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Powered Mobility Device Use: Participation and Accessibility

Cecilia Pettersson



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AKADEMISK AVHANDLING

som för avläggande av doktorexamen i medicinsk vetenskap vid
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Powered Mobility Device Use: Participation and Accessibility

Cecilia Pettersson



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Abstract

This thesis elucidates the use of powered mobility devices in a Swedish context. The overall aim was to increase and deepen the knowledge on powered mobility device use in relation to participation and accessibility in different environments and among different user groups, with a specific focus on independence and autonomy. An additional aim was to contribute to the knowledge base regarding the optimization of use of such devices. The thesis is based on four studies in which different research approaches were applied through the combination of different types of data in order to interpret the complexity of powered mobility device use. Quantitative, qualitative and mixed methods were utilized. The first study was a prospective cohort study in which data was collected using structured interviews at baseline and two follow-ups. The second study was an exploratory multiple longitudinal case study. A focus-group methodology with a descriptive design was used in the third study. The fourth study was a cross-sectional study based on survey data collected from people with spinal cord injury. The main contribution of the studies that constitute the empirical basis of this thesis is that the purpose of providing people with powered mobility devices is mostly fulfilled in that such devices provide their users' with greater opportunities for participation. Nevertheless, there are also problems in terms of accessibility in various environmental arenas that have an impact on mobility. An additional important contribution is that the results show that the experiences of users of powered mobility devices should be taken seriously as they convey different aspects of how the use of such devices could be optimized. In conclusion, this thesis contributes to our understanding of the use of powered mobility devices and has the potential to optimize independence in terms of mobility and participation among users of such devices. Finally, the results have practical implications for occupational therapy in the provision of powered mobility devices. Likewise, this new knowledge about the needs of powered mobility device users in terms of accessibility are of importance to politicians, professionals and other stakeholders engaged in housing provision and physical planning.

List of publications

This thesis is based on the following original papers:

1. Löfqvist, C., **Pettersson, C.**, Iwarsson, S. and Brandt, Å. (2012). Mobility and mobility-related participation outcomes of powered wheelchair and scooter interventions after 4-months and 1-year use. *Disability and Rehabilitation: Assistive Technology*, 7(3): 211–218
2. **Pettersson, C.**, Löfqvist, C. and Malmgren Fänge, A. (2012). Clients' experiences of housing adaptations: a longitudinal mixed-methods study. *Disability and Rehabilitation*, 34(20): 1706–1715
3. **Pettersson, C.**, Iwarsson, S., Brandt, Å., Norin, L., and Månsson Lexell, E. (2014). Men's and women's perspectives on using a powered mobility device: benefits and societal challenges. *Scandinavian Journal of Occupational Therapy*. Advance online publication. Doi: 10.3109/11038128.2014.905634
4. **Pettersson, C.**, Brandt, Å., Lexell E.M., and Iwarsson, S. Autonomy and housing accessibility among powered mobility device users. Submitted.

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Definitions

<i>Accessibility</i>	The relationship between person and environment (Iwarsson & Ståhl, 2003) that can be operationalized by applying the notion of person-environment fit (Lawton & Nahemow, 1973)
<i>Activity</i>	Execution of a task or action by an individual (World Health Organization [WHO], 2001)
<i>Autonomy</i>	Freedom to determine one's own actions or behaviour (Beauchamp & Childress, 2013)
<i>Dwelling</i>	Any type of place in which someone lives, referring to a single physical unit such as a house, apartment or flat.
<i>Home</i>	Home is often used interchangeably with dwelling to denote the place where someone lives. Home is sometimes used to denote a place with specific personal significance beyond simply being somewhere to sleep and eat.
<i>Housing</i>	An overarching term used to denote different categories of dwelling.
<i>Independence</i>	Refers in this thesis to independence from personal assistance in everyday life (Sonn & Åsberg, 1991).
<i>Mobility-related participation aspect</i>	Refers to aspects of participation that absolutely presuppose mobility (Brandt, 2005).
<i>Occupation</i>	Refers in this thesis to groups of activities and tasks of everyday life, named, organized and given value and meaning by individuals and cultures. Occupation is everything people do to occupy themselves, including looking after themselves, enjoying life, and contributing to the social and economic fabric of their communities (Townsend & Polatajko, 2007).
<i>Participation</i>	According to the International Classification of Functioning, Disability and Health (ICF) (WHO, 2001), participation is defined as involvement in a life situation.

Powered mobility device A wheelchair that is powered by batteries. There are two main types: powered wheelchairs and powered scooters. The term powered mobility device denotes both, except in situations when specific aspects of the use of one or the other are being explicitly addressed.

Powered wheelchair A powered wheelchair operated by a joystick or other switches, the majority of which can be used both indoors and outdoors.

Powered scooter A powered scooter operated by handlebars, primarily used outdoors.

Preface

I have been working as an occupational therapist for many years, mainly in primary healthcare. In my professional capacity, I have met people using powered mobility devices and have occasionally had the opportunity to test these devices myself as part of the service delivery process. This gave me some understanding of the sense of freedom they can provide, but also of the potential difficulties involved in their use. These experiences inspired me to learn more about such difficulties, and I realized that I do not know whether powered mobility devices actually fulfil their intended function. I asked myself what does using a powered mobility device really mean for the user; can they do what they want and go where they please. Therefore, I decided to take the opportunity to expand our knowledge of the facilitators and barriers associated with the use of a powered mobility device. In doing so, I have had the privilege of interviewing many people who use these mobility devices. Several of them have raised important issues which they would like to convey to politicians and to professionals involved in the service delivery process – usually occupational therapists, but other healthcare staff are also involved. Knowledge in this field has evolved during my time as a PhD student and, together with my clinical experience, has given me a broad understanding of what using a powered mobility device can be like when it works and does not work as intended. My intention with this thesis is to raise awareness of the prerequisites for using powered mobility devices in terms of participation and accessibility, based on the perspectives of different groups of users. This new knowledge should be applicable in the healthcare context and in societal planning, as well as contributing to the development of evidence-based occupational therapy in this area of practice.

While I was registered as a PhD student at the Department of Health Sciences at the Faculty of Medicine at Lund University, this thesis was completed at the Centre for Ageing and Supporting Environments (CASE), consisting of research teams from the Faculty of Medicine, Faculty of Engineering and Faculty of Social Sciences. Being a PhD student at CASE and affiliated with the centre's graduate school provides the opportunity to share different perspectives on research and practice with many colleagues from both Sweden and other countries. In doing so, my perspective on occupational therapy has developed and I have learned to grasp and understand perspectives other than my own.

Following an initial period of my PhD studies during which I was involved in a project that mainly focused on housing adaptations, I became involved in the project focused on the use of powered mobility devices that resulted in the present thesis. I designed the first study with assistance from the co-authors, performed most of the data collection and some of the analysis, and was also actively involved in writing the paper. Together with the co-authors, I was involved in designing the second study, which was conducted as a part of the aforementioned project on housing adaptations. That study was based on baseline and follow-up data collected by one of the senior authors' of that paper 10 years before I became a PhD student, whereas I performed the follow-up data collection for the study included in the present thesis. I performed the analysis together with the co-authors and had the leading role in writing the paper. The design of the third study, as well as the data collection, analysis and writing of the paper were accomplished with increasing independence, yet in close collaboration with my co-authors. The fourth study was built upon data collected by two PhD students engaged in yet another project, though I participated in collecting data for four of the participants and designed and completed the study independently under the supervision of my co-authors. Each of the four studies from which this thesis is built examines a different sample of powered mobility device users.

The intent of this thesis summary is to give an overview of the parts of my studies that are at the core of how knowledge concerning the use of powered mobility devices has developed in terms of participation and accessibility. Thus, this thesis summary focuses on only the most important aspects of relevance to the use of powered mobility devices. For details of additional aspects, the reader is advised to refer to the four individual papers, which are included.

Introduction

Enabling mobility and participation

Mobility – to move around independently in society and at home – is important for participation (Brandt, 2005; Radomski & Latham, 2008; Rosenkvist, 2008). The ability to move around in the community enables participation in, for example, leisure and social activities (Polgar, 2011; Unsworth, 2012). Everyone should have the same opportunities to participate in society on equal terms. Therefore, when people are not able to walk the distance required to participate in their desired activities, mobility devices might be a relevant intervention (Fomiatti, Moir, Richmond, & Millstead, 2014; UN Convention on Rights of People with Disabilities, 2007). Different reasons such as neurological diseases or musculoskeletal injuries may lead to restricted mobility (Cook, Polgar, & Hussey, 2008; Fairhall, Sherrington, Kurrle, Lord, Lockwood, & Cameron, 2012; Rockwood, 2012). The prevalence of mobility limitations and the use of mobility devices is increasing in line with the ageing population (Cook et al., 2008). Older people and those with progressive disease often start using low-tech devices such as canes, rollators or manual wheelchairs (Cook et al., 2008; Löfqvist, Nygren, Brandt, & Iwarsson, 2009). When these mobility devices cannot be used, for example due to a severe injury or further disease progression, a powered mobility device may be appropriate to facilitate mobility, participation and independence (Buning, Angelo, & Schmeler, 2001; Cook et al., 2008; May & Rugg, 2010; Scherer & Glueckauf, 2005). While there is an increasing body of research targeting different aspects of powered mobility devices, more research is needed to understand participation and accessibility in different environmental arenas by the users of such devices.

Powered mobility devices

A powered mobility device is a wheelchair powered by batteries and there are two main types: powered wheelchairs and powered scooters. A powered wheelchair is operated by a joystick or other switches and can be used both indoors and outdoors, while a powered scooter is operated by handlebars and is primarily used outdoors

(Brandt, 2005; Cook et al., 2008), see figures 1 and 2. In this thesis, the term powered mobility device is used to denote both types of device, except when specific aspects of the use of one or the other are being explicitly addressed. Different terms for powered mobility devices are used in research and practice, for example electric motor driven wheelchair/scooter (International Organization for Standardisation [ISO], 2011) and motorized mobility wheelchair/scooter are used (Fomiatti, Richmond, Moir, & Millsteed, 2013), leading to difficulties when different studies are compared.

Depending on the individual user's needs, powered mobility devices are used indoors and/or outdoors and in different environmental arenas. Adding to the complexity, powered mobility devices are often used in combination with other mobility devices (Biering-Sørensen, Hansen, & Biering-Sørensen, 2004; Hammel, Southall, Jutai, Finlayson, Kashindi, & Fok, 2013). Furthermore, some people use powered mobility devices part-time while others use them on a full-time basis (Cook et al., 2008). Likewise, powered scooters are typically used indoors by people with a significant limitation in their mobility but a relatively good, stable sitting position and arm and hand function, for example in shopping centres, while others use them outdoors (Hansen & Vedsmand, 2010).

In previous research, different mobility devices have often been studied together, without any specific attention to the type of device, despite each type having different purposes and functionalities. Consequently, focusing on specific mobility devices in research has been recommended (Edwards & McCluskey, 2010; Salminen, Brandt, Samuelsson, Toytari, & Malmivaara, 2009). Outcomes research into assistive technology such as powered mobility devices is also needed (Auger, C., Demers, L., G'elinas, I., Jutai, J. W., Fuhrer, M. J., & de Ruyter, F., 2008; Fuhrer, 2007). A considerable number of powered mobility devices enter service each year in Sweden and elsewhere. Since such devices cost quite a lot, the provision of powered mobility devices entails a substantial cost to society (Samuelsson & Wressle, 2014). Thus, it is crucial that powered mobility devices provide the intended benefit.

Provision of powered mobility devices

This thesis focuses on the use of powered mobility devices that is relevant to occupational therapy in the provision of powered mobility devices and about the practical implications for politicians, professionals and other stakeholders engaged in housing provision and physical planning in terms of the accessibility needs of powered mobility device users. The regulations and procedures governing the provision of powered mobility devices vary from country to country, with some countries not having any at all (WHO, 2008). Although the aim of the present thesis was not to study the regulations and procedures specifically, it should be noted that the differences between countries, lead to challenges when comparing studies concerning powered mobility device undertaken in different national contexts. For

instance, there are differences in terms of availability, funding and integration with other interventions.



Figure 1. Powered wheelchair



Figure 2. Powered scooter

In the Nordic countries, assistive technology is mainly publicly financed. Powered mobility devices are usually provided free of charge to people with severe difficulty walking or who are unable to do so due to functional limitations, with the aim of enhancing their independence, activity and participation. The decision to provide an assistive technology is based on a professional assessment of individual need. In Sweden, where the data for this thesis were collected, such assessment is often done by an occupational therapist or a physiotherapist. The criteria for granting a powered mobility device are that the device should increase independence in everyday life and that the individual must be able to drive the powered mobility device independently and safely. Accordingly, both cognitive and practical skills are tested, typically by assessing the user's driving in the actual environment in which the device will be used. In Sweden, interventions involving powered mobility devices are governed by the Swedish Health and Medical Services Act (SFS:1982:763) with each council and/or municipality having its own regulations and procedures. Professionals

involved in the provision of such devices are responsible for ensuring that they are being used in an appropriate way (SOSFS 2008:1)

User groups

To provide some statistics for the Nordic countries, according to the information available, 28 powered mobility devices were delivered per 10,000 inhabitants in Sweden in 2005 (Swedish Institute of Assistive Technology, 2010). A Danish study based on information from 33 municipalities showed that the number of powered scooters delivered had doubled from 2002 to 2006 and that the number of powered wheelchairs delivered had also increased; it was estimated that 32.8 powered scooters and 9.2 powered wheelchairs had been delivered per 10,000 inhabitants in 2006 (Brandt & Stapelfeldt, 2009). The most recent Finnish study showed that an average of 6.7 powered mobility devices were delivered per 10,000 inhabitants in 2001 (Kolomainen, 2003). According to the Norwegian national register, 3.5 powered scooters and 4.7 powered wheelchairs were delivered per 10,000 inhabitants in 2013 (Norwegian Labour and Welfare Service, 2013). There are limited international statistics with which to compare these figures for the use of powered mobility devices, however, to provide one example, 159,000 powered wheelchairs were prescribed in the United States of America in 2002 (Clifton, 2004). In the Nordic countries, all of which are welfare states the criteria for granting powered mobility devices are, despite differences in the way services are delivered, that the devices should increase independence in everyday life.

Users of powered mobility devices are a heterogeneous group in terms of factors such as age, gender, diagnoses, living situation and type of device (Arthanat, Nochajski, Lenker, Bauer, & Wu, 2009). Consequently, there is a need to study the use of powered mobility devices among different groups and in different environmental arenas. However, the present thesis focuses on adults, mainly those over the age of 50. Powered mobility devices are used by people with various diagnoses, characteristics and needs. For instance, people with mobility limitations due to multiple sclerosis (Boss & Finlayson, 2006), stroke (Pettersson, Törnquist, & Ahlström, 2006) and spinal cord injury (Biering-Sørensen et al., 2004) as well as older people with mobility problems caused by other diagnoses or age-related functional decline (Brandt, Iwarsson, & Ståhl, 2004; Löfqvist, Nygren, Brandt, & Iwarsson, 2009). Within the spinal cord injury cohort, powered mobility device use is more common among those with tetraplegia than those with paraplegia (Biering-Sørensen et al., 2004; Chaves, Boninger, Cooper, Fitzgerald, Gray, & Cooper, 2004). Further, those with tetraplegia more often use their devices both indoors and outdoors (Pettersson, Jørgensen, Mårtensson, Lexell, Slaug, & Iwarsson, 2013).

The majority of those who received a powered mobility device in Sweden in 2008 were between 65 and 79 years old (Swedish Institute of Assistive Technology, 2011).

Even if the use of powered mobility devices is most common within this age group, there has been discussion as to whether people with mobility limitations might benefit from being provided with such devices earlier, e.g. before they lose all walking ability (Brandt et al., 2004). For users under the age of 65, powered mobility devices may be used for participation in different environments and occupations than among those aged 65–79 years or more. Consequently, there is cause to include people of different age groups in research into the use of powered mobility devices.

Moreover, in relation to the different types of powered mobility devices, it appears that users of powered wheelchairs are younger and have more extensive impairments than powered scooter users (Cook et al., 2008), for example people with spinal cord injury (Biering-Sørensen et al., 2004). Furthermore, it has been reported that people with neurological or orthopaedic diagnoses are more likely to receive powered wheelchairs, while those with cardio-vascular pulmonary diseases are more likely to receive powered scooters (Karmarkar, Dicianno, Graham, Cooper, Kelleher, & Cooper, 2012). In addition, there seem to be gender differences in relation to the use of powered mobility devices that are somewhat dependant on the diagnosis group being studied. For example, among people with spinal cord injuries more men use powered mobility devices (Biering-Sørensen et al., 2004), most likely explained by the fact that spinal cord injuries are more common among men. There are also gender differences in relation to how the devices are used (Blach Rossen, Sørensen, Würtz Jochumsen, & Wind, 2012). Women appear to use their powered mobility devices less than men while away from their homes (Auger, Demers, Gelinas, Miller, Jutai, & Noreau, 2010), while men appear to have better driving skills than women (Hall, Partnoy, Tenenbaum, & Dawson, 2005). Men also use their powered mobility devices more often and for prioritized occupations, whereas women use them for more differentiated occupations, i.e. many different types of activities (Brandt et al., 2004). While not verified by research, gender differences could be explained by the fact that men and women engage in different types of occupations, have different knowledge of technology (Brandt et al., 2004) or have different experiences in relation to training strategies (Auger et al., 2010; Hall et al., 2005).

All in all, further investigation is required into the use of powered mobility devices among different user groups.

Occupational therapy theory and practice

This thesis is based on an occupational therapy perspective, defined as “a way of looking at or thinking about human doing” (Njelesani, Tang, Jonsson, & Polatajko, 2014, p.233). An occupational therapy perspective is based on specific knowledge

about the complex relationships between person, environment and occupation. Among occupational therapists, the Canadian Model of Occupational Performance and Engagement (CMOP-E) (Townsend & Polatajko, 2007) is a well-known theoretical model, focusing specifically on the components of person, environment and occupation that interact in a dynamic relationship. People are regarded as occupational beings, with occupation denoting human doings involving self-care, productivity, and leisure that are important for health and wellbeing (Christiansen & Townsend, 2011; Townsend & Polatajko, 2007). Overall, a client-centred approach is vital in occupational therapy. This entails clients being involved in making decisions about their rehabilitation together with their therapist, in accordance with their needs and experiences (Townsend & Polatajko, 2007).

In the field of occupational therapy, there is a specific differentiation made between the concepts activity and occupation. As described by Christiansen and Townsend (2011), these concepts are not synonymous because people perform tasks and activities that, in turn, build up occupations. According to Townsend and Polatajko (2007), occupation is the overarching concept that includes activities and tasks, which are described as levels subordinate to occupation. In addition, the focus is on participation in occupations in different environmental arenas (Law, 2002). Since powered mobility devices aim to facilitate mobility and enable activities (Brandt, 2005) and occupations (Buning et al., 2001; May & Rugg, 2010), both activity and occupation are thus relevant to research into the use of powered mobility devices. However, in previous research, activity and occupation related to the use of powered mobility devices have most often been used as interchangeable concepts. In the present thesis, activity denotes performance of an activity, while occupation denotes groups of activities and tasks of everyday life, named, organized, and given value and meaning by individuals and cultures.

Provision of powered mobility devices is a common intervention in occupational therapy (Cook et al., 2008; Wang, Holliday, & Fernie, 2009), and the CMOP-E (Townsend & Polatajko, 2007) has been used to position such interventions in the field of occupational therapy (Wang et al., 2009). According to the CMOP-E, the environment consists of cultural, institutional, physical and social components. Additionally, the environment must be designed and constructed to assist participation in occupations. In this model, a mobility device is seen as an environmental component. Furthermore, based on this model, the use of powered mobility devices should be studied in different environmental arenas and the integration of the device into the user's environment is important (Townsend & Polatajko, 2007). Similarly, the physical and social environment is known to both promote and limit the use of assistive devices in general (Skymne, Dahlin Ivanoff, Claesson, & Eklund, 2012). Likewise, devices should be studied in relation to different user groups and different occupations (Arthanat et al., 2009). Overall, research into the use of powered mobility devices rarely considers personal,

environmental and occupational aspects simultaneously, despite this having been advocated (Dahlin Ivanoff, Iwarsson, & Sonn, 2006).

Accordingly, there is a need for research that takes into account the relationship between person, environment and occupation. In addition, it is important to evaluate these interventions together as the provision of powered mobility devices is often dependent on additional interventions such as housing adaptations in order to meet the needs and expectations of the user.

Participation

Participation is an important goal of rehabilitation (Cardol, de Jong., & Ward, 2002; Dijkers, 2010), often involving several categories of rehabilitation professionals such as occupational therapists, physiotherapists and psychiatrists. The ICF (WHO, 2001) plays an important role not only in research, but very much also in rehabilitation practice. According to the ICF, participation is defined as involvement in a life situation. Hence, the ICF does not focus on perceived participation (Cardol, et al., 2002; Hemmingsson & Jonsson, 2005) and the theoretical definition of participation is unclear (Dijkers, 2010). This indicates the importance of being aware that different definitions of participation exist, which leads to challenges when comparing the results of different studies. Similarly, previous research has revealed that measurement of participation among people who use wheelchairs is complex, and an enhanced understanding is needed of the different personal and environmental aspects that influence participation at home and in the community (Harris, Sprigle, Sonenblum, & Maurer, 2010).

The purpose of providing powered mobility devices is to facilitate participation in activities and in society (Cook et al., 2008; Harris et al., 2010). According to the ICF (WHO, 2001), mobility denotes walking and moving around by changing or maintaining body position or location, whereas activity denotes the execution of a task or action by an individual. Because most activities in everyday life require mobility, independence in mobility is vital to facilitate participation. Independence can denote independence from personal assistance in everyday life (Sonn & Åsberg, 1991); however, Tamaru, McColl and Yamasaki (2007) examined different personal factors relating to independence and how this concept is used among occupational therapists and identified three perspectives on independence – competence, autonomy and psychological qualities. It has also been argued that outdoor mobility is associated with freedom and autonomy (Mollenkopf, Marcellini, Ruoppila, Széman, Tackén, & Wahl, 2004). This concept deserves attention in this context because autonomy is a personal aspect of participation (Cardol et al., 2002; Dijkers, 2010).

Autonomy can be referred to in different ways, as for instance freedom to determine one's own actions or behaviour (Beauchamp & Childress, 2013). According to Cardol et al. (2002), it is important to be aware of both decisional and executional autonomy. As explained by Clapton and Kendall (2002), autonomy involves the ability to choose one's activities and also the ability to perform the selected activities. However, it is limiting to define autonomy as equalling independence as it could then be seen as associated with physical independence, especially for people with permanent functional limitations (Cardol, et al, 2002; Clapton & Kendall, 2002). Accordingly, the concepts independence and autonomy are related to each other and can be interpreted differently, depending on the chosen perspective. For example, according to Haak (2006), the concepts independence and autonomy are intertwined but still separate; most importantly, it is possible for people to perceive themselves as autonomous despite being dependent on the assistance of others. Nevertheless, independence and autonomy are often used interchangeably in both research and practice (Tamaru et al., 2007). Accordingly, aspects of participation, independence and autonomy should be attended to in order to learn more about the use of powered mobility devices.

Upon reviewing current knowledge concerning the use of powered mobility devices in relation to participation, independence and autonomy, earlier research indicates that such devices enable participation and independence in mobility (Blach Rossen et al., 2012; Brandt et al., 2004; Edwards & McCluskey, 2010; Pettersson, Ahlström, & Törnquist, 2007) and enhance quality of life (Brandt et al., 2004; Pettersson, Ahlström, et al., 2007; Pettersson, Appelros, & Ahlström, 2007; Scherer & Glueckauf, 2005). In addition, problems with shopping, leisure activities and visiting family and friends have been found in the use of powered mobility devices outside the home, for example among people who have had strokes (Pettersson et al., 2006). Use of powered mobility devices provides a sense of freedom, increases independence and instils a sense of control (Reid, Angus, McKeever, & Miller, 2003). Furthermore, independence is known to be important to older people who use powered mobility devices (Brandt et al., 2004). In contrast, it has also been shown that independence in terms of mobility does not increase with the introduction of powered mobility devices, which might be due to suboptimal research designs with short follow-up periods (Davies, De Souza, & Frank, 2003). It might also be the case that independence differs between user groups as well being dependent on the length of time the powered mobility device had been used. Furthermore, the use of powered mobility devices has been shown to positively facilitate activity performance (Brandt et al., 2004; Buning et al., 2001). Nevertheless, the devices do not appear to add occupations to the everyday repertoire (Blach Rossen et al., 2012). Other studies have also shown improvement in activity performance by using powered mobility devices, but longitudinal studies are still required (May & Rugg, 2010; Torkia, Reid, Korner-Bitensky, Kairy, Rushton, Demers, & Archambault, 2014). Additionally, longitudinal studies would make it possible to follow people who have

received their first powered mobility device and follow up on their experiences of it (Torkia et al., 2014). Likewise, larger studies that represent different groups of powered mobility device users are needed (Samuelsson & Wressle, 2014).

To summarise, there is insufficient knowledge about participation, independence and autonomy among the users of powered mobility devices. Given that participation is a paramount goal of rehabilitation, autonomy aspects represent a personal perspective on participation that deserves attention. Accordingly, participation, independence and autonomy should be taken into account in order to improve the understanding of how to optimize the use of powered mobility devices.

Accessibility in different environmental arenas

According to Cardol et al. (2002), autonomy may be restricted due to aspects of different environmental arenas. For this reason, different environmental arenas must be accessible for people using such devices in order to make it possible to use powered mobility devices in them. In turn, this requires housing, public buildings, outdoor environments and public transport to be designed for the use of powered mobility devices in order to facilitate the participation, autonomy and independence in mobility of the users of such devices. In terms of the physical environment, there are some obvious requirements in order to make the use of powered mobility devices possible and modifications may be needed to minimize environmental barriers. For example, there has to be enough space to drive and manoeuvre the device, with ramps, lifts and automatic door openers sometimes being needed (Townsend & Polatajko, 2007).

As regards the concept of accessibility, it should be defined as a person-environment relationship (Iwarsson & Ståhl, 2003). Thus, accessibility can be operationalized by applying the concept of person-environment fit (Lawton & Nahemow, 1973). In this concept, physical environmental barriers, assessed based on standards for the design of the physical environment, constitute the environmental component, while the personal component is represented by the individual's combination of functional limitations. Person-environment fit thus expresses the relationship between environmental barriers and the functional capacity on an individual level (Iwarsson & Ståhl, 2003). Defined in this way, accessibility is usually assessed from a professional perspective, preferably with valid and reliable instruments.

Accessibility in society at large

According to the UN (2007), public buildings and places have to be made more accessible for people with mobility limitations. This is in line with legislation passed by the Swedish Parliament in 2010 (SFS 2010:900). Previous research has revealed that accessibility problems, for example in public buildings and outdoors spaces (Fomiatti, et al., 2014; May, Garrett, & Ballantyne, 2010; May & Rugg, 2010; Mortenson, Clarke, & Best, 2013; Torkia et al., 2014) as well as the homes of friends and family, hinder the use of powered mobility devices, which also has an impact on social occupations such as meeting with friends (Reid et al., 2003). In general, previous research into accessibility problems among powered mobility device users mainly studied the use of powered wheelchairs and powered scooters without any differentiating between the two (Fomiatti, et al., 2013). Overall, few studies have been published that focus on accessibility in society for people using powered wheelchairs or powered scooters.

Accessibility in housing

The home is important for health and independence (Fänge & Dahlin Ivanoff, 2009; Haak, Fänge, Iwarsson, & Dahlin Ivanoff, 2007). In order to be able to optimally use a powered mobility device at home, and to be able to move in and out independently, it is important that dwellings are designed to accommodate the use of powered mobility devices (Blach Rossen et al., 2012). According to Reid (2004) and Reid et al. (2003), it is often difficult to use a wheelchair in some areas of the home due to accessibility problems. Similarly, Blach Rossen et al. (2012), state that powered mobility device users expressed the importance of being able to cope independently with occupations such as cooking in their own homes. Therefore, it can be assumed that if powered mobility device users live in housing that is not accessible to such devices, their independence and autonomy would be at risk. However, the environmental barriers in the kitchens were not presented in detail in these studies. Therefore, in order to increase the understanding of the possibility to use powered mobility devices indoors at home, more detailed knowledge on accessibility is needed.

Because accessibility is a prerequisite for participation (Iwarsson & Ståhl, 2003), and autonomy is a personal aspect of participation (Cardol et al., 2002), aspects of participation, accessibility and autonomy should be targeted in order to improve the understanding of the use of powered mobility devices in housing environments. There is a general scarcity of research focusing on autonomy that specifically addresses users of powered mobility devices. There is also insufficient research into how autonomy is related to different types of environmental barriers. This indicates

that more knowledge about powered mobility device use is needed in terms of accessibility and autonomy among people representing different user groups, both overall and in individual subgroups. Besides, if the housing environment is not appropriate for the use of powered mobility devices, it may have to be modified (Blach Rossen et al., 2012; May & Rugg, 2010). Altogether, little is known about housing accessibility, housing adaptations and the environmental barriers that generate the most housing accessibility problems among users of powered mobility devices.

Housing adaptation is an intervention mainly available to those living in welfare states. Each country in which housing adaptation is provided has its own regulations and procedures, leading to considerable international differences in terms of, for example, availability, funding, construction and integration with other interventions. In Sweden, housing adaptations are governed by specific legislation (SFS: 1992:1574) closely linked to the planning and building legislation (SFS 2010:90). Those requiring housing adaptation can apply for a grant from their local municipality covering the full cost of housing adaptation. The need for housing adaptation must be certified by a healthcare professional, usually an occupational therapist. Previous research has demonstrated that housing adaptation increases accessibility (Fänge & Iwarsson, 2005a) and improved self-related ability in everyday life (Pettersson, Lilja, Hammel, & Kottorp, 2008).

In summary, there is little knowledge about accessibility, which is a prerequisite for participation and autonomy among powered mobility device users. Even if dwellings often have to be modified to make the use of powered mobility devices possible, there is a lack of knowledge about housing accessibility and housing adaptations related to the use of such devices. Such knowledge is crucial in order to optimize these types of intervention and make it possible to use powered mobility devices in both society and the home.

Aims

The overall aim of this thesis was to increase and deepen the knowledge on powered mobility device use in relation to participation and accessibility in different environments and among different user groups, with a specific focus on independence and autonomy. An additional aim was to contribute to the knowledge base regarding the optimization of the use of such devices.

The specific aims were:

- To investigate the outcomes of powered mobility device interventions over time, regarding mobility-related participation and independence when moving around in different environments
- To describe users' experiences of accessibility and use of powered mobility devices in a longitudinal study of housing adaptations
- To describe how men and women experience their use of powered wheelchairs and powered scooters in everyday occupations in the home and society at large
- To describe autonomy and the environmental barriers that generate the most housing accessibility problems among powered mobility device users
- To examine personal and environmental aspects and their association with autonomy indoors and outdoors respectively among powered mobility device users

Materials and Methods

Overview of studies 1– 4

In this thesis, different research approaches and methods were combined in order to enhance the understanding of powered mobility device use. The four studies included are labelled as follows: the pre-post study (Study 1), the case study (Study 2), the focus group study (Study 3) and the accessibility study (Study 4) (Table 1). The ambition of combining different research approaches and methods, i.e. quantitative (the pre-post study and the accessibility study), mixed methods (the case study) and qualitative (the focus group study), was to enhance the understanding of powered mobility device use.

The pre-post study was a prospective cohort study with data collection by means of structured interviews at baseline, 4-months and at 1-year follow-up.

The case study was an exploratory, multiple longitudinal case study, employing an embedded mixed-method design (Creswell & Plano Clark, 2011). The case study design was used in order to gain an understanding of participants' views. In the analysis, quantitative data selected from the database of an earlier project, comprising survey data collected with a larger sample, were embedded in qualitative data from semi-structured interviews.

In the focus group study, a focus-group methodology with a descriptive design was used. Data were collected with explicit attention to group discussions in which the participants discussed their own perceptions and experiences of the topic in question; they were seen as experts on the issue in focus (Dahlin Ivanoff, 2002; Krueger & Casey, 2009).

The accessibility study was a cross-sectional study, based on survey data from the Swedish Ageing with a Spinal Cord Injury Study (SASCIS) (Lexell, Jørgensen, Norin, & Iwarsson, 2014). A subset of variables was used, focusing on accessibility and autonomy among those of the SASCIS participants who used powered mobility devices.

Table 1. Overview of the research approach, sampling of participants, data collection methods and analysis in the four studies.

	Pre-post study (Study 1)	Case study (Study 2)	Focus group study (Study 3)	Accessibility study (Study 4)
Research approach	Quantitative prospective cohort	Mixed methods longitudinal	Qualitative focus groups cross-sectional	Quantitative cross-sectional
Sampling	Consecutively enrolled	Purposeful sampling	Purposeful sampling	Recruited from existing database
Data collection methods	Self-reported instruments Semi-structured interviews	Standardized questionnaires/ instruments Semi-structured interviews	Focus groups discussions	Standardized questionnaires/ instruments Self-reported instruments
Analysis	Descriptive statistics Sign-test Paired t-test	Embedded design ¹ Content analysis ² Descriptive statistics	Focus groups analysis ³	Descriptive statistics, Chi-2, Mann-Whitney Bivariate correlations Logistic regression ⁴

Note: In accordance with ¹Creswell and Plano Clark (2011), ²Graneheim and Lundman (2004), ³Krueger and Casey (2009) and ⁴Hosmer Jr and Lemeshow (2004).

Samples and study contexts

The four studies in the thesis were based on different samples, that is, in order to gain more detailed knowledge about the use of powered mobility devices, different groups of users were represented. Based on different criteria, the participants were recruited on the basis that they would be receiving a powered mobility device for the first time (pre-post study), had been powered mobility device users for at least one year (focus group study) or had applied for a housing adaption (case study). For the accessibility study, powered mobility device users were selected from among people with spinal cord injuries who were included in an existing survey study database.

The contexts of the four studies were also different. The pre-post study was part of a comprehensive cross-Nordic project, running from 2009–2013, the aim of which was to provide national and Nordic comparative knowledge about the outcomes of powered mobility device interventions. Participants in the Swedish part of the study were followed over the course of one year: at baseline (T1), follow-up after 4–4.5 months (T2) and after 12–15 months (T3). The case study was based on a longitudinal project (Fänge & Iwarsson, 2005a; Fänge & Iwarsson, 2005b) evaluating housing adaptations that ran from 1999–2001, as well as data collected for the present thesis. Thus, data were collected at four different times: prior to the housing adaptation (T1), 2–3 months after the housing adaptation was completed

(T2), 6 months after T2 (T3) and 10 years after T3 (T4). For the focus group study, the participants were recruited from a rehabilitation clinic in the south of Sweden. The accessibility study was based on data from the SASCIS (Lexell, et al., 2014). The aim of SASCIS was to learn more about people ageing with spinal cord injuries.

Participants and selection criteria

The characteristics of the participants in the four studies in this thesis are presented in Table 2.

The pre-post study

For this study, consecutive sampling was used. The inclusion criteria were: being 20 years of age or more; living in private housing and not in any acute rehabilitation phase; having been granted a powered mobility device for the first time for indoor and/or outdoor use in order to increase mobility and participation and having the cognitive capacity and verbal skills sufficient to participate in personal interviews. Forty-eight people were asked, and 47 agreed to participate in the baseline interviews (T1). At T2, it was possible to interview 42. Reasons for the dropouts (three men and two women) were: not able to reach ($n = 1$), death ($n = 1$) and return of the device ($n = 3$). At T3, the sample consisted of 34 persons (27 powered scooter users and 7 powered wheelchair users). Reasons for dropouts (seven men and one woman) were: return of the device ($n = 2$), death ($n = 1$) and deteriorated health ($n = 5$).

The case study

A stepwise sampling procedure was employed during the recruitment process. In the first step, information was retrieved from municipality registers in order to identify those of the 131 participants that could be followed up 10 years after T3. This sampling procedure resulted in 51 potential participants. Thereafter, a purposeful sampling strategy was employed, aiming to include at least one participant of working age, at least one who lived alone, at least one who had moved to another kind of private accommodation since T3, at least one who had been granted an additional housing adaptation 3–12 months prior to T4, and at least one who was very old. In addition, the participants would have to be able to participate in an interview. Based on these criteria, four potential participants were contacted. Two

agreed to participate, while two declined due to ill-health. Therefore, another four potential participants were identified, who all declined to participate due to ill-health. After a third round of sampling, another four potential participants were contacted, and two of them agreed to participate, resulting, finally, in the inclusion of four participants.

The focus group study

A total of 16 participants were purposefully selected from among those who had taken part in a rehabilitation program at a rehabilitation clinic in the south of Sweden. The inclusion criteria were: age 50 years or older, having used a powered wheelchair or a powered scooter for at least one year and living in ordinary housing. They would also have to be able to understand and speak Swedish and be able to take an active part in a focus group discussion. To capture differences in experiences between men and women, as well as between powered wheelchair users and powered scooter users, the participants were divided into four focus groups. The focus groups were homogeneous in that they consisted of either users of powered wheelchairs or of powered scooters, and either of men or women. To stimulate variations in the discussions (Krueger & Casey, 2009), the focus groups were heterogeneous in terms of diagnosis, age, type and location of housing and time using a powered wheelchair/powering scooter.

The accessibility study

People aged 50 years or older who acquired spinal cord injuries more than 10 years ago were included in the SASCIS (Lexell, et al., 2014). Of the 123 participants in the SASCIS baseline data collection, the 51 participants who used a powered mobility device were selected for the accessibility study; three were excluded due to internal dropout on core variables. Thus, the final sample consisted of 48 powered mobility device users. Seventeen participants used their powered mobility device both indoors and outdoors, while 31 only used it outdoors. Based on this, two subgroups were constructed: “powered mobility device users both indoors and outdoors” and “powered mobility device users outdoors only”.

Table 2. Participant characteristics in the four studies

	Pre-post study	Case study	Focus group study	Accessibility study
Participants, n	34	4	16	48
Gender, men/women, n	23/11	1/3	8/8	33/15
Age, years, median (q1, q3)	74 (62–79)	64	64 (58–63)	64 (56–59)
<i>Type of housing, n</i>				
Living alone	16	2	3	25
Living together with other person	18	2	13	23
<i>Living in type of housing, n</i>				
One- or two-family house	Data not available	4	15	26
Apartment	Data not available	0	1	22
<i>Use of mobility device indoors, n</i>				
Cane/crutches	9	0	0	0
Walker	2	0	0	0
Rollator	18	2	0	7
Manual wheelchair	8	0	0	21
Powered wheelchair	3	2	7	17
Powered scooter	0	0	0	0
<i>Use of mobility device outdoors, n</i>				
Cane/crutches	16	0	0	0
Walker	0	0	0	0
Rollator	17	1	0	0
Manual wheelchair	12	0	0	0
Powered wheelchair	7	2	9	0
Powered scooter	27	2	7	0
Powered mobility device	0	0	0	48

Note: Data are presented at T3 for the pre-post study and at T4 for the case study.

In the pre-post study and the case study it was possible to answer that one or more mobility devices were in use. In the accessibility study the main mobility device in use indoors, and for the furthest distance outdoors were accounted for, and no distinction was made between powered wheelchair and powered scooter.

Data collection and procedures

The pre-post study

Instrument

The Nordic mobility-related participation outcome evaluation of assistive device interventions (NOMO 1.0) (Brandt & Iwarsson, 2012) instrument, developed in a Nordic context for documenting the outcomes of mobility device interventions, was used. The concept target for the NOMO 1.0 is mobility-related participation, i.e. participation involving mobility. The instrument consists of items concerning dependence in mobility in four different environmental arenas (indoors in the home, in and out from the home, indoors in other places, outdoors in general), rated according to the extent of assistance required in mobility (a 4-step ordinal scale, ranging from 'no assistance' to 'very much assistance'). The instrument also contains twenty items concerning mobility-related participation, rated by the frequency of mobility-related participation scale (a 8-step scale, going from 'at least once a day' to 'never'), the ease/difficulty in mobility during participation scale (a 5-step ordinal scale, ranging from 'very easy' to 'very difficult', and 'don't know') and the mobility-related participation repertoire index (i.e. the sum of the number of participation aspects performed, based on the responses to the 'frequency of mobility related participation scale'). NOMO 1.0 also includes a number of descriptive items concerning the use of mobility devices, housing, functional limitations and health. In addition, one open-ended question about the participants' expectations of the powered mobility devices in terms of participation was asked at T1. At T2 and T3, two structured questions were asked about fulfilment of expectations, followed by an open-ended question about which aspects of mobility-related participation the mobility device had actually been used for.

The basic psychometric properties of the instrument have been tested, showing good content validity, internal consistency and test-retest reliability (Brandt & Iwarsson, 2012).

Data collection and procedure

The participants were interviewed at T1 by means of the NOMO 1.0 just after they had been granted a powered mobility device but before they had received it. There were two follow-up interviews: after 4–4.5 months use and when the mobility device had been in use for at least 1 year (12–15 months). The majority of the baseline interviews were performed during spring and summer (n = 24), while the remaining ten were performed in autumn. The interviews were carried out by two experienced occupational therapists, one of whom was both the author of the present thesis and involved in the process of providing ten of the participants with their mobility

devices. At T1, 18 of the interviews were performed at a health centre, 14 in the participants' homes, and two at other locations. The two follow-up interviews were performed in the participants' homes in 95% of the cases and the remainder took place in a health centre.

The case study

The data collection in this study was based on assessments that use well-established instruments and on semi-structured interviews. The Housing Enabler instrument (Iwarsson & Slaug, 2001) was used to collect data presented in the results chapter of this thesis, (for details on the other instruments used, see Paper 2). Housing Enabler is used to describe the magnitude of accessibility problems for each person in their specific home environment, based on data collected by means of interviews and observations. This instrument is based on the notion of person-environment fit (Lawton & Nahemow, 1973), where physical environmental barriers, assessed based on standards for housing design, constitute the environmental component. The presence or absence of 188 environmental barriers (items) in the home and immediate exterior surroundings (exterior surroundings = 33 items; entrances = 49 items; indoors = 100 items; communication = 6 items) were assessed. With the personal component represented by the individual's combination of functional limitations, person-environment fit thus expresses the relationship between environmental barriers and the functional capacity on an individual level. Accessibility is analysed by means of a complex matrix that juxtaposes the profile of functional limitations with the environmental barriers found to be present in the housing of the individual participant.

Interviews

The interview guide for the semi-structured interviews at T4 included questions on three main themes. The first theme concerned the time before assessment of need for the housing adaptation (at T1), and the questions were about the reason for the application for housing adaptation, how the assessment was made and whether the participant felt that they had been listened to by the professionals involved. The second theme concerned the participants' perceptions of the housing adaptation process and contained questions regarding their perceptions of attitudes, their involvement, the efficiency of the process, fulfilment of needs, conducted follow-ups and their satisfaction with the housing adaptations. Finally, the third theme involved questions about the participant's long-term experiences and perceptions of the housing adaptation in relation to housing and health.

Data collection and procedure

The data collection for T1–T4 was performed in the participants' homes by experienced occupational therapists. Each home visit at T1–T4 followed the same procedure, i.e. survey data was collected based on the instrumentation used for the larger project. At T4, this data collection and a semi-structured interview were performed by the author of the present thesis.

The focus group study

Interviews

The interview guide included questions about how the participants experienced their use of the powered mobility device for different occupations and in different environments, whether they experienced any barriers or facilitators related to powered mobility device use, and how they handled potential problems related to the use of their devices.

Data collection and procedure

Four different vignettes (Brondani, MacEntee, Bryant, & O'Neill, 2008) based on the results of the aforementioned case study were used as a starting point for the discussions. The vignette for the powered wheelchair users described a man/woman who used a powered wheelchair indoors and outdoors and had received an indoor housing adaptation. The vignette for the powered scooter users was identical, except that the powered scooter was used outdoors and the man/woman had received an outdoor housing adaptation. All four vignettes exemplified and elucidated the users' considerations about future use of powered mobility devices. The vignettes were complemented with an interview guide that was the same for each of the focus groups.

Each focus group met once, with the same occupational therapists serving as the moderator (author of the present thesis) and co-moderator in each of the sessions, which lasted between 75 and 84 minutes.

The accessibility study

Instruments

The latest version of the Housing Enabler instrument (Iwarsson & Slaug, 2010; Iwarsson, Haak & Slaug, 2012) was used. This version assessed the presence or absence of 161 environmental barriers (items) in the home and immediate exterior surroundings (exterior surroundings = 28 items; entrances = 46 items; indoors =

87 items). Further details of this instrument can be found in the description of the case study. Autonomy was assessed by means of the Impact on Participation and Autonomy Questionnaire (IPA) (Cardol, de Haan, van den Bos, de Jong, & de Groot, 1999), Swedish version (IPA-S) (Larsson Lund, Fisher, Lexell, & Bernspång, 2007). According to the aims of the accessibility study, two out of five domains were used: autonomy indoors (7 items) and autonomy outdoors (5 items). For each item, the response options were very good/good/fair/poor/very poor (range 1–5); higher scores indicate more restriction on autonomy.

The Swedish version of the instrument (IPA-S) has support for validity, reliability and internal validity for use with people with spinal cord injuries (Larsson Lund, Fisher, et al., 2007).

Data collection and procedure

Data were collected from the participants' medical records, interviews and observations in the participants' homes by two PhD students (a physician and an occupational therapist).

Ethical considerations

All principles in the ethical guidelines for human research were followed in accordance with the relevant Swedish national legislation, i.e. the Act concerning the Ethical Review of Research Involving Humans (2003:460) and the Personal Data Act (1998:204), and in accordance with the World Medical Association Declaration of Helsinki (World Medical Association, 2001). For the pre-post study, since it was an extension of a study originally planned for a master's thesis, approval was obtained from the Ethical Board within the educational organization of the Faculty of Medicine. The remaining studies were approved by the Regional Ethical Review Board in Lund, Sweden: the case study (Ref. no 2010/97), the focus group study (Ref. no 2012/376) and the accessibility study (Ref. no 2010/692).

The potential participants were contacted by telephone or by post and informed about the relevant study. Written informed consent was obtained from all participants in each of the four studies prior to data collection in accordance with the principle of autonomy (Beauchamp & Childress, 2013). The participants were also ensured that they could withdraw their participation at any time. In addition, the results from the different studies were presented pseudonymously so that the participants would not be recognized.

For the pre-post study, the participants were invited to participate by an occupational therapist involved in the service delivery process. The participants were also invited to participate by the therapist in connection with the selection and testing of a powered mobility device. For the case study, a civil servant from the municipality contacted potential participants by telephone to inform them about the study. If the person was agreeable to participating in the study, the author of this thesis then contacted the potential participants via telephone in order to provide additional information. At this time, written information about the study was sent to the participants. Similarly, an occupational therapist or a nurse from the Spinal Cord Injury Unit, Department of Rehabilitation Medicine, Skåne University Hospital, Sweden asked potential participants if they would like to take part in the focus group study. Potential participants in the accessibility study were sent written information about it.

Data treatment and quality control

Systematic quality control of the qualitative and the quantitative data was undertaken for all four studies. All interviews in the case study were transcribed by the author and checked by means of listening to the tape-recorded interviews. For the focus group study, the author transcribed one interview, while the other three interviews were transcribed by a person with much experience of transcribing focus group interviews. All four transcripts were checked by the author by means of listening to the tape-recorded interviews.

For the pre-post study, any fault in the database was corrected according to the rating procedures for the NOMO 1.0 instrument used in the data collection. The error rate was not allowed to exceed 0.5%.

For the accessibility study, a proof reading procedure that included a random selection of 20% of the cases was carried out by the author of the present thesis and another PhD student in order to ensure that the database accurately reflected the data reported in the questionnaires. Any discrepancies found were noted on a log sheet and rectified in the database and an error rate was then calculated. Since the error rate after the first 10% was 0.51%, another 10% of the cases were subjected to proofreading, resulting in a total error rate below 0.5%. At this stage, the proofreading procedure was considered sufficient. In addition, the data was validated by checking for ranges, logical consistency and completeness. Missing or unclear data underwent a data cleaning process using Data Clarification Forms. Any changes applied to data in the database during data cleaning were noted on a log sheet. The database was locked once data cleaning was complete.

Data analysis

The pre-post study

Dropout analysis was performed ($n = 13$ compared to the final sample $n = 34$) regarding age, gender, number of functional limitations and overall health. The sign test was used for analysing changes over time in terms of dependence in mobility, frequency of mobility-related participation aspects and ease/difficulty in mobility during participation. Changes in ease/difficulty over time were divided into three groups: participation became easier, unchanged, or more difficult, respectively. Since the frequency of 'does not know' responses concerning ease/difficulty was low ($n = 5$), these responses were excluded. Due to the high number of statistical tests performed, Bonferroni corrections were made (Kazdin, 2003). The paired t-test was used to analyse the mobility related participation repertoire index. Descriptive statistics were used to describe statements of expectations. Outcomes given as responses to the open-ended questions were categorized and utilized for illustrative purposes in the presentation of the results.

P-values < 0.05 were interpreted as statistically significant. The IBM SPSS Statistics version 17 was used for all computations.

The case study

The data were analysed sequentially, according to the mixed method embedded design approach (Creswell & Plano Clark, 2011). The interview data for each participant were analysed first, followed by a descriptive analysis of the survey data, in order to obtain a deeper understanding of each case. Survey data from T1 and T4 were compared in order to detect individual changes. Thereafter, the survey data were embedded into the description of each case and were analysed separately for each participant. In other words, the interview data were analysed, followed by a descriptive analysis of the quantitative data, in order to obtain a deeper understanding of each case. This resulted in narratives with a storytelling approach that aimed to describe each participant over time (Patton, 2002; Yin, 2003). These case-specific analyses were followed by a cross-case analysis, to gain a more comprehensive understanding of the participants' experiences (Creswell, 2007). For this cross-case analysis, the content analysis method, as described by Graneheim & Lundman (2004), was applied to the interview data, resulting in final themes common to all four cases, constructed as follows. The latent content (in condensed meaning units), including all interviews, were first compared and sorted into codes. Thereafter, they were linked together based on the content the codes and also discussed among all authors, resulting in final themes.

In addition to the data presented in the original paper (Paper 2), for this thesis the data collected by use of Housing Enabler were analysed. Using instrument-specific software, several approaches to the analysis of accessibility problems are possible. Since two different versions of the Housing Enabler instrument were used for the case study and the accessibility study, the “weighted environmental barriers” function was used (Slaug & Iwarsson, 2010) in order to present results that could be compared across studies for the present thesis. Accordingly, the results based on this analysis were not reported in the original case study paper. With this function, the environmental barriers that, in combination with the presence of functional limitations in the sample, contribute most to the magnitude of accessibility problems were identified. This computation resulted in a list ranking the environmental barriers from those generating the most accessibility problems to the least. That is, the three environmental barriers in each housing section that generated the most accessibility problems in the sample were identified.

IBM SPSS Statistics version 18 was used for the case study.

The focus group study

A descriptive analysis approach in accordance with Krueger and Casey (2009) was used. In the first step, the transcripts were read and listened to several times in order to get a sense of the material as a whole. Thereafter, sections from the discussions that were relevant to the aim of the study were identified and categorized by the author, focusing on the meaning emerging from the joint discussions rather than on individual comments. In this step, the data were still raw in their context, i.e. close to the participants’ own words. This process was first performed separately for each focus group, and thereafter the emerging results from all groups were further synthesized until a set of preliminary subcategories and categories for the entire material were established. The data analysis was performed interactively by the author (first author of the original paper) and one of the co-supervisors (last author of the original paper). The preliminary results were validated several times by the other co-authors of the original paper and also discussed at a seminar with other occupational therapy researchers experienced in qualitative methodology.

The accessibility study

Frequencies were used to describe autonomy for the total sample both indoors and outdoors, respectively. Environmental barriers and accessibility problems were described for the total sample, and for the two subgroups “powered mobility device users both indoors and outdoors” and “powered mobility device users outdoors only”. The three environmental barriers that generated the most accessibility problems in

each housing section were identified. Further details are described in the section covering data analysis for the case study.

Two logistic regression analyses were accomplished by applying a backward stepwise strategy in order to examine different personal and environmental aspects and their association with autonomy indoors and outdoors (Hosmer Jr & Lemeshow, 2004). In these logistic regression analyses, an odds ratio higher than 1.0 indicates a greater risk of restriction in autonomy and an odds ratio lower than 1.0 indicates a lower risk. The dependent variable for the respective logistic regression models was less or more restriction in autonomy. This was constructed as follows: for all items of autonomy the ratings were dichotomized giving values from 0–7 for autonomy indoors and values 0–5 for autonomy outdoors. The sum scores were then dichotomized at the median, resulting in recoding into less or more restriction in autonomy. The selection of the independent variables representing personal and environmental aspects was based on the CMOP-E (Townsend & Polatajko, 2007) and on the results from the focus group study regarding powered mobility device users' experiences of managing everyday life.

P-values < 0.05 were interpreted as statistically significant. IBM SPSS Statistics version 21 and an instrument-specific software package (Slaug & Iwarsson, 2010) were used for all computations.

Results

Participation

The pre-post study showed that, prior to receiving their powered mobility devices, the participants wanted to use it to get outdoors, into the countryside and the city centre, to visit family and friends, and to socialize in public facilities. Half of them expected that the powered mobility device would make it possible for them to do their day-to-day shopping. Similarly, the results of the focus group study demonstrated that use of a powered mobility device was seen as a prerequisite for being able to manage everyday occupations such as shopping, socializing, and getting out in the fresh air and having a look around.

At the 4-month follow-up (T2) in the pre-post study, the majority stated that they did use the powered mobility device to socialize and do their day-to-day shopping. The number of mobility-related participation aspects reported did not increase significantly over time, but mobility while shopping, going for a walk, visiting friends or going to the pharmacy was perceived as significantly easier after 4 months of using the powered mobility device. See Table 3 for further details. In terms of describing the ease/difficulty of mobility-related participation, half of the participation aspects were rated as significantly easier to perform after the powered mobility device had been in use for 4 months (Table 3). In other words, mobility while shopping, going for a walk, visiting friends or going to the pharmacy was perceived as significantly easier. No other or additional changes were seen at the 1-year follow-up (see Table 3 for details). The results also showed that approximately 80% of the participants had their expectations of the powered mobility device fulfilled and judged the device to be much better or better than expected.

Table 3. Changes in frequency of participation and in ease/difficulty of mobility-related participation at baseline (T1), 4-month (T2) and 1-year follow-up (T3) in the pre-post study, N=34.

Participation aspect	Changes in participation frequency between T1-T3,%				n ^{c)}	Changes in ease/difficulty between T1-T2,% ^{d)}			p-value ^{e)}
	T1	T2	Changes from T1-T2 p-value ^{a)}	T3 ^{b)}		Easier	Unchanged	More difficult	
Kitchen work	85	76	ns	68	24	50	29	21	ns
Washing up	44	38	ns	38	15	53	40	7	ns
Cleaning	44	41	ns	35	24	64	0	36	ns
Restaurant	53	68	ns	65	23	61	35	4	ns
Take care of children	12	9	ns	12	0	0	0	0	ns
Hairdresser	59	56	ns	53	19	58	37	5	ns
Shopping	65	79	ns	76	27	74	22	4	0.001
Other shopping	56	68	ns	71	23	87	9	4	<0.0001
Post	26	12	ns	26	4	50	50	0	ns
Bank	41	44	ns	56	15	87	13	0	ns
Pharmacy	50	53	ns	50	18	44	22	34	0.001
Library	21	15	ns	21	5	60	20	20	ns
Union/church	32	32	ns	41	11	72	14	14	ns
Culture, sport	26	38	ns	29	13	85	15	0	ns
Hobby, exercise	29	29	ns	29	10	83	17	0	ns
Go for a walk/ride	71	97	ns	91	33	91	8	1	<0.0001
Family, friends	85	82	ns	82	27	56	22	4	0.002
Work/studies	6	9	ns	18	3	66	33	1	-
Gardening	23	26	ns	15	9	75	13	12	ns

a) Sign test.

b) No additional significant changes in participation frequency occurred between the 4-month and 1-year follow-ups and therefore no p-value is reported.

c) Number of participants that answered the frequency-scale at both baseline and 4-month follow-up, utilized to calculate the changes in ease. Those responding that they never performed a certain participation aspect at baseline, but who had started doing it four months later were considered to find this easier.

d) No additional significant changes in ease/difficulty occurred between 4-month and 1-year follow-ups and therefore not presented.

e) The sign test is based on data from the ordinal 5-step scale.

The results of the pre-post study showed that after four months' use and after one year's use of a powered mobility device, the need for assistance in mobility from other people decreased significantly when moving around in general outdoor environments and indoors at places other than in the home. No differences were seen in mobility indoors in the home or getting in and out of the home. According to the results of the case study at T4, three of the participants used powered mobility devices and one was waiting for one but had not yet received it. Over time, the participants strived to continue to perform activities and to live an active and social

life. The ability to independently participate in social life and society as a whole was important. A move to another kind of housing was considered to be a way of enhancing participation as they were aware of the risk of restrictions to functioning resulting in increased reliance and restricted participation. On the other hand, they thought that independent participation in social life could be more difficult if they moved. The results of the focus group study also showed that, having received a powered mobility device, participants were no longer in need of home care services or relatives to manage mobility. Their use of powered mobility devices enabled independence in mobility and gave them freedom. Because some participants were completely reliant on their powered wheelchairs, they were worried they would not be able to manage their everyday life and losing their newly gained independence since no repair services were available during weekends. Nevertheless, the results from both the case study and the focus group study demonstrated that some of the participants did not initially want to have the powered mobility device as they saw it as a sign of failure and of decline. Later on, when they had used their device for a while, they reasoned that they saved energy by using it. They also wished that they had got their devices earlier and stated that the occupational therapist should propose a powered mobility device at an earlier stage. Some participants struggled with using their devices among other people because they felt they were being stared at. They had to force themselves to go outdoors when using their powered mobility device.

According to the results of the accessibility study, the 48 participants with spinal cord injuries perceived their autonomy indoors to be generally good, while they perceived there to be more restrictions in their autonomy outdoors. Most restrictions were perceived in 'going on trips and holidays when one wants'. Table 4 contains further details about their autonomy. Autonomy indoors was significantly related to the number of years since they suffered spinal cord injuries and the number of functional limitations, while autonomy outdoors was significantly related to the environmental barrier 'entrance doors that do not stay in open position/close quickly'. The results from the two regression models showed that years living with spinal cord injury were the only significant predictor (Odds ratio = 0.94, 95% CI (0.89–0.99), $p = 0.030$). In other words, it was more likely that participants who had lived longer with spinal cord injuries would perceive less restriction in autonomy indoors. The explained variance was estimated using Nagelkerke's R square at 14.1%. When it comes to perceived restriction in autonomy outdoors, the regression model showed that more functional limitations was significantly predictive of more restrictions in autonomy (Odds ratio=1.641, 95% CI: (1.069 – 2.519), $p = 0.024$) as was living in a dwelling with the environmental barrier 'entrance doors that do not stay in open position/close quickly' (Odds ratio = 4.087, 95% CI: (1.09–15.329), $p = 0.037$). The explained variance was estimated using Nagelkerke's R square at 31.8%.

Table 4. Autonomy indoors and outdoors among the total sample of powered mobility device users in the accessibility study (N = 48).

IPA-S item	Very good	Good	Fair	Poor	Very poor
<i>Autonomy indoors</i>					
Getting around indoors where one wants	17	11	16	2	2
Getting around indoors when one wants	20	9	14	2	3
Washing, dressing, grooming the way one wants	11	12	18	4	3
Washing, dressing, grooming when one wants ¹	10	14	19	2	2
Going to bed when one wants	14	10	15	4	5
Going to the toilet when one needs ²	15	12	13	3	2
Eating and drinking when one wants	30	8	8	2	0
<i>Autonomy outdoors</i>					
Visiting friends when one wants	6	11	14	10	7
Going on trips and holidays when one wants	4	1	17	10	16
Spending leisure time the way one wants	10	13	12	8	5
Frequency of social contacts ¹	7	9	12	15	4
Living life the way one wants	4	12	14	11	7

Note: Autonomy according to the Swedish version of the Impact of Participation and Autonomy (IPA-S) instrument (Larsson Lund, Fisher, et al., 2007).

¹n = 47.

²n = 45.

The provision process

The results of the focus group study showed that the training the participants received was important for their ability to use powered mobility devices. The men who used powered scooters in particular sometimes lacked sufficient training when they received their devices. They also tried to use them in places other than those they were familiar with, and turned back if they encountered accessibility problems, whereas the men who used powered wheelchairs were more careful and checked the accessibility in advance. The women did not dare to take the risk of not being able to use their device when arriving at a new place. For some, this also meant they totally refrained from travelling. Another aspect was that housing adaptations to provide storage for powered scooters had taken a long time to process; consequently, the participants had to wait to receive their devices. The participants emphasized that occupational therapists and administrators in the municipalities have a shared responsibility for housing adaptations and that the collaboration between the different people involved must be improved when powered mobility devices are delivered.

Accessibility

Accessibility in society at large

The results of the case study and the focus group study showed that the participants had learnt through experience which environmental arenas and shops were accessible when using their powered mobility device. To a certain extent, men and women expressed different experiences of powered wheelchairs and powered scooters. The men who used powered wheelchairs complained that the toilets in public buildings were constructed for manual wheelchair users and were not accessible to powered wheelchairs. The women felt excluded since they did not have access to public environments. Another example of exclusion, expressed by both men and women using powered wheelchairs, was that they were sometimes not able to visit friends' homes due to stairs and a lack of accessible toilets. As a consequence, they found it difficult to maintain their social networks. Other examples of the problems experienced were lifts that were too narrow in public buildings, which also had insufficient space outside, and parking spaces with sufficient space for manual wheelchairs but not for powered mobility devices. The results also showed that they sometimes encountered environmental barriers when travelling by train that made it difficult to independently board the train with the powered mobility device. To be able to travel longer distances, it was important for them to transport the powered mobility devices by car and some had received a car modification.

Some of the men in the focus group study and one participant in the case study, who used a powered wheelchair, had informed politicians, media, and others about their need for improved accessibility. The men who used powered wheelchairs emphasized that users and occupational therapists have valuable knowledge about accessibility for powered wheelchairs, and should be involved whenever new buildings are being planned and when planning for accessibility in society as a whole. Moreover, they emphasized that accessibility in public buildings and in society as a whole could be improved if the various stakeholders were able to work together.

Accessibility in housing

The results for the pre-post study showed that most of the participants (76%) thought that their dwellings were well designed in relation to the powered mobility device (at T3). According to the results of the case study, a changing life situation with increasing functional limitations and dependence on additional mobility devices contributed to housing accessibility problems. As a consequence, additional housing adaptations were received over time. Despite housing adaptations, the participants were unable to continue to fully perform all the activities they wanted

to. For example, it was difficult for them to reach the kitchen cupboards and the bin storage was not accessible for the powered mobility device. Similarly, the participants in the focus group study emphasized that the home must be adapted for the use of a powered mobility device in for example, the bathroom, kitchen, entrance, storage room and garden. The results also showed that powered wheelchairs for outdoor use generate accessibility problems in dwellings, which was why they also needed a powered wheelchair designed for indoor use. Some participants struggled with getting the occupational therapist understand their needs and wanted to have one powered mobility device for indoor use and another for outdoors use. However, not all participants received two devices and powered wheelchairs for outdoor use were prioritized, even if that caused accessibility problems when the device was used indoors.

The results of the accessibility study showed that the three environmental barriers (ranked 1–3) that generated the most accessibility problems in exterior surroundings and at entrances were the same for those participants who used their powered mobility devices both indoors and outdoors and those who only used them outdoors, though ranked in a different order. Indoors, the environmental barriers and the ranking order were identical for these two subgroups. Furthermore, some of the environmental barriers that generated the most accessibility problems were the same in the case study and the accessibility study, though ranked in a different order. Table 5 contains further details about the environmental barriers that generated the most accessibility problems in the different housing sections, both in the case study and in the total sample in the accessibility study.

Table 5 The three environmental barriers (ranked 1–3) that generated the most accessibility problems in the three different housing sections in the case study (N=4) and in the accessibility study (N=48).

Housing section	Environmental barrier	No. of participants living in housing with the barrier in question		Environmental barriers ranked 1–3	
		Case study (n=4)	Accessibility study (n=48)	Case study	Accessibility study
<i>Exterior surroundings</i>	No shelter from weather in passenger loading zone (parking)	4	28	1	
	Refuse room/bin can only be reached via steps or other differences in level reach	3	13	2	
	Irregular/uneven surface	2	44	3	2
	Letterbox difficult to reach	2	24		1
	Refuse bin difficult to reach	2	20		3
<i>Entrance</i>	High threshold/level difference/step (sitting-out place/balcony)	3	21	1	
	High thresholds and/or steps	2	36	2	2
	Narrow door (sitting-out place/ balcony)	3	27	3	
	Doors that cannot be fastened in open position	0	38		1
	Doors that do not stay in open position/ close quickly	0	27		3
<i>Indoors</i>	Wall-mounted cupboards and shelves placed high (kitchen)	1	37	1	1
	Stair treads with narrow depth or irregular depth	2	13	2	
	No grab bar at shower/bath and/or toilet	1	18	3	
	Controls in high/ inaccessible position (kitchen)	1	48		2
	Storage areas can only be reached via stairs/threshold or other difference in level	2	37		3

Note. Environmental barriers according to the Housing Enabler instrument (Iwarsson & Slaug, 2010). Data for the case study is at T4; 2 participants used powered wheelchairs indoors and outdoors, and 1 participant used a powered scooter outdoors.

Discussion

With the overall aim to increase and deepen the knowledge on powered mobility device use in relation to participation and accessibility in different environments and among different user groups, the results of this thesis show that there are accessibility problems in society as well as in the users' homes. Based on these results, this thesis has the potential to contribute towards expanding the knowledge base regarding the use of powered mobility devices and optimizing independence in mobility and participation. The main contribution of the studies that constitute the empirical basis of the thesis is to show that the aim of these mobility devices is mostly fulfilled. In other words, powered mobility devices do increase their users' opportunities for participation, but there are also factors such as accessibility problems that impact on their activities. Accordingly, a second important contribution is that the results show that serious attention should be paid to users of powered mobility devices as they convey different aspects of how the use of such devices could be optimized. All in all, the results enrich the knowledge base regarding the use of powered mobility devices and have the potential to optimize independence in mobility and participation among those using such devices. In addition, they have the potential to inform politicians and other stakeholders about the needs that users of powered mobility devices have for improved accessibility.

The impact of powered mobility devices

In accordance with the intentions of the provision of powered mobility devices, the results show that most users of such devices are able to move around independently and to participate in society. In addition, the participants expressed that they were no longer dependent on relatives or friends to push their manual wheelchair after receiving their powered mobility device. Some of the participants in the focus group study stated that they no longer needed home care services due to the powered mobility device. Furthermore, the use of a powered mobility device is seen as a prerequisite for managing occupations such as shopping and socializing. Overall, this indicates that powered mobility devices facilitate participation and independence in mobility. In contrast, the results also show that using a powered mobility device does

not lead to independence in mobility in all environmental arenas. Similarly, there are additional threats to independence in mobility. For example, the availability of servicing for such devices is important in order to maintain independence in mobility as some of the participants were completely dependent on their powered wheelchairs. In other words, if people cannot use their mobility devices, they may become dependent in terms of mobility. Such situations might also lead to people not being able to make their own decisions concerning participation. As argued by Cardol et al. (2002), the ability to make own decisions concerning when and how to perform activities is important for autonomy.

The NOMO 1.0 instrument (Brandt & Iwarsson, 2012), developed to evaluate mobility device intervention in terms of mobility-related participation was used in the pre-post study. Accordingly, it was possible to follow people who had received powered mobility devices for the first time over the course of one year. The results show that the use of powered mobility devices leads to increased participation frequency for some of the participation aspects included in the NOMO 1.0 instrument. Likewise, some participation aspects became easier after the powered mobility device had been in use for 4 months. The fact that powered mobility devices facilitate independence and make it possible to maintain important participation aspects such as shopping, socializing and going for a walk is also shown in other follow-up studies (Pettersson, Ahlstrom, et al., 2007; Rousseau-Harrison, Rochette, Routhier, Dessureault, Thibault, & Côté, 2009). According to the pre-post study, even if the participants for instance went for a walk/ride, shopping or socialized with an increased frequency, the number of mobility-related participation aspects that the participants participated in did not increase. The results also show that the use of powered mobility devices did not result in other or additional participation aspects or changes in the participants' repertoire of participation aspects. Nevertheless, the results do show that, to a great extent, the participants do what they intend to do with their powered mobility devices. Similarly, most of them had their expectations of the powered mobility device fulfilled, which may indicate that the use of powered mobility devices facilitated participation. One explanation of the fact that no additional participation aspects were found may be that people's life habits and routines tend to remain stable (Kielhofner, 2007) and may possibly reflect the habits of this group rather than the devices' lack of impact. This is also partly supported in a study by Auger et al. (2010), exploring life-space mobility following a powered mobility device intervention, which also found the specific locations, mostly around the home and in the neighbourhood, remained stable.

Referring to the results in the present thesis, it seems as if powered mobility device users do not always take participation for granted and have different strategies for enabling participation. For instance, some participants had learnt which shops are accessible to them. Some participants also tried to use their powered mobility devices in places other than those they already knew, while some did not dare to

take the risk of visiting new places. This might illustrate that they have strategies for dealing with the fact that not all environments are accessible. For that reason, they have to prioritize and adjust their use of powered mobility devices to, for example, different accessibility problems in society, as was shown in the case study and the focus group study. It can be assumed that this prioritization is also a strategy used to enable participation and autonomy. To some extent, this is in line with previous research, which has shown that some manual wheelchair users choose to participate in society instead of being independent in activities of daily living as this saved their energy (van de Ven, Post, de Witte, & van den Heuvel, 2008). This in turn implies that participation in leisure and social occupations is important (Hammel et al., 2013). Furthermore, as demonstrated by the results in the case study and the focus group study, users of powered mobility devices strive, in spite of functional decline, to continue to live an active and social life, as well as for autonomy; their devices are important for enabling this. On the other hand, the results in the accessibility study demonstrated that people with spinal cord injuries perceive there to be more restriction in their autonomy outdoors than indoors, for example when visiting friends. Accordingly, it seems as though not having the opportunity to socialize might lead to restricted autonomy. However, there may be other reasons for restricted autonomy outdoors in the specific user group with spinal cord injuries.

Moreover, the powered mobility device users strived for the ability to participate in society on the same terms as other people, confirming the importance of socializing. For example, some participants informed politicians and the media about their need for improved accessibility. This in turn can be assumed to be another strategy for enabling participation and independence in mobility. The participants also revealed that occupational therapists and powered wheelchair users should be involved whenever new buildings are being planned, in line with the findings of Lysack, Komanecky, Kabel, Cross and Neufeld (2007). Because this aspect was stated among different user groups in the present thesis and various examples of accessibility problems were both described in detail and compared to manual wheelchair use, this enriches the knowledge base concerning the optimized use of powered mobility devices. In addition, the fact that some participants were committed to highlighting accessibility problems, for example, might indicate that it is important for people to contribute by using their experience of using powered mobility devices to help other people. For instance, it became clear during the focus group discussions that powered mobility device users find it valuable to contribute with their unique knowledge of such devices. This is consistent with previous research, which has shown that people with disabilities perceive they have a responsibility to contribute to society and believe that society has a responsibility to support participation (Hammel, Magasi, Heinemann, Whiteneck, Bogner, & Rodriguez, 2008).

Accessibility for powered mobility device users

As demonstrated by the results in this thesis, users of powered mobility devices have to struggle with many accessibility problems, especially in public environments and on public transport. The wide range of accessibility problems indicates that the use of powered mobility devices is not associated with only positive experiences. For example, the participants in the focus group study stated that there are accessibility problems when using powered mobility devices in public environments, even if it can be presumed that this is not the case for users of manual wheelchairs. This can be explained by the fact that use of powered mobility devices requires a level of accessibility beyond that stipulated by current environmental design standards. Furthermore, this emphasises the need for the standards governing accessibility in public environments to be adapted to accommodate not only manual wheelchair users, but also people who use powered mobility devices. Similarly, accessibility problems appear to be more pronounced among powered wheelchair users than powered scooter users. This can be explained by the fact that powered wheelchair users often have to use their device indoors in public environments, while powered scooter users may be able to walk short distances and will leave their devices outside. As an example, it is important that lifts are adapted for both powered wheelchairs and powered scooters and that sufficient manoeuvring space is provided outside the lift. However, even if accessibility standards were to be adapted to accommodate the use of powered mobility devices, it also is important to eliminate other challenges in society such as door openers that are out of order (Torkia et al., 2014).

The results from the focus group study demonstrate that powered mobility device users feel excluded from taking part in in everyday occupations in different environmental arenas due to problems with the accessibility of public environments and public transport. Assistance is often needed when boarding or exiting a bus or train with such devices and it can be assumed that such accessibility problems lead to dependence in mobility. In addition, such accessibility problems in transporting the powered mobility device not only may lead to difficulties in, for example, shopping and visiting restaurants that are far away, but also hinder participation. Similarly, in order to enable the user to travel longer distances, it is important that powered mobility devices can be transported by car, as suggested by May, Garrett and Ballantyne (2010). Accordingly, this underscores the need to fully implement the requirements of current Swedish legislation (SFS 2010:900) that public buildings have to be accessible. Also, this is in line with the UN Convention on the Rights of Persons with Disabilities (UN, 2007), which states that public buildings and transport should be accessible.

Turning to accessibility in housing, the accessibility study found the environmental barrier “controls in high/inaccessible position” (in kitchen and hygiene areas) in

almost all dwellings occupied by people with spinal cord injuries. Furthermore, synthesizing the results of the case study and the accessibility study revealed that several of the environmental barriers identified among the top three that generated accessibility problems were the same, for example “wall-mounted cupboards and shelves placed high” in the kitchen. This result is somewhat surprising as it is known that housing adaptation is often imperative when a powered mobility device is used indoors, as found in the present thesis and supported by Reid et al. (2003). It can be assumed that this accessibility problem made it difficult for the powered mobility device users to perform kitchen activities. This is consistent with previous research, which has shown that people who suffered strokes and used wheelchairs complained that cupboards were problematic and that they wanted their kitchens to be redesigned (Reid, 2004). Similarly, associations between physical environmental barriers in housing and participation have been found among people with the late effects of polio (Larsson Lund & Lexell, 2009). However, it should be noted that the identification of accessibility problems in the case study and the accessibility study was based on assessments conducted using the Housing Enabler instrument (Iwarsson & Slaug, 2001, 2010), i.e. based on professional assessments of a person-environment relationship (Iwarsson & Ståhl, 2003), with no information about the users’ perceptions of the extent to which their occupational performance was affected. This indicates that it is important to perform additional assessments by means of observation, as argued by Helle, Iwarsson and Brandt (2013).

All in all, the aim of both housing adaptations and powered mobility devices is independence. Accordingly, it is of the utmost importance that accessibility and the need for housing adaptations are taken into account at the same time in the provision of powered mobility devices in order to make powered mobility device use possible in both the home and in society. In actual fact, the results in the present thesis demonstrate that housing adaptations do not always result in an optimal situation for powered mobility device users, and there appears to be the potential to improve the quality of such services, as validated by the results from the case study and the focus group study. Previous research has revealed that occupational therapists usually conduct home visits for assessments of housing adaptation (Malmgren Fänge, Lindberg, & Iwarsson, 2013). However, a minority use standardized instruments and a minority performed retrospective evaluations (Malmgren Fänge et al., 2013). In view of this, the results in this thesis strengthen the need to improve the quality of housing adaptation interventions by using standardized instruments and retrospective evaluation, as suggested by Malmgren Fänge et al. (2013).

Moreover, in relation to housing accessibility, the results of the case study and the focus group study indicate there is a need to consider providing more than one device during the provision process in order to facilitate the use of powered mobility devices indoors. Solutions based on more efficient assessments prior to the provision of devices, with explicit attention paid to the individual user’s needs, might prevent

the need for additional housing adaptations. In addition, referring to the results of the case study, housing adaptations are not simply a physical environmental intervention that enables occupational performance, they also enable autonomy in relation to socializing outside home. Such knowledge is important not only for the occupational therapists responsible for issuing the certificate required for a housing adaptation, but also for the responsible officials in the municipalities.

Provision of powered mobility devices

The results in this thesis show that some users of powered mobility devices wish that the occupational therapist had made the process of accepting the device easier, for example, by demonstrating the opportunities and advantages of using a powered mobility device. Accordingly, it can be seen as a balancing act between demonstrating the opportunities and advantages of a powered mobility device and being aware of people's readiness to accept one. Also, this implies that it is important to be aware of this aspect in the provision of powered mobility devices. Similarly, previous research into the use of mobility devices has revealed that users' inner feelings and attitude might constitute a barrier to the use of such devices (McMillen & Söderberg, 2002).

Referring to the results in the present thesis, being an independent powered mobility device user involves both challenges and struggles. The powered mobility device users' experiences show that professionals need to be aware of the users' individual needs in the provision of powered mobility devices. For example, collaboration between the different actors involved in provision and housing adaptation should be improved, taking individual needs, type of housing and type of powered mobility device into account. In other words, assessment procedures prior to the receipt of powered mobility device and the associated housing adaptations need to be improved to avoid a delay in the delivery of the device. Such delivery delays could threaten independence in mobility and lead to restrictions on participation. Not having the opportunity to make one's own decisions on when the powered mobility device will be delivered may lead to restrictions on autonomy (Cardol et al., 2002).

Moreover, some gender differences related to the provision of and training in the use of powered mobility devices were demonstrated in the focus group study. The men seemed to use trial and error when driving a powered mobility device, whereas the women did not dare to try using their device in new environments. This indicates that training is important when a powered mobility device is delivered (Edwards & McCluskey, 2010; Hall et al., 2005) and also that the training should be designed differently for men and women, as suggested by others (Auger et al., 2010). However, even if some evidence for different experiences was found, the results should not be generalized to all men and women.

Conceptual and theoretical reflections

The results suggest that participation and accessibility, as well as independence and autonomy are important considerations, both for research into the use of powered mobility devices and for occupational therapy practice. Nevertheless, previous research has revealed that independence and autonomy are often used as interchangeable concepts in both research and practice (Tamaru et al., 2007). Most importantly, in the context of mobility and the use of powered mobility devices, these concepts can be linked to each other and are to some extent intertwined, e.g. participation with independence and accessibility with autonomy. For instance, accessibility problems in housing might lead to a delay in the delivery of a powered mobility device, as well as to dependence in mobility and dependence on relatives and friends to push an unpowered device. This also has consequences such as restrictions on participation and autonomy. Consequently, it seems as though autonomy, a personal aspect of participation, is important in relation to the use of powered mobility devices. Because participation is one of the main goals for rehabilitation interventions (Cardol et al., 2002; Dijkers, 2010), the knowledge provided by this thesis about how aspects of participation, independence and autonomy are intertwined represents an important contribution to an increased understanding of how to optimize the use of powered mobility devices.

In this thesis, accessibility is based on the person-environment relationship (Iwarsson & Ståhl, 2003), as defined by Lawton and Nahemow (1973). According to Iwarsson and Ståhl (2003), accessibility refers to norms and standards and is mainly objective in nature. A closely related concept, not addressed in the present thesis, is usability. The concept usability is subjective in nature and includes the activity component. Moreover, according to the ISO (1998), measurements of effectiveness, efficiency and satisfaction are included in usability. Other authors (Arthanat, Bauer, Lenker, Nochajski, & Wu, 2007; Arthanat et al., 2009) have suggested that the usability of powered mobility devices can be measured using effectiveness (performance of activities, quantity), efficiency (ease and comfort with performing activities when the device is used, quality) and satisfaction (outcome of effectiveness and efficiency). Reflecting upon the results presented in the four studies in the present thesis, user experiences of accessibility are also included, indicating that usability was also studied. However, not all aspects of usability (i.e. effectiveness, efficiency and satisfaction) have been studied specifically in the present thesis. Accordingly, the concept usability is not used in the present thesis.

In this thesis, the CMOP-E (Townsend & Polatajko, 2007) was used as a theoretical model to reflect on the results from all four studies, and was also used when the independent variables in the accessibility study were selected. This model appears to be appropriate because it particularly emphasises the dynamic relationships between

the personal, the environmental and the occupational components and because the results from the four studies reveal not only that the person, the environment and the occupation are important components in the use of powered mobility devices, but also the dynamic relationships between these components. One example of such relationship is the fact that some participants had moved due to accessibility problems in their dwellings, demonstrating that moving to another dwelling can be one way of reducing environmental barriers. This is only one illustration of the relationship between the person, the environment and the occupations included in the CMOP-E (Townsend & Polatajko, 2007), which is constantly evolving among people receiving housing adaptations. As illustrated by the results, changes in either the person (e.g. declining functional capacity), the environment (e.g. reducing physical barriers), the occupation or the use of the mobility device influence this kind of dynamic relationship (Arthanat et al., 2007; Arthanat et al., 2009; Lenker, Scherer, Fuhrer, Jutai, & de Ruyter, 2005). However, according to the CMOP-E (Townsend & Polatajko, 2007), mobility devices are environmental components. Nevertheless, with reference to the results in this thesis, it is not always clear that such devices are environmental components. For instance, the results demonstrate that the provision of a powered mobility device can be seen as a balancing act between demonstrating the opportunities and advantages of a powered mobility device and being aware of people's readiness to have one. When previous research into the use of powered mobility devices used the CMOP-E as a theoretical model to examine the powered mobility device intervention (Wang et al., 2009), there was no further elaboration on the usefulness of the model for this kind of research. Still, according to Cook et al. (2008), the Canadian Model of Occupational Performance (CMOP) (Townsend, 2002) (i.e. the previous version of the CMOP-E) is not an optimal model for research into the use of powered mobility devices, as the role of, for instance, mobility devices is not specifically revealed. To the best of my knowledge, until now, the CMOP-E has not been used in previous research into the use of powered mobility devices. Because this model is often used in occupational therapy, this thesis contributes important reflections on the use of such devices according to this model that may be useful. Furthermore, occupational engagement is used in the CMOP-E, considering a broader perspective on occupation that encompasses participation and autonomy, for example, while the CMOP focuses on performance. Nonetheless, based on the results, a model that captures the different factors influencing the use of powered mobility devices is needed. However, the current reflections in this thesis regarding positioning powered mobility devices as an environmental component in a theoretical model require further discussion. There also needs to be a discussion about how to improve our understanding of the use of such devices and about the issues of participation and accessibility in a theoretical model.

Methodological considerations

In this thesis, different research approaches were applied by means of combining different kinds of data in order to understand complex issues concerning the use of powered mobility devices. In this section, the trustworthiness of the results from the case study and the focus group study will be discussed in terms of their credibility, dependability and transferability (Lincoln & Guba, 1985). The quantitative data from the pre-post study and the accessibility study will be discussed in terms of validity and reliability.

Participants and procedures

In order to make it possible to capture a broad perspective on the use of powered mobility devices, this thesis is built on four studies with different samples of users. Despite different samples were used, the study samples are rather small; therefore it is not possible to generalize the results in this thesis to apply to all powered mobility device users.

Turning to the different studies, the pre-post study was an exploratory study and the small sample size implied that the study was underpowered with little opportunity to control for confounding, perform causal analysis and identify type II errors. Furthermore, few women participated and no control group was used to reduce bias. However, it was not possible to have a control group for ethical and legal reasons (Fomiatti, et al., 2013; Hoenig, Giacobbi, & Levy, 2007), as people in Sweden who need a powered mobility device have a legal right to receive one.

Different aspects of homogeneity and heterogeneity were accounted for in the recruitment process for the focus group study (Krueger & Casey, 2009); however, all participants had a neurological diagnosis. Nevertheless, I do not believe that the results would have been influenced had participants with other diagnoses been included as the aim was to study the experiences of powered mobility device users and not the potential influence of different diagnoses. In terms of limitations, there was one dropout and each focus group comprised only a few participants, which might have limited the range of experiences elucidated (Krueger & Casey, 2009). However, the discussions were lively, a factor that is known to be more important than the number of participants in a focus group (Dahlin Ivanoff, Sonn, & Svensson, 2002; Krueger & Casey, 2009).

Finally, people ageing with spinal cord injuries were included in the accessibility study. Despite the aim of SASCIS (Lexell et al., 2014) not being to study the use of powered mobility devices specifically, this presented an opportunity to study a rather large sample of users as use of powered mobility devices is common within

this specific user group (Biering-Sørensen et al., 2004). The results thus enrich the knowledge base concerning the optimization of the use of powered mobility devices. However, one limitation is that no data on the specific type of powered mobility device were available.

Data collection

The issue of participation and accessibility among powered mobility device users was studied by using different methods for data collection such as focus group discussions, self-reported instruments and assessments of accessibility problems by standardized observation in the participants' dwellings. According to Dijkers (2010), self-reported methods are used most often in data collection, but observation and qualitative methods are also recommended, which may, in turn strengthen the results in the present thesis. Furthermore, multiple perspectives on the use of powered mobility devices and accessibility were applied in the case study in order to understand human experiences. Similarly, according to Lincoln and Guba (1985), the credibility of the data collection and the data analysis can be strengthened by triangulation. In the present thesis, triangulation was performed by combining different data and different methods in the four studies included. In addition, the analyses in the case study and the focus group study were performed by the different authors of the studies. Accordingly, it was possible to capture different aspects of the issue in the present thesis and the results were sometimes not congruent. However, according to Lincoln and Guba (1985), this should not be seen as weakness in the credibility of the results, but instead this can be seen as a strength as different aspects of the use powered mobility devices have been captured.

The fact that the authors involved in the studies in this thesis are occupational therapists deserves attention as this might have affected the data collection. However, in the interviews, the participants were aware of the interviewer's profession. This might lead to the participants having withheld some experiences because they took it for granted that the interviewer already knew about the use of powered mobility devices and housing adaptations, which could be considered as a limitation. It is highly likely that the results could have revealed other facets of experiences if researchers representing professions or disciplines other than occupational therapy had conducted the interviews. However, in-depth knowledge of the field being investigated is absolutely crucial for high-quality studies, independent of the methodology used.

In the focus group study, the vignettes used to initiate the discussions may have influenced the topics put forward. However, they did facilitate the discussions as the participants seemed to recognize themselves in the vignettes, something that has also been confirmed by others (Brondani et al., 2008). To strengthen the credibility

of the focus groups discussions, the moderator initially informed the participants of the study's aim emphasizing that the participants were the experts on the topic. In order to increase their trustworthiness, the vignettes and the interview guide were tested prior to the data collection in two individual pilot interviews with one powered wheelchair user and one powered scooter user and were found to be appropriate.

Regarding the instruments for data collection in the different studies included in the present thesis, the basic psychometric properties of the NOMO-instrument have been tested showing good content validity, internal consistency, and test-retest reliability (Brandt & Iwarsson, 2012). In addition, the IPA-S instrument has support for validity, reliability and internal validity for use with people with spinal cord injuries (Larsson Lund, Fisher, et al., 2007). Furthermore, accessibility was professionally assessed by means of the Housing Enabler instrument (Iwarsson & Slaug, 2001, 2010), with documented reliability and validity (Iwarsson & Isacson, 1996; Iwarsson et al., 2012).

Data analyses and results

Few women took part in the pre-post study, which presumably had an impact on the results since men are known to be more active in the use of powered mobility devices outdoors and men and women engage in different activities (Brandt et al., 2004). However, in order to elucidate such differences, the focus group study was based on the research needs identified in the pre-post study and the case study, leading to the generation of knowledge on such issues.

For the case study, a mixed method approach with an embedded design (Creswell & Plano Clark, 2011) was used, followed by a cross-case analysis. This design allowed greater depth to be achieved in the interpretation of the experiences of housing adaptation and elucidated how such processes are related to the use of powered mobility devices. In other words, the study design contributed in a valid and efficient way to comprehensive results being obtained. However, the study involved four participants from a previous longitudinal study being contacted 10 years later and asking people to relate to situations that occurred that long ago can of course be questioned in terms of credibility (Creswell, 2007). Nevertheless, the results show that the participants provided lots of information and details. Furthermore, the interviews were conducted during home visits, which may make it easier for the participants to recall their experiences of accessibility and housing adaptations. All in all, this could be seen as an important aspect in ensuring the quality of the study and enhancing credibility. In addition, a stepwise sampling procedure was employed. A cross-case analysis, in which similarities and differences

in the participants' experiences were sought, was also performed to gain a more comprehensive understanding of the participants' experiences.

For the case study and the focus group study, all authors were involved throughout the analysis process in order to increase the trustworthiness of the results, which facilitated the attainment of intercoder agreement (Creswell & Plano Clark, 2011). In addition, all of the different steps in the analyses were carefully documented in order to enhance credibility and dependability. Furthermore, the authors discussed amongst themselves how the data would be embedded in the most optimal way possible. To facilitate the credibility in the focus group study, the preliminary results from the discussions were discussed and validated in a seminar. However, it should be kept in mind that the strength of the focus group method is to go "in-depth" into the issue in question (Krueger & Casey, 2009), and not to generate knowledge that can be generalized. However, given the careful sampling procedure, which took homogeneity and heterogeneity into account, the results should be transferable to similar populations. Nevertheless, the fact that the topics discussed were not transferred from one group to another might be regarded as a limitation; however, as the aim was to describe topics related to different groups of powered mobility device users, the design applied was appropriate. Moreover, it should be kept in mind that, a descriptive analysis approach was used in accordance with the study's aim. Since the participants gave many concrete examples and vividly illustrated their experiences, the descriptive approach worked well in producing results that can be readily translated into recommendations for clinical practice. Nevertheless, the pre-understanding of the researchers involved in the study must be taken into consideration when interpreting the findings. It is highly likely, that the findings could have revealed other facets of experiences if researchers representing professions or disciplines other than occupational therapy had been involved in the analysis.

Two different versions of the Housing Enabler instrument (Iwarsson & Slaug, 2001, 2010) were used in the case study and the accessibility study, leading to difficulties in comparing the number of environmental barriers and also the accessibility scores. However, an additional analysis of the data in the case study was performed to allow the results from these two studies in the present thesis to be compared. In other words, the environmental barriers that generated the most accessibility problems (ranked 1–3) were presented for the case study, as well as for the accessibility study. To the best of my knowledge, the accessibility study is the first study to have used data on professionally assessed housing accessibility problems (Iwarsson & Slaug, 2010) with a sample consisting of powered mobility device users. Despite the importance of measuring accessibility professionally when a mobility device is used, it should be noted that some of the accessibility problems identified in the study could be overcome thanks to specific functions of the powered mobility device. One example is indoors where "wall-mounted cupboards and shelves placed high" were found to be an environmental barrier that generated accessibility problems; a barrier

that could be overcome if the powered mobility device in question was of the type that can elevate the user. This might indicate that the Housing Enabler instrument does not take into account specific functions and characteristics of modern powered mobility devices, demonstrating the need for further methodological development in this field of research. Moreover, when interpreting the results concerning accessibility problems, it has to be kept in mind that the ranking of the environmental barriers that generated the most accessibility problems was based on the prevalence of functional limitations in the total sample, i.e. the environmental barrier item-specific score that underlies the ranking is not specific to each individual's particular profile of functional limitations (Rantakokko, Tormakangas, Rantanen, Haak, & Iwarsson, 2013). Consequently, this methodological limitation renders the meaningful interpretation of this facet of the results potentially challenging.

In accordance with the aim of the accessibility study, only two domains of the IPA-S instrument (Larsson Lund, Fisher, et al., 2007) autonomy indoors and outdoors were used. These were considered to be relevant for mobility and powered mobility device use. However, it would have been possible to also evaluate to which extent the participants experienced problems if more domains of the IPA-S had been used. The fact that we did not use such data could be seen as a limitation as it is important to focus on how people experience their problems (Cardol et al., 2002; Larsson Lund, Nordlund, et al., 2007). In the dichotomization of the dependent variable for the respective logistic regression models, the ratings were dichotomized into very good/good or fair/poor/very poor for all items relating to autonomy. However, it is possible that another dichotomization would have generated different results. Furthermore, it has to be noted that the different items in the IPA-S (Larsson Lund, Fisher, et al., 2007) and the Housing Enabler (Iwarsson & Slaug, 2010) target different environmental arenas, which can be seen as a weakness. However, the accessibility study represents a first attempt to study autonomy and accessibility with a specific focus on powered mobility device users. The fact that the results are, to some extent, confirmed by the other studies included in the present thesis indicates that the results are credible and valid.

Conclusions

The overall conclusion of this thesis is that powered mobility devices enable participation to a great extent and increase independence and autonomy. A further conclusion is that accessibility problems in different environmental arenas hinder participation and risk infringing on the human rights of people who use powered mobility devices.

The following specific aspects deserve attention:

- It is vital to acknowledge the characteristics and requirements of both powered mobility devices and accessibility problems in order to optimize the use of powered mobility devices in the home and local neighbourhood, taking into account the complexity of participation, independence and autonomy.
- Existing standards for the design of built environments should be revised and adapted to accommodate not only manual wheelchair users, but also people that use powered mobility devices.
- Occupational therapists should be more active as advocates for powered mobility device users and use their specific knowledge to influence societal planning, in collaboration with politicians, designers, services providers, municipal officials and powered mobility device users.

Practical implications

- The provision of powered mobility devices and housing adaptations must be considered simultaneously, applying an explicitly user-centred perspective. The collaboration between the different actors involved should be improved.
- In the service delivery process, it is important to identify what the user intends to accomplish with the powered mobility device in terms of occupation, participation and autonomy.
- The timing of powered mobility device provision must be carefully considered; finding a balance between demonstrating the opportunities and advantages of such devices and the individual's readiness to begin using one.
- Occupational therapists and powered mobility device users have valuable knowledge about the environmental requirements for the use of such devices and should thus be involved as experts when considering accessibility issues in both housing provision and physical planning in society at large.

Implications for further research

- Evidence-based intervention programs involving the use of powered mobility devices should be further developed, evaluated and subsequently implemented in practice.

- It might be that the Housing Enabler instrument does not take the specific functions and characteristics of modern powered mobility devices into account, which would suggest that further methodological development is needed to improve the validity of the instrument.
- More knowledge is needed concerning housing accessibility and usability as related to the use of powered mobility device users' dwellings.
- It should be investigated as to whether early powered mobility intervention can prevent activity and participation restrictions, with the aim of amending the regulations governing the provision of powered mobility devices and housing adaptations.
- Research-based standards for the design of different types of environments, taking into account the use of powered mobility devices are needed in order to meet powered mobility device users' accessibility requirements.
- Provision of powered mobility devices carries substantial societal costs, suggesting that knowledge about the cost-effectiveness of this kind of service is needed.

Svensk sammanfattning/ Swedish summary

Alla människor ska kunna vara delaktiga i samhället och mobilitet är viktigt för att kunna förflytta sig i bostaden och i samhället i stort. Mobilitet gör det möjligt att vara delaktig i olika aktiviteter som till exempel sociala aktiviteter och fritidsaktiviteter.

Den åldrande befolkningen ökar och eftersom förflyttningssvårigheter ökar med stigande ålder, ökar även antalet förflyttningshjälpmedel som elrullstolar och elskotrar. Ofta börjar personer med förflyttningssvårigheter att använda enklare hjälpmedel som käpp, rollator och/eller manuell rullstol. Om det blir svårt att klara förflyttning med sådana hjälpmedel så kan elrullstol eller elskoter vara lämpliga. En elrullstol styrs oftast med en joystick och kan användas både inomhus och utomhus medan en elskoter har styre och oftast används utomhus. Båda typerna av hjälpmedel är batteridrivna. Vid behov av elrullstol/elskoter görs en individuell bedömning, vilken oftast utförs av en arbetsterapeut. Vidare är det vanligt att elrullstol/elskoter kombineras med andra åtgärder som till exempel bostadsanpassning.

I Sverige är förskrivning av hjälpmedel reglerad i hälso- och sjukvårdslagen. Under 2005 levererades 28 elrullstolar/elskotrar per 10 000 invånare i Sverige. Ett ökat antal elrullstolar/elskotrar medför i sin tur ökade kostnader för samhället. Det är därför viktigt att elrullstol och elskoter kan användas till det som de är avsedda att göra, dvs. att underlätta förflyttning men även att göra det möjligt att klara vardagliga aktiviteter.

Tidigare forskning har visat att användning av elrullstol/elskoter till stor del gör det möjligt att kunna förflytta sig och att kunna vara delaktig i vardagliga aktiviteter men att vissa byggnader i samhället inte är tillgängliga. Vidare så finns det brister i kunskapen om självständighet i mobilitet när man får elrullstol/ elskoter. Dessutom behövs mer kunskap om tillgänglighet och även om anpassning av bostäder vid användning av elrullstol och elskoter vilket i sin tur är viktig kunskap för att möjliggöra delaktighet. Elrullstol och elskoter har till stor del studerats som ett och samma hjälpmedel. Därför behövs mer forskning där dessa olika typer av hjälpmedel studeras som separata hjälpmedel.

Avhandlingens övergripande syfte var att öka kunskapen om användning av elrullstol och elskoter relaterat till delaktighet och tillgänglighet i olika miljöer och bland olika grupper av användare. Ett annat syfte var att bidra till kunskapsbaserade interventioner. Avhandlingsarbetet består av fyra delarbeten som baseras på data från flera olika forskningsprojekt.

Syftet med den första delstudien var att utvärdera effekterna av elrullstol/elskoter bland dem som börjar använda sådana hjälpmedel. Data samlades in vid tre tillfällen och 34 personer (23 män och 11 kvinnor där medianåldern var 74 år) följdes under cirka ett år. Utvärderingen gjordes med hjälp av strukturerade intervjuer utifrån instrumentet NOMO 1.0. De effekter av förflyttningshjälpmedel som fångas med detta instrument är förändringar avseende förflyttningsförmågan som sådan och med hänsyn till vardagliga aktiviteter samt deltagande i samhällslivet, så kallat förflyttningsrelaterad delaktighet. I denna studie gjordes den första bedömningen innan deltagarna hade börjat använda sin elrullstol/elskoter, medan den andra bedömningen gjordes efter fyra månaders användning och den tredje uppföljningen gjordes efter 1 års användning av elrullstol/elskoter. Resultatet visade att behov av hjälp av annan person vid förflyttning minskade vid förflyttning utomhus och inomhus i andra byggnader än bostaden. Vidare visade resultaten att deltagarna upplevde att det hade blivit enklare att förflytta sig. 80 % av deltagarna ansåg att förväntningarna på hjälpmedlet hade uppfyllts. Resultaten visade också att före deltagarna fick hjälpmedlen önskade de kunna använda dem för att komma ut, ta sig till naturen och city, besöka familj och vänner och för sociala aktiviteter.

Syftet med delstudie två var att beskriva erfarenheter av tillgänglighet och användning av elrullstol/elskoter i en longitudinell studie av bostadsanpassningar. Delstudien var en fallstudie där fyra personer (en man och tre kvinnor) som hade fått bostadsanpassning för 10 år sedan intervjuades om sina erfarenheter om tillgängligheten i bostaden och om de bostadsanpassningar de fått. Därutöver gjordes bedömningar av tillgängligheten i bostaden, definierad som individens funktionsnedsättningar och hinder i miljön. Tillgänglighetsproblemen bedömdes med instrumentet Housing Enabler. Först bedömdes individens funktionella kapacitet och därefter förekomsten av miljöhinder i den aktuella bostaden. Sedan beräknades graden av tillgänglighetsproblem, baserade på kombinationen av funktionell kapacitet och miljöhinder. Resultaten visade att deltagarna hade fått försämrade fysiska förmågor och använde mer avancerade förflyttningshjälpmedel. Två deltagare använde elrullstol både inomhus och utomhus medan en deltagare använde elskoter utomhus och en hade fått elskoter men hade inte börjat använda den. Användning av mer avancerade förflyttningshjälpmedel medförde att deltagarna hade fått ytterligare bostadsanpassningar genomförda. Resultaten visade också att deltagarna strävade efter att kunna leva ett aktivt och socialt liv. Vidare visade resultaten att de trots att de hade fått bostadsanpassningar inte kunde utföra alla vardagliga aktiviteter i bostaden. Bland de miljöhinder som genererade mest

tillgänglighetsproblem inomhus i bostaden var hyllor/väggskåp i köket som var högt placerade, grunda trappsteg/trappsteg med ojämnt djupt samt avsaknad av stödhandtag i hygienutrymme.

Den tredje delstudien syftade till att beskriva hur kvinnor och män upplever användning av elrullstol respektive elskoter i vardagliga aktiviteter i bostaden och i samhället i stort. I fyra olika fokusgrupper diskuterade 16 deltagare (8 män och 8 kvinnor där medianåldern var 64 år) sina erfarenheter av att använda elrullstol respektive elskoter. Resultatet visade att de till stor del själva klarade förflyttning genom att använda dessa hjälpmedel. De beskrev också att buss och tåg och även vissa byggnader som restauranger och bibliotek inte är tillgängliga för elrullstol respektive skoter medan de däremot var tillgängliga för manuella rullstolar. Detta i sin tur visar att existerande standarder för tillgänglighet behöver revideras för att göra det möjligt att kunna använda även elrullstol/elskoter. Vidare visade resultaten att det finns behov av att förbättra samarbetet mellan de som är involverade i åtgärder som elrullstol/elskoter och anpassning av bostäder. Slutligen visade resultaten att träningen för att kunna använda elrullstol respektive elskoter behöver utvecklas och anpassas till den enskilde individen.

Syftet med den fjärde delstudien var att beskriva autonomi inomhus och utomhus samt fysiska miljöhinder i bostaden bland elrullstols- och elskoteranvändare. Syftet var också att studera aspekter av person och miljö samt förhållandet till autonomi. I studien deltog 48 personer över 50 år (33 män och 15 kvinnor och där medianåldern var 64 år) med ryggmärgsskada sedan minst 10 år. Tillgänglighetsproblem i bostaden bedömdes även här med Housing Enabler. Resultaten visade att deltagarna upplevde mindre begränsningar i autonomi inomhus än utomhus. Mest begränsningar i autonomi upplevdes när det gällde att kunna åka på semester och resor när man ville samt delta i sociala aktiviteter. De deltagare som hade levt med ryggmärgsskada längre tid upplevde bättre autonomi än de som hade levt med ryggmärgsskadan kortare tid. Resultaten visade också att sämre autonomi upplevdes bland de deltagare som hade miljöhindret hyllor/väggskåp högt placerade i köket. Vidare, sämre autonomi upplevdes bland de deltagare som hade miljöhindret dörrar som inte stannar i öppet läge/stängs snabbt.

Sammanfattningsvis visar resultaten i avhandlingen att elrullstol och elskoter underlättar förflyttning och även att kunna vara delaktig i samhället. Resultaten visar också att för att kunna använda dessa hjälpmedel i bostaden och kunna klara vardagliga aktiviteter så behöver bostaden ofta anpassas. Det finns behov av ett förbättrat samarbete mellan personer som är involverade i hjälpmedelsåtgärder som elrullstol/elskoter och de som är involverade i anpassning av bostaden. Det finns också behov av att anpassa standarder för tillgänglighet i byggnader, allmänna platser samt buss och tåg för att dessa ska vara tillgängliga även för personer som använder elrullstol/elskoter. Det är viktigt att arbetsterapeuter som har specifik kunskap

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References

- Arthanat, S., Bauer, S. M., Lenker, J. A., Nochajski, S. M., & Wu, Y. W. B. (2007). Conceptualization and measurement of assistive technology usability. *Disability and Rehabilitation: Assistive Technology*, 2(4), 235-248.
- Arthanat, S., Nochajski, S. M., Lenker, J. A., Bauer, S. M., & Wu, Y. W. B. (2009). Measuring usability of assistive technology from a multicontextual perspective: the case of power wheelchairs. *The American Journal of Occupational Therapy*, 63(6), 751-764.
- Auger, C., Demers, L., G'elinas, I., Jutai, J. W., Fuhrer, M. J., & de Ruyter, F. (2008). Powered mobility for middle-aged and older adults: systematic review of outcomes and appraisal of published evidence. *American Journal of Physical Medicine and Rehabilitation*, 87(8), 666-680.
- Auger, C., Demers, L., G'elinas, I., Miller, W. C., Jutai, J. W., & Noreau, L. (2010). Life-space mobility of middle-aged and older adults at various stages of usage of power mobility devices. *Archives of Physical Medicine and Rehabilitation*, 91(5), 765-773.
- Beauchamp, T. L., & Childress, J. F. (2013). *Principles of biomedical ethics*. New York: Oxford University Press.
- Biering-Sørensen, F., Hansen, R. B., & Biering-Sørensen, J. (2004). Mobility aids and transport possibilities 10-45 years after spinal cord injury. *Spinal Cord*, 42(12), 699-706.
- Blach Rossen, C., Sørensen, B., Würtz Jochumsen, B., & Wind, G. (2012). Everyday life for users of electric wheelchairs - a qualitative interview study. *Disability and Rehabilitation: Assistive Technology*, 7(5), 399-407.
- Boss, T. M., & Finlayson, M. (2006). Responses to the acquisition and use of power mobility by individuals who have multiple sclerosis and their families. *The American Journal of Occupational Therapy*, 60(3), 348-358.
- Brandt, Å., Iwarsson, S., & Ståhl, A. (2004). Older people's use of powered wheelchairs for activity and participation. *Journal of Rehabilitation Medicine*, 36(2), 70-77.
- Brandt, Å. (2005). *Outcomes of rollator and powered wheelchair interventions : user satisfaction and participation* (Doctoral dissertation). Lund University, Sweden.

- Brandt, Å., & Iwarsson, S. (2012). Development of an instrument for assessment of mobility-related participation outcomes: The NOMO 1.0. *Technology and Disability, 24*(4), 293-301.
- Brandt, Å., & Stapelfeldt, C. (2009). Forbrug af mobilitetshjælpemidler 2002– 2006 – på basis af data fra Zealand Care [Use of mobility devices 2002–2006 – based on data from Zealand Care]. Århus, Denmark: Hjælpemiddelinstittutet.
- Brondani, M. A., MacEntee, M. I., Ross Bryant, S., & O’Neill, B. (2008). Using written vignettes in focus groups among older adults to discuss oral health as a sensitive topic. *Qualitative Health Research, 18*(8), 1145-1153.
- Buning, M. E., Angelo, J. A., & Schmeler, M. R. (2001). Occupational performance and the transition to powered mobility: a pilot study. *The American Journal of Occupational Therapy, 55*(3), 339-344.
- Cardol, M., de Haan, R. J., van den Bos, G. A. M., de Jong, B. A., & de Groot, I. J. M. (1999). The development of a handicap assessment questionnaire: the Impact on Participation and Autonomy (IPA). *Clinical Rehabilitation, 13*(5), 411-419.
- Cardol, M., de Jong, B. A., & Ward, C. D. (2002). On autonomy and participation in rehabilitation. *Disability and Rehabilitation, 24*(18), 970-974.
- Chaves, E. S., Boninger, M. L., Cooper, R., Fitzgerald, S. G., Gray, D. B., & Cooper, R. A. (2004). Assessing the influence of wheelchair technology on perception of participation in spinal cord injury. *Archives of Physical Medicine Rehabilitation, 85*(11), 1854-1858.
- Christiansen, C., & Townsend, E. A. (2011). *Introduction to occupation : The art and science of living : New multidisciplinary perspectives for understanding human occupation as a central feature of individual experience and social organization*. London: Pearson Education International.
- Clapton, J., & Kendall, E. (2002). Autonomy and participation in rehabilitation: Time for a new paradigm? *Disability and Rehabilitation, 24*(18), 987-991.
- Clifton, D. (2004). Paying for power. *Rehabilitation Management, 17*, 32-36.
- Cook, A. M., Polgar, J. M., & Hussey, S. M. (2008). *Cook & Hussey’s Assistive technologies : principles and practice*. St. Louis, Missouri: Mosby Elsevier.
- Creswell, J. W. (2007). *Qualitative inquiry & research design : choosing among five approaches*. Thousand Oaks, CA: SAGE Publications.
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research*. Los Angeles, CA: SAGE Publications.
- Dahlin Ivanoff, S. (2002). Focus Group Discussions as a Tool for Developing a Health Education Programme for Elderly Persons with Visual Impairment. *Scandinavian Journal of Occupational Therapy, 9*(1), 3-9.

- Dahlin Ivanoff, S., Sonn, U., & Svensson, E. (2002). A health education program for elderly persons with visual impairments and perceived security in the performance of daily occupations: a randomized study. *The American Journal of Occupational Therapy*, 56(3), 322-330.
- Dahlin Ivanoff, S., Iwarsson, S., & Sonn, U. (2006). Occupational therapy research on assistive technology and physical environmental issues: a literature review. *Canadian Journal of Occupational Therapy*, 73(2), 109-119.
- Davies, A., De Souza, L. H., & Frank, A. O. (2003). Changes in the quality of life in severely disabled people following provision of powered indoor/outdoor chairs. *Disability and Rehabilitation*, 25(6), 286-290.
- Dijkers, M. P. (2010). Issues in the conceptualization and measurement of participation: an overview. *Archives of Physical Medicine Rehabilitation*, 91(9), 5-16.
- Edwards, K., & McCluskey, A. (2010). A survey of adult power wheelchair and scooter users. *Disability and Rehabilitation: Assistive Technology*, 5(6), 411-419.
- Fairhall, N., Sherrington, C., Kurrle, S. E., Lord, S. R., Lockwood, K., & Cameron, I. D. (2012). Effect of a multifactorial interdisciplinary intervention on mobility-related disability in frail older people: randomised controlled trial. *BMC Medicine*, 10: 120.
- Fomiatti, R., Moir, L., Richmond, J., & Millsteed, J. (2014). The experience of being a motorised mobility scooter user. *Disability and Rehabilitation: Assistive Technology*, 9(3), 183-187.
- Fomiatti, R., Richmond, J., Moir, L., & Millsteed, J. (2013). A systematic review of the impact of powered mobility devices on older adults' activity engagement. *Physical and Occupational Therapy in Geriatrics*, 31(4), 297-309.
- Fuhrer, M. J. (2007). Assessing the efficacy, effectiveness, and cost-effectiveness of assistive technology interventions for enhancing mobility. *Disability and Rehabilitation: Assistive Technology*, 2(3), 149-158.
- Fänge, A., & Dahlin Ivanoff, S. (2009). The home is the hub of health in very old age: Findings from the ENABLE-AGE Project. *Archives of Gerontology and Geriatrics*, 48(3), 340-345.
- Fänge, A., & Iwarsson, S. (2005a). Changes in accessibility and usability in housing: an exploration of the housing adaptation process. *Occupational Therapy International*, 12(1), 44-59.
- Fänge, A., & Iwarsson, S. (2005b). Changes in ADL dependence and aspects of usability following housing adaptation – a longitudinal perspective. *The American Journal of Occupational Therapy*, 59(3), 296-304.

- Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24(2), 105-112.
- Haak, M. (2006). *Participation and independence in old age: Aspects of home and neighbourhood environments* (Doctoral dissertation). Department of Health Sciences, Division of Occupational Therapy and Gerontology, Lund University, Sweden.
- Haak, M., Fänge, A., Iwarsson, S., & Dahlin Ivanoff, S. (2007). Home as a signification of independence and autonomy: Experiences among very old Swedish people. *Scandinavian Journal of Occupational Therapy*, 14(1), 16-24.
- Hall, K., Partnoy, J., Tenenbaum, S., & Dawson, D. R. (2005). Power mobility driving training for seniors: a pilot study. *Assistive Technology*, 17(1), 47-56.
- Hammel, J., Magasi, S., Heinemann, A., Whiteneck, G., Bogner, J., & Rodriguez, E. (2008). What does participation mean? An insider perspective from people with disabilities. *Disability and Rehabilitation*, 30(19), 1445-1460.
- Hammel, J., Southall, K., Jutai, J., Finlayson, M., Kashindi, G., & Fok, D. (2013). Evaluating use and outcomes of mobility technology: A multiple stakeholder analysis. *Disability and Rehabilitation: Assistive Technology*, 8(4), 294-304.
- Hansen, E. M., & Vedsmand, M. (2010). Mobilitet [Mobility]. In Å. Brandt & L. Jensen (Eds.), *Grundbog om hjælpemidler til personer med funktionsnedsættelse* [Textbook on assistive devices for people with disabilities] (p 158-171). Copenhagen, Denmark: Hjælpemiddelinstittuttet and Munksgaard Danmark.
- Harris, F., Sprigle, S., Sonenblum, S. E., & Maurer, C. L. (2010). The participation and activity measurement system: an example application among people who use wheeled mobility devices. *Disability and Rehabilitation: Assistive Technology*, 5(1), 48-57.
- Helle, T., Iwarsson, S., & Brandt, Å. (2013). Validation of housing standards addressing accessibility: exploration of an activity-based approach. *Journal of Applied Gerontology*. DOI: 10.1177/0733464813503042.
- Hemmingsson, H., & Jonsson, H. (2005). An occupational perspective on the concept of participation in the international classification of functioning, disability and health – some critical remarks. *The American Journal of Occupational Therapy*, 59(5), 569-576.
- Hoening, H., Giacobbi, P., & Levy, C. E. (2007). Methodological challenges confronting researchers of wheeled mobility aids and other assistive technologies. *Disability and Rehabilitation: Assistive Technology*, 2(3), 159-168.
- Hosmer Jr, D. W., & Lemeshow, S. (2004). *Applied logistic regression*. New Jersey, CA: John Wiley & Sons.

- International Organization for Standardisation (ISO) (1998). *Ergonomic requirements for office work with visual display terminals (VDTs) – Part II: Guidance on usability*. (ISO 9241-11:1998). Geneva, Switzerland.
- International Organization for Standardisation (ISO) (2011). *Assistive products for persons with disability – classification and terminology*. (ISO 9999:2011). Geneva, Switzerland.
- Iwarsson, S., & Isacson, Å. (1996). Development of a novel instrument for occupational therapy assessment of the physical environment in the home - A methodologic study on "The Enabler". *Occupational Therapy Journal of Research*, 16(4), 227-244.
- Iwarsson, S., & Slaug, B. (2001). *The Housing Enabler : An instrument for assessing and analysing accessibility problems in housing*. Lund: Vetem & Skapen & Slaug Data Management.
- Iwarsson, S., & Slaug, B. (2010). *The Housing Enabler : A method for ratings/screening and analysing accessibility problems in housing*. Lund: Vetem & Skapen HB & Slaug Data Management.
- Iwarsson, S., Haak, M., & Slaug, B. (2012). Current developments of the housing enabler methodology. *British Journal of Occupational Therapy*, 75(11), 517-521.
- Iwarsson, S., & Ståhl, A. (2003). Accessibility, usability and universal design– positioning and definition of concepts describing person–environment relationships. *Disability and Rehabilitation*, 25(2), 57-66.
- Karmarkar, A. M., Dicianno, B. E., Graham, J. E., Cooper, R., Kelleher, A., & Cooper, R. A. (2012). Factors associated with provision of wheelchairs in older adults. *Assistive Technology*, 24(3), 155-167.
- Kazdin, A. E. (2003). *Research design in clinical psychology*. Boston, MA: Allyn and Bacon.
- Kielhofner, G. (2007). *Model of human occupation : Theory and application*. Baltimore, MD: Lippincott Williams & Wilkins.
- Kolomainen, U. (2003). *Sähköisten liikkumisapuvälineiden myöntämiskäytännöt sairaanhoitopiireissä*. [Provision practices of powered mobility devices in Finnish hospital districts]. Jyväskylä: University of Jyväskylä.
- Krueger, R. A., & Casey, M. A. (2009). *Focus groups : a practical guide for applied research*. Thousand Oaks, CA: SAGE Publications.
- Larsson Lund, M., Fisher, A. G., Lexell, J., & Bernspång, B. (2007). Impact on participation and autonomy questionnaire: internal scale validity of the Swedish version for use in people with spinal cord injury. *Journal of Rehabilitation Medicine*, 39(2), 156-162.
- Larsson Lund, M., Nordlund, A., Bernspång, B., & Lexell, J. (2007). Perceived participation and problems in participation are determinants of life satisfaction in people with spinal cord injury. *Disability and Rehabilitation*, 29(18), 1417-1422.

- Larsson Lund, M., & Lexell, J. (2009). Associations between perceptions of environmental barriers and participation in persons with late effects of polio. *Scandinavian Journal of Occupational Therapy*, 16(4), 194-204.
- Law, M. (2002). Distinguished scholar lecture. Participation in the occupations of everyday life. *The American Journal of Occupational Therapy*, 56(6), 640-649.
- Lawton, M., & Nahemow, L. (1973). *Ecology and the aging process*. In C Eisdorfer, MP Lawton (Eds.), *The psychology of adult development and ageing*. Washington DC: American Psychological Association.
- Lenker, J. A., Scherer, M. J., Fuhrer, M. J., Jutai, J. W., & DeRuyter, F. (2005). Psychometric and administrative properties of measures used in assistive technology device outcomes research. *Assistive Technology*, 17(1), 7-22.
- Lexell, J., Jörgensen, S., Norin, L., & Iwarsson, S. (2014). The Swedish Aging with a Spinal Cord Injury Study (SASCIS): Study Protocol for a Longitudinal Cohort Survey. Manuscript in preparation.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: SAGE publications.
- Lysack, C., Komanecky, M., Kabel, A., Cross, K., & Neufeld, S. (2007). Environmental factors and their role in community integration after spinal cord injury. *Canadian Journal of Occupational Therapy*, 74(5), 243-254.
- Löfqvist, C., Nygren, C., Brandt, A., & Iwarsson, S. (2009). Very old Swedish women's experiences of mobility devices in everyday occupation: A longitudinal case study. *Scandinavian Journal of Occupational Therapy*, 16(3), 181-192.
- Malmgren Fänge, A., Lindberg, K., & Iwarsson, S. (2013). Housing adaptations from the perspectives of Swedish occupational therapists. *Scandinavian Journal of Occupational Therapy*, 20(3), 228-240.
- May, E., Garrett, R., & Ballantyne, A. (2010). Being mobile: electric mobility-scooters and their use by older people. *Ageing and Society*, 30(07), 1219-1237.
- May, M., & Rugg, S. (2010). Electrically powered indoor/outdoor wheelchairs: Recipients' views of their effects on occupational performance and quality of life. *British Journal of Occupational Therapy*, 73(1), 2-12.
- McMillen, A.-M., & Söderberg, S. (2002). Disabled persons' experience of dependence on assistive devices. *Scandinavian Journal of Occupational Therapy*, 9(4), 176-183.
- Mollenkopf, H., Marcellini, F., Ruoppila, I., Széman, Z., Tacke, M., & Wahl, H.-W. (2004). Social and behavioural science perspectives on out-of-home mobility in later life: Findings from the European project MOBILATE. *European Journal of Ageing*, 1(1), 45-53.

- Mortenson, W. B., Clarke, L. H., & Best, K. (2013). Prescribers' experiences with powered mobility prescription among older adults. *The American Journal of Occupational Therapy*, 67(1), 100-107.
- Njelesani, J., Tang, A., Jonsson, H., & Polatajko, H. (2014). Articulating an occupational perspective. *Journal of Occupational Science*, 21(2), 226-235.
- Norwegian Labour and Welfare Service (2013). Statistics produced by the department of assistive technology NAV. Available from: NAV Oslo, Norway.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods*. London: SAGE Publications.
- Pettersson, I., Lilja, M., Hammel, J., & Kottorp, A. (2008). Impact of home modification services on ability in everyday life for people ageing with disabilities. *Journal of Rehabilitation Medicine*, 40(4), 253-260.
- Pettersson, C., Jörgensen, S., Mårtensson, L., Lexell, J., Slaug, B., & Iwarsson, S. (2013). Mobility Device Use and Exploration of Housing Accessibility for Powered Mobility Device Users among People Ageing with Spinal Cord Injury. *Assistive Technology: From Research to Practice: AAATE 2013*, 33, 226-231.
- Pettersson, I., Törnquist, K., & Ahlström, G. (2006). The effect of an outdoor powered wheelchair on activity and participation in users with stroke. *Disability and Rehabilitation: Assistive Technology*, 1(4), 235-243.
- Pettersson, I., Ahlström, G., & Törnquist, K. (2007). The value of an outdoor powered wheelchair with regard to the quality of life of persons with stroke: A follow-up study. *Assistive Technology*, 19(3), 143-153.
- Pettersson, I., Appelros, P., & Ahlström, G. (2007). Lifeworld perspectives utilizing assistive devices: individuals, lived experience following a stroke. *Canadian Journal of Occupational Therapy*, 74(1), 15-26.
- Polgar, J. (2011). Enabling community mobility is an opportunity to practice social occupational therapy. *Canadian Journal of Occupational Therapy*, 78(2), 67-71.
- Radomski, M. V., & Latham, C. A. T. (2008). *Occupational Therapy for Physical Dysfunction*. Baltimore: Lippincott Williams & Wilkins.
- Rantakokko, M., Tormakangas, T., Rantanen, T., Haak, M., & Iwarsson, S. (2013). Environmental barriers, person-environment fit and mortality among community-dwelling very old people. *BMC Public Health*, 13(1), 783-780.
- Reid, D., Angus, J., McKeever, P., & Miller, K.-L. (2003). Home is where their wheels are: Experiences of women wheelchair users. *The American Journal of Occupational Therapy*, 57(2), 186-195.
- Reid, D. (2004). Accessibility and usability of the physical housing environment of seniors with stroke. *International Journal of Rehabilitation Research*, 27(3), 203-208.

- Rockwood, K. (2012). Making mobility-related disability better: a complex response to a complex problem. *BMC Medicine*, 10:121-123.
- Rosenkvist, J. (2008). *Mobility in public environments and use of public transport : Exploring the situation for people with acquired cognitive functional limitations*. (Doctoral dissertation). Department of Technology and Society, Lund Institute of Technology, Lund, Sweden.
- Rousseau-Harrison, K., Rochette, A., Routhier, F., Dessureault, D., Thibault, F., & Côté, O. (2009). Impact of wheelchair acquisition on social participation. *Disability and Rehabilitation: Assistive Technology*, 4(5), 344-352.
- Salminen, A. L., Brandt, Å., Samuelsson, K., Töytäri, O., & Malmivaara, A. (2009). Mobility devices to promote activity and participation: a systematic review. *Journal of Rehabilitation and Medicine*, 41(9), 697-706.
- Samuelsson, K., & Wressle, E. (2014). Powered wheelchairs and scooters for outdoor mobility: a pilot study on costs and benefits. *Disability and Rehabilitation: Assistive Technology*, 9(4), 330-334.
- Scherer, M. J., & Glueckauf, R. (2005). Assessing the benefits of assistive technologies for activities and participation. *Rehabilitation Psychology*, 50(2), 132-141.
- Skymne, C., Dahlin Ivanoff, S., Claesson, L., & Eklund, K. (2012). Getting used to assistive devices: ambivalent experiences by frail elderly persons. *Scandinavian Journal of Occupational Therapy*, 19(2), 194-203.
- Slaug, B., & Iwarsson, S. (2010). Housing Enabler 2.0: A tool for housing accessibility analysis. Software for PC. Staffanstorp and Lund, Sweden: Slaug Enabling Development and Vetén & Skapen.
- Sonn, U., & Åsberg, K. H. (1991). Assessment of activities of daily living in the elderly. A study of a population of 76-year-olds in Gothenburg, Sweden. *Scandinavian Journal of Rehabilitation Medicine*, 23(4), 193-202.
- SOSFS (2008:1). *Socialstyrelsens föreskrifter om användning av medicintekniska produkter i hälso- och sjukvården*. [The Swedish National Board of Health and Welfare's Regulations concerning the Use of Medical Devices in Healthcare]. Stockholm: Swedish National Board of Health and Welfare.
- SFS 1982:763. *Hälso och sjukvårdslag* [Swedish Health and Medical Services Act]. Stockholm: Swedish Ministry of Health and Social Affairs.
- SFS 1992:1574. *Lag om bostadsanpassningsbidrag m.m.* [Swedish Act concerning Housing Adaptation Grants etc.]. Stockholm: Swedish Ministry of Health and Social Affairs.
- SFS 1998:204. *Personuppgiftslag* [Swedish Personal Data Act]. Stockholm: Swedish Ministry of Justice.

- SFS 2003:460. *Lag om etikprövning av forskning som avser människor* [Swedish Act concerning the Ethical Review of Research Involving Humans]. Stockholm: Swedish Ministry of Education and Research.
- SFS 2010:900. *Plan och bygglag* [The Swedish Planning and Building Act]. Stockholm: Swedish Ministry of Health and Social Affairs.
- Swedish Institute of Assistive Technology. (2010). *Äldrestatistik 2010: Äldres hälsa, funktionsnedsättning, boende och hjälpmedel* [Statistics concerning older people 2010: Older people's health, disability, housing and assistive devices]. Vällingby: Swedish Institute of Assistive Technology.
- Swedish Institute of Assistive Technology. (2011). *Statistik om hjälpmedel för förflyttning och kognition: Inköpskostnader och förskrivningar 2010* [Statistics concerning assistive devices for mobility and cognition: Purchasing costs and prescriptions 2010]. Vällingby: Swedish Institute of Assistive Technology.
- Tamaru, A., McColl, M. A., & Yamasaki, S. (2007). Understanding 'Independence': Perspectives of occupational therapists. *Disability and Rehabilitation*, 29(13), 1021-1033.
- Torkia, C., Reid, D., Korner-Bitensky, N., Kairy, D., Rushton, P. W., Demers, L., & Archambault, P. S. (2014). Power wheelchair driving challenges in the community: a users' perspective. *Disability and Rehabilitation: Assistive Technology*, Early Online: 1-5. DOI: 10.3109/17483107.2014.898159
- Townsend, E. A. (2002). *Enabling occupation : An occupational therapy perspective*. Ottawa: Canadian Association of Occupational Therapists.
- Townsend, E. A., & Polatajko, H. J. (2007). *Enabling occupation II : Advancing an occupational therapy vision for health, well-being and justice through occupation*. Ottawa: CAOT Publications ACE.
- United Nations (2007). *Convention on the Rights of Persons with Disabilities*. New York.
- Unsworth, C. A. (2012). Community mobility promotes participation for people of all ages and abilities. *Australian Occupational Therapy Journal*, 59(1), 1.
- van de Ven, L., Post, M., de Witte, L., & van den Heuvel, W. (2008). Strategies for autonomy used by people with cervical spinal cord injury: A qualitative study. *Disability and Rehabilitation*, 30(4), 249-260.
- Wang, R. H., Holliday, P. J., & Fernie, G. R. (2009). Power mobility for a nursing home resident with dementia. *The American Journal of Occupational Therapy*, 63(6), 765-771.
- World Health Organization (WHO) (2001). *International classification of functioning, disability and health*. Geneva: World Health Organization.
- World Health Organization (WHO) (2008). *Guidelines on the provision of manual wheelchairs in less resourced settings*. Geneva: World Health Organization.

World Medical Association (2001). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *Bulletin of the World Health Organization*, 79(4), 373.

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