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ORIGINAL REPORT

IMPACT OF HOME MODIFICATION SERVICES ON ABILITY IN EVERYDAY LIFE FOR PEOPLE AGEING WITH DISABILITIES

Ingela Petersson, Reg OT, MSc[1], Margareta Lilja, Reg OT, PhD[1], Joy Hammel, OTR, PhD[2] and Anders Kottorp, Reg OT, PhD[1]

From the [1]Department of Neurobiology, Care Science and Society, Division of Occupational Therapy, Karolinska Institutet, Stockholm, Sweden and [2]Department of Occupational Therapy, University of Illinois at Chicago, Chicago, USA

Objective: **To examine the impact of home modifications on self-rated ability in everyday life from various aspects for people ageing with disabilities.**

Methods: **The study sample was recruited from an agency providing home modification services in Sweden and comprised 73 subjects whose referrals had been approved and who were scheduled to receive home modifications (intervention group) and 41 subjects waiting for their applications to be assessed for approval (comparison group). The subjects rated their ability in everyday life using the Client–Clinician Assessment Protocol Part I on 2 occasions: at baseline and follow-up. The Client–Clinician Assessment Protocol Part I provides data on the clients' self-rated independence, difficulty and safety in everyday life. The data were first subjected to Rasch analysis in order to convert the raw scores into interval measures. Further analyses to investigate changes in self-rated ability were conducted with parametric statistics.**

Results: **Subjects who had received home modifications reported a statistically significant improvement in their self-rated ability in everyday life compared with those in the comparison group. Subjects who had received home modifications reported less difficulty and increased safety, especially in tasks related to self-care in the bathroom and transfers, such as getting in and out of the home.**

Conclusion: **Home modifications have a positive impact on self-rated ability in everyday life, especially on decreasing the level of difficulty and increasing safety.**

Key words: community living, occupational therapy, environmental intervention, ADL, differential item functioning, Rasch analysis.

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Correspondence address: Ingela Petersson, Karolinska Institutet, Department NVS, Division of Occupational Therapy, Alfred Nobels Allé 23, SE-141 83 Huddinge, Sweden. E-mail: ingela.petersson@ki.se

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INTRODUCTION

The provision and use of home modifications has increased and become more important as a result of the growing number of people ageing with disabilities in the community (1, 2). As people age and experience functional limitations, their ability to manage activities of daily living (ADL), both personal tasks (P-ADL) such as showering and dressing and instrumental tasks (I-ADL) such as housework and grocery shopping, will decrease (3). One strategy for reducing problems in everyday life is to adapt the home environment to support individual competence (4), for instance with home modifications. In Sweden, the purpose of home modifications is to reduce environmental demands in the home and the immediate outdoor environment, to enable people with functional limitations to live as independently as possible in their homes and close surroundings (5). The most commonly requested home modifications in Sweden are related to self-care, such as showers, and to mobility inside and outside the home, such as ramps and automatic door openers (2).

Research has indicated that environmental interventions, the majority of which include assistive technology and devices, can reduce an elderly person's level of difficulty (6), dependence and increase safety (7, 8) in everyday life. Environmental interventions are therefore often used with the intention of improving everyday life. However, the specific impact of community-delivered home modification services that involve architectural and structural modifications to the home, such as the provision of lifts, ramps and bathroom remodelling, remains largely undocumented.

There is limited research available on the effects of home modifications on elderly persons living in their own homes. In a randomized controlled trial by Mann et al. (9), the effects of an assistive technology and environmental intervention programme were evaluated. The findings indicated that participants who received environmental interventions showed less decline in functional dependence than those in the comparison group. This study also showed that the provision of environmental interventions has economic benefits, since it reduces the need for institutional and in-home personnel (9). A reduced decline in the level of functional dependence has also been found in a trial conducted by Gitlin et al. (10), focusing on older adults with Alzheimer's disease and their caregivers. The findings here suggested that environmental interventions have positive effects not only on reducing dependence but also on enhancing caregiver self-efficacy. In a longitudinal study Fänge & Iwarsson (11) investigated functional dependency in daily life for a gen-

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eral sample of persons receiving home modifications. The study did not identify any overall changes in functional dependency over time; however, a significant decrease in dependency for the item related to bathing was noted. Nonetheless, the level of independence has been shown to provide only a limited understanding of a person's ability in daily life (12, 13), and of the effects of home modification (11).

In more recent studies by Gitlin et al. (6) a multi-component intervention (including home modifications) for older persons with functional limitations has been evaluated. These studies have shown that the intervention supported improvements in level of difficulty but not in dependency, and also that the intervention had a positive impact on survivorship (14).

In conclusion, previous studies indicate that environmental interventions, such as the provision of home modifications, have a positive impact on functional independence, survivorship and, moreover, provide economic benefits for older adults with both functional and cognitive limitations. Apart from Gitlin et al. (6), most researchers have used functional independence as an outcome measure in order to evaluate impacts of home modification on ability in everyday life. Other aspects beside functional dependency in daily life, such as safety and difficulty as used in Gitlin et al.'s study (6), could provide more insights into ability in everyday life. These outcomes could perhaps also help to illuminate additional effects of home modifications that are not captured in evaluations of functional independence. Furthermore, due to lack of clarity about the contents of the environmental interventions evaluated in research it is not possible to draw conclusions about whether specific home modifications are effective. Instead, those environmental interventions that include the provision of a combination of assistive devices, home modifications and therapy services seem to be beneficial for persons with functional limitations.

With the intention of increasing the knowledge of the effect of home modification services, the aim of this study was to examine the impact of home modifications on self-rated ability in daily life for people aging with disabilities. The specific research questions were: (*i*) is there a difference in self-rated ability (independence, difficulty and safety) in everyday life after receiving home modification? And, if so, (*ii*) on what tasks in everyday life do home modifications have an impact?

METHODS

This study is part of a larger ongoing longitudinal research project conducted in Sweden. The data were collected between autumn 2002 and autumn 2005. The study was approved by an ethics research committee in Karolinska Institutet, Sweden.

Contextual framework of the study

In Sweden every local authority is obliged by law to provide home modifications in the form of a grant to people with disabilities living in the community who require modifications in order to remain in their homes (5). These grants are available to people with all sorts of long-term disabilities and conditions that affect the person's ability to engage in everyday life. Funding is provided irrespective of the financial situation of the applicant and is not dependent on a person's housing situation, e.g. whether they are living in a rented or owner-occupied apartment or house. All costs are covered for modifications that are assessed and considered to be necessary for the person to function in their dwelling, and include diverse aspects such as getting in and out of the home, mobility within the home, and managing personal and instrumental tasks. In order to receive home modifications a person has to apply for a grant from the local Agency for Home Modification (AHM). In addition, a community-based professional, such as an occupational therapist or physician, needs to certify that the person has a genuine need for a modification to address problems he or she encounters in his or her everyday life due to a permanent functional limitation. The final decisions concerning the approval or refusal of an application are made by the professionals at AHM (usually occupational therapists and physiotherapists) in conjunction with the applicant, and when the applicant does not own the dwelling, with the applicant's landlord. The home modification is later installed by professionals, e.g. contracted carpenters with specific competence in home modifications. The home modification process in Sweden has been described in more detail elsewhere (1). In Sweden, with a population of 9 million, approximately 60,000 home modification grants were approved in 2005 at a total cost of 857 million Swedish crowns (2) (about 101 million US dollars in November 2006).

Participants and procedure

Participants were recruited from an AHM in a large city in Sweden during the period 2002–04. Recruitment was conducted through collaboration between the researchers and the professionals (i.e. occupational therapists and physiotherapists) working at the AHM.

The inclusion criteria for participation in the study were: (*i*) 40 years of age or older; (*ii*) living in a community-based dwelling; (*iii*) able to communicate in Swedish and actively participate in the study; and (*iv*) having problems in everyday life and requesting home modification related to at least one of the following 3 areas: (a) getting in and out of the home, for example opening the house door or mobility on the stairs; (b) mobility indoors, e.g. moving between rooms and using the stairs indoors; or (c) self-care in the bathroom, e.g. showering, using the toilet or washing hands and face at the sink. The inclusion criteria were based on areas where a problem was identified and not on a specific home modification, since a home modification such as a handrail may be used in all 3 areas.

Exclusion criteria were: (*i*) reduced cognitive status, based on a Mini Mental State Examination (MMSE) score below 19 (15); (*ii*) depression, based on scores of 24 or above on the CES-D Depression Scale (16). The exclusion criteria were chosen in order to exclude people who would not be able to understand, concentrate on and answer the questions in a valid and reliable manner in the data collection process.

The professionals at the AHM identified potential participants whose applications had been received, and who met the inclusion criteria, from 2 lists: (*i*) a list where the application had been approved and persons were scheduled to receive their home modifications within 4 weeks (refers to the intervention group in this study); (*ii*) a list of applicants whose applications was received within the last month, who were waiting for their application to be investigated by the AHM (refers to the comparison group in this study).

In total, 137 persons who met the inclusion criteria were invited to participate in the study, and of these 23 declined participation in the study. The total sample, therefore, comprised 114 participants ($n = 73$ in the intervention group and $n = 41$ in the comparison group). There were no differences in gender, age or type of home modification requested, between those who agreed to participate ($n = 114$) and those who declined ($n = 23$).

Of the 114 participants at baseline, 105 participated in the follow-up interview. Thus, the attrition rate was 8%. Of the 9 participants not taking part in the follow-up, 2 had died, 2 were too ill, one had decided not to apply for the home modification, one had moved and 3 declined to participate without explanation. A comparison between the remaining 105 participants and the 9 drop-outs did not reveal any differences in terms of the demographics or applied home modifications.

Table I. *Comparison of demographic variables and applied home modifications for participants in the intervention and comparison groups*

	Total ($n=105$)	Intervention ($n=68$)	Comparison ($n=37$)	χ^2 (df)	*t*-test	*p*-value
Age, years, mean (SD)	75.3 (10.9)	75.7 (11.1)	74.6 (10.6)		0.496	0.621
MMSE†, mean (SD)	27.60 (2.4)	27.5 (2.4)	27.7 (2.5)		–0.336	0.715
Gender, *n*				0.183 (1)		0.668
Female	71	45	26			
Male	34	23	11			
Social situation, *n*				1.688 (1)		0.194
Alone	68	41	27			
Someone	37	27	10			
Dwelling, *n*				1.543 (1)		0.214
Apartment	91	61	30			
One-family house	14	7	7			
Requested home modifications, per person, mean (SD)	1.29 (0.6)	1.34 (0.7)	1.19 (0.4)		1.219	0.226
Home modification areas, *n*						
Get in and out of home	57	44	13	8.443 (1)		0.004*
Mobility indoors	7	4	3	0.191 (1)		0.662
Self care in bathroom	53	31	22	1.844 (1)		0.174
Applied home modifications, *n*						
Shower	56	29	17	0.106 (1)		0.745
Toilet	8	4	4	0.827 (1)		0.363
Elevator	17	10	7	0.313 (1)		0.576
Ramp	8	5	3	0.019 (1)		0.889
Handrail	8	6	2	0.398 (1)		0.528
Automatic door-opener	41	33	8	7.289 (1)		0.007*
Other	8	4	4	0.827 (1)		0.363

*$p=<0.05$ between intervention and comparison groups.
†Mini Mental State Examination (MMSE) total score 30, $n=101$.
SD: standard deviation.

The characteristics of the 105 participants included in the analysis are presented in Table I. The 2 groups did not differ in terms of any of the demographic variables, such as age, gender, social situation or dwelling. The participants in both groups had also applied for an equivalent number of home modifications. The intervention group had, however, requested a significantly larger number of home modifications related to getting in and out of the home ($p<0.001$) and, specifically, for automatic door openers ($p<0.006$) (see Table I). All analysis concerning demographic variables was conducted with χ^2 tests for ordinal data and independent samples *t*-tests for interval data. The level of significance for all analyses was set at $p<0.05$ (17).

Instrumentation

Self-rated ability in everyday life was measured at baseline and follow-up using the Swedish version of the Client-Clinician Assessment Protocol (C-CAP) Part I (18). The C-CAP was originally developed in the USA (19). The instrument also consists of a performance-based assessment of the client's performance of ADL and the impact of the home environment, i.e. Part II and III (20). However, in this study only Part I of the C-CAP was used. The C-CAP Part I assesses self-rated independence, difficulty and safety in ADL. The instrument consists of 18 tasks, i.e. P-ADL, I-ADL, mobility and leisure. The C-CAP Part I is conducted as a structured interview, with the occupational therapist working in collaboration with the client. The occupational therapists ask the clients about their self-rated ability in the 18 tasks. For each of the 18 tasks the client is asked 3 questions concerning how they perceive their independence, difficulty and safety. The clients rate their ability on 3 separate rating scales, with the level of independence being rated on a 4-point scale (4 = independent, 3 = uses technical device and/or home modification, 2 = uses only help from a person, 1 = uses both help from a person and technical device and/or home modification), the level of difficulty on a 5-point scale (5 = no difficulty, 4 = a little difficulty, 3 = difficult, 2 = a lot of difficulty, 1 = unable to do at all), and the level of safety on a 3-point scale (3 = feel safe, 2 =feel a little unsafe, 1 = feel very unsafe). The scales are presented to the client in both oral and written form by the occupational therapist to enable the client to identify which category best represents their ability. The chosen score is then documented by the occupational therapist on the C-CAP instrument paper chart. The 3 scales are scored separately and the items are not added together (18). The psychometric properties of the Swedish version of C-CAP Part I have been investigated (20). The findings provided support for internal scale validity, i.e. that a scale measures a single unidimensional construct person response validity, so that the instrument can be used in a valid manner with persons similar to those in the tested sample, and person separation, i.e. if the scale can reliably differentiate a group of persons into different levels (21), although the results differed between the 3 scales. Furthermore, the results showed that the instrument could be applied to people ageing with disabilities, over the age of 40 years, in the home environment (20).

Data collection

The researchers collected the data in the participant's home on 2 different occasions; baseline and follow-up. The average baseline data collection was conducted about 5 months (standard deviation (SD) 4) after the application for home modifications for the intervention group and after approximately 2 months (SD 1) for the comparison group. The follow-up for the intervention group was conducted about 2 months after the home modifications were made, whilst the follow-up for the comparison group occurred about 2 months after baseline. Four research assistants collected all data. The data collection was conducted according to a standard protocol designed for this research study. In order to obtain valid data all research assistants underwent specific training in collecting data for this study given by the principal researcher for this study (ML).

Data analysis

A Rasch model was used for analysing data from C-CAP Part I, using the computer programme FACETS version 3.54 (22). The FACETS programme was developed to allow for multifaceted analysis, but is equally appropriate for simpler 2-faceted Rasch rating scale analyses. The FACETS was used to transfer the raw scores collected for the 3 scales, (independence, difficulty and safety) in C-CAP Part I into interval measures. In this study, FACETS was used to generate individual person ability measures and item difficulty calibrations, expressed in logits (log odds probability units), for the 2 groups at baseline and follow-up. This process has been described elsewhere in more detail (20).

The outcome analysis was further guided by models presented by Chang & Chan (23). In order to identify any differences in self-rated independence, difficulty and safety, the person ability measures generated from baseline and follow-up were used. The comparison was conducted for both the intervention and the comparison groups, with the intention of detecting any change in self-rated ability, using paired sample *t*-tests, with a level of significance set at $p < 0.05$ (15). Cohen's criteria were used to define the degree of effect size (*d*) (24).

When a significant improvement in self-rated ability was identified between the baseline and follow-up on any of the 3 scales, we proceeded to examine the scale on an item level to identify on which specific tasks the home modification may have had an impact. A new series of analyses was conducted where the person ability measures were anchored, i.e. they were set at the ability measures generated from the first analysis, and the item difficulty calibrations for each task were allowed to float. This process has been described elsewhere (25). In this way, it was possible to separately estimate the relative difficulty of each task for the participants at baseline and follow-up (i.e. differential item functioning). When the item difficulty calibrations are estimated they define the relative linear hierarchy of task challenges on each occasion.

In order to detect an actual difference in task challenge between baseline and follow-up, an adjustment of the relative item difficulty calibration values in proportion to the mean overall difference in person ability between baseline and follow-up was computed. This process has been described in more detail elsewhere (25). The extent of difference in the actual task challenge between baseline and follow-up on tasks was finally calculated using a standardized *Z* comparison (26), considering the standard error (SE) of each item difficulty calibration. The SE of the item difficulty calibration provides an estimate of the level of uncertainty in the difficulty calibration (27). Since the size of the SE is dependent on the available amount of data, large samples or data sets may result in artificially small SE values, and therefore increase the risk of Type I error (17). In this study, we therefore used a more conservative approach where the item difficulty measures with an SE value < 0.15 had to have an actual difference of at least 0.43 logit to be considered to be clinically meaningful and to represent a significantly detectable difference ($p < 0.05$), in accordance with earlier studies (28).

Analysis of the demographics and the differences in the person ability measures was conducted using SPSS version 13.0 (29).

RESULTS

The mean person abilities on the independence, difficulty and safety scales for the participants in both the intervention and comparison groups at baseline and follow-up are presented in Table II.

Significant differences were found in self-rated difficulty and safety for the intervention group, indicating that the participants felt they were safer and had less difficulty in everyday life after the home modification. The effect size for the difficulty scale was 0.32 and for the safety scale 0.40, indicating a moderate effect of the intervention (24). The self-rated independence did not change significantly between baseline and follow-up for the intervention group. The mean abilities of the participants in the comparison group were higher than those of the participants in the intervention group at both baseline and follow-up, indicating that the participants in the comparison group rated themselves as more able than the participants in the intervention group. The mean abilities of the participants in the comparison group did not change significantly between baseline and follow-up (Table II).

The participants in the intervention group demonstrated significant mean differences in person ability between baseline and follow-up on the difficulty and safety scales. These scales were further investigated in order to determine whether there were any significant differences in the task challenges at baseline and follow-up (Tables III and IV).

A positive actual difference indicates that the task was estimated to be easier or safer at follow-up than at baseline, whereas a negative difference indicates that the task was considered more difficult or more unsafe at follow-up than at baseline.

Most tasks resulted in positive values, suggesting that the tasks were perceived as easier after the home modification intervention (Table III). There were statistically significant ($p < 0.05$) differences between baseline and follow-up measures of perceived difficulty for 6 tasks: Get in and out of home; Bath/shower; Grooming; Transfer to toilet; Walk a block; and Move in and out of bed.

A comparison of the task challenge between baseline and follow-up for the safety scale are presented in Table IV. All tasks except "Take medication" and "Get on and off a chair" were perceived as safer after the home modification intervention. There were statistically significant differences ($p < 0.05$) between baseline and follow-up measures of safety for 10 tasks

Table II. *Mean ability measures (logit) and difference between baseline and follow-up for intervention and comparison group*

	Intervention group					Comparison group				
	Baseline (73)	Follow-up (68)				Baseline (41)	Follow-up (37)			
	Mean (SD)	*Mean (SD)*	*t*-test	*p*	*d*	*Mean (SD)*	*Mean (SD)*	*t*-test	*p*	*d*
Independence	1.38 (1.05)	1.47 (1.17)	–0.630	0.531	–	2.27 (2.04)	2.35 (1.91)	–0.388	0.701	–
Difficulty	1.18 (0.71)	1.54 (1.54)	–3.353	0.001*	0.32	1.36 (1.03)	1.38 (1.05)	0.081	0.936	–
Safety	3.08 (1.58)	3.75 (1.80)	–3.820	0.001*	0.40	3.42 (1.76)	3.54 (2.01)	–0.090	0.928	–

*Significant difference in person ability measures between baseline and follow-up.

Table III. *Change in self-rated difficulty in everyday life, task challenge measures (logits) for intervention group at baseline (n = 73) and follow-up (n = 68)*

More difficult items at baseline

	Baseline relative measure	SE	Follow-up relative measure	SE	Actual difference[1]
Managing stairs	1.39	0.08	1.56	0.09	0.19
Get in and out of house	1.28	0.08	0.52	0.11	1.12*
Do light housework	1.21	0.10	1.50	0.09	0.07
Do grocery shopping	0.96	0.09	1.08	0.09	0.24
Walk a block	0.76	0.08	0.58	0.10	0.54*
Bath/shower	0.70	0.11	–0.03	0.11	1.09*
Leisure or social activities	0.35	0.10	0.43	0.10	0.26
Get in/out of car	0.32	0.09	0.36	0.10	0.32
Dress lower	0.27	0.09	0.34	0.10	0.29
Prepare food	0.00	0.12	0.42	0.12	–0.06
Move in/out of bed	–0.09	0.10	–0.17	0.12	0.44*
Get on/off of chair	–0.27	0.11	0.06	0.11	0.03
Dress upper	–0.47	0.12	–0.23	0.13	0.12
Transfer to toilet	– 0.55	0.13	–0.84	0.18	0.65*
Walk indoors	–0.74	0.14	–0.67	0.15	0.29
Grooming	–1.27	0.17	–1.64	0.24	0.73*
Feed self	–1.55	0.20	–1.35	0.21	0.16
Take medication	–2.32	0.30	–1.90	0.34	–0.06

Easier items at baseline

*Significant clinical detectable difference in task challenge.
[1]Actual difference = relative difference in task challenge measure between baseline and follow-up + mean difference in ability between the 2 occasions (0.36 logit).
SE: standard error.

Table IV. *Change in self-rated safety in everyday life, task challenge measures (logits) for intervention group at baseline (n = 73) and follow-up (n = 68)*

Less safe items at baseline

	Baseline relative measure	SE	Follow-up relative measure	SE	Actual difference[1]
Managing stairs	2.19	0.16	1.93	0.21	0.93*
Get in and out of house	1.92	0.17	1.25	0.22	1.34*
Walk a block	1.76	0.17	1.51	0.22	0.92*
Bath/shower	1.76	0.18	1.07	0.20	1.36*
Do grocery shopping	0.95	0.23	0.68	0.28	0.94*
Walk indoors	0.07	0.22	0.16	0.25	0.58*
Leisure or social activities	0.00	0.24	–0.30	0.39	0.97*
Dress lower	–0.26	0.25	0.04	0.26	0.37
Prepare food	–0.41	0.30	–1.18	0.53	1.44*
Transfer to toilet	–0.52	0.28	–0.23	0.31	0.38
Move in/out of bed	–0.69	0.30	–0.42	0.31	0.40
Dress upper	–0.70	0.30	–0.25	0.29	0.22
Get in/out of car	–0.71	0.32	–0.59	0.34	0.52
Do light housework	–0.71	0.42	0.17	0.34	–0.21
Grooming	–1.43	0.41	–2.28	0.73	1.52*
Feed self	–1.43	0.41	–0.86	0.37	0.10
Get on/off of chair	–1.78	0.65	–0.09	0.29	–1.02
Take medication	–4.36	1.80	–0.62	0.33	–3.07*

Safer items at baseline

*Significant clinical detectable difference in task challenge.
[1]Actual difference = relative difference in task challenge measure between baseline and follow-up + mean difference in ability between the 2 occasions (0.67 logit).
SE: standard error.

related to self-care in the bathroom, transfers, instrumental activities and leisure.

DISCUSSION

In this study the impact of home modifications on self-rated ability in everyday life was evaluated. The results indicate that a reduction in physical environmental barriers can decrease self-ratings of difficulty and increase safety. This supports the arguments about the environment's impact on performance in everyday life, as discussed in theoretical models (4, 30) and stressed in previous empirical research (3).

The main findings of this study revealed that self-rated difficulty and safety showed a significant positive change after home modifications were made, indicating that home modification services may reduce problems related to these aspects of ability in everyday life. This finding is of great importance to this area of knowledge, since self-rated difficulty and safety have not previously been investigated to any great extent in outcome studies on home modifications.

In contrast to difficulty and safety, this study showed that home modifications did not impact significantly on self-rated functional independence. These findings are in accordance with previous research on environmental interventions where functional independence has been used as an outcome measure (11, 31). This is an important finding, since one of the aims of providing home modifications is to facilitate higher functional independence (5), but the results of this study did not support the claim that functional independence is improved. However, for people ageing with disabilities, the primary goal of home modifications may not be to facilitate functional independence. Additionally, a goal of home modifications may be to enable people with long-term disabilities to stay in their homes. Thus, issues of safety and difficulty are equally important indications as the ability to perform tasks by one's self. Possible reasons for the lack of impact on functional independence could be related to the sample and the measure chosen to determine outcome, the C-CAP Part I. The sample included in this study was already functioning at quite a high level of independence, at baseline. However, it is likely that the level of functional independence could be increased and the caregiver burden decreased by the provision of home modifications for a sample of people who were more dependent at baseline. This, however, needs to be confirmed. It is also possible that, from a longitudinal perspective, the provisions of home modifications may delay the need for social support and functional dependency since this study

showed that home modifications reduce difficulty and increase safety in everyday life, but the relationship between these constructs needs to be investigated further. Measuring functional independence has been found to be problematic, since the concept may not be unidimensional but rather consist of multiple constructs (20, 32). The previous study on the independence scale in C-CAP Part I (20) demonstrated lack of internal scale validity. This current study also shows that the independence scale could not detect any changes after intervention and will therefore not be a sensitive outcome measure in relation to home modification intervention. Based on the results of these 2 studies the independence scale in C-CAP Part I may not be considered as clinically useful or psychometrically sound to apply in clinical research, compared with the other C-CAP scales.

Previous studies on environmental interventions have commonly used total scores in order to measure changes in persons' abilities in everyday life (9, 10, 31). Such total functional scores may not be sensitive to detecting changes in specific tasks related to everyday life in which home modification is targeted, such as bathroom use and entryway access. Additionally, there has been a lack of knowledge concerning the impact of home modifications upon specific tasks in everyday life. In this study, the impact of home modification on specific tasks in everyday life was evaluated. The findings indicated that home modifications seemed to have a direct impact on tasks specifically targeted by the home modifications, such as grooming, bath/shower, and getting in and out of the home. This further supports the conclusion that the improvement in ability was related to the home modifications. Interestingly, an indirect impact of the home modification was detected by participants reporting an increased level of safety in tasks not directly related to the home modification, such as grocery shopping and leisure. This could indicate that modifications made in the home environment may have an additional impact upon tasks performed outside the home and on participation in the community. However, some of the changes found are less explainable and more questionable, such as the participants having experienced decreased safety in taking medication after home modification interventions. Taking part in a home modification process may affect the participants in multiple ways, new needs may arise or the participants may become more aware of other services available in the community. These aspects are problematic to control and measure in an outcome study and are thus a limitation of this study. Further qualitative studies could help to explore and describe further the participants' experiences and changes after home modifications.

The outcome of this study must, however, be viewed with some caution, given the methodological limitations. Firstly, this study focused on the population in society that uses the most community services, including home modifications (33), and on the areas of the home that have been found to contain some of the most common environmental barriers to individuals' participation in ADL (34). It is, however, important to note that this study specifically examined the impact of home modifications related to getting in and out of the home, mobility indoors and performing self-care in the bathroom, and not of home modification in a broader context. Furthermore, the sample used in this study was a limited sample of people living in an urban area who applied for home modifications and therefore may not be generally representative of all people who are in need of, actively request and receive home modifications. It is also important to emphasize that the sample size is relatively small and therefore limits the possibility of drawing any general conclusions.

Secondly, the instrument used to measure outcome, the C-CAP Part I, is new and has only been used to a limited extent in research. Thus, the C-CAP was selected for use in this study because it was found to be the only available instrument for measuring self-rated independence, difficulty and safety in everyday life, which was the aim of this study. In a previous study of C-CAP Part I, some limitations were identified in the instrument's psychometric properties, especially related to the sensitivity in the safety scale and the internal scale validity in the independence scale (20). The problem with the safety scale corresponds with this present study, where large SE values of the items in the safety scale were also identified. The imprecision of these estimations were considered when evaluating changes between baseline and follow-up data. Despite the limitations in the C-CAP Part I, the safety scale did detect significant differences in both person ability measures and task challenge estimations, supporting the responsiveness of the scale to home modifications.

Another significant consideration is the difficulty of measuring whether the self-rated improvements in everyday life were a direct consequence of the home modifications or were related to other aspects, such as receiving technical devices, or were just random variation. The data from the comparison group were used to reduce threats to internal validity, which may have affected the results. The results showed that there were no differences between the groups demographically. The participants in the intervention group had, however, applied for more home modifications related to getting in and out of the home, which may indicate that the participants in this group demonstrated greater problems with transfers. The participants in the comparison group did rate themselves to be more able than the intervention group on all 3 scales at baseline. This may be because of the different conditions for the 2 groups. For example, participants in the intervention group had been waiting for a longer time for their home modifications than had those in the comparison group. It could therefore be possible that there is an effect of time, i.e. that the participants in the intervention group report more difficulties since they have lived longer with their home modification need. The use of the comparison group in this study does provide complementary data and gives an indication of the benefits of home modifications that would not have been observed using only a single intervention group with pre- and post-measurements.

The impact of home modifications on people's ability to manage ADL is an important area that needs further research. How to conduct this research is, however, a question that needs to be discussed. This study has shown some of the challenges that researchers face. These methodological circumstances are

problematic but not at all unique when researchers conduct outcome studies in real-life situations under normal conditions in the community. One example of this was the difficulty of creating a control group that was comparable to the intervention group. In fact other researchers conducting studies in home environments have also pointed out other methodological challenges. Both Fänge & Iwarssson (11) and Golant (35) have emphasized the individual nature of home modification impacts and stress the importance of developing more individual methods in order to identify impacts on persons' lives. Conducting controlled studies in the specific home environment has also been found to be problematic (36), since it is not possible for the researcher to be in total control of the process. This makes research in this area more challenging and involves demands of new and more flexible designs and analysis methods.

This study has generated questions that would be interesting to examine in future research. In particular, as this study focused only on everyday life in the first few months after the installation of home modifications, it would be of value to extend the data collection process over a longer period, in order to evaluate more longitudinal impact of home modification on everyday life. It would also be interesting to apply personally-based methods and qualitative methods in order to determine if these methods could be beneficial in identifying additional impacts of home modifications.

In conclusion, this study has shown that home modifications appear to have their greatest impact on tasks directly related to the home modification, such as getting in and out of the home and performing self-care in the bathroom. Furthermore, home modifications resulted in self-rated reductions in difficulty and increases in safety, but had no effect on functional independence in everyday life tasks. These findings raise important issues concerning the assessments of ADL that are being used as outcome measures in rehabilitation. Level of functional independence is one of the most commonly used outcome measures, not only in research but also in federal documents and in clinical practice (13). Based on the results of this study, it could therefore be questioned whether the level of independence alone is a suitable and complete outcome measure with which to detect improvements in everyday life. This study indicates that there is a need to broaden the assessments of ability in everyday life for people living in their own home environments, to provide sufficient information concerning problems and needs in everyday life, and to detect improvements attributable to home modifications.

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