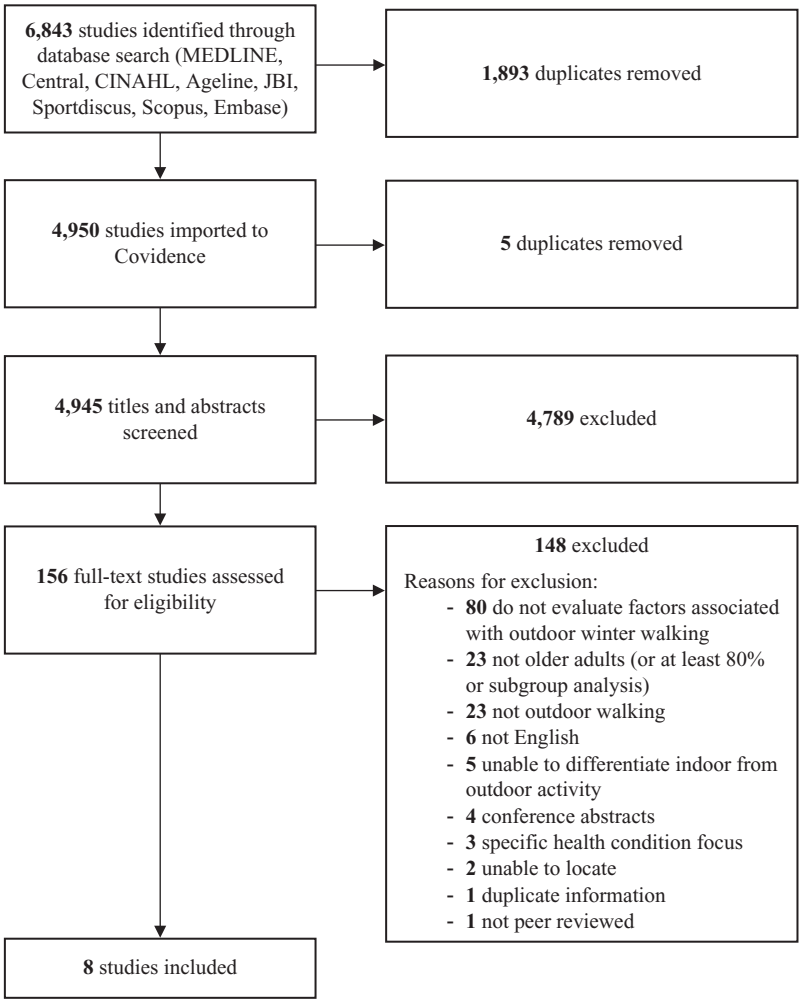

Figure 1. PRISMA diagram.

conducted in Finland (Sakari et al., 2017), Iceland (Bjornsdottir, Arnadottir, & Halldorsdottir, 2012), Sweden (Wennberg, Stahl, & Hyden 2009), the United States (Finlay, 2018) and England (Wu, Luben, & Jones, 2017). Average temperature in the month of January ranged from -15 to +5 degrees Celsius at the included study sites. In total, these studies collectively included 5,484 older adults with ages ranging from 49 to 100.

On average, 70 per cent of the participants were female. As is common in sport medicine literature (Parsons, Coen, & Bekker, 2021), the terms "sex" and "gender" were used interchangeably with male/female and man/woman in a number of the included studies. In most of the eight included studies, the description appeared to be related to the biological description of males and females, as opposed to gender identities. How the determination of male/female or man/woman was made was not clear in all studies. Therefore, we chose to use the term "sex" along with male/female in the description of study participants, as described elsewhere (Government of Canada, Canadian Institutes of Health Research, 2015).

Although our inclusion criterion was age 65 or older, two studies (Li et al., 2013; Wu et al., 2017) included participants outside the age range of this review, but either completed subgroup analysis or had more than 80 per cent of participants within the age range criterion for inclusion. Health conditions and physical function of the participants were described very differently across studies. For example: by walking aid use (Bjornsdottir et al., 2012), physical function assessment (Clarke et al., 2017; Sakari et al., 2017), number of chronic conditions (Li et al., 2013; Sakari et al., 2017, Wennberg et al., 2009) or self-rated health (Wu et al., 2017). The study designs encompassed qualitative approaches including surveys (Li et al., 2013), interviews (Finlay, 2018; Schmidt et al., 2016; Bjornsdottir et al., 2012) and focus groups (Wennberg et al., 2009). Other study types included cross-sectional studies (Clarke et al., 2017; Sakari et al., 2017), exploratory mixed methods (Wennberg et al., 2009) and a prospective cohort study (Wu et al, 2017).

The included studies utilized multiple methods to identify outdoor winter walking including: surveys/questionnaires (Clarke et al., 2017; Li et al., 2013; Wu et al., 2017), accelerometry (Wu et al., 2017), interviews (Bjornsdottir et al., 2012; Finlay, 2018; Sakari et al., 2017; Schmidt et al., 2016; Wennberg et al., 2009), focus groups (Wennberg et al., 2009) and participant observation (Finlay, 2018; Wennberg et al., 2009). Weather conditions and weather data were also collected in some studies (Clarke et al, 2017; Wu et al., 2017). Multiple studies used a combination of methods; for example, the Neighbourhood Environmental Walkability Survey was utilized by Clarke et al. (2017), the results of which were connected to archived weather information. Wennberg et al. (2009) used a

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Table 2. Included study characteristics

Study	Country (city)	January Mean Temperature[a] (°Celsius)	Setting	Type of Study	Number of Older Adult Participants	Age: Mean (SD) [range]	Sex: Female *n* (%)	Description of Health Conditions or Physical Function (Various Methods of Description)
Bjornsdottir et al., 2012	Iceland (not stated)	1° (Reykjavík)	Community- Urban retirement community	Qualitative: interviews	10	84 (NP) [72-97]	10 (100)	5 (50%) used walker or cane outdoors
Clarke et al., 2017	Canada (Vancouver)	4°	Community- Urban	Cross-sectional	161	74.3 (6.3) [65-96]	101 (63)	Mean (SD) 9.7 (1.9) on SPPB (12=high score)
Finlay, 2018	USA (Minneapolis)	−9°	Community - Urban	Qualitative: interviews (Phase 1) and participant observation (Phase 2)	Phase 1:125 Phase 2: 6	Phase 1: 71(NP) [55-92] Phase 2: 71 (NP) [66-78]	Phase 1 84 (67) Phase 2 4 (67)	Not summarized. Noted some participants frail
Li et al., 2013	Canada (Toronto)	–5°	Community- Urban	Qualitative: surveys	27 (60-85 yrs) All ages=183	NP (NP) 3 age groups: [18-34, 35-39, 60-85]	20(74)	21(77%) had at least 1 mobility, hearing. or sight limitation
Sakari et al., 2017	Finland (Jyväskylä or Muurame municipalities)	−8° (Jyväskylä)	Community- Urban and rural	Cross-sectional	834	NP (NP) [75-90]	518 (62)	Mean (SD) number chronic health conditions: 4.0 (2.3) with intact SPPB (10-12); 5.1 (2.5) with poor SPPB (0-9)
Schmidt et al., 2016	Canada (2 communities in Saskatchewan)	−14° (Regina)	Community-Rural	Qualitative: interviews	10	78.8 (9.3) [69-94]	9 (90)	Not summarized
Wennberg et al., 2009	Sweden (Hässleholm and Piteå)	−9° (Piteå)	Community- Urban	Exploratory mixed methods (snow-ice questionnaire) Qualitative: snow/ice focus groups (Piteå)	611 10	77.1 (NP) [65-100]	375 (62) 5 (50)	443 (73%) movement, perception or cognition limitations 5 (50%) used mobility device
Wu et al., 2017	England (Norfolk county)	5°	Community- Predominately rural	Prospective cohort	3123 383 dog walkers	NP (NP) [49-91]	218(57)	61 (15.9%) fair/poor self-reported health

Note. [a]January mean temperature from https://www.timeanddate.com/weather
NP = not provided in the study; SD = standard deviation; SPPB = Short Physical Performance Battery, estimating physical function

combination of focus groups, a questionnaire, and participant observation to measure outdoor winter walking, and Finlay (2018) used both interviews and participant observation. Two studies focused on the rural setting (Schmidt et al., 2016; Wu et al., 2017), one study included both urban and rural settings (Sakari et al., 2017), whereas the remainder of studies focused on the urban setting.

Within these eight studies, factors that were associated with outdoor winter walking were described as barriers or facilitators (Table 3). The barriers and facilitators were then further divided into internal or external factors and categorized using the ICF (Table 4). Internal factors were considered to be person-related, such as one's physical capacities, perceptions, beliefs, and fears, whereas external factors referred to those factors apart from the person such as weather, ice, snow, neighbourhood, and environment. Factors were aligned with the ICF classifications of body function, activity, participation, and the environment. Common categories emerged in the results that allowed an understanding of the categories of factors that were relevant to the study population, both internal and external, that impacted walking outdoors in winter. These categories were physical function, perceptions and fears relating to winter walking conditions (internal factors), and adverse weather conditions and physical environmental conditions (external factors). See Table 4.

Discussion

The objective of this scoping review was to identify internal and external factors associated with outdoor winter walking in older adults. The eight included studies revealed many different factors that were described as external or internal barriers or facilitators. These factors were further summarized into four categories: adverse weather conditions (external), physical environmental conditions (external), physical function (internal), and perceptions and fears relating to winter walking conditions (internal).

The first category that emerged was the impact that weather conditions had on outdoor winter walking in older adults. All of the included studies described at least one weather-related factor that was described as a barrier to or facilitator of outdoor winter walking. These included conditions producing ice, slush, and strong winds (Bjornsdottir et al., 2012; Schmidt et al., 2016), cold temperatures (Bjornsdottir et al., 2012), and higher levels of snow (Clarke et al., 2017) or precipitation (Wu et al., 2017), which were all negatively associated with outdoor walking. These results were perhaps unsurprising, as it seems sensible that harsh weather would tend to decrease older adults' participation in outdoor walking, and this was confirmed by the results. These results appear to confirm that it is realistic to think that, as a general principle, categorically harsher winter days will result in less outdoor winter walking whereas more pleasant winter days will result in more outdoor winter walking. This appears to be consistent with literature that describes decreased gait speed (Montufar et al., 2007) and steps per day in winter (Kimura, Kobayashi, Nakayama, & Kakihana, 2015). Beyond examining weather variables in isolation, Clarke et al. (2017) examined the interplay among neighbourhood walkability, vehicle dependency, and weather conditions. Walkable neighbourhoods encompassed those with shorter block lengths, a greater mix of land use, and more street connectivity (Clarke et al., 2017). Snow was found to be negatively associated with outdoor walking in general but much more strongly so in car-dependent neighbourhoods. This implies that properly designed, built environments can attenuate some of the negative associations between winter weather and outdoor walking. These results highlight the important overlap between winter-related factors and the built, physical environment, pointing to the relevancy of considering how the physical environment an older adult lives in can affect their outdoor winter walking. This is exemplified by the second category.

The second category that emerged were factors related to the physical environment. These factors included conditions of the walking terrain, such as ice-covered surfaces (Bjornsdottir et al., 2012; Finlay, 2018; Li et al., 2013; Schmidt et al., 2016; Wennberg et al., 2009) and lack of snow removal (Finlay, 2018). Li et al. (2013) examined what specific areas of the physical environment were of most concern to outdoor walkers. The most problematic were sidewalks, followed by street crossings and curb ramps. In these three areas, commonly reported barriers were ice, snow, and slush accumulation that made walking difficult. These physical environmental barriers led to winter coping strategies that were explored further by Li et al. (2013) who found that 16 (59%) of the older adult participants coped with these winter challenges by going out less, and consequently reducing outdoor winter walking. Therefore, we see how the physical environment, as affected by winter weather, can be a barrier to outdoor walking.

The third category that emerged was participants' physical function acting as a barrier or facilitator to outdoor winter walking. Older adults with a higher physical function were more likely to walk outdoors in the winter than those with poorer physical function (Clarke et al., 2017), as measured using the Short Physical Performance Battery (SPPB). Sakari et al. (2017) also measured physical function through assessment of the lower extremities using the SPPB, which examines functional strength through walking, sit-to-stand, and standing activities. Sakari et al. (2017) discussed that for older adults with poor lower extremity performance, fear stemming from safety issues was a major barrier. These barriers for those with intact lower extremity performance focused on aspects of outdoor walking such as the distance required to walk, and less so on fears or safety concerns (Sakari et al., 2017). This finding indicated that older adults with poorer physical function may walk less, simply because of their perceptions of winter as a dangerous time to walk. Other functional limitations, including mobility, vision, and hearing impairments, were also found to be barriers to outdoor winter walking for older adults (Li et al., 2013). Many of the aforementioned barriers to outdoor winter walking have also been identified as barriers to outdoor walking in general in a conceptual framework for an outdoor walking intervention, including various aspects of physical function as well as fear and self-efficacy (Salbach et al., 2019).

The fourth category that emerged was how participants perceived that environmental conditions influenced their decision to walk outdoors. Specifically, fear of falling was a consistent subject across many of the included studies, which led to avoidance of outdoor winter walking among older adults (Bjornsdottir et al., 2012; Finlay, 2018; Sakari et al., 2017; Schmidt et al., 2016;). This consistent factor indicated that older adults may perceive the risk of walking outdoors in winter to be greater than the benefit and choose to avoid doing so. Individuals with poor lower extremity performance had higher fear of falls (Sakari et al., 2017).

The results of this scoping review have important implications for our study population, as well as other key stakeholders. As active aging, functional independence, and social participation are all impacted by maintaining one's mobility (Krogstad et al., 2015), being able to walk year-round in a safe and self-directed manner are important goals. By identifying the known facilitators of and

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Table 3. Included study methods and barriers to / facilitators of outdoor winter walking

Study	Method of Identifying Outdoor Walking	Barriers to Outdoor Winter Walking	Facilitators of Outdoor Winter Walking	Other Factors Examined in the Study
Bjornsdottir et al., 2012	Interviews specific to participants' walking behaviours	Ice-covered surfaces Wind Cold	Non-slippery sidewalks	Factors that an individual considered to encourage or inhibit their physical activity
Clarke et al., 2017	Total destinations walked to based on the Neighbourhood Environmental Walkability Survey (NEWS) and linked to archived weather information	More days with snowfall were associated with fewer destinations walked to. The negative effects of snow varied with neighbourhood walkability, with less outdoor walking occurring with snowfall in less walkable, car-dependent neighbourhoods. Vehicle access reduced locations walked to by 28%, reducing walking as a chosen mode of transport.	Females walked to 23% more destinations than males. Those with higher physical capacity walked to a higher number of locations. Living in a walkable neighbourhood was associated with walking to more destinations.	Age Gender Race Canadian born Education level Marital status Cognitive function Vehicle available Functional capacity
Finlay, 2018	Interviews specific to participants' walking behaviours Participant observation	Pathways or sidewalks covered in snow and ice Snow piles at street crossings Exterior fall hazards; e.g., steps and slopes Lack of snow plowing and salting Fear of falling led to decreased time or avoidance of walking outdoors in winter.	Enjoyment of the snowy/ wintery landscape Expressing pride in one's "toughness. and resiliency" towards winter	Demographic information Contextual living information Day-to-day routine Experiences in different contexts such as the home or neighbourhood. and how they have changed with time Subjective sense of well being Service provision Seasonal differences Participant abilities
Li et al., 2013	Questionnaire regarding difficulty with outdoor winter walking and at 9 specific outdoor locations, such as sidewalks and ramps	The presence of snow or ice Those with functional limitations were more likely to describe difficulties in getting about outdoors in winter than those with no functional limitations. Winter coping strategies including remaining home, reducing frequency of going out, avoiding areas/locations with snow/ice/ slush, utilizing vehicles rather than walking, attaining exercise through a gym instead of walking. The following physical environment problems were identified: icy, snowy, or slushy surfaces, snow banks, puddles, needing to traverse over metal manhole covers, tall snow piles preventing appropriate vision between pedestrians and drivers, snow obscuring the pedestrian's ability to tell the difference between curb ramp and the sidewalk.	Winter coping strategies including utilizing ice grip devices and enlisting other individuals for assistance.	Age Gender Household income group Residential environment Postal code Weekly frequency of outdoor excursions in a typical autumn and winter week with or without snow/ice on the ground. Use of assistive devices outside in winter.
Sakari et al., 2017	Interviews specific to participants' walking behaviours	For participants with reduced capacity of their lower extremities (Short Physical Performance Battery): identifying snow and ice as an obstacle to outdoor walking increased odds of having walking limitations. For older adults with intact lower extremity performance, identifying a lack of benches in winter as a barrier to outdoor walking increased odds of having walking limitations		Age Sex Cognitive status Self-rated health Depressive symptoms Walking difficulties BMI Self-reported chronic conditions Education level

(Continued)

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Table 3. *Continued*

Study	Method of Identifying Outdoor Walking	Barriers to Outdoor Winter Walking	Facilitators of Outdoor Winter Walking	Other Factors Examined in the Study
Schmidt et al., 2016	Interviews specific to participants' walking behaviours	Fear of falling on ice in winter. Unfavourable weather conditions that resulted in ice, slush, high winds.		Advantages of being physically active Community context during activity Limitations to being more physical active Available services in the community
Wennberg et al., 2009	Focus group interviews, snow/ice questionnaires, observation		Avoidance of ice on walking surfaces: Surfaces that were level with no rough ice Surfaces that had been sanded Lack of ice on footpaths within the city When footpaths are half sanded Clearance of snow at the route level: • Snow removed right away • No snow on the footpaths within the city Clearance of snow at the detailed level: • Crosswalks had no snow • No snow piles that blocked views • Bus stops lacked snow • Visible curbs • Poles displaying directions are reachable • Benches can be utilized in winter	Age Sex Functional limitation Mobility device Dependence on walking as transport mode
Wu et al., 2017	Accelerometry Questionnaire regarding frequency of dog walking	Not owning a dog Higher levels of precipitation Decreasing day length Lower temperature	Dog ownership, particularly those who walk their dog regularly	Minutes of sedentary behavior Maximum temperature Age Sex Education Health status

barriers to outdoor winter walking in older adults, there can be knowledge regarding why older adults may walk less in the winter, what factors surrounding winter pose difficulties for them, and how policy, programs, or other strategies may assist in facilitating walking in winter. Understanding that ice, snow, or slush-covered walkways will negatively impact walking for older adults identifies that prioritizing walkway clearance, sanding iced pathways, and removing snow from benches, as examples, are important tasks in the built environment. Specifically, Li et al. (2013) and Finlay (2018) identified snow at locations such as curb ramps, bus stops, crosswalks, and sidewalks as barriers to outdoor walking. To support this as a priority, Wennberg et al. (2009) found that a facilitator to walking was prompt snow removal so that walking surfaces were visible. Departments in cities or towns can benefit from this information by utilizing it to focus resources on tasks that can reduce barriers to outdoor walking for older adults. The finding that poorer physical function will negatively affect outdoor winter walking (Sakari et al., 2017) through fear identifies that interventions to improve physical function in older adults could potentially facilitate walking. This is supported by Clarke et al. (2013), who found that higher physical function was positively associated with the number of destinations walked to in winter among their older adult participants.

A number of studies were excluded, as they evaluated outdoor physical activity, but did not specifically identify walking. All eight studies used interviews and questionnaires to identify outdoor walking in this scoping review. One study also used accelerometry (Wu et al., 2017), while two used observation (Finlay, 2018; Wennberg et al., 2009). It should be noted that although an older adult may be less physically active and walk outdoors in winter less, indoor walking alternatives may be used as a compensatory strategy to allow older adults to remain physically active (Li et al., 2013).

Consultation

Consultation was had with the older adult community members of the Winter Walk Team. Both team members agreed that the results of this study were applicable to their association members. It was noted that much of the information applies to people of all ages. The importance of public works and others to be able to remove snow, ice, and slush was supported. Experience was shared that when this occurs, it makes older adults feel safer and more able to have a good walking experience. It was also supported that

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Table 4. Synthesis of results – ICF categorization of factors associated with outdoor winter walking

Descriptor	Barriers to Outdoor Winter Walking	Facilitators of Outdoor Winter Walking
Internal Factors	**Body Function**	**Body Function**
(Physical function and perceptions and fears relating to winter walking conditions)	Poorer lower extremity performance (Sakari et al., 2017) Functional limitation - including mobility, vision, hearing, cognition (Li et al., 2013) Fatigue - Ice/snow presence made walking tiring (Finlay, 2018) Perception of snow and ice as barriers in individuals with poorer lower extremity performance (Sakari et al., 2017) Negative perceptions of walking (Finlay, 2018) Fear of falling (Sakari et al., 2017; Bjornsdottir et al., 2012; Finlay, 2018; Schmidt et al., 2016) Feelings of insecurity in individuals with poorer lower extremity performance (Sakari et al., 2017) **Activity/Participation** Winter coping strategies: • Rely more on automobiles instead of walking (Li et al., 2013) • Stay home (Li et al., 2013) • Go out less (Li et al., 2013) • Avoid the area/location (Li et al., 2013) • Use a gym for exercise rather than taking usual outdoor walk (Li et al., 2013)	Greater physical function (Clarke et al., 2017) Good lower extremity performance (Sakari et al., 2017) Perception of familiar surroundings in individuals with poorer lower extremity performance (Sakari et al., 2017) Enjoying the snowy/wintery landscape (especially when there is sun) (Finlay, 2018) Those who express pride in their toughness and resiliency to endure long winters (Finlay, 2018) **Activity/Participation** Winter coping strategies: • Be more careful, • Use ice grip devices, • Get assistance from others, • Walk on street rather than sidewalk (Li et al., 2013)
External Factors	**Environment**	**Environment**
(Adverse weather conditions and physical environmental conditions)	More days with snow (Clarke et al., 2017) or higher overall precipitation (Wu et al., 2017) Snow and ice presence on walking surfaces (Bjornsdottir et al., 2012; Li et al., 2013) A combination of more days with snow, less walkable neighbourhood, and car dependency (Clarke et al., 2017) Icy surfaces, snowy/slushy surfaces, snow banks, puddles, walking on metal manhole covers, high snow banks obstructing pedestrians and drivers from seeing each other, difficulty in distinguishing curb ramp from the sidewalk (Clarke et al., 2017) Challenges with: • Sidewalks (Finlay, 2018; Li et al., 2013) • Street crossings (Finlay, 2018; Li et al., 2013) • Curb ramps (Finlay, 2018; Li et al., 2013) • Outdoor stairs and ramps building or transit • Entrances (Finlay, 2018; Li et al., 2013) • Bus stops (Li et al., 2013) • Roads without sidewalks and driveways (Li et al., 2013) Lack of resting places in winter (snow covered benches) (Sakari et al., 2017) Wind (Bjornsdottir et al., 2012) Cold weather (Bjornsdottir et al., 2012) Decreasing day length (Wu et al., 2017) Lack of snow plowing and salting (Finlay, 2018) Other Lack of vehicle access (Clarke et al., 2017)	Non-slippery sidewalks (Bjornsdottir et al., 2012) Avoidance of ice on walking surfaces (Wennberg et al., 2009): • Surfaces that were level with no rough ice • Surfaces that had been sanded • Lack of ice on footpaths within the city • Footpaths are half sanded Clearance of snow at the route level (Wennberg et al., 2009): • Snow removed right away • No snow on the footpaths within the city Clearance of snow at the detailed level (Wennberg et al., 2009): Crosswalks had no snow • No snow piles that blocked views • Bus stops lacked snow • Visible curbs • Poles displaying directions are reachable • Benches can be utilized in winter Living in a walkable neighborhood (Clarke et al., 2017) Park/green area nearby (Sakari et al., 2017) Other Dog ownership, even during wet or shorter days (Wu et al., 2017)
		Personal Females walked to more destinations in winter than males (Clarke et al., 2017)

planning for green space, trails, and benches is very important. It was noted that in the previous year with COVID-19, an increase in dog ownership and experiences with isolation and physical distancing may be motivations for older adults to get outdoors more; the importance of addressing fear of falling and interventions for fall prevention are essential.

It was stressed that it will be important to address other knowledge translation strategies of this project; for example, creating an infographic showing the need for cities/municipalities to clear snow from walking paths and sidewalks, which could convince municipal decision makers of the value of clean streets and sidewalks in winter. It is also important to make the connection between walking and one's own health; winter walking is hampered because municipalities do not connect snow with walking and health.

Limitations

There were some limitations to the current scoping review. Our methodology did not evaluate the quality of the studies included, as is common in a scoping review. In a scoping review of 344 scoping reviews, Pham et al. (2014) found that only 22 per cent assessed the methodological quality of their respective included studies, with the majority stating that scoping reviews do not prioritize quality assessment or that quality assessment is not commonly a part of their methodology. Second, including only studies in English

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excluded potential research conducted in other cultures or languages. Third, the choice to limit the scope of this review to focus on walking was beneficial for assessing a specific facet of physical activity in older adults. The limitation of this approach was that there were a large number of studies in the screening stages that were excluded because the outcomes examined were physical activity levels and not specifically walking. This identified that there was an abundance of research surrounding winter and its effect on physical activity in older adults in general. Some factors may have been missed by this scoping review by way of studies that discussed walking as a type of physical activity among participants in the study, but in measuring physical activity did not distinguish between types of physical activity, specifically walking, in the results. It was unclear in some studies whether the winter walking challenges were reported during the winter season or if winter weather was reflected upon at another time, in interviews or with questionnaires. Another potential limitation was that most studies focused on the urban setting; challenges specific to rural settings were not identified in the analysis. Perhaps this scoping review may spark interest in more in-depth examinations of walking as a specific type of physical activity in the winter months among older adults.

Conclusions

This scoping review identified the factors associated with outdoor winter walking for older adults. The studies in the review included both observed and perceived facilitators and barriers to winter walking that were internal and external in nature. Four main commonalities were found in the results: the impact of adverse weather conditions, the physical environment, physical function, and perceptions and fears relating to winter walking conditions. Overall, the studies cumulatively and consistently found that harsh winter weather conditions producing snow, ice, wind, and cold temperature decreased outdoor winter walking for older adults (Bjornsdottir et al., 2012; Clarke et al., 2017; Schmidt et al., 2016; Wu et al., 2017). Fear of falls was consistently a barrier for older adults, especially those with poorer lower extremity performance (Sakari et al., 2017).

Additional questions result from this review. For example, are challenges in outdoor winter walking for pleasure or exercise different from the requirements for and challenges to safe outdoor walking necessary for transport, to get to and from vehicles for transportation to other activities outside the home? This may assist in the development of indoor programs focusing on skills necessary for safe outdoor winter walking, as determined by the purpose that older adults may identify.

Research findings from this study and further research studies could be used in developing public education strategies geared towards older adults. Rehabilitation and exercise professionals can use the information from this article to educate their clients about the facilitators of and barriers to outdoor winter walking. Being aware of the barriers can assist health care professionals in implementing alternatives and solutions to these barriers, such as home and community exercise programs.

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