Powered Mobility Devices in a Nordic Context: Service Delivery, Effectiveness and Methodological Development

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The overarching aim of this thesis was to contribute to the methodological development in the field of assistive technology and to generate knowledge about the service delivery process and outcomes of powered wheelchair and powered scooter (hereafter denoted powered mobility devices) interventions in Nordic context. The thesis is based on four studies, of which two focus on psychometric testing of two instruments: the User Satisfaction with Assistive Technology Services (SATS) (test-retest reliability and agreement) and the Nordic Mobility Related Outcome Evaluation of Assistive Device Intervention (NOMO 1.0) (test-retest reliability and agreement, construct validity). In the third study effectiveness in terms of mobility-related participation in a sample of users of powered mobility devices was investigated, while in the fourth study we focused on documentation of the service delivery process and user satisfaction with the process among users of powered scooters. The informants were adult, first time users of powered mobility devices from Denmark, Finland and Norway, who were interviewed up to four times during a one year period, using the NOMO 1.0, the SATS and study-specific questionnaires (Paper 1). The main contribution of the methodological studies was that the reliability of the SATS (Paper 1) and NOMO 1.0 (Paper 2) was acceptable, with values mostly above the recommended levels for the psychometric properties investigated. Both instruments can be reliably administered in interviews with powered mobility device users, though the SATS needs revision. The results of the third study identified that powered mobility devices contribute to mobility-related participation by making participation aspects easier for people using such devices. Buying groceries and going for a walk/ride increased in frequency, and men, scooter users, and users with poor self-reported health seemed to benefit most from the use of the devices. The fourth study revealed that the user satisfaction with the service delivery process was high. Also, it showed that more time was spent on assessments, administration in the Danish compared with the Norwegian sample. Also, the total time spent on the service delivery process in the two samples was larger in the Danish compared to the Norwegian sample. There was no association between time spent on steps of the process and user satisfaction. In summary, the results have implications for practises involving provision of powered mobility devices. This thesis furthermore contributes with new knowledge about the psychometric properties of the SATS and NOMO 1.0 constituting an important foundation for assessments within the field of assistive technology. Also, the new knowledge about the service delivery process and effectiveness of powered mobility devices use presented is of importance for politicians, policy-makers and professionals within the field.

Key words: agreement, independence, mobility, mobility-related participation, participation, powered scooter, powered wheelchair, reliability, user satisfaction, validity

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Paper 3: Sund T, Iwarsson S, Anttila H, Brandt Å. (2014). Effectiveness of powered mobility devices in the community in terms of mobility-related participation: a prospective study among people with mobility restrictions. *Re-submitted after revision*.

Paper 4: Sund T, Iwarsson S, Andersen MC, Brandt Å. (2013). Documentation of and satisfaction with the service delivery process of electric powered scooters among adult users in different national contexts. *Disability and Rehabilitation: Assistive Technology,* 8, 151-160.

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Definitions

Activity is the execution of a task or action by an individual (World Health Organization WHO, 2001).

Activity limitations are difficulties and individual may have in executing activities (World Health Organization WHO, 2001).

Assistive device denote any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities (Cook, Polgar, et al. 2008).

Assistive device intervention means to intervene, i.e. to come between (others) (Hornby, Gatenby et al. 1963). In the present thesis this includes for example the actions taken by professionals, in cooperation with the users, with regards to services associated with assistive device acquisition and training (Fuhrer, Jutai et al., 2003; Lenker, Schoemaker et al., 2012).

Assistive technology refers to a broad range of devices, services, strategies, and practices that are applied to solve the problems faced by individuals who have disabilities (Cook, Polgar, et al. 2008).

Effectiveness is understood as the degree of impact an assistive device has on the user's ability to function in daily life, and activity and participation can be considered an effectiveness dimension (Jutai, Demers et al., 2005; Brandt, Samuelsson et al., 2011).

Environment means the physical and social surroundings in terms of indoor/outdoor and public/private environments. Assistive devices and the service delivery systems are part of the environment (World Health Organization WHO, 2001). The *environment* has many dimensions of which the physical and social dimensions are targeted in this thesis. Further, the environment can be divided into micro, meso and macro levels (Kapiriri, Norheim, et al. 2007). For example, for the assistive technology service delivery systems the macro-level decision makers set the context for priority setting for the meso-, and micro-levels. The meso-level decides different county/local programs and follow-up that decisions made at the macro-level are implemented at the meso- and micro levels. The micro level is responsible for the services at the local level.

Impairments are problems in body function or structure such as significant deviation or loss or abnormality of psychological, physical, or anatomical structure or function (World Health Organization WHO, 2001; Cook, Polgar, et al. 2008).

Mobility is referred to as 'moving by changing body position or location or by transferring from one place to another, by carrying, moving or manipulating objects, by walking, running or climbing, and by using various forms of transportation' (World Health Organization WHO, 2001 page 138). Further, mobility refers to any movements that lead to a change in position or location by one's own means performed with or without technical assistance (Routhier, Vincent, et al. 2003). Mobility in this sense is considered as an activity in itself. In this thesis mobility by means of a powered mobility device is focused.

Mobility-related participation is participation involving mobility (Brandt, 2005). See *mobility* above.

Mobility devices refer to assistive devices designed to compensate for mobility restrictions. See *mobility* above.

Outcomes research can be defined as the systematic study of the effects produced by assistive devices in the lives of users and their environment ICF (Jutai, Demers, et al., 2005).

Participation is involvement in a life situation, and can be defined as taking part, being included or engaged in an area of life, being accepted, or having access to needed resources (World Health Organization WHO, 2001).

Powered mobility device is a term which includes motor driven wheelchairs with a tiller-type control to steer the wheelchair (scooters) or joystick (powered wheelchairs) steering (Cook, Polgar, et al. 2008; International standard ISO 9999, 2011).

Powered wheelchair refers to a wheeled mobility base with a power drive to the wheels, a control interface that the individual uses to direct the movement of the wheelchair, an electronic controller, and power accessories (e.g. recline, tilt) (Cook, Polgar, et al. 2008).

Reliability is defined as the degree to which the assessment is free from assessment error (Mokkink, Tewee et al. 2010). Studying groups of people as in this thesis, reliability can also be seen as the ability to differentiate between subjects and is defined as the ratio of variability between subjects to the total variability of all measurements in the sample (Streiner and Norman, 2008).

Scooter is a powered wheelchair design featuring three or four wheels, a tiller steering system, and a bucket mounted on a single post coming up from the base (Cook, Polgar, et al. 2008).

Service delivery process is the process of assisting the individual in the selection, acquisition or use of an assistive device (Cook, Polgar, et al. 2008).

Users refers to people who already use a powered mobility device or who can benefit from using one because their ability to walk is restricted (World Health Organization WHO, 2008). This thesis includes adult users.

User satisfaction is referred to as being pleased or content (Hornby, Gatenby, et al., 1963). In the field of assistive technology, user satisfaction means the user's critical evaluation of different aspects of assistive devices and related service delivery processes, which is influenced by individual expectations, perceptions, attitudes and personal values (Demers, Weiss-Lambrou, et al., 2000).

Validity refers to the degree to which an instrument truly assesses the construct(s) it purports to assess, and whether an instrument describes the intended quality and to what extent (Mokkink, Tewee, et al., 2010).

Preface

Assistive technology is my field of interest as I work for a central unit within the Norwegian Labour and Welfare Service, which has the administrative, economic and professional responsibility for all 18 assistive technology centres in Norway, one located in each county. The central unit has the responsibility to coordinate and follow-up the activities of the assistive technology centres in the country. The assistive technology centres in Norway are resource centres serving the whole county in the field of assistive technology. They give advice and guidance to the local authorities and other partners in the county, in addition to buying and distributing the assistive devices to the municipalities. The assistive technology centres are also responsible for the service and repairs of the assistive devices. It is my job to assist the assistive technology centres in such a way that they have the necessary finances, professionals, and tools to work with their users in a good and functional manner. Follow-up interviews with some of the employees with the objective to improve the services has been part of my work, as well as planning and conducting user surveys within the field of assistive technology in Norway.

The work with this thesis started in 2002 when I was the Norwegian representative in a Nordic interdisciplinary project involving all the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. The project was targeted towards constructing an instrument to assess effectiveness of mobility assistive devices, in terms of mobility-related participation. The project was co-ordinated by the Danish Centre of Assistive Technology (Dr. Å. Brandt), and Lund University (Prof. S. Iwarsson) had the scientific responsibility for the project. In the beginning of 2009, the Nordic Mobility Related Outcome Evaluation of Assistive Device Intervention (NOMO 1.0) was constructed and translated into four Nordic languages. A manual in all five languages was also developed.

After the construction of the instrument, there was a need for empirical testing, and discussions and planning of *The Nordic Powered Mobility Device Project* began. The aims of this project was to test and further develop the NOMO 1.0 and to evaluate the effectiveness of powered wheelchair and scooter interventions regarding mobility, participation, quality of life, user satisfaction, and costs, in addition to investigate what takes place in the service delivery process. It was also decided to conduct psychometric testing of the Satisfaction with the Assistive Technology Services (SATS) instrument.

Partners in Denmark, Norway and Finland participated, and this thesis is based on data collected within the project. Finland entered the project one year later than the other two countries.

As the author of this thesis I have taken an active part throughout the research process. Being an experienced physiotherapist has been a great advantage for me as I have been working for many years within the field of rehabilitation and assistive technology. My background, involving experiences with assistive device interventions, has been advantageous and facilitated the collaboration with user groups as well as with Nordic colleagues. All in all, this has contributed to a more profound understanding of the phenomena under study. My physiotherapy background has of course characterised my interpretations of the results, however working in an interdisciplinary research team and research centre have brought about different perspectives and enriched the research process.

Introduction

Mobility is basic and necessary – usually a prerequisite - for carrying out activities and participating in society (Cook, Polgar et al., 2008). Activity and participation in daily life is important for health and well-being, and the ability to perform activities is important to an individual's functioning in daily life (World Health Organization WHO and The World Bank, 2011). Every individual should have the opportunity to participate in society, spend time with other people, and fulfil social roles of their choice and as expected by others (United Nations, 2006). Impairments can result in disabilities that, when combined with environmental barriers and personal factors, can reduce participation in home and community activities (World Health Organization WHO, 2001). Assistive devices can increase mobility and independence through reducing the effects of disability and facilitate the performance of activities in daily life (World Health Organization WHO, 2001; United Nations, 2006; Cook, Polgar et al., 2008).

Wheelchairs are examples of assistive devices which may increase the user's mobility and thus enable him/her to perform daily activities and to participate in society (Field, 1999; Routhier, Vincent et al., 2003; Woods, 2003; Brandt, Iwarsson et al., 2004; Cook, Polgar et al., 2008; World Health Organization WHO, 2008). The user group in focus in this thesis are users of powered wheelchairs and/or scooters (hereafter denoted powered mobility devices) in a Nordic context, more specifically, in Denmark, Finland and Norway.

More than one billion people in the world are living with some form of disability, of those nearly 200 million experience considerable difficulties in functioning. In the years to come, disability will be an even greater concern because its prevalence is on the rise. This is due to an ageing population and the higher risk of disability in older people as they often experience decreased functional capacity and increased difficulty in mobility and hence difficulty in performing activities in daily life (World Health Organization WHO and The World Bank, 2011). Access to powered mobility devices is therefore an important issue for persons with disabilities, and the demand for such devices is expected to increase in the future.

The cost of powered mobility devices varies between different countries. For example, in Norway in 2013, 6.10 Euros per inhabitant were spent on powered mobility devices (The Norwegian Labour and Welfare Service NAV, 2014). Since many resources are

being spent on these devices there is a need to know the outcomes of these interventions. Moreover, as public and private funding begin to demand evidence of effectiveness to support their provision, knowledge about their effectiveness is required (Fuhrer, 2007; Cooper, Cooper et al., 2008). In order to use the resources efficiently, knowledge is required to provide evidence of the long-term effects of powered mobility devices (Evans, Frank et al., 2007; Auger, Demers et al., 2010; Löfqvist, Petterson et al., 2012; Samuelsson and Wressle, 2014). Moreover, knowledge is needed about how and where the powered mobility devices are being used, how frequently they are used, and who benefit most from using the powered mobility devices (Evans, Frank, et al., 2007; Cooper, Cooper, et al., 2008).

Since every country determines their policy and organisation of the services, variations in the structure and the service delivery process are expected within the field of powered mobility devices as shown by Kylberg, Löfqvist, et al. (2014). Knowledge about what goes on in the service delivery process and whether structural differences influence the process would help in identifying the optimum way to organise the services. Feedback from the users in terms of their satisfaction with the services provided is important in this context (Lenker, Scherer, et al., 2005). In order to generate necessary knowledge, assessment instruments of high quality are needed (Lenker, Scherer, et al., 2005).

Mobility as a prerequisite for activity and participation

Mobility is fundamental to enable daily activities that are required in the various areas of daily life, such as personal care, work, education, leisure and play (Cook, Polgar et al, 2008). There may be a gap between people's mobility and their needs and wishes. Furthermore, people who cannot be mobile may have problems carrying out daily activities without help from others. These problems can create a vicious circle of immobility, where being passiveness negatively influences health and leads to isolation and more passivity, and eventually increased mobility restrictions (Marcellini, Gagliardi, et al., 2004).

The aspect of mobility in focus in this thesis is mobility in daily life. Mobility in this sense is often perceived as synonymous with using various modes of transport (Rosenkvist, 2008), while in this thesis mobility refers to moving around or from one point to another by means of powered mobility devices (Brandt, Löfqvist, et al., 2009).

There are many causes of mobility restrictions. Problems in mobility can be brought about by disease, trauma or ageing (Routhier, Vincent, et al., 2003). Disorders that result in such restrictions may be neurological, musculoskeletal, or cognitive. The onset of a disorder, whether it is acquired or congenital, also affects the individual's mobility needs (Cook, Polgar et al., 2008). According to Kaye et al (2002) individuals who have

sustained a cerebral vascular accident constitute the main group of mobility device users (Kaye, Kang et al., 2002). Also people with orthopaedic or rheumatic conditions account for another large group of mobility device users. In a cross-sectional study among users of powered wheelchairs of all ages, Frank et al. (2013) found that neurologic/neuromuscular conditions predominated (81%). Conditions presenting at birth or during childhood constituted 39 per cent of the cases (Frank and De Souza, 2013). Impairments may cause muscle weakness or joint stiffness, making it difficult for the individuals to move about on their own and hence causing mobility restrictions. Available Nordic statistics stated that in 2013 in all 33 per cent of the powered mobility devices were provided to users aged 50-70 years in Norway, while users older than 70 years constituted 27 per cent. Women received 65 per cent of the powered mobility devices that year (The Norwegian Labour and Welfare Service NAV, 2014).

Powered mobility devices may enable individuals to overcome the mobility restrictions. Therefore, it is important to know whether the devices have the wanted effects and contribute to mobility, and to what extent the powered mobility devices solve the users' mobility problems. Consequently, subsequent research within this field is important in order to generate knowledge about the effects of powered mobility devices on the users' lives (Jutai, Demers, et al., 2005).

Disability, activity and participation

Disability can be defined as the gap between a person's capabilities and the demand made by the social and physical environment (World Health Organization WHO, 2001; Jette, 2006). Thus, disability is not seen as characteristics or attributes of a person, but rather as a product of the interaction between a person and the environment (Lie, 1997; Wenneberg, 2009). The gap made by the imbalance in this interaction can be overcome, at least to a certain extent, by means of assistive devices, such as powered mobility devices (The Norwegian Labour and Welfare Service NAV, 2001).

The domains of the International Classification of Functioning, Disability and Health (ICF) can be seen as health domains and health related components of well-being. Disability is an umbrella term for impairments, activity limitations and participation restrictions. The participation component is qualified by one's performance, which means what an individual does in his or her current environment (World Health Organization WHO 2001).

The definition of participation brings in the concept of involvement in terms of *taking part, being included or engaged in an area of life, being accepted, or having access to needed resources* (World Health Organization WHO, 2001 page 15). In this thesis the focus is on participation involving mobility, referred to as mobility-related participation

(Brandt, Iwarsson et al., 2004; Brandt, 2005). One of the aims of powered mobility device interventions is to reduce disability and to maximize a person's function, as well as to allow an expansion of participation in various life roles (World Health Organization WHO, 2001). Consequently, it is important to investigate to what extent this is achieved.

Environmental factors have an impact on all components of functioning and encompass individual environmental factors, services, and systems, including service delivery systems of assistive devices. Powered mobility devices are also included in the category of environmental factors. (World Health Organization WHO, 2001; Wressle and Samuelsson, 2004). Even if environmental factors are considered to influence the effectiveness of powered mobility devices, a search in the CINAHL, Pubmed and Cochrane databases did not identify any articles describing how different services affect the effectiveness of powered mobility devices. Consequently, we do not know how the services should be organized and delivered in order to obtain the most positive effects. Knowledge about time use in the service delivery process, for example, would help to identify the most optimal way to organise the services, which in turn would help the authorities to prioritise resources and the professionals to improve the service delivery processes. Therefore, it is of interest to investigate what goes on and which actors are involved in the service delivery process of powered mobility devices.

Assistive devices - assistive technology

Assistive technology is an umbrella term that refers to a broad range of assistive devices, services, strategies and practises that are conceived and applied to ameliorate the problems faced by individuals with disabilities (Cook, Polgar et al., 2008).

An assistive device is defined as any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities (Cook, Polgar et al., 2008). An assistive device is regarded to be a facilitator that can improve mobility, functioning and reduce disability for people with disabilities (World Health Organization WHO 2001). According to Cook, Polgar et al. (2008), functional outcomes are the only real measure of success of assistive devices. For that reason, it is important to have knowledge about the effectiveness of devices like powered mobility devices. Further, Cook, Polgar et al. (2008) focus on individuals with disabilities, which underscores the importance of treating each application of powered mobility devices as unique. Consequently, it is also important to get feedback from individual users on how they appraise the effects of the powered mobility devices and the related service delivery process.

The provision of assistive devices is considered to be of great importance, and the United Nations (UN) (United Nations, 1994) and the World Health Organization (WHO) (World Health Organization WHO and The World Bank, 2011) recommend assistive devices as important tools in creating equal opportunities for people with disabilities, and urge the member states to establish services to facilitate access to appropriate affordable assistive devices to people who need them (United Nations, 1994; WHO, 2005; United Nations, 2006; United Nations, 2013).

Powered mobility devices

By definition a *wheelchair* is a chair with a backrest mounted on wheels, which allows people with mobility restrictions to move around (Blouin and Bergeron, 1997; Routhier, Vincent et al., 2003). According to the international standard ISO 9999:2007 powered wheelchairs are intended to provide wheeled mobility and body support for persons with limited ability to walk (International standard ISO 9999, 2011). The standard divides powered wheelchairs into four categories: 1) electric-motor-driven wheelchairs with manual steering (scooters), i.e. wheelchairs powered by electricity, with control of direction (steering) by mechanically changing the orientation of the pivot drive wheel(s) without powered assistance; 2) electric-motor-driven wheelchairs with powered steering, i.e. wheelchairs powered by electricity, with powered control of direction; 3) combustion-motor-driven wheelchairs, i.e. wheelchairs powered by a combustion engine; and 4) attendant-controlled powered wheelchairs, i.e. wheelchairs powered by electricity, designed to be operated by an attendant. Wheelchairs from the first two categories are included in this thesis.

Powered wheelchairs can be further divided into three groups: wheelchairs for indoor use, wheelchairs for mixed use (i.e. indoor and outdoor) and wheelchairs for outdoor use (Attali and Pelisse, 2001). Wheelchairs from all the three categories are represented in this thesis. Scooters are designed for persons with limited walking ability, while powered wheelchairs are usually provided to persons with more severe impairments (Cooper, Thorman et al., 2002).

Powered mobility is understood to be the ability to move around in a self-propelled wheelchair and overcome obstacles encountered when carrying out daily activities or social roles such as preparing meals, shopping, washing oneself, studying and participating in leisure activities or in the community (Routhier, Vincent, et al., 2003). Powered mobility requires being able to move the device and use its accessories, such as the brakes or controls in a safe way (Cook, Polgar, et al., 2008).

The first powered wheelchairs were produced early in the 20th century. Although the technology was present, the innovation was dependent on three important factors before it became meaningful. These were the development in antibiotics (the penicillin was discovered in 1929), expansion of rehabilitation services in the 1940s, and the

growth of a disability movement (particularly after World War II). Since then numerous producers have put in a good deal of effort in developing and improving the wheelchairs. Today, there is a great variety in brands and functions of powered mobility devices (Woods, 2003).

For example, in Norway in 2013, a total of 2,372 powered wheelchairs and 1,769 scooters were provided, which is equivalent to 4.7 powered wheelchairs and 3.5 scooters per 10,000 inhabitants (The Norwegian Labour and Welfare Service NAV, 2014). According to the United States Census in 2010, there were 3.6 million wheelchair users over the age of 15 (Bureau, 2010). Approximately 30 per cent of the wheelchairs are powered mobility devices (Flagg, 2009).

From a participation and social integration standpoint, the main objective when recommending a powered mobility device is to select the wheelchair that best allows users to carry out their daily activities. A good match between the user and the device is essential (Scherer and Graddock, 2002). If this match is successfully achieved, the provider (in Nordic countries most often an occupational therapist or a physiotherapist) must be aware of the different factors that influence powered mobility performance. According to Routhier, et al. (2003) these factors are: the user him/herself, the wheelchair, the environment, the daily activities and social roles, and the assessment and training received. A good understanding of these factors optimize participation of powered mobility device users (Routhier, Vincent et al., 2003). The different steps of the service delivery process are important in order to achieve this (Cook, Polgar, et al., 2008).

The Donabedian's conceptual model for quality assessment

Conceptual models provide a theoretical basis for advancing scientific knowledge and improving professional practise (Lenker and Paquet, 2003). Edyburn (2002) stated that models help practitioners and researchers to understand key variables, relationships, and systems that stimulate advancements in theory, research and development, policy and practise. Within assistive technology research, a conceptual model can provide a framework for classifying areas of inquiry and for developing predictive models of utilization patterns (Gitlin, 1998; Light, 1999). Further, a conceptual model can provide evaluating design alternatives and predict users performance (Stanney and Maxey, 1997).

The Donabedian model is a conceptual model for quality assurance, incorporating three key components: *structure of care*, *process of care* and *outcome of care* (Donabedian, 1988). Based on Donabedian's own experiences and according to a literature review

within stroke rehabilitation there is a key relationship between these components. That is, structure predicted both process and outcome of care, and better processes predicted better functional outcomes and user satisfaction (Donabedian, 2003; Hoenig, Lee et al., 2010).

According to Donabedian (2003), *structure of care* refers to certain attributes of the setting in which care occurs, including material resources, human resources, and organizational structure. *Structure of care* refers to more than health care, as Donabedian have broadened the scope to include other services, for example rehabilitation services (Donabedian, 2003).

The *process of care* refers to what is actually done during giving and receiving care, and includes different services as long as they pertain to the performance of the professionals as they care for the user, for example the service delivery process of powered mobility devices. *Outcome of care* includes the end result of particular health care practises (Donabedian, 1988).

Assistive technology is usually not denoted as *care*. However, as the assistive technology is an important part of rehabilitation services, the model may be applicable for the field of assistive technology. A relevant question for this thesis is whether this relationship between *structure of care, process of care* and *outcome of care* is applicable for the field of powered mobility devices in a Nordic context. See figure 1.

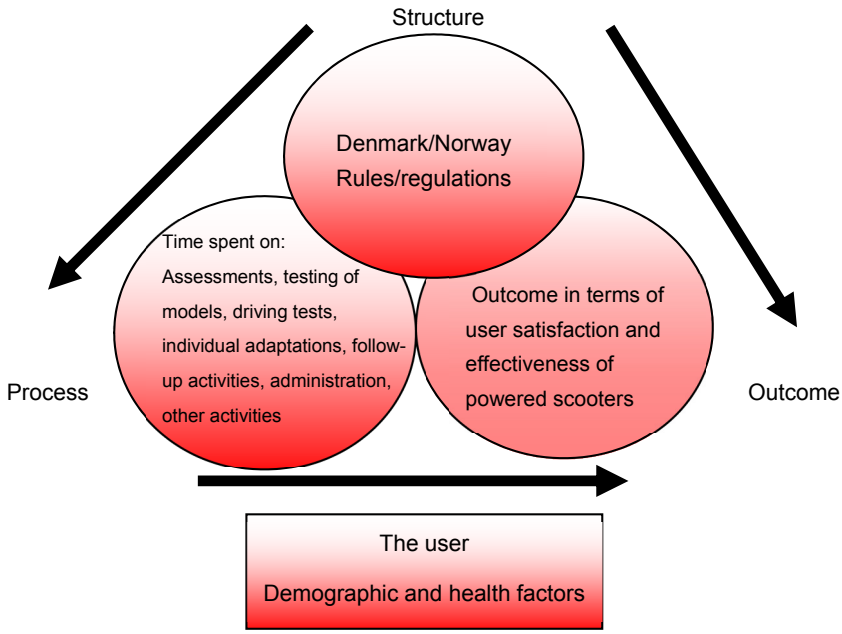

Figure 1.

The relationship between structure, process and outcome in the context of assistive technology, as inspired by Donabedian (Donabedian, 2003) and Hoenig (Hoenig, Lee et al., 2010).

Structure of assistive device services

The structure of a field includes its policies and systems (Donabedian, 2003). The policies of the health and social services in the Nordic countries are based on a common set of basic values. The countries may not all approach welfare provision in exactly the same way, but the similarities between the countries are sufficient enough to constitute a recognizable *Nordic welfare model.* This model is based on values of equal opportunities, social solidarity and security for all (Greve, 2007). Provision of assistive devices like powered mobility devices is part of the Nordic welfare model. Even so, there are differences in the way the services are organized and some of the regulations are different. Recent research has identified differences between other countries. For instance, in spite of similarities in assistive technology legislation and policy between Sweden and Latvia, there are marked differences in the availability of assistive devices, and how, for and by whom the devices were provided. In short, the interpretation of the laws is different in the two countries (Kylberg, Löfqvist, et al. 2014).

Rehabilitation services comprise of certain conditions under which they are provided (Donabedian, 2003). The services include services and programs at a local/community, regional, state or national level, aimed at delivering interventions to individuals for their physical, psychological and social well-being in settings. Examples are services that are delivered on a short-term, long-term, periodic or one-time basis, in a variety of setting, such as community, home-based, school, and work settings, as well as hospitals, clinics. The services also include the personnel who provide these services (World Health Organization WHO, 2001).

Rehabilitation systems include administrative control and monitoring mechanisms that govern the range of services provided to individuals for their physical, psychological and social well-being in settings like those above. The systems include *implementing regulations and standards that determine eligibility for services, provision of devices, assistive technology or other adapted equipment, and legislation such as health acts that govern features of a health system such as accessibility, universality, public funding and comprehensiveness* (World Health Organization WHO, 2001 page 203). In some countries, assistive technology is organized as part of the health care system, while in others as part of the social system. Also in some countries, some of the assistive technology services are dependent on private funding. This means that the regulations and how the services are organized may differ between countries. In most countries the services and the assistive devices are funded from numerous sources rather than from one system that have the overall responsibility for the funding of assistive technology (Cook, Polgar et al., 2008).

As the demand for powered mobility devices will increase in the future (Deloitte and Touche, 2003), effective service delivery systems are required in order to make assistive device provision affordable (World Health Organization WHO and The World Bank, 2011). Consequently, it would be interesting to know how different structures influence the processes and the outcomes of them.

Provision of powered mobility devices in Denmark, Finland and Norway

Based on individual rights, the provision of assistive devices is covered by the terms of the Social Services Act in Denmark, the Health Care Act in Finland, and the Act on Social Security in Norway. In all three countries, assistive devices are provided to people whose functional capacity is permanently impaired due to illness or injury. In addition, the assistive devices must be deemed necessary and appropriate with regard to improving the user's ability to be independent in performing activities in daily life. The policy in all three countries aims at providing the most suitable yet cheapest assistive device, free of charge for the user. There is one exception, however; in Denmark from 2008, depending on the individual functional ability, users are given a grant for 50 per cent of the cost of scooters and must pay the rest themselves if the scooter is defined as

consumer goods (such as dish washing machines) and not an assistive device (Mindegaard and Andersen, 2011). In Denmark and Finland, the municipalities have to provide grants for assistive devices and consumer goods for people with long-term disability, while in Norway the assistive devices are paid by the state. User participation in the service delivery process is emphasized in all three countries (NUH-Nordic centre for Rehabilitation Technology, 2007).

In all three countries, the provision of assistive devices is mostly based on the functional ability of the user. Still, in Finland a diagnosis defined by a physician is required (NUH-Nordic centre for Rehabilitation Technology, 2007). In all three countries, occupational therapists or physiotherapists employed by the municipalities are responsible for identifying and assessing the user needs, recommending and providing assistive devices, as well as following up on the users' situations in daily life. The assistive technology centres give consultations to the municipalities. In all three countries the interpretation of the eligibility criteria for granting the assistive devices vary according to the municipalities, units and single clinicians (NUH-Nordic centre for Rehabilitation Technology, 2007). The assistive devices are being purchased, adapted/adjusted and delivered by the assistive technology centres in Norway, while in Denmark and Finland this is done by the municipalities or by the users themselves in the cases when they pay part of the cost of the scooter.

In all countries the municipalities have a fundamental responsibility for the health care, social and rehabilitation services, including provision of assistive devices. Norway has a national system for provision of assistive devices and has established 18 assistive technology centres, one in each county. These centres have employed therapists with expert knowledge about assistive device application and adaptability. The centres deal with the applications for assistive devices in Norway, while in Denmark and Finland the municipalities are responsible for this. In Finland, granting assistive devices needs a physician's referral. In Denmark and Finland, the ways the assistive technology services are organized vary according to the municipalities.

An overview of the characteristics of the service delivery system in Denmark, Finland and Norway is presented in Table 1.

Table 1.
The characteristics of the service delivery systems of assistive devices in Denmark, Finland and Norway.

	Denmark	**Finland**	**Norway**
Legislation	Social Services Act	Health Care Act	Act on Social Services
Responsible for handling the applications	Municipalities	Municipalities	Assistive technology centres (state)
Responsible for the service delivery process	Municipalities	Municipalities	The municipalities supported by the assistive technology centres
Responsible for financing the assistive devices	Municipalities	Municipalities	Assistive technology centres
Powered wheelchairs*	Free of charge	Free of charge	Free of charge
Scooters*	Depending on functional ability some users are given a grant for 50% of the cost of scooters and must pay the rest themselves	Free of charge	Free of charge

*Powered wheelchairs and scooters are provided free of charge (see the Danish exception above) to people whose functional capacity is permanently impaired due to illness or injury. In addition, the powered wheelchairs and scooters must be necessary and appropriate with regard to improving the user's ability to participate in daily life.

Outcome of the assistive device intervention

Assistive technology outcomes

Jutai et al. (2005) have classified outcomes according to how assistive devices are distinguished, based on their intended effect on the user. This classification (taxonomy) reflects the combinations of user population, type of assistive device, service and context for use. The outcomes have been classified into *effectiveness, social significance* and *subjective well-being.*

The *effectiveness* group is concerned with how assistive devices might affect user functioning or change in health condition. It embraces the full assistive device effect, defined as functioning by the ICF (Jutai, Demers, et al., 2005). In this thesis, effectiveness in terms of mobility-related participation is central.

Outcomes from the *social significance* group reflect the meaning that society attaches to effectiveness outcomes, the extent to which outcomes are important to the society, primarily in terms of their economic effect.

The *subjective well-being* group includes users' cognitive and affective evaluations of how the assistive devices have affected their lives. Cognitive appraisals of assistive devices include satisfaction (Jutai, Demers, et al., 2005). In this thesis, user satisfaction with different aspects of the service delivery process is in focus.

In social services and health care, outcomes research is vital as a basis for improvement of the quality of the interventions or to document effectiveness of the assistive devices provided to the users (Jutai, Demers, et al., 2005; Brandt, Kreiner, et al., 2010; Lenker, Fuhrer, et al., 2010; De Vet, Terwee, et al., 2011).

User satisfaction

Satisfaction is defined as the user's critical evaluation of different aspects of assistive devices and related service delivery processes, which is influenced by individual expectations, perceptions, attitudes and personal values (Demers, Weiss-Lambrou, et al., 2000). User satisfaction is a vital outcome (Sackett, Rosenberg, et al., 2007; Brandt, Kreiner, et al., 2010), and previous research has suggested that user satisfaction is a construct separate from ,for example, mobility-related participation and should be evaluated in studies of outcomes of assistive devices (Wessels and DeWitte, 2003; Karmarkar, Collins, et al., 2009; Brandt, Kreiner, et al., 2010). As stated by Jutai, el al. (2005) satisfaction is a dimension of *subjective well-being*, which in the context of assistive technology refers to the degree to which an assistive device affects how users appraise and feel about their lives in terms of particular domains or in total. In this thesis it is assumed that satisfaction is influenced by the service delivery process of powered mobility devices as well as the structure of the services (Donabedian, 2003).

A search for articles published in the last 15 years in the CINAHL, Pubmed and Cochrane databases identified some articles about user satisfaction with powered mobility devices. The degree of satisfaction with the powered wheelchairs was fairly high (Garber, Bunzel et al., 2002; Lacoste, Weiss-Lambrou et al., 2003; Fitzgerald, Collins et al., 2005; Brochard, Pedelucq, et al., 2007) or moderate (Evans, Frank, et al., 2007), more satisfied with the wheelchair itself than with aspects of the service delivery process (Jedeloo, De Witte, et al., 2002; Wressle and Samuelsson, 2004). The identified studies varied with regard to age and diagnoses of the informant as well as types of assistive devices included in the studies in addition to powered mobility devices. Some studies were diagnosis-specific (Trail, Nelson, et al., 2001; Garber, Bunzel, et al., 2002; Chan and Chan, 2007; Medola, Elui, et al., 2010; Ward, Sanjak, et al., 2010), while others included informants with different kinds of impairments (Lacoste, Weiss-Lambrou, et al., 2003; Evans, Frank, et al., 2007). Jedeloo, et al (2002)

revealed in a study among adult users that whilst satisfaction was high, a difference in satisfaction was found between three local service delivery systems in The Netherlands. Some studies have expressed concern about the length of waiting times (Evans, Frank, et al., 2007) and follow-up services (Wressle and Samuelsson, 2004). No papers based on studies in the Nordic context were found about user satisfaction with specific aspects of the service delivery process of powered mobility devices. However, Brandt (2005) investigated user satisfaction with wheeled walkers and related service delivery processes using Quest 2.0, and found that the informants were less satisfied with related services than with the wheeled walker. Studies on other user groups than those who use powered mobility devices have concluded that satisfaction is increased when users are properly informed and involved during the service delivery process (Martin, Martin, et al., 2011; Borg, Larsson, et al., 2012), and an active follow-up increases user satisfaction (Hansen, Tresse, et al., 2004). While we have some knowledge about user satisfaction with powered mobility devices and related services, more knowledge is needed. For example, no studies about user satisfaction with different aspects of the service delivery process were linked to different service delivery systems. Consequently, there is a need for additional research within this field.

Effectiveness

Effectiveness is assessed in terms of the impact of the assistive devices on the user's life and needs, and is a matter of whether the assistive devices work as intended. Activity and participation can be considered an effectiveness outcome (Jutai, Demers et al., 2005; Brandt, Samuelsson et al., 2011).

During the past 15 years, some studies have reported on the effectiveness of powered mobility devices. A systematic review aiming to determine the effectiveness of mobility assistive device interventions in terms of activity and participation for people with mobility restrictions concluded that interventions and outcome measurement methods varied between studies. Consequently, it was not possible to draw any general conclusion about the effectiveness of mobility assistive device interventions. However, evidence was found that mobility assistive devices do improve activity and participation and increase mobility among the users (Salminen, Brandt et al., 2009).

Two other systematic reviews concluded that the powered mobility devices positively impact mobility, activity and participation (Hoenig, Pieper, et al., 2007; Fomiatti, Richmond, et al., 2013). The devices were most frequently used for shopping, going to malls or large discount stores and visiting friends (Hoenig, Pieper, et al., 2007; Edvards and McClusky, 2010), or had a positive effect on activity and participation within social and civic life among users (Pettersson, Törnquist, et al., 2006). Increased frequency of going for a walk, and that shopping, walking and visiting friends/family was easier were also reported (Löfqvist, Pettersson, et al., 2012). Similar results were shown by others

(Evans, Frank, et al., 2007; Auger, Demers, et al., 2010; Samuelsson and Wressle, 2014). No studies comparing the effectiveness of powered mobility devices between different countries were found.

Several articles concluded that, due to relatively small sample sizes, sub-group analyses were not feasible, and that larger studies with prospective designs and well-defined user groups are required to provide evidence of the long-term effects of powered mobility devices (Evans, Frank, et al., 2007; Auger, Demers, et al., 2010; Löfqvist, Pettersson, et al., 2012; Samuelsson and Wressle, 2014). Studies are needed to investigate where the devices are being used, how frequently they are used, ease/difficulty in using them, and who benefit the most from using the powered mobility devices. Further, there is a need to compare the results between countries with different service delivery systems (Evans, Frank, et al., 2007; Cooper, Cooper, et al., 2008). Consequently, there is a lack of knowledge about the effectiveness of powered mobility devices, especially regarding dimensions of participation (Lenker, Harris et al., 2013) such as mobility-related participation (Brandt, Iwarsson et al., 2004), which can, for example, be investigated in terms of frequency and ease/difficulty of mobility during participation in daily life (Dijckers, 2010).

Methodological development

Instruments that capture key outcomes like effectiveness of powered mobility device interventions and user satisfaction with the related services are central to clinical praxis and health/social sciences. For that purpose, high quality instruments with known psychometric properties are required. Studies on psychometric properties are an important element of research with the main objective to assess, appraise and improve instruments within different fields (De Vet, Terwee et al., 2011), including assistive technology (Lenker, Scherer et al., 2005). In other words, knowing the validity and reliability of the instruments used is important for making correct interpretations of data (Streiner and Norman, 2008). Consequently, knowledge about properties in terms of reliability and validity of instruments like the Satisfaction with the Assistive Technology Services (SATS) and the Nordic Mobility Related Outcome Evaluation of Assistive Device Intervention (NOMO 1.0) is important. Further, known psychometric properties of the SATS and NOMO 1.0 will inspire researchers and clinicians to use these instruments in future studies (De Vet, Terwee, et al., 2011). Accordingly, the SATS and the NOMO 1.0 are two central instruments in this thesis.

Reliability

The reliability of an instrument is the ability to differentiate between subjects and is the ratio of variability between subjects to the total variability of all measurements in the sample. Reliability denotes the overall consistency of a measure, and is a measure of

the proportion of the variability in scores which was due to true differences between individuals. A measure has high reliability if it produces similar results under consistent conditions – in a reproducible fashion. It is important to know the reliability an instrument produces because it reflects the amount of both random and systematic error inherent in any measurement (Streiner and Norman, 2008).

A test-retest reliability of the Danish version of the SATS has been carried out by means of telephone interviews with 38 scooter users, with satisfactory results (weighted kappa mean value=0.68) (Landis and Koch, 1998; Andersen, Olesen et al., 2010). No other information about the reliability exists on any of the national versions of the SATS. Consequently, further reliability testing of the instrument is needed.

A previous version of the NOMO 1.0 has been tested for test-retest reliability with satisfactory results (substantial to almost perfect) (Brandt, Löfqvist et al., 2008). For details, see Paper 2. Since the instrument was subsequently revised, new reliability tests are required.

Validity

Validity refers to the degree to which an instrument truly measures the construct(s) it purports to measure (Mokkink, Tewee et al., 2010), and whether an instrument describes the intended quality and to what extent. Knowing the validity of an instrument is important because it determines the degree of confidence we can place on the inferences we make about users based on their scores from the measure contexts (Streiner and Norman, 2008).

The items of the SATS and the NOMO 1.0 have been subject to discussions among experts, users and researchers, and thus satisfy the criteria for content validity. For details, see Paper 1 and 2. The Finnish version of the SATS was tested for face and linguistic validity with 19 users who recently had received a wheeled walker or a wheelchair. They concluded that the items of the SATS were acceptable, easy to answer (promoting a clear understanding of the wording of each item) and relevant for assessing user satisfaction with the service delivery process of assistive devices (Ahtola, Heinonen, et al., 2011). For details, see Paper 1. The NOMO 1.0 instrument has not been tested for construct validity. Besides, large-scale studies performed in various contexts are also needed (Streiner and Norman, 2008). Consequently, further validity studies of the NOMO 1.0 with specific user groups are needed.

Service delivery process of assistive devices

In the field of assistive technology the service delivery process of assistive devices includes the services that directly assist the user in the selection and use of an assistive device (Cook, Polgar et al., 2002). This is a multidisciplinary process involving the expertise of professionals like e.g. physiotherapists, occupational therapists (Samuelsson and Wressle, 2008) and technicians or engineers (Ward, 1994). To date, no consensus has appeared in rehabilitation or assistive technology outcome studies with regards to attributes of the service delivery process of assistive devices (Lenker, Fuhrer, et al., 2010). However, assessing the needs of the individual, trying different scooter models, performing driving tests, performing necessary adaptations and adjustments in addition to housing adaptations (if necessary) are regarded as important steps of the service delivery process of powered mobility devices. Administrative work (handling applications and documentation of the process) are also important steps of a service delivery process, as is follow-up activities (de Witte, 1994). The follow-up is important in order to reduce accidents and to allow for adjustments to improve the fit of the wheelchair (Greer, Brasure, et al., 2012). In this thesis a follow-up took place after the user had received the powered mobility device and included home visits if readjustments or exchanging of parts and/or accessories were needed.

A study within the field of hearing aids has concluded that user's experience of an assistive device solution is affected by the perceived quality of the centre in supporting the user (Federici and Borsci, 2014). However, very little is known about the quality of the service delivery processes of powered mobility devices, specifically about who does what in the processes. Moreover, little is also known about outcomes of powered mobility device interventions related to what goes on in the service delivery process (Brandt, Kreiner, et al., 2010; Lenker, Fuhrer, et al., 2010). Studies within this field are needed in order to identify characteristics of effective service delivery processes and their influence on outcomes.

Summary

The demand for evidence-based practise in health and social services, including assistive technology, is increasing, but the evidence of the effects of powered device interventions is limited. Studies with well-defined user groups are required to provide evidence in favour of the long term effects of powered mobility devices, and who benefit most from them (Evans, Frank, et al., 2007; Auger, Demers, et al., 2010; Löfqvist, Petterson, et al., 2012; Samuelsson and Wressle, 2014).

The knowledge about what goes on in the service delivery process and user satisfaction with specific aspects of the process and effectiveness of powered mobility devices are still scarce. Moreover, no studies were found which compared the results between countries with structural differences, for example between the Nordic countries. Such studies are needed (Evans, Frank, et al., 2007; Cooper, Cooper, et al., 2008). Consequently, more research within this field is needed.

Many studies, which have addressed the impact of powered mobility devices on the lives of older adults, have relied on outcome instruments with very little evidence of reliability and validity for the population (Mortenson, Miller, et al., 2008). Accordingly, there is a strong need for psychometric testing in order to strengthen the evidence for whether the results produced by the SATS and the NOMO 1.0 can be interpreted in a confident way.

Aims

The overarching aim of this thesis is to contribute to the methodological development in the field of assistive technology, and to increase knowledge about the service delivery process and outcomes of powered mobility device interventions among adult first time users in a Nordic context. A further aim is to investigate whether there are any associations between the three key elements of Donabedian's conceptual model for quality assessment when scooters are provided to adult users in a Nordic context.

Based on samples of powered mobility device users in the three Nordic countries, the specific aims were to investigate:

- The test-retest reliability of the SATS among adult users of powered mobility devices
- The test-retest reliability and construct validity of the three scales and one index of the B-part of the NOMO 1.0
- The effectiveness of powered mobility device interventions in a one year perspective regarding:
  - Increase in the frequency and number of mobility-related participations
  - Ease in mobility during mobility-related participation
  - Differences in sub-groups of age, gender, living situation, national context, type of powered mobility device and self-reported health
- The service delivery process in terms of:
  - Steps taken in the scooter service delivery process and actors involved when scooters were provided
  - Time spent during the different steps of the scooter service delivery process, and whether there were differences in national contexts
  - Scooter users satisfaction with regards to the different aspects of the service delivery process, and whether there were differences in user satisfaction and effectiveness in national contexts

- Association between the time spent during the different steps of the scooter service delivery process and user satisfaction with regards to the service delivery process

- The association between the key elements of Donabedian's comceptual model, (structure, process and outcomes) regarding:

  - Whether differences in rules predict the time spent on the different steps of the service delivery process and outcomes in terms of user satisfaction with aspects of the process and effectiveness of scooter interventions

  - Whether differences in the time spent on the different steps of the service delivery process predict outcomes in terms of user satisfaction with aspects of the process and effectiveness of scooter interventions

Materials and methods

Overview of studies 1 - 4

This thesis involved adult informants from three Nordic countries: Denmark, Finland and Norway. The data were collected over a period of more than one year in each country. Due to challenges in the financing the cross-national project, the data collection in Finland started one year later than in Denmark and Norway. This is the reason why Finnish data were not included in the service delivery process study (the first article that was published). In Norway, the procedures for data collection for the test-retest reliability study of the SATS were not followed in a satisfactory way and this is the reason why Norwegian data are not present in that study. In Denmark, the informants in the test-retest of the SATS did not participate in the rest of the Nordic study.

An overview of the specific aims of the studies, design, methods, and analyses are presented in Table 2, while the data collection occasions and the instruments used are presented in Table 3.

The four studies included are labeled as follows: the SATS study (Paper 1), the NOMO 1.0 study (Paper 2), the effectiveness study (Paper 3), and the service delivery process study (Paper 4).

Table 2.
Overview of the aims, design, sampling of informants, data collection methods and analysis in the four studies.

	SATS* study (Paper 1)	NOMO 1.0** study (Paper 2)	Effectiveness study (Paper 3)	Service delivery process study (Paper 4)
Aims	Psychometric testing of The SATS	Psychometric testing of the NOMO 1.0 instrument, part B	To investigate the effectiveness of powered wheelchair and scooter interventions	To describe the service delivery process and user satisfaction with the process
Design	Test-retest	Test-retest	Follow-up	Follow-up
Number of informants (N)	94 Denmark: 40 Finland: 54	248 Denmark: 62 Finland: 67 Norway: 119	180 Denmark: 46 Finland: 50 Norway: 84	136 Denmark: 50 Norway: 86
Data collection methods* **	The SATS instrument	The NOMO 1.0 instrument	The NOMO 1.0 instrument	Study specific instrument, the SATS instrument
Time	July 2010 – February 2011	June 2010 – February 2013	May 2009 – February 2012	May 2009 – January 2011
Analysis	Descriptive statistics, Intraclass correlation coefficient (ICC). Percentage of exact agreement	Descriptive statistics, percentage of non-applicable responses (acceptability), percentages of *never* responses to the frequency scale (applicability of the ease/difficulty scale), Cronbach's alpha, inter-item and item-total correlations, ICC, percentage of exact agreement, factor analysis	Descriptive statistics, Mann-Whitney or Kruskal-Wallis test, the Sign test, T-test	Descriptive statistics, Mann-Whitney or Kruskal-Wallis test, linear multiple regression, ordinal regression, summary of qualitative comments

*SATS=Satisfaction with the Assistive Technology Services
**NOMO 1.0=Nordic Mobility Related Outcome Evaluation of Assistive Device Intervention
***Demographic and health data were collected by means of the NOMO 1.0 part A and analyzed with descriptive statistics

Table 3.
Overview of the data collection and instruments used in studies 1 - 4, involving informants from Denmark, Finland and Norway

No	Study	Data collection occasion	Type of data	Instrument	Type of data collection*
T0	The service delivery process study (4)	Registration of data as the service delivery process went along**	Documentation of the service delivery process	A study-specific instrument	Registration of actors and time spent in the different steps of the process
T1	The effectiveness study (3), the NOMO 1.0 study (2)	Baseline. The informants were about to be provided a powered wheelchair or scooter	Demographic and health data, data about the frequency of mobility-related participation, and ease/difficulty in mobility	The NOMO 1.0 instrument***, baseline version A ICD-10 based study-specific questionnaire	Face-to-face interviews in the informants' homes
T2	The service delivery process study (4)	1-2 months after the cases had been closed**	Informant satisfaction with different steps of the service delivery process	The SATS instrument***	Telephone interview
T3	The SATS study (1)	1-3 months after the cases had been closed***	Informant satisfaction with different steps of the service delivery process, test data for the SATS instrument****	The SATS instrument****	Telephone interview
T4	The SATS study (1)	About two weeks after T3***.	Informant satisfaction with different steps of the service delivery process, retest data for the SATS instrument****	The SATS instrument***	Telephone interview
T5	The effectiveness study (3), the NOMO 1.0 study (2)	Follow-up. About one year after the informants received their powered wheelchair or scooter	Demographic and health data, data about need for assistance, frequency of mobility-related participation, and ease/difficulty in mobility. Test data for the NOMO 1.0 instrument****	NOMO 1.0 instrument***, baseline version A ICD-10 based study-specific questionnaire	Face-to-face interviews in the informants' homes
T6	The NOMO 1.0 study (2)	About two weeks after T5.	As above, retest data for the NOMO 1.0 instrument****	As above	As above

*The case managers or the local occupational therapist/physiotherapist collected the data at T0. All other data collection was carried out by interviewers hired for the project.
**No data from Finland were available by the time study 3 (Paper 4) was completed.
***No informants from Norway participated in the test-retest interviews of the SATS. The informants for the Danish test-retest study of the SATS did not participate in the other studies.
****SATS=User Satisfaction with the Assistive Technology Services. NOMO 1.0=The Nordic mobility-related participation outcome evaluation of assistive device intervention.

Informants

The Nordic powered mobility device project

Based on the inclusion criteria, the informants for *the Nordic powered mobility project* were recruited as they were about to be provided with a powered mobility device in the municipality of Odense in Denmark, from 10 of 20 hospital districts in Finland and from 8 of 19 counties in Norway. The informants were interviewed several times during the project. For details, see Table 2, Table 3 and Figure 2. Information collected in the interviews was used in all four studies. However, in the test-retest study of the SATS, the Danish informants did not participate in the other studies. All the informants represented a variance in terms of urban and rural areas.

The inclusion criteria included persons who:

- Were about to receive a powered wheelchair or scooter for the first time, where the decision to provide the device had been made, but the device had not been delivered
- Were 18 years of age or older
- Had sufficient cognitive functions and verbal skills for participation in interviews (based on the case managers' prior and present knowledge about the informants)
- Were living in ordinary housing, including adapted dwellings

Persons who did not want to use the powered mobility devices were excluded, and so were those living in a nursing home. Persons who had been exposed to recent injuries or accidents or had rapidly progressing diseases such as amyotrophic lateral sclerosis were excluded.

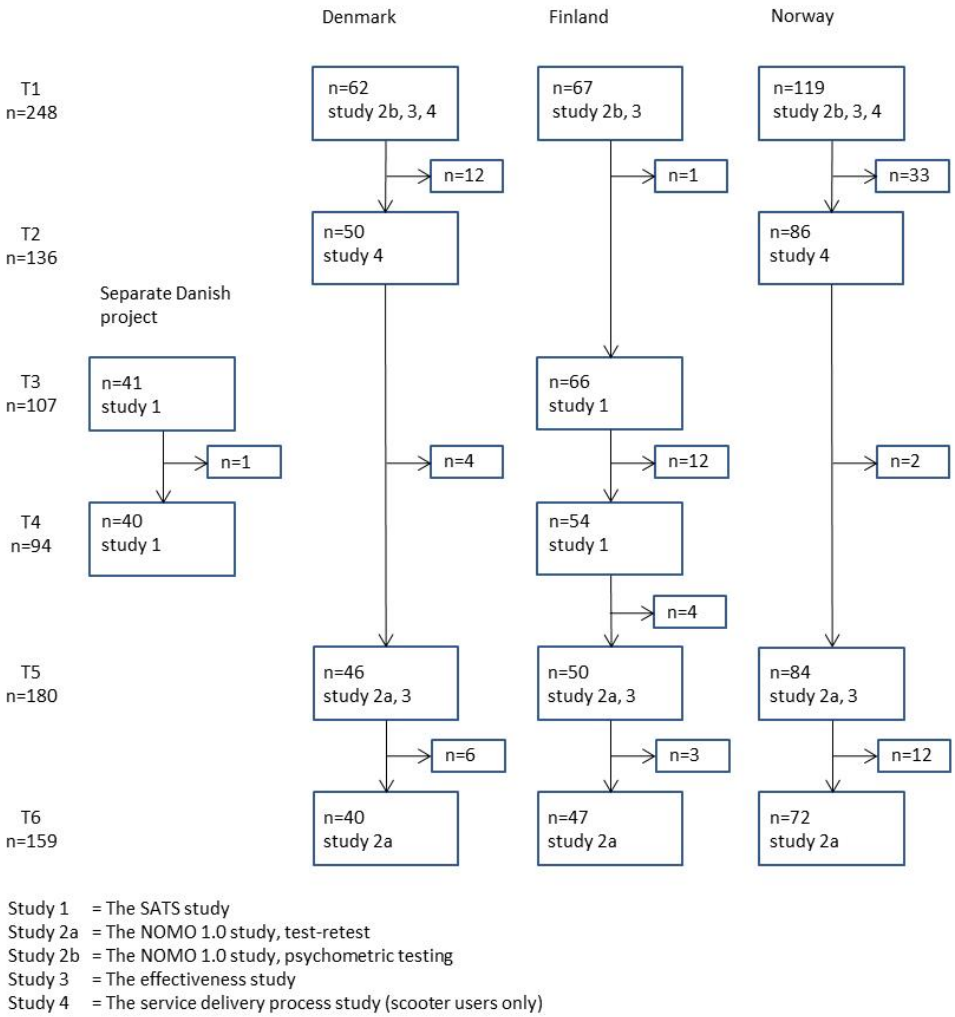

Figure 2.
The samples of the Nordic project.

Outcome of the assistive device intervention

Methodological development

The SATS study

The SATS study was based on Danish and Finnish samples. The informants were recruited from 14 Danish municipalities. A total of 65 persons were invited in Denmark, of whom 24 declined to participate. During the study, one informant dropped out due to illness, leaving 40 informants for the study. Only two Danish informants received a powered wheelchair. See Figure 2.

In Finland, 68 informants consented to participate, of whom two dropped out prior to the SATS interviews because they did not want to continue. Another 12 cases were excluded, mostly because the time interval between the interviews exceeded a limit of 18 days because of holiday time. Thus, the final Finnish SATS test-retest sample consisted of 54 informants. See Figure 2.

In the Danish sample, the mean age was 67.5 (SD=13.1) years, with 20 (50%) men. In the Finnish sample, the corresponding figures were 55.6 (SD=12.1) years and 20 (37%) were men. For further details, see Paper 1 and Figure 2.

The NOMO 1.0 study

For the NOMO 1.0 study 297 persons were recruited from Denmark, Finland and Norway (n=143). In all, 49 people did not accept to participate, mostly because they did not want to, leaving 248 informants for the baseline interviews. In all, 89 informants did not participate in the retest interviews, leaving us with 159 informants. The main reasons for not participating were that they did not want to continue, were too ill, had been hospitalized, or had passed away.

At the baseline, the mean age was 67.9 (SD=15.3) years, with 116 (47%) being men. For further details, see Paper 2 and Figure 2.

The effectiveness study

Of 248 persons who accepted to participate, 54 were lost to follow-up mostly because they did not want to participate, were too ill or had passed away. In order to diminish bias due to changing physical environments, another 14 informants who had moved to a different house/flat during the study period were also excluded, leaving 180 informants for the study. For details of the recruitment, see Figure 2.

The mean age of the total sample was 68.7 (SD=14.7) years, with 49 (27%) aged 80 and older. In all, 86 (48%) were men. The informants using a powered wheelchair were younger than those using a scooter. The mean number of self-reported impairments

was 4.2 with more impairments among powered wheelchair informants compared to those using a scooter. Informants younger than 61 years had more impairments and more lived with another person compared to the older ones. A great majority of the informants had been provided a powered mobility device for outdoor use. For further information, see Paper 3.

Service delivery process of assistive devices

The service delivery process study

Out of 82 persons who were invited to participate in the study in Denmark, 54 accepted. The main reason for lack of participation was that people simply *did not want to*. Four users became seriously ill or passed away during the data collection period. Another two persons did not answer the satisfaction questions, leaving a final sample of 50 Danish informants.

In Norway, 104 persons were invited to participate, of whom 18 did not want to, leaving 86 informants who accepted to be interviewed. See Figure 2.

The mean age was 70.3 (SD=14.8) years in the Danish and 75.8 (SD=12.1) in the Norwegian sample. There were 25 (50%) men in the Danish and 46 (53%) men in the Norwegian sample. In the Danish sample, 34 (68%) of the informants had received a grant for 50 per cent of the cost of the scooter. Further details are presented in Paper 4.

Ethical considerations

All principles of ethical guidelines for human research were followed. All the informants gave informed written consent and were guaranteed anonymity and confidentiality. They were informed that they at any time could withdraw from the project, and that this would not have any consequences for future services. According to current national legislation, a formal ethical approval was not necessary in Denmark, but permission to store personal data was granted by the Danish Data Protection Agency. In Finland the larger project was approved by the Ethical Council of the Hospital District of Helsinki and Uusimaa (Record no: 417/13/03/00/09). As the project was part of routine follow-up activities by the Norwegian Labour and Welfare Service a formal ethical approval was not necessary, however, the Norwegian Data Inspectorate was informed (Registration no: 40030).

Data collection and procedures

The informants for the Nordic project were recruited consecutively. However, random sampling was used to recruit informants for the Danish part of the test-retest study of the SATS. Except for the Danish interviewers of the SATS study (occupational therapy students), all the interviews were performed by experienced occupational therapists or physiotherapists in all three countries. The number of interviewers varied during the course of the project. Between four and six interviewers collected the Danish data, between 15 and 17 the Finnish, and 12 interviewers collected the Norwegian data. For further details, see Papers 1-4. The interviewers attended a one day briefing course before the interviews started. The course was repeated before the T5 interviews (see Table 3). Guidelines for the data collection were distributed to all the interviewers, and the inclusion/exclusion criteria were explained in detail. The procedures for performing the interviews were discussed, and the interviewers were encouraged to gain experience in using the instruments by interviewing each other or other colleagues before interviewing the actual informants.

A local study coordinator was established in Denmark who coordinated the interviews and assured the quality of the data collection, while the case managers (the informant's contact person) or interviewers did this in Finland and Norway. In addition, the national coordinators (authors of Papers 1-4) controlled the quality of the data.

For all the studies, demographic, health and descriptive data, including information on which assistive devices the informants already had, were collected by means of part A of the NOMO 1.0 instrument (Brandt, Løfqvist et al., 2009; Löfqvist, Pettersson et al., 2012). In addition, the most important diagnoses (maximum three for each informant) were collected by means of an ICD-10 based study-specific questionnaire.

Concerning the test-retest reliability and agreement studies, the aim was to conduct two interviews at 14 days intervals, that could occasionally be stretched to 18 days. This interval was chosen because it represented a good balance between stability of scale under study (satisfaction and effectiveness) and the independence of repeated tests (Streiner and Norman, 2008). With regards to the effectiveness study, the study aim was to accomplish the follow-up interviews (T5) one year after the baseline ones (T1).

In order to reduce researcher bias (Demers, Wessels et al., 1999, Hellbom and Persson 2001), none of the interviewers collected data from their own clients. None of the authors of the papers had any contact with the informants.

Outcome of the assistive device intervention

Methodological development

Instruments

The SATS and NOMO 1.0 instruments were subject to psychometric testing.

Data collection and procedures

The SATS study (Paper 1) had a test-retest design. Two telephone interviews (T3 and T4, see Table 3) 7-18 days apart were used as the means to gain information from the informants. In the Danish sample, the mean number of days between two interviews were 13.5 (SD=1.1), while in the Finnish sample the mean number of days was 11.8 (SD=3.3).

A couple of days before the interviews all the informants received the questionnaire by mail, enabling them to reflect on the questions and complete the questionnaire before the telephone call. During the interview, and on their own version of the form, the interviewer registered the informant's answers to each item. For further information, see Paper 1 and Figure 2.

Regarding the test-retest and percentage of exact agreement part of the NOMO 1.0 study, the mean number of days between the two interviews was 13.2 (SD=2.5). Data were collected at baseline (T1) and at two interviews occurring about one year later (T5, T6) (see Table 3). For further details, see Paper 2.

The effectiveness study

Instrument

The data for the effectiveness study was collected by means of face-to-face interviews before (baseline T1) and after (follow-up/test T5) provision of powered mobility devices by means of the NOMO 1.0 (Brandt, Iwarsson et al., 2004). For details, see Paper 2 and Paper 3. The instrument was constructed in collaboration with all the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. It was developed based on the International Classification of Functioning, Disability and Health ICF (World Health Organization WHO, 2001). The instrument and a manual are available in four Nordic languages. The NOMO 1.0 consists of a descriptive part A (background variables) and an outcome part B consisting of 24 items representing three scales and one index: *need for assistance* (four items), *frequency* and *ease/difficulty* of mobility-related participation (20 items), and *number* of participation aspects performed (index).

The items of the *frequency* scale are rated on an eight-point ordinal scale ranging from *daily* to *never*, while those of the *ease/difficulty* scale are rated on a five-point ordinal scale ranging from *very easy* to *very difficult*. In addition, a *does not know* response option is available. Also, *does not wish to answer* and *reason unknown* response options are available to the items of both scales (Brandt, Løfqvist et al., 2008). The NOMO 1.0 does not provide a total score.

The NOMO 1.0 consists of a baseline and a follow-up version with an identical part B. In addition to the NOMO 1.0 items, at the follow-up a question is asked about changes in health condition and social events that may have occurred between the two interviews. The change in scores of the scales and the index express the effectiveness of the powered mobility device interventions. For further details of the NOMO 1.0, see Papers 2 and 3.

Interviews

The informants for the effectiveness study were recruited from Denmark, Finland and Norway. They were interviewed face-to-face during home visits by the same interviewer. However, in Finland some of the interviews were accomplished at an assistive technology centre. The baseline interview (T1) took place shortly before the informants received their powered mobility devices and the follow-up interview (T5) about one year later (mean 386.9 days; SD=52.78). For further details, see Paper 3.

Service delivery process of assistive devices

The service delivery process study

Instruments

To document the service delivery process in the Danish and Norwegian samples, a study-specific instrument was constructed based on our experiences concerning the steps usually involved in a service delivery process of a scooter. The time was measured in the number of minutes spent by each occupational therapist, physiotherapist or dealer on the steps of the service delivery process for the following items: *assessment of the user's needs for a scooter; testing of various models; driving tests; individual adaptation; follow-up activities; management of housing adaptations (ramps, charging possibilities of batteries etc.; administration;* and *other activities* (see Paper 1). Face validity was established based on criteria found in the literature and the Horizontal European Activities of Rehabilitation Technology (HEART) study (de Witte, 1994), as well as discussions between the author and one of his supervisors, both of whom are

experienced in the field. A manual was constructed with definitions of the above items and explanations on how to measure the time taken for each of them. The content of the manual was explained to the data collectors before the study started.

User satisfaction with different aspects of the service delivery process in Denmark and Norway was collected by means of the SATS. The instrument was constructed in Norway based on cooperation with representatives from the user organisations to assess user satisfaction with the assistive service delivery process from a cost-effective approach. The instrument has a structured interview format comprising the following nine items formulated as questions: *Accessibility to the professionals, information, coordination between the professionals, knowledge of the professionals, waiting time, participation, instruction and training, follow-up services,* and *overall satisfaction*. A five-point rating scale ranging from *very dissatisfied* to *very satisfied* and a *does not know* response option are offered. In addition, an option to give additional comments is included. The instrument is constructed to be generically applicable to provision of all kinds of assistive devices. The SATS was translated into Danish and Finnish. For further details, see Papers 1 and 4.

Interviews

Informants were recruited from Denmark and Norway. The local occupational therapists or physiotherapists in Norway and the case manager from Denmark involved in the service delivery processes were given instructions on how to collect data on time use for all actors involved (e.g. municipalities, assistive technology centres, dealers) for each step in the service delivery process as the process went along (T0). In Norway, parts of the service delivery process took place in the assistive technology centres, and this part was documented by the interviewers. In all other aspects, the procedures were identical in Denmark and Norway.

The first interview (T1) (demographic and health data) took place in face-to-face interviews in the informants' homes just before they had received their scooter. The second interview (T2) (user satisfaction) was performed, by telephone, when the case had been closed, i.e. the scooter had been delivered, and the training and immediate follow-up services had been given (see Table 2 and Figure 2). The mean number of days between the two interviews were 72.1 (SD=49.4), with no differences between the two national samples. For further details, see Paper 1.

Data analysis

For all the studies, descriptive statistics, independent samples T-test or Chi-squared tests were used for data with a normal distribution to compare the samples regarding demographic and health data, while the Mann-Whitney U test or Kruskal-Wallis test were used to analyze group differences in non-parametric data.

Because reliability is context and population specific (Streiner and Norman, 2008; Mokkink, Terwee et al., 2012), it was decided to analyze the Danish and Finnish samples separately for the SATS study. For further details, see Paper 1. However, in order to get a large enough sample for the NOMO 1.0 study, the three national samples were analyzed together (De Vet, Terwee et al., 2011). The same applied for the effectiveness study. For the service delivery process study, the Danish and Norwegian samples were analyzed separately.

Percentages of the *does not wish to answer, reason unknown* and *does not* know responses were calculated for all items, with a cut-off point of 15 per cent for data from both the SATS and NOMO 1.0 study in order to assess the general acceptability of items per cent. As the percentages of these responses were fairly small, were within acceptable limits, and were not part of the ordinal scales, they were excluded from further analyzes (De Vet, Terwee et al., 2011).

The SPSS 21.0 was used for all analyzes (SPSS Inc., 2009), and for the majority of the analyzes the level of statistical significance was set to $p \leq 0.05$. When necessary and due to the high numbers of statistical tests performed, Bonferroni corrections were applied (Kazdin, 2003).

Outcome of the assistive device intervention

Methodological development

For both the SATS and the NOMO 1.0 study, the internal consistency was investigated in three ways: item-total and inter-item correlations in addition to the calculation of Chronbach's alpha. The calculation of Cronbach's alpha was used to estimate the internal consistency for the items of the SATS scale, and the *need for assistance* and *frequency* scales of the NOMO 1.0, with recommended values between 0.70-0.90 (Streiner and Norman, 2008). For items with inter-item correlations <0.20, an item-total correlation analysis was carried out to examine the impact of removing these items. In terms of scale homogeneity, item-total correlations greater than 0.30 are preferable

in order to reflect some covariance with the common components among the items. Values greater than 0.30 are recommended, and values greater than 0.70 may indicate item redundancy (De Vet, Terwee et al., 2011). The inter-item values were calculated for the *need for assistance, frequency* and *ease/difficulty* scales of the NOMO 1.0 as well as the SATS scale. Items were successively removed to study if the alpha increased/decreased.

In both studies, the test-retest was assessed for each item by means of the Intraclass correlation coefficient (ICC), a two-way mixed model, and by single measures (ICC 2.1) (Weir, 2005). Item ICC was reported because clinically each item provides information about different aspects under study. A coefficient of 0 represents a totally unreliable measurement and 1 indicates perfect reliability. It is reasonable to accept ICC greater than 0.5 as indicators of acceptable reliability, though levels greater than 0.7 are recommended (Streiner and Norman, 2008).

As the items of the SATS and the NOMO 1.0 had less than 9 response alternatives (Graham, Milanowski et al. 2012), a percentage of exact agreement was established for each item by calculating the number of identical responses in proportion to the total number of responses. Levels greater than 75 per cent are recommended (Stemler, 2004).

In both studies and based on baseline data, floor/ceiling effects were established by means of percentages of responses above 20 per cent at the highest or lowest end of the ordinal scale of the items of the two instruments (McHorney and Tarlov, 1995).

With the NOMO 1.0 study we investigated the item performances on six measurement properties: general acceptability, ease/difficulty scale applicability, internal consistency, test-retest reliability, percentage of exact agreement and floor- and ceiling effects. Moreover, a factor analysis has also been performed in order to establish the construct validity of the NOMO 1.0.

Data from T5 and T6 were used for the test-retest reliability and agreement test and baseline data (T1) were used for all the other analyzes (see Table 2).

The items of the *ease/difficulty* scale are applicable when responses other than *never* are given to the items of the *frequency* scale. The number of missing *ease/difficulty* responses should not exceed 15 per cent per item. Higher percentages may indicate that the items are not applicable to the informants (De Vet, Terwee et al., 2011). The proportions of *never* responses for the 20 items of the *frequency* scale were computed, first for each informant and then for the total sample.

A factor analysis was used to investigate the construct validity of the *need for assistance* and *frequency* scales of the NOMO 1.0. Since the *ease/difficulty* scale had many intentional missing responses, and because a factor analysis required five times as many

informants as items (5x20=100) (Dancey and Reidy, 2011), the items of the *ease/difficulty* scale were not subject to a factor analysis. As there was no clear idea of the number and types of components, an explorative factor analysis was conducted to evaluate the structure of the *need for assistance* and *frequency* scales (De Vet, Terwee et al., 2011). First a correlation matrix was produced to check the strength of the correlations, followed by extraction of a set of components. Components with Eigen values above 1.00 were retained, and how much variance they accounted for was calculated. To make the interpretation easier, the axes were rotated in order to maximize high correlations and minimize low ones. Factor loadings were examined using a cut-off of 0.2 (based on the same cut-off level as for the inter-item correlations) and items with low factor loadings were considered for removal. Further analysis was carried out using 0.30, 0.40 and 0.50 as different cut-off levels. The objective of all the above analyzes was to select the solution which gave the most optimal composition of items. If the cumulative explained variance was low, more components might be retained in order to provide a better count of the variance (De Vet, Terwee et al., 2011). For further details, see Paper 2.

The effectiveness study

In the effectiveness study the Sign test was used to analyze differences in frequency and ease/difficulty in participation between baseline and follow-up. For items with significant differences, a further sign test was used to analyze differences concerning the following sub-groups: age groups (<61 years, 61-79 years, >79 years), gender, living alone or not, national context, type of powered mobility device, and self-reported health. Also for items with significant differences, the effect size was calculated. An effect size of 0.20 was interpreted as small, 0.50 as moderate, and an effect size of 0.80 as large (De Vet, Terwee et al., 2011). Finally, the number of aspects (normally distributed) performed, means and 95 per cent confidence intervals were calculated for the total sample, and the T-test was used to analyze differences between sub-groups at baseline (T1) and follow-up (T5). The effect size was also calculated. For further details, see Paper 2.

Service delivery process of assistive devices

The service delivery process study

A linear multiple regression analysis was performed with summed total time as the dependent variable. For the independent variables, different steps according to the instrument for documentation of the service delivery process were used. Ordinal regression was used to analyze factors predicting user satisfaction with the SATS items as dependent variables, while independent variables were summed total time spent on main steps of the service delivery process involving the user of the device: *assessment, selection of model, driving test* and *follow-up services.*

Results

Outcome of the assistive device intervention

Methodological development

The SATS study

The main results were that the ICC values for the majority of items in both national samples were above the recommended level of 0.70. The percentage of exact agreement varied between 54.2 per cent and 79.5 per cent in the Danish and between 69.2 per cent and 81.1 per cent in the Finnish sample. For further details, see Table 4 in Paper 1.

The Cronbach's alpha was 0.96 (n=25) in the Danish and 0.88 (n=33) in the Finnish sample. None of the Danish inter-item correlations were below 0.20. In the Finnish sample, the inter-item correlations between *instruction and training* and five other items varied between -0.05 and 0.16. Removing *instruction and training* from the Finnish version of the SATS increased the Cronbach's alpha from 0.88 to 0.89. In the Danish sample and regarding possible item redundancy, the inter-item correlations for all but one of the items (*all in all satisfaction)* were below 0.70. In the Finnish sample all but two items (*information, all in all satisfaction)* were below this level.

Very satisfied and *satisfied* were the prominent scores in both the samples. A ceiling effect was identified for all the items for both samples, since more than 20 per cent of the scores were clustered at the positive end of the scale (*very satisfied)*. More than 50 per cent of the informants had given a *very satisfied* score to four items in the Danish and eight items in the Finnish sample. Very few informants had given a *dissatisfied* or *very dissatisfied* score. For further details, see Paper 1.

In the Danish sample and concerning the *follow-up* item, 27.5 per cent and 35.0 per cent at the test and retest respectively gave a *does not know* response, and in the Finnish sample the corresponding percentages were 25.9 per cent both at the test and retest, which are above the recommended level of 15 per cent. The *does not know* responses were below the recommended level for all the other items. For further details, see Table 3 in Paper 1.

The NOMO 1.0 study

One important finding was the general acceptability was high as the percentages of non-applicable responses were below 3 per cent for all the items of the *need for assistance* and *frequency of participation* scales, and 6.7 per cent or lower for the items of the *ease/difficulty* scale.

Regarding the ease/difficulty scale applicability, the percentage of *never* responses to the different items of the *frequency* scale was above the accepted level of 15 per cent for all but one (*kitchen work)* of the items.

The Cronbach's alpha for the four-item *need for assistance* scale was 0.84. The successive removal of items produced Cronbach's alpha values between 0.76-0.85. The inter-item correlations varied between 0.42-0.69, and the item-total correlations varied between 0.38-0.59.

For the items of the *frequency* scale the Cronbach's alpha value was 0.78. The inter-item values varied between -0.16-0.56, and the item-total ones between 0.15-0.51. The successive removal of items produced Cronbach's alpha values between 0.75-0.79.

The item ICCs were above the recommended level of 0.70 for two of the items of the *need for assistance* scale and 18 of 20 items of the *frequency* scale. The ICCs for two of the items of the *ease/difficulty* scale were above 0.70. The ICC for the *participation repertoire* index was 0.94.

The percentage of exact agreement for the items of the *need for assistance* scale varied between 70.7 per cent and 87.4 per cent, for the items of the frequency scale between 50.9 per cent and 97.5 per cent, and those of the *ease/difficulty* scale between 40.0 per cent and 72.2 per cent.

A ceiling effect was identified for all the items and a floor effect for the *move about outdoors* item of the *need for assistance* scale. Concerning the items of *frequency* scale, due to high number of intentional missing *never* responses, the *daily* and *about once a year* response alternatives were considered to represent the ends of the ordinal scale. A ceiling effect was detected for the *daily* response alternative for the *kitchen work* item. For the other items the percentages were below the recommended level of 20 per cent. All the percentages of *once a year* responses were below the recommended level. No floor/ceiling effects were identified for the items of the *ease/difficulty* scale. For further details, see Table 3 in Paper 2.

The factor analysis of the *need for assistance* scale identified one component accounting for 68.7 per cent of the variance, and for the *frequency* scale, six components accounting for 57.3 per cent of the variance. For further details, see Tables 3 and 4 and Figure 2 in Paper 2.

The effectiveness study

The results show that powered mobility device interventions make mobility easier for participation in eight aspects over the one year study period: *visiting restaurants/cafes/pubs*, *buying groceries*, *other shopping*, *posting letters*, *going to the bank, going to the chemist's, going for a walk/ride*, and *visiting family/friends*. No aspects became more difficult. *Buying groceries, going for a walk/ride,* and *visiting family/friends* became easier for most of the sub-groups. The effect size varied from moderate to large.

Buying groceries (small effect size), and g*oing for a walk/ride* (moderate/large effect size) were the participation aspects that increased in frequency during the one year study period. Furthermore, the results showed variations between the sub-groups. The frequency of both aspects increased for men, informants aged 61-79 years, the Danish sample, and informants using a scooter. For further details, see Table 4 and Table 5.

The number of mobility-related participation aspects increased from 10.1 (SD=4.2) at baseline to 10.8 (SD=3.9) at follow-up. The effect size was small. Informants aged 61-79 years, Danish informants and those with poor self-reported health increased their number of participation aspects at follow-up compared with the baseline. At follow-up compared to baseline, the increase in number of mobility-related participation aspects varied between -6 and +10.

All in all, men, scooter users, and informants with poor self-reported health seem to benefit the most from the use of powered mobility devices. For further details, see Table 4 and Paper 4.

Concerning *going for a walk/ride* there were no gender differences neither at baseline nor follow-up. Both men and women increased the frequency of this aspect, indicating that both benefited equally much from the powered mobility device use in this respect. However, at baseline women were *buying groceries* more frequently than men (p=0.002), while at follow-up there were no gender differences, indicating that the powered mobility device use had a greater impact in terms of increased frequency on men compared to women when buying groceries. Analysis at baseline and follow-up of the items of the *ease/difficulty* scale showed no significant gender differences. Still, compared to the women there was a tendency for men to achieve easier mobility between baseline and follow-up, resulting in significant differences for more participation aspects compared to women. For example, at baseline 32.5 per cent of the men rated that *going to the bank* was *very easy* or *easy*, while at follow-up 61.7 per cent gave the same responses. The corresponding figures for women were 29.5 per cent at baseline and 48.3 per cent at follow-up. Similar figures were found for the *going to the chemist's* and *other shopping* items.

The age group 61-79 years benefited for more participation aspects than the older and younger ones. See Table 5.

For Danish and Norwegian informants being provided with a scooter, the Danish informants were buying groceries more often than the Norwegian informants ($p=0.006$). Also, the effects of the scooter intervention were larger in the Danish compared to the Norwegian sample concerning doing the laundry ($p=0.015$), cleaning ($p=0.015$), shopping ($p=0.001$), and posting letters ($p=0.035$). However, there were no differences between the two national samples for the other items. Moreover, there were no differences between the two national samples for the ease/difficulty in mobility during participation. There were no differences in the change in the number of participation aspects performed. Therefore, it cannot be concluded that there were differences in effectiveness in terms of frequency of participation and ease/difficulty in mobility during participation between the two samples. Hence, the results do not support Donabedian's conceptual model as regards to structure predicting outcomes.

Table 4. *The frequency of mobility-related participation and ease/difficulty of mobility before (baseline, T1) and after (follow-up, T2) provision of a powered wheelchair or scooter in the total sample, N=180*

	Frequency of mobility-related participation[a]						Ease/difficulty in mobility-related participation[b]						
Item	n	T1 median (IQR)	T2 median (IQR)	Changes between T1 and T2, p-value[cd]	Informants who performed activities at T1, n	Informants who performed activities at T2, n	n	T1 median (IQR)	T2 median (IQR)	Changes between T1 and T2, p-value[cd]	Easier at T2, n	Unchanged at T2, n	More difficult at T2, n
Kitchen work	180	1 (1-3)	1 (1-3)	.766	150	147	138	3 (2-4	3 (2-3)	0.321	40	65	33
Laundry	180	4 (3-8)	4 (3-8)	.603	111	110	100	3 (2-4)	3 (2-4)	0.204	29	46	25
Cleaning	180	6 (3-8)	6 (3-8)	.230	99	95	77	3 (2-4)	3 (3-4)	.499	17	40	20
Take care of children	180	8 (8-8)	8 (8-8)	.243	39	33	25	3 (2-4)	3 (2-4)	.287	9	11	5
Restaurant/cafe/pub	180	6 (5-8)	6 (5-8)	.043	119	126	109	3 (3-4)	3 (2-3)	**<.001**	53	35	21
Hairdresser's	180	6 (6-8)	6 (6-8)	1.000	132	130	120	3 (2-4)	3 (2-3)	.012	44	47	29
Shopping groceries	180	3 (2-8)	3 (2-5)	**<.001**	135	151	131	3 (3-4)	2 (2-3)	**<.001**	70	42	19
Other shopping	179	6 (5-7)	6 (5-7)	.615	137	151	128	4 (3-4)	3 (2-4)	**<.001**	62	44	22
Post	179	7 (6-8)	7 (6-8)	.911	92	95	76	3 (2-4)	2 (2-3)	**<.001**	36	30	10
Bank	180	7 (5-8)	7 (5-8)	.525	104	106	84	4 (2-4)	2 (2-3)	**<.001**	44	29	11
Chemist's	180	6 (5-8)	6 (5-8)	.450	108	113	99	3 (2-4)	3 (2-3)	**.001**	43	37	19
Library	180	8 (8-8)	8 (8-8)	.860	41	39	32	3 (2-4)	2 (2-4)	.091	16	10	6
Social activities/church	180	8 (4-8)	7 (4-8)	.906	86	92	68	3 (2-4)	2 (2-3)	.059	22	32	14
Culture/sport	180	8 (6-8)	8 (6-8)	.149	72	79	55	3 (3-4)	3 (2-3)	.004	25	21	9
Hobbies/physical activities	180	8 (3-8)	8 (3-8)	1.000	59	63	44	3 (2-4)	3 (2-3)	.019	18	19	7
Deliver/collect children	179	8 (8-8)	8 (8-8)	.065	12	10	8	4 (3-4)	3 (2-4)	.157	4	3	1
Going for a walk/ride	180	6 (2-8)	2 (1-4)	**<.001**	105	160	96	3 (3-4)	2 (2-3)	**<.001**	54	27	15
Visiting familiy/friends	180	5 (3-6)	5 (3-6)	.290	157	163	147	3 (3-4)	3 (2-4)	**<.001**	66	67	14
Work/study	180	8 (8-8)	8 (8-8)	1.000	13	14	8	3 (2-4)	3 (2-4)	1.000	2	5	1
Garden	180	8 (6-8)	8 (6-8)	.784	58	52	41	4 (3-4)	4 (3-4)	.690	14	16	11

a Response alternatives: 1=daily; 2=several times a week; 3=about once a week; 4=several times a month; 5=about once a month; 6=several times a year; 7=about once a year; 8=never.
b Response alternatives: 1=very easy; 2=easy; 3=neither easy or difficult; 4=difficult; 5=very difficult.
c The sign test.
d For frequency and ease/difficulty in mobility-related participation p=0.0025 was considered significant.

Table 5.
The significant effects in a 1-year perspective of powered mobility device interventions in terms of increased frequency, easier mobility and increased number of participation aspects performed among adult users in Denmark, Finland and Norway, N=180*

	n	Increased frequency of		Easier mobility when								Increase in no. of
Items		Buying groceries	Going for a walk/ride	Going to restaurant/cafe/pub	Buying groceries	Doing other shopping	Posting letters	Going to the bank	Going to the chemist's	Going for a walk/ride	Visiting family/ friends	Participation aspects
Groups												
Age-group <61 years	48		x									
Age-group 61-79 years	83	x	x		x			x		x	x	x
Age-group >79 years	49					x					x	
Men	86	x	x		x	x		x	x	x	x	
Women	94		x		x					x	x	
Living alone	91	x			x					x	x	
Living with others	89		x			x					x	
Danish sample	46	x	x							x	x	x
Finnish sample	50			x								
Norwegian sample	84		x		x			x		x	x	
Powered wheelchair	32		x	x	x					x		
Scooter	148	x	x		x	x	x	x		x	x	
Good self-reported health	72	x			x					x		
Poor self-reported health	107		x	x	x	x	x	x		x	x	x

* Bonferroni corrections were applied for all analyses ($p<0.0025$), except for the changes in number of participation aspects ($p<0.05$).

X=Indicates items with significant differences in a one year perspective.

Service delivery of assistive devices

Service delivery process study

More time was spent on *assessments*, *administration*, and *total time* in the Danish compared to the Norwegian sample, which indicates that there are national differences in time spent on these steps of the service delivery process. The total median number of minutes spent on the service delivery process was 363 minutes in the Danish and 205 minutes in the Norwegian sample. The results support Donabedian's conceptual model that different structures of assistive technology systems predict what goes on in the service delivery process. For further details, see Table 3 in Paper 4.

In both the Danish and the Norwegian samples, the municipalities did most of the work in the service delivery process. The assistive technology centres in Norway were mainly involved in the administrative work and to some extent in the other steps of the process. The follow-up services were done in about half of the cases in the Danish (56.0%) and in less than half in the Norwegian (41.0%) sample.

The satisfaction scores were high, with about half of the informants being *very satisfied*, and less than one in 16 being either *dissatisfied* or *very dissatisfied.* The *very satisfied* scores were lowest for the follow-up services. Still about three out of four informants were *satisfied/very satisfied* with these services. There were no differences between the national samples, except for satisfaction with the *waiting times*. That is, the informants of the Norwegian were more satisfied than those of Danish sample. A post-hoc analysis showed no association between the real waiting times and user satisfaction when analyzing the samples together as well as separately.

The ordinal regression analysis identified no association between *assessment, selection of models, driving test, follow-up services* and user satisfaction. For further details, see Paper 4.

Discussion

This thesis contributes to increasing the knowledge regarding the psychometric properties of the SATS and the NOMO 1.0, in addition to knowledge about aspects of the service delivery process and the effectiveness of powered mobility devices in daily life.

This thesis addresses methodological development of the SATS and the NOMO 1.0 instruments. Based on the mostly positive results of this thesis, both instruments can be reliably administered in interviews with adult users of powered mobility devices in Denmark, Finland and Norway.

The results show that powered mobility device interventions improve mobility-related participation among adult users in Denmark, Finland and Norway. As the mean age of the informants was 68.7 years, this can show that the powered mobility devices are effective in daily life for people older than this. Specific groups - men, scooter users, and users with poor self-reported health - seem to benefit most from the intervention.

As to the knowledge generated about the service delivery process this thesis identified which steps and who does what in the various steps of the service delivery process when scooters are provided for the first time to adult users. Structural differences of the services seem to be associated with the time spent in some of the steps of the service delivery process. Unlike conclusions by Donabedian (2003) and Hoenig, Lee, et al. (2010) the expected associations between the structures, steps of the service delivery process and the outcomes in terms of user satisfaction and effectiveness were not found.

Outcome of the assistive device intervention

Methodological development

The SATS study

The main result was that the ICC values of all but one item of the Danish and all but three items in the Finnish sample were above the recommended values of 0.70, which indicates that the SATS may be reliably administered for telephone interviews among adult-aged powered wheelchair and scooter users. However, it should be noted that

since only two informants in the Danish sample had received a powered wheelchair, it cannot be concluded that the Danish version of the SATS is applicable for studies with this user group.

The fact that the Cronbach's alpha coefficient was above the recommended level of 0.70 for both the Danish and Finnish samples indicates high internal consistency. Consequently, the SATS seems to capture the same phenomenon, but this provides no evidence whether or not the items assess the phenomenon they claim to assess (user satisfaction with aspects of the service delivery process) (De Vet, Terwee, et al., 2011). On the other hand, high Cronbach's alpha values most likely indicate redundancy rather than a desirable level of internal consistency. So, there is a need to consider whether some of the items should be excluded (Streiner and Norman, 2008), especially in the Danish version of the SATS. The result in the Finnish sample that the inter-item correlation between *instruction and training* and five other items were below 0.20 in addition to fairly low item-total correlations, indicates that *instruction and training* is not able to discriminate satisfaction with the service delivery process very well (De Vet, Terwee, et al. 2011). In addition, a Finnish study has recommended removing the *follow-up* and *all in all satisfaction* items from the SATS. The argument for the latter was that sufficient information could be collected by means of the other items of the SATS (Ahtola, Heinonen, et al., 2011). This means that a revision of the SATS is needed.

The fact that in both samples, fairly high proportions of the informants gave a *does not know* response to the *follow-up* item may represent a validity problem since the acceptability of this item may be questioned (Streiner and Norman, 2008; Mokkink, Terwee, et al., 2012). One reason for the high proportions of the *does not know* responses could be that some of the interviews were carried out before a follow-up took place, so the informants could not actually know how satisfied they were. This indicates that the item should not be administered soon after delivery of the powered mobility device, in contrast to the other items. On the other hand, an average time-span of 72 (SD=49) days between the delivery of the powered mobility devices and the satisfaction interview ought to be ample time for a follow-up to take place. As the follow-up service is an important part of the service delivery process (Hansen, Tresse et al., 2004), there is a need to consider when to ask the users about this. Consequently, the *follow-up* item should be retained in the SATS, but should be asked at a certain time after the delivery of the assistive devices, for example, three months.

Since considerably more than 20 per cent of the informants gave a *very* satisfied response to all the items of both samples, a marked ceiling effect was identified (McHorney and Tarlov 1995). Other assistive technology instruments have the same problem; the wheelchair outcome measure (Auger, Demers, et al., 2010), the Psychosocial Impact of Assistve Devices Scale (PIADS) (Demers, Monette, et al., 2002) and the QUEST 2.0 (Demers, Monette, et al., 2002). One way of solving this challenge

could be to construct an unbalanced scale with more *satisfied* than *unsatisfied* response alternatives. This would result in median values closer to the middle of the scale and effectively increase the variance among the informants and the SATS's responsiveness, and so improving the ICC (Streiner and Norman, 2008). The fact that a ceiling effect was identified in the present study, emphasizes the importance of integrating open-ended questions that allow informants to give qualitative comments to the various items, and to interpret these very carefully (Brazil, Cupido, et al., 2013).

In Paper 1 we recommended a qualitative study to investigate how informants interpret the meaning of the different SATS items, for example, by applying a cognitive interviewing technique (Willis, Reeve, et al., 2005), which could supplement the Finnish SATS face and linguistic study of the instrument (Ahtola, Heinonen, et al., 2011). This was subsequently carried out in a Danish study (Babatunde, Klitgaard, et al., 2014), which concluded that items 1-4 of the SATS had low face-validity as the items seemed to be unclear and that the informants interpreted them differently, possibly due to double-barrel questions (Streiner and Norman, 2008). Items 5-9 had high face-validity (Babatunde, Klitgaard, et al., 2014). Based on the results from the Finnish face and linguistic study by Ahtola, Heinonen, et al. (2011) and the Danish qualitative study by Babatunde, Klitgaard, et al. (2014) in addition to some of the results from the SATS study (e.g. the follow-up item and high internal consistency), there is a need to revise the SATS instrument. A factor analysis should be carried out in order to establish the dimensionality of the items of the SATS and to see whether there is a need for item reduction. Then the reliability of the revised instrument should be established (De Vet, Terwee, et al., 2011).

The NOMO 1.0 study

The results of the present NOMO 1.0 study contribute to increased knowledge about the psychometric properties of the NOMO 1.0 in terms of acceptability, applicability, internal consistency, test-retest reliability, percentage of exact agreement, floor and ceiling effects, and construct validity. With only few exceptions, the items were acceptable to the informants who were able to answer the different questions included in the instrument. The reliability of the three scales and the index was acceptable, as with only some exceptions the values were above the recommended values. Consequently, the NOMO 1.0 may be used for research interviews with adult powered mobility device users.

The fact that the ICCs for almost all of the items of the *frequency* scale were above the recommended level of 0.70, indicate that these items of the NOMO 1.0 have satisfactory reliability. The result that the ICC values were above 0.70 for only two of the items of the *ease*/difficulty scale may be caused by the probability that the informants visit different grocery stores, shops, restaurants/cafes/pubs-/etc. and may have thought of different places with different environmental challenges in the test and

retest interviews when being asked to rate the degree of ease/difficulty. Previous research also suggest thinking of different places as a possible cause (Brandt, Löfqvist et al., 2008; Pettersson, 2014). In addition, more moderate ICCs may also be caused by informants' difficulties to recall affective experiences (Kreuger and Schkade, 2008; De Vet, Terwee, et al., 2011). As e*ase/difficulty* refers to affective experiences and cognitive judgements, it may be susceptible to mood differences at the two interviews. A study within the field of subjective well-being has for example documented that such subtle events influenced the results, and that 4 per cent to 34 per cent of the total variance were accounted for by situation-specific factors (Kreuger and Schkade, 2008). One reason for the good reliability of the *frequency* scale compared to the *ease/difficulty* scale may that the *frequency* scale focuses on reconstructing specific events and probably is less vulnerable to current mood or environmental challenges at the time of the interview. As the ICC values were above 0.50 for 15 of the 20 items of the *ease/difficulty* scale, and previous studies claim that acceptable items are expected to demonstrate ICCs of 0.50 or higher, our results may be thought of as suitable (Demers, Weiss-Lambrou et al., 2001; Brandt, Löfqvist et al., 2008).

The fact that the Cronbach's alpha values were above the recommended level of 0.70 may be because the scale consists of many items (De Vet, Terwee et al., 2011). However, concerning the *frequency* items, with 133 of 190 inter-item correlations <0.20 and item-total correlations <0.30 for six items, this indicates that the items of the *frequency* scale are not part of the same construct (De Vet, Terwee, et al., 2011). One reason for low inter-item correlation may be because the *frequency* scale is a broad concept ranging from indoor activities like kitchen and household maintenance to many different outdoor activities which represent different challenges when it comes to mobility-related participation. The fact that the six components identified for the *frequency* scale indicates a multi-dimensional scale, which means, for example, that a sum score for the scale is not applicable because the summation process loses information about the underlying separate components. On the other hand, presenting one score for each component is an alternative (De Vet, Terwee, et al., 2011). As an exploratory factor analysis is used in the early stages of research in order to generate hypotheses about the relationship between the components, all relevant components should be included (Tabachnick and Fidell, 2013). Further psychometric testing is needed before a final conclusion can be reached. However, one can see the present results as empirical results of the component structure of the frequency scale. Thus, a hypothesis can be made, which in future studies can be tested by means of confirmatory factor analysis. Unlike the *frequency* scale, the items included in the *need for assistance* scale seem to be uni-dimensional, and a sum score for the scale can be made (De Vet, Terwee, et al., 2011).

The effectiveness study

Using the NOMO 1.0 instrument (Brandt, Löfqvist, et al., 2008), developed to evaluate mobility device intervention in terms of mobility related participation in a pre-post study, it was possible to follow the informants over the course of one year. The main contribution that the effectiveness study makes is the finding that powered mobility device interventions make mobility easier during participation and increases the frequency of participation aspects such as buying groceries and going for a walk/ride, and that the outcomes results varied regarding the sub-groups. Men, scooter users, and users with poor self-reported health seem to benefit the most from the use of powered mobility devices. The results further strengthen the available evidence that powered mobility devices increase mobility-related participation in daily life among adults with mobility restrictions (Brandt, Iwarsson, et al., 2004; Pettersson, Törnquist, et al., 2006; Evans, Frank, et al., 2007; Hoenig, Pieper, et al., 2007; Auger, Demers, et al., 2010; Löfqvist, Pettersson, et al., 2012; Samuelsson and Wressle, 2014). It may be concluded from this that the devices seem to be effective and relevant in daily life for the users, many of them being older people. The *ease/difficulty* scale seems to be the central outcome of the study. However, the moderate ICC values of this scale show that large and heterogeneous samples are needed in order to produce significant effects (De Vet, Terwee et al., 2011). Further, *ease/difficulty* may also have other effects than those found in this study, and should be investigated in future studies.

As identified in the service delivery process study (see Paper 1), it is possible that not all of the steps of the service delivery process may have been carried out in all cases. Nevertheless, the service delivery process seem to have resulted in powered mobility device models that enable people with mobility restrictions to participate in daily life. On the other hand, future research ought to investigate if the number of steps completed in the service delivery process is associated with the effectiveness of powered assistive devices.

One reason why the frequency of participation did not increase for more aspects in the present study may be that adults have defined roles in daily life and usually continue to do what they previously have been doing (Auger, Demers et al., 2010; Dijckers, 2010). Moreover, existing research literature has concluded that *buying groceries* and *going for a walk/ride* are two of the few participation aspects that usually increase in frequency after powered mobility device provision. Consequently, an increase for more participation aspects may not be expected (Hoenig, Pieper, et al., 2007; Edvards and McClusky, 2010; Löfqvist, Pettersson, et al., 2012; Samuelsson and Wressle, 2014). Still, a small but significant increase in the number (0.64 participation aspects) of participation aspects performed after the provision of powered wheelchairs and scooters was found. Such a small increase can rather be regarded as a matter of maintenance of daily activity repertoire rather than an actual increase. Moreover, the changes varied considerably among the informants, from an increase of up to ten aspects to a decrease

of six participation aspects performed, indicating that not all users benefit equally from the powered mobility device interventions. Nevertheless, even if the results did not identify other participation aspects and only a small increase in the number of participation aspects performed, the results show that, to a great extent, the users were able to do what they intended to do and had previously done with their powered mobility devices.

Men seem to benefit more from the intervention than women, which support previous research (Brandt, Iwarsson, et al., 2004; Auger, Demers, et al., 2010). One explanation may be that women appear to use their mobility devices less than men while being away from their homes (Auger, Demers, et al., 2010), and that men use their powered mobility device more for prioritized and different aspects than women (Brandt, Iwarsson, et al., 2004). Another explanation may be that men have better powered mobility device driving skills than women resulting in more use of the devices (Hall, Partnoy, et al., 2005). However, there was a tendency for women to perform all the participation aspects more frequently than men, both before and after the powered mobility device intervention. For example, at baseline women were *buying groceries* more frequently than men, while at follow-up there were no gender differences, indicating that the powered mobility device use had a greater impact in terms of increased frequency on men compared to women when buying groceries. Further, compared to the women there was a tendency for men to achieve easier mobility between baseline and follow-up, resulting in significant differences for more participation aspects compared to women. While we have some knowledge about gender differences, more information is needed in order to fully comprehend gender differences concerning powered mobility device use.

The finding that the impact of the powered mobility devices seems to be larger for people aged 61-79 years than for the other age groups may be explained by the fact that a larger percentage of these informants lived alone compared to those in the youngest age group. Thus, they presumably had less people to assist them in aspects such as buying groceries. Concerning informants younger than 61 years, more powered wheelchair users and having more health problems compared to others may have made them more dependent on the person(s) they lived with. Therefore, the powered mobility devices may have had relatively little impact on the youngest age group's participation aspects. Furthermore, the oldest age group did not seem to benefit from the powered mobility device intervention to a great extent. Previous research has shown that very old mobility device users use their powered mobility devices to a lesser extent than younger age groups (Brandt, Iwarsson, et al., 2004), which may reflect that very old people generally are less active than the younger ones. Perhaps the users of powered mobility devices do not want to get out as much as the younger ones, but on the other hand, perhaps they want to go out more, but cannot of unknown reasons. Consequently, more knowledge is needed about the different age groups and the use of powered mobility devices.

Service delivery process of assistive devices

Service delivery process study

Studies within the field of powered mobility have generally been concerned with the assistive devices and with less focus on the service delivery process. This study is a step towards a better understanding of the impact the service delivery process has on the effectiveness of powered mobility devices.

The main contribution of the service delivery process study is the finding that the service delivery processes in terms of time use differ between the two national samples studied. Another important finding is that the user satisfaction regarding the different aspects of the service delivery process was generally high, and was not associated with the time use in the service delivery process.

The fact that the informants' satisfaction with the various steps of the service delivery process were high in both the Danish and Norwegian samples may indicate that the occupational therapists and physiotherapists in these countries generally do a good job regarding scooter provision, which is supported by other studies (Jedeloo, De Witte et al., 2002). Federici and Borsci (2014) concluded that there was a strong correlation between a high degree of user satisfaction with the processes and user perception of the existence of high quality service delivery processes, which support that the service delivery processes probably have been of reasonably high quality in both countries. One explanation for no differences in user satisfaction between the two national samples could be the fact that most of the time in the service delivery process was spent on assessments and administration, neither of which is visible or important for the users in the sense of knowing the professional appraisals and judgments before a final conclusion. Thus, this does not impact user satisfaction. The fact that a ceiling effect was found in the SATS study, which reduces the instrument's responsiveness, may be one explanation why it was difficult to detect an association between user satisfaction and the time spent on different steps of the service delivery process and also to detect differences between the two national samples.

One may wonder about what is being measured when we ask users to rate their satisfaction because of the fact that there were no differences in user satisfaction between the two samples in spite of differences in the time spent on different aspects of the service delivery process. Moreover, according to Donabedian's model the results were unexpected. There is some evidence that interpersonal attributes in terms of the psychosocial interplay between the therapist and the user is a key determinant of user satisfaction regarding the services (Lian and Wilsgaard, 2005; Mathiesen, Freil, et al., 2007; Hush, Cameron, et al., 2011; Suhonen, Papastavrou, et al., 2012). One explanation for this is that the users are incapable of assessing the technical aspects of

the service delivery process because of their lack of knowledge of this aspect of the services, and that their evaluation therefore may be affected by other factors, such as the extent that the therapists are willing to answer questions, or even their politeness (Mathiesen, Freil et al., 2007). Consequently, user satisfaction may be more dependent on the user/therapist relationship than on the time spent in the service delivery process.

Based on this, it may be questioned whether user satisfaction within the service delivery process (as opposed to user satisfaction with the assistive devices) is an outcome in terms of effects on the lives of users and their environments (Jutai, Demers, et al., 2005), or rather a quality indicator and hence, evidence for more or less successful service delivery processes (Dittmar, 1997; Donabedian, 2003; Jutai, Demers, et al., 2005; Lenker, Fuhrer, et al., 2010). Satisfaction with the service delivery processes as a quality indicator may act as an intermediate factor, which has an impact on real outcomes, such as effectiveness in terms of performance of activities and overall satisfaction with the assistive devices.

The conclusions in a qualitative study by Gramstad, Storli, et al. (2014) challenge the notion of satisfaction with the service delivery process as being measurable, as there may be several complicated reasons for older people not to acknowledge unsatisfactory experiences in the service delivery process. If so, this may also explain why there was no significant association between user satisfaction and the time spent in the service delivery process in our study. However, we have no information to support the conclusions made by Gramstad, Storli, et al. (2014).

The finding that the assessments and administration were done in almost all the cases in both the Danish and Norwegian samples, and that selection of model, driving tests, individual adaptation of the device, follow-up services and other activities were carried out to a varying degree, are partly supported by other studies. For example, a study by Evans et al. (2007) concluded that users were concerned that they would not be assessed in time for changing needs. The question is whether all the steps need to be carried out in all the cases. Future studies are needed to investigate this.

The fact that follow-up was ignored in about half of the cases in the study perhaps indicates a problem since follow-up is important in order to ensure that the scooter functions appropriately over time (Jedeloo, De Witte, et al., 2002; Evans, Frank, et al., 2007; Scherer, Jutai, et al., 2007). On the other hand, the time-span between the delivery of the scooter and the time registration may have been too short in some cases for follow-up to take place. Yet, as identified in 30 per cent of the cases in a Swedish study on manual wheelchairs and wheeled walkers covering a period of 12 months, there may not have been a need for follow-up (Samuelsson and Wressle, 2008). However, we have no information to support this. Nevertheless, the fact that user satisfaction was lowest concerning follow-up services coincides with findings in other studies measuring satisfaction with the service delivery process of powered wheelchairs (Wressle and Samuelsson, 2004; Brandt, Kreiner, et al., 2010), indicating that high

satisfaction scores on follow-up services are unusual. On the other hand, the satisfaction scores with the *follow*-up item were still fairly high. One reason for this may be due to users' lack of acknowledgement of unsatisfactory experiences (Gramstad, Storli et al., 2014).

Donabedian's conceptual model

Based on experiences by Donabedian (2003) and the review by Hoenig, Lee, et al. (2010), one of the aims of this thesis was to investigate whether Donabedian's conceptual model for quality assessment is applicable when scooters are provided to adult users in a Nordic context.

The result that more time was spent on assessments, administration and total time in the service delivery process of the Danish compared to the Norwegian sample, and the fact that there are structural differences in terms of different rules between the two countries supports that the structure predicts the processes (Donabedian, 2003). However, with no differences in effectiveness and user satisfaction between the Danish and Norwegian samples of scooter users, the assumptions that the structure and the service delivery process predict the outcomes are not supported.

The fact that some users must pay a part of the cost of the scooter is one important explanation how structural differences seem to predict the time spent in the service delivery process. In this thesis, 34 (68%) of the informants had paid part of the cost of the scooter themselves which means that the Danish therapists must decide who is eligible to receive the scooter free of charge and who is not. In Denmark, the therapists must do the assessments extremely thoroughly in order to reach a correct decision because the decision has economic consequences for the user. In addition, they need to spend a great deal of time documenting the service delivery process thoroughly, while this amount of documentation is not needed in Norway. Consequently, it is reasonable to think that the differences in rules (structure) between Denmark and Norway concerning scooters is an important reason for more time spent on the different steps of the service delivery process in the Danish sample. This explanation is supported by a previous Danish study, which concluded that the time spent on the service delivery process had increased on average by 76 per cent since the new rules were implemented in 2008 (Mindegaard and Andersen, 2011).

The finding that the informants in Denmark had more health problems and had more assistive devices before they received the scooter, indicate that the criteria for being provided a scooter are stricter in Denmark compared to in Norway. This could also be another explanation for why more time was spent on the steps of the service delivery process in Denmark. Unlike the informants of the Danish sample, many of the informants in Norway lived in rural areas. In these small communities the therapists probably know most of the users personally and therefore also their health situation

reasonably well, possibly resulting in less extensive documentation. This could explain why less time was spent on assessments, administration and total time in the Norwegian compared to the Danish sample. Consequently, it is important to investigate whether stricter rules in Denmark compared to Norway, or tacit knowledge have any influence on the time spent in the service delivery processes of scooters in the two countries.

In spite of the fact that our results support that structure predicts the process, other aspects of structure than the rules can perhaps explain the time differences between the two samples. Differences between the two countries in terms of rehabilitation staffing, leadership, and equipment would influence the structure (Needham and Koruplu, 2010). Another possibility is differences in experiences in assessing users for assistive device solutions between the therapists involved in this study. However, we have no information to support this.

The result that neither differences in rules nor differences in time seem to predict the outcomes in terms of user satisfaction and effectiveness, can be explained by too small differences between the service delivery systems of the two countries. In all the Nordic countries experienced occupational therapists or physiotherapists usually do the assessment of users thoroughly, and in cooperation with the users, testing different models of powered mobility devices with great skills in order to find a device that fits the users' needs (NUH-Nordic centre for Rehabilitation Technology, 2007). In other countries like between Latvia and Sweden the structural differences are larger, which may affect how the service delivery process is realised in practise (Kylberg, Löfqvist, et al. 2014). Perhaps comparing the outcomes in terms of effectiveness and user satisfaction with countries with larger structural differences would give other results? Future research is needed in order to answer this question.

The results do not support that structure or process predict the outcomes in terms of user satisfaction with the service delivery process and effectiveness of the interventions, except for the fact that Danish informants increased their frequency buying groceries, doing the laundry, cleaning, shopping, and posting letters more than the Norwegian informants. Still, there were no differences regarding the other participation aspects. Based on Donabedian's conceptual model and the review by Hoenig, Lee, et al. (2010), our anticipations that structural difference, and the differences in time spent on the service delivery process predict the outcome in terms of user satisfaction and effectiveness are not supported by the present results.

Based on the results in this thesis, one should be careful to make conclusions, and await the results from testing in other contexts and within other fields of assistive devices before reaching strong conclusions. With robust research based on several projects pointing in the same direction, the situation would be quite different. On the other

hand, the results of the present thesis contribute to some understanding of the relationship between the key elements of Donabedian's conceptual model within assistive technology, and the results should inspire to further testing of this relationship.

Methodological considerations

As the informants of the project were recruited based on consecutive sampling from different sources, the informants represented a variance in terms of urban and rural areas, amongst other things. However, when interpreting the results it should be kept in mind that neither of the samples was nationally representative for the populations of powered mobility device users. Moreover, not all the Nordic countries were represented in the studies as no Swedish or Icelandic informants participated. Moreover, the Danish, Finnish and Norwegian informants were not included in all studies. Therefore, the results of this thesis cannot be generalized to all powered mobility device users in the Nordic countries.

One limitation to the recruitment of the informants is that no standardized assessment was used to evaluate their cognitive functioning due to practical reasons. On the other hand, the case managers had good knowledge about the potential informants, and with their longstanding professional experience, it was believed that they were capable of making a valid selection.

De Vet, Terwee, et al. (2011) emphasize that reliability is a characteristic of an instrument used in a population. Consequently, if the SATS and the NOMO 1.0 are to be used in other cultures and for other types of devices or user groups, further psychometric testing should be carried out.

Telephone interviews were chosen for the SATS study and part of the service delivery process study because this method has been found to be reliable for investigations within assistive technology (Auger, Demers, et al., 2010). Telephone interviews are less time consuming than face-to-face interviews (Holbrook, Green, et al., 2003) and give access to broad geographical area at a lower cost. On the other hand, telephone interviews may have some disadvantages, one of which may be the reduction of social cues. The interviewer does not see the informant, so the body language cannot be used as a source of extra information. However, social cues as voice and intonation are still available. Although social cues are reduced, enough social cues usually remain while doing a telephone interview without a hindrance (Opdenakker, 2006). As for the data collection made in telephone interviews (questionnaires mailed to the informants on beforehand) and during home visits the informants were shown the different response alternatives to the questions, which probably helped the informants to get an overview of the response alternatives and to select the appropriate one. During the home visits

the informants had the opportunity to observe the users and his/her surroundings to see whether, for example, a spouse tried to influence the responses made by the informants. If so, the interviewer could politely ask him/her to refrain from doing so.

A limitation of the SATS study is that no information about possible changes in the informants' situations between the test and retest was collected in Finland. Changes could have affected the informants' responses and these informants should have been excluded from the study (Streiner and Norman, 2008). However, the chance for such changes to happen during the maximum of 18 days interval between the interviews is small, and is probably the reason why a question about this has not been asked in other test-retest reliability studies (Mills, Holm, et al., 2007; Auger, Demers, et al., 2010; Patterson, McDonald, et al., 2014). In Denmark, to assure that the informants did not have access to the results from the first interview when the interviews were repeated, their SATS forms were returned by mail immediately after the first interview. In Finland, this procedure was not applied, but a closer inspection of the collected data showed that no informants gave exactly the same responses in the two interviews. Consequently, there is no reason to believe that the slightly different modes of administration affected the results.

A noteworthy strength of the effectiveness study is the prospective design, and that the sample was diverse and large enough to allow for valid sub-group analyses. A possible limitation of the effectiveness study may be the one year period between the baseline and follow-up due to the risk of negative incidences during the period that may have influenced on the results. However, a previous study showed that a four month follow-up interval gave the same results as a one year follow-up (Löfqvist, Petterson et al., 2012). Moreover, an interval of more than one year may be considered a strength of the present thesis as Gitlin, Luborsky, et al. (1998) defined the initial six months after powered mobility device provision corresponding to an initial use period, while the stage beyond the first year delineates expert use. In this thesis, it was believed that expert use is necessary for a valid evaluation of the effectiveness of powered mobility device interventions.

Concerning the effectiveness study and in contrast to studies by Hoenig, et al. (2007) and Auger, et al. (2010) with similar results, our study was a "before and after comparison" and not a randomized controlled trial, which may be considered as a study limitation (Cochrane, 1973). However, a controlled design would require providing the powered mobility devices to some users and not to others, and since the legislation in the Nordic countries entitles persons with disabilities to assistive devices mostly free of charge (NUH-Nordic centre for Rehabilitation Technology 2007), such research is not possible due to legal and ethical reasons (Djulbegovic and Hozo, 2002). Furthermore, according to Djulbegovic and Hozo (2002) randomized controlled studies should be undertaken only if there is substantial uncertainty about which intervention would benefit a person most. With few exceptions we found moderate to

large positive changes after powered mobility device interventions. Since the results from previous research are pointing in the same direction, there can be no substantial doubt of the effectiveness of powered mobility devices regarding mobility-related participation in daily life (Benson and Hartz, 2000).

In the effectiveness study, the lack of information about the outdoor environment barriers such as high curbs, uneven pavement, and hills may be considered a study limitation. Environmental barriers may have caused accessibility problems, possibly contributing to the explanation of the variation in number of participation aspects performed (Brandt, Iwarsson, et al., 2004). Edvards, et al. (2010) concluded that less than two thirds of the informants agreed that they could access most locations when using their powered mobility device, indicating the presence of barriers to some informants. On the other hand, Evans, Frank, et al. (2007) reported that reasons for infrequent use did not relate to environmental barriers. Brandt, Iwarsson, et al. (2004) concluded that apart from visiting family and friends, physical barriers did not play a pronounced role in performing other participation aspects. One explanation may be that the users have adapted their behavior by choosing routes without physical barriers or by going to accessible places rather than to places they really want to go to (Fänge, Iwarsson, et al., 2002). In contrast to shops and restaurants, the specific homes of family and friends cannot be replaced by another. In this thesis, as users who had moved to a different environment (a new house/flat) between baseline and follow-up were excluded from the analyses, the physical environment was considered to be a stable factor during the one year study period.

Concerning all studies, the number of interviewers may also be a limitation of the thesis because interviewers with different levels of experience from using standardized instruments could have influenced the variance error (Slaug, Schilling et al., 2012). However, the interviewers in this study were all trained to perform the interviews. Apart from the Norwegian data collection for the SATS study, there was no information indicating that the other interviews were performed in a sub-optimal way or differently in the three countries. For scientific purposes it is preferable to have a small number of trained interviewers in order to maximize reliability. The fact that the present thesis had many interviewers simply reflects the complex reality of the clinic setting (De Vet, Terwee, et al., 2011). That is, since the SATS and the NOMO 1.0 will be used by numerous interviewers and not only in ideal research circumstances by trained researchers, the number of interviewers may be considered a strength (Iwarsson and Isacsson, 1996).

Conclusions and Implications

Conclusions

This thesis has contributed to the methodological development in the field of assistive technology and has generated new knowledge about the effectiveness and the service delivery process when powered mobility devices are provided to adult first time users in a Nordic context. Some of the results have been used to investigate the relationship between the three key elements of Donabedian's conceptual model when scooters are provided to users from two Nordic countries, Denmark and Norway.

As most of the results from the psychometric testing of the SATS and NOMO 1.0 were above the recommended levels, both instruments can be reliably administered in studies among adult users of powered mobility devices in Nordic context. The factor analysis of the *need for assistance* and *frequency* scales of the NOMO 1.0 identified uni-dimensionality for the first scale and multi-dimensionality for the other. However, further psychometric testing is required for the NOMO 1.0 regarding the validity. As for the SATS, the instrument needs to go through a basic investigation of its validity. There is a need to consider the wording of the items in order to avoid, for example, double-barrel questions. A factor analysis should be carried out in order to establish the dimensionality and to see if there is a need for item reduction. In other words, a revision of the instrument is needed. Concerning the NOMO 1.0, (further validity studies) a confirmatory factor analysis is needed. Reliability and validity studies are needed for the study-specific questionnaires used in the SATS study. All three instruments need to be psychometrically tested in other user groups of assistive devices than powered mobility devices and in other cultures than the Nordic countries.

Supporting previous research, this thesis showed that the powered mobility device interventions increase mobility-related participation in daily life among adult users in a Nordic context. Mobility became easier for several aspects, and *buying groceries* and *go for a walk*/ride were carried out more frequently. Men, scooter users, and users with poor self-reported health seem to benefit the most from the interventions.

Assessments and administrative work were accomplished in almost all the cases, while the other steps of the service delivery process were carried out to a various degree when

scooters were provided to users in Denmark and Norway. More time was spent on assessments, administration and total time in the Danish sample. The user satisfaction with different aspects of the service delivery process was high. However, there was no association between time spent in the service delivery process and use satisfaction and effectiveness.

The finding that there were differences in time spent on the service delivery process between samples from two countries with structural differences confirm the assumption that structure of the services predicts the time spent in the service delivery process. Different rules regulating the area seem to be an important explanation for the time differences. The expected association between the structure, the time spent in the service delivery process and the outcomes in terms of user satisfaction with the service delivery process and effectiveness was not found.

Implications for practise

Assessment instruments of high quality are needed in order to generate necessary knowledge in the field of assistive technology (Lenker, Scherer, et al., 2005). This thesis contributes to methodological development of the SATS and the NOMO 1.0., which can be used in studies within the field of powered mobility devices within the Nordic countries. It should be kept in mind that, due to moderate ICC values to the *ease/difficulty* scale og the NOMO 1.0, fairly large and heterogeneous samples are needed.

Policy makers responsible for the assistive technology systems need to consider the efficient use of financial resources when they plan the services. The conclusion that the national differences in regulations seem to be an important explanation for the time differences in the service delivery process in this thesis, is something politicians should bear in mind when they want to implement new regulations within the field of powered mobility devices. Changes may have unintended consequences.

This thesis contributes to the evidence of the effects of powered mobility devices to adults with mobility restrictions. Participation in daily life includes activities in and outside the home. Therefore, people with disabilities need support to maintain a variety in their repertoire of participation aspects. The results that the interventions increase the mobility-related participation in daily life is a piece of evidence that indicate that such support is achieved and that investing in powered mobility devices is important for the users' health and well-being (World Health Organization WHO and The World Bank, 2011).

Implications for future research

In spite of satisfactory psychometric properties of the SATS and the NOMO 1.0, further psychometric testing of the instruments is needed. The NOMO 1.0 needs further testing for construct validity in terms of a confirmatory factor analysis in order to test whether the data fit a predetermined component structure (De Vet, Terwee, et al., 2011).

Concerning the SATS, the instrument needs first of all to be revised. Secondly, a qualitative study to investigate how informants interpret the meaning of the different SATS items is recommended, for example, by applying a cognitive interviewing technique (Willis, Reeve, et al., 2005). As a third step and in order to investigate the component structure of the instrument, an explorative factor analysis should be carried out. Further reliability studies to investigate the revised instrument's acceptability, applicability, internal consistency, test-retest agreement, percentage of exact agreement, and floor/ceiling effects should be carried out. The same should be carried out for the study-specific instruments used in this thesis.

The SATS was constructed to assess the service delivery process of all kinds of assistive devices, while the NOMO 1.0 was constructed to evaluate the effectiveness of mobility assistive devices. Consequently, the instruments should also be tested with other user groups than powered mobility device users before being used in research studies with these groups. It is important to compare the results between countries with different service delivery systems. Therefore, psychometric testing of the instruments with user groups outside the Nordic countries should be carried out if they are to be used in other countries.

The service delivery process is important in order to ensure that the users are provided with assistive devices that meet their needs. To get a better understanding of the role of the service delivery process, there is a need to investigate if the number of steps accomplished in the service delivery process is associated with the effectiveness of assistive devices, and if some of the steps of the process are unnecessary for some of the user groups.

More knowledge is needed about the effects of powered mobility devices related to the different age groups, and researchers should take steps to plan and carry out studies within this field. The results may contribute to a further explanation to why some age groups seem to benefit more from powered mobility devices than others.

In today's society, evidence of effectiveness is often not enough. As much emphasis is put on the economic consequences of different services, including assistive technology, there is a need to investigate the efficiency of systems and interventions (Donabedian, 2003). For example, cost benefit studies are needed within the field of assistive technology.

Norsk sammendrag / Norwegian summary

Bakgrunn

Å kunne bevege seg rundt omkring er en forutsetning for å utføre ulike aktiviteter i hverdagen. Sykdom og skade kan føre til bevegelsesvansker og funksjonsnedsettelse hos den enkelte. Tilgang til hjelpemidler er viktig for personer med bevegelsesvansker fordi hjelpemidlene kan kompensere for brukernes funksjonstap, og brukes i dag av mange, ikke minst eldre mennesker. Verdens helseorganisasjon WHO vektlegger det å inkludere den eldre befolkningen og skape forutsetninger for at eldre også kan være aktive og delaktige i samfunnet. I og med at eldre mennesker i gjennomsnitt har flere kroniske sykdommer og flere funksjonsnedsettelser enn den øvrige befolkningen, vil en aldrende befolkning gi noen utfordringer på hjelpemiddelområdet i de kommende årene. I de nordiske landene brukes det i dag mange ressurser på hjelpemidler, og en økning i antall eldre vil bety at flere vil ha behov for hjelpemidler i årene framover.

For å sikre en effektiv ressursutnyttelse, er det viktig å evaluere hvilken nytte brukerne har av hjelpemidlene. Dessuten er det viktig å identifisere hva som karakteriserer de som har nytte av hjelpemidlene og de som ikke har det. Likeledes er brukernes evalueringer av tjenestene viktige fordi slike evalueringer kan informere og rettlede beslutningstakere og fagfolk blant annet til å identifisere optimale måter å organisere og utføre tjenestene på. For å evaluere disse tingene, trengs det instrumenter av høy kvalitet og med kjente psykometriske egenskaper. I denne avhandlingen er det tatt utgangspunkt i brukere som har fått utlånt en elektrisk rullestol med manuell styring (scooter) eller joystick styring (elektrisk rullestol) i tre nordiske land: Danmark, Finland og Norge.

Donabedian's model for kvalitetsundersøkelser er sentral i avhandlingen. Modellen beskriver tre ulike faktorer: *struktur, prosess* og *outcome.* Ifølge Donabedian selv og en litteraturgjennomgang innenfor forskning blant slagrammede, er det en sammenheng mellom de tre faktorene ovenfor: struktur predikerer prosess og outcome, mens prosessen også predikerer outcome. *Structure* omfatter infrastrukturen for tjenestene og omfatter blant annet regelverket som styrer området. På hjelpemiddelområdet gjelder dette reglene som bestemmer hvem som kan få/ikke få låne hjelpemidler fra det

offentlige. *Process* omfatter det som foregår mellom fagfolkene og den enkelte bruker. På hjelpemiddelområdet gjelder dette for eksempel utredninger, utprøvinger av ulike typer hjelpemidler, testkjøring av elektriske rullestoler og scootere, nøvendige tilpasninger av hjelpemidlene, oppfølgingen som gis etter at hjelpemidlet er tatt i bruk. Administrative arbeid er også en del av prosessen. *Outcome* er sluttresultatet av en formidlingsprosess. På hjelpemiddelområdet omfattes dette blant annet av hvilken nytte brukerne har av hjelpemidlene sine. Brukertilfredshet tilhører også innenfor denne gruppen.

Ett av målene i denne avhandlingen er å undersøke de psykometriske egenskapene til to sentrale instrumenter i avhandlingen: *Satisfaction with the Assistive Technology Services (SATS)* og *the Nordic Mobility Related Outcome Evaluation of Assistive Device Intervention (NOMO 1.0)*.

Et annet mål er å undersøke hvilken nytte de ulike informantene har av hjelpemidlene i form av lettere utførelse og økning i antall og utførelse av aktiviteter i hverdagen, målt med NOMO 1.0.

Det er også ett av formålene med denne avhandlingen å beskrive tidsbruken og hvem gjør hva i formidlingsprosessen (studiespesifikt instrument), samt brukernes tilfredshet med ulike aspekter ved prosessen (tilfredshet målt med SATS). Videre er det et mål å undersøke hvordan ulike hjelpemiddelsystemer påvirker formidlingsprosessen og resultatene av den.

SATS er konstruert for å evaluere brukernes tilfredshet med ulike aspekter ved hjelpemiddelformidlingen: *Tilgjengelighet til fagfolkene, informasjon om hjelpemidler som er gitt, koordinasjon mellom fagfolkene, fagfolkenes kunnskaper om hjelpemiddelløsninger, ventetiden, brukernes mulighet til å delta i formidlingsprosessen, opplæring i bruken av hjelpemidlet, oppfølgingen etter at hjelpemidlet er tatt i bruk, alt i alt, hvor fornøyd er du med formidlingsprosessen i denne saken.* Brukerne blir bedt om å besvare spørsmålene ut ifra en fem punkt skale fra 1=svært misfornøyd til 5=svært fornøyd. Det foreligger også et *vet ikke* svar alternativ. For mer informasjon, se Paper 1.

NOMO 1.0 er konstruert for å evaluere nytten av forflytningshjelpemidler, og består av fire ulike skalaer: 1) *behov for hjelp fra andre under forflytning*; 2) *hvor ofte utføres ulike aktiviteter i dagliglivet* (20 aktiviteter); 3) *hvor lett/vanskelig det er å forflytte seg* når aktiviteter i dagliglivet uføres (de samme 20 aktivitetene; og 4) *antall utførte aktiviteter* (indeks). Informantene intervjues to ganger. Det første intervjuet skjer i det de er i ferd med å få utlånt et forflytningshjelpemiddel. Det andre intervjuet skjer etter at informantene har brukt forflytningshjelpemidlet minst 3-4 måneder. Forskjellen mellom det første og det andre intervjuet gir et uttrykk for nytten av forflytningshjelpemidlet. For mer informasjon, se Paper 2.

Delstudiene i avhandlingen omfattet voksne brukere som har fått utlånt en elektrisk rullestol eller scooter for første gang. Informantene ble rekruttert fra Odense kommune

i Danmark, fra 10 av 20 sykehus distrikter i Finland, og fra 8 av 19 fylker i Norge. En oversikt over de ulike delstudiene og datainnsamlingen er presentert i Tables 2 og 3, samt Figure 1 ovenfor.

Delstudie 1 (Paper 1)

I delstudie 1 undersøkte vi de psykometriske egenskapene til SATS instrumentet i form av test-retest reliabilitet og agreement blant voksne brukere av elektriske rullestoler og scootere i danske og finske utvalg. De samme informantene ble stilt de samme spørsmålene i to telfonintervjuer med ca to ukers mellomrom av samme intervjuer. Reliabilitet, andel exact agreement, intern konsistens og floor/ceiling effekt ble undersøkt. Resultatene viste at de fleste verdiene var innenfor anbefalte nivåer.

Studien viste at resultatene til SATS instrumentet var sammenlignbare med andre instrumenter innenfor hjelpemiddelområdet og at SATS kan benyttes i telefonintervjuer blant brukere av elektriske rullestoler og scootere. Imidlertid, revidering av instrumentet og ytterligere psykometrisk testing av instrumentet er nødvendig.

Delstudie 2 (Paper 2)

I delstudie 2 undersøkte vi test-retest reliabilitet og agreement, samt konstruksjonsvaliditet til NOMO 1.0 blant voksne brukere i danske, finske og norske informanter med elektriske rullestoler og scootere. Instrumentets generelle akseptanse, lett/vanskelig skalaens anvendelse, intern konsistens, test-retest reliabilitet, andel exact agreement, floor/ceiling effekter ble undersøkt. En faktor analyse ble gjennomført for å undersøke instrumentets konstruksjonsvaliditet. Data i forbindelse med test-retest reliabilitet og agreement delen ble innhentet ved hjelp av to intervjuer med ca to ukers mellomrom.

Resultatene viste at reliabiliteten var akseptabel, og med de fleste verdiene innenfor aksepterte verdier. Faktor analysen identifiserte en komponent for *behov for hjelp fra andre* skalaen, og seks komponenter for *hvor ofte* skalaen. I fremtidige studier bør instrumentet testes for sensitivitet og ytterligere validitetstesting.

Delstudie 3 (Paper 3)

I delstudie 3 ble det undersøkt hvilken nytte voksne danske, finske og norske informanter har hatt av sine elektriske rullestoler og scootere i et ettårs perspektiv. Gjennomsnittsalderen for informantene var 69 år. Resultatene viste at det ble lettere å utføre mange aktiviteter, og at innkjøp av dagligvarer og kjøre på tur ble utført oftere enn før informantene fikk hjelpemidlene. Antall utførte aktiviteter økte litt, men ikke i samme omfang. At informantenes gjennomsnittsalder var 69 år (noe som betyr at halvparten av informantene var eldre enn 69 år) viser at den eldre delen av befolkningen ser ut til å ha god nytte av elektriske rullestoler og scootere. Angående alder, gruppen 61-79 år ser ut til å ha mest nytte av disse hjelpemidlene. Basert på positive endringer for flest aktiviteter viser resultatene at menn, scooter brukere og brukere med dårlig selvrapportert helse har mest nytte av de elektriske rullestolene og scooterne.

Studiens resultater styrker bevisene for at elektriske rullestoler og scootere øker deltakelsen i dagliglivet for voksne mennesker med nedsatt funksjonsevne.

Delstudie 4 (Paper 4)

I delstudie 4 undersøkte vi hvem som gjorde hva og hvor mye tid som ble brukt på de ulike oppgavene i formidlingsprosessen. Undersøkelsen som omfattet voksne informanter med scootere fra Danmark og Norge. I begge landene formidles hjelpemidler stort sett gratis til brukerne. Det er en viktig forskjell mellom Danmark og Norge med hensyn til scootere. Fra 2008 og basert på funksjonsvurderinger, får en del brukere i Danmark et tilskudd tilsvarende 50 prosent av kostnaden til scooteren selv dersom den defineres som et forbruksgode (som for eksempel en oppvaskmaskin) og ikke et hjelpemiddel. I Norge får personer som fyller inngangsvilkårene scooteren gratis.

Resultatene viste at mer tid ble brukt på utredninger, administrasjon og total tid i det danske sammenlignet med det norske utvalget. Utredninger og administrative oppgaver var gjennomført i alle sakene, mens utprøving, testkjøring, nødvendige tilpasninger av scooteren, og oppfølging var utført i variabel grad. I alt 68 prosent av de danske informantene hadde betalt deler av kostnadene til scooteren med egne penger. En viktig årsak til forskjellen i tidsbruken mellom det danske og norske utvalget skyldes den nye regelen som danskene innførte i 2008. Det nye regelverket medfører at fagfolkene i Danmark må gjøre utredningene veldig nøye for å bestemme hvem som får scooteren gratis og hvem som må betale store deler av kostnadene selv. I og med at avgjørelsene kan påklages må de danske fagfolkene registrere sine vurderinger meget nøye, noe som ikke er påkrevd i like stor grad i Norge. Forklaringen støttes av en tidligere dansk studie

som konkluderte med at tidsbruken i formidlingsprosessen hadde økt i gjennomsnitt med 76 prosent etter at den nye regelen ble innført. Resultatene støtter påstanden om at strukturelle forskjeller fører til forskjeller i formidlingsprosessen, i dette tilfelle forskjeller i tidsbruken mellom det danske og norske utvalget.

Oppsummering

Denne avhandlingen gir et viktig bidrag til kunnskapen om de psykometriske egenskapene til både SATS og NOMO 1.0 instrumentet. Det betyr at man med større trygghet kan tolke resultatene når disse to instrumentene benyttes i fremtidige studier på hjelpemiddelområdet.

Denne avhandlingen kaster også lys over hvilken nytte brukerne har av elektriske rullestoler og scootere. Disse hjelpemidlene ser først og fremst ut til å gjøre forflytningen lettere, ikke minst for de eldre brukerne. Selv om innkjøp av dagligvarer og å gå på tur gjøres oftere, ser det likevel ut for at brukerne utfører de samme aktivitetene og i samme omfang som tidligere.

De viktigste bidragene til denne avhandlingen er å tilføre hjelpemiddelområdet kunnskaper om hvem som gjør hva i formidlingsprosessen av elektriske rullestoler og scootere til voksne brukere. Det er verdt å merke seg at strukturelle forskjeller mellom Danmark og Norge ser ut til å ha påvirkning på tidsbruken i formidlingsprosessen. Dette er kunnskap som politikere bør tenke over når de ønsker å innføre nye regler på området. Nye regler kan bety mindre effektive prosesser.

I denne avhandlingen har målgruppen vært brukere av elektriske rullestoler og scootere. I framtidige studier bør man undersøke hvilken nytte brukerne har av hjelpemidlene og hva som skjer i formidlingsprosessen når andre hjelpemidler enn elektriske rullestoler og scootere formidles til brukerne. Man bør sammenligne resultatene med andre land med større strukturelle forskjeller enn det som er tilfelle mellom de nordiske landene. Det vil bidra til å gi et mer helhetlig bilde av hjelpemiddelområdet og vil være viktige innspill når den fremtidige hjelpemiddelpolitikken skal utformes i ulike land.

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References

Ahtola S, Heinonen A, Haikonen K, and Anttila H. (2011). Adaptation and validation of the modified KWAZO and EATS-2D instruments into Finnish circumstances. *Everyday Technology for Independence and Care AAATE 2011, Assistive Technology series. IOS Press BV, Amsterdam, Netherlands.* M. S. Gert Jan Gelderblom, Leon Adriaens, Klaus Miesenberger, 29: 300-307.

Andersen M, Olesen PK, Iversen HK, Jensen HN, and Jacobsen LT. (2010). *SATS - Satisfaction with Assistive Techonology Service. En undersøkelse af test-retest reliability af den danske version af SATS (A test-retest reliability test of the Danish version of SATS).* Bachelor-thesis in Danish. University College Nordjylland, Denmark.

Attali X, and Pelisse F. (2001). Looking back on the evolution of electric wheelchairs. *Medical Engeneering & Physics,* 23: 735-743.

Auger C, Demers L, Gelinas I, Miller WC, Jutai JW, and 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 & Rehabilitation,* 91(5): 765-773.

Auger C, Demers L, Gelinas I, Routhier F, Mortenson WB, and Miller WC. (2010). Reliability and validity of telephone administration of the wheelchair outcome measure for middle-aged and older users of power mobility devices. *Journal of Rehabilitaion Medicine,* 42: 574-581.

Babatunde JO, Klitgaard G, Nielsen CB, and Petersen KB. (2014). *Face-validity af undersøgelsesredskabet SATS (Face-valitity of the SATS).* Bachelor thesis. Aalborg, Denmark, University College Northern Denmark.

Benson K, and Hartz AJ. (2000). A comparison of observational studies and randomized controlled studies. *The New England Journal of Medicine*, 352: 1878-1886.

Blouin M, and Bergeron C. (1997). *Distionnaire de la readaption. Tome 2: Termes d'intervention et d'aides techniques.* Quebec, Sainte-Foy, QC: Les Publications du Quebec.

Borg J, Larsson S, Østergren PO, Rahman AS, Bari N, and Khan AH. (2012). User involvement in service delivery predicts outcomes of assistive technology use: a cross-sectional study in Bangladesh. *BMC Health Services Research*, 12: 330.

Brandt Å. (2005). *Outcomes of rollator and powered wheelchair interventions. User satisfaction and participation (Doctoral dissertation).* Faculty of Medicine, Division of Occupational Therapy, Lunds University. Lund, Sweden.

Brandt Å, Iwarsson S, and Ståhl A. (2004). Older people's use of powered wheelchairs for activity and participation. *Journal of Rehabilitation Medicine,* 36(2): 70-77.

Brandt Å, Kreiner S, and Iwarsson S. (2010). Mobility-related participation and user satisfaction: Construct validity in the context of powered wheelchair use. *Disability and Rehabilitation: Assistive Technology,* 5(5): 305-313.

Brandt Å, Löfqvist C, Jonsdottir I, Salminen A-L, Sund T, and Iwarsson S. (2009). NOMO 1.0. *Norsk Manual (NOMO 1.0 Norwegian Manual)*. Available at www.nav.no. Oslo.

Brandt Å, Löfqvist C, Jonsdottir I, Sund T, Salminen A-L, Werngren-Elgström M, and Iwarsson S. (2008). Towards an instrument targeting mobility-related participation: Nordic cross-national reliability. *Journal of Rehabilitation Medicine*, 40(9): 766-772.

Brandt Å, Samualsson K, Tøytari O, Salminen A-L. (2011). Activity and participation, quality of life and user satisfaction outcomes of environmental control systems and smart home technology: a systematic review. *Disability and Rehabilitation: Assistive Technology,* 6(3): 189-206.

Brazil K, Cupido C, Taniguchi A, Howard M, Akhtar-Danesh N, and Frolic A. (2013). Assessing Familiy Members' Satisfaction with Information Sharing and Communication during Hospital Care at the End of LIfe. *Journal of Palliative Medicine,* 16(1): 82-86.

Brochard S, Pedelucq JP, Cormerais A, Thiebaut M, and Remy-Neris O. (2007). Satisfaction with technological equipment in individuals with tetraplegia following spinal cord injury. *Ann Readapt Med Phys,* 50(2): 78-84.

USA Cencus Bureau (2010). *Disability Statistics and Information*. Retrieved September 3, 2014.

Chan S, and Chan A. (2007). User satisfaction, community participation and quality of life among Chinese wheelchair users with spinal cord injury: a preliminary study. *Occupational Therapy International*, 14(3): 123-143.

Cochrane AL. (1973). *Effectiveness and Efficiency: Random Reflections on Health Services.* London: Nuffield Provincial Hospitals Trust.

Cook AM, Polgar JM, and Hussey SM. (2008). *Cook&Hussey's Assistive Technologies: Principles and practice. 3rd. edition.* St-Louis, Missouri: Mosby Elsevier.

Cooper RA, Cooper R, and Boninger ML. (2008). Trends and Issues in Wheelchair Technologies. *AssistiveTechnology,* 20: 61-72.

Cooper RA, Thorman T, and Cooper R. (2002). Driving characteristics of electric-powered wheelchair user: how far, fast, and often do people drive. *Archives of Physical Medicine and Rehabilitation,* 83: 250-255.

Dancey CP, and Reidy J. (2011). *Statistics Without Maths for Psychology.* Harlow, England: Prentice Hall/Pearson Education Limited.

De Vet HCW, Terwee C, Mokkink LB, and Knol DL. (2011). *Measurement in Medicine. Practical Guides To Biostatistics and epidemiology*. Cambridge: Cambridge University Press.

de Witte L. (editor). (1994). *European Service Delivery System in Rehabilitation Technology, a comprehensive description of service delivery systems in 16 European countries, HEART (Horizontal European Activities of Rehabilitation Technology) Line C.* Hensbroek, iRv, Institute for Rehabilitation Research.

Deloitte&Touche. (2003). *Access to Assistive Technology in the European Union*. Brussels: European Commission.

Demers L, Monette M, Descent M, Jutai J, and Wolfson C. (2002). The Psychosocial Impact of Assistive Devices Scale (PIADS): Translation and preliminary psychometric evaluation fo a Canadian-French version. *Quality of life Research,* 11: 583-592.

Demers L, Monette M, Lapierre Y, Arnold DL, and Wolfson C. (2002). Reliability, validity, and acceptability of the Quebec User Evaluation of Satisfaction with assistive Technology (QUEST 2.0) for adults with multiple sclerosis. *Disability and Rehabilitation,* 24(1/2/3): 21-30.

Demers L, Weiss-Lambrou R, and Ska B. (2000). *Quebec User Evaluation of Satisfaction with assistive Technology QUEST version 2.0. An outcome measure for assistive technology devices.* New York: The Institute for Matching Person & Technology.

Demers L, Weiss-Lambrou R, and Ska B. (2001). Item analysis of the Quebec User Evaluation of Satisfaction with assistive Technology (QUEST). *Assistive Technology*, 12(2): 96-105.

Demers L, Wessels RD, Weiss-Lambrou R, Ska B, and de Witte LP. (1999). An international content validation of the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST). *Occupational Therapy International,* 6(3): 159-175.

Dijckers MP. (2010). Issues in the Conceptualization and Measurement of Participation: An overview. *Archives of Physical Medicine & Rehabilitation,* 91(Suppl 1): S5-S16.

Dittmar SS. (1997). *Overview. A functional approach to measurement of rehabilitation outcomes. Functional Assessment and outcome measures for the Rehabilitation Health Professional.* S. Dittmar and G. Gresham. Gaithersburg, Maryland: Aspen Publishers.

Djulbegovic B, and Hozo I. (2002). At what degree of belief in research hypothesis is a trial in humans justified? *Journal of Evaluation in Clinical Practice*, 8: 269-276.

Donabedian A. (1988). Quality of care. How can it be assessed? *JAMA,* 260(12): 1743-1748.

Donabedian A. (2003). *An Introduction to Quality Assurance in Health Care.* New York: Oxford University Press.

Edvards K, and McClusky A. (2010). A survey of adult power wheelchair and scooter users. *Disability and Rehabilition: Assistive Technology,* 5(6): 411-419.

Edyburn DL. (2002). Models, theories and fremeworks: Contributions to understanding special education technology. *Special Education Technology Practice,* 4: 16-24.

Evans S, Frank AO, Neophytou C, and De Souza L. (2007). Older adults' use of, and satisfaction with, electric powered indoor/outdoor wheelchairs. *Age Ageing,* 36(4): 431-435.

Fänge A, Iwarsson S, Persson A. (2002). Accessibility to the public environment as perceived by teenagers with functional limitations in a south Swedish town centre. *Disability and Rehabilitation,* 24: 318-326.

Federici S, and Borsci S. (2014). Providing assistive technology in Italy: the perceived delivery process quality as affecting abandonment. *Disability and Rehabilitation: Assistive Technology,* Early Online: 1-10.

Field D. (1999). Powered mobility: a literature review illustrating the importance of a multivaceted approach. *Assistive Technology,* 11: 20-33.

Fitzgerald S, Collins DM, Cooper RA, Tolerico BS, Kelleher A, Hunt P, Martin S, Impink B, and Cooper R. (2005). Issues in maintenance and repairs of wheelchairs: A pilot study. *Journal of Rehabilitation Research & Development,* 42(6): 853-862.

Flagg J. (2009). *Wheeled Mobility Demographics. Industry Profile on Wheeled Mobility.* S. Bauer and M. Buning. New York: Rehabilitation Engeneering Research Center on Technology Transfer. University of Buffalo.

Fomiatti R, Richmond J, Moir L, and Millsteed J. (2013). A systematic Review of the Impact of Powered Mobility Devices on Older Adults' Activity Engagement. *Physical & Occupational Therapy in Geriatrics,* 31(4): 297-309.

Frank AO, and De Souza LH. (2013). Recipients of Electric-Powered Indoor/outdoor Wheelchairs Provided by a National Health Service: A Cross-Sectional Study. *Archives of Physical Medicine and Rehabilitation,* 94: 2403-2409.

Fuhrer M. (2007). Assessing the efficacy, effectiveness, and cost-effectiveness of assistive technology interventions for enhancing mobility. *Disability and Rehabilitation: Assistive Technology,* 2(3): 149-158.

Fuhrer M, Jutai JW, Scherer MJ, and DeRuyter F. (2003). A framework for the conceptual modelling of assistive technology device outcomes. *Disability and Rehabilitation,* 25(22): 1243-1251.

Garber S, Bunzel R, and Monga TN. (2002). Wheelchair utilization and satisfaction following cerebral vascular accident. *Journal of Rehabilitation Research and Development,* 39(4): 521-534.

Gitlin L. (1998). *From hospital to home: Individual variations in experience with assistive devices among older adults. In Designing and using assistive technology.* Baltimore: Paul H. Brookes.

Gitlin L, Luborsky MR, and Schemm RL. (1998). Emerging concerns of older stroke patients about assistive device use. *The Gerontologist,* 38: 169-180.

Graham M, Milanowski A, and Miller J. (2012). Measuring and Promoting Inter-Rater Agreement of Teacher and Principal Performance Ratings. Center for Educator Compensation Reform, Institute of Education Sciences. www.files.eric.ed.gov/fulltext/ED532068.pdf. Retrieved: June 5, 2013.

Gramstad A, Storli SL, and Hamran T. (2014). Older individuals' experiences during assistive technology device service delivery. *Scandinavian Journal of Occupational Therapy,* Early online: 1-8.

Greer N, Brasure N, and Wilt TJ. (2012). Wheeled Mobility (Wheelchair) Service Delivery: Scope of the Evidence. *Annals of Internal Medicine,* 156(2): 141-146.

Greve B. (2007). What Characterize the Nordic Welfare State Model. *Journal of Social Sciences,* 3(2): 43-51.

Hall K, Partnoy J, Tenenbaum S, and Dawson DR. (2005). Power mobility driving training for seniors: a pilot study. *Assistive Technology,* 17(1): 47-56.

Hansen R, Tresse S, and Gunnarson RK. (2004). Fewer accidents and better maintenance with active wheelchair check-ups: a randomized controlled clinical trial. *Clinical Rehabilitation,* 18: 631-639.

Hellbom G. and Persson J. (2001). Estimating user benefits of assistive technology and services - on the importance of independant assessors. In Maincek et al (editors), Assistive Technology - Added Value on the Quality of Life. *Assistive Technology,* 551-554.

Hoenig H, Lee J, and Stineman M. (2010). Conceptual Overview of Frameworks for Measuring Quality in Rehabilitation. *Topics in Stroke Rehabilitation,* 17(4): 239-251.

Hoenig H, Pieper C, Branch G, and Cohen HJ. (2007). Effect of Motorized Scooters on Physical Performance and Mobility: A clinical Randomized Clinical Trial. *Archives of Physical Medicine & Rehabilitation,* 88: 279-286.

Holbrook A, Green M, and Krosnick J. (2003). Telephone versus face-to-face interviewing of national probability samples with long questionnaires: comparisons of respondent satisficing and social desirability response bias. *Public Opinion Quarterly,* 67: 79-125.

Hornby A, Gatenby EV, and Wakefield H. (1963). *The Advanced Learner's Dictionary of Current English*. London: Oxford University Press.

Hush JM, Cameron K, and Mckey M. (2011). Patient Satisfaction With Musculoskeletal Physical Therapy Care: A Systematic Review. *Physical Therapy,* 91(1): 25-36.

International standard ISO 9999. (2011). *Assistive products for persons with disability - Classification and terminology, 5th. edition*. Geneva: International Organization for Standardization.

Iwarsson S, and Isacsson Å. (1996). Development of a novel instrument for occupational therapy assessment of physcial environment in the home - a methodologic study on "the enabler". *Occupational Therapy Journal of Research,* 16: 227-244.

Jedeloo S, De Witte LP, Linssen BAJ, and Schrijvers AJP. (2002). Client satisfaction with service delivery of assistive technology for outdoor mobility. *Disability and Rehabilitation,* 24(10): 550-557.

Jedeloo S, De Witte LP, and Schrijvers AJP. (2002). A user-centred approach to assess the effectiveness of outdoor mobility devices and services. *International Journal of Rehabilitation Research,* 25(2): 137-141.

Jette AM. (2006). Toward a Common Language for Function, Disability, and Health. *Physical Therapy,* 86(5): 726-734.

Jutai JW, Demers L, Scherer MJ, and DeRuyter F. (2005). Toward a taxonomy of assistive technology device outcomes. *American Journal of Physical Medicine & Rehabilitation,* 84: 294-302.

Karmarkar AM, Collins DM, Kelleher R, and Cooper RA. (2009). Satisfaction related to wheelchair use in older adults in both nursing homes and community dwelling. *Disability and rehabilitation; Assistive Technology,* 4(5): 337-343.

Karpiriri L, Norheim OF, Martin DK. (2007). Priority setting at the micro, meso and macro levels in Canada, Norway and Uganda. *Health Policy,* 82(1): 78-94.

Kaye S, Kang T, and LaPlante MP. (2002). Wheelchair use in the United States. *Disability Statistics Abstract,* 23: 1-4.

Kazdin AE. (2003). *Research Design in Clinical Psychology.* Boston: Allyn & Bacon.

Kreuger AB, and Schkade DA. (2008). The reliability of subjective well-being measures. *Journal of Public Economics,* 92(8): 1833-1845.

Kylberg M, Löfqvist C, Tomsone S, Phillips J, Liepina Z, and Iwarsson S. (2014). A European perspective on the service delivery systems for assistive technology - differences and similarities between Latvia and Sweden. *Journal of Cross-Cultural Gerontology.* In press.

Lacoste M, Weiss-Lambrou R, Allard M, and Densereau J. (2003). Powered tilt/recline systems: why and how are they used? *Assistive Technology,* 15(1): 58-68.

Landis JR, and Koch GG. (1998). The measurement of observer agreement for categorical data. *Biometrics,* 33(1): 159-174.

Lenker JA, Fuhrer MJ, Jutai J, Demers L, Scherer MJ, and DeRuyter F. (2010). Treatment Theory, Intervention Specification, and Treatment Fidelity in Assistive Technology Outcomes Research. *Assistive Technology,* 22: 129-138.

Lenker JA, Harris F, Taugher M, and Smith RO. (2013). Consumer perspectives on assistive technology outcomes. *Disability and Rehabilitation: Assistive Technology,* 8(5): 373-380.

Lenker JA, and Paquet VI, (2003). Review of Conceptual Models for Assistive Technology Outcomes Research and Practice. *Assistive Technology,* 15: 1-15.

Lenker JA, Scherer MJ, Fuhrer MJ, Jutai JW, and DeRuyter F. (2005). Psychometric and administrative properties of measures used in assistive technology device outcomes research. *Assistive Technology,* 17(1): 7-22.

Lenker JA, Schoemaker LL, Fuhrer MJ, Jutai JW, Demers L, Tan CH, and DeRuyter F. (2012). Classification of assistive technology services: Implications for outcomes research. *Technology and disability,* 24: 59-70.

Lian O, and Wilsgaard T. (2005). Pasienttilfredshet - et godt kvalitetsmål? (Patient satisfaction - a good measure of quality?). *Tidsskrift for Velferdsforskning,* 8(1): 19-33.

Lie I. (1997). *Rehabilitering og habilitering. Prinsipper og praktisk organisering (Rehabilitation and habilitation. Principles and organizing)*. Oslo: Ad Notat Gyldendal.

Light J. (1999). Do augmentative and alternative communication interventions really make a difference?: The challenges of efficacy research. *Augumentative and Alternative Communication,* 15: 13-24.

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.

Marcellini F, Gagliardi C, and Spazzafumo L. (2004). *Mobility and the local outdoor environment.* H. Mollenkopf, F. Marcellini, I. Ruoppila and M. Tacken (editors). In: Aging and outdoor mobility: A European study. Amsterdam: IOS Press.

Martin JK, Martin LG, Stumbo NJ, and Morill JH. (2011). The impact of consumer involvement on satisfaction with and use of assistive technology. *Disability and Rehabilitation,* 6: 225-242.

Mathiesen TP, Freil M, Willaing I, Jørgensen T, Andreasen AH, Ladelund S, and Harling H. (2007). Do patient Differentiate Between Aspects of Healthcare Quality? *Journal of Healthcare Quality,* 29(1-10).

McHorney CA, and Tarlov AR. (1995). Individual-patient monitoring in clinical practice: are available health status surveys adequate? *Quality of life Research,* 4: 293-307.

Medola FO, Elui VMC, and Santana CS. (2010). The selection of the wheelchair and the satisfaction of individuals with spinal cord injury with your device. *Revista Iberoamerica de Fisioterapia y Kinesioligua,* 13(1): 17-21.

Mills TL, Holm MD, and Schmeler M. (2007). Test-Retest Reliability and Cross Validation of the Functioning Everyday With a Wheelchair Instrument. *Assistive Technology,* 19: 61-77.

Mindegaard P, and Andersen MC. (2011). Elscootere som forbrugsgoder (Elscooters as consumer goods). *Ergoterapeuten,* 3: 16-17.

Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM, and De Vet HCW. (2012). *COSMIN checklist manual*. Available at: www.cosmin.nl, www.emgo.nl. Retrieved June 28, 2012.

Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM, and De Vet HCW. (2010). The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *Journal of Clinical Epidemiology,* 63: 737-745.

Mortenson WB, Miller WC, and Auger C. (2008). Issues for the selection of wheelchair-specific activity and participation outcomes measures: a review. *Archives of Physical Medicine and Rehabilitation,* 89: 1177-1186.

Needham DM, and Koruplu R. (2010). Rehabilitation quality improvement in an intensive care unit setting: implementation of a quality improvement model. *Topics in Stroke Rehabilitation,* 17(4): 271-281.

NUH-Nordic centre for Rehabilitation Technology. (2007). *Provision of Assistive Technology in the Nordic Countries*. Helsinki: NUH-Nordic centre for Rehabilitation Technology.

Opdenakker R. (2006). Advantages and Disadvantages of Four Interview Techniques in Qualitative Research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 7(4): art. 11. http://nbn-resolving.de/urn:nbn:de:0114-fqs0604118. Retrieved October 15, 2014.

Patterson P, McDonald FEJ, Butow P, White KJ, Costa DSJ, Millar B, Bell ML, Wakefield CE, and Cohn RJ. (2014). Psychometric evaluation of the Sibling Cancer Needs Instrument (SCNI): an instrument to assess the psychosocial unmet needs of young people who are siblings of cancer patients. *Support Care Cancer,* 22: 653-665.

Pettersson C. (2014). *Powered Mobility Device Use: Participation and Accessibility (Doctoral dissertation)*. Medical faculty. Lund, Lund University. PhD: 134.

Pettersson I, Törnquist K, and 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.

Rosenkvist J. (2008). *Mobility in Public Environments and the Use of Public Transport: exploring the situation for people with aquired cognitive functional limitations (Licentiate thesis)*. Lund: Lund Institute of Technology, Lunds University.

Routhier F, Vincent C, Desrosiers J, and Nadeau S. (2003). Mobility of wheelchair users: a proposed performance assessment framework. *Disability and Rehabilitation,* 25(1): 19-34.

Sackett DL, Rosenberg WM, Gray JA, Haynes RB, and Richardson WS. (2007). Evidence based Medicine: What is and what it isn't. 1996. *Clinical Orthopaedics an Related Research,* 455: 3-5.

Salminen A-L, Brandt Å, Samuelsson K, Tøytari O, and Malmivaara A. (2009). Mobility devices to promote activity and participation: a systematic review. *Journal of Rehabilitation Medicine,* 41(9): 697-706.

Samuelsson K, and Wressle E. (2008). User satisfaction with mobility assistive devices: An important element in the rehabilitation process. *Disability and Rehabilitation*, 30(7): 551-558.

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): 330-335.

Scherer MJ, and Graddock G. (2002). Matching person and technology (MPT) assessment process. *Technology and Disability,* 14(3): 125-131.

Scherer MJ, Jutai J, Fuhrer M, Demers L, DeRuyter F. (2007). A framework for modelling the selection of assistive technology devices (ATDs). *Disability and Rehabilitation Assistive Technology,* 2(1): 1-8.

Slaug B, Schilling O, Helle T, Iwarsson S, Carlsson G, and Brandt Å. (2012). Unfolding the phenomenon of interrater agreement: a multicomponent approach for in-depth examination was proposed. *Journal of Clinical Epidemiology,* 65(9): 1016-1025.

SPSS Inc. (2009). *Introduction to Statistical Analysis Using SPSS Statistics.* Chicago.

Stanney K, and Maxey J. (1997). *Socially centred design. In: Handbook of human factors and ergonomics.* New York: Wiley.

Stemler SE. (2004). A comparison of consensus, consistency, and measurement approaches to estimating interrater reliability. *Practical Assessment, Research & Evaluation,* 9(4): 1-17.

Streiner DL, and Norman GR. (2008). *Health measurement scales - a practical guide to their development and use*. New York: Oxford University Press.

Suhonen R, Papastavrou E, Efstathiou G, Tsangari H, Jarosova D, Leino-Kilpi H, Patiraki E, Karlou C, Balogh Z, and Merkouris A. (2012). Patient satisfaction as an outcome of individualised nursing care. *Scandinavian Journal of Caring Sciences,* 26(2): 372-380.

Tabachnick BG, and Fidell LS. (2013). *Using Multivariate Statistics*. New Jersey: Pearson Education, Inc.

The Norwegian Labour and Welfare Service NAV. (2001). *Nasjonal standard. Kvalitet i formidling av hjelpemidler. Utprøving av hjelpemidler*. Oslo: NAV.

The Norwegian Labour and Welfare Service NAV. (2014). *Statistics of assistive technology in Norway*. Oslo: NAV.

Trail M, Nelson N, Van JN, Appel SH, and Lai EC. (2001). Wheelchair use by patients with amyotrophic lateral sclerosis: a survey of user characteristics and selection preferences. *Archives of Physical Medicine and Rehabilitation,* 82(1): 98-102.

United Nations. (1994). *Standard rules on equalisation of opportuneties for persons with disabilities*. New York: United Nations. Department of public information.

United Nations. (2006). *Convention on the Rights of Persons with Disabilities.* Geneva: United Nations.

United Nations. (2013). *Side-events to the High-level meeting of the General Assembly on Disability and Development*. New York: United Nations.

Ward AL, Sanjak M, Duffy K, Brawer E, Williams N, Nichols M, and Brooks BR. (2010). Power wheelchair prescription, utilization, satisfaction, and cost for patients with amyotrophic lateral sclerosis: preliminary Data for Evidence-Based Guidelines. *Archives of Physical Medicine and Rehabilitation,* 91(2): 268-272.

Ward DE. (1994). *Prescribing seating for wheeled mobility. Theory, application, and terminology.* Kansas City, KS: Health Wealth International.

Weir J. (2005). Quantifying Test-retest Reliability Using the Intraclass Correlation Coefficient and the SEM. *Journal of Strength and Conditioning Research,* 19(1): 231-240.

Wenneberg H. (2009). *Walking in old age. A year-round perspective on accessibility in the outdoor environment and effects of measures taken.* Department of Technology and Society, Traffic & Roads (Doctoral dissertation). Lund: Lund University. Phd.

Wessels R, and DeWitte L. (2003). Reliability and validity of the Dutch version of QUEST 2.0 with users of various types of assistive devices. *Disability and Rehabilitation,* 25: 267-272.

World Health Organization. (2005). *Disability, including prevention, management and rehabilition.* World Health Assembly resolution WHA58.23, 58th session. Geneva: World Health Organization.

Willis G, Reeve B, and Barofsky I. (2005). *The use of cognitive interviewing techniques in quality-of-life and patient-reported outcomes assessment.* In: Outcomes Assessment in Cancer: Meaures, Methods and Applications. J. Lipscomb, C Gotay, C Snyder (eds.) Cambridge: Cambridge University Press.

Woods B. (2003). A short history of Powered Wheelchairs. *Assistive Technology,* 15: 164-180.

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 Health Organization WHO and The World Bank. (2011). *The World Report on Disability*. Geneva: World Health Organization.

Wressle E, and Samuelsson K. (2004). User Satisfaction with Mobility Assistive Devices. *Scandinavian Journal of Occupational Therapy,* 11: 143-150.