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Facilitating walking, cycling or the use of greenways among persons most exposed to the harmful effects of climate change: A systematic narrative review

STATE OF KNOWLEDGE

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AUTHOR

Pierre Paul Audate, Ph.D., Specialist Scientific Advisor
Direction de la santé environnementale, au travail et de la toxicologie

UNDER THE COORDINATION OF

Mélanie Beaudoin, M. Env., Scientific Advisor and Professional Coordinator
Direction de la santé environnementale, au travail et de la toxicologie

REVIEWERS

Dominique Gagné, Scientific Advisor
Éric Robitaille, Ph.D., Researcher
Institut national de santé publique du Québec

Dominic Villeneuve, Ph.D., Assistant Professor
Geneviève Cloutier, Ph.D., Associate Professor
Université Laval

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LAYOUT

Aurélie Franco, Administrative Officer
Direction de la santé environnementale, au travail et de la toxicologie

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GLOSSARY

Self-efficacy: closely linked to motivation, self-efficacy refers to belief in one's own ability to organize and execute actions to achieve certain results (Meyer & Verlhiac, 2004).

Social capital: a multi-dimensional term encompassing all the norms and networks that facilitate collective action for mutual benefit. Social capital is often strengthened by the social cohesion, interactions, social ties and values that form an individual's or community's network, but it can also be affected by conflict (Gannon & Roberts, 2020; Woolcock, 1998).

Street connectivity: variable referring to the proximity of links and the density of connections or intersections. A neighbourhood with a well-connected street network has streets with many intersections, short distances to destinations, and few dead-ends and cul-de-sacs (Mecredy et al., 2011).

Active travel or transportation: modes of transportation that involve physical action or the expenditure of human energy, rather than a motorized device. Walking and cycling are the most popular modes of active travel (PHAC, 2012; Papon & De Solère, 2010).

The physical environment: all the natural and artificial elements that compose the environment (MSSS, 2012). It includes **the built environment**, which is made up of elements created, transformed or organized by humans, such as different modes of land use, transportation systems and design features (Robitaille, 2015).

Social environment: the social environment is defined as the socio-demographic composition of an environment, as well as the relationships, groups, social norms and social processes that exist between individuals living in that environment (Riazi & Faulkner, 2018; Suglia et al., 2016; Yen & Syme, 1999).

Climatic factors: ecological factors linked to atmospheric and meteorological circumstances in a given region. Climate is determined by **meteorological factors** such as temperature, wind, humidity and precipitation (Aquaportail, 2009; Saskatchewan Ministry of Education, 1998).

Individual factors: a combination of biological, genetic, physical and socio-economic characteristics (age, education level, income level) as well as **personal factors** (knowledge, attitudes, preferences, lifestyle habits) specific to the individual (Anctil et al., 2012; HSE, n.d.).

Pedestrian potential: characteristic of the built environment that encourages walking by ensuring pedestrian comfort and safety. A street with pedestrian potential connects people with a variety of destinations in a reasonable amount of time and offers visual interest along pedestrian routes (Robitaille, 2015; Southworth, 2005).

Seniors or elderly persons: according to the Office québécois de la langue française, these are people whose age places them within the last broad periods of life, specifically those aged 60 and over according to the World Health Organization, or aged 65 and over according to other organizations.

Persons in disadvantaged situations: these are people in situations of observable, measurable disadvantage. This disadvantage can be material or social.

Persons vulnerable to climate change: these are population groups at greater risk of exposure to the harmful effects of climate change. The most vulnerable groups include seniors, Indigenous peoples, children and young people, pregnant women and the socially and economically disadvantaged, among others. Many factors such as income level, education and housing quality, among others, can have an impact on the vulnerability of these population groups (Health Canada, 2018).

Land-use mix: refers to the presence of a diversity of urban activities and functions (residential, commercial, recreational, etc.) in a given geographic area.

Greenways: a network of linear green spaces that allow people to access destinations close to their neighbourhoods. In brief, these are ecological corridors that link sites of interest such as parks and other destinations in urban, suburban or rural areas (Paneerchelvam et al., 2020; Shoeybi et al., 2006).

HIGHLIGHTS

This knowledge synthesis falls within the context of the Villes vivantes project, whose aim is to help municipalities take concrete action to implement local greenways for the benefit of certain population groups that are more likely to suffer the harmful effects of climate change, such as seniors and persons in disadvantaged situations. The predicted increased frequency of episodes of extreme heat and cold resulting from climate change will have an impact on the active modes of transportation practiced by these groups. Based on fifty studies, this synthesis presents a number of individual or personal factors, as well as factors relating to the physical or built environment, or the social, climatic or meteorological environment, that influence active travel and the use of greenways by seniors or those in disadvantaged situations.

- Factors relating to the physical or built environment are the most widely studied in the literature reviewed.
- There is a positive association between pedestrian potential (density, land-use mix, street connectivity, number of destinations) and active travel for both target population groups.
- According to some studies, the absence or poor maintenance of pedestrian and cycling infrastructures can hinder active travel.
- The presence of street furniture (benches, drinking fountains, garbage cans), paved surfaces and flat sidewalks are infrastructure features that encourage active modes of travel for many study participants.
- Winter conditions appear to have a negative impact on the active travel habits of seniors and persons in disadvantaged situations. It is not always cold weather or rain that limits walking or cycling, but rather physical obstacles such as snow or ice on sidewalks or bike paths.
- A number of strategies and initiatives, such as adequate snow clearance, good signage, decorations and illumination of walkways and bike paths, as well as their separation from vehicular traffic, can increase users' sense of security and encourage the use of greenways, even during winter.
- Several studies show that a greater sense of personal safety and an agreeable social environment arising from interpersonal interactions encourage active modes of travel.
- Finally, this knowledge synthesis highlights the beneficial effects of greenways, as infrastructure features capable of encouraging active modes of travel among groups more likely to suffer from the effects of climate change.

SUMMARY

Background

The predicted increase in the frequency of episodes of extreme heat and cold related to climate change will have an impact on active modes of travel or transportation. For example, they may limit access to certain essential services in both summer and winter. They can also cause significant damage to pedestrian and cycling infrastructures, increasing the risk of falls and injuries for citizens. Seniors and persons in situations of material and social disadvantage are among the population groups most exposed to these consequences, due to their pre-existing difficulties accessing essential services (e.g., physical limitations resulting from seniors' age, limited socio-economic means of those in disadvantaged situations). Identifying the factors that facilitate or hinder the modes of travel used by these groups will help support public health efforts to promote healthy, active lifestyles for their benefit in a climate change context. Several studies have already identified factors in the built environment that positively or negatively influence walking and cycling among these population groups.

This knowledge synthesis is part of an effort to explore all the factors that can facilitate or hinder active travel and the use of greenways by seniors and by those in disadvantaged situations, two among the population groups most at risk of suffering the effects of climate change. It will provide municipalities with the theoretical basis for developing local greenways for the benefit of these populations.

Methodology

The question at the heart of this literature review is: **what factors facilitate or limit walking, cycling or the use of greenways among seniors and persons in disadvantaged situations?**

To answer this question, we carried out a review of the literature on walking, cycling and the use of greenways by seniors and persons in disadvantaged situations. A total of six databases from two search engines (Ovid and EBSCO) were queried in April 2022 to find relevant studies. Grey literature databases and literature review reference lists were also consulted to identify additional studies. Studies were screened for inclusion and exclusion criteria. A total of 50 studies were selected for inclusion. Data were then extracted from the included studies for analysis. Finally, the factors that facilitate and limit walking, cycling and the use of greenways were analyzed and presented in the results of this knowledge synthesis.

Results

Factors facilitating or limiting active travel or the use of greenways among seniors or those in disadvantaged situations have been grouped into four categories. Individual or personal factors, physical or built environment factors, social environment factors and climatic or meteorological factors.

Personal goals related to the motivation to stay healthy, a sense of personal safety, and individual characteristics such as education level all positively influence walking. However, in the case of other individual characteristics, such as income level, the studies that have considered their impact tend to present inconsistent results.

The determinants of pedestrian potential such as density, land-use mix, design features, number or accessibility of destinations, distance to services and street connectivity are all documented facilitators of active travel for the population groups studied. Conversely, factors such as the absence or poor maintenance of pedestrian and cycling infrastructures are identified as barriers.

The positive influence of exposure or proximity to green spaces is also supported by the results of this knowledge synthesis. Indeed, several studies have demonstrated a positive association between green spaces and walking.

Several of the included studies also reported a positive association between perceived social environment and walking. The social environment referenced includes the presence of physically active people in the immediate environment, interactions with others, social trust and the opportunity to build individual social capital. However, it would be useful for the authors of studies on the social environment to develop a common terminology and indicators to better define its determinants.

Temperature is one of the most studied climatic parameters in the literature consulted. The evidence found appears to corroborate a positive association between temperature and engaging in active travel. However, these studies were not carried out under conditions of extreme heat. Moreover, very few studies have explored active travel habits during winter among the target groups of this synthesis. Those that did identified weather conditions such as rain or snow as barriers to active travel. Nevertheless, cold does not appear to be the main constraining factor in winter, but rather obstacles on sidewalks. Further studies on the subject could bolster this hypothesis.

Discussion and courses of action

The majority of the studies included rely on perception measures to examine the influence of various factors on modes of active travel. Moreover, the vast majority of these studies are cross-sectional, which limits the possibility of establishing causal links. It would therefore be appropriate to encourage studies that use objective measures and other methodological approaches, to strengthen the evidence available in the literature. For example, the use of pedestrian and cyclist counters on stretches of road would be a good tool. Nevertheless, this review does point to some courses of action for encouraging walking, cycling and the use of greenways among two of the population groups at risk of suffering the consequences of climate change.

To encourage these practices, areas need to be adequately maintained and designed with sufficiently wide paths and sidewalks, high residential and population density, good street connectivity and a mix of services within walking distance. Other elements such as flat sidewalks,

the presence of greenery or appropriate vegetation and street furniture (benches, toilets, garbage cans) will improve user comfort and motivation. Clearing snow and ice from pedestrian and cycling infrastructures in winter is also a key factor in encouraging walking, cycling and the use of greenways.

1 INTRODUCTION

Active modes of travel or transportation (walking, cycling) are associated with a considerable number of physical and mental health benefits, such as reducing the risk of certain chronic diseases, and reducing the incidence of stress-related problems or depression (Knott et al., 2018; Martin et al., 2014; Smith et al., 2010; Wu et al., 2021). The adoption of these modes of transportation also has socio-economic and environmental benefits. In fact, it reduces transportation costs and costs associated with vehicle maintenance for citizens, and reduces greenhouse gas (GHG) emissions as well as air pollution for communities (Pérez et al., 2017). However, socio-environmental concerns linked to climate change will also have an effect on active transportation. On the one hand, predictions of an increase in the frequency and intensity of precipitation (e.g., rain, freezing rain), as well as episodes of extreme heat, and freezing and thawing, could limit people's active travel (walking, cycling) in both summer and winter (Demers-Bouffard, 2021). On the other hand, these climatic events can damage active transportation infrastructures such as sidewalks and bike paths, increasing maintenance costs for municipalities and risks to public health and safety.

Indeed, all populations are vulnerable to the health risks posed by climate change. However, certain population groups such as Indigenous peoples, the elderly, children and young people, socially and economically disadvantaged persons and those with pre-existing health conditions are among those most likely to suffer the negative effects of climate change. Several factors linked to existing inequalities in our society, such as income level, education, poverty, housing quality and difficulties accessing healthcare, partly explain the vulnerability of these population groups (Health Canada, 2018). For example, age-related physiological changes can reduce the mobility of seniors, restricting their access to health care or other resources in extreme weather conditions. In addition, persons experiencing high levels of social and material disadvantage are among the most vulnerable to the fatal consequences of periods of extreme heat (Rey et al., 2009).

By providing an opportunity to engage in physical activity to improve health, active modes of transportation can help make these population groups less vulnerable to climate change. Indeed, studies have shown that active travel is associated with better physical health, improved weight and cholesterol levels, reduced obesity and a reduced risk of all-cause mortality (Andersen et al., 2000; Habinger et al., 2020; Schauder and Foley, 2015).

Given the context of an aging population, it is an opportune time to develop policies and interventions that take into account the capacity of at-risk population groups to adapt to the harmful effects of climate change. In the specific case of Québec, there are already a number of policies and action plans in place to promote active modes of transportation (the Sustainable Mobility Policy 2030, the Aging and Living Together, at Home, in One's Community policy, the Government's health prevention policy and the active mobility plans of municipalities, among others). However, active travel is not always given priority when budgetary resources are being allocated (Cabana-Degani & Rheault, 2022). Moreover, accessing essential destinations by foot

or by bike isn't always easy or safe for vulnerable populations (Vivre en ville, 2018). It is therefore relevant to improve understanding of the factors influencing active modes of travel to encourage their prioritization by provincial and municipal governments, particularly with a view toward promoting the health of seniors and those in situations of material and social disadvantage.

A growing number of studies point to the existence of a range of factors that can encourage walking and cycling among seniors or those in disadvantaged situations (Bird et al., 2010; Caspi et al., 2013; de Melo et al., 2010; Li et al., 2013; Mertens et al., 2019; Pearson et al., 2022). Several of these studies have already reported an association between factors related to the built environment and walking. For example, according to Li et al. (2013), over 37% of seniors in Toronto, Canada, walk less outdoors in winter due to slippery sidewalk conditions and snow. In addition, other factors related to the built environment, such as determinants of pedestrian potential, have been identified in a literature review as facilitators of utilitarian walking (Grasser et al., 2013). Another more recent systematic review has also documented the positive association between walking and several individual (employment status, perceived health status, perceived safety) and social (number of social ties, perceived social support) factors among persons in disadvantaged situations (Hilland et al., 2020). Surprisingly few studies have investigated the impact of climate or weather conditions on walking and cycling. By targeting all the factors facilitating and limiting walking and cycling among seniors and those in disadvantaged situations, this review will paint a more comprehensive portrait and thus provide clarity for municipalities implementing local urban greenways in a context of climate change.

This knowledge synthesis was initiated as part of the Villes vivantes (Living Cities) project of Nature Québec's Milieux de vie en Santé program. The main objective of this project is to help municipalities take concrete action to implement local greenways for the benefit of certain populations vulnerable to climate change (seniors, persons in disadvantaged situations). The approach taken consists in identifying the factors that facilitate or hinder walking, cycling or the use of greenways among the targeted population groups.

1.1 Context

1.1.1 Some beneficial effects of urban greenways

It is worth presenting here a few studies dealing specifically with the beneficial effects of greenways, before introducing the results of studies focused on the factors that facilitating or limit walking, cycling or the use of greenways. Indeed, greenways are infrastructure features that can positively influence individual or personal factors such as lifestyle habits (physical activity), economic factors and factors linked to the social or physical environment in which individuals evolve.

At the individual level, observations made before and after the construction of a greenway in an disadvantaged neighbourhood in Philadelphia, U.S.A., revealed slight increases in physical activity of moderate and vigorous intensity among people using the greenway. In the same

study, utilitarian walking was considered the main reason for using this new green infrastructure (Auchincloss et al., 2019). Other studies have also reported a link between greenways and physical activity. For example, one study conducted in Vancouver, Canada showed that participants who lived less than 300 metres from a newly-developed greenway increased their physical activity after the work was completed. According to this study, the probability of engaging in an average of 20 minutes of daily physical activity was doubled, reducing the likelihood of having a sedentary lifestyle by 54% among study participants (Frank et al., 2019). Another study carried out earlier in Roanoke, U.S.A., observed an increase in physical activity among people living within 800 metres of a newly built greenway, as compared with people living between 800 metres and 1.5 km from it (West & Shores, 2011). On the other hand, the documented evidence showing the positive influence of greenways on physical activity remains modest, since the results of studies are not always statistically significant (West & Shores, 2011).

Physical activity and social factors, such as interactions between people, encourage the use of greenways. Keith et al (2018) examined the preferred uses of greenways in Georgia and in Texas, in the U.S.A. On the one hand, the results revealed that study participants' main motivations for using greenways were to engage in physical exercise and to escape the stress of urban life. On the other hand, the cultural benefits of having social interactions and connecting with community were more widely recognized by users of one of the greenways in the study. In the other greenway, where most users tended to travel longer distances to access the trails, outdoor recreation and physical activity were considered the main benefits of its use. Upon examining the effects of the physical and social environment of a greenway, Chang (2020) observed that seniors living near this green infrastructure participated much more in outdoor social activities than their peers.

The presence and use of greenways strengthens social capital, because they create conditions that foster exchanges between different population groups. Having studied the ethnic distribution of two greenways in two cities in southern Michigan, Coutts and Miles (2011) reported that the ethnocultural composition of neighbourhoods did not predict the ethnic origin of people using the greenways in their vicinity. This means that greenway trails can be seen as infrastructure features that facilitate connections between various ethnic groups. In addition, a higher level of social capital was available to seniors living near this form of green infrastructure (Chang, 2020).

Greenways can also positively influence other social factors, such as the safety of nearby areas. In a study carried out in Chicago, Harris et al. (2018) observed a positive influence exerted by a greenway on different types of crime (violent crime, vandalism, disorderly conduct), particularly in neighbourhoods with low socio-economic status. In fact, the construction of the greenway led to a reduction in the per capita crime rate in less-advantaged neighbourhoods. The authors of the study suggest that this reduction could be attributed to more frequent use of the greenway, or to the strengthening of social interactions fostered by its use. In a second part of the study, the authors demonstrated that properties close to the greenway were subject to fewer acts of vandalism. This can be explained by the presence of more people in the area, resulting naturally

in increased surveillance in the vicinity of the newly-constructed greenway. For their part, Keith et al. (2018) reported that safety was the main concern of greenway users, particularly for women and ethnic minorities.

In economic terms, the presence of greenways can also help reduce the costs associated with population health problems. They also influence the economy by facilitating property appreciation. Hunter et al. (2020) modeled the potential cost-benefit of investing in an urban greenway in Belfast, Northern Ireland. They deduced that for every euro invested, there was a return on investment of two to six euros, owing to the various social co-benefits associated with the greenway, such as appreciation of nearby property values, flood mitigation, tourism and health. A previous study from the same country demonstrated that greenways are a cost-effective intervention that can reduce health costs by increasing users' levels of physical activity (Dallat et al., 2014).

Studies carried out in several other countries, such as South Korea and the United States, have shown that the construction of greenways positively influences the appreciation of land and real estate values (Kang & Cervero, 2009; Payton & Ottensmann, 2015). For example, Noh (2019) shows that converting abandoned railways into greenways, in California, can potentially increase the value of single-family homes. Having compared property values pre and post greenway construction, the author reported an increase of 2.25% based on the proximity of properties to the greenway. The construction of new greenways also influences the geography of office sectors, as it attracts companies concerned with providing an attractive urban environment for employees (Jang & Kang, 2016).

In addition to positively influencing social and economic factors, greenways can play a role in achieving environmental sustainability by acting to mitigate atmospheric pollutants. A longitudinal study (2012-2015) in Vancouver investigated the causal relationship between a newly constructed urban greenway and the self-reported GHG emission estimates of residents living near the greenway. The study found that GHG emissions were reduced by 20.9%, attributable to a reduction in vehicle kilometres travelled by residents due to the presence of this active transportation infrastructure that promotes cycling (Ngo et al., 2018). Another study carried out in the same context also showed that the newly developed greenway contributed to a 251% increase in participants' cycling trips as compared with the control group (Frank et al., 2021).

Generally speaking, greenways can be positively associated with the reduction of air contamination. A study carried out in Seoul, South Korea, compared the level of air contamination over six days on three greenway paths and on nearby sidewalks. The results of the study revealed that greenways positively influenced air pollution reduction. Indeed, concentrations of ultrafine particles and black carbon were 30% lower on greenways than on other sidewalks (Ahn et al., 2021).

2 METHODOLOGY

2.1 Research question and objectives

The core question of this literature review is: **what are the factors that facilitate or limit active transportation and the use of greenways among seniors or those in disadvantaged situations given a context of climate change?**

The aim of this knowledge synthesis is to encourage municipalities to take concrete action to develop local greenways for the benefit of certain population groups at risk from the harmful effects of climate change (the elderly, persons in disadvantaged situations). More specifically, it aims to:

- Identify all the factors that facilitate or hinder active travel among these two population groups, which are among the most vulnerable to climate change.
- Highlight the value of urban greenways as infrastructures that can facilitate active modes of travel to improve the health of target population groups.

2.2 Search strategies

To answer the study's question and meet its objectives, a narrative review of the literature was carried out using a systematized approach. A systematized narrative review is a type of literature review that synthesizes current knowledge and performs a critical analysis to gain an overall portrait and identify gaps in a given subject area. Unlike a traditional narrative review, systematized narrative requires an explicit description of the methodology used to search for information. This literature search is most often performed systematically, as is the case for other types of systematic reviews or scoping reviews (Framarin & Déry, 2021). Nevertheless, a narrative review offers more flexibility than a systematic review when it comes to selecting articles. For example, articles can be selected by a single person, unlike with a systematic review, which requires two people to select the articles. This approach is often prioritized when the scope of the research question is broad, and can evolve as the review process progresses (Framarin & Déry, 2021). The systematized narrative review approach was chosen in this case because the scope of the research question is rather broad and less circumscribed. Thus, studies focused on active transportation as well as those focused on greenway use by two population groups vulnerable to the effects of climate change (seniors and persons in disadvantaged situations) were targeted. Choosing the systematized narrative approach, allowed for the rapid literature review to be carried out in a shorter timespan than is usually recommended for a systematic review. In addition, a clearly defined literature search strategy and inclusion/exclusion criteria were used for study selection, a departure from the traditional narrative approach.

Literature search strategies were developed with reference to three groups of concepts: 1) active transportation or greenways; 2) facilitator or barrier; and 3) seniors or disadvantaged persons. Several keywords corresponding to the three groups of concepts were chosen to build the search strategies. Next, two search engines (Ovid and EBSCO) were used to locate studies via

scientific literature databases. A total of six databases from these two search engines were queried in April 2022 to find relevant studies: Ovid (Global Health, Medline, PsycInfo), EBSCO (Environment Complete, CINAHL Complete, GreenFILE) (see search strategies in Appendix 1.1, p. 46). These interdisciplinary databases cover a wide range of topics, including biomedical sciences, social sciences and humanities, and environmental health.

For the grey literature, another search strategy was developed and applied using the Google search engine and the websites of municipal organizations, such as vancouver.ca and portland.gov, among others (see grey literature search strategies in Appendix 1.2, p. 50). These municipal websites were included because documents from these municipal organizations were identified using the general grey literature search strategy. The first ten pages of results for each website were consulted. The documents examined had to meet the same inclusion and exclusion criteria used for the scientific literature. Only studies meeting the criteria were considered. For this review, the literature search strategies included French keywords, in addition to the English terms used in the scientific literature.

Table 1 provides a summary of all the databases included in the literature search. Other relevant studies were added to the list of studies obtained after reviewing the grey literature. Additional studies were obtained after reviewing the reference lists of systematic reviews that had been excluded from selection during the scientific literature selection process.

Table 1 Databases consulted during the literature search

Ovid	EBSCO	Grey literature
• Global Health • Medline • PsycINFO	• Environment Complete • CINAHL Complete • GreenFILE	• Google • Vancouver.ca • Portland.gov • Aevv-egwa.org

Once identified, the studies were transferred to the Covidence online systematic review software for elimination of duplicates and selection of relevant studies.

2.3 Selection of relevant studies

To produce this knowledge synthesis, recent studies published in French or English, between 2000 and 2022, applicable to the context of member countries of the Organisation for Economic Co-operation and Development (OECD) were considered. These studies had to be about: 1) factors that facilitate or limit active transportation (walking, cycling); and 2) access to or use of greenways by seniors or those in disadvantaged situations. A set of inclusion and exclusion criteria was developed to facilitate selection of the most relevant studies (Table 2, p. 11).

Duplicates were then discarded and an initial sorting of article titles and abstracts was carried out. Next, the full text of the studies selected at this stage was reviewed for a second round of selection, applying the exclusion criteria to discard less relevant studies.

Table 2 Study inclusion and exclusion criteria

	Inclusion criteria	Exclusion Criteria
Subject	Active transportation **OR** Access to or use of greenways (green alleys, nature trails and paths) **AND** Factors that limit or facilitate active transportation, or access to or use of greenways	The study is not focused on active transportation or greenways (nature trails and paths) **OR** The article focuses on active transportation or greenways without presenting limiting or facilitating factors **OR** Medical study; medical conditions of target populations **OR** Motorized mobility **OR** Study carried out in a controlled environment or indoors **OR** Study presenting the same data as a previous study **OR** The study does not specify walking and/or cycling as a mode of travel
Types of articles	Empirical or theoretical studies	Thesis, dissertation, commentary or editorial
Target populations	Seniors Persons in disadvantaged situations	Children or adults who are not in disadvantaged situations
Geography	OECD member country	Non-OECD member country

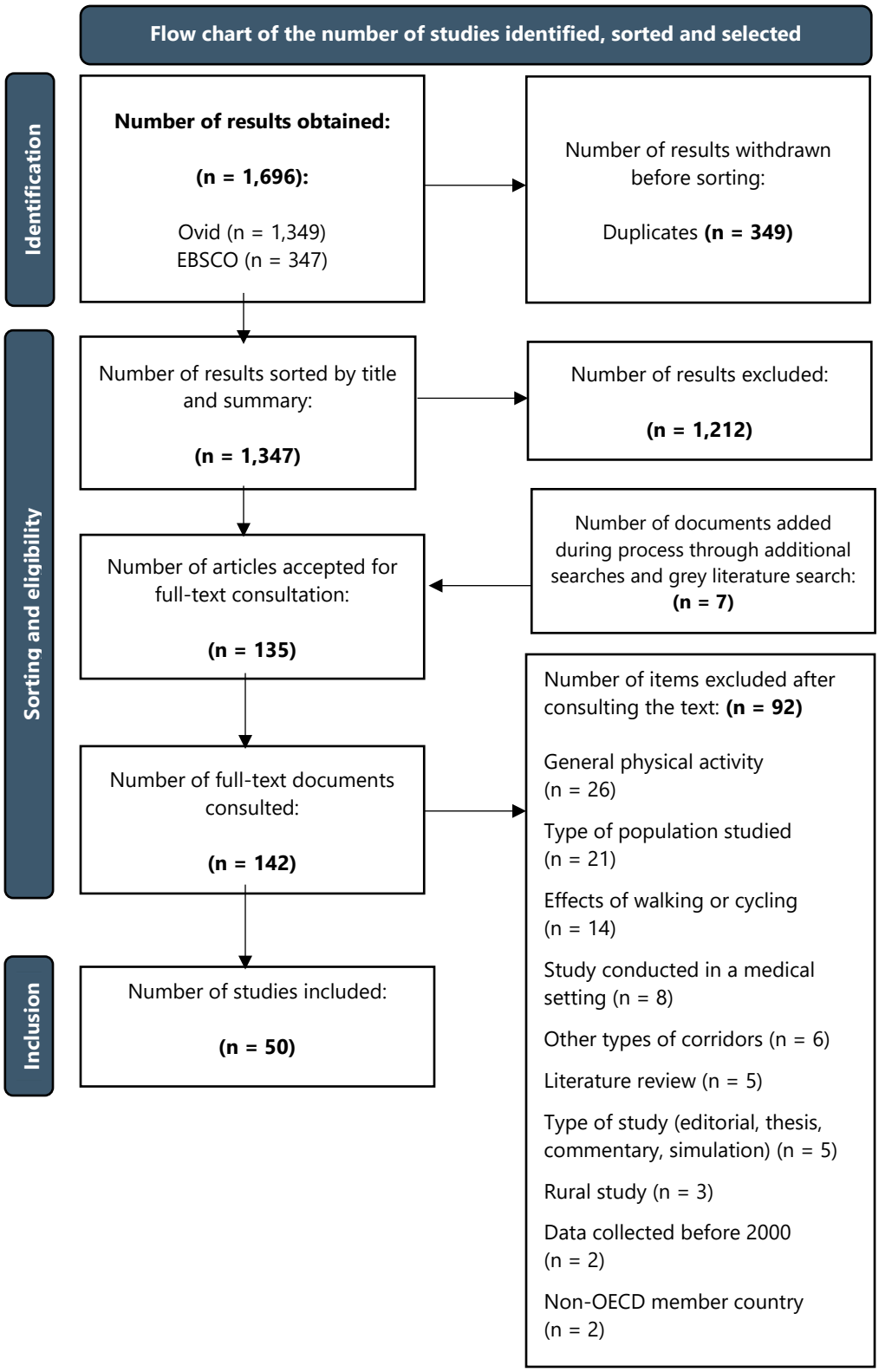
Table 2 Study inclusion and exclusion criteria (continued)

	Inclusion criteria	Exclusion Criteria
Context	Urban or suburban environment	Rural environment
Data reference years	2000 to 2022	Before 2000
Article languages	French or English	Other languages

Following consultation of the full text of the selected studies, a few additional articles were added to the list of selected studies. Data were then extracted from the included studies. The data included the following elements: authors, year of publication, country, type of population studied, type of activity (walking, cycling, greenway use), season (winter, spring, summer, autumn), study objective, type of study (quantitative, qualitative or mixed), study design (cross-sectional, longitudinal or other), summary of the methodology, nature of factors (facilitators, barriers), types of measures (goals, perceptions, motivations), indicators measured and summary of key findings. The most relevant data extracted are presented in Appendix 2.

A total of 50 studies were included in this knowledge synthesis, 43 of which were retrieved from scientific databases and seven from grey literature searches and from hand searching after consulting the reference lists of literature reviews that were not selected (Figure 1, p. 13).

Figure 1 **Diagram of literature search results**



2.4 Overview of included studies

The majority of studies included in this knowledge synthesis were published in the last ten years (Figure 2). Most of these studies were carried out in North America. In fact, the United States and Canada are the two countries with the highest number of studies (Figure 3). Although the search strategy was designed to identify studies for two of the population groups most at risk from the harmful effects of climate change, namely seniors and those in disadvantaged situations, only 12% (6/50) of the studies focused specifically on the second group (Figure 4).

The age of participants considered in studies of persons in disadvantaged situations is 16 years or older, while studies of seniors consider mostly seniors aged 65 or over. The majority of studies consider participants aged 65 or over as seniors (Figure 5). On the other hand, about ten studies consider people aged 60 and over to be seniors.

Figure 2 Number and year of publication of included studies

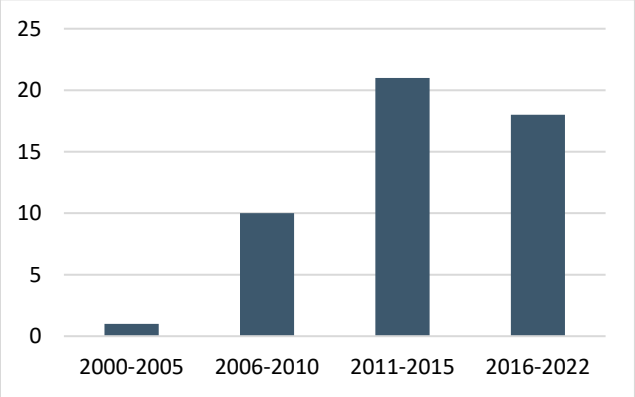


Figure 3 Country of study

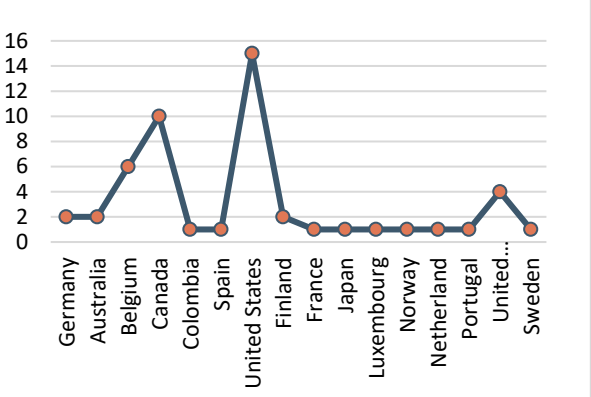


Figure 4 Age categories covered in included studies

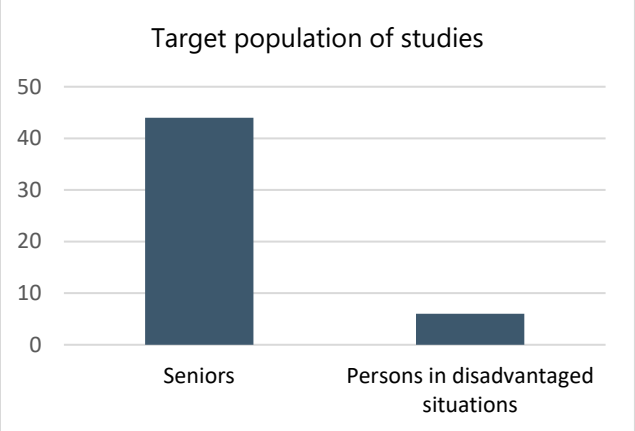
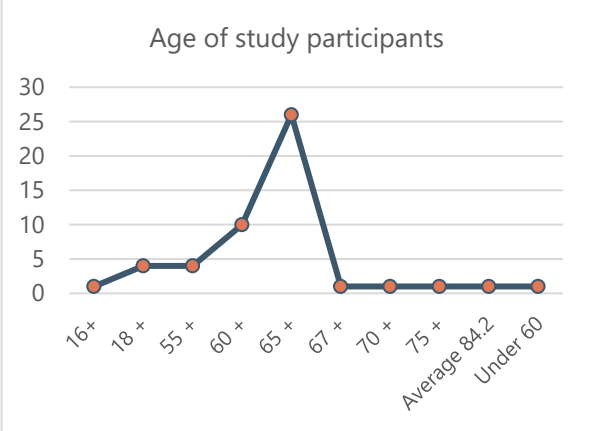


Figure 5 Target population groups of the included studies



Of the 50 studies included in this knowledge synthesis, 74% (n = 37/50) were quantitative studies, 14% (n = 7/50) were qualitative studies and 12% (n = 6/50) were mixed method studies. Of the quantitative studies, almost 90% (n = 33/37) were cross-sectional. Only two were longitudinal studies; of the remaining two, one used a controlled design and the other a pre-post design. The majority of studies focus on factors that facilitate or limit walking in general. Some are more specific about the type or purpose of walking (utilitarian or recreational). Very few studies explored the factors that facilitate/limit cycling specifically or the use of greenways by the two population groups that are the focus of this review (Table 3).

A considerable number, namely 46% (n = 23/50) of the studies analyzed factors that facilitate one or more forms of active travel (walking, cycling) or the use of greenways. The same percentage of studies explored both facilitating and limiting factors, while the remaining four explored only limiting factors. However, very few of the 50 studies included used objective measures to analyze the factors facilitating or limiting participants' walking, cycling or greenway use. The majority of results are based on participants' perceptions (Table 4).

Table 3 Categorization of the 50 included studies

Categories	Number of articles
Articles on walking in general	27
Articles on utilitarian walking	10
Articles on active transportation in general (walking, cycling)	5
Articles on greenways	3
Articles on recreational walking	2
Articles on cycling in general	2
Articles on utilitarian cycling	1

Table 4 Types of measures considered in the included studies

Types of measures	Number of articles
Articles whose results are based on participants' perceptions	25
Articles whose results are based on objective measures and participants' perceptions	10
Articles whose results are based on objective measures	9
Articles whose results are based on participants' perceptions and motivations	5
Articles whose results are based on participants' motivations	1

To carry out the analysis, the factors facilitating or limiting walking, cycling or greenway use that were identified in the studies were grouped into four categories: individual or personal factors (Section 3.1); physical or built environment factors (Section 3.2); social environment factors (Section 3.3); and climatic or meteorological factors (Section 3.4). Note that many of the studies explore more than one of these four categories. These factors can also interact to influence walking, cycling and the use of greenways among population groups at risk from the harmful effects of climate change (Figure 6, p. 28).

2.5 Peer review

In accordance with the *Cadre de référence sur la révision par les pairs des publications scientifiques* of the Institut national de santé publique du Québec, a pre-final version of this report was submitted to external reviewers. Using the institute's grid (Institut national de santé publique du Québec, 2020), the reviewers were asked to validate the accuracy of the report's content, the relevance of the methods used, and the appropriateness of the conclusions and proposed courses of action. The project team compiled a table indicating each of the comments received, whether or not they were retained, for what reasons, and how they were addressed in the final version.

3 RESULTS

Generally speaking, the literature we consulted examined a number of factors that facilitate or limit walking, cycling or the use of greenways by seniors or those in disadvantaged situations. These factors have been grouped into four categories: individual or personal factors (Section 3.1), physical or built environment factors (Section 3.2), social environment factors (Section 3.3), and climatic or meteorological factors (Section 3.4). For the set of studies analyzed, the largest number (23/50) explore only facilitators, while a smaller number (4/50) address only barriers, with the remainder (23/50) addressing both.

3.1 Individual or personal factors that can influence active travel modes

This section briefly describes the articles included that address, in a variety of ways, the individual or personal factors facilitating or limiting walking, cycling or the use of greenways by seniors or those in disadvantaged situations. Several of the included studies (n = 27/50) take into account a range of individual or personal factors that facilitate or hinder the practice of these activities. These factors include age, income, education, individual motivations, health status and personal safety concerns (fear of falling, fear of incivility).

3.1.1 Factors that can encourage walking

The individual or personal factors that can facilitate walking in the two population groups targeted in this review are varied. Many of the studies reviewed identified individual motivation as a factor that encourages people to walk. These studies report that **the health benefit** is a factor that facilitates walking. For example, in a study of the walking habits of seniors from diverse cultural backgrounds in Australia, Bird et al. (2010) reported that 57% of participants walked to stay healthy and fit. The second most common reason given was needing to get to shops. For many participants in this study, this was the reason for a substantial proportion of their weekly walking. The health dimension was also reported as the main reason for walking in several studies conducted in Canada and Norway (de Melo et al., 2010; Krogstad et al., 2015; Mitra et al., 2015). Other individual motivations, such as **engaging in physical exercise, utilitarian travel, contact with nature or the opportunity to have social interactions**, were also identified as factors positively linked to walking among seniors (Grant et al., 2010; Krogstad et al., 2015; Mitra et al., 2015; Perchoux et al., 2019). Upon examining certain personal characteristics related to utilitarian walking among seniors, Laatikainen et al. (2018) found that personal goals related to physical activity had a direct positive effect on utilitarian walking. According to these authors, the greater the importance given to physical activity and sports-related goals, the more likely seniors were to walk.

In addition to being discussed in the studies as a motivation for walking, the health status of individuals is presented in some of the studies as an individual factor influencing this activity. Better perceived health status is associated with a greater likelihood of walking (de Melo et al.,

2010; Mason et al., 2011; Wang & Lee, 2010). **Self-efficacy**, which underlies a willingness to engage in physical activity, even when doing so is difficult, is also a factor that positively influences walking. After examining the likelihood of seniors in Belgium engaging in walking, over a three-year period, Mertens et al. (2019) demonstrated that those with higher self-efficacy scores were 4.36 times more likely to engage in walking. Self-efficacy is reported in several other studies as a factor that encourages walking among seniors or people in disadvantaged situations (Gallagher et al., 2014; Hall & McAuley, 2010).

Other individual factors, such as **age** and **income level**, can also have an influence on utilitarian or recreational walking. Being younger is associated with a greater likelihood of walking, as is a higher income level (de Melo et al., 2010). Indeed, problems that limit walking increase with age, so this association is quite negative. For example, Krogstad et al. (2015) reported in their study that around 16% of newly retired people (aged 67-69) reported having difficulty walking, as did 62% of seniors aged 85 or over. Participants stressed the need for thorough planning, especially in winter, to remove barriers and make walking easier. In the case of income, other studies have produced contradictory results. People with higher incomes can sometimes walk less frequently, because they have more opportunities to purchase motorized means of transportation. For example, Laatikainen et al. (2018) demonstrated a direct negative effect of income on walking. According to these authors, the higher their income level, the less people walk. Hinrichs et al. (2019) concurred, finding that low financial status is positively associated with utilitarian walking due to the decreased use of automobiles. Conversely, de Melo et al. (2010) reported that a higher level of income was associated with a higher number of steps per day among seniors.

Level of education is also a factor that can positively influence walking. The higher their level of education, the more people walk (Laatikainen et al., 2018). In their study, Mertens et al. (2019) observed, during a follow-up period, that seniors with a higher level of education were 4.34 times more likely to engage in utilitarian walking than those with a lower level of education. The results of another study also suggest that educating vulnerable people about the co-benefits of walking, rather than warning them about the risks of inactivity, is a more effective way of encouraging this active mode of travel. In this study, seniors who were informed of the benefits of walking walked more than those who were informed of the negative effects or consequences of not walking. In a second component of the study, the participants who were informed of the potential positive effects of walking were also found to have increased the number of steps they took compared to others (Notthoff & Carstensen, 2014).

A strong sense of personal safety is also an individual factor that positively influences walking. Indeed, a strong sense of perceived safety is associated with more frequent walking in at least seven of the studies that explore individual or personal factors (Carrapatoso et al., 2018; Caspi et al., 2013; Gallagher et al., 2010; Gomez et al., 2010; Li et al., 2005; Mason et al., 2011; Van Cauwenberg et al., 2014). For example, in a study conducted in Colombia, participants who reported feeling protected or very protected from traffic were more likely to report walking for at least 60 minutes. Surprisingly, in the context of this country, the high number of intersections can also cause people to feel unsafe on roads, in contrast to the reality of northern countries

where intersections can foster a feeling of safety due to mandatory stops for motorists (Gomez et al., 2010).

3.1.2 Factors that can limit walking

Although less well researched, some individual factors, such as a **reduced sense of safety**, can hinder or limit walking among seniors. For example, certain situations, such as the fear of being hit by a car, generate feelings of insecurity in seniors. In their study, Bird et al. (2010) found that fear of crime and personal safety concerns were issues mentioned by participants that walked very little. Nevertheless, the results indicate that motivations vary according to gender, cultural group and the amount of walking practiced. **Fear** as a limiting factor is also expressed in other forms, such as the fear of losing one's dog while walking (Gallagher et al., 2010), the fear of falling during winter (Klicnik & Dogra, 2019), the fear of being attacked by strangers or the fear of falling victim to the bad behaviour of drivers (Mitra et al., 2015) or the attitude of cyclists (Stahl et al., 2008) and feeling unsafe on roads (Strath et al., 2007).

3.1.3 Factors that can influence cycling

Six of the studies analyzed present individual factors that can influence cycling among seniors (Klicnik & Dogra, 2019; Mertens et al., 2019; O'Rourke & Dogra, 2020; Strath et al., 2007; Vietinghoff, 2021; Winters et al., 2015). Among these factors, **a history of cycling** seems to be a factor that motivates seniors to cycle. In a mixed-methods study conducted in Vancouver, Canada, a history of cycling was the predominant theme in interviews with cyclists who cycled to maintain an active lifestyle in adulthood (Winters et al., 2015). **Greater perceived benefits of cycling** can also encourage people to engage in this activity. This is what Mertens et al. (2019) demonstrated in their study. In fact, participants who perceived greater benefits were more likely to engage in utilitarian cycling. On the other hand, perception of the activity as a social norm (being encouraged to do physical activity because someone else thinks it's good for you) does not necessarily predict cycling. In the same study, it was shown that participants whose perception of cycling as a social norm was stronger were less likely to engage in utilitarian cycling.

A number of other individual factors can hinder cycling among seniors or those in disadvantaged situations. These include, **fear of falling** (Klicnik & Dogra, 2019; O'Rourke & Dogra, 2020), **feeling personally unsafe** (Strath et al., 2007; Winters et al., 2015) or **health status** (Klicnik & Dogra, 2019). **Low socio-economic status** can also be a limiting factor for certain population groups due to the high costs of bicycles (Klicnik & Dogra, 2019). In addition to the barriers associated with financial insecurity, being a member of an **ethnic community** can limit cycling for certain groups. For example, lack of knowledge or information about city cycling networks and other spatial inequalities limit cycling among certain ethnic groups (Vietinghoff, 2021).

3.1.4 Factors that can influence use of and access to greenways

Many of the individual factors facilitating or limiting walking and cycling presented above can also directly influence the use of greenways by populations vulnerable to climate change. For example, two of the included studies discuss **feeling unsafe** as a personal factor that hinders the use of greenway paths by seniors. In a mixed-methods study conducted in North Carolina, U.S.A. to assess which elements of a greenway seniors consider important as regards physical activity, feeling unsafe was a key concern. This perceived lack of safety is sometimes linked to **fear of falling** due to wet or icy paths (Dorwart, 2015), **fear of incivility** or fear of falling due to other features of the built environment (Ottoni et al., 2021).

3.2 Factors in the physical or built environment that can influence active travel modes

There is growing evidence that factors in the physical or built environment can positively influence walking, cycling or the use of greenways among the two population groups of concern in this knowledge synthesis. Most studies that address these factors use objective or perceived measures to examine the factors. This section presents 41 articles addressing one or more factors in the physical or built environment that facilitate or limit the use of these active travel modes by seniors or those in disadvantaged situations.

3.2.1 Factors that can encourage walking

Several factors in the physical or built environment, such as **the pedestrian potential** of streets or neighbourhoods, **pedestrian facilities** or **the proximity of green spaces**, all contribute to encouraging people to walk. The results obtained by several of the studies reinforced this finding.

The pedestrian potential of streets or neighbourhoods was widely studied in the literature consulted and appears to be a physical or built environment factor that facilitates walking. To measure this pedestrian potential, most studies used or adapted the Neighborhood Environment Walkability Scale (NEWS). This tool measures several determinants of pedestrian potential, such as density, land-use mix, design, destination accessibility, distance to services, street connectivity or road safety (Robitaille, 2015). Several of the included studies identified one or more of these determinants as facilitators or barriers to active travel. Indeed, some twenty studies addressed the determinants of pedestrian potential as factors that facilitate walking.

In a recent study exploring the impact of the built environment on utilitarian walking by seniors in Germany, the authors observed a positive relationship between residential density and walking. Each unit increase in residential density was associated with a higher probability of engaging in more frequent walking and utilitarian walking. Pedestrian infrastructure was associated with a 36% greater probability of walking and a 33% greater probability of utilitarian walking (Brüchert et al., 2020). Even in areas of low socio-economic status, residential density appears to be positively associated with recreational walking (Sugiyama et al., 2015). Generally

speaking, environments with a high residential or population density encourage walking. According to Troped et al. (2017), population density, stores and services, as well as intersection density indirectly predict recreational and utilitarian walking among seniors via perceived land-use mix. In fact, greater perceived land-use mix significantly and positively predicts walking among seniors. The same was found by Mertens et al. (2019), who observed that seniors who perceived a greater mix of land uses were 3.42 times more likely to engage in walking as a means of transport.

Other authors had previously demonstrated a positive association between the number of destinations in a neighbourhood and active travel by seniors in countries such as Canada or the United States (Chudyk et al., 2015; de Melo et al., 2010; Michael et al., 2006; Mitra et al., 2015). According to Chudyk et al. (2015), the most important destinations for low-income seniors in Vancouver were grocery stores, shopping malls, restaurants and cafés. Each ten-point increase in the pedestrian potential score of neighbourhood streets was associated with a 20% increase in the number of trips made on foot. The study by Clarke et al. (2017), carried out in the same Canadian context, also confirms this positive relationship between the pedestrian potential of streets and utilitarian walking by seniors. This positive relationship was also found in the European context, where the probability of seniors walking was positively associated with the number of nearby destinations (services/stores) (Perchoux et al., 2019). Nevertheless, the relationship between pedestrian potential and utilitarian walking can sometimes vary by gender, as was demonstrated by Gallagher et al. (2014). In their study, the presence of destinations (local services and stores within walking distance) was associated with neighbourhood walking for women, while neighbourhood density and design were more significant for men.

In addition to encouraging active travel, pedestrian potential is positively associated with the amount of time spent walking. Greater pedestrian potential or street connectivity corresponds to more minutes spent walking (Delclos-Alio et al., 2020) or more steps per day for seniors (Hall & McAuley, 2010). According to the results of the studies analyzed, in order to encourage walking as a means of transportation for seniors, a neighbourhood should offer good access to stores and services, well-maintained pedestrian infrastructure, aesthetically attractive surroundings, streets with little traffic and places for social interaction (Van Cauwenberg et al., 2012; Inoue et al., 2011). Short distances to destinations (Hinrichs et al., 2019), safe intersections, well-designed sports and recreational areas and the presence of public transit stops (Laatikainen et al., 2018; Li et al., 2005; Perchoux et al., 2019) also encourage utilitarian and recreational walking by seniors. Other aspects, such as perceived neighbourhood safety, tranquility and landscape aesthetics are positively related to outdoor walking (Wang & Lee, 2010; Zandieh et al., 2016).

Several of the included studies addressed aspects of urban design as facilitators of walking. For example, Van Cauwenberg et al. (2016) conducted a study aimed at understanding the influence of environmental factors on how well streets attract utilitarian walking in Belgium. They found that the flatness of sidewalks was by far the most attractive factor according to study participants. The quality, maintenance and absence of obstacles on sidewalks were identified as

facilitators of walking in several of the other studies analyzed (Van Cauwenberg et al., 2012; Gallagher et al., 2010; Krogstad et al., 2015; Stahl et al., 2008; Strath et al., 2007).

Furthermore, the studies analyzed suggest that environments with higher levels of comfort encourage walking. For example, the presence of street furniture such as benches, garbage cans and drinking fountains (Van Cauwenberg et al., 2012, 2016; Krogstad et al., 2015; Van Cauwenberg et al., 2014), traffic calming devices (Van Cauwenberg et al., 2016; Krogstad et al., 2015) and pedestrian crossings (Van Cauwenberg et al., 2012), as well as the integration of pedestrian paths with other elements used by families, such as playgrounds, can facilitate neighbourhood walking (Gallagher et al., 2010). Other elements, such as the separation of pedestrians from cycling paths, are also associated with walking (Gomez et al., 2010; Stahl et al., 2008; Strath et al., 2007). On the other hand, no studies have been identified that specifically address the contribution of street furniture (benches, garbage cans, drinking fountains, etc.) to users' walking experience.

Urban forests are a type of green space that encourages walking. Upon examining the association between the amount of open space and forest in an urban neighbourhood and the amount of walking done by seniors, study authors have observed that a higher percentage of forest is positively associated with walking (Besser & Mitsova, 2021). On the other hand, the percentage of open space in the neighbourhood was not always associated with minutes of neighbourhood walking per day, except in the case of African-Americans. Many of the studies included in this literature review also reported that open spaces, landscape aesthetics, pleasant outdoor environments and natural elements positively influence walking (Van Cauwenberg et al., 2012; Gallagher et al., 2010; Sawyer et al., 2017; Strath et al., 2007; Zandieh et al., 2016).

The proximity of parks and other green spaces has also been highlighted in a number of studies as an important factor encouraging walking among seniors or those in disadvantaged situations. According to Mitra et al., (2015) proximity to parks and the natural environment was an important facilitator of walking. In their assessment of seniors' perceptions of the relationship between parks and active transportation, Hinrichs et al., (2019) observed that seniors who were more inclined to perceive parks or green spaces as facilitators of neighbourhood mobility were ten times more likely to walk to stores than their peers. This positive association between proximity to green spaces and walking was also observed by Gomez et al. (2010). According to their study, people who lived near parks were more likely to walk for at least 60 minutes a week. In another study from Portugal, the authors noted that perceived proximity to parks was positively associated with walking intensity (a minimum of 30 minutes per day at a cadence of 100 steps per minute) in older men (Carrapatoso et al., 2018).

Exposure to vegetation and the amount of green, open and recreational space are also associated with walking in several other studies (Van Cauwenberg et al., 2016; Li et al., 2005; Van Cauwenberg et al., 2014). The more that people are exposed to natural or open environments where they live, the more they are encouraged to walk. For example, the results of multivariate analyses from a cross-sectional study conducted in the U.S.A. indicated that seniors who lived at

the end or on the corner of streets were more likely to walk for over 10 minutes than others (Wang & Lee, 2010).

3.2.2 Factors that can limit walking

To a lesser extent, the studies consulted explored several factors in the physical or built environment that can limit walking among seniors or those in disadvantaged situations. Among the most frequently mentioned factors are **unsafe pedestrian environments**, such as those with missing or poorly maintained sidewalks (Klicnik & Dogra, 2019; Mitra et al., 2015; Strath et al., 2007), particularly during the winter (Li et al., 2013; O'Rourke & Dogra, 2020; Stahl et al., 2008), poor signage or complex intersections (Grant et al., 2010; Klicnik & Dogra, 2019), and **the absence of street furniture**, such as benches (Klicnik & Dogra, 2019; Stahl et al., 2008).

Other factors, such as **isolated paths**, **vacant spaces or overgrown vegetation** (Gallagher et al., 2010), can also negatively influence walking. In the study by Mitra et al. (2015) which explored the relationship between the neighbourhood-built environment and walking among seniors in Canada, several respondents mentioned cul-de-sacs or dead-end roads as being less attractive, because they don't lead to any destination. **Physical disorder** in the neighbourhood, the presence of graffiti and vandalism are also negatively associated with walking (Caspi et al., 2013; Michael et al., 2006). A more favourable perception of the state of pedestrian infrastructure is not always associated with a greater likelihood of walking, as this may depend on the context of the country (Mertens et al., 2019). For example, Gomez et al., (2010) demonstrated that, in a context such as Colombia's, persons living in areas with a higher connectivity index were less likely to walk for at least 60 minutes.

3.2.3 Factors that can influence cycling

In the literature consulted, several studies discuss the presence of adequate cycling infrastructure as a factor that positively influences bicycle use (Strath et al., 2007; Winters et al., 2015). In their quantitative cross-sectional study of seniors' environmental preferences for cycling, Van Cauwenberg et al. (2019) found that **flat bike paths** and those **separated from traffic** were two of the three most important factors, the third being traffic density. Other studies highlight **the absence or lack of cycling infrastructure** as a barrier to cycling (O'Rourke & Dogra, 2020; Strath et al., 2007; Vietinghoff, 2021). Failure to enforce regulations and the lack of maintenance policies for these types of infrastructure can also be a limiting factor (Klicnik & Dogra, 2019).

3.2.4 Factors that can influence the use of greenways

In addition to the factors that encourage walking and cycling, several other factors have been identified as facilitators of greenway use. For example, **the type of pavement**, **the street furniture** and **the location** of greenways are all elements that can encourage their use. The type of pavement can make the greenway more accessible and safer (Ottoni et al., 2021). In an assessment of the design elements that seniors consider important for physical activity, 77%

preferred paved surfaces to dirt roads. The same percentage (77%) of these seniors mentioned that they liked using the greenway, because it was close to a water fountain. In fact, around two-thirds of participants mentioned the importance of **street furniture** (benches, garbage cans, drinking fountains) (Dorwart, 2015). Participants thought that benches made walking easier. Indeed, benches allow users to rest and thus prevent physical fatigue as well as the risk of falls or injuries. The distance of a greenway from traffic is also considered a factor that encourages its use by seniors (Ottoni et al., 2021).

On the other hand, it should be noted that **a lack of lighting**, and **paths that are too narrow or wet** due to a **lack of maintenance** are among the characteristics of the physical or built environment that hinder the use of greenways. Nor do people appreciate finding **drain inlets on the paths** of this type of green infrastructure (Dorwart, 2015; Ottoni et al., 2021).

3.3 Social environment factors that can influence active travel modes

The social environment is defined as the socio-demographic composition of a neighbourhood, along with the relationships, groups and social processes that exist between individuals living in that environment (Suglia et al., 2016). The following section presents the results of 12 studies that address one or more factors in the social environment that positively or negatively influence walking, cycling or the use of greenways among seniors or those in disadvantaged situations.

3.3.1 Factors that can encourage walking, cycling or the use of greenways

According to the literature consulted, **a positive, supportive social environment** encourages walking. In an assessment of the relationship between perceived social environment and walking by Hispanic seniors in neighbourhoods in Miami, Florida, Brown et al. (2011) observed, following a 12-month period, that the social environment of the neighbourhood was predictive of walking. Seniors residing in neighbourhoods with the highest initial perceived social environment scores were 2.57 times more likely to have walked at least one block in the week prior to follow-up, compared to seniors residing in neighbourhoods with lower perceived social environment scores. Also, Sawyer et al. (2017) observed that several social environment factors (good social support, more trust in neighbours, better social interactions, good cohesion and a strong sense of safety) were associated with an increased likelihood of walking in the neighbourhood five days a week. Other authors have also reported a positive association between a supportive social environment and walking (Van Cauwenberg et al., 2012; Gallagher et al., 2010; Inoue et al., 2011). The presence of physically active people and places for social interaction are some of the features that improve the social environment and encourage walking in neighbourhoods (Van Cauwenberg et al., 2012; Gallagher et al., 2010).

Social capital is one of the determinants of the social environment that can encourage walking. However, the results of the studies analyzed are not always entirely conclusive; and are sometimes even contradictory. In fact, social capital perceived as an individual resource may differ from social capital perceived as a community resource (trust, social cohesion of the

community). On the one hand, some studies show a positive association between **social cohesion** in a neighbourhood and walking (Wang & Lee, 2010). For example, Van Cauwenberg et al. (2014) found that seniors are more likely to walk daily when they have more contact with their neighbours or when they perceive that they can rely on their neighbours. In the same vein, Caspi et al. (2013) have shown that those with low **individual social capital** walk less. On the other hand, the results of the latter study pointed to a negative relationship between **community social capital** and walking. One of the explanations put forward by the authors to justify this finding is that persons in disadvantaged situations who have a better perception of their neighbourhood's community social capital may be more open to car-sharing or car-pooling to get to service points, hence they would be less likely to walk than their peers. A similar observation was made in a study exploring active transportation among seniors. In this study, Mertens et al. (2019) observed a negative relationship between community social capital (trust, social cohesion) and utilitarian walking. Seniors who perceived greater trust and social cohesion in their neighbourhoods were 2.36 times less likely to use walking as a means of transportation.

As regards greenways, generally speaking, most seniors describe their social interactions in this type of infrastructure positively (Ottoni et al., 2021). A less crime-prone social environment that facilitates social cohesion can encourage the use of greenways by seniors or those in disadvantaged situations. Indeed, feeling safe when walking alone in a neighbourhood, even at night, is associated with more frequent walking (Mason et al., 2013).

3.3.2 Factors that can limit active travel

Incivilities were described in several of the studies as factors that hindered walking, cycling or the use of greenways. As examples of incivilities that discouraged active travel in the neighbourhood, some participants in the included studies mentioned the presence of people with potentially threatening behaviour, fighting or begging (Gallagher et al., 2010). Perceiving several serious local incivilities (drunkenness and burglary) as problems is also associated with less frequent active travel (Mason et al., 2013).

3.4 Climatic or meteorological factors that can influence active travel modes

Few of the studies included in this knowledge synthesis (n = 11/50) addressed one or more climatic or meteorological factors influencing active travel or the use of greenways by seniors or those in disadvantaged situations. Of these studies, 73% focused essentially on walking, 18% on active transportation in general, and 9% on factors that influence the use of greenways.

3.4.1 Factors that can influence walking, cycling or the use of greenways

Among the climatic factors influencing walking and cycling discussed in the included studies are **temperature**, **wind** and other meteorological factors, such as **precipitation** or **the winter season**. With regard to temperature, the results of the studies consulted vary. The authors of

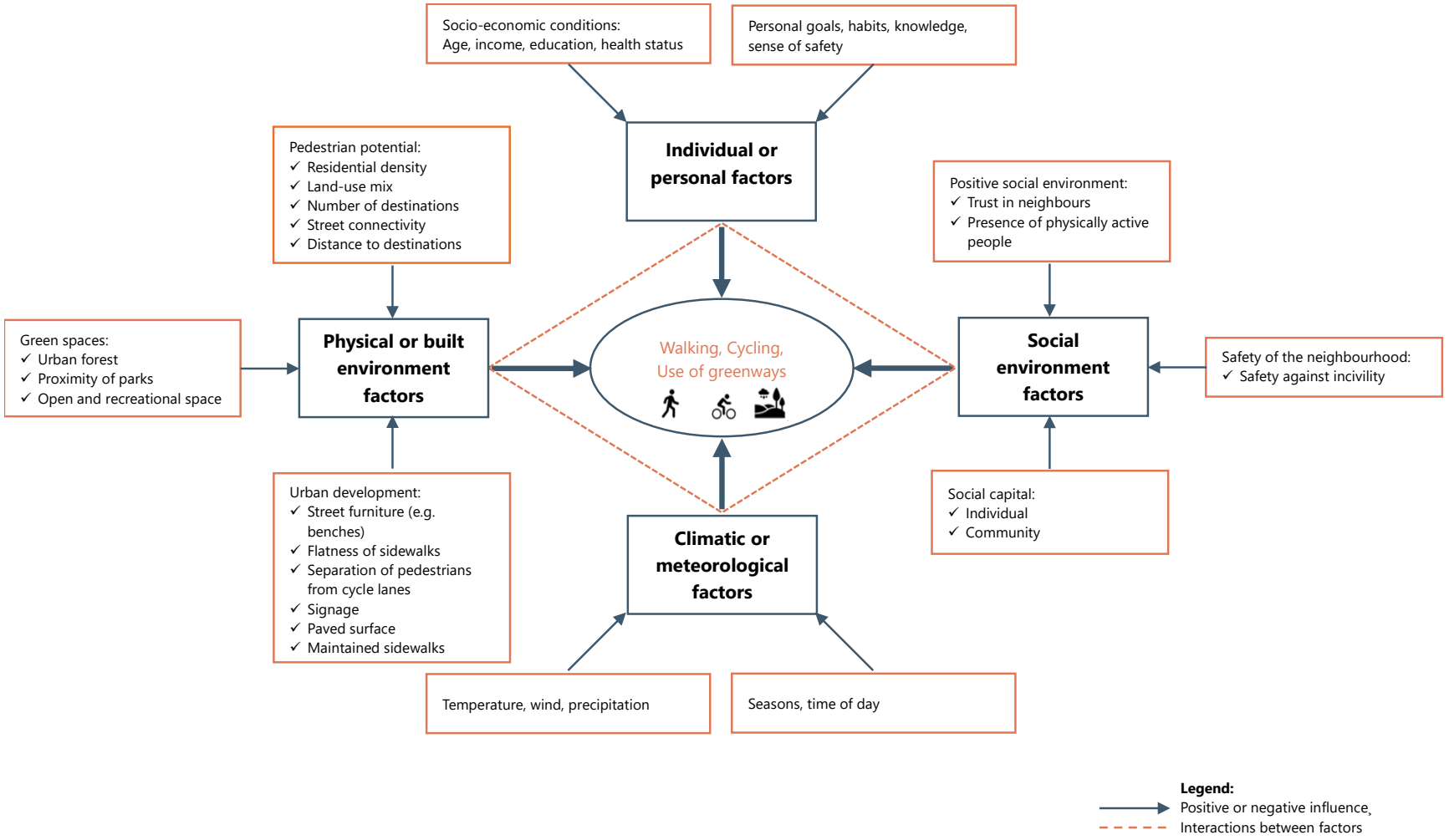
one study observed a strong correlation between global solar radiation and an increase in time spent walking of 16.1 minutes for men and 19.2 minutes for women in winter and summer. Overall, they found that a ten-degree increase in maximum temperature (between 0 and 25°C) increased walking by seven minutes. Similar but inverse effects were observed for precipitation, wind and humidity (Klenk et al., 2012). In another study aimed at understanding the influence of temperature on the likelihood of retired seniors in the U.S. walking 2 hours per week, Dunn et al. (2012) found that higher temperatures were associated with a higher likelihood of walking at least 2.5 hours per week for women. However, the inverse relationship was observed among men. The authors explain this inconsistent observation by pointing to the income levels of men, who may own more motorized means of transportation, or the motivations for walking, which may differ according to gender. Other authors have observed a positive association between temperature and active transportation. Upon examining the influence of climatic or meteorological conditions on active transportation among seniors, the authors observed that higher temperatures, higher wind speeds and the absence of rain measured hour-to-hour were linked to walking and cycling (Prins & Lenthe, 2015). However, none of these studies were carried out under extreme heat conditions (temperatures in excess of 30°C). After controlling for pedestrian potential, the results of another study showed that low temperatures (< 10°C) have a significant negative effect, particularly for those residing in areas with low pedestrian potential. This same study showed that temperature and rainfall moderate the effect of neighbourhood pedestrian potential on seniors' walking habits. Low temperatures (< 10°C) are particularly strongly associated with less walking in pedestrian areas, and the presence of rain is negatively associated with time spent walking (Delclos-Alio et al., 2020).

Other weather factors were briefly discussed as having a positive or negative influence on active transportation (Gallagher et al., 2010; Klicnik & Dogra, 2019). One of the meteorological factors, the winter season, was included in five studies as a factor that influences active travel. According to Van Cauwenberg et al. (2012), winter can negatively influence pedestrians' sense of safety due to early darkness and the fear of falling due to ice or snow. Other studies have observed a decrease in the number of destinations to which seniors travel during this period (Clarke et al., 2017; Li et al., 2013). According to Clarke et al. (2017), who conducted a study in Vancouver, a 1% increase in the proportion of days with snowfall decreases the number of destinations to which seniors walk by 76%. Even seniors living in neighbourhoods with favourable pedestrian conditions walk up to 25% less under snowy conditions. On the other hand, the cold itself does not seem to be a factor that negatively influences people's active travel in winter. Rather, it is obstacles such as snow or icy conditions that limit active travel, according to Li et al. (2013). In the latter study, the percentage of seniors venturing outdoors in winter fell from 67% on a day without snow or ice to 42% on a day with snow or ice. This study revealed that the key elements reducing accessibility in winter were icy sidewalks and puddles at pedestrian crossings. Another study highlighted the importance of winter maintenance and obstacle removal as a means of encouraging walking (Krogstad et al., 2015).

In short, good weather conditions can encourage the use of greenways by seniors and those in disadvantaged situations. In their study of seniors' use of a greenway's trails in the U.S.A., Price et al. (2012) demonstrated that seniors were most often observed using the greenway in spring (40.1%), when the weather was sunny (76.8%), and when the temperature was moderate (56.2%). They were most often observed walking in the morning or afternoon, and engaging in more strenuous physical activity in the morning or evening. The likelihood of seniors walking was lower in spring, fall and winter than in summer. The likelihood of seniors walking was higher during sunny periods than when it rained. The same observation was made when temperatures were moderate, between 15°C and 26°C. However, the likelihood of observing seniors engaging in strenuous physical activity is higher in autumn, winter and spring than in summer. According to the latter study, seniors also engage more in physical activity that is more strenuous than walking when it is raining or the temperature is high. This may be due to some seniors having made a personal commitment to themselves to use greenways to stay physically active, regardless of weather conditions, according to the study authors.

In summary, the literature presented suggests that the active travel patterns of the population groups studied are influenced by various individual or personal factors, and by factors tied to the physical or built environment, the social environment or climatic or meteorological conditions. However, these factors do not always act independently (Figure 6, p. 28). Indeed, several of the articles analyzed examined many of these factors in the same study.

Figure 6 **Conceptual diagram of factors facilitating or limiting walking, cycling or the use of greenways inspired by Zhu et al. (2008)**



4 ANALYSIS AND DISCUSSION

The aim of this knowledge synthesis is to identify factors that facilitate or limit walking, cycling or the use of greenways among seniors or those in disadvantaged situations. Studies show positive or negative associations between various factors (individual or personal, physical or built environment, social environment, or climatic or meteorological) and walking, cycling or the use of greenways. These findings were presented in the previous section. Individual or personal factors and those relating to the physical or built environment appear to be the most widely studied in the literature. Nearly 88% of the studies included explored one or more components of these factors that influence walking, cycling or the use of greenways. On the one hand, personal goals linked to the motivation to stay healthy, education and a sense of personal safety were identified as individual or personal factors that positively influence walking. Another literature review (Hilland et al., 2020) also found there to be consistent evidence of associations between perceived individual safety and different types of walking (utilitarian or recreational). Moreover, a study not included among the reviewed studies also reported that a sense of safety was among the factors influencing the use of greenways (Akpinar, 2016). As mentioned earlier, concerns about personal safety, particularly for ethnic minorities, were also reported in a study conducted in Georgia, U.S.A., where most respondents (75%) indicated that engaging in physical activity was among the most important motivations for using greenways (Keith et al., 2018). This study was not included among the 50 articles analyzed, as it did not specifically target the two population groups of interest to this knowledge synthesis. On the other hand, rather inconsistent evidence was presented concerning certain socio-economic characteristics, such as income level. For example, the de Melo et al. (2010) study documents a positive association between income and walking, while Laatikainen et al. (2018) report that this factor has the inverse effect on walking.

Based on the studies reviewed, the importance of physical and built environment factors to the active travel habits of seniors and those in disadvantaged situations is readily observable. Another literature review conducted previously reported that the perception of neighbourhood aesthetics, pedestrian potential and personal safety show consistent positive associations with walking (Hilland et al., 2020). Of these factors, the influence of the determinants of pedestrian potential, both perceived and objectively measured, seems to be the most studied. Indeed, the role of pedestrian potential in facilitating walking is well established. This association was confirmed in several of the studies included in our results (see Section 3.2.1).

The positive influence of exposure or proximity to green spaces is also supported by the results of the present knowledge synthesis. In fact, several studies have shown the positive association between green spaces and walking. However, one study pointed out that overgrown vegetation can affect the perception of safety in certain neighbourhoods and hinder walking, since people fear becoming the victim of crime (Gallagher et al., 2010). Well-maintained vegetation is not only visually attractive, but is also important for seniors' sense of safety (Kimic & Polko, 2022).

Other elements of the built environment that can ensure people's comfort, such as benches, traffic calming devices, well-maintained sidewalks or the integration of pedestrian paths with other elements used by families, such as playgrounds, are also documented as elements that encourage walking, cycling or the use of greenways among the population groups studied. However, none of the included studies specifically focused on these elements as objects of study.

In the literature consulted, the documented factors related to the physical or built environment that most restrict walking, cycling or the use of greenways are: the absence or poor maintenance of sidewalks, the absence or poor maintenance of cycling infrastructure, the absence of street furniture, and physical disorder (e.g., the presence of graffiti) in neighbourhoods. A recent literature review on cycling as a means of transportation also found that many of these elements related to safety and cycling infrastructure constitute the main barriers to cycling (Pearson et al., 2022). However, no articles were found that specifically examined noise and/or pollution caused by vehicular traffic as factors that could limit walking or cycling, or discourage the use of greenways. Other authors mentioned the influence of these environmental factors on people's walking experience or walking habits (Ferrer et al., 2015; Middleton, 2010).

To a lesser extent, some studies investigated factors related to the social environment, while others instead considered climatic or meteorological factors as facilitators or barriers to active travel. Several of the included studies reported a positive association between the social environment and walking. This social environment is viewed as favourable when it includes the presence of physically active people in the immediate environment, interactions with others, and the opportunity to build individual social capital. The studies consulted reported that greater perceived individual social capital is associated with a greater likelihood of walking (Caspi et al., 2013; Van Cauwenberg et al., 2014). On the other hand, greater perceived community social capital (trust, social cohesion) appears instead to produce the inverse effect on utilitarian walking, according to Mertens et al. (2019). As the authors of the latter study point out, it may be that when seniors or those in disadvantaged situations have greater confidence in their communities, they are more open to car-sharing or car-pooling, and thus walk less to reach essential services. The indicators used to explore the influence of the social environment (number of social interactions, social cohesion, social capital) reflect the multitude of ways that researchers refer to social constructs in discussions of the social environment. It would be worthwhile to standardize social environment indicators, as has been done for pedestrian potential. Similarly, it would be useful to standardize the tools used to assess the safety of the social environment (Hilland et al., 2020).

This knowledge synthesis did not identify any studies addressing interactions with pets as factors that could influence the walking habits of seniors or those in disadvantaged situations. Other studies have demonstrated the role played by pets as factors that encourage walking, referring both to walking one's own pet and to seeing other people with their pets (Cutt et al., 2008; Degeling & Rock, 2013).

The final factors to receive less attention in the literature are climatic or meteorological factors. Firstly, an attempt was made to disaggregate the data by season. Despite the use of keywords such as "winter" or "summer" in the search strategy, only 12 of the included studies specifically mentioned the season during which the studies were carried out. Of these 12 studies, only two explored winter and summer respectively, while three discussed both seasons in combination. Thus, the influence of climatic or meteorological factors on walking, cycling or the use of greenways is a subject that has received very little attention in the literature.

Temperature is one of the most studied climatic parameters to date. The findings appear to corroborate a positive association between temperature and walking for temperatures oscillating between 10°C and 26°C. On the one hand, some studies have observed that higher temperatures are associated with a higher probability of walking (Klenk et al., 2012). On the other hand, low temperatures are particularly strongly associated with less walking (Delclos-Alio et al., 2020). Other meteorological conditions, such as rain and snow, also appear to be factors that negatively influence walking behaviour (Clarke et al., 2017; Li et al., 2013). However, further studies would be needed to strengthen these observations. For example, in a study conducted in Calgary, Canada, Amiri and Sadeghpour (2015) reported that 71% of cyclists would have no problem cycling when temperatures were below -20°C. The main concern was safety due to ice on bike paths. Clarke et al. (2017) also observed that, even during the winter season, it is not always the cold that hinders walking, but rather obstacles on sidewalks such as snow or slippery slopes. Other factors, such as luminosity (day, night) or microclimatic conditions (sunny areas, shady areas), could also be studied to see how they affect the comfort (visibility) or preferences of pedestrians and cyclists. None of the included studies explored the influence of these specific aspects on active travel modes. Lee et al. (2020) mentioned in their study the preference of some pedestrians, including seniors, for shaded areas.

In a context of climate change, active transportation (walking, cycling) is a solution with an important role to play in reducing GHG emissions and air pollution while improving population health (Brand et al., 2021). Nevertheless, pedestrians and cyclists are among those most exposed to the consequences of dangerous climatic events because of their outdoor activities. Several studies have already raised concerns along these lines in the scientific literature (Böcker et al., 2013; Thomas et al., 2013; Zhao et al., 2018). However, these studies look at the effects of meteorological events on walking and cycling, without really exploring the behavioural adaptation strategies of pedestrians and cyclists. Based on the literature reviewed, there is very little scientific evidence about how pedestrians and cyclists can adapt to extreme weather events. For example, there is a lack of knowledge about the effects of sidewalk maintenance on pedestrian and cyclist behaviour after snowfall or other forms of precipitation. This lack of knowledge is even more evident with respect to specific vulnerable groups, such as seniors or those in disadvantaged situations. In examining the impacts of meteorological conditions on active travel among greenway users, Zhao et al. (2019) observed that over 28% of users continued to walk or cycle even in rainy weather. The results of this study also indicated that, although weather conditions can negatively influence walking and cycling, pedestrians and

cyclists tend to be more resilient under certain conditions or during certain periods. For example, they are more resilient on weekdays than on weekends.

Overall, the literature consulted studied many factors that influence walking, cycling or the use of greenways among seniors or those in disadvantaged situations. The literature is dominated by quantitative studies (37/50) of a cross-sectional nature (33/37). This predominance of cross-sectional studies makes it difficult to assess the strength of the evidence and establish causal relationships. Indeed, these cross-sectional studies indicate that the data they used were collected only once, at one specific time. It therefore seems necessary to encourage the use of other approaches, such as longitudinal studies, to better understand the influence of the factors studied over time and better establish cause-and-effect relationships. It would also be useful to have more qualitative studies that would better document the experiences of pedestrians and cyclists. The literature would also benefit from the addition of studies on how meteorological variations and extreme climatic events influence the behaviour and active travel experiences of pedestrians and cyclists.

4.1 Strengths and limitations of this knowledge synthesis

The strengths of this knowledge synthesis are rooted in the overall portrait it provides of all the factors that influence two modes of active travel (walking, cycling) as well as the use of greenways. On the one hand, the methodological elements applied (inclusion of scientific and grey literature, literature search of interdisciplinary databases) enabled us to identify a wide variety of studies addressing several factors that influence active travel and the use of greenways by the two target population groups. On the other hand, this review has limitations, since it provides a descriptive synthesis based on a general assessment of the results of the included studies. The quality of the studies was not assessed. Indeed, the review highlights factors that influence active travel according to the existing literature, without excluding studies based on quality. In addition, confounding factors were not considered when interpreting and analyzing the results of the included studies. Neither was the degree of support for the evidence presented considered in this review, due to the exploratory nature of the approach and the desire to consider studies that used a variety of methods (quantitative, qualitative or mixed). Consequently, the results presented must be interpreted with a degree of caution. Nevertheless, they can serve to encourage more robust studies of the factors that influence active travel by groups vulnerable to climate change. They can also serve to guide interventions aimed at encouraging active travel, particularly the development of urban greenways.

Despite our desire to include studies involving persons in disadvantaged situations, very few of the included studies (12%) touched on this specific population group. The literature would be enhanced by better documentation of the factors that facilitate or hinder active travel among this population group. These observations point toward interesting avenues of research that remain to be explored.

4.2 Courses of action

Based on the literature reviewed, a number of initiatives can be undertaken to encourage active travel or the use of greenways by populations vulnerable to climate change. For example, the presence of green spaces within walking distance (ten to 20 minutes on foot) would encourage walking. However, the time that certain population groups, such as seniors, may require to get to green spaces is an important factor to consider when designing secondary greenways that would facilitate access to these essential features. In a recent study, Zhang et al. (2022) observed that seniors prefer having to walk for about 30 seconds to one minute less than others to arrive at urban parks. It is therefore essential that green spaces be located relatively close to residential areas. Fan et al. (2017) suggest that people should live at most about 300 metres or a four-minute walk from a 2 to 20 hectare green space within their neighbourhood, and 2 km from a 20 to 100 hectare green space within their municipality. The presence of street furniture, such as benches along footpaths, would reduce the distance vulnerable people have to walk before reaching destinations such as grocery stores or green spaces, for example.

In addition to green spaces, this review calls for action relative to the types of destinations that encourage active travel among groups vulnerable to climate change. On the one hand, a study carried out in Germany reported a significant association between the likelihood of utilitarian walking and shopping destinations located between ten and 20 minutes from seniors' places of residence (Hasselder et al., 2022). In addition, in their meta-analysis, Cerin et al. (2017) found that utilitarian walking among seniors was more consistently associated with destination mix than residential density or street connectivity. They also reported that destinations such as bus stops, shopping malls and parks are shown to have the greatest positive influence on active travel among seniors. Restaurants and institutional destinations have less of an influence on active travel. In contrast, Hasselder et al. (2022) found no significant association between utilitarian walking and bus stops. They did, however, report significant associations for commercial destinations, such as small shops, pharmacies and bakeries. It would therefore be relevant to encourage research into the types or mix of destinations that would better encourage active travel among people at risk from the harmful effects of climate change. For example, important contributions could be made to the existing literature by improving knowledge of the types of recreational activities that should be located within a short distance to encourage active travel by vulnerable people. The 15-minute city concept that has recently emerged in urban planning debates can also serve to guide urban planning practices whose objective is also to promote destinations that encourage active travel. Indeed, this concept advocates for a city design that allows all residents to access such destinations in less than a quarter of an hour (Sustainable Communities, 2021).

This literature review also identified several other factors that hinder active travel among groups vulnerable to climate change. Nevertheless, there are a number of urban design features that can overcome these obstacles. For example, street furniture (benches, drinking fountains, garbage cans, toilets) in green spaces or greenways sheltered from the sun and wind can provide rest areas and thermal comfort, and encourage active travel, even during the winter

(Leng et al., 2020). These micro-scale features can foster a greater sense of safety among pedestrians and thus help overcome fear as a factor that limits walking (Van Cauwenberg et al., 2016). In addition, the provision of well-maintained bike paths that are separated from traffic could encourage cycling among groups with no physical limitations (Pearson et al., 2022). Winter installations, such as decorations and illumination of footpaths, are some of the other initiatives that can also encourage the use of green spaces such as greenways for active travel even during the winter (Bergeron et al., 2020).

Road insecurity is one of the most significant reasons people avoid active travel, especially in winter. Frequent clearing of snow from sidewalks, paths and bike paths in winter can motivate more people to use active modes of travel. It is also important to maintain adequate lighting for longer hours to promote a sense of personal safety for all user groups and compensate for the shorter days of winter (Bergeron et al., 2020). Good signage along sidewalks, footpaths and bike paths is also recommended to overcome barriers in winter.

This review did not include studies on heated sidewalks. These offer a solution that might reduce the need for snow removal in winter. However, it is up to decision makers to analyze the feasibility of this approach, since there are costs associated with these types of measures.

Finally, the proposed strategies and initiatives for encouraging active travel in all seasons should be accompanied by efforts to raise public awareness, particularly among groups vulnerable to climate change. As was observed in one of the studies included in this review, these efforts should prioritize positive messages, focusing on the benefits of active travel to foster motivation for walking, cycling and, in all likelihood, the use of urban greenways (Notthoff & Carstensen, 2014).

5 CONCLUSION

The main objective of this knowledge synthesis was to identify the factors that facilitate or hinder walking, cycling or the use of greenways among seniors or persons in disadvantaged situations. These factors were identified and divided into four categories: individual or personal factors (Section 3.1); physical or built environment factors (Section 3.2); social environment factors (Section 3.3); and climatic or meteorological factors (Section 3.4). Based on the studies reviewed and analyzed, individual or personal factors and physical or built environment factors appear to be the most studied. There is substantial evidence pointing to the influence of two of these factors: a sense of personal safety and the determinants of the pedestrian potential of streets (residential density, population density, road network connectivity, land-use mix) This finding is based on evidence reported in several studies demonstrating that these factors facilitate active travel. Similar observations were reported in a meta-analysis of 42 studies examining relationships between the built environment and active transportation among seniors (Cerin et al., 2017). Conversely, factors such as lack of safety, and poor or absent maintenance of pedestrian and cycling infrastructure are identified as barriers to walking and cycling. That said, properly maintained areas, sufficiently wide paths and sidewalks, high residential and population density, good street connectivity and a mix of services within reasonable walking distance would encourage active travel by seniors and those in disadvantaged situations. Other elements such as flat sidewalks, the presence of greenery or appropriate vegetation and the presence of street furniture (benches, drinking fountains, garbage cans, toilets) can improve comfort and encourage walking or cycling for utilitarian or recreational purposes. Similarly, in the case of greenways, users are generally attracted by clean paths with a smooth paved surface and natural elements. On the other hand, they are concerned about elements that reduce their sense of safety (Keith & Boley, 2019).

In terms of generating new knowledge, it would be relevant to encourage research into the way micro-scale design elements (benches, drinking fountains, traffic calming devices) can influence the experience or comfort of people using active travel modes, particularly in a context of climate change. In the same vein, research aimed at exploring the influence of weather variations or the effect of extreme climatic events on the behaviour of pedestrians and cyclists would be of interest. In addition, the use of longitudinal research designs could help to better document changes to the ways these users adapt their behaviour to climate change. Furthermore, most of the studies included in this review rely on perceptual measures to explore the influence of the identified factors on walking, cycling or the use of greenways. It is therefore appropriate to encourage research using more objective measures so as to better document these influencing factors.

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APPENDIX 1 LITERATURE SEARCH STRATEGY

1.1 Strategies for searching the scientific literature

Search strategy for **Global Health, Medline** and **PsycInfo** (Ovid)

Queried on April 13, 2022

#	Query	Results
1	((active* adj2 (commut* or transit* or transport* or travel*)) or ((bicycl* or bik* or cycl* or green* or ((in-line or inline) adj skat*) or jog* or pedestrian* or rollerblad* or run* or skateboard* or walk*) adj6 (corridor* or facilities or facility or infrastructure* or lane* or neighborhood* or path* or road* or route* or street* or way*)) or footpath* or greenway* or mobilit* or trail* or walkability or walkable).ti,kf,id. or Jogging/or Running/ or Walking/	137555
2	(access* or ((barrier* or constraint* or facilitat* or motivator*) adj6 (usage* or "use" or utili#ation)) or crime* or "de-icing" or ((perceiv* or perception*) adj6 (environment* or insecurit* or risk* or safety or security)) or preference* or season* or snow* or summer or weather or winter).ti,ab,kf,id.	1761259
3	(ag?ing or elder* or senior* or deprived or disadvantaged or equality or equity or inequalit* or inequit* or marginaliz* or poverty or underserved or ((aged or old* or "low income" or poor* or vulnerable*) adj (adult* or group* or individual* or people* or person* or population* or user*))).ti,kf,id. or Aged/ or "Aged, 80 and over"/or Aging/ or "Healthy aging"/or Poverty/ or "Vulnerable population"/	3995233
4	1 and 2 and 3	1773
5	4 and (english or french).lg.	1728
6	..l/ 5 yr=2000-2022	1677
7	6 not (((developing or ((least or less or lesser) adj developed) or undeveloped or "under-developed" or ((low or lower) adj (income* or resource*)) or undeserved or under-served or deprived or poor or poorer or transition or transitional) adj (countr* or econom* or nation* or population*)) or "third world*" or ((south or middle) adj "east asia*") or ((central or east* or south* or west* or "sub saharan" or subsaharan) adj africa*) or Afghan* or Angola* or Angolese* or Angolian* or Armenia* or Bangladesh* or Benin* or Bhutan* or Birma* or Brazil* or Burma* or Birmese* or Burmese* or Boliv* or Botswan* or "Burkina Faso*" or Burundi* or "Cabo Verde*" or Cambod* or Cameroon* or "Cape Verd*" or Chad or China or Chinese or Colombia* or Comoro* or Congo* or "Cote d'Ivoire*" or Djibouti* or Egypt* or "El Salvador*" or	1531

Search strategy for **Global Health, Medline** and **PsycInfo** (Ovid) (continued)

Queried on April 13, 2022

#	Query	Results
7	"Equatorial Guinea*" or Eritre* or Ethiopia* or Gabon* or Gambia* or Gaza* or Ghan* or Guatemal* or Guinea or Haiti* or Hondur* or "Hong Kong*" or Hongkong* or India* or Indones* or Iran* or "Ivory Coast*" or Kenya* or Kiribati* or Kosovo* or Kyrgyz* or "Lao PDR*" or Laos* or "Latin* America*" or Lesotho* or Liberia* or Madagascar* or Malaw* or Mali or Mauritan* or Mauriti* or Mexic* or Micronesi* or Mocambiqu* or Moldov* or Mongolia* or Morocc* or Mozambiqu* or Myanmar* or Namibia* or Nepal* or Nicaragua* or Niger* or Pakistan* or Palestinian* or "Papua New Guinea*" or Philippine* or Rhodesia* or Rwanda* or Samoa* or "Sao Tome*" or Senegal* or Shanghai or "Sierra Leone*" or "Solomon Islands*" or Somalia* or "South Sudan*" or "Sri Lanka*" or Sudan* or Swaziland* or Syria* or Taiwan* or Tajikist* or Tanzan* or Timor* or Togo* or Tonga* or Tunis* or Ugand* or Ukrain* or Uzbekistan* or Vanuatu* or Vietnam* or "West Bank*" or Yemen* or Zaire* or Zambia* or Zimbabw*).ti.	1531
8	7 not (blood or cancer* or cardio* or "covid-19 transmission*" or cyclosporiasis or dementia or diabetes or disorder* or (fall* adj2 (prevent* or risk*)) or flood or food or fracture* or hiv or injured or middle-aged or muscle* or musculoskeletal or nurse* or plasma or polypharmac* or respiratory or stroke* or surger* or thromboembolism or vaccine* or "virtual reality" or "vitamin d").ti.	1349

Search strategy for **Environment Complete, CINAHL Complete** and **GreenFILE** (EBSCO)

Queried on April 13, 2022

#	Query	Results
S1	TI ((active* N3 (commut* OR transit* OR transport* OR travel*)) OR ((bicycl* OR bik* OR cycl* OR green* OR ((in-line OR inline) W0 skat*) OR jog* OR pedestrian* OR rollerblad* OR run* OR skateboard* OR walk*) N7 (corridor* OR facilities OR facility OR infrastructure* OR lane* OR neighborhood* OR path* OR road* OR route* OR street* OR way*)) OR footpath* OR greenway* OR mobilit* OR trail* OR walkability OR walkable) OR SU ((active* N3 (commut* OR transit* OR transport* OR travel*)) OR ((bicycl* OR bik* OR cycl* OR green* OR ((in-line OR inline) W0 skat*) OR jog* OR pedestrian* OR rollerblad* OR run* OR skateboard* OR walk*) N7 (corridor* OR facilities OR facility OR infrastructure* OR lane* OR neighborhood* OR path* OR road* OR route* OR street* OR way*)) OR footpath* OR greenway* OR mobilit* OR trail* OR walkability OR walkable)	47 208
S2	TI (access* OR ((barrier* OR constraint* OR facilitat* OR motivator*) N7 (usage* OR use OR utili?ation)) OR crime* OR "de-icing" OR ((perceiv* OR perception*) N7 (environment* OR insecurit* OR risk* OR safety OR security)) OR preference* OR season* OR snow* OR summer OR weather OR winter) OR AB (access* OR ((barrier* OR constraint* OR facilitat* OR motivator*) N7 (usage* OR use OR utili?ation)) OR crime* OR "de-icing" OR ((perceiv* OR perception*) N7 (environment* OR insecurit* OR risk* OR safety OR security)) OR preference* OR season* OR snow* OR summer OR weather OR winter) OR SU (access* OR ((barrier* OR constraint* OR facilitat* OR motivator*) N7 (usage* OR use OR utili?ation)) OR crime* OR "de-icing" OR ((perceiv* OR perception*) N7 (environment* OR insecurit* OR risk* OR safety OR security)) OR preference* OR season* OR snow* OR summer OR weather OR winter)	1 065 362
S3	TI (ag#ing OR elder* OR senior* OR deprived OR disadvantaged OR equality OR equity OR inequalit* OR inequit* OR marginaliz* OR poverty OR underserved OR ((aged OR old* OR "low income" OR poor* OR vulnerable*) W0 (adult* OR group* OR individual* OR people* OR person* OR population* OR user*))) OR SU (ag#ing OR elder* OR senior* OR deprived OR disadvantaged OR equality OR equity OR inequalit* OR inequit* OR marginaliz* OR poverty OR underserved OR ((aged OR old* OR "low income" OR poor* OR vulnerable*) W0 (adult* OR group* OR individual* OR people* OR person* OR population* OR user*)))	296 970
S4	((S1 AND S2) OR SU "Public use of trails") AND S3	408
S5	S4 AND LA (english OR french)	406

Search strategy for **Environment Complete, CINAHL Complete** and **GreenFILE** (EBSCO) (continued)

Queried on April 13, 2022

#	Query	Results
S6	S5 AND (DT 2000-2022)	390
S7	S6 NOT TI (((developing OR ((least OR less OR lesser) W0 developed) OR undeveloped OR "under-developed" OR ((low OR lower) W0 (income* OR resource*)) OR undeserved OR under-served OR deprived OR poor OR poorer OR transition OR transitional) W0 (countr* OR econom* OR nation* OR population*)) OR "third world*" OR ((south OR middle) W0 "east asia*") OR ((central OR east* OR south* OR west* OR "sub saharan" OR subsaharan) W0 africa*) OR Afghan* OR Angola* OR Angolese* OR Angolian* OR Armenia* OR Bangladesh* OR Benin* OR Bhutan* OR Birma* OR Brazil* OR Burma* OR Birmese* OR Burmese* OR Boliv* OR Botswan* OR "Burkina Faso*" OR Burundi* OR "Cabo Verde*" OR Cambod* OR Cameroon* OR "Cape Verd*" OR Chad OR China OR Chinese OR Colombia* OR Comoro* OR Congo* OR "Cote d'Ivoire*" OR Djibouti* OR Egypt* OR "El Salvador*" OR "Equatorial Guinea*" OR Eritre* OR Ethiopia* OR Gabon* OR Gambia* OR Gaza* OR Ghan* OR Guatemal* OR Guinea OR Haiti* OR Hondur* OR "Hong Kong*" OR Hongkong* OR India* OR Indones* OR Iran* OR "Ivory Coast*" OR Kenya* OR Kiribati* OR Kosovo* OR Kyrgyz* OR "Lao PDR*" OR Laos* OR "Latin* America*" OR Lesotho* OR Liberia* OR Madagascar* OR Malaw* OR Mali OR Mauritan* OR Mauriti* OR Mexic* OR Micronesi* OR Mocambiqu* OR Moldov* OR Mongolia* OR Morocc* OR Mozambiqu* OR Myanmar* OR Namibia* OR Nepal* OR Nicaragua* OR Niger* OR Pakistan* OR Palestinian* OR "Papua New Guinea*" OR Philippine* OR Rhodesia* OR Rwanda* OR Samoa* OR "Sao Tome*" OR Senegal* OR Shanghai OR "Sierra Leone*" OR "Solomon Islands*" OR Somalia* OR "South Sudan*" OR "Sri Lanka*" OR Sudan* OR Swaziland* OR Syria* OR Taiwan* OR Tajikist* OR Tanzan* OR Timor* OR Togo* OR Tonga* OR Tunis* OR Ugand* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Vietnam* OR "West Bank*" OR Yemen* OR Zaire* OR Zambia* OR Zimbabw*)	**347**

1.2 Search strategies for grey literature

English

greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|season|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

French

"trames|corridors|routes|voies|ruelles AROUND(2) vertes|verts"|"transport|déplacement AROUND(1) actif"|"mobilité active"|marchabilité|vélo utilisation|accès|perception|préférences|barrières|contraintes|obstacles|neige|hiver|été|saison|temperature aînés|"personnes aînées"|inégalités|"faible AROUND(1) revenu"

Exploratory versions

(greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" AROUND(4) use|access) "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

("trames|corridors|routes|voies|ruelles AROUND(2) vertes|verts"|"transport|déplacement AROUND(1) actif"|"mobilité active"|marchabilité|vélo AROUND(4) utilisation|accès) aînés|"personnes aînées"|inégalités|"faible AROUND(1) revenu"

PDF documents (e.g.: reports)

ext:pdf greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

ext:pdf "trames|corridors|routes|voies|ruelles AROUND(2) vertes|verts"|"transport|déplacement AROUND(1) actif"|"mobilité active"|marchabilité|vélo utilisation|accès|perception|préférences|barrières|contraintes|obstacles|neige|hiver|été|saison aînés|"personnes aînées"|inégalités|"faible AROUND(1) revenu"

Canadian sites

site:ca greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

site:ca "trames|corridors|routes|voies|ruelles AROUND(2) vertes|verts"|"transport|déplacement AROUND(1) actif"|"mobilité active"|marchabilité|vélo utilisation|accès|perception|préférences|barrières|contraintes|obstacles|neige|hiver|été|saison aînés|"personnes aînées"|inégalités|"faible AROUND(1) revenu"

Examples for specific sources

site:tandfonline.com greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

site:vancouver.ca greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

site:aevv-egwa.org greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

site:portland.gov greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|usage|perception|safety|snow|summer|weather|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

(site:vancouver.ca OR site:aevv-egwa.org OR site:portland.gov) greenways|trails|cycling|walking|"active AROUND(2) transportation|mobility" use|access|barriers|constraints|facilitators|motivators|preferences|perception|safety|snow|summer|winter "older adults"|seniors|deprived|disadvantaged|equity|inequalities|inequities|"low income"

APPENDIX 2 SUMMARY TABLES OF INCLUDED STUDIES

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Besser and Mitsova	2021	United States	Seniors	65 years+	Walking	NS[1]	Quantitative	Cross-sectional	Objective	Physical/built environment	A higher percentage of forest was associated with more walking in the neighbourhood for the entire sample. The percentage of open space in the neighbourhood was not associated with minutes of walking per day in the neighbourhood. However, a higher percentage of open space was associated with more neighbourhood walking among African-Americans.
Bird et al.	2010	Australia	Seniors	60 years+	Walking	NS	Quantitative	Cross-sectional	Motivations	Individual Personal	57% of participants walked to stay fit and healthy. The second most common reason for walking was the need to go shopping (for many participants, this represented a substantial proportion of their weekly walking activity). Fear of crime and concerns about personal safety were problems expressed by those who had walked very little. Nevertheless, the results indicate that motives vary according to the amount of walking done, gender and cultural group.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Brown et al.	2011	United States	Seniors	70 years+	Walking	NS	Quantitative	Pre-post	Perceptions	Social environment	In 12 month follow-up, perception of the neighbourhood's social environment was found to be predictive of walking for seniors. The perception of a positive and more supportive social environment was associated with greater distances travelled by participants after the follow-up period. Seniors residing in neighbourhoods whose scores for perceived neighbourhood social environment were in the top half at baseline assessment were 2.57 times more likely to have walked at least one block in the past week, compared to seniors residing in neighbourhoods with perceived social environment scores in the bottom half.
Brüchert et al.	2020	Germany	Seniors	65 years+	Utilitarian walking	Summer	Quantitative	Cross-sectional	Perceptions	Physical/built environment	The denser the residential area, the more likely participants were to walk. Each unit increase in residential density was associated with an increased likelihood of walking and of frequent utilitarian walking. Pedestrian infrastructure was associated with a 36% greater likelihood of walking and a 33% greater likelihood of utilitarian walking. Other parameters of pedestrian potential, such as street connectivity, neighbourhood aesthetics, road safety and proximity to destinations, were all associated with walking and utilitarian walking.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Carrapatoso et al.	2018	Portugal	Seniors	65 years+	Recreational walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	Perceived road safety and a pleasant environment were associated with the achievement of 10,000 steps per day, for older women. Perceived proximity to parks was positively associated with walking intensity (peak 30-minute cadence above 100) in older men. This parameter indicates that men walk for at least 30 minutes a day at a rate of 100 steps per minute. Nevertheless, the study showed no significant association between perceptions of residential density, access to mixed land use, access to public transportation, walking/biking infrastructure, safety (traffic/crime), pleasantness of the neighbourhood environment and compliance with the 10,000 steps a day recommendation, among older men.
Caspi et al.	2013	United States	Persons in disadvantaged situations	18- 65 years+	Utilitarian and recreational walking	NS	Quantitative	Cross-sectional	Perceptions	Social environment Physical/built environment Individual Personal	In the fully-adjusted models, the results showed that those reporting low individual social capital walked less. Similarly, those who reported low perceived personal safety walked less. Overall, 21.8% of participants walked less than 10 minutes a day for utilitarian purposes, 34.8% for leisure and 16.8% for both. Furthermore, those who reported high community social capital walked less for all types of walking. Physical disorder and community safety were not associated with walking behaviour.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Chudyk et al.	2015	Canada	Seniors	65 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	Objectives	Physical/built environment	Participants travelled to six different destinations per week. Over 75% of participants travelled to the grocery store, and over 50% of participants travelled to a restaurant/cafe and/or shopping mall during the week of data collection. Between 20% and 42% of participants made at least one trip to the other most common destinations. The most important destinations for low-income seniors were grocery stores, shopping malls and restaurants/cafés. The prevalence of neighbourhood destinations is positively associated with the number of trips made by this population. The destinations most frequently visited for the purpose of exercising were the neighbourhood, natural environments and recreation centres. Each ten-point increase in the street's pedestrian potential score was associated with a 20% increase in the number of trips made on foot.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Clarke et al.	2017	Canada	Seniors	65 years+	Utilitarian walking	Winter	Quantitative	Cross-sectional	Objective	Climatic/meteorological Physical/built environment	Seniors living in neighbourhoods with higher pedestrian potential (greater density of intersections, shorter block lengths, more shops and services) walked to more destinations. The number of destinations to which elderly residents walked dropped to almost zero when there was snow. Even seniors living in neighbourhoods with favourable pedestrian conditions walked up to 25% less when there was snow. A 1% increase in the proportion of days with snow would reduce the number of destinations to which seniors walked by 76%. Rain was not a barrier to mobility for these seniors living in Vancouver.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Delclòs-Alió et al.	2020	Spain	Seniors	65 years+	Walking	NS	Quantitative	Cross-sectional	Objective	Climatic/meteorological Physical/built environment	Pedestrian potential was found to be positively related to minutes walked per day. Temperature does not appear to have a statistically significant effect, while the presence of rain is negatively associated with minutes walked per day. A neighbourhood's pedestrian potential is positively associated with the amount of time seniors spend walking, whereas rain generally deters them. Controlling for pedestrian potential, the results showed that low temperatures (< 10°C) have a significant negative effect, particularly for those residing in areas with low pedestrian potential. The study showed that temperature and rain moderate the effect of neighbourhood pedestrian potential on seniors' walking habits: low temperatures are particularly strongly associated with less walking in pedestrian areas, and rain is negatively associated with walking time.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
de Melo et al.	2010	Canada	Seniors	65 years+	Walking	Autumn Spring	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment Individual Personal	The results showed an average number of steps per day of 5,289. The average for seniors aged 65 to 74 was significantly different (7,169 ± 4,898) from those aged 75 to 84 (4,339 ± 2,762) and 85 and over (3,560 ± 2,766). Thus, being younger was associated with more walking, as was higher income. Participants in the spring study had fewer average steps per day (4,533 ± 2,467) than those in the fall study (6,422 ± 5,491), but the difference was not significant. Of the environmental factors tested (access to services, street connectivity, walking and cycling infrastructure, neighbourhood aesthetics, safety), only access to services was associated with the number of steps per day. With respect to personal or individual factors, participants with higher incomes and better perceived health walked more than those with lower incomes and poorer perceived health. Health was identified as the main reason for walking.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Dorwart C.	2015	United States	Seniors	65 years+	Greenway	NS	Mixed		MotivationsPerceptions	Physical/built environment Individual Personal	All participants replied that they used the path for recreational purposes. A majority of participants (88%) used the path for recreational purposes only, while 12% used the greenway for both recreation and transportation. None of the participants used the path solely for transportation. 77% of participants preferred the paved surface to the dirt path. The same percentage (77%) reported that they liked using the greenway, because it was close to a water fountain. Two-thirds mentioned the importance of street furniture (benches, garbage cans). However, people did not care for drain inlets on the paths. The women only walked, while the men also ran and cycled. Participants expressed their fear of wet or icy trails.
Dunn et al.	2012	United States	Seniors	65 years+	Walking	Autumn	Quantitative	Longitudinal	Objective	Climatic/meteorological	The authors found that higher temperatures were associated with a higher probability of walking at least 2.5 hours/week for women. On the other hand, higher temperatures were associated with a lower probability of walking at least 2.5 hours/week for men. The authors explain this difference by referring to income levels or motivations. Men may own more means of transportation due to higher incomes, or the motivations for walking may differ according to gender. Precipitation was not significantly associated with walking behaviour.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Gallagher et al.	2014	United States	Seniors	60 years+	Walking	NS[1]	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	The presence of destinations (local services and shops within walking distance) was associated with neighbourhood walking among women, while neighbourhood density and design were more significant for men. Self-efficacy (confidence in walking in a neighbourhood despite potential barriers) was significantly associated with neighbourhood walking habits. Self-efficacy explains 27% of neighbourhood walking time for women, while it explains 32% for men. Mobility limitations were significantly associated with neighbourhood walking time when first entered into the model, but became insignificant when total self-efficacy and expectations were entered.
Gallagher et al.	2010	United States	Seniors	60 years+	Walking	NS	Qualitative		Perceptions	Climatic/meteorological Physical/built environment Social environment Individual Personal	The factors encouraging seniors to walk that emerged from the qualitative analysis were the presence of people, the neighbourhood's built environment, safety, sidewalks and traffic, animals and public footpaths. The presence of physically active people encourages walking. Integrating pedestrian paths with other elements of the park used by families, such as play areas, can encourage walking in the neighbourhood. Some participants mentioned that people with potentially threatening behaviour, those involved in criminal activity or fighting, or homelessness discouraged walking in the neighbourhood.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Gómez et al.	2010	Colombia	Seniors	60 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment Individual Personal	People who lived near parks were more likely to walk for at least 60 minutes in a typical week. Those living in areas with the highest connectivity index were less likely to walk for at least 60 minutes a week. This can be explained by feelings of insecurity attributable to the high number of intersections. Participants who reported feeling safe or very safe from traffic were more likely to report walking for at least 60 minutes. The presence of bicycle paths was slightly associated with walking.
Grant et al.	2010	Canada	Seniors	65 years+	Walking	NS	Qualitative		Perceptions Motivations	Physical/built environment Individual Personal	On the one hand, the themes present in the analysis highlight the reasons seniors walk (exercise, managing daily life, contact with nature, social ties and discovery). On the other hand, other themes highlight certain factors in the physical environment (e.g., the presence of vehicles at intersections) that can act as barriers to walking.
Hall and McAuley	2010	United States	Seniors	65 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment Individual Personal	Participants who did not reach 10,000 steps per day reported lower self-efficacy scores, more physical limitations. They had significantly fewer footpaths within 1 km of home, and reported significantly less street connectivity and road safety than those who reached 10,000 steps a day.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Hinrichs et al.	2019	Finland	Seniors	75 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	Seniors were more likely to walk to shops if they perceived parks or green spaces in their neighbourhood as facilitators of outdoor mobility. Those who perceived parks or green spaces in their neighbourhoods as facilitators of mobility were 10 times more likely to walk to the stores than their peers. The presence of footpaths was not significantly associated with the likelihood of walking. Other factors, such as lower socio-economic status, less frequent car use, short distances to destinations and street connectivity, were also positively associated with utilitarian walking.
Inoue et al.	2011	Japan	Seniors	65 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions	Social environment Physical/built environment	Access to sports facilities, social environment and neighbourhood aesthetics were all associated with walking. Environmental attributes differed according to type of walking or gender. Negative associations were observed between walking and safety from crime, as well as road safety among men.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Klenk et al.	2012	Germany	Seniors	65 years+	Walking	Winter Summer	Quantitative	Cross-sectional	Objective	Climatic/meteorological	Average daily walking time was comparable for men and women. The results indicated a positive association between walking time and the meteorological parameters considered. The strongest correlation was observed for global solar radiation, with an increase of 16.1 minutes for men and 19.2 minutes for women, in both winter and summer. A ten-degree increase in maximum temperature increased walking time by seven minutes. Similar but inverse effects were observed for precipitation, wind and humidity.
Klicnik and Dogra	2019	Canada	Seniors	55 years+	Active transportation (walking, cycling)	Winter Summer	Qualitative		Perceptions	Climatic/meteorological Physical/built environment Individual/personal	Factors relating to the environment, to individual constraints and to their interactions were identified as factors influencing active transportation. Seemingly non-modifiable constraints (e.g., weather and personal health) that interact with modifiable constraints, such as urban design, were observed.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Krogstad et al.	2015	Norway	Seniors	67 years+	Walking	Winter Summer	Mixed		MotivationsPerceptions	Climatic/meteorological Physical/built environment Individual Personal	The survey showed that walking difficulties increase with age. Some 16% of new retirees (aged 67-69) reported having difficulty walking, as did 62% of seniors aged 85 and over. Participants pointed out the need to thoroughly plan a walk, especially in winter, to eliminate barriers. Participants ranked the health dimension as the most important (61%) reason for walking. 52% considered the motivation to be getting fresh air outdoors; physical exercise (50%) and well-being (46%) were other motivations mentioned by study participants.
Laatikainen et al.	2018	Finland	Seniors	55 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	Residential density, the presence and maintenance of sidewalks, public transit stops, intersections and recreational sports areas were positively associated with utilitarian walking among seniors. Education and personal goals related to physical activity also had a direct positive impact on walking. The greater the importance given to physical activity and sport-related goals, the more likely seniors were to walk. Income had a direct negative effect on walking. The higher the income level, the less people walked. The higher the level of education, the more people walked.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Li et al.	2005	United States	Seniors	65 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	A positive relationship was observed between factors in the built environment (density of workplaces, residential density, amount of green and open space for recreation, number of street intersections) and neighbourhood walking. Perceived safety was positively related to walking. A significant association was observed between the number of street intersections and perceptions of safety.
Li et al.	2013	Canada	Seniors	65 years+	Walking	Winter	Mixed		Perceptions	Climatic/meteorological Physical/built environment	According to the study, participants walk less outdoors in winter. On the other hand, the results show that the cold itself had little impact on walking frequency among seniors, while the presence of snow and/or ice on the ground kept seniors at home. The percentage of seniors who took outdoor excursions in winter dropped from 67% on a day without snow and ice to 42% on a day with snow and ice. The survey revealed that the key elements reducing accessibility in winter were icy sidewalks and puddles at pedestrian crossings.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Mason et al.	2011	United Kingdom	Persons in disadvantaged situations	18 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	Better perception of physical and mental health was associated with walking. People who drank alcohol were more likely to walk than those who did not. Similarly, those who got their main meal at a fast-food restaurant more than once a week, as opposed to less frequently, were more likely to walk. Visiting parks or shops was also associated with walking. People living in private housing were more likely to walk than those living in social housing. The quality of parks and open spaces was significantly associated with walking. A positive perception of the social environment was associated with a greater likelihood of walking.
Mason et al.	2013	United Kingdom	Persons in disadvantaged situations	18 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions	Social environment Individual Personal	Feeling safe at home or feeling safe walking alone in the neighbourhood at night was associated with more frequent walking. Perceived occurrences of several serious local incivilities (drunkenness and burglary) were associated with less frequent walking. On the other hand, perceiving drug dealing or drug use as a serious problem was associated with more frequent walking. There was a weak association between the number of reported crimes and walking. This can be explained by the lack of transportation solutions in the neighbourhoods. The fact that these populations in disadvantaged areas have less access to cars is also an explanation.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Mertens et al.	2019	Belgium	Seniors	65 years+	Active transportation (walking, cycling)	NS	Quantitative	Longitudinal	Perceptions	Physical/built environment Social environment Individual Personal	After the follow-up period, it was found that seniors with a high level of education were 4.34 times more likely to engage in utilitarian walking than those with a lower level of education. Adults with a higher self-efficacy score (willingness to engage in physical activity even when it is difficult to do so) were 4.36 times more likely to engage in utilitarian walking. Seniors who perceived more trust and social cohesion (community social capital) in the neighbourhood were 2.36 times less likely to walk as a means of transportation. Participants who perceived a greater mix of land uses were 3.42 times more likely to engage in utilitarian walking. Contrary to expectations, better perceived pedestrian infrastructure and better perceived safety from crime were associated with a lower probability of walking. Participants who more strongly perceived cycling as a social norm (being encouraged to do physical activity because someone else thinks it's good for you) were less likely to cycle for utilitarian purposes. Participants who perceived greater benefits were more likely to cycle for utilitarian purposes.
Michael et al.	2006	United States	Seniors	65 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment	The presence of shopping malls was positively associated with walking, while the presence of graffiti and vandalism were negatively associated with walking.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Mitra et al.	2015	Canada	Seniors	65 years+	Walking	NS	Qualitative		MotivationsPerceptions	Physical/built environment Individual Personal	Participants in this study walked primarily to be physically active and for other health benefits. Weather conditions were considered a barrier to walking. However, some felt that the main barrier was the state of the sidewalks during these extreme weather conditions, rather than the weather itself, that prevented them from walking. Several respondents mentioned that dead ends or cul-de-sacs did not appeal to them, because they do not lead to any destination. Fear of being mugged by strangers was the most common personal safety concern. Proximity to parks and the natural environment was an important factor linked to walking.
Notthoff and Carstensen	2014	United States	Seniors	60 years+	Walking	NS	Quantitative	Controlled	Objective	Individual Personal	The results suggest that informing seniors of the potential benefits of walking may be more effective than warning them of the risks of inactivity. Seniors who were informed about the benefits of walking walked more than those who were informed about the negative effects of not walking. In the second part of the study, participants who were informed of the potential positive effects of walking increased the number of steps they walked.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
O'Rourke and Dogra	2020	Canada	Seniors	55 years+	Active transportation (walking, cycling)	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	The most cited barriers to active transportation in the first neighbourhood were: lack of bike paths (100%), sidewalks with snow/ice (94.1%) and road safety (82.4%). Second neighbourhood: sidewalks with snow/ice (85.2%), lack of bike paths (81.3%) and road safety and safety of paths (75.9%). Third neighbourhood: bike paths without barriers (100%), unpainted bike paths (100%) and fear of falling (66.7%). Fourth neighbourhood: sidewalks with snow/ice (71.4%), traffic speed (63.6%), road safety (63.6%) and lack of bicycle paths (62.5%).
Ottoni et al.	2021	Canada	Seniors	60 years+	Greenway	NS	Mixed		Perceptions	Physical/built environment Social environment Individual Personal	Participants said that the type of pavement made the greenway safer and more accessible to users of different ages. Participants saw the benches as an aid to walking, as they could stop to rest. They saw benches as a way to avoid injury or physical fatigue. Most participants described social interactions on the greenway in a positive manner.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Perchoux et al.	2019	Luxembourg	Seniors	65 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	MotivationsPerceptions	Physical/built environment Individual Personal	Of the 2,446 destinations, 41% were reached on foot. The reason given for travel was most frequently “personal” (24%), followed by "daily shopping" (16%) and "health appointments" (16%). The likelihood of walking was positively associated with the number of services and shops nearby. Street connectivity characterized by from 0 to 8 intersections was positively associated with the probability of walking, while above 8 intersections, a negative correlation was observed. The association between distance and walking differs according to the reason for walking. Travel patterns also showed that the likelihood of walking for essential activities such as "daily shopping" decreases as distance increases.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Price et al.	2012	United States	Seniors	60 years+	Greenway	All four seasons	Quantitative	Cross-sectional	Objective	Climatic/meteorological	Overall, seniors used the greenway most often in the spring (40.1%), when the weather was sunny (76.8%) and when temperatures were moderate (56.2%). They were most often observed walking in the morning or afternoon, and doing more strenuous physical activity in the morning or evening. The likelihood of seniors walking was lower in spring, fall and winter than in summer. The probability of seniors being observed walking was higher during sunny periods than when it rained. The same observation was made when the temperature was less than 15°C, compared with a temperature higher than 26°C. The probability of observing seniors engaged in intense physical activity is higher in autumn, winter and spring than in summer.
Prins and van Lenthe	2015	The Netherlands	Seniors	65 years+	Active transportation (walking, cycling)	Spring	Quantitative	Cross-sectional	Objective	Climatic/meteorological	The results showed that higher temperatures, higher wind speeds and the absence of rain measured on an hourly basis were associated with more walking. Cycling increased with higher temperatures.

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Sawyer et al.	2017	United Kingdom	Persons in disadvantaged situations	16 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment Social environment	All factors related to the social and physical environments that were measured (social support, neighbourhood trust, social interaction, social cohesion and safety, aesthetics of the built environment, physical disorder, aesthetics and maintenance of open spaces) were significantly associated with an increased likelihood of walking in the neighbourhood five days a week.
Stahl et al.	2008	Sweden	Seniors	65 years+	Walking	NS	Mixed		Perceptions	Physical/built environment, Individual Personal	The top three environmental barriers mentioned by respondents to the questionnaires were: problems clearing snow from sidewalks, the lack of pedestrian infrastructure, accident prevention linked to slippery slopes, the attitude of cyclists and the absence of benches. The following measures were identified as facilitators: traffic regulation measures and development and maintenance measures.
Strath et al.	2007	United States	Seniors	55 years+	Active transportation (walking, cycling)	NS	Qualitative		Perceptions	Physical/built environment Social environment Individual Personal	The results were grouped into several categories. Among those that encourage active transportation are: the presence and maintenance of sidewalks, well-maintained bicycle paths or lanes, and traffic control. Categories such as land use and landscape aesthetics were highlighted. Poor or lack of maintenance of sidewalks, crosswalks, bicycle paths or lanes, and road safety are categories that limit walking.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Sugiyama et al.	2015	Australia	Persons in disadvantaged situations	18 years+	Recreational walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment	The study revealed that residents of low socioeconomic status (SES) areas walked less often for recreation than those in high SES areas. Residential density was the only parameter associated with walking in low-SES areas.
Troped et al.	2017	United States	Seniors	60 years+	Walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment	Overall, the results demonstrated positive effects of the built environment on recreational and utilitarian walking among older women. Population density, shops/services and intersection density indirectly predict recreational and utilitarian walking through perceived land-use mix. Perceived greater land-use mix also positively and significantly predicted walking.
Van Cauwenberg et al.	2019	Belgium	Seniors	65 years+	Utilitarian cycling	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment	According to the majority of study participants, the type of bike path was the most important environmental attribute for utilitarian cycling. The second most important attribute was traffic density, followed by flatness and distance.
Van Cauwenberg, de Donder et al.	2014	Belgium	Seniors	60 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	Perceptions	Social environment	Results showed significant positive relationships for frequency of contact with neighbours, social support from neighbours, high number of immigrants residing in the neighbourhood, neighbourhood involvement and volunteering. Participants were more likely to walk daily when they had more contact with their neighbours, or when they perceived that they could count on their neighbours for social support.

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Van Cauwenberg, Van Holle et al.	2014	Belgium	Seniors	65 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment Individual Personal	The presence of vegetation, benches and surveillance was positively linked to the incentive to walk. Environments with higher levels of comfort, friendliness and safety were perceived as more conducive to walking.
Van Cauwenberg et al.	2016	Belgium	Seniors	65 years+	Utilitarian walking	NS	Quantitative	Cross-sectional	Perceptions	Physical/built environment	For the sample as a whole, the flatness of sidewalks was by far the most attractive element for walkers. It was followed by traffic volume and maintenance. Flatness was also the most important factor in the first two subgroups: 1 and 2. Traffic volume and vegetation were the most important factors for subgroups 3 and 4, respectively.
Van Cauwenberg et al.	2012	Belgium	Seniors	65 years+	Utilitarian walking	NS	Qualitative		Perceptions	Climatic/meteorological Physical/built environment Social environment	According to the results, to promote walking as a means of transportation for seniors, a neighbourhood should have good access to shops and services, well-maintained pedestrian infrastructures, aesthetically appealing areas, streets with little traffic and places for social interaction. In addition, the neighbourhood environment should evoke feelings of familiarity and be safe from crime. Nevertheless, winter was associated with a poor sense of security from crime due to early darkness, and fear of falling due to ice and snow.

Authors	Year	Country	Type of population	Age	Types of activities (walking, cycling, greenway use)	Season	Type of study	Type of study design	Types of measures	Categories of factors	Key results
Vietinghof	2021	France	Persons in disadvantaged situations	Less than 60 years	Cycling	NS	Qualitative		Perceptions	Physical/built environment Individual Personal	The barriers to cycling perceived by study participants can be broadly grouped into four categories: racism, financial barriers, information/knowledge barriers and spatial inequalities. Study participants explicitly and implicitly discussed racism as a determining factor affecting access to cycling services. Other factors, such as financial insecurity, lack of information about programs and lack of infrastructure, are barriers to cycling.
Wang and Lee	2010	United States	Seniors	Average 84.2	Walking	NS	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment Social environment Individual Personal	Based on bivariate tests, two personal, one social and fifteen environmental variables (five at the site level and ten at the neighbourhood level) were significantly associated with the frequency and duration of walking among seniors in the neighbourhood. The results of multivariate analyses indicated that seniors who lived on a lot at the end or corner of streets were more likely to walk for more than ten minutes than others. The higher the levels of landscaping and pedestrian potential, the more likely seniors were to walk in their neighbourhoods. Social cohesion in the neighbourhood was also associated with the walking.

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Winters et al.	2015	Canada	Seniors	60 years+	Cycling	Autumn	Mixed		Perceptions Objective	Physical/built environment Individual Personal	According to the interview analysis framework, the factors that facilitate cycling are: adequate infrastructure, a history of cycling activity and the social aspects of cycling. Factors that were barriers to cycling, for those who said they cycled and those who said they did not: lack of safety, including traffic safety and cyclist behaviour, and theft.
Zandieh et al.	2016	United Kingdom	Seniors	65 years+	Walking	Summer	Quantitative	Cross-sectional	Perceptions Objective	Physical/built environment	Perceived neighbourhood safety, tranquility and landscape aesthetics were positively related to outdoor walking. Perceived traffic conditions, pavement condition, presence of shops and services, and air quality, all aspects of pedestrian potential, were not statistically related to walking.

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