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OLDER PEOPLE'S USE OF POWERED WHEELCHAIRS FOR ACTIVITY AND PARTICIPATION

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***Objective*: The aims of this study were to investigate outcomes of older people's use of powered wheelchairs and risk factors for negative outcomes.**

***Design*: The study was a cross-sectional interview-study including 111 powered wheelchair users over 65 years of age.**

***Results*: All participants used their powered wheelchair in the summer; nearly all users regarded it as important and found that it gave them independence. The wheelchair made activity and participation possible for the users. The most frequent activity in the summer was going for a ride, and in the winter it was shopping. However, some could not use the wheelchair for visits, and supplementary travel modes are called for. Users who could not walk at all or who could not transfer without assistance were more likely not to be able to carry out prioritized activities. Furthermore, other risk factors for negative outcomes and need for further research were identified.**

***Conclusion*: The use of powered wheelchairs is a relevant societal intervention in relation to older people with limited walking ability in order to make activity and participation possible. It is likely that a larger proportion of older people could benefit from this intervention, in particular if current practices are improved taking activity and participation outcomes into consideration.**

Key words: self-help devices, assistive technology, treatment outcomes, rehabilitation, occupational therapy, mobility, eligibility determination.

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INTRODUCTION

For most of us, mobility is a prerequisite to be able to carry out important activities and to participate in societal life, e.g. going for walks, shopping and visits (1–3). Impaired body functions, such as limited walking ability, may lead to restricted activity and participation (4). In order to improve this, rehabilitation measures are usually taken, e.g. physical training. Even so it is not always possible to restore body functions totally, and adaptive strategies such as the use of assistive technology may then be employed (5, 6).

People with very limited walking ability often use manual wheelchairs to improve their mobility. However, using a manual wheelchair requires considerable stamina and upper extremity strength and mobility, especially outdoors. If the person does not possess these abilities or loses them, e.g. due to progressive illness, a powered wheelchair may be used instead (7) to enhance activity and participation (8).

In some countries, e.g. the Nordic countries, assistive technology is granted free of charge provided it is considered a relevant rehabilitation strategy, but in some other countries the provision of assistive technology depends on insurance conditions. Furthermore, regulations and assistive technology service systems differ between countries (9). In Denmark there are no national formalized eligibility criteria, but the device must represent a substantial improvement in the person's possibilities to carry out activities and/or to participate in societal life, and in some cases eligibility criteria have been formulated locally (9).

In this study the term "powered wheelchair" is used, denoting a wheelchair powered by batteries. Powered wheelchairs are divided into two major subgroups, and both are included in this study. One is the scooter type that has 3 or 4 wheels and is steered manually by handlebars, the other is the joystick-controlled type, which has 4 wheels and is steered electronically by a joystick.

Theories and models in relation to assistive technology

As regards theoretical frameworks reflected in research into assistive technology, to our knowledge no specific studies have been published. The *International Classification of Functioning* (ICF) provides a structure describing environmental facilitators and barriers influencing activity and participation, but it does not aim at describing relationships (4). A number of other theories and models describe activity performance as a person-environment-activity transaction, (e.g. 10, 11), but no explicit distinctions between assistive technology and other environmental factors have been presented, omitting the possibility of studying relations between the use of assistive technology and other environmental factors. Even so, one model, "The human activity assistive technology (HAAT) model" (12), developed by Cook & Hussey, describes how human performance is influenced by factors concerning the person, the activity, the assistive technology and the context in which the activity is performed,

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when an assistive device is used. The model suggests that each of these domains contains a number of factors that influence activity performance, but also that these factors influence each other. This means that performance using assistive technology may change due to various conditions, e.g. different environments, characteristics of the device, the user and the activity, implying that these factors need to be addressed in clinical work and research.

Outcomes of using a powered wheelchair

Most literature on powered wheelchairs concerns the assessment of user needs and abilities, how to use a powered wheelchair, technical features, etc. (e.g. 13), while research on activities and participation and other outcomes of using powered wheelchairs is scarce. Moreover, the studies are mainly qualitative or pilot studies (7, 14) and the majority of the body of research has methodological limitations (15).

The few studies found mainly identified positive outcomes in terms of opportunities to carry out activities and participate in societal life, and that the users' self-esteem was enhanced (7, 8, 16). In contrast, a larger Dutch study on the effectiveness of powered wheelchairs showed that nearly a quarter of the users found that their powered wheelchair solved their mobility problems to a lesser extent than expected (17). The study did not examine the causes underlying this kind of result, but a number of studies have found that one essential factor might be physical environmental barriers (16, 18).

One often-used outcome measure in relation to assistive technology is frequency of use, since it may indicate aspects of how effective and useful the device is (19). This applies especially to non-use, since non-used devices are ineffective for the user and a waste of societal resources. In a Danish study it was found that 11% never or hardly ever used their powered wheelchair, while a Swedish study showed that all powered wheelchair users of a 70–76-year-old population used them (20).

Need for knowledge about outcomes of using powered wheelchairs

Walking ability decreases with age, for example, it is estimated that 20% of Danish men aged 67–79 years and 39% of those over 79 years of age are not able to walk 400 metres without difficulty. Women's walking ability is even more affected, as 25% of women aged 67–79 years and 58% of women over 79 years of age cannot walk 400 metres without difficulty. These figures are similar in other western countries. Thus a large number of older people have mobility problems and the use of powered wheelchairs could be expected to be frequent among older people. However, this is not the case. Only 1.0–1.6% of older people use powered wheelchairs (3, 20). Currently, Danish municipalities report an increasing number of applications for powered wheelchairs from older people, and some of the municipalities are concerned about the expense. In order to determine whether this expense is justified, information about the outcomes of powered wheelchairs is crucial. It is important to determine whether people who have a powered wheelchair can actually use it to carry out prioritized activities, and if they cannot, to determine the reasons for this.

It is complex to measure outcomes of assistive technology and identify factors resulting in positive or negative outcomes (6, 12). However, if factors predicting outcomes of using a powered wheelchair can be identified, this will be important background knowledge for planning intervention programmes and for the assessment of older applicants' expected benefit of a powered wheelchair.

The aim of this study was to examine outcomes of older people's use of powered wheelchairs. The first objective was to describe frequency of use, the users' perception of the wheelchairs' importance, and the users' feeling of independence while using it. The second objective was to investigate activities carried out using the powered wheelchair, accomplishment of prioritized activities, and barriers to this. The third objective was to identify risks of negative outcomes.

MATERIALS AND METHODS

Project organization

A project leader (first author) managed the project, constructed the project questionnaire and analysed the data. A project steering group was set up, comprising 7 persons representing different expertise: users, vendors, occupational therapists, physiotherapists and researchers within the field of rehabilitation. The tasks of the project steering group were to advise the project leader about the contents of the questionnaire and to discuss the results of interviews. Persons employed by the National Danish Institute of Social Research (SFI) carried out the interviews.

The study was part of a larger project, which also included issues on, for example, satisfaction with the powered wheelchair and related services. A Danish report has been published and further results will be presented elsewhere.

Design

The study had a cross-sectional interview design. Interviews were carried out by means of a structured interview questionnaire constructed for the study. All results are based on the powered wheelchair users' subjective statements.

Research district

Procedures and local regulations for granting powered wheelchairs to older people differ between Danish municipalities, especially in relation to the sizes and geographical locations of municipalities. In order to obtain national representation the sampling was carried out on the basis of municipality size and random location; all Danish municipalities were divided into 3 groups consisting of small (<10,000 inhabitants), medium-sized (10,000–100,000 inhabitants) and large municipalities (>100,000 inhabitants). An equal number of users was included from each group. The municipalities were selected at random from each group; 2 large, 4 medium-sized, and 6 small municipalities were selected. Of the 12 municipalities selected originally, 1 large municipality did not want to participate and 3 small municipalities did not have enough older users of powered wheelchairs. Consequently, another large and 3 small municipalities were included, resulting in 12 municipalities in all.

Sample of users

There is no national register of assistive device users in Denmark, but each municipality keeps records. On the basis of earlier studies (3, 21) it was calculated that in order to obtain a sufficiently large sample to be able to carry out the analyses, approximately 110 users were needed. Given an expected response rate of 70%, 160 users had to be asked to participate. From the selected municipalities persons aged over 65 who had had a powered wheelchair for at least 1 year were selected. In the 4

small municipalities all users were enrolled, while in the large and medium-sized municipalities users were selected at random by computer.

A total of 153 users were asked to participate. Three users were found to be under 65 years of age and another user did not have a powered wheelchair but a three-wheeled moped, and therefore these 4 users were excluded. Of the remaining 149 users, 117 were willing to participate. However, 6 could not be interviewed, because they were not able to participate at the time of the interview, either because they were ill or because they were on holiday. Thus there were 38 non-respondents and 111 users were interviewed (74%).

The mean age of the users was 77 years (median 76, range 65–92 years) and approximately half were men ($n = 56$). Nearly one-third of users ($n = 32$) were not able to walk at all, but a larger proportion could only move round in a wheelchair ($n = 53$). Of the remaining 58 users, 1 could only walk short distances with personal assistance, more than half ($n = 38$) could do this using an assistive device, and about one-third ($n = 16$) could walk shorter distances without any assistance. Some ($n = 17$) could not transfer to the wheelchair without help from others. About three-quarters ($n = 84$) of the users had a scooter-type powered wheelchair, and the remaining ($n = 27$) had a joystick-controlled type. On average, the users had used a wheelchair for 4.5 years (range 1–22 years). Some ($n = 18$) had impaired visual function and could not read a normal newspaper at all or only with great difficulty. Finally, only few ($n = 15$) could drive a car, but more than half ($n = 62$) had driven a car previously, and about one-fifth ($n = 24$) had a car in the household. Most of the users lived alone ($n = 77$). About half lived in a private house ($n = 55$), while some ($n = 14$) lived in a flat, slightly more than one-third lived in sheltered housing ($n = 37$) and 2 lived in a nursing home.

In order to investigate whether the study sample was representative of the study population, the study sample and the group of non-respondents were compared as regards all data available for the latter: age, gender, and size of municipality. The Student *t*-test was used for continuous parametric data and the χ^2 test for dichotomized data. No statistically significant differences at the level of $p < 0.05$ were found between the 2 groups.

Procedure

Administrative staff from the municipalities contacted the selected users by letter, informing them about the study and asking them to participate. If the users did not reply they were contacted by phone and asked whether they were willing to participate. Names and addresses of the users willing to participate were sent to the SFI, and anonymous data concerning age, gender and municipality of residence of those not willing to participate were reported to the project leader.

Twelve experienced interviewers carried out the interviews in spring and summer months. In order to obtain reliability the interviewers went through a training session prior to the interviews. Each interviewer contacted the users in order to arrange the interviews and after they had carried out the interviews on home visits. Data were made anonymous and entered into a database. If a user could not participate, age, gender and municipality of residence were recorded. All data were finally sent to the project leader.

Interview instrument

The study-specific questionnaire used in the interviews was a structured questionnaire constructed on basis of the aims of the study, practical experiences of the project steering group, literature studies and the human activity assistive technology (HAAT) model (12). It was constructed in close co-operation between the project steering group and the project leader. The SFI was also consulted. After the questionnaire had been constructed a pilot test was carried out. The test included 4 male and 4 female users of powered wheelchairs, ages ranging from 72 to 85 years, from a municipality not selected for the study. After each pilot interview the questionnaire was optimized and the new version used in the following interview. The pilot interviewing stopped when 2 interviews had not resulted in any changes.

The interview questions were structured and close-ended with the exception that in some questions the response category "other" was included, giving the opportunity for comments. The interview questions concerned the following issues:

Person. Six questions about background factors (age, gender, cohabitation, car in household, housing, how long the user had had the powered wheelchair) and 4 about aspects of body functions (walking ability (based upon questions in the Functional Limitations Profile (22)), ability to transfer to wheelchair, visual function (whether the person had difficulty reading a normal newspaper), ability to drive a car).

Assistive technology. One question about the type of powered wheelchair.

Activity. Seven questions: 1 about indoor/outdoor use of wheelchair, 2 about activities carried out using the wheelchair outdoors in the summer and in the winter (11 response categories based on results from a study on older people's outdoor mobility (3), the categories are shown in Table I), 2 about travelling by bus and train using the powered wheelchair and about bringing it in a car, 1 about which prioritized places the powered wheelchair could not be used to go to (same response categories as the question about outdoor activities), and 1 about how the users in that case reached these places [response categories: go with others, by taxi, by special transportation supplied by the municipality, by private car, does not go, other].

Environmental barriers for carrying out prioritized activities. One question about the reasons why the powered wheelchair could not be used to go to prioritized places (response categories: distance barriers, weather conditions, physical ability to sit long enough, and physical environmental barriers).

Outcome dimensions. Five questions: 1 about agreement with the statement that the powered wheelchair could be used to go to prioritized places (response categories: total agreement, partial agreement, partial disagreement, total disagreement, and does not know), 1 question concerning how important the wheelchair was for the user (response categories: the same as the ones used for going to prioritized places), 1 concerning whether it made the user feel more independent (response categories: total agreement, partial agreement, partial disagreement, and does not know), and 2 about frequency of use in the summer and in the winter (response categories: at least once a day, once per week, once per month every summer/winter, does not use it).

Data analysis

The first part of the study was merely descriptive. In the second part differences between male and female activities and differences between activities carried out in the summer and winter were tested using the χ^2 test. Wilcoxon's signed rank test was used to analyse differences between frequency of use in the summer and winter.

In the third part odds ratios (OR) for the investigated negative outcomes (dependent variables) for individuals who had certain characteristics (independent variables) were computed. ORs provide information about probability, and ORs higher than 1.0 indicate a greater probability of the investigated outcome, whereas ORs less than 1.0 indicate a lesser probability. If 1.0 is included in the confidence limits the probability is neither greater nor lesser (23). The independent variables included in this analysis were age, gender, walking ability, ability to transfer, visual function, car in household, ability to drive a car and cohabitation. The dependent variables (negative outcomes) were the following 4 outcome dimensions: the user did not agree that the wheelchair could be used for going to prioritized places, the user did not feel independent using the powered wheelchair, and low frequency of use in the summer/in the winter. The outcome dimension "importance" could not be analysed because of lack of variance of the data.

In order to carry out the analysis data was dichotomized. The general principle applied was maximum contrast. For instance, walking capacity was divided into "could walk a little" and "could not walk at all". As regards continuous data (age), the median was used for dichotomization. Data about agreement with statements were dichotomized so that agreement and partial agreement were categorized as "yes", partial disagreement and disagreement as "no" (corresponding to the dependent variables: "the user did not agree that the wheelchair could be used for going to prioritized places" and "the user did not feel independent using the powered wheelchair"), and if the user did not know, the answer was not included in the analysis. Frequency of use was dichotomized in different ways concerning summer and winter, because it cannot be expected that the powered wheelchair is used as often in the winter as in the summer. If the wheelchair had been used at least once a day in the summer it was categorized as "frequent use", and if it was used less it was "low frequency of use". In the winter, if the wheelchair had been

Table I. *Older men's and women's activities using powered wheelchair in summer and winter (n = 111)*

Activities	In the summer			In the winter		
	Men ($n = 56$) *n* (%)	Women ($n = 54$) *n* (%)	All ($n = 111$[a]) *n* (%)	Men ($n = 56$) *n* (%)	Women ($n = 54$) *n* (%)	All ($n = 111$[a]) *n* (%)
Go for a ride	49 (88)	43 (80)	92 (83)****	34 (61)***	20 (37)	54 (49)
Shopping	41 (73)*	45 (83)	87 (78)	32 (57)***	40 (74)	73 (66)
Visit friends and family	33 (59)	30 (56)	63 (57)	22 (39)	20 (37)	42 (38)
Go to church, churchyard	14 (25)*	20 (37)	35 (32)	7 (13)**	10 (19)	18 (16)
Go to daycentre, club, etc.	17 (30)	12 (22)	30 (27)	13 (23)	11 (20)	24 (22)
Moving around in the garden	9 (16)	13 (24)	22 (20)*****	2 (4)	1 (2)	3 (3)
Moving around indoors in own or other's home	8 (14)	11 (20)	19 (17)	5 (9)	7 (13)	12 (11)
Go to café, restaurant, etc.	8 (14)	10 (19)	18 (16)	6 (11)	5 (9)	11 (10)
Go to cinema, library, theatre, etc.	4 (7)**	12 (22)	16 (14)	2 (4)**	10 (19)	12 (11)
Other activities	10 (18)	9 (17)	19 (17)	8 (14)	7 (13)	15 (14)

[a] The sample consisted of 56 men and 54 women and 1 with unidentified gender.
* $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$ compared with women. **** $p < 0.05$ and ***** $p < 0.01$ for the whole group compared with

used at least once a week it was categorized as "frequent use", and if it was used less it was "low frequency of use".

The ORs were computed in 2 steps. First, bivariate analyses were carried out using the χ^2 test, and crude ORs were computed, then multivariate analyses were performed. All independent variables were included in the multivariate analysis of each outcome dimension in order to exclude the confounding effect of these variables. The crude ORs identify groups of users that may be at risk of negative outcomes, while the multivariate analysis reveals the influence of each independent variable, that is, when the impact of other confounding variables is excluded. For the multivariate analysis the logistic regression method (backward: LR) was used excluding variables stepwise one at a time, the exclusion criterion being the highest statistically significant value. The confidence limits were 95%. In all analyses the significance level was $p < 0.05$.

Ethics

The users who participated in the study gave informed consent and they were guaranteed anonymity. The Danish registration authorities granted the SFI permission for data collection and database construction. Since it was not an experimental study it was not necessary to have the study formally approved according to Danish ethical rules.

RESULTS

Importance, independence and frequency of use

Of the 111 users nearly all regarded their powered wheelchair as very important ($n = 102$) or somewhat important ($n = 6$), 2 users did not think that it was important, and 1 answer was missing. A large proportion of the users also agreed that the powered wheelchair gave them freedom to get about independently ($n = 99$), some partly agreed ($n = 6$) and only few disagreed ($n = 6$).

All used their powered wheelchair outdoors. About four-fifths ($n = 88$) used it entirely outdoors, some ($n = 14$) also used it indoors all the time, and the remaining ($n = 9$) also used it indoors now and then. In the summer the major part of the users ($n = 71$) used their powered wheelchair outdoors at least once a day, one-third ($n = 36$) used it at least once a week, 3 used it less, and 1 answer was missing. In the winter they used their powered wheelchair less frequently outdoors ($p < 0.001$); about a quarter ($n = 26$) used it at least once a day, less than half ($n = 46$) used it at least once a week, about a fifth ($n = 25$) used it less, and some ($n = 14$) never used it outdoors in the winter.

Activities carried out using the powered wheelchair

The most frequent activities the powered wheelchair was used for were going for a ride, shopping, and visiting friends and family. In the summer the most frequent activity was going for a ride ($n = 92$), while fewer used it for that in the winter. The most frequent activity carried out in the winter was shopping ($n = 54$). In the winter the activities investigated were carried out less frequently than in the summer, even though this difference was statistically significant only in relation to going for a ride ($p < 0.05$) and moving around in the garden ($p < 0.01$) (Table I).

Most activities were carried out by about the same proportion of men and women, but more women than men used the wheelchair for shopping, for going to church and cemetery, and for going to the cinema, library, theatre, etc. This was the case in the summer as well as in the winter. However, more men than women used the powered wheelchair for going for a ride in the winter (Table I).

About one-third ($n = 39$) of the users used their powered wheelchair when they travelled longer distances, while the rest did not. Only a few ($n = 10$) then transported their powered wheelchair in their private car. Even fewer ($n = 6$) went by bus or train sitting in their wheelchair, while a larger proportion ($n = 27$) used special transportation, i.e. travelling in a specially equipped bus supplied by the municipality.

Use of the powered wheelchair to accomplish prioritized activities

By far most users agreed totally that they could use their powered wheelchair to carry out prioritized activities ($n = 84$), 10 agreed partly, 8 disagreed partly, 7 disagreed totally and 2 did not know. As to specific activities nearly a third ($n = 40$) had problems using the wheelchair to carry out one or more activities. In particular, visits to friends and family caused problems since about a fifth ($n = 23$) stated that they would like

Table II. *Number of users who could not use their powered wheelchair to carry out prioritized activities and reasons for this (n = 40[a])*

	Number of users	Reasons					
		The wheelchair cannot go far enough	It is too cold	Cannot sit for sufficiently long time	Too many stairs, doorsteps, etc.	Other reasons	Missing reason
Going for a ride	4	4	0	0	0	0	0
Shopping	6	1	1	0	1	2	1
Visit friends and family	23	10	1	0	7	3	2
Go to church and churchyard	7	2	1	1	2	1	0
Go to daycentre, club, etc.	2	0	0	0	1	0	1
Moving around the garden	1	0	0	0	0	1	0
Moving around indoors at home or in other people's homes	2	0	0	0	1	1	0
Go to café, restaurant, etc.	5	1	0	0	3	1	0
Go to cinema, library, etc.	4	1	0	0	3	0	0
Other purposes	10	0	0	0	0	1	9
Number of times a reason was mentioned		19	3	1	18	10	13

[a] Some users could not carry out several activities, and therefore the number of activities that could not be carried out is higher than the number of users having problems.

to use their powered wheelchair for this activity, but that it was not possible (Table II).

Experience of barriers to carrying out prioritized activities. The most frequent reasons why the powered wheelchair could not always be used to carry out prioritized activities were that it could not go far enough or that there were too many stairs, doorsteps, etc. along the way or at the destination. Cold weather and problems with sitting in the wheelchair for a sufficiently long time were only rarely reported as barriers (Table II).

When the users could not use the powered wheelchair to move around outdoors, some just did not go ($n = 17$), others ($n = 16$) went by car driven by friends or family, and only few ($n = 8$) went by taxi or special transportation supplied by the municipality.

Risks of negative outcomes

When users of powered wheelchairs were over 76 years of age it was more likely that they did not think that the powered wheelchair could be used for prioritized activities (OR = 3.0). After adjustment for confounding factors this risk was even higher (OR = 6.3). Age was also a risk factor in terms of frequency of use, both in the summer and the winter, since the probability that the age category 77–92 years would use their powered wheelchair frequently was 3–4 times less than the younger age category. It was also much more likely that women did not think that they could use their powered wheelchair to carry out prioritized activities compared with men. When the crude odds ratio was calculated it was not statistically significant, but after adjustment the odds ratio became statistically significant and much higher (OR = 9.5), especially having a car in the household seemed to be a confounding factor. Gender had no impact on any of the other outcomes investigated (Table III).

The users' physical abilities had some impact: when the users were not able to transfer without assistance or to walk at all, the risk that they would not think that they could use the wheelchair for prioritized activities was much increased. After adjustment of the data walking ability was not a risk factor anymore, mainly because the ability to transfer seems to have been a confounding factor. This is underlined by the fact that the risk that users who were not able to transfer without assistance would think that they could not use the powered wheelchair for prioritized activities was very high (OR = 25.3) after adjustment. When the users could not walk or transfer without assistance the risk that they would not feel independent using their powered wheelchair was also increased. After adjustment of the data, however, only ability to walk turned out to be statistically significant, being a confounding factor in relation to ability to transfer.

Visual function also played a role, since it was more likely that users with visual difficulties could not carry out prioritized activities (OR = 3.1), and the risk increased after the data had been adjusted (OR = 8.5). The change of OR after adjustment was mainly caused by the variable "having a car in the household", which in other words was a confounding factor in relation to visual function.

Table III. *Characteristics of older users in risk of negative outcomes using powered wheelchair in terms of goal attainment, feeling of independence, frequency of use in the summer and winter. Crude odds ratios (OR) and ORs*[a] *adjusted by means of logistic regression analysis (n = 111)*

	Did not agree that the powered wheelchair could be used to carry out prioritized activities		Did not agree that the powered wheelchair gave independence		Low frequency of use in the summer: < every day		Low frequency of use in the winter: < every week	
Determinant	Crude OR	Adjusted OR (Cl)	Crude OR	Adjusted OR (Cl)	Crude OR	Adjusted OR (Cl)	Crude OR	Adjusted OR (Cl)
77–92 years old[b]	3.0*	6.3* (1.4–28.4)	1.1		3.4**	3.3** (1.5–7.5)	2.7*	3.7** (1.5–9.2)
Female[c]	2.9	9.5** (1.8–50.1)	2.2		0.7		1.2	
Could not walk at all[d]	5.0**		15.2**	15.0* (1.7–134.5)	1.0		1.8	
Need of assistance to transfer to p.w.[e]	8.4**	25.3*** (4.4–145.5)	6.5*		0.7		2.4	
Some visual difficulties[f]	3.1*	8.5* (1.6–43.7)	1.1		2.0		1.0	
Car in household[g]	2.5		2.0		1.1		2.0	3.2* (1.1–8.9)
Could not drive a car[h]	1.2		n.p.		0.8		1.1	
Lived alone[i]	1.7		2.4		1.2		2.1	

[a] 95% Cl and only ORs statistically significant at a level of $p < 0.05$ are included.
* $p < 0.05$, ** $p < 0.01$. *** $p < 0.001$.
p.w. = powered wheelchair.
Reference groups (OR = 1.0): [b] 65–76 years old; [c] Male; [d] Could walk a little; [e] Not need of assistance to transfer to p.w.; [f] No visual difficulties; [g]No car in household; [h]Could drive a car; [i] Lived together/other.
n.p. = not possible to carry out analysis.

It had no impact on any of the outcome variables whether the user was able to drive a car or not. However, when there was a car in the household the probability that the user would not use the powered wheelchair in the winter was increased.

DISCUSSION

The findings in this study demonstrate that older people with limited walking ability benefit from using a powered wheelchair. Almost all users regarded their powered wheelchair as important and found that it gave independence. They also thought that the wheelchair in most cases could be used for activity and participation, and all used their powered wheelchair. Thus this societal intervention can be considered to be relevant. But the study also identified barriers for effective use of the powered wheelchair, and results of the analysis of risk factors for negative outcomes provided us with new knowledge indicating the need for development of improved intervention strategies.

The activities that older people carried out using their powered wheelchairs were similar to the activities that older people without limited walking abilities carry out walking or cycling (3) thereby enhancing activity and participation, even though some users could not carry out all prioritized activities using the powered wheelchair. These results are in line with the results of other studies (7, 8, 17, 20).

The main activity that some users could not always carry out using the powered wheelchair was visiting friends and family, which is of concern because social relationships are important for participation in societal life (2). The barriers reported in the current study concerned the characteristics of the powered wheelchair, and the physical environmental context. As to the characteristics of the powered wheelchair, the problem was that it could not go far enough, probably because some family members live so far away that it would not be realistic to go in a powered wheelchair, even if it could go farther. The physical environmental barrier preventing the users from visiting friends and family concerned stairs, doorsteps, etc., while this type of barrier did not prevent the users from shopping. On the basis of former studies it was expected that physical environmental barriers would prevent the powered wheelchair users from carrying out more activities (14, 18), so it was surprising that the physical barriers did not play a more pronounced role. The explanation may be that the users had adapted their behaviour (5, 24) by going routes without physical barriers or by going to accessible places rather than to places they really want to go to (25). The explanation given is supported by the fact that especially physical barriers played a role in relation to visiting friends and family, and in contrast to public facilities such as, for example, shops, the specific homes of friends and family cannot just be substituted with another.

Users over 76 years of age were more likely not to think that the powered wheelchair could be used to carry out prioritized activities. This finding is supported by a study about older people's activity performance, which revealed that older people show age-related decline (26). However, other studies have

shown that age does not seem to be a factor in its own right, but due to other factors such as impaired body function, bad health or environmental barriers (3, 27). One of the reasons for these different results is probably the methodological approach of the studies, indicating that more research is needed about age as a factor for outcomes of assistive technology. Knowledge about the age factor is especially important because the prevalence of assistive device use increases in older age (28).

The gender distribution of the study sample differed from the gender distribution of the general population of people over 65 years of age. Given the sampling strategy applied, it is likely that the sample is representative for the Danish population of older powered wheelchair users, implying that a greater proportion of older men than of older women use powered wheelchairs. Another gender difference was that it was much more likely that men could use their powered wheelchair to carry out prioritized activities. On the other hand women used the powered wheelchair for more differentiated activities than men did. One explanation for these gender differences may be that men's and women's activities generally differ (3, 29–30) and another that men and women relate to technology in different ways, men finding it easier to use high technology based devices than women do (e.g. 31). Still, the issue of gender and use of assistive devices is largely unexplored, and in order to obtain reliable knowledge about this phenomenon other studies are needed.

Methodological considerations

The HAAT model (12) was used in this study, and it seems to be useful. The investigated factors have proved to play a role for the outcome dimensions investigated; some personal factors influenced the possibility to carry out prioritized activities, the range of the powered wheelchair and stairs and doorsteps may be barriers, and the sort of activity carried out also played a role. The study does shed some light upon how these factors influence a number of outcome dimensions, but still only little is known about the interrelationships between the 4 domains, how they influence various outcome dimensions, and underlying mechanisms. An example is physical barriers and why in some situations they constitute major problems and in other situations minor problems for users of powered wheelchairs.

The current study was a cross-sectional study. A drawback of this design is that it is difficult to establish the direction between cause and outcome, and in order to obtain this, longitudinal analytic studies should be carried out (32). Such studies and qualitative studies can give us further knowledge about some of the issues raised in this study, for example, concerning the significance of age, gender and physical environmental barriers.

The study was performed in Denmark, and the results can be considered as representative of this country. Some of the results may apply to other countries, but not all due to different geographical conditions or assistive technology service systems.

Practical implications

The study shows that users with some walking ability and/or ability to transfer to the wheelchair without assistance benefited substantially from using a powered wheelchair. However, in some countries (33) and some Danish municipalities the eligibility criteria for granting a powered wheelchair are that only applicants who cannot walk at all and/or are not able to transfer to the wheelchair without assistance are entitled to get one. Another common criterion is that the user must be in need of the powered wheelchair for shopping or for going specific places. Yet the users' needs seem to be different; the most frequent activity reported in the current study was going for a ride, and also visits to friends and family were frequent. The need to go outside to get fresh air and sunlight is a basic health requirement and must be considered as important as more targeted activities (e.g. 34). Likewise, it has been shown that not only physical, but also social activities have positive effects on survival rates (35). Thus, early intervention before the user may lose all walking ability would enable the user to stay active and prevent participation restrictions. The results of the present study do not support the mentioned criteria for granting powered wheelchairs, and since eligibility criteria should be as valid as possible a revision of existing criteria should be considered.

The powered wheelchair cannot be used in all situations to carry out prioritized activities, especially in case of long distances and environmental barriers. In order to make participation in societal life possible there is a need to supplement powered wheelchairs with other transport possibilities.

In conclusion, the vast majority of older powered wheelchair users consider their device to be important and that it gives them independence, and all of them use it. The powered wheelchair makes it possible for them to carry out most prioritized activities and to participate in societal life. This means that provision of powered wheelchairs can be regarded as worthwhile. However, in some cases, especially for visits, the powered wheelchair cannot be used and other means of transportation must be supplied in order to make participation possible. The results of this study indicate that the use of powered wheelchairs should be extended to older people with less impairment than is common today preventing activity limitations, even though exact criteria cannot be stated on the basis of this study. A number of risk factors in relation to various outcome dimensions have been identified, which is useful for planning measures to improve older people's outcomes of using a powered wheelchair. Finally, a number of issues that need further investigation have been identified, especially the significance of age, gender and physical environmental barriers in relation to the use of powered wheelchairs to enable activity and participation.

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