To prevent without over-protecting
- children and senior citizens injured during outdoor activities

Lina Gyllencreutz
“I know that anything can happen at any time. Therefore I am completely calm.”

Moominmamma
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Abstract

**Background:** Injuries are a common public health problem. Non-fatal injuries may result in pain and disabilities. Falls are a common causes of non-fatal injuries and many of these injuries occur during some physical activity. Children and senior citizens are two groups of special interest as their body constitution makes them more vulnerable to injuries than the general population. Outdoor environments influence the risk of injury as people are generally physically active when outdoor. Despite a higher risk for injury, physical activity is a common recommendation for a healthy lifestyle. Children and senior citizens should be able to safely participate in outdoor activities and gain health benefits. There is a need to highlight the complexity of balancing injury risk and the healthy benefits of outdoor activities among these two groups.

**Aim:** The overall aim of this thesis was to investigate injuries among children and senior citizens sustained during outdoor activities and explore experiences and perceptions on risk and possibilities to increase safety in the outdoor environment.

**Methods:** The studies were performed in northern Sweden. The participants were children through the age of 12 (Studies I & II) and senior citizens aged 65 and older (Studies III & IV). In Studies I and III, a cross-sectional retrospective study design was used. The data were collected from an Injury Data Base (IDB) at a hospital with a catchment area of 60 kilometres in a well-defined population. Data in Study III was complemented with a study-specific questionnaire. Injury data were analysed descriptively. Study II was a field study that included 14 days of observations, six focus-group interviews with children, and four focus-group interviews with teachers. The three data sources were taken together and analysed using qualitative content analysis. Study IV was a focus-group interview study with 31 senior citizens divided into six focus-groups. Data in Study IV was analysed with qualitative content analysis.

**Results:** In Study I, 795 children attended the emergency department from 2007 through 2009 and were registered in the IDB with non-minor injuries, such as fractures. The most commonly reported activities contributing to injuries were play, sport, and transport. Other factors contributing to the incident were often related to the ground surface. Contributing products were, for example, trampolines, climbing frames, bicycles, and downhill skis. In the field study (Study II), children at schoolyards were seen climbing high in trees, speeding down slides, or fighting with sticks in the woods. Different
perspectives on risk and safety influenced or restricted the children’s outdoor play activities. In Study III, 300 senior citizens were registered in the IDB after injuries from pedestrian falls from January 2009 through April 2011. Women were overrepresented. Sixty percent suffered non-minor injuries. Fracture was the most common injury type. Environmental factors, especially ice, snow, and irregularities on the ground surface were the most commonly described causes to the injury incidents. As the incidents happened in public transport areas, the respondents indicated that they hold the local authorities responsible for poor sidewalk and road maintenance. However, they admitted their own responsibility in preventing similar incidents by changing their behaviour and using safety products. The senior citizens in the focus-group interview study (Study IV) described how they needed to adjust to age-related changes when outdoors, for example, by taking responsibility and using common sense. Facilitating possibilities for outdoor mobility increased with the feelings of safety within the outdoor environment and when using safety devices. To the contrary, fear of falling, shortcomings of safety devices, and dangerous elements such as ice, snow, and interactions with bicyclists constrained outdoor mobility.

**Conclusion:** Non-minor injuries such as fractures among children and senior citizens that are sustained during outdoor activities must be a focus of injury prevention. Different perspectives on risk and safety influence children’s outdoor play at the schoolyard and senior citizens’ outdoor mobility. There is a need for balance between teachers’ common sense knowledge and the knowledge base of injury prevention. In the same manner, there is a need for balance between healthy activities and an acceptable injury risk for participating in outdoor activities. Nurses are well suited to work with this complexity and to optimize these efforts both at schools and in other public settings.
Svensk sammanfattning


möjlighet till utomhusaktiviteter under skoltid. I studie III, registrerades 300 skadehändelser av äldre personer efter att de fallit och skadats som fotgängare under januari 2009 till april 2011. Kvinnor var överrejresenterade i skadematerialet. Sextio procent drabbades av icke-lindriga skador. Frakturer var den vanligaste skadtypen. Faktorer i omgivningen som is och snö var den vanligast beskrivna orsaken till skadehändelsen, samt att det var dåligt sandat på skadeplats. Då skadehändelserna inträffade i offentliga områden angav de skadade fotgängarna att kommunen var ansvarig för det dåliga underhållet av trottoarer och gator/vägar. Men de erkände också sitt eget ansvar för att förhindra att liknande skadehändelser skulle upprepas, det vill säga genom att ändra sitt beteende och använda säkerhetsprodukter. De pensionärer som deltog i fokus-grupp intervjuerna (Studie IV) beskrev hur de anpassade sig till åldersrelaterade förändringar för att kunna vara aktiva utomhus, bland annat genom att ta ansvar och använda sunt förnuft. Att känna sig trygg i närmiljön och att använda säkerhetsprodukter ökade möjligheten till utomhusaktiviteter. Däremot ansågs fallrädsla, brister i säkerhetsprodukter och farliga omgivningar som snö, is och samspellet med cyklister på gång och cykelbanor förhindra utomhusaktiviteter.

**Slutsats:** Icke-lindriga skador som frakturer bland barn och äldre personer och som uppkommer under utomhusaktiviteter kan vara, och måste vara, i fokus för skadeforebyggande arbete. Olika perspektiv på risker och säkerhet kan påverka barns utelek på skolgården och äldre personers mobilitet. Det finns ett behov av en balans mellan lärarnas sunda förnuft och den kunskapsbas som finns inom skadeprevention. På samma sätt finns det ett behov av en balans mellan hälsosamma fysiska aktiviteter och en acceptabel skaderisk. Sjuksköterskor är en lämplig grupp professionella som kan arbeta med denna komplexitet och försöka optimera insatser för att barn och äldre personer på ett säkert sätt ska kunna delta i utomhusaktiviteter på skolor och i andra offentliga områden.
Original papers

This thesis is based on the following papers, which will be referred to in the text by their Roman numerals, I-IV.


II Gyllencreutz, L., Rolfsman, E., Frånberg, G-M., & Saveman, B-I. Approve or disapprove risky outdoor play among school children – a field study. Manuscript


IV Gyllencreutz, L., & Saveman, B-I. Everyday outdoor mobility in old age – focus-group interviews with active senior citizens. Accepted in Healthy Aging Research

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Introduction

This thesis was a part of the five-year (2009-2014) research program "Evaluation of Safety and Security (ESS)" funded by the Swedish Civil Contingencies Agency (MSB). The research program focused on examining the relevance and effectiveness of safety programs in municipalities, for example, increased safety in parks, playgrounds, and walkways. In particular, this thesis investigates injuries sustained during outdoor activities among children and old people (interchangeable with senior citizens) and explores experiences and perceptions of risk and possibilities to increase safety in the outdoor environment.

As a specialist nurse in prehospital emergency care, I have seen children and old people injured in different situations, and I have asked myself “Could this have been prevented?” When the ESS program searched for a doctoral student, I thought it might be an opportunity for me to gain knowledge in the area of primary preventive nursing to use also in prehospital emergency care.

Understanding injuries, their causes, consequences, and opportunities for prevention is influenced by and drawn from a range of disciplines; epidemiology, biomechanics, ergonomics, and the behavioural and social sciences (1-4). This thesis, which arises within the nursing discipline, will highlight the importance of primary prevention and the complexity of injuries in relation to healthy outdoor activities. The background section of the thesis will describe this complexity through a brief introduction to the concept of injury control and registration and why the injury panorama needs to be explored. Children and old people are two groups of interest for preventive measures as they are particularly vulnerable to sustaining injuries.
**Background**

**Injuries – control and registration**

One definition of injury is a bodily lesion at the organic level, resulting from acute exposure to energy (mechanical, thermal, electrical, chemical, or radiant) in amounts that exceed the threshold of physiologic tolerance. In some cases (e.g., in drowning, strangulation, or freezing), the injury results from an insufficiency of vital elements (5). An injury event can be characterized as either unintentional or intentional where intentionality is primarily referred to as an intentional force (violence) against the victim (oneself or another person) (6). Historically and also by some today, injuries are viewed as accidents and as the result of human error, fate, or bad luck. In this thesis, the word accident is not used. Instead the terms injury event or injury incident have been used indicating events that can be studied, understood and, thereby, prevented (7). No further classification of intent has been undertaken.

Injuries can be prevented or controlled at three levels; 1) strategies reducing exposure to injury risk (primary prevention), 2) limiting the consequences of injuries in the case an injury event occurs (secondary prevention), and 3) rehabilitating the injured from further consequences of the injury (tertiary prevention) (8-10). The approach to injuries is open for various scientific disciplines to confront the injury problem. In nursing, providing secondary, and tertiary prevention have mostly been in focus, through appropriate nursing care and rehabilitation in prehospital and hospital contexts (11). Primary injury prevention in nursing is, for example, nurses in a child welfare centre promoting child safety seats, facilitating the rental of infant seats, or promoting the use of bicycle helmets. District and school nurses have significant roles in moderating primary preventive strategies among children and old people but also in promoting healthy activities (12, 13). Injury prevention initiatives, however, require a thorough knowledge of injury incidents and mechanisms based on systematic injury registrations and research (14).

In countries with well-developed injury statistics systems, a lot is known about the relatively small number of injury deaths, less about hospitalized in-patient events, and even less about persons treated as outpatients on an ambulatory basis. Assessing the “true” burden of non-fatal injuries remains somewhat challenging given the variety of data systems in use (15, 16). In Europe, a common injury statistics system, the European Home and Leisure Accident Surveillance System (EHLASS) was introduced in a project in the
mid 1980’s. Nationally, the Injury Data Base (IDB) was developed in Sweden from EHLASS and was initiated in the mid 1990’s. Currently, in Sweden, the IDB is the only data register that contains comparable statistics on injury events within the home and leisure sector. Only nine hospitals submit injury data to the IDB that is collected by The National Board of Health and Welfare. The IDB, thereby, only covers approximately 9% of the total population of Sweden making it difficult to present valid national data of injuries. Even so, the IDB is based on data from the medical sector and describes the burden of different injuries, which may be of interest when allocating economic public resources to various activities.

**Injuries – a public health problem**

Injuries constitute a major public health problem and are under-recognized problems facing the nations today. Approximately 5 million people die annually as a result of injuries, accounting for 9% of the world’s deaths in 2000 (17). The burden of injuries is unevenly distributed as there are, for example, steep social gradients between and within countries. People of lower socio-economic standing who have little education and/or are unemployed not only have a higher risk of incurring injuries, but they also risk suffering more severe consequences when injury does occur (18-20). Other contributing factors to injuries include, for example, culture, ethnicity, gender and age (21-26).

The focus of this thesis is first and foremost, associated with two age groups – children and old people – because several studies have shown that children and old people are particularly vulnerable to sustaining injuries (18, 19). Injuries are the leading cause of death and disability among children and young people in all EU countries (27). In Sweden, approximately one in four child deaths is caused by an injury event. This rate may be closer to one-third if infants are excluded. Approximately 70 children die due to injuries each year in Sweden (28). Among old people (65+ years), injuries are the fifth leading cause of death (after cardiovascular disease, cancer, stroke and pulmonary disorders) and falls constitute two-thirds of these deaths (29). Approximate 2,000 Swedish old people die each year because of injury events (30).

Even though mortality is an important indicator of the magnitude of the injury problem, fatal injuries are only part of the problem. Millions of people around the world are injured each year and survive (17). The proportions of fatal and non-fatal injuries can be illustrated using a pyramid to give a rough picture of level of treatment; inpatient and outpatient treatment respectively (Figure I). In addition to this pyramid, there is an unknown number of
minor injuries that are treated at home and never lead to any contact with the healthcare system. However, the exact ratios between the proportions of the figure are affected by local circumstances (31). The proportions of the pyramid will also differ by age groups and injury types. For example, the pyramid of child injuries may be broader at the bottom compared to the pyramid of the old people, as minor injuries among children are common during childhood (28, 30).

**Figure I.** Injury pyramid and level of treatment among children and old people in Sweden.

*The National Board of Health and Welfare (28),
** Swedish Civil Contingencies Agency (30)

For some of the non-fatally injured, injuries cause only temporary pain and inconvenience. For others, injuries may lead to chronic pain and life-long disability or medical impairment. An injury affects not only the person who is hurt, but also others who are involved in the injured person’s life. With a
non-fatal injury, family members or friends often need to be involved in the care of the injured person, which can result in stress, absence from work, and loss of income (32). Thus, the importance in human and economic terms of non-fatal injuries should not be underrated and are of high priority for further investigation, and also a priority in present thesis.

The main differences between fatal and non-fatal injuries are the injury causes (33). In the US and other Western countries, the leading causes of deaths are motor vehicle crashes, suffocations, and drowning, whereas falls and being struck by or against an object or another human are the most common non-fatal causes (34, 35). Although, fall-related injuries account for almost five times as many hospital admissions in Sweden than for those injured in motor vehicle crashes, fall-related injuries including outdoor falls have not received the same attention in research (36, 37).

**Two age-groups of interest – children and old people**

*Injuries among children*

Sweden has one of the lowest child injury mortality rate in the world (38). This may be because of a society approach to the promotion of safety in the beginning in the 1950s. Sweden has since then worked with the development of injury surveillance, information, education, environmental improvements and product safety (39). Despite a decrease in injury rate, approximately 150,000 children per year receive medical attention nationally at an ED. Of those, 18,000 children are hospitalized (28). In nearly all age groups, more boys than girls are injured. The injury frequency among children is increasing by age (40-42). Commonly, injury events occur due to a fall during leisure time activities; mostly in the homes, at sport facilities, in traffic and at playgrounds (43). Injuries such as contusions, wounds, concussions, and fractures are common, particular during more physically activities (44-45). Forearm fractures are a common fall-related injury among children (46). Despite injury preventive efforts, there is still a need for knowledge of injuries, especially non-minor injuries sustained during healthy physically activities. Furthermore, approximately 10 to 25% of school-age child injuries occur at school (47), in Sweden about 36,000 children annually (48). As children spend a lot of compulsory time at school, the school environment is of particular interest.

*Injuries among old people*

Each year in Sweden approximately 115,000 people 65 years old or older visit Emergency Departments (EDs) because of an injury event and of those, 80,000 are hospitalized. These injuries account for approximately half a million hospital bed days (30). Fall-related injuries is the most common cause of hospital admissions among old people in Sweden (49, 50). Of all
fall-related injuries resulting in hospitalization, hip fractures are the most common (51), generating 245,000 hospital days per year in Sweden (36). Old people who experience fall-related injuries may have longer hospital stays and a greater mortality rate than younger people because of their diminished recovery capacity (37). Thus, a large number of individuals never fully recover from their fall-related injuries. This means that, to a large extent, fall-related injuries among old people are directly fatal or lead to disabilities and even premature death (35). Although societal costs are high, the true cost of fall-related injuries may be on an individual level. For example, falls and fall-related injuries do not always require health care, but may lessen quality of life through a new fear of falling, loss of confidence, and self-imposed physical inactivity, as well as, an increased risk of admittance to old-age homes (29, 52). Thus, fall-related injuries necessitate further research and preventative measures.

About 50% of falls occur within the homes and the immediate surroundings. Many studies have identified home hazards and personal risk factors for falls within the bedroom, living area, and kitchen (53). Indoor falls are more often associated with frail people, whereas outdoor falls are associated with more active and healthy people. It seems important to consider the differences between active versus inactive old people. Active old people are more likely to spend time outdoors walking and, thus, be exposed to the risk of sustaining a fall (54, 55). To date, small amounts of research or public attention have focused on outdoor falls (56-58). Outdoor falls are not often distinguished in research and are assumed to occur at least as often as indoor falls among old people (54, 57).

**Injuries – environment and risk**

Injuries result from the transfer of energy (the agent) to a person. A vector (e.g., another person or motor vehicle) is essential for energy transfer to the person. Additional, elements of the physical environment (sun, rain, snow, stones) and elements of the biological environment (animals, other humans, plants etc.) but also elements of the social environment (laws, rules etc.) are involved in the release of injury-producing energy (59, 60). Thus, contributing factors to injuries are the environment and potential risks within it. In this thesis, the focus is on the outdoor environment and injury risk. Risk is also a complex concept, as it encompasses a variety of activities and behaviour which may be socially constructed varying from one context to another. Risk often conveys a negative connotation. However, risk is actually on a continuum that can be both positive and negative (61). Thus, being prepared to take a risk is fundamental to human learning as we endeavour to develop new skills and try new behaviours (62, 63). The ability
to assess potential risky situations and to avoid excessive risk in the outdoor environment may be interpreted as an important life skill that can protect against injury events (61, 64). The risk of becoming injured is, in this thesis, described as individual’s perceptions and experiences of risk in an outdoor environment and is influenced by the concept sense-making of risk (65). Briefly, this concept means that an individual’s risk understanding and behaviour are linked to each other. The concept also shows how one’s understanding is related to the surrounding environment. For example, an individual may perceive the risk of slipping and resulting in a fracture to be large. Making sense of that risk might make the individual think that the risk is acceptable because it is a part of everyday life and is something that others have experienced (66) (Figure II).

Figure II. The injury producing process; when energy exceed the tolerance level of human tissue - the human will sustain an injury

**Outdoors – an environment for both children and old people**

Outdoor environments are essential for everyday activities like shopping, visiting friends, doctor, dentist or participating in economic, cultural, spiritual, and civic activities (67). The outdoor environment is important for people’s health and wellbeing (68). For example, people who are physically
active outdoors improve their balance, physical condition, and muscle strength. Outdoor environments may enhance memory and improve group dynamics among children at schools (69). Physical activity, such as walking, bicycling, and play are commonly recommended as a health promotion strategy for reducing the risk of obesity and long-lasting diseases. Exposure to physical activity is also a risk of injury, particularly in the outdoor environment where the activity level might be higher, and the risk might be hidden (70, 71). This may raise a question about the risk of sustaining injuries during physical activities. Increasing knowledge of how to participate in outdoor physical activities without risking serious injuries remains a priority in research (70, 72-75).

It may be assumed that weather conditions impact the frequency of outdoor activities (76, 77). The setting of this thesis is in northern Sweden where winter lasts approximately five to six months a year. The weather is prone to quick changes. In winter, it is common for the roads to be covered with snow, ice, melting snow, melting ice, or mixed icy and snowy surfaces. The same weather conditions can be seen in other cold regions, for example in the Nordic countries, Russia, parts of American continent and several other countries. The rest of the year is mostly ice and snow free with bright and warm summers lasting about three months.

**Children at risk**

The physical characteristics of young children affect the injury outcome. Children’s smaller stature increases the risk of injury, for example, in the traffic environment as they are less visible than adults and have difficulties seeing over obstacles such as cars. Further, studies in road traffic have shown that children younger than 12 years also lack the cognitive development needed to manage and move safely in modern traffic (78). Further, children have less blood volume. Therefore, they are more vulnerable to blood loss. Their skin surface area to body mass ratio is higher than for adults making them more prone to heat loss and more sensible to burns (79). Children younger than 12 years old differ from adults to a larger extent in anatomic and physiological aspects than older children (80). With this background, it was reasonable, in this thesis, to focus on children 0-12 years of age.

While growing up, children face a range of new and unfamiliar situations that increase their risk of injury. Childhood is a time for play, development, increasing independence, autonomy, and learning how to manage risks using one’s own judgement (61, 81). As children develop, their curiosity and wish to experiment are not always matched by their capacity to understand or to respond to risky situations (82). Thus, in addition to physical aspects, the
risk for injuries is also influenced by, for example, children's cognition, temperament, impulsiveness, activity level, and sensation for seeking risks (83). These abilities change substantially as they grow older (24, 84, 85).

Outdoor environments often stimulate children to engage in more challenging risk-taking play (86, 87). However, the design of the outdoor environments influence the risk of injury and it is common for the surrounding environment to be designed as a construct for adults rather than for children's needs (88, 89). As children are often impulse driven and lack decision-making skills regarding themselves, they have limited control over their own wellbeing and life (90, 91). It is generally the role of caregivers (92), neighbours, and municipalities to ensure every child's right to grow and thrive in safe environments without the risks of sustaining non-minor injuries (93). Hence, outdoor activities are not only a source of development but also a risk for injury.

The goal of injury prevention is, thus, not to stifle children's development but to provide opportunities for children to learn and make safe decisions (94-97). However, an increasing obsession with risk aversion and fear among adults has served to diminish the quality of the children's play (98, 99). In addition, playing outdoors has led to a discussion regarding the impact on children's health and how risk minimization measures have the potential to limit children's opportunities for positive risk-taking and risky play. In the short term, limiting risky play may ensure children's safety, but in the long term may have a negative influence on children's development and psychological wellbeing, activity level, and confidence in themselves and their abilities (87, 100). Thus, it is of vital importance to explore how to prevent children from non-minor injuries without over-protecting risky play and healthy development, particularly in the challenging outdoor environment.

Old people at risk
The biological aging process is described as an accumulation of damage in cells and tissues that causes a progressive general function impairment and a higher risk of dying (101). A normal aging process gradually leads to age-related problems such as sensory impairment (e.g., vision and hearing), disorders of the musculoskeletal system (arthritis, osteoporosis) and cognitive problems (memory loss) (102, 103). The normal aging process may include diseases such as cancer, Alzheimer's disease, cardiac and vascular disease (104). However, with increasing age, substantial individual differences in function are seen, and old people are becoming a more heterogeneous group (105). There is a suggestion to divide people in different ages and to describe the third age as a long, physically active, and
relatively healthy period after retirement. The third age is the period retired persons have before becoming dependent on others for their daily lives; the fourth age (106). In the fourth age, people are more inactive and suffer more and more from dependence and ill health (107). Despite this argument, in this thesis, I refer to old people as a group of senior citizens aged 65 and older.

The proportion of people 65 years and older in the population is growing because of decreasing birth rates and an increasing life expectancy. In European countries in 2014, there were 33% more people aged 80 and above compared to 2004 (108). There is a public belief that old people are more healthy and active than in previous generations. As countless benefits of physical activity are well documented and associated with improved length and quality of life, physical activity is often recommended as a health promotion strategy (109-111). The recommended level are 30 minutes or more of at least moderate-intensity physical activity on most, preferably all days of the week (112). Many old people express that they would like to be more physically active and mobile than they are. However, vigorous activity seem to decrease with age while moderate activity and walking increases (113). Naturally, reduced mobility seems not to be entirely voluntary among old people (114). Additional, a consequence of physical activity may be that it challenges the aging body and increases the exposure to the injury risk (115). With an increasing older population, efforts such as safe mobility and environments will be required to make the community inclusive of old people and supportive for active aging (67). Thus, it is of importance to explore how risks influence people’s outdoor mobility.

**Safety for all – both children and old people**

There are only one outdoor environment for all people. Thus, municipalities ought to ensure safety for all ages and in particular vulnerable groups such as children and old people. However, safety is more than merely “non-injury” (116). Safety is a state or situation in which hazards and conditions leading to physical injury, psychological or material harm are controlled in order to preserve the health and well-being of individuals and the community. It contributes to a perception of being sheltered from danger (117). The definition includes both a subjective and an objective dimension of safety. The subjective dimension of safety covers the individual’s feelings and perception of safety and being safe (118). The objective dimension of safety is concerned with the community in which individuals live, their behavioural and environmental factors measured against external criteria (119). In the context of outdoor mobility, fear of falling and moving outdoors may relate to both subjective and objective dimension of safety (120). Another example
is parents who will not let their children walk to school because of heavy traffic (121). Both dimensions sometimes influence each other positively or negatively. Therefore, the two perspectives exist as partners in every safety effort (122). In this thesis, safety is described by the individual’s own perceptions and experiences.

**Theoretical frameworks**

The complex web of the contributing aspects of injury incidents that is described in the background may be understood from several theoretical perspectives to gain a more comprehensive understanding. This can be achieved in different ways depending on the paradigm and discipline exploring injury incidents. This thesis has been based on two points of departure; injury prevention and the theory of social representations. The framework of injury prevention is used during the analysis of the results, and both frameworks are used in the discussion and thereby contribute to understanding the results in a more comprehensive way.

**A framework of injury prevention**

One point of departure in this thesis is built on the injury preventive framework developed by W. Haddon Jr. (59). Haddon created a matrix that conceptualizes causes and measures to prevent injuries and combines the triad of human, product (vehicle), and environment (physical and socioeconomic) with a temporal dimension covering pre-event, event, and post-event phases (59) (Table 1). The pre-event phase includes preventive strategies that eliminate the transfer of energy to an individual, meaning, reducing people’s exposure to injury-risk situations (c.f., primary prevention). Bicycle helmets, for example, do not prevent the bicyclist from crashing, but they do reduce the severity of head injury if a crash should occur. The event phase includes preventive strategies that reduce the energy transfer when an injury event occurs which reduces the severity of injuries in a particular situation (c.f., secondary prevention). The post-event phase includes strategies that help an individual survive and recover from an injury, such as emergency medical services, trauma care, and rehabilitation. In other words, the post-event phase uses strategies that reduce the consequences of the injury (c.f., tertiary prevention). Further, in each of these phases the human, the product, and the environmental factors are involved, which offer many opportunities for injury reducing actions (59). In this thesis, the injury data have partly been analysed, categorized, and discussed with the help of Haddon’s matrix.
Additionally, as a complement to this matrix, Haddon proposed 10 countermeasures that would prevent or reduce the transfer of energy (123, 124) and reduce the consequences of sustained injuries. The 10 injury countermeasures are:

1) Eliminating the hazard, and then goes stepwise;
2) Reducing the amount of energy contained in the hazard,
3) Preventing the release of the hazard,
4) Modifying the rate or spatial distribution of the hazard,
5) Separating the hazard in time or space from those to be protected,
6) Separating the hazard from those to be protected by a material barrier,
7) “Softening” or modifying the relevant basic qualities of the hazard,
8) Making individuals more resistant to the hazard,
9) Countering the damage already done by the hazard, and last
10) Stabilizing, repairing, and rehabilitating the individual injured. The 10 countermeasures do not link specifically to the different phases of the matrix, although there are countermeasures appropriate for each cell of the matrix. In this thesis, the results are discussed according to the countermeasures and preventive strategies are exemplified.

**A framework of social representations**

A second point of departure in this thesis is that reality is constructed, and people’s experiences shape their perceptions of reality and their actions in different situations. Thus, the theory of social representations was used to understand and describe perceptions and actions in the outdoor environment. Social representations are described as beliefs, concepts, and knowledge that people develop collectively and which are reflected in communications, experiences, and actions. Representations contribute to common sense, a form of everyday knowledge that hold us together and help us orient to social life (125, 126). These social representations of a particular phenomenon give people a social bond and gives substance to group functioning and actions. Individuals and groups (e.g., nurses, teachers, schoolchildren or old people) who share the same representations understand actions on the same premise. Actions are, therefore, influenced...
by social representations embedded in organizations and culture. It could be emphasized that representation not only influences people’s daily practices but constitutes these practices (127).

The theory consists of two mechanisms; anchoring and objectification. Anchoring is a process where unfamiliar information becomes understandable because it is related to the existing knowledge systems. In turn, objectification implies a concretization of such common knowledge (128). In this thesis, anchoring and objectification contribute to understanding the result of how the informants communicate risks and safety, and how they act and practice based on these representations.
Rationale

Injuries are a public health problem, not only in Sweden, but worldwide. Fatal injuries are only part of the problem and non-fatal injuries may lead to pain and disabilities. Children and old people are two age groups of interest as they sustain injuries to a great extent and also are more vulnerable due to their bodily constitution. The environment influences the risk for injury. Many injuries occur during some physical activity. In the outdoor environment, the injury risk might be hidden, and the activity level might be higher than indoors. For most people, the outdoor environment is associated with healthy and daily activities. Thus, more attention needs to be given to injuries sustained in the outdoor environment to explore circumstances and thereby develop preventive strategies.

Childhood is a time for play and development. Risk-taking behaviour is a normal part of children’s life and managing risk is an important survival skill. However, injuries may be a devastating outcome of risk-taking behaviour. An increasing obsession with risk avoidance and safety has led to a discussion of the impact on children’s health by risk minimizing measures. Thus, there is a need for research regarding the prevention of children during play without over-protecting healthy activities.

Normally, aging leads gradually to age-related losses in function. However, the third age is described as a healthy and active period of time for old people. As healthy aging is often described as staying active, participating in and contributing to the society, the outdoor environment influences the ability to do so. In an era when active aging is promoted, it is of importance to further understand how old people experience and perceive risk and safety in the outdoor environment and how it influences mobility.
Aim and objectives

The overall aim of this thesis was to investigate injuries sustained during outdoor activities among children and senior citizens and to explore experiences and perceptions of risk and possibilities to increase safety in the outdoor environment. The specific objectives addressed in the respective studies were:

To investigate non-minor injuries sustained during outdoor activities, among children 0-12 years old and to explore the circumstances surrounding these incidents (Study I).

To explore injury risk situations among children (6-12 years old) during outdoor play in the school environment (Study II).

To investigate injuries among senior citizen pedestrians who fell in a public outdoor environment including health care costs. Further, the aim was to describe their self-reported causes of the incident and suggested preventive strategies (Study III).

To explore active senior citizens’ experiences and perceptions of how safety can be increased and risk reduced in outdoor environments (Study IV).
Materials and methods

Design

A cross-sectional retrospective study design was used in Studies I and III and data from the IDB were used. Study III was complemented with a study-specific questionnaire inspired by the theoretical framework of Haddon (59) and developed in cooperation with stakeholders from the Umeå municipality. Study II was an explorative field-study with naturalistic observations (c.f., 129) and focus-group interviews inspired from the results of Study I and the theory of social representations (127). Study IV was a focus-group interview study that was enriched as a complement to Study III with a healthy and active perspective on risk, safety, and preventive strategies among old people (c.f., 130) (Table 2).

Table 2. Overview of design, sample, data collection and analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Sample</th>
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<tr>
<td>I</td>
<td>Descriptive retrospective cross sectional study</td>
<td>795 non-minor injured children (0-12 years old)</td>
<td>IDB data (2007-2009)</td>
<td>Descriptive statistics</td>
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<tr>
<td>II</td>
<td>Explorative field-study</td>
<td>Teachers and children (6-12 years old)</td>
<td>Observations at schoolyards (14 days, ~84 hours) 4 focus-group interviews with 28 teachers 6 focus-groups interviews with 46 children</td>
<td>Qualitative Content Analysis</td>
</tr>
<tr>
<td>III</td>
<td>Descriptive retrospective cross sectional study</td>
<td>300 senior citizens (65 years and older) injured as pedestrians</td>
<td>IDB data (Jan 2009 - April 2011) Complementary questionnaire</td>
<td>Descriptive statistics</td>
</tr>
<tr>
<td>IV</td>
<td>Qualitative interview study</td>
<td>31 senior citizens (65 years and older)</td>
<td>6 focus-group interviews</td>
<td>Qualitative Content Analysis</td>
</tr>
</tbody>
</table>
Setting

The studies were performed in northern Sweden, where the climate closely touches the sub-arctic climate. Such climates now and then reach −30° C during winter and in summer the temperature may rise to 30° C. The summers are about three months long. During the five winter months (November to March), the sun rarely rises above the horizon and most of the day is dark from November to February. During the summer, the sun almost always remains above the horizon, and both day and night are bright.

All studies focused on the outdoor environment, excluding motor-vehicle crashes in Study I and pedestrian–motor vehicle collisions in Study III. The sites of the injury incidents in Study III were public roads, sidewalks, and pedestrian and cycle paths where the municipality is responsible for the conditions and the surface maintenance.

The studies were performed in two municipalities in northern Sweden. Studies I, III & IV were performed in Umeå, with a population of approximately 120,000 at the time of studies. Fourteen percent (17,000) of the total population were children between the ages of 0 and 12, and 14% (17,900) were 65 years and older (131). Study II was performed in the municipalities of Umeå and Örnsköldsvik. Örnsköldsvik had a population of around 55,000 at the time of the study (132). The explorative field-study (Study II) was conducted at the schoolyards of two elementary public schools. The schoolyards had both nature milieu and fixed play equipment. The two schools were chosen for convenience and because of the similar outdoor suburban environments. They enrolled 175 to 250 pupils each with children in the preschool through fifth grade. During the school day, children spent their breaks outside at the schoolyard.

In Studies I and III, the time of the study was denoted by the time of day, day, and month. In Study I, the time of the injury events were also denoted as either school or leisure time. If the injury event occurred when the child was at school, day-care, a youth leisure centre, or in transit to or from school, the time was denoted as school time. Other times were denoted as leisure time.

Sample and procedure

The samples of children in Study I and senior citizens in Study III were derived from a comprehensive total data set of a well-defined population and geographic area from the IDB at Umeå University Hospital. The data sets also contained self-reported circumstances of the injury incident collected
through the open-ended questions in the IDB. In total, 6,749 children (0-12 years) were registered in the IDB from 2007 to 2009. Those injured indoors (n=3079) and those injured in motor-vehicle crashes (n=443), and those with no injuries, minor (n=2037), or fatal injuries (n=1) or unknown (n=394) were excluded from Study I. Thus, 795 injury events sustained in an outdoor environment causing non-minor injuries of at least concussions or fractures among children were included in Study I. The same child might be injured several times during the time period and thereby be represented more than once in the dataset.

A total of 3,114 senior citizens were injured in the Umeå municipality from January 2009 through April 2011 (Study III). Of those, 965 including 119 unknown cases were injured in outdoor environments. Only those senior citizens who had fallen as pedestrians in the public city area in the Umeå municipality from January 2009 to April 2011 and registered in the IDB were included in the study (n= 300). The data set in Study III also contained data from the complementary questionnaire sent out to the injured pedestrians within a few weeks after the injury incident. Of the 300 injured pedestrians, 216 (72%) returned the questionnaire. Additional, health care costs information were derived from previous research and approximated in Study III (133, 134).

In Study II, all children and teachers at the two schools were eligible participants to be observed. All children, their parents, and teachers were informed of the upcoming field study and the study’s aim before the data collection started. The observations did not focus on specific individuals but on the play situations. In this way, some children and teachers might have been observed several times while others may not have been observed. The observations were accomplished over four weeks in October and November 2012 and two weeks in February and March 2013. Six days of observations were conducted at one school and eight days at the other school. The observations included all scheduled activities at the outdoor schoolyard from 8:00 am to 3:00 pm. During the period of the study, the air temperature ranged between +5 to -10 degrees Celsius.

Teachers and children enrolled only in preschool class and the fifth grade (i.e., the youngest and oldest) at the schools were also eligible participants to the focus-group interviews. In total, 28 teachers and 46 children participated in the 10 focus-group interviews. The focus-group interviews in Study II were conducted subsequent to the observation period. Four focus-groups with teachers and six focus-groups with children were conducted.
In Study IV, a purposive sampling strategy was employed. Relating to the research topic, the recruiting strategy was to invite active, healthy, and mobile senior citizens to participate, as they are most likely spend time outdoors. The participants were recruited from an annual meeting of the Swedish Motor Association and a Senior-safety day in the city. Consecutively, as the senior citizens agreed to participate (n=31), four to eight people were grouped together. The groups contained both men (n=16) and women (n=15). The ages ranged between 65 and 83; mean age for women was 73 and for men 70. Six focus-group interviews were carried out during 2014 a couple of weeks after the participant’s recruitment. The focus-group interviews were conducted in a conversation room at the university.

**Data**

**Injury Data Base (IDB)**

In Studies I and III, the retrospective data were collected from the IDB. The IDB data is built upon information about injured persons who attend an ED. At the Umeå University Hospital, all injured persons in need of medical treatment have been registered at the Umeå University Hospital since 1985. (IDB from 1995). External missing cases are continuously checked and result in less than 10%. Umeå University Hospital is the only hospital in the area that treats injuries and has a catchment radius of 60 km.

An injured person who visits the ED receives a questionnaire with fixed and open response alternatives and is completed by the injured person or with the help of a family member or staff. The questionnaire contains detailed information about the injury event. This information, along with medical records, ambulance and police reports is assembled in the IDB. The IDB contains variables regarding the injury and the injury event, for example, visiting time, injury day, month, treatment, age, gender, contact cause, injury type, injury mechanism, injury location, situation, activity, causes, triggers, and products.

Data of injury severity was based on the Abbreviated Injury Scale (AIS) (135), and the injury causes were coded as NOMESCO Classification of External Causes of Injuries (NCECI) (136). If an individual has more than one injury, the maximum injury is denoted as MAIS (Maximum AIS) and indicates the most severe AIS value. AIS 1 are minor injuries (e.g., bruises, wounds, or sprains), AIS 2 are moderate injuries (e.g., concussions with loss of consciousness or radius fractures), AIS 3 are serious injuries (e.g., fractures of the femur or spleen ruptures), and AIS 4–6 are severe, critical, and maximum (fatal) injuries, respectively (135).
Complementary questionnaire
The study-specific complementary questionnaire in Study III was distributed in two versions. The first version was distributed in 2009 and included 13 questions of which two-thirds were multiple-choice questions. One example of a question was, “Did you use any of the following during the incident?” with the fixed alternatives: sticks, walking aids, wheelchair, walker, etc. The rest of the questions were open-ended, for example, how the incident happened. The questionnaire distributed in 2011 was a slightly revised version of the previous and contained questions about safety information. Both questionnaires were face-validity tested with a group of researchers and representatives from the municipality office.

Observation
In Study II, data were generated by naturalistic observations in real time. The focus of interest was to capture realistic circumstances of play activities at the schoolyard and, if possible, preventive actions among children and teachers. Initially, the observations were unstructured, open, and explorative (c.f., 137). All scheduled outdoor play activities were observed. They were observed from a short distance from the activities. Gradually, circumstances with unsuccessful completion of the play activities, for example, falls, collisions, or violence which might result in injuries, were prioritized for observation (c.f., 59, 80). During the observations, field notes were written to sort the vast amount of data and transcribed verbatim within two days of the observations and are considered as text in the analysis (c.f., 137).

An observation structure and a scheme, incorporating environmental factors, child and teacher actions, and school intentions (policy and law), were developed specifically for this study. The structure and scheme reduced the risk of inconsistency during data collection. The co-authors could view the scheme and discuss whether the observations reflected and described injury risk and risk situations or not (138).

Focus-group interviews
Data in Studies II and IV were collected through focus-group interviews to provide an extent of views on the research topic based on the participants’ own understanding and shared experiences (c.f., 130, 139). The questions were inspired by the concept of sense making of risk and focused on the individual’s understanding of risk as not only an individual construct but also influenced by social relations and general beliefs (66).

Two researchers moderated the focus-group interviews. The participants were encouraged to interact with each other in a respectful manner and to take turns in speaking. The moderators intervened solely to keep the
discussion on topic and to encourage the more reserved participants to speak. In study II, the focus-group interview began with general questions about children’s outdoor play. Then, it progressed to attitudes toward risk-taking, safety, and injury; and views on environmental factors, school intentions and, laws that may influence risky play. The questions were adapted for either teachers or children and age-adapted for the children. The interviews were audio recorded and lasted approximately 60-90 minutes each. The strategy to use both observations and focus-group interviews in Study II was considered useful to provide different perspectives of the participant’s wordings and actions; capturing the discrepancy between what is said and what is done.

In Study IV, the focus-group interviews beginning with general questions of outdoor activities and mobility in the public outdoor environment. The discussion then progressed to risk, safety, and preventive strategies. Each focus-group interview was audio-recorded and lasted an average of 85 minutes (range 70-100 minutes).

**Data analysis**

Descriptive statistics were used on the total population data set in Studies I and III. Numbers and proportions show the differences between groups. Chi² test analysed differences between the respondents and the non-respondents of the complementary questionnaire in Study III. Data were analysed using Excel and IBM SPSS statistic 21; IBM Corp., Armonk, NY, USA.

Data from the study-specific complementary questionnaire (Study III) were analysed by content as related to Haddon’s Matrix (59). The part used in the analysis was the triad of human, product, and environment in the event-phase as they relate to causes and preventive actions.

In Study II, data from the three sources were analysed; field notes from child observations, texts from children’s and teachers’ interviews. A qualitative content analysis was made of the transcribed text (140). All transcripts were read at the start of the analysis to get a sense of the whole. Then, meaning units were identified and abstracted while preserving content. The abstractions were given temporary codes in the text body. The coding was used to facilitate linking and sorting the meaning units connected to each other. The codes were then sorted into preliminary subcategories. After content comparison within and across them, they were combined into categories (c.f., 140). Three risky play types and another three categories of allowable play emerged in the analysis.
The theory of social representations (127) was found usable to describe and understand how children and teachers communicate risks and safety, and how they act based on their experiences and perceptions. The result of how individuals’ diverse experiences might shape their perception of reality and their resultant actions are discussed in relation to theory.

In Study IV, the program Open Code (141) was used to make the transcribed text more manageable and orderly. The analysis was guided by qualitative content analysis (140). First, the entire text was repeatedly read to get a sense of the whole of each transcript. Next, meaning units were identified and the surrounding text, in the meaningful units, was included to not lose the context and to avoid fragmentary units. The next step was to condense meaning units while preserving the content to get a more manageable text. Furthermore, the condensed meaning units were coded with a few words describing the content. After content comparison within and across the codes, they were combined into subcategories and categories. The content within the categories is related to each other and different from the other categories (142). In the result of Study IV, seven subcategories and three categories emerged.
Ethical considerations

The studies included in this thesis followed the Declaration of Helsinki-Ethical Principles for Medical Research Involving Human Subjects that safeguards the participants’ rights of autonomy and self-determination (143). The researcher verified confidentiality during data collection, analysis, and publication. The studies were approved by the Regional Ethical Review Board in Umeå (2012-490-31Ö; 2013-448-31Ö) and the Research Committee at Västerbotten County Council, Sweden.

Inclusion in the IDB is optional for the people who attend the ED after an injury incident. However, few people choose not to participate. All analyses were performed with care for patient security and confidentiality. The authors worked with an anonymous dataset in Studies I and III, that is, the dataset was managed and analysed without the patients’ personal identification numbers. In Study III, answering the complementary questionnaire was voluntary, and the questionnaire did not contain any questions that might be experienced as insulting.

In Study II, informed consent for schoolyard observations was obtained from the Principal of each school. Further, the children and their parents received an informative letter and a written informed consent form for allowing their child to participate in focus-group interviews. Those who returned the written informed consent form were invited to participate in the interviews. Each child participant prior to the focus-group interview beginning gave oral assent. In Study IV, senior citizens received an informative letter and a written informed consent form for focus-group interview participation. At the beginning of each interview of Studies II and IV, participants were reminded of the purpose of the study and guaranteed confidentiality. Participation in the focus-group interviews was voluntary, and withdrawal without a given reason was permitted, but no one withdrew.

To ensure confidentiality, the participant identities were replaced with fictive names or codes in the verbatim transcriptions of the focus-group interviews (Studies II & IV). Additionally, school and road names were replaced.

The research in this thesis was not considered a risk for harm to the participants. On the contrary, it is possible that participation may have been eye opening for some participants regarding injury risk and safety. Thus, their participation contributed to a learning opportunity and primary prevention.
Results

The presentation of results is based on the findings from each study. First, the injury panorama among non-minor injured children (0-12 years old) is described including descriptions of circumstances surrounding the outdoor injury incidents (Study I). This is followed by analyses of injury risk situations among children (6-12 years old) during outdoor play in the school environment. The risk situations were explored in the field (Study II). Second, the injury panorama among senior citizens who had fallen as pedestrians in a public outdoor environment is described including health care costs and self-reported causes of the incident and suggested preventive strategies (Study III). Last, senior citizen’s experiences and perceptions of how safety can be increased and risk reduced in outdoor environments are described in Study IV.

Injury panorama among children (Study I)

Injuries, severity and time
Seven hundred ninety-five Swedish children aged 0-12 sustained non-minor injuries (MAIS 2 & 3) participating in outdoor activities during the three studied years. Of the 795 children, 778 sustained moderate and 17 serious injuries. There were no children seriously injured under the age of six. The annual injury incidence was 17/1000 children and increased with age. Boys were overrepresented in the injury statistics (55%). Boys, four and 11 years-old, accounted for about 60 to 70% of the injury incidents in each age-group. A slight overrepresentation of injury incidents was seen in the spring and summer months (April to September) peaking in May (n=107). Ten of the 17 MAIS3 injury incidents occurred during winter. One-third of the injury incidents among children occurred during school time peaking in September (n=42). The rest (except 12 cases registered as unspecific) occurred during leisure time. Of the MAIS3 injuries, 16 occurred at leisure time. Children aged seven to 12 became injured more frequently during leisure time compared to school time, except for five-year-old children who also accounted for a high amount of injury incidents during leisure time. The five and 11-year-old children’s injury events occurred more often (60-70%) during leisure time.

Three out of four injury incidents (n=547, 72%) were related to falls. Collisions were the second most common injury mechanism (n=197, 25%). Collisions were more common among older children than younger. One hundred and eighty-three children between the ages of seven and 12 suffered moderate (MAIS 2) injuries when falling at ground level. The MAIS3 injuries
were characterised by falls from higher than one meter (e.g., from rooftops and trees) or ground-level falls during downhill skiing. Half of the MAIS3 injuries were sustained during collisions. Most children \((n=716, 90\%)\) sustained fractures, especially of the upper extremities \((n=562, 78\%)\) and in particular the radius \((n=259, 33\%)\). MAIS3 injuries were located on the lower extremities, the torso, the upper extremities and the head. The second most common injury type was concussion \((n=50, 7\%)\). Of all injured children, 244 \((31\%)\) were hospitalised for a total of 537 hospital bed days.

**Contributing factors and circumstances**

The surface, such as asphalt, snow, ice, and bare ground constituted a common contributing factor to the injury incidents regardless of activity. For younger children, play \((n=434)\) was the most commonly reported activity leading to injuries, whereas sport \((n=191)\) and transport activities \((n=134)\) became more common with increased age. Play and sport products were reported as contributing factors to the injury incidents. Of those who reported play products \((n=132)\), 80 were between three and seven years old. Sport products \((n=154)\) were more commonly reported during leisure time, whereas play products \((n=74)\) were more commonly reported by those children injured during school time.

The activity preceding the injury during play was described as a voluntary jump, being pushed by another child, or riding, for example, a toboggan. Some examples of the children’s description of the cause of the injury incident included losing their grip on the climbing frame or trapping an arm or leg when sliding down the slide. Common products contributing to the injury when playing were trampolines, climbing frames, swings, and toboggans. A circumstance leading to injuries when playing on the trampoline was falling off when leaning on or jumping against the safety net. Children also fell when climbing down the ladder outside the trampoline; sometimes landing on stones or a chair on the ground. Children riding toboggans sustained injuries when falling off or jumping with the toboggan. Nine children became seriously (MAIS3) injured when playing. Two of them became seriously injured (MAIS3) when falling off or colliding on the trampoline. One child became seriously injured when falling from a climbing frame. Two children sustained femur fractures (MAI3) when they crashed into trees. Another child rode the toboggan down a playhouse roof sustaining an MAIS3 injury. The others, fell from roofs or balconies.

Products contributing to injuries sustained during sport activities were; downhill skis, snowboards, ice skates, horses, soccer balls, and other human beings. They described falling when their ski stuck in the snow, when they jumped, or attempted to show off. The ski lift was involved in a few injury
incidents. Five children became MAIS3 injured during sports activities. Circumstances leading to those injury incidents included jumping with skis, the ski binding not releasing, or colliding with a tree or another skier. Other sport activities contributing to injury incidents were fighting for the soccer ball or when running, for example, backward during exercise.

Contributing to injury incidents during transport activities were bicycles and/or the surfaces. The contributing surfaces were described as gravelled or other surface irregularities. Most children, who were injured while running or walking, tripped or slipped. Those who bicycled reported that they rode at high speed, lost control, and crashed into, for example, rubbish bins or trees. They also fell on the pavement or fell when trying to show off. Three children became MAIS3 injured when they crashed with the bicycle, one in high speed and the other two when they jumped over homemade ramps. Bicycle passengers were injured when the bicycle turned over or when a heel or foot got stuck in the spokes of the wheel.

**Risky play types and categories of allowable play (Study II)**

Children’s play was characterized by three risky play types: 1) play at heights, 2) play with speed, and 3) rough and tumble play. Risk elements at the schoolyard were asphalt, gravel, trees, swings, and slides. Having too many children at the same place with too few adults present was also a risk element, according to the informants. When playing at height children climbed on play equipment and other available equipment such as on wooden boat/house, a barge, or snow banks. The risks for injuries were described as falling or when children voluntary jumped. When playing with speed children ran, biked, rode scooters, or slid down slides or snow banks. The risks for injury were described as falling or colliding with each other or with, for example, trees or stones. When playing rough and tumble, children competed and were involved in more violent play, for example, fighting with sticks. The children described their own or friends’ resultant injuries including concussions and fractured arms, legs, or ribs.

Three discernible categories emerged regarding the informants’ perceptions based on their statements and actions at the schoolyard: 1) approved play, 2) play with limits and 3) disapproved play. Within these categories, the risky play types led to different actions and were perceived differently among the informants.

**Approved play**

Teachers and children wanted approved play at the schoolyard. Free play at heights, at high speed, and with rough and tumble were allowed at the
schoolyard. Teachers who allowed play at heights saw risk as beneficial for children's development. The teachers would rather say – “How fun, see how high you are in the tree”, instead of telling the child to climb down. Teachers wanted children to test limits even if it means the child could be injured. It was seen as unreasonable to caution or overprotect children. In fact, they believed that soft surface or other preventions if falling was to be too protected. Overprotection inhibits children's development, and it is not appropriate to cultivate caution within the children. There was an awareness of injury risk at the schoolyard. Teachers and children did not believe that the risk could be entirely avoided as they saw injuries as accidents occurring from bad luck. Teachers felt that it was impossible to supervise all the children all time and, therefore, it was not their responsibility if children get hurt. According to both teachers and children, failure helps teach new abilities. Nevertheless, children who sustained, for example, a fracture described how they later avoided participating in the same activity in which they had been injured.

Teachers who allowed play with speed desired that children learn to think for themselves and make judgements about what is reasonable or not. They wanted children to question and not just follow the lead. Children participating in rough and tumble play expressed the risk as a part of the game.

**Play with limits**

Not all teachers shared the same opinions about what activities were and were not approved at the schoolyard. The teachers expressed “It depends”. The approvals were, according to the informants and directly observed, judged case by case. Things like age, development, and personality of both the children and the teachers influenced the judgement. Characteristics of personality among teachers were previous experiences of injuries or incidents and being a parent themselves. Activities were judged by how serious the teachers perceived the risk involved in the activity to be. There were divergent opinions of the seriousness of injuries. Some teachers believed a broken arm was serious, whereas others considered fractures to not be all that serious. This divergent was also shown in the teacher’s opinions of what situations should be reported as incidents or not. Children, on the other hand, uttered concrete descriptions of serious injuries. Fractures, twisted ankles, blood, or smashing their head into something were considered as serious injuries. Scrapes were described as minor injuries. According to the children, risky activities included acting impulsively or doing something that feels scary. Boys’ play was described as more intense. Usually, an injury event or near event had to happen before limits were set, meaning that no limits were set because no one had been previously injured.
To play in the schoolyard may look dangerous, and according to the children their play was limited just because it appeared dangerous. On the other hand, they said it was not dangerous because they are used to playing that way.

Teachers were seen limiting children’s play at heights. Children were told to climb down from trees and high rocks; however, the stage of climbing the children were in before being told to climb down varied. According to the teachers, manufactured play equipment was perceived as safer compared to, for example, trees and rocks. Children were also observed limiting their own play and that of others. Some teachers limited speed when children went down slides or snow banks, alone, in tandem with others, or head first.

**Disapproved play**
Risky play activities may be disapproved by the school staff with or without the cooperation of the children. Nowadays, according to teachers, children are more restricted and allowed to do less on their own than when the teachers were schoolchildren. Thus, there are more restrictions today, and the teachers stated that children play less and with more supervision. Mostly, the informants thought that in the name of safety the product or activity that “causes” the injury incident was categorically removed or restricted, meaning there are less challenging products or activities allowed at the schoolyard today.

As children should feel safe and not humiliated at the schoolyard, rough and tumble play was often disapproved. For example, the play king of the hill (pushing each other down a hill) was disapproved.

**Injury panorama among senior citizens (Study III)**

**Injuries, severity and time**
From January 2009 to April 2011, 300 senior citizens (n=221 women; n= 79 men) aged 65 and older (m=74 years) sustained fall-related injuries when walking within the studied city area. The incidence was 27/1000 persons per year. More than half of the injured pedestrians were younger senior citizens (65-74 years old). Among the injured, women (n=221; 74%) were overrepresented. More than half of the injured pedestrians (n=179, 60%) suffered non-minor (MAIS 2+) injuries. Women (n=146, 66%) suffered more non-minor injuries whereas men (n=33; 42%) suffered more minor injuries (Study III, Table 2, page 4). The majority (n=160) of pedestrian falls occurred between 10 am and 2 pm distributed evenly over the days of the week. Most pedestrian injury events (n=242; 81%) occurred during the months of November to April (wintertime).
Type and hospitalisation
Fractures were the most common injury type (n=198; 47%) among the senior citizens who fell as pedestrians. Younger seniors (65-74 years) suffered fractures more often than older senior citizens (75 years and older). Fracture locations were mostly the wrist, upper arm, and shoulder. Superficial contusions and wounds were the second most common injury type and was the more common injury type among older senior citizens. Of all the injured, 65 (22%) required in-hospital treatment (n=35 younger; n=30 older) and they were hospitalised for a total of 549 hospital bed days. On average, women spent nine days in the hospital and men spent five days. Half of the injured pedestrians spent less than five days in a hospital bed, but there was a group of six seniors who were hospitalised from three weeks up to 1.5 months. The total cost for the hospital stays was estimated at approximately 760,000 EUR. For those who suffered hip fractures, the cost was estimated at approximately 298,200 EUR.

Injury scene and causes
For senior citizens who responded to the questionnaire (n=216), most of them used shoes with “raffled soles” at the time of the injury incident. Some (n=29) reported using walking sticks, walkers, or spikes. None of the injured senior citizens were using mobile phones, radios, or mp3 players at the time of the injury incident. In 70% (n=152) of the injury events, the scene/road was covered with snow on ice, slush, or polished ice. In 180 of these events, traction sand was perceived as inadequate. A few (n=44) incidents occurred during dry road conditions. Injured pedestrian (n=166; 77%) reported the environment as causative to the injury incident, for example, icy spots (n=125), surface irregularities (n=20), lack of snow removal (n=11), and curb stones (n=6). Human impact, such as dizziness, was reported by 19 respondents as causative to the injury incident.

Preventive strategies
Almost 40% (n=67) of the injured pedestrians suggested environmental improvements as preventive strategies. Changes in one’s own behaviour, for example paying more attention, were less often suggested (n=55). The rest of the injured pedestrians suggested a combination of environmental improvements, changes in human behaviour, and the use of safety products as preventive strategies.

Perceptions and experiences of risk and safety (Study IV)
Senior citizens’ perceptions and experience of how safety can be increased and risk reduced in outdoor environments emerged in three categories; 1) to
adjust to age-related changes, 2) to facilitate possibilities and, 3) constraining elements for outdoor mobility.

**Adjust to age-related changes**

Being aware of one’s own age was one way of adjusting to age-related changes. The senior citizens did not want to see themselves as old. As long as they were healthy, they wanted to continue with independent outdoor activities associated with health and wellbeing. Outdoor activities were also assumed to have preventive effects on falling and its consequences. As senior citizens, they experienced an awareness of the risk of falling. They have started to think about possible consequences of falling, especially if they were alone. With age, they believe that they will fall more abruptly. Also, medications, dizziness, and changes in vision impact their abilities for outdoor mobility. However, as senior citizens they were no longer embarrassed to use safety devices. Taking responsibility was another way of adjusting to age-related changes. The senior citizens believed that safe outdoor mobility required common sense and required thinking ahead. They recounted not exposing themselves to unnecessary dangers and, therefore, stored spikes in the car and checked the outdoor temperature before going outside. They have learned from experience, but not all of them felt they had become wiser with age. In their efforts to take responsibility, they reported hazards and suggested improvements to the municipality authorities. However, they felt their suggestions were not heeded. “It feels like it requires a compound force behind an argument if there should be a change” (Male; 80)

**To facilitate possibilities**

Facilitating possibilities for outdoor mobility was related to feeling safe within the environment. Performing activities with others in familiar environments with accessible facilities such as cafés and toilets increased safety. Also, ice-free and bright conditions were factors for increased safety. Soft surfaces and year round accessibility to outdoor trails would facilitate mobility and were suggestions given by the informants for increased safety. Feeling safe was also related to the usage of safety devices and were sometimes described as necessary for outdoor mobility. Using safety devices preventatively made both the participants and their families feel safer. Safety devices needed to be easy to use, preferably automatic. A fashionable design made the products more desirable and did not make the participants feel old with ailments.

**Constraining elements**

Constraining elements for outdoor mobility related to fear. Fear of falling makes the participants hesitate or stop doing certain outdoor activities. Fear
was particularly associated with ice but also associated with previous injuries, assaults, or falling and not being found. “After the injury, I will never ever go outdoors again” (female; 68)

Participants also discussed how road users (pedestrians, bicyclists, car-drivers) who lacked attention were an element for fear. The interactions between pedestrians and bicyclists were complicated and frightening. On the other hand, pedestrians seem to lack attention to motor traffic and there also seems to be a lack of knowledge about traffic rules.

Dangerous environments were constraining for outdoor mobility. Surface irregularities, such as potholes, cobblestones, and propped up manhole covers, were described as fall risks for pedestrians, cyclists, and for those using walkers or wheelchairs. Inconsistent construction of pathways creates uncertainty when walking and bicycling. Winter conditions are an additional constraining element for mobility. When the temperature fluctuates, that is one day is frozen and the other day is thawing, the environments become even more dangerous. Slippery surfaces and insufficient graveling were aspects for staying indoors. Lack of snow removal constrains outdoor mobility. In the contradict, removal of snow could also constrain outdoor mobility as it created hard-packed snow that can become slippery or deep with grooves that make it difficult for bicyclists to get around. Snow removal also packs snow against the pavement making the entrance to the pavement difficult. Darkness is a constraining element that relates to the unclear environment, and inconsistent construction makes it even more dangerous. Bright lights shining on pavements and pathways were suggested.

All safety devices described by the participants had shortcomings that constrained their use and, thereby, constrained outdoor mobility. One hidden drawback of the safety devices was a false sense of security. With spikes or sticks, the senior citizens exceeded their walking capacity or did not pay enough attention to the slippery surfaces. Another drawback when using spikes was the difficulty of putting them on and off. It was described as difficult as many models need to be drawn over the shoes. Putting on or taking off spikes also required finger strength and often a chair to sit on. Additionally, a reason for not using the safety devices was the difficulty to carry them around (e.g., indoors) after use.
Discussion

The overall aim of this thesis was to investigate injuries among children and senior citizens sustained during outdoor activities and to explore experiences and perceptions of risk and possibilities to increase safety in the outdoor environment.

The main finding in this thesis concerning children and senior citizens was the high number of fractures sustained during outdoor activities. The circumstances preceding the injury incidents were mostly falls occurring during play or sport activities when bicycling or walking. The ground environment contributed to the injury incident, and winter conditions were a particularly common causative factor for injury incidents among senior citizens. Contributing products for injury incidents among children were diverse. In addition to the injury panorama, another main finding in this thesis indicating that different perceptions and experiences of injury risk and safety influence children’s and senior citizen’s possibility to participate in outdoor activities. For children, who played at heights, with speed, and rough and tumble; the risky play was either allowed, limited or restricted. The play was judged case-by-case by the children and teachers and influenced by their characteristics. For old people, adapting to age-related changes, having confidence of safety within the environment, and using safety devices facilitated outdoor mobility. On the contrary, fear of falling, shortcomings of safety devices, and dangerous environments were constraining elements for outdoor activities.

In this part of the thesis, the main findings concerning children and senior citizens are discussed separately and related to primary prevention and social representations. Thereafter, a brief description of the complexity of injuries and outdoor activities is exemplified within an ecological approach to safety promotion.

Children – balancing risky activities with healthy development

Maintaining a balance between the risk of injuries and outdoor activities seem to be a challenge for children and their caregivers (e.g., parents and teachers). Children who suffer fractures from falls or collisions during outdoor activities, is a main result (Study I). This study confirms the numbers of injuries children are exposed to and is, thereby, complementary to what is described in Swedish national statistics (28) and by others (43). However, there remains a need to explore the circumstances preceding the injury events and possible preventive strategies. From a primary preventive
perspective described in Haddon’s 1st of the 10 countermeasures of injury prevention (123), the hazard need to be eliminated. Basically, in this context, it could mean that the hazard is the child doing outdoor activities and that the circumstances preceding the injury incidents need to be eliminated. This was a preventive strategy described in Study II, as products or activities that “cause” the injury incidents were categorically removed or restricted. Even though removing products or forbidding activities may be the most effective way of ensuring safety, there are contradictions to this effort. Contradictive attitudes among teachers and children were seen in Study II, as they described risk-taking as an inevitable part of learning and a challenge for learning new abilities. Thus, children were observed playing at heights, with speed and, rough and tumble at the schoolyard (Study II). Other studies have indicated that not all risk taking is bad (144-146). This is somewhat in conflict with injury prevention but raises the question about what degree of risk is acceptable. Thus, to understand the allowing approach among teachers and children in Study II, it may be useable to compare the result with what is said in the social representation theory (127). Teacher’s risk knowledge can be seen as derived from personal or teaching professional experience rather than from a medical and injury preventive perspective. They use common-sense knowledge of injury risk and do not focus on injury prevention as their first priority as teachers are to give children the possibility to learn and develop. For example, teachers said “how fun, see how high you are in the tree”, instead of telling the child to climb down. Thus, it is justified to believe that teachers anchor the common-sense knowledge to their educational intention, school policy, and laws that promote learning. Teachers’ social representation is also perceived by the children at the school and seen in the actions at the schoolyard.

Based on findings in Studies I and II, it seems necessary to find primary preventive measures that preserve the challenge of play but prevent against at least non-minor injuries. Safety efforts need to be balanced with opportunities for children’s learning and development. Enforcing safety interventions without identifying the perceived cost to children’s learning and development will undermine trust in the intervention advice. School nurses have much knowledge in primary prevention, child development, and injuries. Thus, they have an important role in integrating primary prevention with learning intensions. School nurses may be in positions to help create optimal outdoor environments to support children’s play and developmental needs. School nurses can also integrate with parents and educational professionals who have specific knowledge of the children’s activities in the outdoor environment. Additionally, the children are resources in this process and should not be overlooked. Involving children and utilising their specific
skills and experiences in the process of making the outdoor environment safe and challenging is important.

Another example of primary prevention is the 4th of Haddon’s 10 countermeasures (123). The countermeasure suggests, for example, modifying the environment to become soft and reducing the energy causing the injury. The ground surface was described as contributing to the injury incidents (Study I), which is in accordance with other research (147-149). Additionally, various products contributed to the injuries in different activities. For example, trampolines and climbing frames were commonly reported as contributing to injury incidents when children played (Study I). This is in line with previous research (74,150-153) indicating an increase in trampoline injuries during leisure time (152) and more severe injuries when falling from climbing equipment (153). Regulations regarding product safety and surface have long received considerable attention in research, for example, using soft surrounding surface (147, 148, 154, 155) and sometimes leading to a successful reduction in injury rates (149). However, imposing too many safety restrictions in the environment has been described as constraining children’s mobility and free play. Totally safe environments and products might lose their appeal for children (156-159). There is research indicating a growing concern for risk with the result that adults prevent children from participating in risky activities. Thus, a growing trend toward over-protective safety measures is described (95, 160, 161). This was a concern among the teachers and children in Study II. The teachers did not want to over-protect the children at the schoolyard. Soft surfaces or other safe playground equipment was interpreted as over-protective (Study II). Optimizing child safety in all circumstances may not always be the best approach to injury prevention as it may negatively influence child development and health (94, 96, 162).

On the other hand, severe injuries cause negative effects on the children’s development and health. Minor injuries that do not require medical treatment at an ED should be the maximum injury for children to learn from injury experiences. Thus, based on the findings in Study I, which is in line with previous research (28), there is knowledge about injury severity from falls to motivate the implementation of safety products that have shown a reduction in injury rate and severity (147, 149). As schools represent an environment that can be purposefully modified to minimize injury and maximize activity (48, 163, 164), primary preventive strategies may be enforced. For example, energy absorbing surfacing beneath play structures at the schoolyard could be compulsory as such measures may not interfere with learning or development.
A third example of primary preventive strategies, in line with the 3rd of Haddon's 10 countermeasures for injury prevention (123), interpreted as supervision of children can hamper the contact between injury energy and children. Others have shown that supervision at the school does not have an immediate relation to the risk, but more with the intention of showing that the schools take responsibility for safety (64, 161). Findings in Study II, indicate that teachers felt it was impossible to supervise all the children all the time at the schoolyard. This is an interesting finding as teachers have the responsibility for children’s safety during all activities during school hours (165, 166). Appropriate supervision is a critical factor in preventing childhood injuries, whereas indirect supervision or no supervision are associated with increased risk (167-169). In school settings, teachers overseeing the schoolyard may be seen as a safety system. Activities judged case-by-case may influence children’s play in a negative way. Based on the finding in Study II, teachers are in need of more knowledge about injury risk and primary prevention and how, for example, supervision may increase learning possibilities for children. School nurses have an important role to educate and train teachers and children about injuries, risks, and how to systematically prevent risky situations. Health-promotion conversations with teachers, children, and school nurses together may increase an understanding of how it would be possible to prevent injuries without interfering with learning possibilities.

The results from Studies I and II do not explain how to allow children to take acceptable risks at the schoolyard without putting themselves in undue danger of non-minor injuries. Nevertheless, the different perspectives of injury prevention and education need to be taken into consideration to achieve the goal of allowing children to play with acceptable levels of risk that promote healthy development and at the same time avoid non-minor injuries.

**Old people – balancing healthy activities and injury risk**

Maintaining a balance between injury risk and outdoor pedestrian activities among senior citizens seems to be a challenge. In Study III, senior citizens 65 years and older suffered from fractures when falling as pedestrians. Women were overrepresented, which is in line with other studies, showing that women in general are more affected by fall-related injuries (170-173). Younger old people (65-74 years) suffered fractures more often than senior citizens 75 and older. This is an interesting but difficult result to interpret. Maybe it is in line with previous studies showing that outdoor falls are more commonly among healthy and active people. Furthermore, healthy and active old people may be unaware that their high activity levels may increase
their risk for falling and sustaining fall-related injuries (174, 175). From a primary preventive perspective, the prevention of falls is important when reducing the occurrence of injuries. However, it is not a desirable situation if old people choose to not go out walking because of a high injury risk. Thus, primary preventive efforts need to promote healthy activities. Based on the findings in Study III, it might be effective to increase awareness of fall-related injuries among old people who are still active as pedestrians and to support healthy activities with effective fall-preventive strategies such as exercises with balance and strength components (c.f., Haddon’s 8th strategy). Additionally, targeted interventions might be needed (55, 176). Within the group of people who remain active outdoors, specific suggestions for women seem important and are also presented in several studies (110, 109). It may be necessary to raise awareness among, for example, district nurses that outdoor pedestrian activities are a risk factor for falls so that they can inform about fall prevention at the same time as they recommend physical activity for a healthy lifestyle. The nurses may take the responsibility of educating old people along with other professionals (e.g., physiotherapeutic and occupational therapists) to give various perspectives on healthy aging without risk for injuries. More municipality engagement among nurses for the health of the active old people is warranted.

The injured pedestrians in Study III reported environment related aspects as causative to the injury incidents. Winter conditions were the most common related aspects and injured pedestrians suffered more severe consequences during wintertime (Study III). This is in line with previous research indicating seasonal variations in injury risk and severity (173, 177, 178). As the injury incidents happened in public transport areas the respondents in Study III indicated that they held the local authorities responsible for poor maintenance of side-walks and roads. In addition to that, the results in Study IV, indicate that winter conditions were a constraining element for outdoor mobility. The participants described fluctuating temperatures causing slippery surfaces, the lack of or inadequate snow removal and insufficient graveling as reasons for staying indoors (Study IV). An interesting questions that arise is how much do injuries “caused” by winter conditions cost individuals and society in general and what costs could be saved with an effective ice and snow removal program?

People who choose to live in this part of the world with winter conditions still have the rights to a safe environment. The 1st of the 10 countermeasures developed by Haddon, indicates the removal of hazards in the environment (123). Based on findings in Studies III and IV, several suggestions for primary prevention arise. For example, improvements in de-icing, snow removal, pavement gritting, and repairing uneven surfaces. Eliminating risks
may be done by promptly (178), especially if user of the public transport areas could easily report changes in the conditions to the local authorities responsible for the maintenance. District nurses have a health promoting responsibility for the residents in the municipality. Thereby, they might advocate measures that can expand the possibilities for old people to continue to participate and be active in the community. Additionally, nurses may take responsibility for safety for the old pedestrians and be spokespersons in the municipality for old people’s need for healthy pedestrian activities in the outdoor environment so they could continue to participate in society (67).

Another finding associated with the environment is the indication that inconsistent constructions of pathways was constraining for outdoor mobility (Study IV). Inconsistent construction creates uncertainty when walking and bicycling. Further, the deficits among bicyclists and pedestrians in paying attention to other road users, was described as risky behaviour (Study IV). Risky behaviour might be less dangerous (in line with Haddon’s 6th strategy) if the risk was separated in time or place or enclosed with a physical barrier. In that way, the risk and the person may be close to each other but without danger arising. This has been evaluated in an attempted separation of risk for injury incidents among bicyclists and pedestrians at a pathway bridge (179). Modifications, such as speed reducing markings and clear walking and bicycling instructions at the start of the bridge were made with the aim of reducing injuries. However, these modifications seemed unsuccessful, as instead, there was an increase in severe injury incidents. Environmental changes could invert the effect of the intent and need to be taken into consideration when suggesting safety efforts.

Furthermore, senior citizens exceeded their walking capacity or did not pay enough attention to the slippery surface when using spikes (Study IV). This is somewhat in line with research showing that increased safety in the outdoor environment may increase the exposure time for walking as more people might feel safe to do so (54, 177). Basic knowledge of injury prevention may help people to make decisions based on activities' risk levels. Health promoting conversations with nurses and old people may be a suitable way to increase knowledge about primary prevention and an active lifestyle.

Another perspective based on people's behaviour is the description of following the “path of least resistance” when considering safety. In Study IV, participants described that they sometimes lack adherence to using safety devices despite knowing they could prevent injury. This is somewhat in line with previous studies (180, 181), describing products such as anti-slip
devices as strongly important to use and something they will recommend others to use (182). However, in Study III, the majority of injured pedestrian did not use safety devices at the time of the injury incident and just a few of them suggested the use of safety devices as a preventive strategy. This is a contradictive result but may be understood within the social representation theory. For example, a common belief might be that injuries do not affect me, just others (183). It may be assumed that old people’s risk knowledge is derived from experience and if they never experience or reflect over why injuries occur, it might be realistic to consider injuries as accidents and random incidents. The tradition of using the term “accident” hangs on and may affect people’s perceptions of how and to whom fall-related injuries occur. As long as the word “accident” is used, people may think that an injury incident is random and not preventable (184). This is in contrast to the medical professional’s approach to injury prevention. District nurses have an important role in motivating a change in the attitude toward injuries from an “accident”, which may influence people to use safety products less, to an “injury event” approach, which may help people to understand the effectiveness of primary preventive efforts. Additional to that, if people perceive the shortcomings of products (Study IV) as more constraining than the potential injury warrants, it seems logical that comfort comes before safety. In Haddon’s matrix for injury prevention, product improvements may be seen as a strategy for primary prevention (59). District nurses also have an important role in providing information regarding safety products for outdoor activities as well as involving senior citizens in the process of making products user-friendly to increase the usability.

Another adverse effect of fall and fall-related injuries is the fear of falling which is described in a large amount of research (185-187). In Study IV, fear was one constraining element for outdoor mobility and might be a question for nurses to raise with healthy and active people as it has been shown that fear of falling reduces physical activity (185, 188) and, thereby, the ability to participate in everyday activities.

The results from Studies III and IV indicate that improvements are needed to create safe access to the outdoor environment and thus, healthy activities. There are several potential ways in relation to Haddon’s matrix and the 10 countermeasures to create a balance between injury risk and active and healthy aging. However, it incorporates actions from individuals, professionals, and stakeholders from the municipality as well as from society.
An ecology approach to safety

Health and safety may be understood in the context of an ecological system where the individual is only one dimension (189). Other dimensions in the ecological system are the physical and the social environments. These dimensions act at five levels; intrapersonal, interpersonal, organizational, community, and societal.

Figure III. The injury iceberg adjusted to present thesis

Based on the result of this thesis, the risk of injury during outdoor activities among children and senior citizens may be illustrated by an injury iceberg (Figure III). The individual can be seen as just the top of the iceberg where other dimensions determines individual behaviour (190). At the intrapersonal level the characteristics of individuals; their knowledge, skills, life experiences, attitudes and behaviours will interface with the environment. To change the injury risk behaviour for individuals during outdoor activities, it is necessary to address the environmental and social issues hidden beneath the waterline of the iceberg. On the interpersonal level the immediate physical environment and social networks in which the
children and senior citizens live with their family, friends, and peers will influence behaviour. Health promoting conversations about injury, prevention and healthy activities may increase the knowledge of safety awareness. This will benefit not only children and old people but also people in their surroundings. At the organization level, the numbers of adults at the school yard may influence children’s opportunities to engage in healthy outdoor activities safely. A call for more adults in the school may not only go to the school organization but to, for example, senior citizen’s associations. For old people, it could be an opportunity to continue to involve and engage in society and it may also increase their physical activity with health benefits. At the community level, effective de-icing, snow removal and provision of facilities close to the pedestrian activities was facilitating to old people’s outdoor activity. This may not only be true for old people, but for people of all ages. Improved road maintenance also increased the feeling of safety and outdoor activity. An increase in pedestrian activity in the municipality is in line with a healthy life style and being climate smart. More people active as pedestrians may also influence decisions on society levels regarding for example infrastructure. Separating pedestrians and bicyclists may increase the feeling of safety and help increase pedestrian activities.

An ecological approach may give a picture of the composite system of different dimensions integrating and revealing that actions in one part affect other parts of the system. An ecological approach may raise several suggestions for designing and implementing interventions to maximize co-benefits across multiple domains of health and safety.

**Methodological considerations**

A combination of methods was used to investigate injuries sustained during outdoor activities among children and senior citizens and to explore experiences and perceptions of risk and possibilities to increase safety in the outdoor environment. The methods used made it possible to increase the understanding of the complexity of injury incidents.

Data used in this thesis was drawn from the IDB, questionnaires, observations, and focus-group interviews. Comprehensive details about the research process such as clear and distinct descriptions of setting, sample, data, procedure, and process of analysis increase the validity offering the reader the ability to transfer the results and conclusions to other similar contexts and situations, or to repeat the studies as closely as possible.

A major strength of Studies I and III is the data from the IDB that was considered the best available data collection as the aim was to investigate
injuries among children and senior citizens. The IDB is a reliable database, established in Umeå in 1995. Already in the late 1980s, injury registration was available at the Umeå University Hospital. Since then, the injury registration has been used for injury research (191-193). The strength with the IDB is that the hospital has a well-defined catchment area of about 143,000 inhabitants. It registers both inpatients and outpatients as the general practitioner on call (outside ordinary working hours) is located at the hospital. By checking against the hospital’s compulsory E-number registration for “external cause” of inpatient treatment, the problem of losing inpatients in the data set is eliminated. The proportion of registrations missed in the group of outpatients is usually less than 10% in the monthly control of the register’s quality.

Study I, investigated non-minor (MAIS2-3) injuries. This limitation might be seen as a strength for several reasons. For example, non-minor injuries may be the type of injury most needing preventative strategies. Preventive strategies for these injury events may also be beneficial for less severe injuries. Minor injuries can be treated outside the health care system. Therefore, another strength of investigating non-minor injuries is that these injuries are less affected by dropouts and under-registration. Fatal injury incidents were excluded from the studies, as injury mechanisms, and injury preventive strategies might differ between non-fatal and fatal injury incidents (33).

In Study I, the circumstances of the injury incident are identified using open-ended questions and in Study III by a complementary questionnaire. This may be seen as a strength as first-hand knowledge is considered as the best knowledge concerning the research topic (194). For example, preventive strategies suggested by the injured person may clarify the most appropriate strategies in how the injury incident could have been prevented (Study III). However, in Study I, it might be more likely, among children aged 0-12, that the adults linked to the child (e.g., parents or teachers) answered the questionnaire rather than the child. When data do not come directly from the children, the data may be skewed as it is uncertain if, for example, the parent was at the scene of the injury. A weakness in Studies I and III is that the questionnaire distributed at the ED is the same for all individuals regardless of, for example, their age and injury type.

A strength in Studies II and III is the use of theoretical frameworks to sort and understand the results. In Study II, the social representation theory gave a comprehensive understanding of the result and help to understand how the informants in the study communicate risks and safety, and how they act and practice based on these perceptions. In Study III, the complementary
questionnaire was inspired by the theoretical framework of injury prevention developed by Haddon (59). Haddon’s Matrix is a well-known model used in injury prevention and safety promotion work and conceptualises causes and strategies to prevent injuries. The matrix was used to sort the data in a systematic way and understand the logic of the events and increase the internal validity (195).

The design of Study II considered a triangulation of methods relevant to investigating perception and experiences of risks and safety during outdoor activities at the schoolyard among children. The triangulation refers to the data collection, analysis and research perspectives. Register data collection or questionnaires to quantify the occurrence would not have given the understanding of how the informants communicate risks and safety and how they act and practice based on these perceptions.

Content analysis was chosen in Studies II and IV because of its focus on describing similarities and differences (c.f., 140). To increase the internal validity, the analysis process moved continuously between the original text and the different analysis steps (creation of meaningful units, condensing, codes, subcategories and categories). This procedure is recommended and describes a validity analysis process (140, 196, 197). The use of representative quotes may increase understanding for the reader (195, 197). Further, credibility increases as categories and subcategories respond to the aim of the research (c.f., 140). All the steps in the analysis process (creation of meaning units, condensing, codes, subcategories and categories) have been discussed with the co-authors, and we came to a consensus. A discussion between researchers in the analysis process may be a way to achieve consistency in how data are interpreted and titled (140). This mutual dialogue and cooperation in the analysis process can, therefore, be seen as a factor that increases dependability in the study process. Further, dialogue not only among co-authors, but also among other researchers and, for example, at seminars may help confirm the dependability of the studies.

A limitation of Study IV is that the study sample, purposive and suitable to the research interest, was too homogenous as only Swedish native senior citizens participated. Other groups, for example, immigrants who might have other cultural routines for outdoor activities might give another picture of how safety can be increased and risk reduced in outdoor environments.

Studies II and IV were conducted during winter conditions which might have influenced the participants in mostly addressing winter issues. However, the focus-group interviews were broad and included discussions of summer conditions as well.
Conclusion

Children and old people are non-minor injured during outdoor activities contributed to by unsafe environments and products. It requires preventive strategies to reduce the amount and the severity of the injuries. Not only through reducing or restricting access to challenging outdoor activities or equipment; instead primary prevention efforts need to be integrated with a healthy and active lifestyle approach.

Different perspectives on risk and safety influence both children’s outdoor play at the schoolyard and senior citizens’ outdoor mobility. There is a need for balance between common sense knowledge among people and the knowledge base of injury prevention. There is also a need for balance between healthy activities and an acceptable injury risk for participating in outdoor activities. Nurses with vast amounts of knowledge in primary prevention and health may be well suited to work with this complexity to ensure safe access both at schools and in other public settings.

Preventive strategies and further research

Improvements in de-icing and snow removal was suggested as a necessity for safe access to outdoor activities during winter conditions. Effective de-icing and snow removal strategies for pedestrian safety are interesting for further research to reduce individual suffering and health care costs. Soft surfaces may be considered as a safety improvement and implemented in places where children and old people may be at risk for fall-related injuries, for example, at playgrounds, schoolyards, health care facilities, old ages homes, and store entrances. Further research is needed about cost-effective preventive measures.

It is not only the responsibility of the municipality to achieve safety for the citizens. Individuals are also responsible for their own safety, for example, using safety devices and following safety restrictions. Safety devices are not always optimally designed for outdoor use, taking into account the design, weather conditions, and outdoor environment. Improvements in the usability of safety products may increase the usage and thus, safety. Suggestions from old people and children regarding what they themselves could do and what stakeholders in the community could do, may give guidelines for further research to improve safety devices, recommendations and safe outdoor environments. Child friendly and aging-friendly environments may be of interest for further research to create environments that bring different generations together.
Different perspective on risk and safety influence outdoor activities among children. Common sense knowledge and the knowledge base of injury prevention not always match as people interpret risk and safety within their social representations. To understand the complexity of healthy activities and acceptable injury risk further research need to utilize multi-method and mixed method approaches.
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Success is not final, failure is not fatal, it is the courage to continue that counts
(Winston Churchill).

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Courage not always bark. Sometimes courage is the little voice at the end of the day that says: I try again tomorrow
(Mary Anne Radmacher)

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