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Doctoral thesis

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Keywords:
Older people; Pedestrian; Accessibility; Barrier-free design; Usability; Mobility; Perceived safety; Winter maintenance

Abstract:
Accessibility throughout society has been gaining interest on both international and national levels in order to meet the transportation needs of, for example, older people as pedestrians. The overall aim of this thesis is to examine the implementation process in municipal planning, and effects of measures taken, to achieve barrier-free outdoor environments the year round. Older peoples' perceptions as pedestrians in terms of usability, mobility, and perceived safety, as well as municipal employees' views, contribute to the findings presented. A mixed-method approach is applied involving qualitative (interviews, focus group interviews, and participant observations) and quantitative (questionnaires) studies, which are conducted before and after measures to improve accessibility in both bare-ground and snow/ice conditions are implemented. An index, developed within this thesis, shows a large variation in the implementation process concerning accessibility among Swedish municipalities. Thus, there is still much to do to accomplish a society accessible to all citizens. Knowing which measures to prioritise will likely benefit the implementation process. This thesis shows only minor effects of the implemented measures though. Nevertheless, difficulties reported in walking due to physical barriers have in fact decreased. In conclusion, removal of physical barriers the year round have potential for encouraging walking in old age, especially among older people with functional limitations and mobility devices. A travel-chain perspective on accessibility is essential though involving removal of physical barriers from indoor to outdoor environments, from one transport mode to another, from public to residential areas. Older peoples' needs as pedestrians are not completely fulfilled by current legislative directives on accessibility (BFS 2003:19 HIN1), which calls for a focus on other issues as well, e.g. problems with bicycles and cyclists on pavements and footpaths as well as the need for benches to rest on. In snow/ice conditions, it concerns improved ice prevention and snow removal, especially snow removal on detailed level. Safety/security-related issues are important as well; however, barrier-free environments are to be considered as a basic precondition for peoples' ability to use an environment at all. In the end, this thesis has implications for further research and for policy/planning at different levels in society.

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List of terminology

Accessibility	The relationship between a person's functional capacity and the demands of the environments. An objective concept, relating to societal norms and legislation, and measured on population or group level (Iwarsson & Ståhl, 2003). See also *usability*.
Accessibility adviser	A profession in which the municipal accessibility adviser is an expert in accessibility issues and the needs of different user groups.
Accessibility plan	A municipal planning document, including inventory work of existing physical barriers, for implementing accessibility in public environments according to the directives in *BFS 2003:19 HIN1*.
Age, ageing	Ageing is the gradually, irreversible organic process of growing older involving declining functional capacity. Age is usually defined as the number of years since a person's birth (chronological age). However, age can also be biologically, psychologically, and socially determined (Dehlin & Rundgren, 2000).
BFS 2003:19 HIN1	A retroactive Swedish governmental directive on accessibility requiring the municipalities to remove different predefined types of existing barriers in public environments before 2010 (the "easily removed barriers" directives). Further refined by BFS 2004:15 ALM1 valid for new constructions. See also *easily removed barriers*.
BG	Bare-ground conditions. Ground conditions with no snow and ice, which therefore more likely occur during summer months.
Boverket	The National Board of Housing, Building and Planning (Boverket). Boverket is the central government authority for town and country planning as well as for management of land and water resources, building and housing.
DR	Directives and recommendations. In the Municipality

	study (Study 1) in this thesis referring to Swedish governmental legislation, directives and guidelines concerning accessibility, e.g. BFS 2003:19 HIN1.
Easily removed barriers	Obstacles that can be deemed reasonable to remove in view of the benefit of the measures and the conditions at the site. The financial implications must not be unreasonably onerous for the property owner, the manager of the premises or the business operator (BFS 2003:19 HIN1). See also *BFS 2003:19 HIN1.*
Environment	The physical surroundings in terms of indoor/outdoor and public/private environments. In this thesis, the public outdoor environment is the focus, which includes the traffic environment and pedestrian facilities such as pavements and footpaths. The distinction between public and private is important because maintenance in public outdoor environments generally is taken care of by the municipalities, while private outdoor environments (e.g. residential areas) are the responsibility of private property owners. Environment in terms of the social surroundings is not treated within this thesis.
Fear of crime	A feeling expressed by avoidance or protection behaviours, an abstract fear when being in a perceived threatening environment, or a concrete evaluation of the risk of being victim of a personal or personal-property attack (Beaulieu et al., 2007). See also *fear of falling*, *fear of moving outdoors* and *perceived safety*.
Fear of falling	Perceived self-confidence at avoiding falls during essential, relatively non-hazardous activities (Kressig et al., 2001). See also *fear of crime, fear of moving outdoors* and *perceived safety*.
Fear of moving outdoors	An emotional condition that can lead to avoidance of outdoor activities well within a person's functional health capacity (Rantakokko et al., 2009). See also *fear of crime*, *fear of falling* and *perceived safety*.
Functional limitation	Functional capacity refers to the performance of the person, or more specifically a person's ability to perform daily activities; functional limitations refers to restrictions in that performance (Jette, 2006).
Implementation	The treatment and consideration of accessibility issues in policy and planning and the process in which actual

	measures to improve accessibility in the outdoor environment for older people and people with disabilities are carried out.
Kick sled	A type of mobility device used on snow/ice. Kick-sled riding is rather common in the north of Sweden, especially among older people.
Mobility	Spatial outdoor mobility, i.e. the motion of persons and goods in space to surmount distances (SIZE, 2006), both transportation to get access to desired places and people (destination-dependent) and in order to just move around (destination-independent) (Metz, 2000). In this thesis defined as older peoples' perceived level of realised outdoor mobility as pedestrians in terms of walking, with or without destination. See also *pedestrian* and *walking*.
Mobility device	An assistive device for mobility, e.g. rollator, wheelchair, cane, etc.
Municipality	The local authorities in Sweden. The Swedish Parliament (Riksdagen) is the supreme political decision-making body in Sweden. Sweden is then divided into 20 counties/regions and 290 municipalities. The municipalities have a considerable degree of autonomy, have independent powers of taxation, and are responsible for matters relating to the inhabitants and their immediate environment. The population size of the municipalities varies from 2516 to 810 120 inhabitants (data from 2008, Statistics Sweden).
Older people	Persons that are 65 years of age and older. See also *age, ageing*.
Pedestrian	Road users using the traffic environment on foot, including people using wheelchair, rollator, or other mobility devices. See also *walking*.
Perceived safety and security	The subjective perception of safety, where safety refers to a state without danger. Perceived security is another subjective concept, where security refers to a state without *intentional* danger (Wretstrand, 2003). Perceived safety and security are composed of three dimensions: cognitive (perceived probability), emotional (fear and anxiety) and behavioural (avoidance or protective behaviours) (Sjöberg, 1996; Beaulieu et al., 2007). See also *fear of crime*, *fear of falling* and *fear of moving outdoors*.

S	Statement. The Municipality study (Study 1) in this thesis includes statements, which respondents should agree or disagree with, on how accessibility is treated in the municipality and by municipal politicians and employees.
SALAR	Swedish Association of Local Authorities and Regions (Sveriges Kommuner och Landsting, SKL). SALAR represents the governmental, professional and employer-related interests of Sweden's 290 municipalities and 20 counties/regions.
Sc	Statement component, categorised statements (*S*).
SF	Static factor. In the Municipality study (Study 1) in this thesis referring to the actual implementation of accessibility in municipal policy and planning, e.g. the existence of accessibility plan, programme for handicap policies (or similar), accessibility adviser, cooperation with organisations, or implemented measures for improved accessibility in the municipality.
SI	Snow/ice conditions. Ground conditions with snow and ice, which therefore more likely occur during winter months.
SNRA	Swedish National Road Administration (Vägverket). SNRA is a national authority assigned the overall responsibility for the road transport system in Sweden.
STS	Special transport services. STS is a special service offered for people who have problems using conventional public transportations.
Travel chain	A travel chain generally involves several trips made by one or several travel modes, e.g. a walk from the home to the bus stop, a bus ride, and a final walk from the bus stop to the destination. In this thesis, a travel-chain perspective on accessibility implies that every event occurring during a trip from start to finish must be usable in order to be a realistic alternative for travelling (Ståhl, 1997; Börjesson, 2002).
Usability	The interrelation between a person's functional capacity and the demands of the environment during an activity, e.g. walking. A subjective concept, referring to a person's perception of a certain environment, and assessed on the individual level (Iwarsson & Ståhl, 2003). See also

	accessibility.
U	Usability factor. In the Bare-ground and Snow/ice studies (Study 2-3) in this thesis referring to single environmental factors concerning the usability of the outdoor environment.
Uc	Usability category. Categorised usability factors (*U*).
Walking	A travel mode; transportation in the outdoor environment on foot. See also *pedestrian*.
Year-round	A year-round perspective on accessibility involves both removal of physical barriers in outdoor environments in bare-ground conditions as well as keeping these environments accessible during winter by winter maintenance on pavements and footpaths (snow/ice conditions).

List of papers

Paper 1
Wennberg H, Ståhl A, Hydén C (2009) Implementing accessibility in municipal planning - Planners' view. Journal of Transport and Land-use, 2 (2) [Spring 2009], pp. 3-21.

Paper 2
Wennberg H, Ståhl A, Hydén C (2009) Older pedestrians' perceptions of the outdoor environment in a year-round perspective. European Journal of Ageing (in press).

Paper 3
Wennberg H, Hydén C, Ståhl A (2009) Barrier-free outdoor environments: Older peoples' perceptions before and after implementation of legislative directives. (submitted)

Paper 4
Wennberg H, Hydén C, Ståhl A (2009) Effects of improved winter maintenance in pedestrian environments: Older peoples' and practitioners' views. (submitted)

Introduction

In the field of transport and urban planning, the overall objective is to ensure an economically efficient and sustainable provision of transport services. The Swedish transport policy starts in *accessibility* as functional objective; however, impact on safety, environment, and health are also to be considered (Prop. 2008/09:93). A transport system accessible to everyone involves planning and design at *macro level* (functional structure of a city/region/country, range of available transport modes, etc.) down to the *micro level* (design of the street, pavement, crossing, etc.). In this context, older people - persons 65 years and older - are one important group to focus on. Older people are the fastest growing group of the population in developed countries, and by the year 2030 every fourth person will be over 65 (OECD, 2001). Europe is pointed out as the oldest world region viewed from a global perspective (CAHP, 2004). The ageing population is a great challenge for our society, for example, when providing for older peoples' safe, lifelong mobility.

Mobility is to be considered as a prerequisite for people to handle everyday activities, for participation in society and possibilities to maintain social contacts (Mollenkopf et al., 2004). The ability to be mobile is also often associated with independence, freedom, and vitality. Banister & Bowling (2004) also emphasise the importance of mobility for older peoples' quality of life. Gaining access to desired places and people, or moving around for recreational purposes, generally implies transportation. Changing urban and regional structures with a functional and spatial separation of living, work, leisure, and other activities required to meet daily needs, makes travelling longer distances a necessity (Mollenkopf et al., 2004; Whelan et al., 2006). Most trips are therefore made by car, also among older people, and car driving is predicted to be even more common in the future mainly due to more women with access to car (Rosenbloom & Herbel, 2009; Whelan et al., 2006; TRANSEK, 2005). Ceasing to drive negatively influences mobility; transportation without a car often involves dependence on other people (Rosenbloom & Herbel, 2009; Rosenbloom & Winsten-Bartlett, 2002). Even though there are differences between, for example, Europe and the US in this matter, growing car-dependence is a global trend (OECD, 2001).

Even though most trips are made by car, transportation as pedestrians, or in public and special transport services, becomes more important as people age (Tacken, 2004; Whelan et al., 2006). In fact, 30-50% of older peoples' journeys are made wholly on foot in many European countries (OECD, 2001). Then there is also walking as a part

of other transport modes, for example, walking to the bus stop, to the car, etc. Providing transportation options for non-drivers in the community, such as usable pavements and other pedestrian facilities as well as public transportation, is therefore a precondition for many people to stay mobile and independent in old age (Burkhardt et al., 1998; Mollenkopf et al., 2004; Michael et al., 2006). In addition to facilitating walking to ensure older peoples' mobility, encouraging walking behaviour could also help out to maintain physical functional status and overall health (Borst et al., 2008). On the societal level, there are benefits from keeping older people independently mobile since they become in less need of support from society in terms of home care or special living arrangements, special transport services, etc. (Hakamies-Blomqvist et al., 1999). There is also a demand for more sustainable transportation, such as walking, in order to deal with global warming and other environmental issues (OECD, 2000).

There are several barriers to good access in outdoor environments due to poor design and maintenance of pedestrian facilities. Such barriers include narrow pavements, poor crossing facilities, high kerbs, uneven or slippery surfaces, stairs without handrails, lack of benches, poor lighting, etc. (Lavery et al., 1996; Carlsson, 2004; Ståhl et al., 2008). Older people themselves often emphasise such *details* in the design of outdoor environments (Ståhl et al., 2008). Another issue concerns how to keep outdoor environments accessible year round. In some areas of the world, snow and ice are barriers to access during winter. Pudas & Fjellström (2007) have compared accessibility in bare-ground and snow/ice conditions showing that for people with mobility impairments, there is decreased accessibility in snow/ice conditions regarding unevenness, slipperiness and sight. For people with visual impairments, snow/ice conditions bring considerable deterioration regarding visual and tactile guidance. Signs and other information may be covered by snow, which also makes orientation more difficult. However, in some respects snow/ice conditions might improve accessibility, since differences in levels are reduced and pavements may become wider (Pudas & Fjellström, 2007). In order to keep outdoor environments accessible year round, areas such as the Nordic countries, parts of the US, Canada, Japan, and several other countries in the world need proper strategies for winter maintenance of pavements and footpaths.

Extensive research has been carried out, especially in the field of public health research, to examine correlations between environmental features and physical activity in terms of walking. A review of 18 such studies, provided by Owen et al. (2004), concluded that walking among people of all ages is associated with aesthetic attributes, convenience of facilities for walking, accessibility of destinations, and perceptions about traffic and busy roads. In the field of transportation and urban planning research, the promotion of mobility among older people has also been emphasised. SIZE (2006) placed improved conditions of pavements as the highest ranked solution for improving mobility among older people after speed reductions to prevent pedestrian accidents. The "Let's go for a walk!"-study (Ståhl & Iwarsson,

2007), the "Keeping Elderly People Mobile"-study (Mollenkopf et al., 2004), and the MOBILATE-study (Mollenkopf et al., 2005) have in one way or another focussed on such environmental support for outdoor mobility in old age.

Barrier-free environments have potentials for preventing falls among older people (Ståhl & Berntman, 2007) as well as fear of falling (Ståhl & Iwarsson, 2007). One third of all people above 65 falls at least once annually and almost every second fall occur outdoors (Luukinen et al., 1994). Ståhl & Berntman (2007) show that 90% of the injuries among older pedestrians are due to falls and that 80% of those occurring outdoors are associated with poor pavement conditions. Such poor conditions are also what older people themselves often report as accessibility problems (ibid). Furthermore, increased *sense* of safety and security is an important solution for improving mobility (SIZE, 2006). Fear can become a psychological barrier that negatively influences older peoples' choices of activities and outdoor mobility (Marcellini et al., 2004). Previous studies in the field of public health research have shown relationships between fear of falling, frailty, and restriction of activities among older people (Delbaere et al., 2004; Arfken et al., 1994; Howland et al., 1993). Fear of crime is another activity-restricting issue (Piro et al., 2006; Keane, 1998; Ward et al., 1986). In the context of outdoor mobility, Rantakokko et al. (2009) show that environmental features in the nearby environments (poor surface conditions, slopes/hilliness, and noisy traffic) correlate with fear of moving outdoors.

Older people are often, also in this thesis, defined as persons 65 years and older. It should be noted though, that there is a large variation of functional capacity within the age group of older people and among persons of the same age. Age is therefore difficult to determine solely in chronological terms and can also be biologically, psychologically, and socially defined (Dehlin & Rundgren, 2000). Older people and people with disabilities are often treated as one group with similar needs in policy and planning even though the two groups differ. For example, older people more often suffer from a combination of different functional limitations (Hovbrandt et al., 2007), such as reduced vision, hearing, and movement. The ageing process involves per definition gradually declining functional capacity, and with increasing age functional limitations and use of mobility devices become more common (Parker et al., 2008; Löfqvist et al. 2007). This process may negatively influence older peoples' possibilities to independently carry out everyday activities (Hovbrandt et al., 2007).

International and national directives on accessibility

Accessibility throughout society for older people and people with disabilities has been gaining attention on both international and national levels. The UN Standard Rules on Equalization of Opportunities for People with Disabilities (UN, 1993) and the UN Convention on the Rights of Persons with Disabilities (UN, 2006) emphasise disability as a human rights issue and a matter of legislation. The European

Community and its member states have jointly signed the UN Convention and have also entered accessibility as part of the agenda adopted by the EU council of Lisbon 2000 targeting 2010 as the goal for full accessibility (Euro Access, 2008). Within the transport sector, several efforts have been carried out. The European Conference of Ministers of Transport (ECMT) Working Group on Access and Inclusion plays an important role in bringing together governments and experts from different countries to exchange ideas on transport for people with reduced mobility in order to achieve barrier-free travel. ECMT was transformed in 2006 into International Transport Forum though, but the Working Group remains as a network of experts on accessibility issues. The importance for governments to improve accessibility and thus the mobility of older people is emphasised in, for example, ECMT (2000a).

On national levels, there are wide variations in the progress achieved. Legislation to improve access ranges from strongly proactive countries to those where few measures have been carried out (Euro Access, 2008). ECMT (2000b; 2006) report on legislative developments during the 1990s and the 2000s. The Americans with Disabilities Act of 1990 provides technical norms and standards for accessible design (ADA 1990). Another example is the UK, which adopted a Disability Discrimination Act in 1995, and added a second DDA in 2005 with further requirements appended to the legal framework for transport accessibility (DDA 1995; 2005). In 2005 France reviewed its 1975 law on compensation and social coverage, "Equal Rights and Opportunities, Participation and Citizenship of Disabled Persons", and added important standpoints on accessibility of transport and public buildings (LOI n° 2005-102).

In Sweden, the Parliament adopted a national action plan for a future policy for disabled people, "From patient to citizen" in 2000. One of the goals of the plan is to make public environments accessible to people of all ages with disabilities (Prop. 1999/2000:79). This plan led to the Swedish governmental directives on accessibility, related to the Planning and Building Act, requiring municipalities to eliminate different predefined types of barriers, so-called "easily removed barriers", in public environments before 2010 (BFS 2003:19 HIN1). These directives are retroactive, requiring not only that new constructions be accessible, but also that existing barriers be eliminated. BFS 2004:15 ALM1 goes still further than BFS 2003:19 HIN1, presenting stricter demands for new constructions. Similar detailed directives, connected to planning and building legislation, for planning and design of roads and streets have been adopted in many other European countries as well (Euro Access, 2008). The Swedish directives are also backed by guidelines used in municipal policy and planning. For example, guidelines for identifying barriers to access in built environments and preparing a municipal accessibility plan (SALAR, 2004) as well as measures and measurements for designing accessible environments (SALAR, 1994; Svensson, 2001; 2008a) have been included.

From policy to practise

The international and national requirements that public outdoor environments be accessible for all citizens in 2010 impose great challenges for society, and obviously for those actors involved in implementation of policy into practise. In Sweden, legislative directives, such as BFS 2003:19 HIN1, make accessibility a challenging area for the municipal politicians and employees involved in, for example, transportation and urban planning. Accessibility is an important aspect in municipal policy and planning documents, e.g. the municipal handicap programme and the accessibility plan. Some municipalities have employed an accessibility adviser, who is an expert in accessibility issues and the needs of different user groups. Accessibility is also a subject for the disability rights movement and other national interest organisations, such as senior organisations, as well as the Municipal Advisory Council for the Disabled (Kommunala Handikapprådet, KHR) and the Municipal Pensioner's Advisory Council (Kommunala Pensionärsrådet, KPR).

Despite legislation, directives, and guidelines, accessibility is not always considered in municipal planning. One explanation is conflicting interests and needs between actors involved in the implementation process. Lack of financial resources is one factor slowing down this process, however, Grönvall (2004) points out other conflict areas as well: lobbying, knowledge, structures, commitment, technique/aesthetic, time, and legislation. These conflicts occur on different levels: within a person or group, between persons or groups, and between the person/group and society. On the societal level, there may be other interests (capacity or safety concerns, aesthetics, building conservation, etc.) that conflict with accessibility interests. On an individual level, a person may not be entirely convinced of the benefits of an accessibility measure as compared to another interest. For example, an architect may know how to create accessible environments, but this knowledge may not coincide with the architect's preferences in aesthetics. Conflicting interests and needs within the areas mentioned above can be barriers in the implementation of policy into practise. Thus, the implementation process is facilitated by bridging such conflicts on all levels.

Theoretical context

Accessibility

Accessibility concerns person-environment relationships. In the field of ageing research, a psychological model developed by M. Powell Lawton - the ecological model of adaptation and ageing - is well-established and widely used (Figure 1). According to Lawton's model, there is an interaction between individual competence (capacity) and environmental press (demand); some environments impose great pressure on individuals, while others do not (Lawton & Nahemow, 1973). In Lawton

(1986), the environmental docility hypothesis suggests that the less competent the individual, the greater the impact of environmental factors on that individual. Hence, an improvement in the environment can make a huge difference for a person with lower capacity, while a minor deterioration in individual capacity can totally upset the balance.

The concept of accessibility is defined by Iwarsson & Ståhl (2003), according to the ecological model and environmental docility hypothesis, as the relationship between a personal and an environmental component. Hence, accessibility must be analysed by an integration of information on both components. Accessibility is an *objective* and measurable concept, relating to societal norms and legislation, and is mainly measured on population or group level.

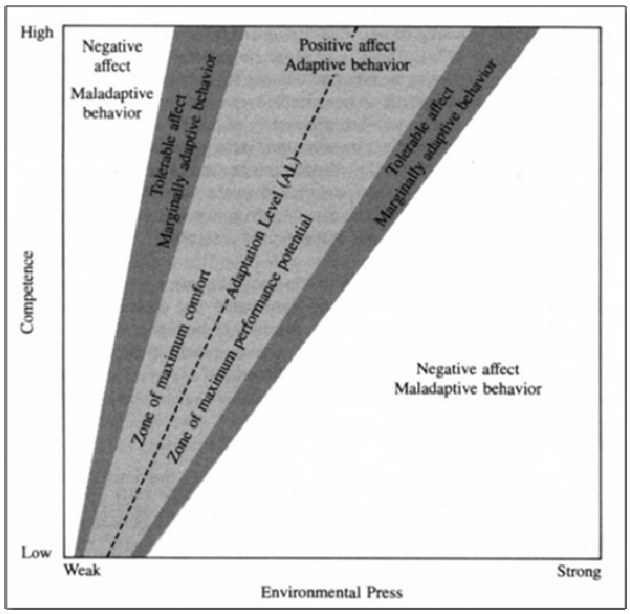


Figure 1: The ecological model of adaptation and ageing (Lawton, 1986).

In this context, concepts of functioning, disability, and health are relevant for describing consequences of disease and injury as well as of the ageing process (Jette, 2006). For example, *functional limitation* refers to "limitation in performance at the level of the whole organism or person", which is to be compared with *impairment* referring to "anatomical, physiological, mental or emotional abnormalities" (Jette, 2006, p. 731). The World Health Organization's International Classification of Functioning, Disability and Health (ICF) framework provides a common, international language for disablement that looks beyond disease and mortality and instead focuses on how people live with their conditions. The ICF framework is based

on contemporary disablement models, which describe *disability* as the gap between a person's capabilities and the demands created by the social and physical environment (Jette, 2006). Thus, disability is no longer seen as characteristics or attributes of the person, but rather as a product of the interaction of the person with the environment.

Usability

Usability comprises, in addition to the personal and environmental components, an activity component referring to the human activities in the environment. In other words, usability is the extent to which human needs, based on individual or group preferences, can be fulfilled in terms of activity performance in an environment (Iwarsson & Ståhl, 2003). Hence, usability is analysed by an integration of information about functional capacity, environmental demands, and activity (e.g. walking). Thus, usability is *subjective* in the sense that it refers to a person's perception of a certain environment.

Usability is difficult to predict due to the dynamics in outdoor environments and variation in the capacity of the individual using the environment (Iwarsson & Ståhl, 2003). For example, an accessible pavement (accessible according to current legislative directives on accessibility) may turn unusable if it is temporarily blocked by a parked vehicle, a heap of snow or leaves, or other dynamic factors of the environment. Likewise, a person's health may differ from day to day (or during the day), thereby decreasing functional capacity, which may cause the person's perception of the environment to vary. Furthermore, a trip, e.g. walking from the home to the grocery store, can be a complex chain of events that all have to be usable. Several recurring minor barriers may, taken together, turn insurmountable for people with functional limitations. In this context, the *travel-chain perspective* is essential; if one link in the travel chain is missing, the whole chain fails (Ståhl 1997; Börjesson 2002).

The usability concept is to some extent related to the concept of satisfaction as they both concern peoples' needs and the fulfilment of these needs. An *importance-satisfaction* approach on peoples' perceptions is adopted by, for example, Steg et al. (2007). They examine how satisfied people are with different environmental factors in the view of perceived importance of these factors. Jensen et al. (2002) among others have examined usability qualitatively by means of participant observations. Here, older peoples' difficulties when using the outdoor environment as pedestrians and when travelling by public transportation were examined both in terms of the participant's self-reported perceptions and of the researcher's observations.

Mobility

The concept of mobility has many different meanings and contexts of use. In this thesis, spatial outdoor mobility is the focus, referring to the "motion of persons and goods in space to surmount distances" (SIZE, 2006, p. 14). Mobility is to be

considered as more than daily travelled distance and has therefore both objective and subjective dimensions. Mobility refers to the transportation to get access to desired places and people (destination-dependent) as well as to the movement in order to just move around (destination-independent). However, the destination-independent dimensions of mobility, which most likely are important as well for fulfilling older peoples' mobility needs, are seldom used in studies found in the literature (Metz, 2000). The subjective meaning of mobility for older people is described by Mollenkopf et al. (2004) as a positive emotional experience; a "joy". They also refer to mobility as a basic human need, the movement per se, movement in and observation of natural surroundings, or as a social need. In this context, Metz (2000) points out destination-independent dimensions of mobility in terms of psychological benefits of movement ("getting out and about"), exercise benefits of physical movement, and social benefits by involvement in the local community. Metz (2000) also points out another subjective dimension of mobility: potential travel, i.e. knowing that mobility is an option even though actual travel is not undertaken. Thereby, the focus shifts to peoples' intensions or reasons for being mobile and thus to the mobility-related concept of *motility* referring to peoples' capacity (or possibility) to be mobile (Kaufmann et al., 2004).

There may be a gap between peoples' realised mobility and their needs and wishes. Metz (2000) suggests that people tend to strive for their optimal level of mobility. Older people and people with disabilities may try to maximise their travel in contrast to people with a high level of mobility, e.g. business men, who most likely try to minimise. Furthermore, people who cannot be mobile may have problems carrying out everyday activities without help from others. Mollenkopf et al. (1997) suggest that older peoples' mobility is influenced by the social situation, where those with social networks of family and friends are more likely to be mobile. Other individual factors such as age, health condition, and ability to drive a car are also decisive (ibid). Inability to carry out daily life and social activities can create a vicious circle of immobility, where being passive negatively influences health and leads to isolation and more passivity (Marcellini et al., 2004). Michael et al. (2006) suggest that being able to remain living and ageing in your own home and to take care of yourself is important for older people, and is facilitated by the design of the local neighbourhood. Access to local shopping and services, attractive outdoor environments, possibility to rest during a walk, good pedestrian facilities, and access to public transport contribute to an independent, active life style in old age (ibid).

Perceived safety

Safety and security - as in freedom from hazard, fear, and anxiety - are essential human needs (Maslow, 1954). A distinction between the two concepts *safety* and *security* is emphasised by Wretstrand (2003) who describes safety as a state without danger and security as a state without *intentional* danger. Perceived safety and security are composed of two dimensions: a *cognitive* dimension concerning the perceived

probability of potential incidents, and an *emotional* dimension concerning fear and anxiety related to potential incidents (Sjöberg, 1996). For example, the risk of being victimized can be perceived as low although people feel insecure when walking alone at night. Beaulieu et al. (2007) also suggest a third dimension: a *behavioural* dimension referring to behaviours of avoidance or of protection. In the literature, several specific terms related to perceived safety and security are found. *Fear of falling* is a safety-related term frequently used in the literature, especially in the field of public health research, as "perceived self-confidence at avoiding falls during essential, relatively non-hazardous activities" (Kressig et al., 2001, p. 1457). A security-related term is *fear of crime* which is defined as "a feeling expressed by avoidance or protection behaviours, an abstract fear when being in a perceived threatening environment, or a concrete evaluation of the risk of being victim of a personal or personal-property attack" (Beaulieu et al., 2007, p. 338). In the context of outdoor mobility, Rantakokko et al. (2009, p. 634) use the term *fear of moving outdoors* as "an emotional condition that can lead to avoidance of outdoor activities that are well within a person's functional health capacity", which relates both to safety and security.

The perception of safety differs from person to person and can also be varying for one person. Knowledge and experiences influence perceptions (Drottz-Sjöberg, 1991). For example, fear of falling is associated with prior experiences with falls (Friedman et al., 2002) and fear of crime with prior victimisation (Beaulieu et al., 2007; Acierno et al., 2004). However, fear of falling is also prevalent among non-fallers, as well as fear of crime among non-victims, and personal vulnerability is often mentioned as an explanatory factor (ibid). Generally, people tend to feel safer in well-known situations that they have under control and benefit from, and where potential incidents only imply minor consequences (Breck et al., 2000). Older peoples' fear of falling are likely associated with an increasing risk of injuries with increasing frailty (Murphy et al., 2002). And fear of crime is explained by physical and social vulnerability in terms of gender, age, ethnicity, income, educational level, social isolation, and current psychological functioning (Beaulieu et al., 2007; Acierno et al., 2004).

Reflections on previous research

Previous research and current international and national directives on accessibility agree that the physical environment must be adapted to the needs of older people and people with disabilities in order to ensure their safe, independent mobility. The legislative directives requiring public outdoor environments to be accessible for all citizens in 2010 impose challenges for society, and obviously for municipalities. The treatment and consideration of accessibility issues in municipal policy and planning are of crucial importance for the actual outcome of international and national policy directives. Except for a study presented in Grönvall (2004), no studies are found in the literature on the implementation process in municipalities concerning

accessibility. Thus, there is a need for examining this implementation process in terms of, for example, how far the municipalities have managed to implement legislative directives on accessibility, and which accessibility problems still remain. Further, there is no study found in the literature that has examined effects of implementation of legislative accessibility directives on older peoples' perceptions of the outdoor environment and on their actual mobility. Municipal planners' and practitioners' perspectives on the solutions for improving accessibility may, in addition to older peoples' perspectives, contribute to knowledge of how to achieve barrier-free outdoor environments.

Even though previous studies have identified numerous environmental factors associated with older peoples' mobility, few have shown how to prioritise these factors in terms of relative environmental support (Sugiyama & Ward Thomson, 2007). There is a large heterogeneity within the age group of older people, and little is yet known about whether individual background variables influence accessibility needs. Knowledge on which measures to prioritise, and why, could also help in bridging conflicting interests and needs of actors involved in the process of implementing policy into planning (Grönvall, 2004). Furthermore, studies involving snow/ice conditions are rare, except for studies conducted within the field of fall-related injuries among pedestrians (cf. Stevens et al., 2007) and within the field of anti-slip devices and slipperiness of footwear (cf. Gard & Berggård, 2006; Grönqvist & Hirvonen, 1995). Previous studies in the field of accessibility have mainly focussed on bare-ground conditions (cf. Ståhl et al., 2008; Carlsson, 2004; Lavery et al., 1996). However, how to keep outdoor environments accessible the year round is an issue yet to be examined.

Achieving supportive environments, and thus enabling walking among older people, requires proper planning and design, backed up by scientific evidence obtained from empirical research (Sugiyama & Ward Thompson, 2007). There are few studies found in the literature that have examined effects of *actual* implementation of measures to achieve barrier-free pedestrian environments on older peoples' mobility and perceived safety as pedestrians, especially not in a year-round perspective involving both bare-ground and snow/ice conditions. Except for Ståhl & Iwarsson (2007) and Rantakokko et al. (2009), few studies have examined the relation between improved accessibility and perceived safety; previous research has mainly focused on the relation between perceived safety and mobility (cf. SIZE, 2006; Mollenkopf et al., 2004). Further, most of the studies mentioned above are cross-sectional; before-after studies involving implementation and evaluation of physical improvements of the outdoor environment are rare in the literature. One exception is the before-after study "Let's go for a walk!" reported in Ståhl & Iwarsson (2007). Sugiyama & Ward Thompson (2007) point at the necessity to conduct observations at several points in time in order to investigate whether environmental interventions cause changes in peoples' perceptions and activity. Such a longitudinal approach is one way to study

causal relationships between, as in this thesis, accessibility, usability, mobility, and perceived safety for older people as pedestrians.

In conclusion, there is a need for more knowledge on the implementation process in the municipalities concerning accessibility in terms of, for example, how to measure progress and how far the municipalities have accomplished in the process. It is also relevant to study environmental factors that facilitate walking in the view of older peoples' own perceptions, especially when it comes to judging any gap between issues pointed out by older people themselves and issues emphasised by current legislative directives. A year-round perspective on accessibility involving snow/ice conditions as well are also important to consider. Thus, the focus of this thesis is on the application of legislative directives (concerning bare-ground conditions) and actual strategies (concerning snow/ice conditions) to improve accessibility and thereby encourage walking in old age. A framework describing the focus of the thesis is illustrated in Figure 2. On a societal level, the framework starts in legislation, directives, and guidelines on accessibility and their implementation in municipal planning in order to improve actual accessibility in outdoor environments. In this thesis, the focus is on the "easily removed barriers" directives (BFS 2003:19 HIN1) as it applies to existing outdoor environments. When moving from the objective concept of accessibility to the subjective concept of usability, a transition from societal level to an individual level also takes place. Accessible outdoor environments will, hypothetically, improve the usability of the outdoor environment. In this thesis, usability of the outdoor environment is examined by how satisfied older people are with different environmental factors in the perspective of their perceived importance of these factors. In a planning context, such an importance-satisfaction approach is useful when it comes to identifying need for intervention and prioritising measures. More usable outdoor environments will, again hypothetically, improve mobility and perceived safety among older people as pedestrians. In this thesis, mobility is defined as older peoples' perceived level of realised (in contrast to desired level) outdoor mobility in terms of walking, with or without a destination, outside the home. As the framework also suggests, mobility can be facilitated by an improved perceived safety as well. Perceived safety refers to the subjective dimension of safety as perceived by older people themselves. In this thesis, the focus is on fear of falling and fear of traffic (e.g. related to speed of vehicles, traffic volumes, crossing the street). In order to capture the whole picture of how people feel about moving outdoors, it is also necessary to include fear of crime. Thus, perceived security is also treated to some extent even though the main focus is on perceived safety.

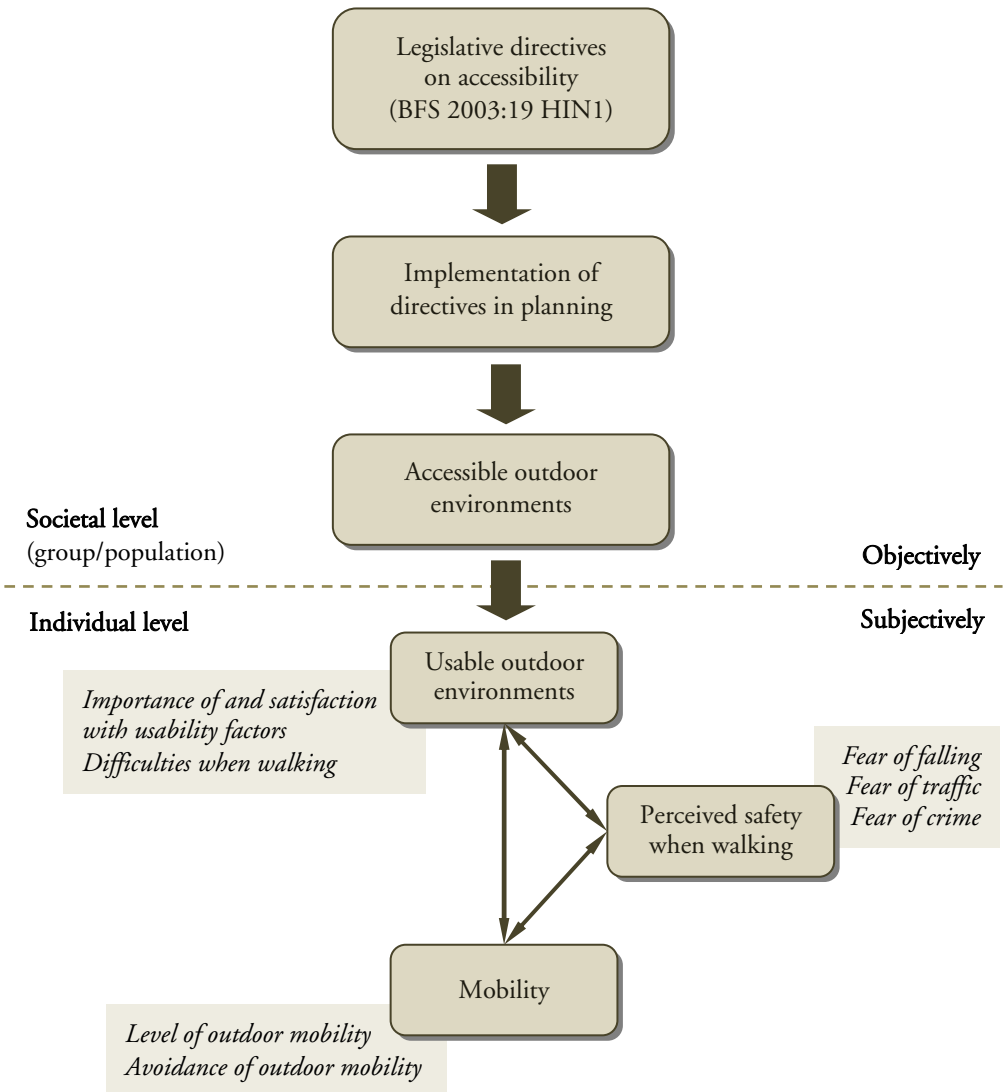


Figure 2: Framework describing the focus of the thesis.

Aim

The overall aim of the thesis is to examine the process of implementing measures in the municipalities, and effects of measures taken, to achieve year-round barrier-free outdoor environments involving both bare-ground and snow/ice conditions. Older peoples' perceptions as pedestrians in terms of usability, mobility, and perceived safety when walking in the outdoor environment - before and after measures are implemented - contribute to findings presented in this thesis. The findings are also based on municipal employees' (planners and other practitioners) views on the implementation process and on measures to encourage walking in old age. Below, four research questions are specified as presented in the result sections.

❶ The implementation process is examined in terms of how accessibility issues are currently dealt with and carried out in municipal planning in order to discover how older peoples' accessibility needs are met in daily practise. What have the municipalities in Sweden accomplished so far in terms of actual efforts to achieve accessible public outdoor environments? Are municipal employees aware of current legislation, directives, and guidelines on accessibility? What do they think about the treatment of accessibility issues within the municipality and among municipal politicians and employees?

❷ Older peoples' perceptions of the outdoor environment, before any implementation of measures to improve accessibility, are examined. Perceptions are scrutinised in terms of the importance of and satisfaction with environmental factors concerning both bare-ground and snow/ice conditions, here referred to "usability factors", as perceived by older people themselves. Are there important usability factors that older people are dissatisfied with under prevailing conditions in their neighbourhood? Do individual background variables influence their perceptions? Is the current Swedish governmental directive on accessibility, BFS 2003:19 HIN1, in line with how important the usability factors are as perceived by older people?

❸ Effects of implemented measures to improve accessibility by removal of physical barriers in both bare-ground and snow/ice conditions are examined. Are outdoor environments perceived more usable by older people themselves after implementation? Are older peoples' mobility and perceived safety as pedestrians improved after implementation?

❹ The implementation process is also examined in terms of municipal employees' views on implemented measures to improve accessibility in outdoor environments. What do the municipal employees think about the implemented measures and about their potential effects? What problems remain after implementation? What are the future challenges for municipal politicians and employees in the implementation process concerning accessibility for older people?

Method

Study design

The thesis is based on three studies: the Municipality study (Study 1), the Bare-ground study (Study 2), and the Snow/ice study (Study 3). The studies are also presented in four papers (Paper 1-4). A mixed-methods approach, using both qualitative and quantitative methods, was applied in the studies. The qualitative methods included interviews with municipal employees as well as focus group interviews and participant observations with older people. The quantitative methods involved questionnaires among municipal employees and older people. Creswell & Plano Clark (2007) suggest several mixed-methods designs of which *the exploratory design* (results from qualitative methods help in developing and informing the quantitative method) and *the explanatory design* (qualitative data help in explaining and building upon quantitative results) were used in this thesis.

Figure 3 and Table 1 provide a methodological overview of studies and papers. The Municipality study (Study 1) investigated how, and to what extent, accessibility issues are currently dealt with and carried out in daily planning in Swedish municipalities by means of a questionnaire (1. in Figure 3, Paper 1 in Table 1). Interviews were then conducted in eight of the municipalities with the aim of selecting two municipalities for participation in further studies (2. in Figure 3). The Bare-ground study (Study 2) and the Snow/ice study (Study 3) involved both qualitative and quantitative methods, and were conducted before and after implementation of measures to improve accessibility in the outdoor environment (3.-6. in Figure 3, Paper 2-4 in Table 1). These two studies began with focus group interviews with older people in which relevant usability factors were identified concerning accessibility in outdoor environments. Participant observations with older people were also conducted in the Bare-ground study. The usability factors identified in the Bare-ground study were supplemented with issues included in the Swedish legislative directives concerning accessibility in focus for this thesis, the "easily removed barriers" directives (BFS 2003:19 HIN1). This was not possible within the Snow/ice study simply because current accessibility directives do not include snow/ice conditions. The usability factors identified were then examined quantitatively, using questionnaires to quantify the importance of and satisfaction with each factor, as well as to examine older peoples' mobility and perceived safety as pedestrians. After implementation, similar questionnaires were used. These were sent out directly after the implementation periods in the study districts. For the support and interpretation of the results from

the questionnaires, focus group interviews and participant observations (in the Bare-ground study) with older people were conducted after implementation, as were interviews with municipal employees involved in implementation.

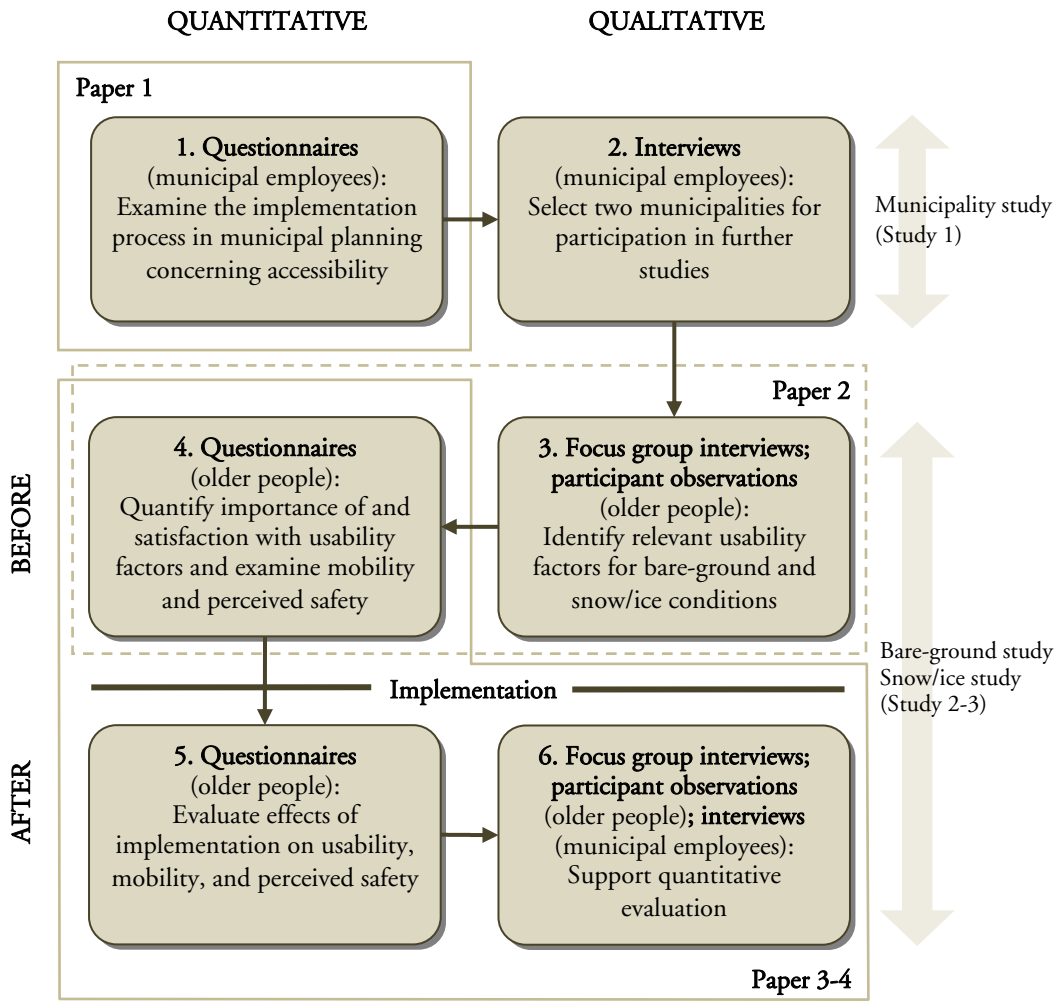


Figure 3: Design of the studies within the thesis.

Table 1: Overview of the papers within the thesis.

		Paper 1	Paper 2	Paper 3	Paper 4
Based on study		The Municipality study (Study 1)	The Bare-ground and the Snow/ice study (Study 2-3)	The Bare-ground study (Study 2)	The Snow/ice study (Study 3)
Focus		Implementation process in municipal planning concerning accessibility	Importance of usability factors (bare-ground + snow/ice conditions)	Effects of implementation (bare-ground conditions)	Effects of implementation (snow/ice conditions)
Design		Cross-sectional	Cross-sectional	Before-After	Before-After
Mixed-method approach			QUAL-QUAN (exploratory)	QUAN-QUAL (explanatory)	QUAN-QUAL (explanatory)
Data collection	QUAN	Questionnaire	Questionnaire	Questionnaire	Questionnaire
	QUAL		Focus groups interviews; Participant observations	Focus groups interviews; Participant observations; Interviews	Focus groups interviews; Interviews
Participants	QUAN	Municipalities: N=188	Older people: N=356+611	Older people: N=244+244	Older people: N=461+461
	QUAL		Older people: N=19 (3 groups)+4 (4 walks)	Older people: N=10 (2 groups)+3 (3 walks) Municipal employees: N=4	Older people: N=8 (1 group) Municipal employees: N=3
Data analysis QUAN	Analyses	Frequencies; Differences between independent groups	Frequencies; Differences between independent groups	Frequencies; Differences between related groups	Frequencies; Differences between related groups
	Variables	Nominal; Ordinal (categorical)	Nominal; Ordinal (categorical)	Nominal; Ordinal (categorical)	Nominal; Ordinal (categorical)
	Statistical methods	Factor analysis; Mann-Whitney U test	Factor analysis; Mann-Whitney U test	Sign Test; McNemar test	Sign Test; McNemar test
Data analysis QUAL			Content analysis: categorisation of interview transcripts and observation notes	Content analysis: categorisation of interview transcripts and observation notes	Content analysis: categorisation of interview transcripts

Note: The interviews conducted within the Municipality study (Study 1) are not reported in Paper 1-4, only in this thesis.

The Municipality study (Study 1)

Quantitative part

A postal questionnaire was sent to all 290 municipalities in Sweden, where the respondents were municipal employees working with accessibility in the field of traffic planning (the questionnaire is placed in Appendix 1 in Paper 1). In order to formulate relevant questions and maximise response rate, experts were consulted in a pilot survey and names of intended respondents were gathered in beforehand. The questionnaire was sent out in November 2004 followed by two reminders, one before and one after the year-end holiday break. 188 of the municipalities participated in the survey (response rate 65 %). Telephone interviews were also conducted among non-responding municipalities in order to do an analysis of the drop-outs. In the telephone interviews a selection of questions from the questionnaire was posed to an employee working with accessibility issues in traffic planning.

The questionnaire included 16 questions and 21 statements, which were then reduced and reorganised in the data analysis into the following three categories:

- Static factors (SF) concerning the existence of SF1: accessibility plan, SF2: program for handicap politics, SF3: accessibility adviser, SF4: cooperation with the Advisory Council for the Disabled, the Pensioner's Advisory Council or other interest organisations within the municipality, and SF5: actual implemented measures.
- Directives and recommendations (DR) concerning the awareness and use of DR1: the "easily removed barriers" directives (BFS 2003:19 HIN1), DR2: Accessible City (SALAR, 2004), DR3: Streets for everybody (SALAR, 1994), DR4: Building away handicaps (Svensson, 2001), and DR5: Traffic for an attractive city (SALAR et al., 2004).
- Statements (S) of how accessibility is treated in the municipality for the respondents to agree (or disagree) with, which were categorised by factor analysis into statement components (Sc) concerning Sc1: Implementation, discussion and cooperation, Sc2: Attention and quality, Sc3: Pressure from citizens, Sc4: Perceived level of knowledge, and Sc5: Conflicting interests.

The data analysis comprised descriptions of what the municipalities had accomplished so far within the field of accessibility. A quantitative ranking of each municipality on the implementation process in municipal planning concerning accessibility was done using the number of positive, neutral, and negative answers to the questions concerning static factors (SF), directives/recommendations (DR), and statements (S, Sc) as indicators: i.e. an *Accessibility Implementation Index* (Table 2). Because it was necessary to classify each statement as having either a positive, neutral or negative

answer, only those 12 statements concerning implementation, discussion, and cooperation (Sc1) and attention and quality (Sc2) were included in the index calculation. High value of the Accessibility Implementation Index indicates a high standard concerning the treatment and consideration of accessibility in the municipality and vice versa. The index is presented separately for each of the three categories (SF, DR, and S) as well as summarized by type of municipality (types defined by SALAR, 1998). Furthermore, relations between actual efforts in the implementing process (existence of SFs) and municipal employees' agreement with statements of how accessibility issues are treated in the municipality and among municipal politicians and employees (S, Sc) are examined as well as between use of governmental directives/recommendations (DR) and agreement with the statements (S, Sc). The significance analyses of differences in agreement with statements depending on existence of static factors (SF) and use of DRs were conducted by Mann-Whitney U test ($p<0.05$).

Table 2: Indicators in the Accessibility Implementation Index.

Indicator		Positive	Neutral	Negative
Static factors (SF)				
SF1	Accessibility plan	Yes (incl. in process)	-	No
SF2	Programme for handicap policies or similar	Programme for handicap policies	Other policy	No policy
SF3	Accessibility adviser	Yes (employed or consultant)	-	No
SF4	Cooperation with interest organisations	Yes	No, but planning to	No
SF5	Implemented measures	Yes	-	No
Directives and recommendations (DR)				
DR1	BFS 2003:19 HIN1	Knows about and uses	Knows about, but not using	Does not know about
DR2	Accessible city			
DR3	Streets for everybody			
DR4	Building away handicaps			
DR5	Traffic for an attractive city			
Statements on the treatment of accessibility within the municipality (S)				
S1	Extensive and purposeful work is carried out in our municipality in order to improve accessibility for older road users.	Agree completely or almost compl.	Agree partly	Disagree
S2	Aspects concerning older people are part of the daily traffic safety work.			
S3	Aspects concerning older people are part of the daily accessibility work.			
S4	Projects concerning accessibility and older road users receive attention from the municipal politicians.			
S5	Efforts concerning accessibility and older road users are receiving sufficient funding in comparison with other issues.			

Continued on next page

S6	As a planner, I feel that I can carry out projects concerning accessibility and older road users to a sufficient extent and of satisfactory quality.			
S7	My colleagues pay attention to me when it comes to issues concerning older road users.			
S8	I get attention from my boss when it comes to issues concerning older road users.			
S9	I often cooperate with other employees in order to carry out projects concerning accessibility and older road users.			
S14	It is difficult for the employee to know who is responsible for accessibility issues.	Disagree	Agree partly	Agree completely or almost complet.
S17	Issues concerning older road users are considered in the political agenda of the municipality.	Agree completely or almost complet.	Agree partly	Disagree
S18	There is a discussion between employees about issues concerning accessibility and older road users.			

Qualitative part

Among those 188 municipalities who had responded to the questionnaire, two were to be selected for participation in further studies by means of interviews. The following inclusion criteria were used:

- Level of implementation in municipal planning concerning accessibility: to ensure inclusion of both municipalities who had made extensive efforts, as well as those who had accomplished less, municipalities having a negative (<0) or positive (>0) Accessibility Implementation Index were considered, especially concerning the existence of an accessibility plan (SF1) and an accessibility adviser (SF3).
- Type of municipality (SALAR, 1998): to ensure inclusion of municipalities with larger to middle-sized urban areas, types 3-4 (larger and middle-sized cities) were selected.
- Climate zone (SNRA, 2000): to ensure a focus on both bare-ground and snow/ice conditions, municipalities in the south and the north of Sweden were considered. In climate zone 1, there is likely a longer period of bare-ground conditions during the summer months and in climate zone 4-5, a longer period of snow/ice conditions during the winter months.
- Proportion of older people of total population: municipalities with around an average proportion of older people (19%) were selected.

The selection resulted in eight potential municipalities. Within each municipality, the head of the Technical Services Department, at least one municipal employee at the department, and the accessibility adviser (if such existed) were interviewed. In the end, the two middle-sized cities of Hässleholm and Piteå were chosen. Hässleholm,

who was found to have a positive Accessibility Implementation Index, was interesting for the Bare-ground study (Study 2) mainly due to their ambition to immediately initiate their work with implementing their accessibility plan and to concentrate their efforts in a defined area and limited time period. Piteå, with a negative Accessibility Implementation Index, was found interesting for the Snow/ice study (Study 3) mainly due to their northerly location (Climate zone 4) and their way of handling winter maintenance of pavements with a minimum number of actors involved compared with other municipalities. Both municipalities were also interested in, and could allocate resources to, this project.

The Bare-ground and the Snow/ice study (Study 2-3)

Qualitative part - before

In the qualitative part conducted before implementation, relevant factors concerning usability in bare-ground and snow/ice conditions were identified using focus group interviews and participant observations (only in the Bare-ground study) with older people (65 years and older) living in the two study districts. The participants were recruited at the local senior centre in the study districts. The selection was done by voluntary entry by older people visiting the local senior centre. In the Bare-ground study, the focus group participants were also invited to partake in the participant observations. One focus group with nine participants and four participant observations were held in the Bare-ground study and two focus groups with ten participants in all in the Snow/ice study. The participants in both studies represented an age range from 63[1] to 93 years and both men and women were represented as well as both users of mobility devices and non-users (see Table 1 in Paper 2 for specific characteristics of the participants).

Focus group interviews were conducted in late spring 2006 in the Bare-ground-study. In the Snow/ice study, they were conducted as soon as possible after the winter season, in early spring 2006. The interview guide used for the focus groups interviews consisted of the following themes (in the Snow/ice-study, the guide was adapted to snow/ice conditions by referring to conditions during the winter 2005/2006).

- Introduction: place of living, places interesting to visit, frequency of walking, etc.
- General thoughts about living and being in the study district

[1] One 63-years old person had signed up for the focus group. Even though the focus of the study was on those over 65, this person was allowed to participate.

- Difficulties associated with walking in the study district: perceived problems, actual incidents, avoidance of places and situations, suggestions for solutions, etc.
- Conclusions

Participant observations, followed by interviews, were conducted in late spring 2006 in the Bare-ground study. Such was not done in the Snow/ice-study due to time limitations. During the participant observations, the participants took a walk on a self-chosen route, for example from their home to the local senior centre, together with an observer. Each participant was systematically observed and all critical incidents occurring during the walk were noted either through the observer's annotations or by the participant's own remarks. This critical incident technique was originally developed by Flanagan (1954), and was further developed by Jensen et al. (2002) by adapting the technique to assessing person/environment relations. A critical incident was defined as a situation where a usability problem occurred as a result of a malfunctioning interaction between the person and the environment, or in other words a troublesome situation that more or less hindered the participant's advance during the walk (Jensen et al., 2002), e.g. stumble on an unevenness, be forced to lift the rollator over a kerb, etc. After the walk, an interview was conducted where the participant's general perceptions of the walk and specific problems on the chosen route were emphasised.

In the analysis, the qualitative information was transcribed and analysed with content analysis in order to find general patterns and to categorise identified problems and incidents into usability factors. In the Bare-ground study, the focus group interviews and participant observations resulted in 15 usability factors concerning bare-ground conditions. After being supplemented with the 19 accessibility factors from the "easily removed barriers" directives (BFS 2003:19 HIN1), a total of 27 unique usability/accessibility factors concerning bare-ground conditions were included in the Bare-ground study (Table 4). The focus group interviews in the Snow/ice study resulted in 18 usability factors concerning snow/ice conditions (Table 5).

Quantitative parts - before and after

The quantitative parts of the Bare-ground and Snow/ice studies included questionnaires that were sent out on two occasions (before and after implementation). The questionnaires were study-specific and were based on the results from the qualitative studies as well as on questionnaires used in a number of studies reported in previous literature, e.g. the study "Let's go for a walk!" (Hovbrandt et al., 2007; Ståhl et al., 2008). The before-questionnaires were constructed, tried out in a pilot test, and then distributed by mail in May 2006 in the Bare-ground study and in April 2006 in the Snow/ice study. The after-questionnaires were similar to the ones used before with a few exceptions; some location-specific and open questions were excluded to provide space for questions concerning the attention to and relevance of implemented

measures (only in the Bare-ground study). The after-questionnaires were distributed by mail in September 2007 in the Bare-ground study and in April 2007 in the Snow/ice study. Each questionnaire was also followed by two reminders.

The questions were structured with predefined alternatives; there were also a few open questions. The questionnaires consisted of 36 questions in both studies. One part of the questionnaire was based on the usability factors identified by the focus groups interviews and participant observations. Here, the respondents were asked to state how important each one of the usability factors was to them and how satisfied they were with each one of the factors. A five-point rating scale was used, where 1=very unimportant (or very unsatisfied), 2=unimportant (or unsatisfied), 3=neither, 4=important (or satisfied), and 5=very important (or very satisfied). The questionnaire also included questions concerning the respondents' mobility and perceived safety as pedestrians. The questions concerning mobility referred to respondents' perceived level of realised outdoor mobility in terms of frequency of walks, with or without a destination, outside their home. In the Bare-ground study, outdoor mobility during the summer months was the focus and in the Snow/ice study, during the winter months. Further, it referred to questions examining how often outdoor mobility was avoided and reasons for such avoidance. The question concerning perceived safety referred to feelings of fear or anxiety when walking outdoors. Reasons for such feelings were examined in terms of fear of robbery/assault/threat, falling, crossing the street, or of involvement in traffic accident as well as general feelings of anxiety.

Background information on the respondents, such as age, sex, functional limitations, use of mobility devices, and access to car or special transport services (STS), was also collected in the questionnaires. On the basis of two of these individual background variables, two new variables were created. Based on the items of the personal component of the Housing Enabler (Iwarsson & Slaug, 2001), functional limitations and use of mobility devices were scored dichotomously (yes/no). Eleven types of functional limitations (difficulties in interpreting information; severe loss of sight; complete loss of sight; severe loss of hearing; poor balance; limitations of stamina; difficulty in moving head; difficulty in reaching with arms; difficulty in handling/fingering; difficulty in bending/kneeling; overweight) and three types of mobility devices (stick/crutch; rollator; wheelchair) could be scored. The functional limitations were categorised into (1) only movement-related, (2) only perception/ cognition-related, and (3) both movement- and perception/cognition-related functional limitations (Hovbrandt et al. 2007). Based on respondents' access to car and STS, *dependence* on walking as transport mode was then defined as having access neither to a car (of one's own or someone else's) nor to STS. Thus, *independence* was defined as having access to either a car or STS.

The respondents were older people (65 years and older) living in the two study districts. In the Bare-ground study, all of the 616 older people living in the study

district were included in the sample of the before-questionnaire (response rate 58%, N=356). For the after-questionnaire, those respondents who had filled in the before-questionnaire and still lived in the study district were included in the sample (response rate 73%, N=244). In the Snow/ice study, a random sample of the 1726 older people living in the study district included 1006 persons in the sample of the before-questionnaire (response rate 61%, N=611). For the sample of the after-questionnaire in the Snow/ice study, the same procedure as in the Bare-ground study was chosen (response rate was 81%, N=461). Table 3 shows the characteristics of the respondents in terms of age, sex, functional limitations, use of mobility device, and dependence on walking as transport mode.

Table 3: Characteristics of the respondents.

	Bare-ground study (Study 2)			Snow/ice study (Study 3)		
	Before (N=356)	Before (N=244)	After (N=244)	Before (N=611)	Before (N=461)	After (N=461)
Age, mean (range)	77.5 (65-99)	77 (65-99)	78 (66-100)	77.1 (65-100)	77 (65-100)	78 (66-101)
Age groups, N (%)						
65-79 years old	202 (58.0 %)	146 (60.6%)	139 (58.4%)	374 (63.7 %)	293 (65.5%)	253 (58.0%)
80- years old	146 (42.0 %)	95 (39.4%)	99 (41.6%)	213 (36.3 %)	154 (34.5%)	183 (42.0%)
Sex, N (%)						
Men	129 (36.8 %)	94 (38.7%)	92 (38.5%)	229 (37.9 %)	169 (37.1%)	168 (37.8%)
Women	222 (63.2 %)	149 (61.3%)	147 (61.5%)	375 (62.1 %)	287 (62.9%)	276 (62.2%)
Functional limitations, N (%)						
Only reduced movement	133 (37.4 %)	94 (38.5%)	87 (35.7%)	225 (37.4 %)	172 (38.1%)	179 (39.3%)
Only reduced cognition/perception	40 (11.2 %)	27 (11.1%)	18 (7.4%)	55 (9.2 %)	46 (10.2%)	53 (11.6%)
Both reduced movement and perception/cognition	98 (27.5 %)	63 (25.8%)	72 (29.5%)	163 (27.1 %)	114 (25.2%)	107 (23.5%)
No functional limitations	85 (23.9 %)	60 (24.6%)	67 (27.5%)	158 (26.3 %)	120 (26.5%)	117 (25.7%)
Mobility device, N (%)						
Stick/crutch	51 (14.3 %)	27 (11.1%)	31 (12.7%)	60 (9.8 %)	46 (10.0%)	46 (10.0%)
Rollator	71 (19.9 %)	41 (16.8%)	44 (18.0%)	155 (25.4 %)	98 (21.3%)	112 (24.3%)
Wheelchair	22 (6.2 %)	8 (3.2%)	9 (3.7%)	22 (3.6 %)	9 (2.0%)	6 (1.3%)
No mobility device	232 (70.3 %)	174 (76.0%)	169 (73.2%)	361 (64.7 %)	290 (68.7%)	278 (64.2%)
Dependence on walking as transport mode, N (%)						
Dependent (=access neither to car nor to STS)	93 (26.6 %)	72 (29.8%)	71 (29.6%)	121 (20.1 %)	98 (21.5%)	88 (19.8%)
Independent (=access to car and/or STS)	256 (73.4 %)	170 (70.2%)	169 (70.4%)	482 (79.9 %)	357 (78.5%)	357 (80.2%)
Access to car	195 (54.8 %)	142 (58.6%)	137 (56.9%)	361 (59.9 %)	284 (62.4%)	267 (59.9%)
Access to special transport services (STS)	68 (19.5 %)	32 (13.2%)	41 (17.1%)	137 (22.7 %)	82 (18.0%)	99 (22.3%)

Note: More than one functional limitation and type of mobility device per respondent, and access to both car and STS, were possible. There are also respondents with unknown age, sex, and dependence on walking as transport mode.

In the data analysis, factor analyses (Varimax rotation, eigen values >1) were conducted in order to categorise the 27 and 18 usability factors (U) into a number of usability categories (Uc). The factor analysis of the 27 usability factors (U) from the Bare-ground questionnaire resulted in five usability categories (Uc) (Table 4). The factor analysis of the 18 usability factors (U) from the Snow/ice questionnaire was rejected as it did not yield any factors that could be logically interpreted. Instead, these factors were reduced into 12, where the six excluded factors were considered to be too peripheral for the scope of this thesis since they referred to specific, not generally familiar, locations within the study district. Categorisation based on expert knowledge of the remaining 12 usability factors from the Snow/ice questionnaire yielded three usability categories concerning snow/ice conditions (Table 5).

Table 4: Usability factors/categories (U/Uc): bare-ground conditions (BG).

BG-Uc1	Physical barriers
BG-U1	Smooth surface conditions, no holes
BG-U2	Drainage grooves can be easily crossed
BG-U3	Low kerbs
BG-U4	Pavements with no steep gradients
BG-U5	Zebra crossings exist
BG-U6	No kerbs at zebra crossings
BG-U7	Resting surfaces exist in slopes
BG-U8	Shrubbery and tree branches are cut
BG-Uc2	Orientation and warning
BG-U23	No blocking commercial signs/baskets
BG-U24	Continuous guidance routes
BG-U25	Clear warning markings
BG-U26	Clear contrast markings
BG-U27	Kerb exists at zebra crossings
BG-Uc3	Bus stops and shops
BG-U11	Bus shelter at bus stops
BG-U12	High kerb at bus stops
BG-U13	Close to nearest bus stop
BG-U21	Automatic door openers in shops
BG-U22	Ramps at entrances in shops
BG-Uc4	Orderliness
BG-U9	Removal of graffiti and litter
BG-U10	Lighting
BG-U14	No parked bicycles
BG-U15	No cyclists in pedestrian areas
BG-U16	Clear separation of pedestrians and cyclists
BG-Uc5	Benches and stairs
BG-U17	Seating places (benches) exist
BG-U18	Seating places (benches) in good order
BG-U19	Handrails on stairs
BG-U20	Well-contrasted steps on stairs

Table 5: Usability factors/categories (U/Uc): snow/ice conditions (SI).

SI-Uc1	Snow removal, route level
SI-U1	Snow removed immediately
SI-U2	No snow on footpaths nearby residence[1]
SI-U3	No snow on footpaths in central city
SI-U8	No snow on pedestrian streets[1]
SI-U9	No snow on footpaths to grocery store[1]
SI-Uc2	Snow removal, detailed level
SI-U4	No snow on zebra crossings
SI-U5	No snow at bus stops
SI-U6	Kerbs are visible (snow removed)
SI-U7	No blocking heaps of snow
SI-U16	Usable benches in winter
SI-U17	Reachable poles
SI-Uc3	Ice prevention
SI-U10	No ice on footpaths nearby residence[1]
SI-U11	No ice on footpaths in central city
SI-U12	Even surfaces, no rough ice
SI-U13	Sanded surfaces
SI-U14	No ice on pedestrian streets[1]
SI-U15	No ice on footpaths to grocery store[1]
SI-U18	Half of the footpath is sanded

[1] Factors excluded after categorisation.
Note: SI-U18 refers to that kick-sled riders can use their kick-sleds on the unsanded surface.

For the before-data, significance analyses with the Mann-Whitney U test ($p<0.05$) were conducted in order to discover differences in the importance of usability factors and categories depending on individual background variables (age, sex, functional limitations, use of mobility device, and dependence on walking as transport mode). For the before-after analyses, significance analyses with the Sign test and McNemar test ($p<0.05$) were conducted in order to examine differences between the before and after situation in terms of respondents' satisfaction with each usability factor/category as well as of mobility and perceived safety. Importance of and satisfaction with usability factors (ordinal level of measurements) are presented in the result section of this thesis by mean values even though equally spaced intervals on the scale cannot be fully assumed. A combination of importance and satisfaction is also illustrated in a two-dimensional Cartesian plane with satisfaction (1-5) on the x-axis and importance (1-5) on the y-axis. For mobility and perceived safety, frequencies and percentages are presented.

Qualitative part - after

In order to support and to help in interpreting the quantitative results, focus group interviews and participant observations (in the Bare-ground study) with older people, as well as interviews with municipal employees, were conducted in both studies. These qualitative studies were held as soon as possible after the implementation period and the analyses of the quantitative data.

The participants for the focus group interviews were recruited among the questionnaire respondents. In the Bare-ground study, two focus groups were held with five participants in group 1 (persons using mobility devices) and five in group 2 (persons not using mobility devices). The focus group participants represented an age range from 71 to 93 years, of which three were women and seven were men. In the Snow/ice study, one focus group with eight participants was held. The focus group participants represented an age range from 70 to 89 years, of which three were women and five were men. The group included respondents using mobility devices, as well as those who did not. For the participant observations in the Bare-ground study, the participants were three of the persons who had participated in the before-observations, and they walked the same self-chosen route as before. Thus, a comparison with the participant observation in the before-study was possible. The three participants in the observations were all women, representing an age range from 84 to 95 years, of whom two used mobility devices. The interviews with municipal employees (planners and other practitioners) involved those employees that had been in contact with this project in one way or another. In the Bare-ground study, four municipal employees at the Technical Services Department, of whom two were directly involved in this project and two were involved in the accessibility work in general within the municipality, were individually interviewed. In the Snow/ice study, the interviewed municipal employees were those working with winter maintenance within the study district; one foreman and two workers were interviewed.

The focus group interviews began with a general discussion about the usability of outdoor environments within the study district, and as time went on, the discussion was led towards the implemented improvements and the results from the quantitative parts of the study. At this stage, a brief presentation of the results from the questionnaire study was given. The interview guide consisted of the following four themes:

The Bare-ground study

- General thoughts about usability of outdoor environments within the study district the past two years *(not mentioning the study and implementation).*
- The standard on pavements and other pedestrian facilities: differences and similarities at present compared with two years ago *(now the study and implementation are mentioned).*
- The pedestrian tunnel, park, benches, and bus stops: differences and

The Snow/ice study

- General thoughts about usability of outdoor environments within the study district during the winter 2006/2007 *(not mentioning the study and implementation).*
- The winter 2006/2007 compared with the winter before (2005/2006): differences and similarities concerning winter maintenance on pavements and footpaths *(now the study and implementation are mentioned).*
- The weather during the winter season

similarities at present compared with two years ago.
- Thoughts about the questionnaire results from the before-after study (leading the discussion to be about potential effects of improved accessibility).

in focus (2006/2007): differences and similarities compared with the winter before (2005/2006)
- Thoughts about the questionnaire results from the before-after study *(leading toward potential effects of improved winter maintenance).*

The interviews with municipal employees revolved around the interviewees' views on the implementation process and on solutions for improving accessibility for older people. On the basis of the usability factors, a comparison of the situation in the study districts before and after implementation was the main focus for the interviews. The interview guide consisted of the following four themes:

The Bare-ground study
- General thoughts about the municipality's accessibility work: what is good and what can be better?
- Actual accessibility situation within the study district at present and compared with two years ago: what is improved and what is still not accessible? *(reviewing each usability factor concerning bare-ground conditions)*
- The process of improving accessibility during the project time: satisfaction with implementation, attention to the project among the employees and politicians, etc.
- General thoughts on how older people perceive the improvements: viewpoints received at the municipality and discussion of the results from the questionnaires

The Snow/ice study
- The weather during the winter 2006/2007 compared with the winter 2005/2006: differences and similarities
- Snow removal during the winter 2006/2007 compared with the winter before (2005/2006): actual implemented improvements and potential improvements for the future *(reviewing each usability factor concerning snow removal)*
- Ice prevention during the winter 2006/2007 compared with the winter before (2005/2006): actual implemented improvements and potential improvements for the future *(reviewing each usability factor concerning ice prevention)*
- General thoughts about working with winter maintenance during the project time: satisfaction with implementation, attention to the project among the employees, etc.

In the analysis, the qualitative information from the focus groups interviews with older people and interviews with municipal employees was transcribed and analysed with qualitative content analysis in order to find general patterns that could support and help in interpreting the results from the questionnaires. The qualitative information from the participant observations was transcribed and analysed with

qualitative content analysis in order to find general patterns and identity critical incidents that, in comparison with the participant observations conducted before implementation, could help in the interpretation.

Implementation

In the Bare-ground study, the measures to improve accessibility in the outdoor environment were implemented by the municipality of Hässleholm within a defined study district during the implementation period of May 2006-September 2007. The study district was defined together with representatives from the municipality. The chosen area was located in the central area of Hässleholm, an urban area of approximately 287 000 m^2, including apartment blocks (1610 persons of all ages lives within the study district) as well as shops and other services, the railway and bus station, etc. Implemented measures were based on an inventory of the accessibility of outdoor environments made by the accessibility adviser at the Technical Services Department at the municipality. The physical barriers identified within the study district were removed during the implementation period. The barriers were such as the "easily removed barriers" directives, BFS 2003:19 HIN1, forces municipalities in Sweden to eliminate before 2010, e.g. differences in levels, uneven surfaces, drainage grooves difficult to cross, and high kerbs as well as poor contrast and warning, lighting, or balance support. The directives also involve entrances, e.g. ramps and automatic door openers. However, these barriers are the private property owners' responsibility and are not included in this study.

In addition to the accessibility measures, the municipality of Hässleholm renewed a park within the study district involving groundwork, pruning shrubbery, new benches and plantations, and lighting. The municipality also improved a pedestrian tunnel under the railway connecting two parts of the study district (graffiti removal, repainting, and installation of camera surveillance). Further, more benches, better public transport facilities (bus stops), and pruning shrubbery/tree branches were also measures taken within the study district during the implementation period. Table 6 provides an overview of implemented measures. It should be noted that the 27 usability factors were included to varying extent in the implementation; U5, U14, U16, and U21-23 were not taken care of at all.

Table 6: Types and frequency of implemented accessibility measures and other measures in the study district during the implementation period (May 2006-September 2007). N/N refers to the number of implemented accessibility measures in relation to number of remaining barriers according to the inventory.

Accessibility measures (BFS 2003:19 HIN1)		
Type	Description	N/N
Difference in level, uneven surfaces, drainage grooves, and kerbs	Smooth surface conditions (no holes), drainage grooves can be easily crossed, kerb heights, no steep gradients, resting surfaces	56/56
Contrast/warning	Continuous guidance routes, clear warning and contrast markings, well-contrasted steps on stairs	13/13
Orientation	Signs and other markings	2/2
Lightning	Lighting	1/1
Balance support	Handrails on stairs	1/1
Entrances	Ramps, automatic door openers, etc.	0/52
Other measures		
Type	Description	N
Benches	More benches and keep benches in good order	15
Shrubbery/tree branches	Cut blocking shrubbery/tree branches	3
Pedestrian tunnel	Graffiti removal, repainting the tunnel, installing camera surveillance.	1
Park	Renewing a park involving ground work, prune shrubbery, new benches and plantations, and lighting.	1
Bus stops	Relocation of bus stops (shorter distances), bus shelter at all bus stops, high kerbs at all bus stops, etc.	4

In the Snow/ice-study, improvements of the winter maintenance (snow removal and ice prevention) in pedestrian environments within the study district were carried out during the winter season of 2006/2007 by the municipality of Piteå. Before the implementation began, the research team held a seminar with those municipal employees working with winter maintenance in order to discuss the project and raise awareness of older peoples' needs. Prioritised routes within the study district, an urban area of approximately 540 000 m^2, were chosen by representatives from both the Technical Services Department and the Elderly Care Department in the municipality. These routes were frequently used pavements and footpaths with important destinations for older people, such as residential areas, the local senior centre, grocery stores, health centres, etc. Along the prioritised routes the following improvements were implemented:

- Routes were daily inspected by employees from the Technical Services Department in order to examine the need for snow removal and ice prevention.
- Snow removal was intensified on routes, e.g. the criterion for starting snow removal was lowered from 7 to 3 centimetres of snow. This prevents snow from being trampled and thereby difficult to remove if transformed into ice or icy snow.

- Snow removal on a detailed level was emphasised, e.g. removing snow at zebra crossings, around poles and traffic lights, etc., to clear the route for older people using mobility devices.
- Ice prevention (sanding) was done when needed and always immediately after the snow was removed.

❶ Implementation: Accomplished accessibility in the municipalities

The implementation process in municipal planning concerning accessibility are examined, and quantified by the Accessibility Implementation Index, in terms of actual efforts in the process (here referred to as "static factors"), awareness and use of governmental directives and recommendations on accessibility, and perception of the treatment and consideration of accessibility issues among municipal politicians and employees. The results presented in this section are based on quantitative data from the Municipality study (Study 1).

Accomplished level of implementation

The Municipality study (Study 1) showed a large variation in the level of implementation in municipal planning concerning accessibility. Several municipalities had made extensive efforts within the field, as opposed to others that had accomplished less. In other words, accessibility issues were treated differently among the Swedish municipalities. For example, 57% of the municipalities were aware of and applied the "easily removed barriers" directives (BFS 2003:19 HIN1) in daily planning. However, 15% of the municipalities were not aware of these legislative directives at all. An accessibility plan existed in 16% of the municipalities, including those municipalities where the work with creating this plan was still in progress, and 18% of the municipalities had an accessibility adviser employed.

The treatment of accessibility issues among municipal politicians and employees varied in the municipalities according to those employees responding to the questionnaire (Table 7). For example, half of the municipalities (51%) claimed that they carried out effective and purposeful work in order to improve accessibility (S1). Aspects concerning accessibility for older road users were generally on the agenda of the employees at different levels (S7, S8), albeit to a smaller extent on the political agenda (S4, S17). In a minority of the municipalities (23%), efforts made to increase accessibility were receiving sufficient funding in comparison with other issues (S5), and in 28% projects concerning accessibility for older road users could be carried out to a sufficient extent and of satisfactory quality (S6). In a majority of the municipalities, a need for improved knowledge concerning accessibility issues and

older road users among the municipal politicians (64%) and employees (55%) were reported (S19, S20).

Table 7: Statements (S) of how accessibility issues are treated among municipal politicians and employees: frequencies and percentages, N=188.

		Agree completely or almost compl.	Agree partly	Disagree
Sc1	Implementation, discussion and cooperation			
S1	Extensive and purposeful work is carried out in our municipality in order to improve accessibility for older road users.	92 (51%)	78 (43%)	10 (6%)
S2	Aspects concerning older people are part of the daily traffic safety work.	107 (59%)	66 (36%)	8 (5%)
S3	Aspects concerning older people are part of the daily accessibility work.	103 (58%)	65 (36%)	11 (6%)
S9	I often cooperate with other employees in order to carry out projects concerning accessibility and older road users.	94 (53%)	62 (35%)	21 (12%)
S14	It is difficult for the employee to know who is responsible for accessibility issues.	52 (29%)	56 (32%)	68 (39%)
S17	Issues concerning older road users are considered in the political agenda of the municipality.	46 (28%)	73 (45%)	45 (27%)
S18	There is a discussion between employees about issues concerning accessibility and older road users.	78 (43%)	79 (44%)	24 (13%)
Sc2	Attention and quality			
S4	Projects concerning accessibility and older road users receive attention from the municipal politicians	98 (57%)	66 (39%)	7 (4%)
S5	Efforts concerning accessibility and older road users are receiving sufficient funding in comparison with other issues.	38 (23%)	85 (50%)	46 (27%)
S6	As a planner, I feel that I can carry out projects concerning accessibility and older road users to a sufficient extent and of satisfactory quality.	49 (28%)	84 (47%)	44 (25%)
S7	My colleagues pay attention to me when it comes to issues concerning older road users	105 (58%)	70 (39%)	5 (3%)
S8	I get attention from my boss when it comes to issues concerning older road users.	115 (65%)	57 (33%)	4 (2%)
Sc3	Pressure from citizens			
S10	Older people bring considerable pressure through the municipal handicap council (or similar) regarding accessibility issues for older road users.	95 (53%)	62 (35%)	22 (12%)
S11	The pressure group of older people get attention of their opinions (if such pressure exists)	68 (43%)	81 (51%)	10 (6%)

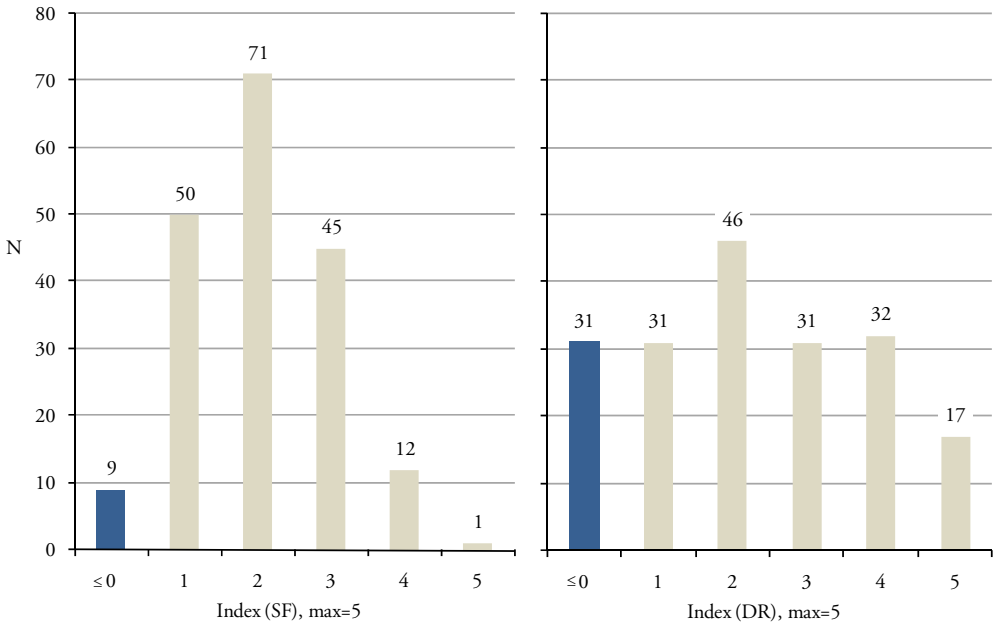
Continued on next page

S12	Citizens (individual older people, relatives or care givers) bring considerable pressure regarding accessibility issues for older road users.	62 (35%)	95 (53%)	22 (12%)
S13	The pressure group of citizens get attention of their opinions (if such pressure exists)	51 (31%)	108 (65%)	7 (4%)
Sc4	Perceived level of knowledge			
S19	There is a need for improved knowledge among the municipal politicians regarding accessibility issues and older road users.	114 (64%)	56 (32%)	8 (4%)
S20	There is a need for improved knowledge among the employees of the municipality regarding accessibility issues and older road users.	99 (55%)	75 (41%)	7 (4%)
S21	There is a need for improved knowledge among the citizens in the municipality regarding accessibility issues and older road users.	125 (70%)	47 (27%)	6 (3%)
Sc5	Conflicting interests			
S15	Efforts for older road users often lead to conflicts with the wishes of other road users.	31 (17%)	87 (48%)	62 (35%)
S16	Efforts for older road users often lead to conflicts between employees (or between departments) in the municipality.	8 (5%)	45 (25%)	124 (70%)

The municipal employees' agreement with the statements (S) was found to have implications for the municipalities' actual efforts in the implementation process concerning accessibility (SF) and regarding the respondents' awareness and use of governmental directives and recommendations on accessibility (DR). Municipalities that had an accessibility plan, an accessibility adviser, cooperated with interest organisations, had implemented measures to improve accessibility, and/or used governmental directives and recommendations on accessibility, agreed with the statements to a higher extent (responded more positively to) than municipalities without such items. For example, existence of an accessibility plan related to the statement concerning a discussion among municipal employees concerning accessibility issues (S18). Municipalities with an accessibility adviser were more likely to have issues concerning older people as part of their daily accessibility work (S3) than those without an adviser. Further, municipalities that used the documents on the "easily removed barriers" directives (BFS 2003:19 HIN1) were more likely to agree with statements concerning implementation, discussion and cooperation (Sc1), such as the statements "Aspects concerning older people are part of our daily accessibility work" (S3) and "I often cooperate with other employees in order to carry out projects concerning accessibility and older road users" (S9).

An instrument for quantifying implementation levels

A quantitative ranking of the implementation process in municipal planning concerning accessibility gave each municipality three separate indices for actual efforts (static factors, SF), use of governmental directives and recommendations on accessibility (DR), and statements concerning how accessibility issues are treated among municipal politicians and employees (S). Figure 4 shows the number of municipalities for each level of the indices in the Accessibility Implementation Index. Few municipalities had reached the highest indices; one municipality was found to have all of the five static factors, 17 of the municipalities used all five directives and recommendations, and one municipality agreed positively with all of the 12 statements that were included in the index. In other words, few municipalities had answered positively to all questions included in the indices. In fact, there were more municipalities (9, 31, and 15 respectively) that had reached the lowest indices (≤0) by answering neutrally or negatively to all questions included in the indices.



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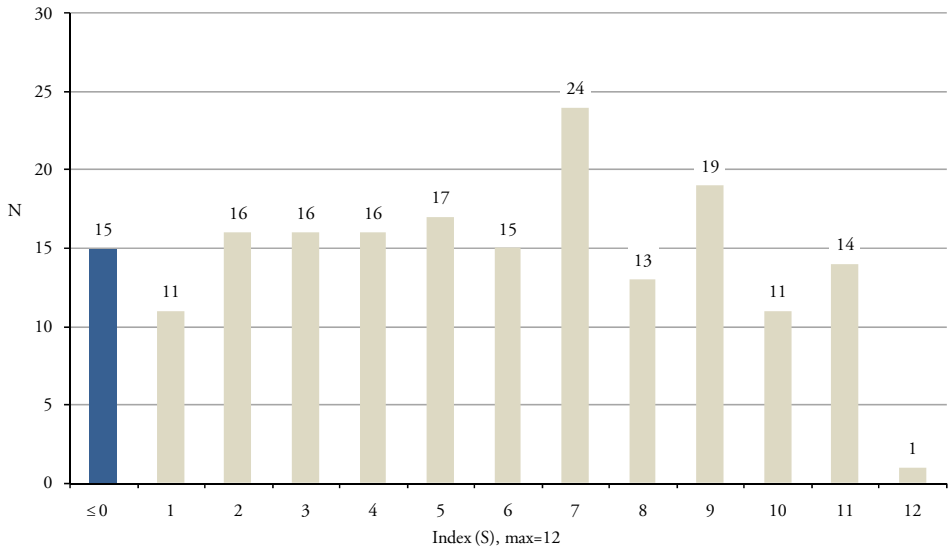

Figure 4: Number of municipalities for each level of the indices in the Accessibility Implementation Index: static factors (SF), directives and recommendations (DR), and statements (S), N=188.

The size of the municipality was related to the Accessibility Implementation Index; municipalities with fewer inhabitants had accomplished less and had therefore a lower summarised index. There was also a variation of the summarised index by the type of municipality. Big cities (Stockholm, Gothenburg, and Malmo) and larger cities have the highest mean indices, while sparsely populated, industrial, rural, and other smaller municipalities have the lowest (Figure 5).

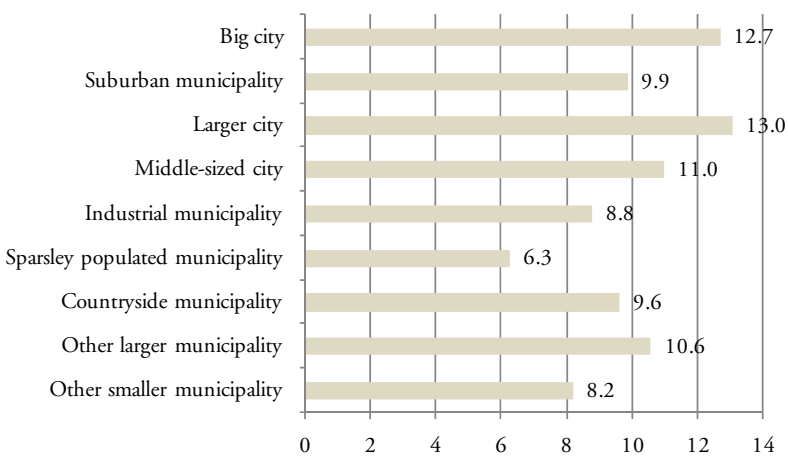

Figure 5: Summarised Accessibility Implementation Index (mean) by type of municipality, N=188.

❷ Older peoples' perceptions of the outdoor environment

Older peoples' perceptions of the outdoor environment are illustrated in terms of the importance of and satisfaction with usability factors/categories (U/Uc) concerning bare-ground (BG) and snow/ice (SI) conditions. Individual background variables (age, sex, functional limitations, mobility device, and dependence on walking as transport mode) are found to influence the perceived importance of several usability factors and categories. The results presented in this section are based on quantitative before-data from the Bare-ground study (Study 2) and the Snow/ice study (Study 3).

Usability

The importance of usability factors/categories is presented in Table 8-9. In bare-ground conditions, the most important usability factors concerned the category Orderliness (BG-Uc4), especially the factors "no cyclists in pedestrian areas" (BG-U15) and "lighting" (BG-U10). Benches & Stairs (BG-Uc5) was the second most important usability category in bare-ground conditions, where "handrails on stairs" (BG-U19) was found among the most important factors. In snow/ice conditions, the most important usability factors concerned the category Ice prevention (SI-Uc3), especially the factors "even surfaces, no rough ice" (SI-U12) and "sanded surfaces" (SI-U13). Snow removal on detailed level (SI-Uc2) was considered less important than on route level (SI-Uc1); however, the single usability factors "no blocking heaps of snow" (SI-U7) and "no snow on zebra crossings" (SI-U4) were almost as important as those concerning Ice prevention (SI-Uc3).

A combination of the importance of and satisfaction with the usability factors/categories is illustrated in Figure 6. Single factors such as cyclists and bicycles on pavements and footpaths (BG-U14, BG-U15, and BG-U16) and prevalence of graffiti and litter (BG-U9) are found in the top left quadrant of the Cartesian plane, i.e. factors of high relevance for older people, but with which they are unsatisfied. "Even surfaces, no rough ice" (SI-U12) is found to be right in the middle on the two top quadrants. The only usability factor found below the x-axis is "usable benches in winter" (SI-U16), which is thus of low importance for the respondents.

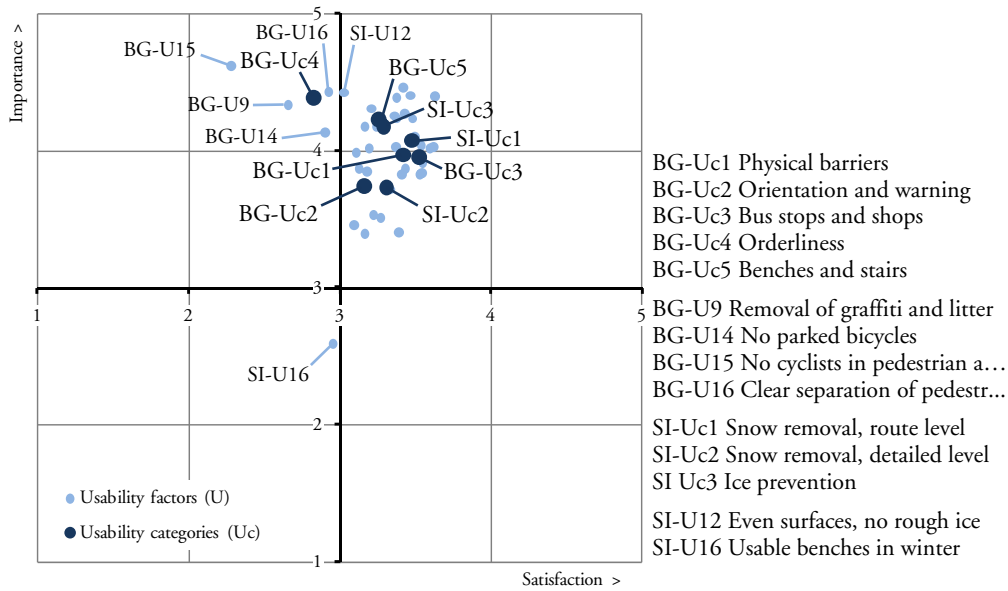

Figure 6: Importance of and satisfaction with usability factors/categories (U/Uc) concerning bare-ground (BG) and snow/ice (SI) conditions, N=356.

Influence of individual background variables

There were differences in the importance of and satisfaction with usability factors/categories in both bare-ground and snow/ice conditions depending on individual background variables. Respondents' sex, followed by reported functional limitations and use of mobility device, and then by age, influenced usability.

Women perceived several usability factors as more important compared with men (Table 8-9). Women stated all usability categories concerning both bare-ground and snow/ice conditions as more important than men did. Except for three single factors (BG-U15, BG-U16, and SI-U16), differences were also found for all usability factors. However, men and women had similar ranking of the factors, i.e. those factors that were considered to be the most important as perceived by women were also found among the most important factors as perceived by men.

Respondents having functional limitations and using mobility devices perceived several usability factors concerning both bare-ground and snow/ice conditions as more important compared with others (Table 8-9). For example, the usability category Physical barriers (BG-Uc1) was considered more important by respondents with functional limitations or by users of mobility devices. The usability factors "no snow on zebra crossings" (SI-U4) and "no blocking heaps of snow" (SI-U7) were also more emphasised by users of mobility devices than by non-users. However, when

comparing different types of functional limitations (reduced movement vs. reduced perception/cognition), no differences were found. The comparison "reduced movement vs. no reduced movement" showed almost similar results as the comparison depending on occurrence of functional limitations in general. For people with reduced perception/cognition, the factor "no blocking commercial signs/baskets" (BG-U23) was more important than for those with no such reduction. Also regarding type of mobility device (cane/crutch, rollator, and wheelchair), few differences were found.

The differences in perceptions between respondents 65-79 years old and those 80 years and older are less evident than for other background variables (Table 8-9). The importance of all usability categories concerning bare-ground conditions increased with age, except for the category Orderliness (BG-Uc4). The usability factors "no kerbs at zebra crossings" (BG-U6), "high kerb at bus stops" (BG-U12), "close between bus stops" (BG-U13), and "automatic door openers" (BG-U21) were considered as more important by the oldest old (80 years and older) than by the younger old (65-79 years old). For the oldest old, Benches & Stairs (BG-Uc5) was just as important as Orderliness (BG-Uc4). In snow/ice conditions, the importance of the usability category Snow removal on route level (SI-Uc1) increased with increasing age. However, only a few single factors were stated as increasingly important by age.

Table 8: Mean values for the statistically significant differences (Mann-Whitney U, $p<0.05$) of the importance of usability factors/categories (U/Uc) concerning bare-ground conditions, N=356.

		Total	Age		Sex		Functional limitations		Mobility device		Walking as transport mode	
			65-79	80-	Men	Women	Yes	No	Yes	No	Dependent	Independent
BG-Uc1	Physical barriers	4.0	3.9	4.1	3.7	4.1	4.1	3.6	4.2	3.9	4.2	3.9
BG-U1	Smooth surface conditions, no holes	4.3			4.1	4.4	4.4	4.0	4.5	4.2		
BG-U2	Drainage grooves can be easily crossed	3.8	3.8	4.0	3.5	4.1	4.0	3.4			4.1	3.7
BG-U3	Low kerbs	4.0	3.9	4.2	3.8	4.2	4.2	3.6	4.5	3.8	4.3	3.9
BG-U4	Pavements with no steep gradients	3.8	3.7	4.0	3.5	4.0	3.9	3.4	4.1	3.7	4.1	3.7
BG-U5	Zebra crossings exist[1]	4.0	4.0	4.1	3.8	4.2	4.1	3.8				
BG-U6	No kerbs at zebra crossings	3.9	3.7	4.1	3.6	4.1	4.0	3.3	4.4	3.7	4.1	3.8
BG-U7	Resting surfaces exist in slopes	3.5	3.3	3.8	3.3	3.7	3.6	3.1	3.9	3.3	3.8	3.4
BG-U8	Shrubbery and tree branches are cut	4.3			4.1	4.3						
BG-Uc2	Orientation and warning	3.7	3.6	3.9	3.5	3.9	4.1	3.6	3.9	3.7	3.9	3.7
BG-U23	No blocking commercial signs/baskets	4.0			3.7	4.1	4.1	3.7	4.2	3.9		
BG-U24	Continuous guidance routes	3.5			3.3	3.7			3.8	3.5		
BG-U25	Clear warning markings	3.9	3.8	3.9	3.7	4.0						
BG-U26	Clear contrast markings	3.9			3.6	4.0					4.1	3.8
BG-U27	Kerb exists at zebra crossings	3.4	3.3	3.6	3.1	3.6					3.7	3.3
BG-Uc3	Bus stops and shops	4.0	3.8	4.1	3.7	4.1			4.2	3.8	4.3	3.8
BG-U11	Bus shelter at bus stops[1]	3.9	3.8	4.1	3.7	4.1	4.0	3.6	4.1	3.8	4.3	3.8
BG-U12	High kerb at bus stops	4.0	3.9	4.2	3.7	4.2	4.2	3.6	4.3	3.9	4.4	3.9
BG-U13	Close to nearest bus stop[1]	3.8	3.7	4.0	3.5	4.0	3.9	3.4	4.0	3.8	4.2	3.7
BG-U21	Automatic door openers in shops	4.0	3.9	4.2	3.7	4.2	4.1	3.7	4.4	3.9	4.3	3.9
BG-U22	Ramps at entrances in shops	4.0	3.8	4.2	3.7	4.1	4.1	3.6	4.3	3.8	4.2	3.9
BG-Uc4	Orderliness	4.4			4.3	4.5	4.3	4.0				
BG-U9	Removal of graffiti and litter[1]	4.3			4.2	4.4						
BG-U10	Lighting	4.5			4.3	4.6					4.6	4.4
BG-U14	No parked bicycles	4.1			4.0	4.2						

Continued on next page

BG-U15	No cyclists in pedestrian areas[1]	4.6											
BG-U16	Clear separation of pedestrians and cyclists[1]	4.4											
BG-Uc5	Benches and stairs	4.2	4.2	4.3	4.0	4.3					4.4		4.2
BG-U17	Seating places (benches) exist[1]	4.0	3.9	4.1	3.8	4.1	4.1	3.7					
BG-U18	Seating places (benches) in good order[1]	4.2			4.1	4.2	4.2	4.0					
BG-U19	Handrails on stairs	4.4	4.3	4.5	4.2	4.6	4.5	4.2	4.5	4.3	4.6		4.4
BG-U20	Well-contrasted steps on stairs	4.3			4.0	4.5	4.4	4.1			4.5		4.2

[1] Not included in the "easily removed barriers" directives, BFS 2003:19 HIN1.

Table 9: Mean values for the statistically significant differences (Mann-Whitney U, $p<0.05$) of the importance of usability factors/categories (U/Uc) concerning snow/ice conditions, N=611.

		Total	Age		Sex		Functional limitations		Mobility device		Walking as transport mode	
			65-79	80-	Men	Women	Yes	No	Yes	No	Dependent	Independent
SI-Uc1	Snow removal, route level	4.1	4.0	4.1	4.0	4.1	4.1	3.9	4.2	4.0		
SI-U1	Snow removed immediately	4.1	4.0	4.1	4.0	4.1	4.1	3.9	4.2	4.0		
SI-U3	No snow on footpaths in the central city	4.1	4.1	4.2	4.0	4.2	4.2	4.0	4.2	4.0		
SI-Uc2	Snow removal, detailed level	3.7			3.6	3.8	3.8	3.6	3.8	3.7		
SI-U4	No snow on zebra crossings	4.2	4.2	4.3	4.2	4.3	4.3	4.1	4.4	4.2		
SI-U5	No snow at bus stops	3.4			3.1	3.6			3.2	3.5	3.7	3.3
SI-U6	Kerbs are visible (snow removed)	4.2			4.0	4.3	4.2	4.0	4.3	4.1		
SI-U7	No blocking heaps of snow	4.2			4.1	4.3			4.3	4.2		
SI-U16	Usable benches in winter	2.6					2.7	2.2	2.8	2.4		
SI-U17	Reachable poles	3.7			3.6	3.8						
SI-Uc3	Ice prevention	4.2			4.0	4.3	4.2	4.1	4.3	4.1	4.3	4.1
SI-U11	No ice on footpaths in the central city	4.4			4.3	4.4	4.4	4.3	4.5	4.3		
SI-U12	Even surfaces, no rough ice	4.4	4.4	4.5	4.3	4.5	4.5	4.3	4.6	4.3		
SI-U13	Sanded surfaces	4.4			4.3	4.5			4.5	4.4		
SI-U18	Half of the footpath is sanded	3.5	3.4	3.6	3.3	3.6					3.8	3.4

Perceptions in relation with legislative directive

The usability factors concerning bare-ground conditions included factors from the "easily removed barriers" directives (BFS 2003:19 HIN1) as well as factors derived from the qualitative studies. The factors from the legislative directives were found to be important for older people, and became increasingly important by age and among older people with functional limitations and mobility devices. However, eight of the factors in bare-ground conditions, and all factors in snow/ice conditions, were *not* included in the "easily removed barriers" directives (Figure 7, also marked in Table 8). Several of the not included factors were found to be perceived as important by the respondents. In bare-ground conditions, this mainly concerned Orderliness (BG-Uc4), for example "no cyclists in pedestrian areas" (BG-U15), "clear separation of pedestrians and cyclists" (BG-U16), and "removal of graffiti and litter" (BG-U9), as well as Benches and Stairs (BG-Uc5), for example "seating places (benches) in good order" (BG-U18). Another factor not included, "zebra crossings exist" (BG-U5), was also considered important by the respondents.

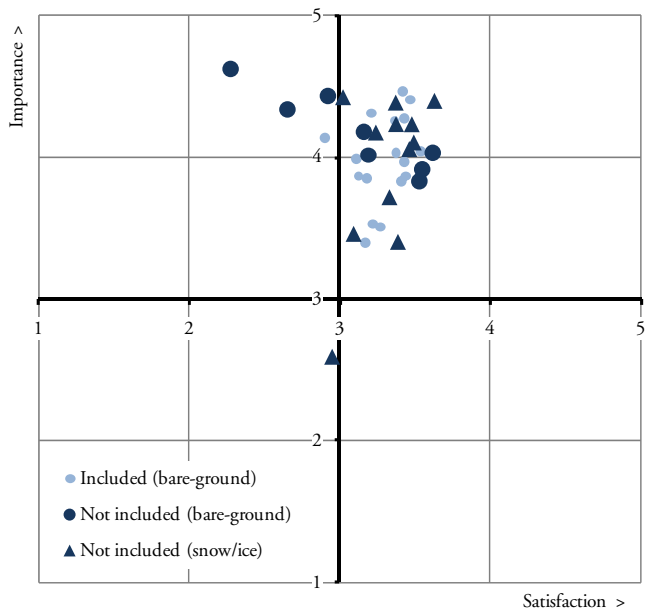

Figure 7: Importance of and satisfaction with usability factors (U) concerning bare-ground and snow/ice conditions: factors included in BFS 2003:19 HIN1 versus those not included, N=356/611.

❸ Effects of implemented measures

Effects of measures to improve accessibility in outdoor environments by removing physical barriers in the outdoor environment according to the "easily removed barriers" directives (BFS 2003:19 HIN1) as well as by improving winter maintenance on pavements and footpaths are illustrated in terms of usability, mobility and perceived safety before and after implementation. The results presented in this section are based on quantitative before-after data from the Bare-ground study (Study 2) and the Snow/ice study (Study 3).

Usability

In the Bare-ground study, respondents were more satisfied with outdoor environments within the study district after implementation, both concerning outdoor environments nearby their residences (p=0.025) and in other public areas (p=0.049). More specifically, there was increased satisfaction after implementation with orderliness-related factors, such as "removal of graffiti and litter" (BG-U9) (p=0.000) and with "clear separation between pedestrians and cyclists" (BG-U16) (p=0.017). However, there was decreased satisfaction with "no kerbs at zebra crossings" (BG-U6) (p=0.000) and "no commercial signs and baskets" (BG-U23) (p=0.047). In the Snow/ice study, there were almost no statistically significant differences between the before and after situation regarding respondents' satisfaction with winter maintenance, except for a decreased satisfaction with "usable benches in winter" (SI-U16) (p=0.028) after implementation. Table 10-11 present satisfaction with usability factors/categories before and after implementation.

Table 10: Mean values of satisfaction with usability factors/categories (U/Uc) concerning bare-ground conditions and differences in satisfaction after implementation (Sign test, $p<0.05$), N=244.

		Satisfaction, mean		Change after implementation, N (%)			
		Before	After	Decreased	Increased	No diff.	Sign.
BG-Uc1	Physical barriers	3.5	3.4	101 (42.8%)	95 (40.3%)	40 (16.9%)	0.721
BG-U1	Smooth surface conditions, no holes	3.5	3.4	50 (21.8%)	58 (25.3%)	121 (52.8%)	0.501
BG-U2	Drainage grooves can be easily crossed	3.6	3.5	50 (22.8%)	40 (18.3%)	129 (58.9%)	0.343
BG-U3	Low kerbs	3.4	3.4	60 (26.8%)	52 (23.2%)	112 (50.0%)	0.508
BG-U4	Pavements with no steep gradients	3.5	3.4	56 (25.9%)	45 (20.8%)	115 (53.2%)	0.320
BG-U5	Zebra crossings exist	3.7	3.7	49 (21.9%)	45 (20.1%)	130 (58.0%)	0.757
BG-U6	No kerbs at zebra crossings	3.5	3.3	63 (29.3%)	28 (13.0%)	124 (57.7%)	0.000*
BG-U7	Resting surfaces exist in slopes	3.3	3.2	46 (22.4%)	38 (18.5%)	121 (59.0%)	0.445
BG-U8	Shrubbery and tree branches are cut	3.4	3.4	44 (19.6%)	55 (24.6%)	125 (55.8%)	0.315
BG-Uc2	Orientation and warning	3.2	3.2	90 (41.7%)	84 (38.9%)	42 (19.4%)	0.705
BG-U23	No blocking commercial signs/baskets	3.2	3.0	61 (28.4%)	40 (18.6%)	114 (53.0%)	0.047*
BG-U24	Continuous guidance routes	3.3	3.3	30 (15.7%)	40 (20.9%)	121 (63.4%)	0.282
BG-U25	Clear warning markings	3.2	3.3	30 (15.8%)	37 (19.5%)	123 (64.7%)	0.464
BG-U26	Clear contrast markings	3.2	3.3	35 (18.7%)	43 (23.0%)	109 (58.3%)	0.428
BG-U27	Kerb exists at zebra crossings	3.3	3.2	44 (22.8%)	45 (23.3%)	104 (53.9%)	1.000
BG-Uc3	Bus stops and shops	3.6	3.5	90 (39.1%)	87 (37.8%)	53 (23.0%)	0.881
BG-U11	Bus shelter at bus stops	3.6	3.5	47 (21.5%)	50 (22.8%)	122 (55.7%)	0.839
BG-U12	High kerb at bus stops	3.6	3.6	40 (18.3%)	36 (16.5%)	142 (65.1%)	0.731
BG-U13	Close to nearest bus stop	3.6	3.5	46 (21.3%)	40 (18.5%)	130 (60.2%)	0.590
BG-U21	Automatic door openers in shops	3.7	3.6	50 (23.4%)	38 (17.8%)	126 (58.9%)	0.241
BG-U22	Ramps at entrances in shops	3.5	3.5	48 (22.5%)	46 (21.6%)	119 (55.9%)	0.918
BG-Uc4	Orderliness	2.8	3.0	86 (37.1%)	116 (50.0%)	30 (12.9%)	0.041*
BG-U9	Removal of graffiti and litter	2.7	3.0	33 (14.8%)	89 (39.9%)	101 (45.3%)	0.000*
BG-U10	Lighting	3.5	3.5	46 (20.7%)	56 (25.2%)	120 (54.1%)	0.373
BG-U14	No parked bicycles	2.9	3.0	52 (24.9%)	54 (25.8%)	103 (49.3%)	0.923

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BG-U15	No cyclists in pedestrian areas	2.3	2.4	38 (17.0%)	56 (25.1%)	129 (57.8%)	0.080
BG-U16	Clear separation of pedestrians and cyclists	3.0	3.1	46 (21.2%)	73 (33.6%)	98 (45.2%)	0.017*
BG-Uc5	Benches and stairs	3.3	3.3	87 (39.0%)	85 (38.1%)	51 (22.9%)	0.939
BG-U17	Seating places (benches) exist	3.2	3.2	49 (22.1%)	60 (27.0%)	113 (50.9%)	0.338
BG-U18	Seating places (benches) in good order	3.2	3.3	47 (21.7%)	62 (28.6%)	108 (49.8%)	0.180
BG-U19	Handrails on stairs	3.5	3.4	48 (21.9%)	38 (17.4%)	133 (60.7%)	0.332
BG-U20	Well-contrasted steps on stairs	3.3	3.2	58 (26.7%)	50 (23.0%)	109 (50.2%)	0.501

Table 11: Mean values of satisfaction with usability factors/categories (U/Uc) concerning snow/ice conditions and differences in satisfaction after implementation (Sign test, $p<0.05$), N=461.

		Satisfaction, mean		Change after implementation, N (%)			
		Before	After	Decreased	Increased	No diff.	Sign.
SI-Uc1	Snow removal, route level	3.5	3.5	124 (27.7%)	118 (26.3%)	206 (46.0%)	0.748
SI-U1	Snow removed immediately	3.5	3.5	96 (21.5%)	95 (21.3%)	256 (57.3%)	1.000
SI-U3	No snow on footpaths in central city	3.6	3.5	100 (22.7%)	84 (19.0%)	257 (58.3%)	0.269
SI-Uc2	Snow removal, detailed level	3.4	3.3	197 (43.9%)	177 (39.4%)	75 (16.7%)	0.326
SI-U4	No snow on zebra crossings	3.5	3.6	81 (18.3%)	90 (20.4%)	271 (61.3%)	0.541
SI-U5	No snow at bus stops	3.4	3.4	71 (19.0%)	64 (17.1%)	239 (63.9%)	0.606
SI-U6	Kerbs are visible (snow removed)	3.3	3.4	89 (20.2%)	113 (25.7%)	238 (54.1%)	0.106
SI-U7	No blocking heaps of snow	3.4	3.4	101 (23.4%)	92 (21.3%)	239 (55.3%)	0.565
SI-U16	Usable benches in winter	3.0	2.9	72 (18.8%)	47 (12.3%)	264 (68.9%)	0.028*
SI-U17	Reachable poles	3.3	3.3	86 (23.0%)	75 (20.1%)	213 (57.0%)	0.431
SI-Uc3	Ice prevention	3.3	3.3	163 (36.1%)	171 (37.8%)	118 (26.1%)	0.702
SI-U11	No ice on footpaths in central city	3.4	3.4	99 (22.6%)	98 (22.3%)	242 (55.1%)	1.000
SI-U12	Even surfaces, no rough ice	3.1	3.1	102 (23.2%)	104 (23.7%)	233 (53.1%)	0.944
SI-U13	Sanded surfaces	3.7	3.7	82 (18.9%)	75 (17.3%)	276 (63.7%)	0.632
SI-U18	Half of the foot path is sanded	3.1	3.1	72 (18.0%)	84 (21.1%)	243 (60.9%)	0.378

Usability in terms of importance of and satisfaction with the usability factors and categories before and after implementation are presented in Figure 8-9. The illustration shows only minor differences between the before and after situation. The factor "clear separation of pedestrian/cyclists" (BG-U16) has moved from the top left quadrant to the top right, i.e. is still important but is associated with less dissatisfaction. Two factors have moved to a location on the border between the two top quadrants. "Removal of graffiti and litter" (BG-U9) has moved towards less dissatisfaction; however, "no blocking commercial signs/baskets" (BG-U23) has moved in the opposite direction. Factors concerning cyclists and bicycles on pavements and footpaths (BG-U14 and BG-U15) are still associated with dissatisfaction. Also the factor "even surfaces, no rough ice" (SI-U12) is still found in the middle of the two top quadrants.

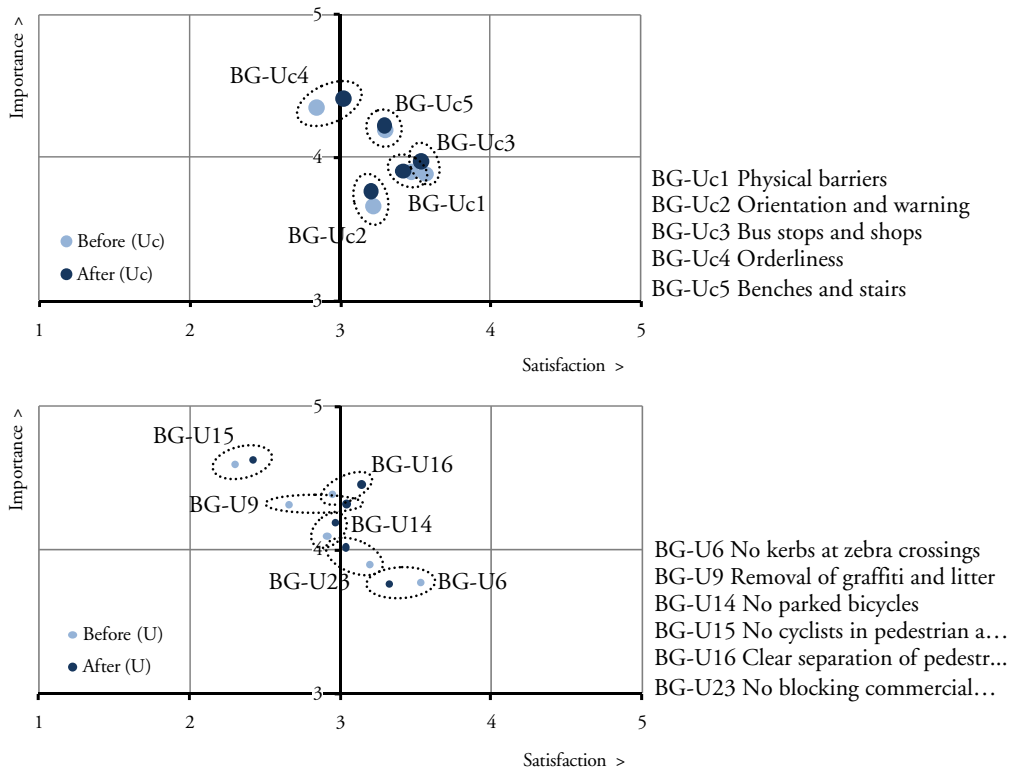

Figure 8: Importance of and satisfaction with usability factors/categories (U/Uc) concerning bare-ground conditions: before versus after implementation, N=244.

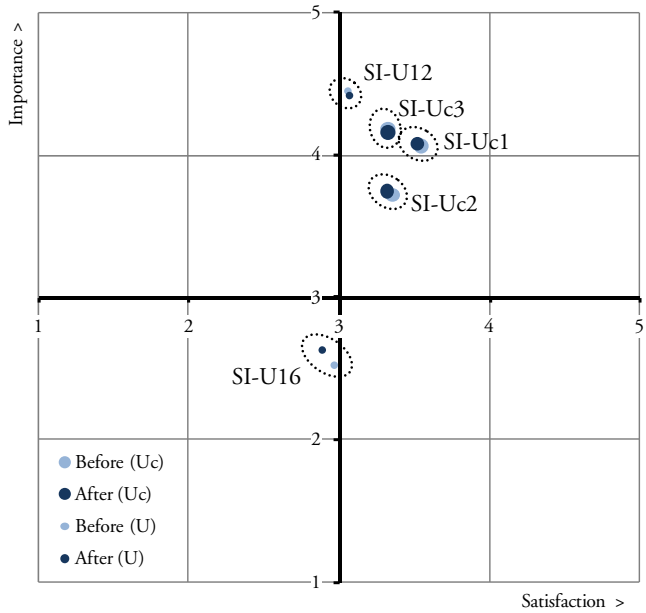

Figure 9: Importance of and satisfaction with usability factors/categories (U/Uc) concerning snow/ice conditions: before versus after implementation, N=461.

A majority of the respondents perceived difficulties when walking outdoors. In the Bare-ground study, 62% at least sometimes perceived difficulties. No statistical significant difference was found after implementation (56%). The corresponding figures in the Snow/ice study were 49% and 48%. Figure 10 illustrates reasons for perceiving difficulties when walking in the study districts regardless of ground condition. In both studies, ice and slipperiness are found among the most reported difficulties. In the Bare-ground study, poor snow removal and cyclists on pavements and footpaths are reported almost as frequent as ice and slipperiness. No statistical significant differences in reported difficulties regardless of ground condition were found after implementation.

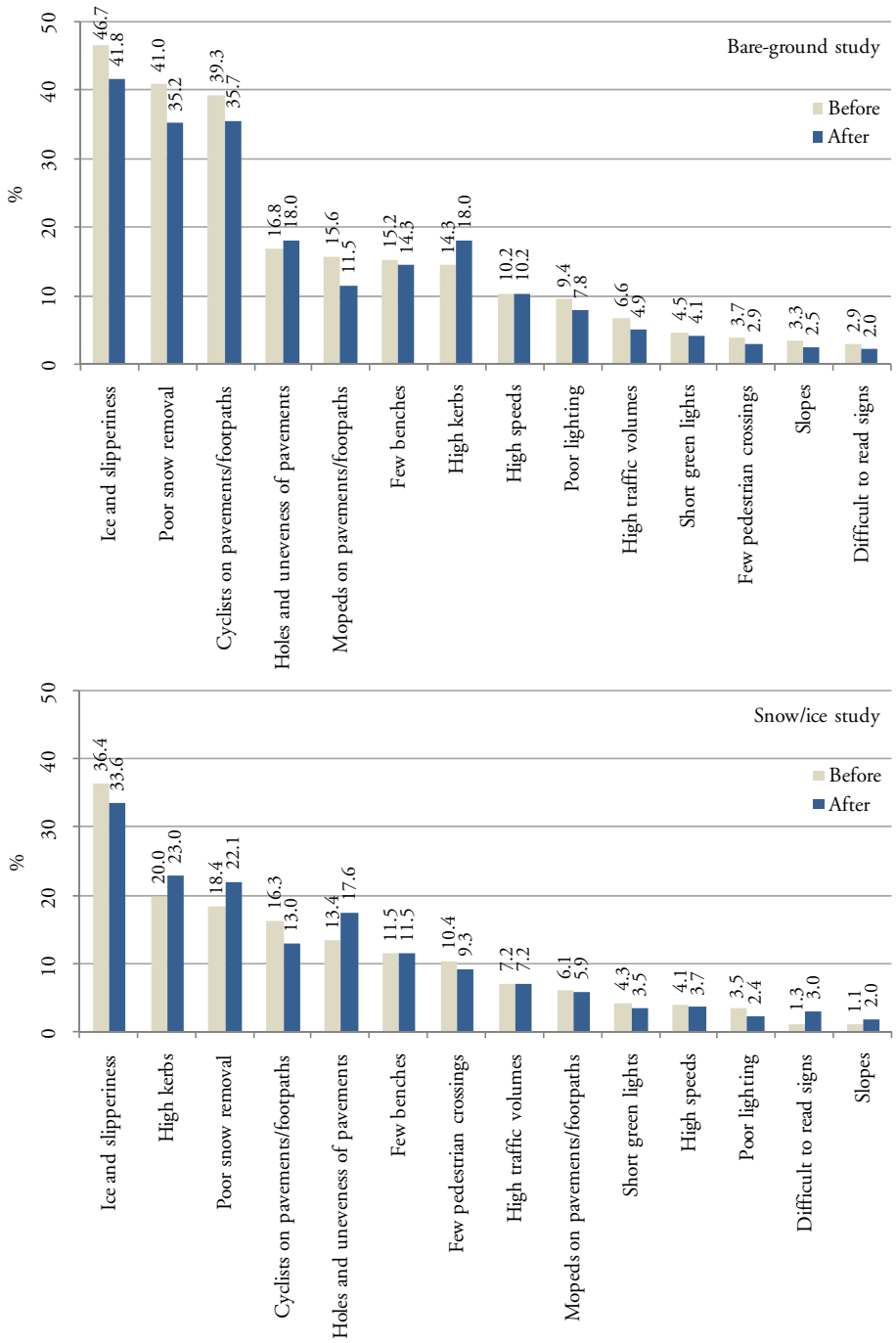

Figure 10: Frequency of perceived difficulties when walking outdoors (regardless of ground condition): before versus after implementation (McNemar test, $p<0.05$), N=244/461.

Mobility

A majority of the respondents walked outdoors at least once a week, and around one third walked on daily basis. The level of outdoor mobility is slightly lower in snow/ice conditions than in bare-ground conditions. After implementation, the Bare-ground study showed an unchanged mobility and in the Snow/ice study the mobility had actually decreased (p=0.031). Avoidance of outdoor mobility was more common during winter. In the Bare-ground study, 63% of the questionnaire respondents stated that they at least sometimes avoided walking before implementation. The corresponding figure was 73 % in the Snow/ice study. No statistical significant difference was found after implementation (60%, 69 % respectively). Frequency of walking, and of avoidance of walking, is presented in Figure 11.

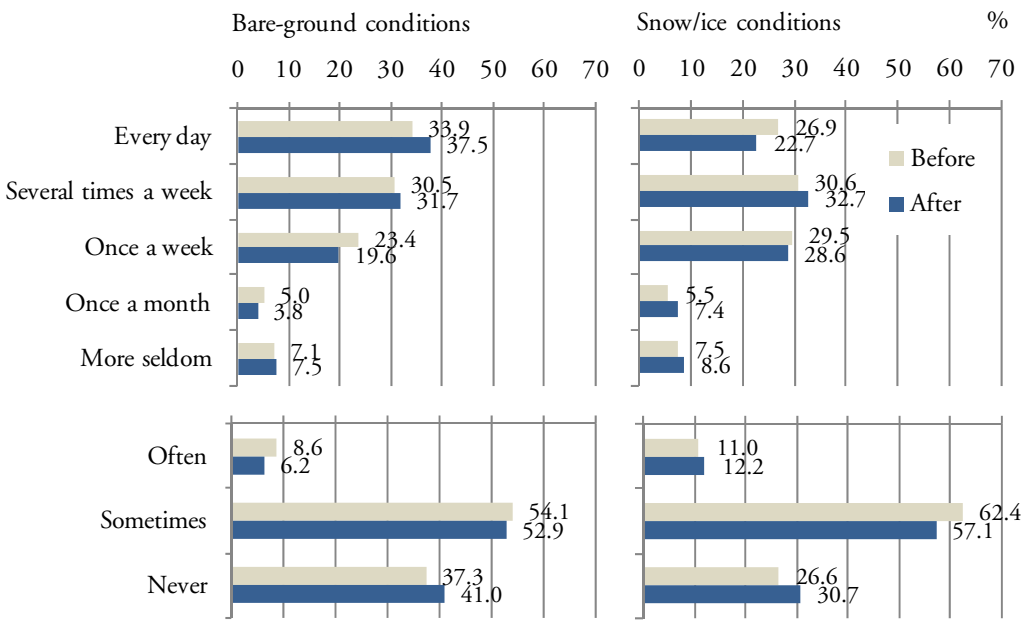

Figure 11: Frequency of walking (top), and of avoidance of walking (bottom), outside the residence in bare-ground and snow/ice conditions: before versus after implementation, N=244/461.

There are several reasons for avoiding outdoor mobility, and the most common is weather conditions (Figure 12). In both studies, personal health was also stated as a factor restricting mobility. After implementation, fewer respondents stated difficulties in walking due to barriers in the outdoor environment (p=0.023) and difficulties in walking due to snow and ice (p=0.008) as reasons to avoid walking. Other reasons were found to be unchanged. One noteworthy finding in the Snow/ice study was that

among the respondents using a mobility device (N=132), 27% of the respondents in the before-questionnaire reported that the mobility device was poorly adapted for outdoor use.

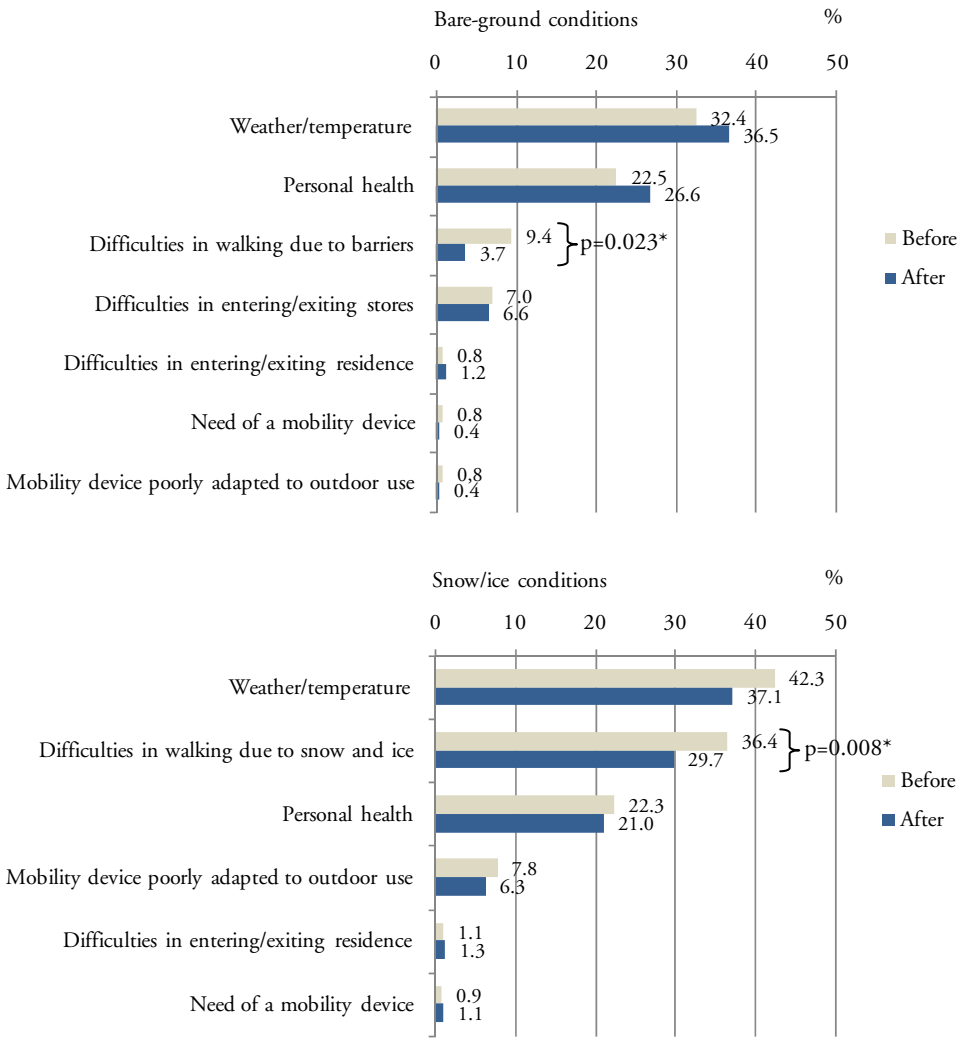

Figure 12: Frequency of reasons to avoid walking in bare-ground and snow/ice conditions: before versus after implementation (McNemar test, $p<0.05$), N=244/461.

Perceived safety

In the Bare-ground study, 57% of the questionnaire respondents stated that they at least sometimes felt fear or anxiety when walking in the study district before implementation (regardless of ground condition; Figure 13). The corresponding figure in the Snow/ice study was 35%. No difference was found after implementation in the Bare-ground study; however, in the Snow/ice study the perceived safety has increased (p=0.045).

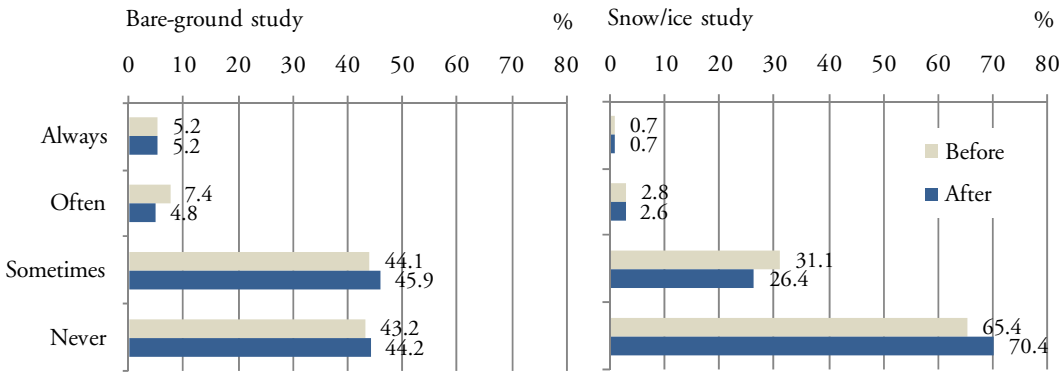

Figure 13: Frequency of perceived unsafety when walking outdoors (regardless of ground condition): before versus after implementation, N=244/461.

Concerning reasons for perceived unsafety, fear of robbery/assault/threat was the most common when walking in the study districts, especially in the Bare-ground study (Figure 14). The Snow/ice study showed a decreased frequency of both fear of involvement in traffic accident (p=0.026) and fear of robbery/assault/threat (p=0.040) after implementation. No statistical significant differences after implementation were found in the Bare-ground study however. None of the studies showed any differences regarding fear of falling.

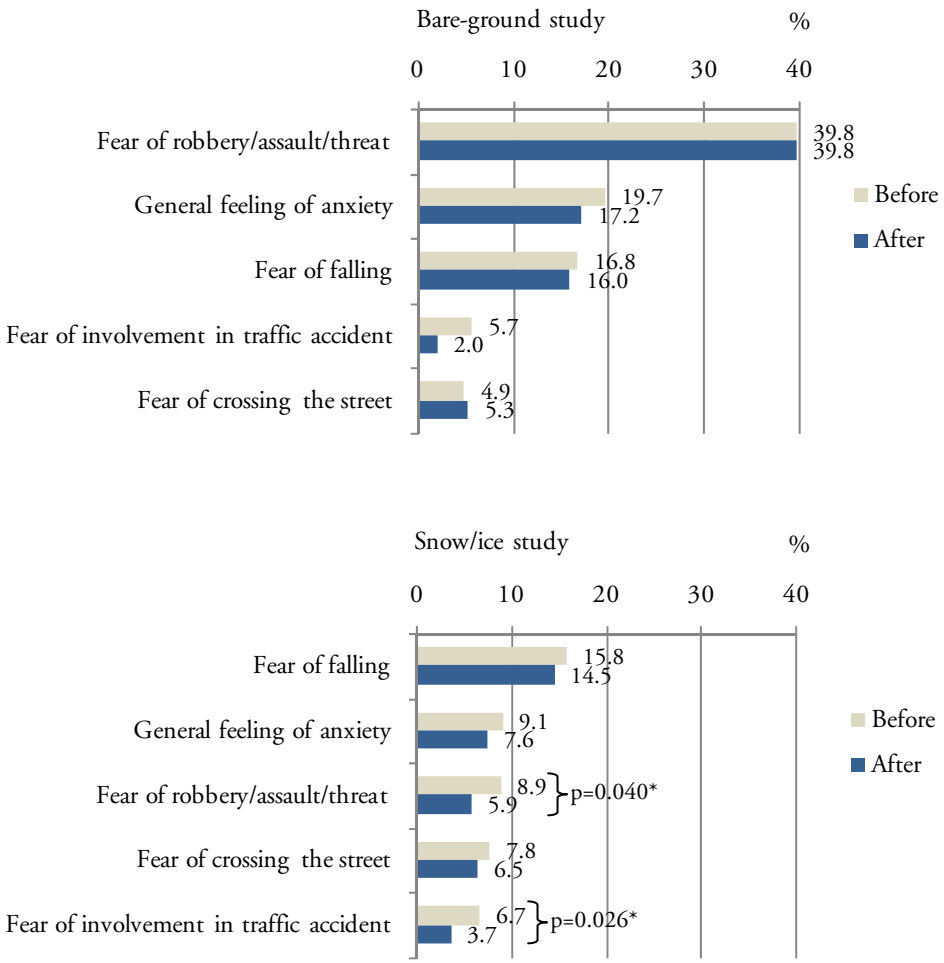

Figure 14: Frequency of reasons to feel fear or anxiety when walking outdoors (regardless of ground condition): before versus after implementation (McNemar test, $p<0.05$), N=244/461.

❹ Implementation: Municipal employees' views

The interviews with municipal employees generated extensive information about the implementation process in municipal planning concerning accessibility. The findings presented in this section are based on the qualitative parts conducted after implementation in the Bare-ground study (Study 2) and the Snow/ice study (Study 3).

Implemented improvements and potential effects

The municipal employees interviewed were unanimous that accessibility for older people had been improved within the study districts. In the Bare-ground study, all physical barriers within the study district registered in the municipal accessibility plan were removed during the implementation period. Here, the interviewees also pointed to more benches and a renewed pedestrian tunnel as an important part of implemented measures. One of the interviewees in the Bare-ground study described peoples' reactions to the efforts as: *"All such things as lowered kerbs at pedestrian crossings are appreciated by everybody - perambulators, older people, and wheelchairs - and contrasted step markings and similar enhancement we made in our own staircases - those are the things that are most appreciated"*. In the Snow/ice study, the interviewed municipal employees pointed out that winter maintenance during the winter season in focus (2006/2007) had shifted from an area-orientated to a route-orientated strategy. This means that important destinations within the study district are seen as linked together. One interviewee in the Snow/ice study expressed this as: *"Previously, the city was just an area, but nowadays the focus is on the routes. The routes are being given higher priority - not just fixing a little here and a little there*." Overall, the interviewed municipal employees in the Snow/ice study were satisfied with the municipality's efforts along these prioritised routes. The efforts were described by the employees as more frequent removal of snow, starting earlier after a snowfall, and followed by sanding immediately afterwards.

Potential effects of implemented measures were discussed by the interviewed municipal employees in both studies. In the Bare-ground study, one of the interviewees said: *"There are more available routes - opportunities to elect shorter route - because we have lowered more kerbs and made other improvements"*. The interviewed

municipal employees also suggested that it may take some time before older people become aware of these new opportunities. The interviewees in the Bare-ground study identified accessibility measures in terms of removing physical barriers according to the "easily removed barriers" directives as being less noticeable by people in general than the larger measures implemented, such as the rebuilt pedestrian tunnel and park.

Remaining problems in the study districts

In the Bare-ground study, lighting and more benches were examples of issues that can be further improved according to the interviewed municipal employees. The interviewees also mentioned safety/security-related issues causing unwillingness among older people to go out more than necessary. Efforts other than removing physical barriers are to been made to improve feelings of safety and security, involving actors from several sectors of society. Outside the study district of the Bare-ground study, there is also more to be done, for example within the residential districts near the central city. One interviewee expressed this as: *"There is not a single crossing within the central city that we have not adapted or that you cannot cross with a wheelchair or rollator, or if you have visual impairments. But if we look outside this area [the study district], then we find one and another weak links".* Furthermore, the question was also raised in the Bare-ground study about which physical barriers can be considered as "easily removed" according to the governmental directives due to the unreasonably high costs for removal. For example, implementing measures in an existing environment, such as ramps at entrances, can be difficult if there is not enough space.

The importance of accessibility in both outdoor and indoor environments, as well as in both public and private (e.g. residential areas) environments, was an issue in both studies. In the Bare-ground study, the interviewed municipal employees felt that accessibility requirements concerning entrances and buildings will likely not be fulfilled by 2010. They criticised other departments within the municipality for not showing enough interest in and commitment to accessibility issues and, for example, the Urban Planning Department for not exerting enough pressure on private property owners in order to get them started with implementing accessibility measures in indoor environments and at entrances. One employee expressed this as: *"We will have to work hard to satisfy these requirements [BFS 2003:19 HIN1]. However, when it comes to real estates, there will be problems because serious adaptation there has not started yet".* The responsibility of private property owners was also an issue in the Snow/ice study. Here, the implementation was conducted in public outdoor environments, i.e. on those pavements and footpaths that were the municipality's responsibility. The interviewed municipal employees in the Snow/ice study emphasised the importance of sufficient winter maintenance in the residential areas as well, which often was the responsibility of private property owners. One interviewee stated: *"It is better that we attend to everything at once; you remove a weak link in the chain by doing so,"* suggesting that involvement of only one actor could facilitate a more even standard of the winter

maintenance. In the end, accessibility throughout the whole travel chain becomes evident, which was expressed by one of the interviewees in the Bare-ground study as: *"Why should people go out when they are able to leave their homes but cannot complete an errand, for example, not being able to enter stores?"*.

Future challenges

The changing climate and its effect on winter maintenance were emphasised by the municipal employees interviewed in the Snow/ice study. The interviewees all agreed that a "new winter" is taking place, characterised by constant fluctuations between plus and minus degrees, between autumn and winter weather, between freezing and thawing. These fluctuations increase the problems of iciness, especially concerning uneven surfaces with rough ice. Nowadays, winter maintenance is more based on ice prevention than on snow removal, as opposed to some years ago. One interviewee expressed this as: "*We simply have to live with this [changed weather conditions]. It makes work more difficult. It's easier if it's either cold or warm. But now it's cold, then warm, and then cold, back and forth. That makes everything more difficult."* The interviewees in the Snow/ice study therefore pointed to the necessity to increase the frequency of snow removal and ice prevention (sanding) in order to preserve the same standard as before. This will, however, in turn increase the necessity to sweep away grit, which normally is done only in the spring. Thus, further improvements of winter maintenance under these weather conditions are a matter of resources.

Lack of financial resources was pointed out as a barrier in the process of improving accessibility for older people and people with disabilities. In the Bare-ground study, one of the interviewees said: *"The lack of funds sets the limits. Therefore we cannot work as hard as we should. This is, after all, a minor part of our entire effort"*. Another interviewee said: *"This involves relatively minor measures; lowering kerbs is not very expensive, but if you add everything together…"* The interviewees also made the point that when rebuilding existing environments, the rebuilt location is not necessarily connected to the surrounding routes and therefore sometimes becomes *"an inaccessible accessible island"*, as one of them expressed it. Although the process of improving accessibility within the municipality is influenced by economic issues, the organisation matters as well. The interviewees asked for more commitment from all municipal departments, that all departments take their part of the responsibility, and for continuous cooperation between departments in the municipality.

Nevertheless, despite some difficulties in implementing accessibility in the daily work at the municipality, the municipal employees interviewed in the Bare-ground study had noticed an increased focus on accessibility issues during the past several years, both among municipal employees and politicians. The heightened awareness was explained by the fact that 2010, when society is to be accessible according to legislative directives, is rapidly approaching, as well as by the influence of research

projects such as this. One interviewee expressed this as: *"I believe that this study has done well. It has enhanced the question in more ways."* Another interviewee said: *"It has helped out in bringing the question to the politicians. The question has been raised and we are talking about these issues"*. In the Snow/ice study, the interviewed municipal employees also agreed that a valuable outcome of this research project was heightened awareness of the importance of details in the winter maintenance of pedestrian environments, e.g. removal of blocking heaps of snow on pavements and zebra crossings and removal of snow around poles and traffic lights, in order to correspond to older peoples' needs as pedestrians. One interviewee expressed this as: *"Not that I haven't thought about how older people should be able to walk, but I haven't thought about the little things."* Another interviewee said: *"You think in another way now. Maybe you were a bit nonchalant regarding older peoples' needs before. You tried to delve into it well, but didn't get the whole picture. A little lumpiness on the road wasn't the end of the world, you thought; a zebra crossing was such a short distance."* The need for knowledge among all actors involved in the implementation process - from design and planning to construction and maintenance - was also emphasised by the interviewees in the Bare-ground study. Here, they mentioned construction workers, who might need more awareness of the importance of details when designing accessible outdoor environments, for example when they are adapting a construction drawing to the prevailing circumstances of a construction site.

Discussion

Accessibility throughout society for older people and people with disabilities has become increasingly important in Sweden since legislation, directives and guidelines on accessibility came into force. Even though studies presented in this thesis show that there is still much to be done in order to achieve barrier-free outdoor environments, a majority of the Swedish municipalities treat accessibility as an important issue. The municipalities have started the process of implementing measures to improve accessibility even though there is a large variation in the level accomplished so far. Overall, there is a need for further governmental and municipal action to ensure that this implementation process takes place throughout the whole travel chain. A year-round perspective on accessibility is also essential since outdoor environments that are accessible and usable in bare-ground conditions are not necessarily accessible und usable in snow/ice conditions. This thesis shows that older people consider poor ice prevention and snow removal, especially snow removal on a *detailed* level in terms of removal of blocking heaps of snow on pavements and zebra crossings and around poles and traffic lights, as two of the largest accessibility problems. Thus, achieving barrier-free outdoor environments involves removal of physical barriers throughout the year, including winter maintenance as well.

The studies presented in this thesis show that difficulties reported in walking due to physical barriers in bare-ground and snow/ice conditions have in fact decreased after implementation of measures to improve accessibility in outdoor environments. However, implemented measures are found to have only minor impact on older peoples' satisfaction with outdoor environments and on their mobility and perceived safety as pedestrians. These modest results were rather unexpected in the light of previous research emphasising the importance of removing barriers in outdoor environments (Ståhl, et al., 2008; SIZE, 2006; Mollenkopf et al., 2004; Lavery et al., 1996). However, there are several possible explanations that must be taken into consideration when drawing conclusions from these findings. For example, it is likely that minor accessibility measures gradually implemented at several locations (e.g. lowering kerbs), as well as continuous maintenance measures when needed (e.g. snow removal), are less noticeable than larger construction measures (e.g. improving pedestrian tunnels). Perhaps more important, there was actually a rather low presence of usability problems related to physical barriers in bare-ground and snow/ice conditions already in the before situation in the two study districts. Improvements from a rather good to a slightly better level may have been difficult for the residents in the study districts to appreciate. In the Bare-ground study, this explanation is

supported by the participant observations conducted before and after implementation, as well as by the fact that the municipality of Hässleholm is one of those Swedish municipalities showing a high standard in the treatment and consideration of accessibility issues in municipal planning according to the Municipality study. In the Snow/ice study, the municipality of Piteå, unlike many other municipalities, is taking responsibility for winter maintenance on all pavements and footpaths in public areas within the city. Minimising the number of actors involved may contribute to a more even standard of winter maintenance (Berntman, 1999; 1989). Another issue in the Snow/ice study concerned differences in weather conditions between the before and after situation. However, no differences in such short terms were considered to be a significant explanation of the modest findings. In the long run though, a "new winter", characterised by smaller amounts of snow, higher average temperatures, and frequent temperature fluctuations between freezing and thawing, is pointed out as a major concern.

Legislation, directives and guidelines on accessibility consider people with disabilities in general; however, this thesis focuses on older people defined as people 65 years and older. The heterogeneity within age group of older people implies a variety and complexity concerning older peoples' perceived needs as pedestrians. Generally, both functional limitations and use of mobility devices become more common with increasing age (Parker et al., 2008; Löfqvist et al., 2007). Within this thesis, different environmental factors concerning the usability of the outdoor environment (usability factors) are examined. The combination of information of how important the usability factors are to older people as pedestrians, and how satisfied they are with the factors, serves as an instrument for judging the need of interventions and for prioritising measures (Steg et al., 2007). Those usability factors associated with high importance and low satisfaction should simply be handled first. For the population of older people as a whole, this mainly concerns cyclists and bicycles on pavements and footpaths, prevalence of graffiti and litter, and ice prevention. However, the priority looks different if differences in older peoples' perceptions of the outdoor environment depending on age, functional limitations, and use of mobility devices are taken into consideration. The oldest old (80+), older people with functional limitations, and those using mobility devices perceive accessibility issues as more important than the younger old (65-79) and those without functional limitations or mobility devices. This is in line with the ecological model of ageing and adaptation and the environmental docility hypothesis emphasising the relation between an older person's capacity and environmental demands (Lawton & Nahemow, 1973; Lawton, 1986).

It is also interesting that those factors that are perceived to be the most important in the age group of older people as a whole are not necessarily found among the most important factors as perceived by the oldest old (80+) or by older people with functional limitations or mobility devices. In other words, there are also *relative* differences in older peoples' perceptions depending on age, functional limitations, and use of mobility devices. For example, the 65-79 year olds perceive orderliness-

related factors in bare-ground conditions, i.e. preventing cyclists and bicycles on pavements and footpaths as well as graffiti and litter, as most important. However, for the age group of 80+, removal of physical barriers becomes important as well. These results might not be considered very surprising since transition between the two age groups involves declining functional capacity (Baltes & Smith, 2003). Laslett (1991) refers to two different phases of old age: the third and the fourth ages. The third age begins with retirement and is a phase characterised by freedom from work, financial security, and personal achievement. However, entering the fourth age involves higher incidence of illnesses and/or functional limitations causing more or less dependence and decrepitude. The transition from the third to the fourth age occurs, in developed countries, at around 75-85 years of age depending on which definition is applied (Baltes & Smith 2003). Furthermore, clear gender differences also emerged; women assign higher importance to several of the usability factors concerning both bare-ground and snow/ice conditions than do men. No *relative* differences in the perception are found between men and women though; those factors that women consider to be the most important are also identified as the most important factors by men.

The outcome of implemented measures in the Bare-ground and Snow/ice studies is influenced by the fact that the participants in the studies conducted after implementation are the same as in those conducted before. The participants have therefore aged (one and a half years in the Bare-ground study and two years in the Snow/ice study). As demonstrated in this thesis, age, functional limitations, and mobility devices are all relevant predictors of older peoples' perceptions of the outdoor environment. The "Let's go for a walk!"-study in Ståhl & Iwarsson (2007), examining older peoples' perceptions before and after measures to improve accessibility and safety in the outdoor environment were implemented, faced approximately the same age-related effects as the studies presented in this thesis. Even though older people in their study stated that they perceived fewer problems in the outdoor environment after implementation, no changes in mobility and feelings of safety/security are reported. One or two years of ageing may seem not very long time, but the age-effect might to some extent have ironed out the impact of implemented measures.

Even after implementation, there are still problems remaining in the two study districts, especially concerning failing links on otherwise accessible routes. In the Bare-ground study, it is reported that accessibility problems at entrances remain after implementation. Many private property owners do not undertake their legal obligation, according to the interviewed municipal employees, and accessibility requirements concerning entrances and indoor environments will likely not be met by 2010. In the Snow/ice study, the implementation did not involve any change in the level of winter maintenance within residential areas, areas that generally are private property owners' responsibility. Remaining problems with winter maintenance therefore concerned the difficulty to sustain good maintenance on continuous routes

with no sections of the route with lower standards. Walking from one's residence to, for example, the grocery store is often a complex chain of events that all have to be usable, and therefore missing links, such as inaccessible entrances and residential areas, may make the walk impossible to carry out (Ståhl, 1997; Börjesson, 2002). Such a travel-chain perspective on accessibility may have implications for the design and planning of outdoor environments. It is important to consider the accessibility of both outdoor and indoor environments, as well as of both public and residential areas.

Problems concerning orderliness-related issues, and the sense of safety and security, also remain after implementation. In the Bare-ground study, satisfaction with orderliness-related issues rose from a very low to a higher, yet still unsatisfactory, level. Except for the improved pedestrian tunnel, no measures were directed to address safety/security-related issues, which might be one explanation for the unchanged mobility and perceived safety in the Bare-ground study. The qualitative parts of the study indicate that there are remaining problems in the study district including, for example, cyclists and bicycles on pavements and footpaths. Other safety/security-related issues, such as fear of victimisation and presence of graffiti and litter, sabotage and vandalism, are also reported as major problems. Previous studies in the field emphasise the importance of a sense of safety and security for older peoples' mobility (Mollenkopf et al., 2004; SIZE, 2006). Thus, safety/security-related issues must also be handled in the planning and design of outdoor environments.

Removal of physical barriers in the outdoor environment has *potential* to encourage walking among older people, especially among those with functional limitations and mobility devices. These types of measures are indicated by legislation, directives and guidelines on accessibility, even though this thesis introduces issues that have not yet received much attention. Older peoples' needs as pedestrians will not be totally fulfilled by the legislative directives in focus for this thesis: the ''easily removed barriers'' directives, BFS 2003:19 HIN1. In other words, even if the municipalities manage to remove all physical barriers in the outdoor environment by 2010 according to the directives in BFS 2003:19 HIN1, barriers to access will remain. In the Bare-ground study, such omitted factors concerned, for example, benches to rest on (and kept in good order) and pavements and footpaths with clear separation of pedestrians and cyclists. For new constructions, the directives in BFS 2004:15 ALM1 are stricter than for existing environments and the omitted factors mentioned above are emphasised in BFS 2004:15 ALM1. Nevertheless, factors included in the "easily removed barriers" directives, BFS 2003:19 HIN1, are perceived as important by older people themselves. These factors are also becoming more important among the oldest old (80+) and among older people with functional limitations and mobility devices. A year-round perspective on accessibility, as introduced by the Snow/ice study in this thesis, is not established in the legislative directives in BFS 2003:19 HIN1 and BFS 2004:15 ALM1. These directives focus on bare-ground conditions. However, removal of physical barriers in snow/ice conditions as well, for example, by developing

effective strategies for winter maintenance on pavements and footpaths, must also be treated in policy and planning.

In the end, the municipalities' process of implementing measures to improve accessibility in outdoor environments is crucial for the actual outcome of international and national policy directives. There is a large variation in how accessibility issues are treated and carried out in daily municipal planning in Sweden. Some municipalities have made extensive efforts in the implementation of legislative directives in municipal planning, while others have accomplished less. For example, smaller municipalities in terms of number of inhabitants are less likely to have come far in the implementation process compared with larger municipalities. Ironically, there are a higher proportion of older people in smaller municipalities. In order to gain an even standard throughout the country, these municipalities have to start implementation as well. It should be noted, however, that the Municipality study was conducted in 2004, and therefore the implementation process has likely made some progress by now. Even so, the question arises whether the municipalities will manage to eliminate all "easily removed barriers" before 2010, since the implementation process seems to have been slow, especially in the beginning. Full accessibility in 2010 might have been a realistic goal if the process of implementing accessibility in municipal planning had started actively and efficiently when the legislative directives in BFS 2003:19 HIN1 were released, but from the results of this thesis it seems unlikely to be achieved. Advancing the implementation process is therefore of great importance. This thesis shows that the treatment and consideration of accessibility issues among municipal politicians and employees are positively affected by the establishment of well-defined planning and policy documents on accessibility in the municipality, by the presence of a municipal accessibility adviser, and by cooperation with interest organisations and between different departments in the municipality. The municipal process of improving accessibility in outdoor environments undoubtedly benefits from improved knowledge of which measures to prioritise, and this thesis is a contribution to the field in this matter.

Methodological considerations

The design of the studies presented in this thesis, using both qualitative and quantitative research methods, was successful in capturing different views of the topic in focus. Even though the main focus of this thesis was on the quantitative parts, these findings were much enhanced by the qualitative parts. The Bare-ground study (Study 2) and the Snow/ice study (Study 3) both included an *exploratory* mixed-method design where qualitative findings helped in developing and informing the quantitative method (Creswell & Plano Clark, 2007). The focus group interviews and participant observations created a pre-comprehension of the characteristics of potential respondents, their needs and problems, and the characteristics of the two study districts. For example, half-sanded footpaths were brought up in the focus

group interviews in the Snow/ice study as a rather important issue for those participants using kick-sleds, which may have been missed if the qualitative studies had not been conducted. The qualitative studies therefore helped in formulating questions so as not to overlook any relevant issues. In the Municipality study (Study 1), the quantitative part (the questionnaire) served as a pre-screening of potential municipalities for cooperation in further studies. An *explanatory* mixed-methods design was also applied in the Bare-ground and Snow/ice studies, where qualitative methods helped in supporting and interpreting quantitative findings in terms of explaining significant (or non-significant) results, outlier results, or surprising results (Creswell & Plano Clark, 2007).

Exploratory and explanatory mixed-method designs are successful in terms of benefiting from the advantages and avoiding the disadvantages of each single research method (Creswell & Plano Clark, 2007). However, there are still methodological difficulties associated with conducting mail surveys, not least concerning how to reach a representative sample of the population. For example, women tend to be overrepresented (Trost & Hultåker, 2007); however, in the Bare-ground and Snow/ice studies, the proportion of women is similar among the questionnaire respondents as among the residents in the study districts. Further, by limiting population samples to "older people living in the community", very old people tend to become undersampled since larger proportions of them live in residential establishments (Gubrium & Holstein, 2001). This might also be the case in these studies. People with difficulties in reading and understanding written, complex text are also undersampled by mail surveys. It is likely that such complex and extensive questionnaires as used in the Bare-ground and Snow/ice studies are not a suitable method for examining accessibility/usability needs among people with perceptive/cognitive disabilities. This might be the reason why this study found no differences in perceived importance of barriers between those who have reduced perception/cognition and those who have not, even though people with reduced perception/cognition are assumed to be in need of, for example, clear visual and tactile guidance (SALAR, 2004).

In addition, the Municipality study faced difficulties in reaching the intended respondents, in this case municipal employees working with accessibility issues in the field of transportation and urban planning. Therefore, the preparations of the mail survey included a pre-investigation of names and addresses of the intended respondents in each municipality. This resulted in 258 of 290 questionnaires being sent directly to the intended respondent; the rest (32) were addressed to "an employee working with accessibility in the field of traffic planning". This effort resulted in a higher response rate for the directly sent questionnaires (68%, 34% respectively). The analysis of the drop-outs shows the importance of sampling; the municipalities that did not participate in the survey have accomplished less within the field in comparison with municipalities who participated. Thus, if all 290 municipalities are taken into consideration, the level of implemented accessibility in municipal planning

would likely have been lower than presented in this thesis. Perhaps telephone interviewing can be tested in the future to collect data necessary for the Accessibility Implementation Index. Furthermore, it should also be remarked that the respondents in the Municipality study are individuals, and their answers therefore reflect their personal opinions of the implementation of accessibility in municipal planning and of how accessibility issues are treated among municipal politicians and employees. A total investigation of the treatment of accessibility issues among all municipal politicians and employees was not conducted, since that was not within the purpose, resources or possibilities of the study. However, larger municipalities may have more than one employee working with accessibility issues and, consequently, more than one person could therefore take part in filling in the questionnaire. This may have decreased the impact of the individual employee on the answers.

Another issue in the Bare-ground and Snow/ice studies concerned the use of technical language, e.g. pole, drainage groove, resting surface, contrast/warning marking, and continuous guidance route. In order to facilitate respondents' understanding, such technical language was rephrased if possible, or a short explanation was provided. In the Bare-ground and Snow/ice studies, pilot testing the questionnaires with three persons gave feedback on, for example, length, formulations, difficult/technical language, text size, design, etc. In the Municipality study, pilot testing was also conducted with two persons working with accessibility in municipal planning. Here, the pilot study helped in asking relevant questions and in minimising the number of questions in the questionnaire.

There are various difficulties associated with evaluations in real environments and with receiving valid information on peoples' perceptions. In and nearby the study districts, other activities and measures influencing peoples' perceptions have likely taken place during the implementation periods. Efforts were therefore made in the questionnaires to focus on the specific study district, implementation period, and implemented measures. For example, people in general do not distinguish between public and residential areas, although the actors involved in municipal planning and maintenance do. To focus on the conditions of *public* areas, where the measures were implemented, the questions in the questionnaires consistently referred to conditions of "pavements and footpaths". Further, the awareness of accessibility issues likely arises due to an eye-opening effect by the project itself as well as due to attention in local media and among people in general. More focus on accessibility issues is positive since it may put accessibility on the general agenda in municipal planning; however, it may also influence peoples' perceptions. Receiving valid information from respondents is a general difficulty in research. For example, Festinger's Theory of Cognitive Dissonance (Festinger, 1957) may also help to explain difficulties associated with receiving valid information from respondents. Festinger's theory describes how peoples' actions affect their attitudes and vice versa in order to avoid cognitive dissonance (feeling uncomfortable or disharmony) and to strive for consonance (feeling comfortable and harmony). Striving for consonance implies that

common answers, especially among older people, to questions examining difficulties and problem could be, for example, "it is alright", "I am happy as it is", or "I am doing fine, the situation of others may be worse". This has implications when designing studies examining how people perceive their situation; the challenge for the researcher is to reach beyond such facades. In the participant observations, one strategy to control for unconscious coping behaviour was to ask the participant for alternatives to the chosen routes and then how the chosen route differs from the alternative. In the focus group interviews, the participants were asked to come up with places and situations that they avoided and reasons for avoiding them.

Most studies reported in the literature on correlations between environmental features and walking are cross-sectional, while before-after studies (or intervention studies) examining effects of actual measures implemented in outdoor environments on older peoples' perceptions and on walking behaviour are rare. The necessity to conduct observations at several points in time in order to investigate whether environmental interventions cause changes in peoples' perceptions and walking behaviour is pointed out by Sugiyama & Ward Thompson (2007). The Municipality study confronts problems associated with cross-sectional studies; for example, it is difficult to determine the causality and the direction of the relations between the factors concerning static factors (SF), directives and recommendations (DR), and statements concerning how accessibility issues are treated among municipal politicians and employees (S). The statistical analysis only shows that, for example, municipalities with accessibility plans display a statistically significant relationship with the statements. It is possible that municipal politicians and employees in those municipalities were more positive from the very beginning, even before any policy decision was made, and not necessarily that it was the policy decision that impacted how accessibility issues are considered. An approach different from the cross-sectional is the longitudinal; however, the longitudinal approach also introduces difficulties. In the Bare-ground and Snow/ice studies, this mainly concerned sampling issues in terms of older people who died or moved from the study districts during the implementation period, and the age-effect on peoples' perceptions as well as other difficulties associated with conducting evaluations in real environments.

The statistical analyses applied on data collected in the studies within this thesis involved significance analyses of group comparisons. Significance analysis always implies a risk to incorrectly declaring an effect because of random error variations in the sample, i.e. findings of false "significance" or "type 1 error" (Schweigert, 1994). For a chosen p-value of 0.05, the risk of false positives is 5%. When performing multiple statistical significance tests on the same data, as in the analyses within this thesis, p-value adjustment by Bonferroni correction or other method can be considered necessary in order to ensure that the overall risk of false positives still remains at the 5% level. However, it could be argued that when reducing the risk of making a type 1 error, the risk of making type 2 errors, i.e. findings of false "insignificance", increases. Thereby p-value adjustment may imply that beneficial

interventions are rejected (Feise, 2002). In the end, as Feise (2002) also argues, a study's statistical significance should be balanced with the magnitude of effect, the quality of the study, and with findings from other studies when drawing conclusions. In addition, the significance analyses can be considered as being performed under the assumption that the statements (in the Municipality study) and the usability factors (in the Bare-ground and Snow/ice studies) are independent variables. Thus, p-value adjustment is unnecessary since the variables are tested separately. Due to the great heterogeneity within the age group of older people, all respondents are likely not stating the same importance of each usability factor. Stated importance rather depends on individual needs. However, the use of factor analysis in order to categorise the single factors into components or categories is based on correlations between the variables, i.e. the categorisation of the factors assumes dependency. Still, it can be argued that all respondents are likely not stating the same importance of each usability category, rather depending on individual needs. Furthermore, the factor analysis are not to be seen as more than a *support* in categorising different types of problems into target areas for interventions.

Implications for research and policy/planning

This thesis, examining older peoples' perceptions as pedestrians and outcomes of barrier-free outdoor environments, presents interesting findings that have implications for future research within different fields as well as for policy and planning at different levels in society.

A *year-round perspective* on accessibility is established; removal of physical barriers in snow/ice conditions as well by effective strategies for winter maintenance in pedestrian environments is important in many countries of the world. On the legislative level, a relevant question is how physical barriers in snow/ice conditions should be treated in relation to the treatment of physical barriers in bare-ground conditions. As it is today, snow/ice conditions are hardly ever mentioned. There is also a need for more research on accessibility in a year-round perspective, which has been a neglected research area. The Snow/ice study presented in this thesis is, to my knowledge, the first attempt to examine effects of improved winter maintenance on older peoples' perceptions and walking behaviour. Further research could, in collaboration between researchers and practitioners from different fields together with input from road users, provide both methodological and technological improvements (Berntman, 1999; 1989). Methods for ice prevention must be improved in order to correspond with the currently changing weather conditions, for example, developing more effective strategies for ice prevention as well as alternative ice prevention materials. In order to manage snow removal on a detailed level, better adapted vehicles and other technical equipment are relevant. Technological developments may also imply mobility devices better adapted for outdoor use in snow/ice conditions. Further, continuous updating of local weather data for the maintenance staff is

necessary so they can predict and immediately implement preventive winter maintenance efforts when needed, which in turn demands knowledge of climatology (Berntman, 1999; 1989). In other words, the year-round perspective on accessibility emphasises removal of physical barriers throughout the year involving a focus on both bare-ground and snow/ice conditions.

The *travel-chain perspective* on accessibility is revisited; walking from A to B is often a complex chain of events that all have to be usable and missing links, such as inaccessible entrances, may make a trip impossible to carry out. If walking is seen as a part of other transport modes such as public transport, accessible bus stops and vehicles are also important in a travel-chain perspective. In other words, the travel-chain perspective on accessibility involves removal of physical barriers throughout the entire travel chain - from indoor to outdoor environments, from one transport mode to another, from private/residential to public areas, etc. The vulnerability of older people also indicates the importance of being aware that several recurring minor barriers may make an otherwise accessible environment unusable (Ståhl 1997; Börjesson 2002). Thus, the importance of *details* in the planning and design of outdoor environments is central. In bare-ground conditions, this concerns kerb heights, width of pavements, uneven and sloping surfaces, arm rests on benches, etc. In snow/ice conditions, it concerns snow removal on a detailed level in terms of removal of blocking heaps of snow on pavements and zebra crossings and removal of snow around poles and traffic lights. Achieving accessible outdoor environments throughout the entire travel chain requires continuous cooperation between different sectors in society, not at least continuous cooperation between municipal departments, as well as involvement of all actors concerned in the implementation process. On the legislative level, this raises questions on how the responsibility between those actors involved in the implementation process (e.g. private property owners) should be handled.

In a *policy/planning perspective*, the experiences from this thesis might benefit the exchange of ideas on both national and international levels and may in the longer perspective have implications for national and international accessibility agendas. The results may interest other countries as well, for example concerning benefits of having an accessibility adviser who is of great significance in emphasising accessibility issues on the daily agenda. The fact that older peoples' needs as pedestrians in the outdoor environment are not completely fulfilled by current Swedish governmental directives on accessibility (the "easily removed barriers" directives, BFS 2003:19 HIN1) calls for a focus on these issues as well in order to promote older peoples' mobility the year around. This mainly concerns winter maintenance, problems with bicycles and cyclists on pavements and footpaths, and the need for benches to rest on.

The Accessibility Implementation Index instrument presented in this thesis could be, after some refinements, an aid for governments in annual evaluations on municipal and national levels. The index as presented in this thesis provides a quantitative

ranking of actual efforts (static factors; SF), directives and recommendations (DR), and statements concerning how accessibility issues are treated among municipal politicians and employees (S), and is one way to analyse the outcome of the instrument. One way of improving the index is to conduct focus group interviews with experts within the field to collect information on the importance of each item within the three indices (SF, DR, and S). A follow-up survey based on the Accessibility Implementation Index instrument is interesting for future research in order to study progress in the municipalities. Such a longitudinal approach could also gain better understanding of the relations between actual efforts in this implementation process and how accessibility issues are treated in the municipality. Further, the index method does not claim to investigate *actual* accessibility conditions in the outdoor environment. A comparison of the actual conditions in a sample of municipalities and the result of the index could also be an interesting methodological step in future research.

For those actors involved in the field of transportation and urban planning, knowing which measures to prioritise to ensure older peoples' mobility is essential. The planner should focus on the environmental factors that are relevant for older peoples' mobility emphasising the variety and complexity in older peoples' needs as pedestrians and prioritising the needs of the most vulnerable persons in the age group. In the view of previous research and findings presented in this thesis, removal of physical barriers in the outdoor environment in both bare-ground and snow/ice conditions has *potential* to encourage walking among older people, especially among those older people with functional limitations and mobility devices. Even though the focus of this thesis is on older people, these types of measures also have the potential to benefit people with disabilities as well. Barrier-free outdoor environments are to be considered as a *basic precondition* for peoples' ability to use the environment at all. The contrary, inaccessible outdoor environments, implies that walking is difficult or even impossible. When applying such approach, accessibility can be considered to be the first level in a range of measures to ensure older peoples' mobility as pedestrians. Other aspects, such as safety and security, are to be seen as the subsequent levels in that range and must also be handled in order to encourage older peoples' mobility as pedestrians. Speed restrictions of motor vehicles, safe pedestrian crossings, enforcement of cyclists using pavements and other pedestrian areas, and clear separation of pedestrians and cyclists on shared paths are examples of measures to improve pedestrian safety (Svensson, 2008b). The *sense* of safety and security is another important matter, and there is a need for more research concerning strategies for improving this aspect as well, involving researchers from a broad range of disciplines. For example, making approaching cyclists more audible may be a solution for people with reduced hearing to feel safer on shared paths.

For the society as a whole, this thesis indicates that improved knowledge and awareness of accessibility issues are important for advancing the process of implementing policy concerning accessibility into actual planning. There is likely a

need for information and education about accessibility issues among actors involved in the implementation process, from those involved in policies as well as planning and design to those involved in construction and maintenance. Improving knowledge and awareness is to be considered as a long process in order to reach all actors involved. This thesis indicates that even though traffic planners over the past several years are showing an improved awareness of how to design accessible outdoor environments for older people and people with disabilities, contractors who are doing the final construction work, as well as municipal politicians and employees working in other fields than traffic planning may lack such knowledge. Private property owners are another group of actors likely in need if improved knowledge and awareness. Studies involving actual implementation, such as the ones reported in this thesis, contribute with more knowledge about the relation between accessibility, usability, mobility, and perceived safety, and hopefully also with increased attention to accessibility issues.

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