Eur J Ageing (2007) 4:201–211
DOI 10.1007/s10433-007-0064-2

ORIGINAL INVESTIGATION

Very old people's use of the pedestrian environment: functional limitations, frequency of activity and environmental demands

Pia Hovbrandt · Agneta Ståhl · Susanne Iwarsson · Vibeke Horstmann · Gunilla Carlsson

Published online: 3 November 2007

Abstract Due to decreased functional capacity as well as high environmental demands there is a risk of diminishing activity outside home in very old age (age 80+). In order to explore differences according to functional limitations (FL) among very old people with respect to frequency of activity, perceived health, overall perception of neighbourhood environment, and perceived problems in the pedestrian environment, data derived from a postal questionnaire survey to very old people living in an urban area in Sweden were used. This explorative study is based on the subsample of people aged 80+ who reported outdoor activities (n = 97). Four groups of respondents with different types of FL were identified: with no FL (n = 23), with only movement-related FL (n = 26), with only perception/cognition-related FL (n = 16), and with both movement- and perception/ cognition-related FL (n = 32). The majority of the respondents reported rather high frequency of activity outside home. When examining differences between the four groups, the analysis indicated how the complexity of FL and perceived problems in the pedestrian environment impacted on their activity performance. Persons with both movement- and perception/cognition-related FL were less satisfied with their frequency of activity, experienced their health more negatively and experienced more problems in the pedestrian environment than in the other groups. The findings from this study indicate the importance of considering combinations of FL in creating supportive environments for activity and health.

Keywords Health promotion · Neighbourhood · Oldest old

P. Hovbrandt (✉) · S. Iwarsson · V. Horstmann · G. Carlsson
Department of Health Sciences,
Division of Occupational Therapy and Gerontology,
Lund University, Box 157, 221 00 Lund, Sweden
e-mail: pia.hovbrandt@med.lu.se

A. Ståhl
Department of Technology and Society,
Lund Institute of Technology,
Lund University, Lund, Sweden

Introduction

Engagement in activities outside home is important and contributes to health in old age (Atchley 1998; Legarth et al. 2005; Silverstein and Parker 2002). However, due to personal factors, such as age-related functional limitations (FL) older people differ in their potential for activity outside home. Environmental factors such as high kerbs and poor lighting can be obstacles for activity performance outside home as well (Lavery et al. 1996). Studies in the field of public health have found that people are more active when they live in accessible and safe neighbourhoods (Leslie et al. 2005; Suminski et al. 2005), although these studies did not focus specifically on older people. Functional limitations increase with age (Iwarsson 2005; Ruoppila and Raitanen 2004), and consequently the risk of reduced activity performance is higher in very old age. Whilst there are several studies on older people aged 65+ (Crombie et al. 2004; Lavery et al. 1996; Paterson et al. 2004), few studies have been carried out focusing on very old people (aged 80+) and their activities outside home. The large variation of functional capacity and activity performance in the population of over 65 years accounts for pronounced heterogeneity. Thus, to understand older people's engagement in activities outside home in a more differentiated way, there is a need for studies targeting more homogenous samples, e.g. in terms of age spans.

Moreover, in order to come up with concrete suggestions for changes in the physical environment current experiences are essential to ensure validity when persons themselves express problems in their environment (Fange and Iwarsson 2003). Therefore, in order to capture older people's perceived problems in the pedestrian environment in a valid way, it is essential to approach very old people currently engaged in activities outside home. Still, such studies are rare, and a first step towards deepened knowledge is to explore perceptions of environmental problems, accessibility and safety in pedestrian environments in this selected group of older people.

Focusing on person–environment interactions as described in the ecological model of aging (Lawton and Nahemow 1973), the docility hypothesis (Lawton and Simon 1968) can shed more light on the prerequisites for out-of-home activity in very old age. According to the docility hypothesis, older people with FL are more vulnerable to environmental demands than those with higher functional capacity, while as yet little is empirically known about e.g. how FL affect out-of-home activity in more detail. From the perspective of occupational therapy, activity is often addressed, using person–environment–activity transactions as the theoretical base (Carlsson 2002; Law et al. 1996). That is, a transactional relationship is assumed between individuals, the environment in which they live, and the activities they perform. The word transactional denotes that the relationship between the three components is dynamic, and difficult to separate from each other (Townsend et al. 2002). To gain a more comprehensive understanding of prerequisites for activity outside home for very old people, we need to focus on the person, environment and activity separately as well as transactionally (O'Brian et al. 2002).

According to a previous research it is a well known fact that due to environmental barriers in the outdoor environment, older people have activity performance difficulties outside home (Carlsson 2004; Mollenkopf et al. 2004; Shumway-Cook et al. 2002, 2003). Further, in a recent qualitative study, Hovbrandt et al. (2007) concluded that complex person–environment–activity transactions influence activity performance among very old people outside the home. However, to generate knowledge with potential to inform the design of supportive environments for activity outside home in very old age, it is important to consider physical environmental demands as well as FL in more detail.

Several studies show how both physical and cognitive limitations (Tinetti et al. 1995) affect activity among older people, especially their mobility, i.e. the ability to move about outside home (Rudinger et al. 2004). Mobility impairment is related to physical limitations, fatigue and shortness of breath (Leveille et al. 2002), poor muscle strength and balance (Guralnik et al. 1995; Sakari-Rantala et al. 1998), muscle rigidity, paresis in upper and lower extremities (Ferruci et al. 2004). Further, impaired vision can impact negatively on activities outside home for older people (Crews and Campbell 2001; Heyl et al. 2005). Regarding cognitive limitations, activities such as shopping and transportation are negatively affected (Agüero-Torres et al. 2002). During later years, extensive research with a focus on mobility impairment and environmental demands (Amann et al. 2006; Mollenkopf et al. 2004) has been accomplished. However, it is a well-known fact that with advancing age, it is common that different types of FL occur simultaneously, potentially influencing the potential for activity outside home in a negative way. To date, most studies have focused on specific types of FL, not on the effect of combinations of FL at group level on older people's activities outside home. There are studies demonstrating such approaches (Carlsson et al. 2002; Rantanen et al. 2001), while research on how combinations of FL impact on very old people's performance of activities outside home is still in its infancy.

Activities outside home such as going out for walks, meeting friends, and participating in leisure activities are highly valued by older people (Agahi and Parker 2005; Banister and Bowling 2004; Legarth et al. 2005; Silverstein and Parker 2002). Due to declining functional capacity such activities are more difficult to engage than activities in the home (Andersson Svidén et al. 2004; Bowling 1995). Physical well-being relates to people's abilities to perform the activities they need and wish to do without consideration of their physical capacity (Christiansen and Baum 2005), i.e. the impact of FL on activity performance. As physical well-being can be described as one aspect of health (WHO 1946), reduced activity performance due to FL may result in poorer health in very old age. Additionally, the frequency of activities outside home is related to health (Banister and Bowling 2004; Simonsick et al. 2005), and older people want to have more frequent activities outside home (Mollenkopf et al. 1997). Furthermore, Valdemarsson and colleagues (2005) investigated preferences and frequencies of visits to public facilities among older people and found several problems in the physical environment hindering activity performance. However, no considerations about functional limitations were taken in this study. Even if there are studies indicating the links between frequency of activity, environmental problems and health, little is known about how very old people with different combinations of FL perceive their frequency of activity, especially when focusing on the pedestrian environment.

As the environment and places close to home are essential in older people's everyday life (Krause 2003; Oswald et al. 2005) and attachment to place is important for adjustment, and for a positive image of oneself (Oswald

et al. 2005; Rowles 2000; Taylor 2001) usable environments are vital. A usable physical environment is one in which a person is able to move around, be in and use for desired activities (Iwarsson and Ståhl 2003). Standpoints on usability are taken from an individual perspective, expressing subjective perceptions of the efficiency, satisfaction and difficulty in activity (Steinfeld and Danford 1999).

One strategy to reduce the negative consequences of FL and thereby enhance activity outside home is to reduce physical barriers in the pedestrian environment; another strategy is to support the older person with mobility devices (Wressle and Samuelsson 2004). However, due to barriers in the pedestrian environment and combinations of FL, use of mobility devices increases the complexity of activity performance outside home in very old age, and can even obstruct performance (Hovbrandt et al. 2007) For example, if a person is dependent on a mobility device, uneven pavements can make walking to the shop impossible; if it is difficult to get the rollator on to the bus this can result in no more travelling. Since the use of mobility devices increases with age (Dahlin-Ivanoff and Sonn 2005; Löfqvist et al. 2007), more knowledge on the impact of mobility devices on frequency of activity is crucial for enhancing activity outside home for very old people.

Although it is well-known that places close to home are of vital importance for daily life in old age, a deeper understanding is needed about the relationship between frequency of activity among very old people with different types of FL and their perceived health, and perceptions about the physical environment as pedestrians. Such knowledge has potential to support development and real measures of environments to enhance very old people's activity performance and health. As previous research has not focused on descriptions by very old people with different types of FL; on detailed information about perceived environmental problems which is crucial for societal planning, more studies with this focus are called for. Therefore, the specific aims of this explorative study were:

- to investigate differences between groups of very old people according to their different types of FL with respect to frequency of activity, satisfaction with frequency of activity, perceived health, overall perception of neighbourhood environment, and perceived problems in the pedestrian environment
- to investigate how frequency of activity is related to perceived health, overall perception of neighbourhood environment, and perceived problems in the pedestrian environment.
- to investigate differences between very old people with and without mobility devices with respect to frequency of activity and satisfaction with frequency of activity.

Methods

Sampling procedure

This study is based on a subsection of data from an extensive postal questionnaire with a focus to identify and prioritize concrete measures for implementation of increased accessibility and safety in the pedestrian environment among older people. The questionnaire was part of a larger project in a defined geographic district in a medium-sized town with 79,000 inhabitants in Southern Sweden (Ståhl et al. 2007); the study district was chosen based on population and housing type composition, distances to key destinations in the town centre, and availability of public transportation. The study district consisted of three connected areas close to the town centre, with a mixture of single-family houses and apartment blocks. By means of a population register all persons aged 65 years or older in the study district were sampled ($N = 556$): 22% of the total population. Along with a letter giving information about the project, and explaining that participation was voluntary, the postal questionnaire was sent as a sample, followed by a reminder after 3 weeks. Since data from respondents with current experience of their pedestrian environment in very old age were necessary to target the objective of the current study, only respondents aged 80+ were included, that is 112 out of the 339 returned questionnaires. Further on, as our purpose was to get knowledge based on valid self-reports, only respondents who reported that they took part in activities outside home were included, leaving us with 97 respondents.

Data collection

The data used were based on a subset of questions from the postal questionnaire concerning person, environment, and activity. Questions about sex and marital status, FL, reliance on mobility devices, and perceived health were included. Based on the items of the personal component of the Housing Enabler (Iwarsson and Slaug 2001), FL was subjectively assessed in the questionnaire by asking the respondents: "Do you have any of the following limitations?" The items were scored dichotomously ("yes" and "no"), and the respondents were informed that they could report more than one FL (Table 1). According to the Housing Enabler manual, assessment of FL should be based on a combination of both interview and observation, but for this study the items were self-reported. Concerning reliance on mobility devices the respondents were asked: "Do you use any mobility device when you move outdoors?" The response alternatives were: "I do not use a

Table 1 Characteristics of the sample, $N = 97$

Characteristics	Women ($n = 61$)	Men ($n = 36$)	Total ($N = 97$)
Age, mean (range)	84.4 (80–92)	83.8 (80–93)	84.2 (80–93)
Marital status, *n*			
Widow/widower	13	28	41
Married	5	1	6
Unmarried	40	7	47
Divorced	3	0	3
Functional limitations[a], *n*			
Poor balance	15	10	25
Limitations of stamina	15	13	28
Difficulty in moving head	2	1	3
Difficulty in reaching with arms	4	4	8
Difficulty in handling/fingering	4	5	9
Difficulty in bending/kneeling	23	16	39
Overweight	2	1	3
Difficulty in interpreting information	2	2	4
Severe loss of sight	15	5	20
Complete loss of sight	1	2	3
Severe loss of hearing	17	15	32
Reliance on mobility device[b], *n*			
No mobility device	27	14	41
Stick/crutch	19	13	32
Rollator	22	8	30
Wheel-chair	2	2	4

[a] Each respondent could report more than one functional limitation

[b] Each respondent could report reliance on more than one mobility device

mobility device", "I use a stick/crutch", "I use a rollator", and "I use a wheelchair", and it was possible for the respondents to report use of more than one mobility device. Basic demographics, FL, and reliance on mobility devices in the sample are shown in Table 1.

Perceived health was rated by means of one single global question "How do you perceive your health?" from the Gothenburg Quality of Life instrument (Tibblin et al. 1990). The respondents were asked to rate their perceived health on a scale from 1 = "very bad" to 7 = "excellent, could not be better".

The overall perception of the neighbourhood environment as a pedestrian was rated by one single question: "How do you perceive your outdoor environment in the neighbourhood?" Respondents were asked to rate their perception on a scale from 1 = "very bad" to 7 = "excellent, could not be better". In addition, 14 items on perceived problems in the outdoor environment were included in the questionnaire. The respondents were asked: "Please state the problems you perceive as a pedestrian; "respondents could choose more than one item (Table 2).

Frequency of activity was rated by the question: "How often do you take part in activities (such as shopping, visiting friends/relatives, culture, exercise, visiting parks, restaurants/cafés) outside home?" Seven response alternatives were given, ranging from 1 = "seldom/never" to 7 = "daily". Whether the respondents took part in these activities by foot or by other transports are not known in this study. With respect to satisfaction with frequency of activity, respondents were asked: "Are you engaged in activities as much as you want?", with the response alternatives "yes" and "no".

Data treatment

Based on studies of relevant literature concerning different aspects of the personal component (Kielhofner 2004; WHO 2001), compared to the explanations of functional limitations in Housing Enabler (Iwarsson and Slaug 2001), and professional knowledge, four groups of respondents with different types of functional limitations (FL) were constructed. In the total sample all FL from the questionnaire were represented and the four groups of respondents were: respondents with no FL ($n = 23$), with only movement-related FL ($n = 26$), with only perception/cognition-related FL ($n = 16$), and with both movement- and perception/cognition-related FL ($n = 32$) (Table 3). In the group of respondents with only movement-related FL, poor balance ($n = 10$), limitations of stamina ($n = 12$), and difficulty in bending/kneeling ($n = 19$), were frequent. In the group of respondents with only perception/cognition-related FL, difficulty in interpreting information and complete loss of sight were not represented. These FL were only represented as combined with a movement-related FL, meaning that in the group of respondents with perception/cognition-related FL only severe loss of sight ($n = 12$) and severe loss of hearing were represented ($n = 6$). In the group of respondents with both movement- and perception/cognition-related FL the most frequent were: poor balance ($n = 15$), limitations of stamina ($n = 16$), difficulty in bending/kneeling ($n = 20$), severe loss of sight ($n = 15$), and severe loss of hearing ($n = 20$).

Based on previous research and experience acquired in traffic planning and mobility (cf. Lavery et al. 1996; Stahl 1992) perceived problems in the environment were grouped into five categories: anxiety and fear, perceived risk of accidents, physical barriers, lack of comfort, and perceived risk of conflicts with other unprotected road users (Table 2). For each category and for each individual the number of problems perceived was calculated and used in the analyses.

Table 2 Categorization of perceived problems among the respondents in the pedestrian environment, $n = 89$

Category variable	Perceived problems in the pedestrian environment	Number of reports for each item[a]	Total number of perceived problems
Anxiety and fear	General feeling of insecurity	15	
	Bad lighting	5	
	Fear of meeting with traffic incident	8	
	Fear of falling	27	
	Fear of robbery, assaults, threats	19	74
Risk for accident	Fast traffic	10	
	Dense traffic	7	
	Problems with crossing streets	20	
	Signal light crossing	20	57
Physical barriers	High curbs	29	
	Uneven pavements	19	48
Lack of comfort	Few benches	36	36
Risk for conflicts with other unprotected road users	Bikes on pavements	55	
	Mopeds on pavements	21	74

Note: Eight respondents did not report any perceived problems in the pedestrian environment, leaving us with reports from 89 persons

[a] The respondents could report more than one alternative of perceived problem in the environment

Statistical methods

Due to skewed data distributions, use of ordinal data, and the small sample sizes, non-parametric tests were used in this study. Differences between the four groups of respondents regarding FL were tested by means of the Kruskal–Wallis test with regard to frequency of activity, perceived health, overall perception of neighbourhood environment, and the number of problems in each of the five categories of perceived problems in the outdoor environment. Thereafter, pairwise comparisons were performed by means of Mann–Whitney's *U*-test, adjusting for multiple comparisons with the Bonferroni method: as six comparisons were made, the obtained *P*-values were multiplied by six. Differences between the four groups with regard to satisfaction with frequency of activity were tested by the Chi-square test; here too, pairwise comparisons were performed with Bonferroni correction. By means of Spearman's rank correlations the frequency of activity was correlated to perceived health, overall perception of neighbourhood environment, and the number of perceived problems in the categories of perceived problems in the pedestrian environment. When it comes to the effect sizes of correlation coefficients, the interpretation will follow Cohen's proposal (1992), recommending that a numerical value of $r < 0.2$ is considered as a "small effect", 0.5 as a "medium effect", and 0.8 as a "large effect". Differences in frequency of activity between users of mobility devices and those who did not use mobility devices were assessed by means of the Mann–Whitney's *U*-test. The difference in satisfaction with frequency of activity was assessed by means of the Chi-square test. All analyses were accomplished using the SPSS. *P*-values below 0.05 were considered significant in all tests.

Results

Frequency of activity and satisfaction with frequency of activity

As seen in Table 4, more than one-third of the respondents ($n = 35$) reported that they were engaged in activities outside home on a daily basis and nearly one-fourth ($n = 21$) reported activities several times a week. When comparing the groups of respondents with respect to their frequency of activity the analysis demonstrated significant differences ($P = 0.003$) between the groups. The group of respondents without any FL and the group with only perception/cognition-related FL reported a significantly higher frequency of activity than the group of respondents with only movement-related FL ($P = 0.036$ and $P = 0.006$, respectively). Even though the frequency of activity in all groups was rather high, one-third of the respondents ($n = 32$) reported that they were not engaged in activities outside home as much as they wanted to. When comparing differences between the groups according to satisfaction with frequency of activity, the analysis demonstrated statistically significant differences ($P = 0.007$). Pairwise comparisons showed significant differences between the group with only perception/cognition-related FL and the group with both movement- and perception/cognition-related FL ($P = 0.024$). One respondent in the group with

Table 3 Number of functional limitations occurring in the groups of respondents, N = 97[a]

Functional limitations	Groups of respondents[a]		
	Movement-related FL, n = 26	Perception/ cognition-related FL, n = 16	Movement- and perception /cognition-related FL, n = 32
Movement-related			
Poor balance	10		15
Limitations of stamina	12		16
Difficulty in moving the head	1		2
Difficulty in reaching with arms	2		6
Difficulty in handling/fingering	3		6
Difficulty in bending/kneeling	19		20
Overweight	1		2
Perception/cognition-related			
Difficulty in interpreting information		0	4
Severe loss of sight		6	15
Complete loss of sight		0	2
Severe loss of hearing		12	20

Note: Each respondent could report more than one functional limitation

[a] Respondents reporting no functional limitations (n = 23) are not included here

only perception/cognition-related FL was not satisfied with frequency of activity while half of the respondents (n = 16) in the group with both movement- and perception/cognition-related FL were not satisfied with their frequency of activity.

Perceived health

Irrespective of the respondents' different FL, perceived health was rated as rather high, with a median score of 4–6 in all groups (Table 4). Still, there were statistically significant differences in perceived health between the four groups (P = 0.001). The analysis showed that the group of respondents without any FL scored their health significantly higher than the group with both movement- and perception/cognition-related FL (P = 0.018).

Overall perception of neighbourhood environment and perceived problems in the pedestrian environment

The high median score (5–6) for overall perception of the neighbourhood environment indicates that the respondents were quite satisfied with their neighbourhood (Table 4). The comparison between the groups with respect to perceived problems in the environment demonstrated significant differences only in the category, anxiety and fear (P = 0.040). In this category, the group of respondents with both movement- and perception/cognition-related FL reported more problems than the group of respondent with no FL as well as the group of respondents with only perception/cognition-related FL.

Factors related to frequency of activity

There were no significant correlations either between perceived health and frequency of activity or between overall perception of neighbourhood environment and frequency of activity (Table 5). For the categories of perceived problems there were statistically significant correlations between anxiety and fear and frequency of activity ($P < 0.001$), as well as between physical barriers and frequency of activity (P = 0.03), while the effect sizes were small. The negative correlations indicate that the more problems these respondents perceived, the lower their reported frequency of activity.

Frequency of activity with respect to use of mobility device

Almost half of the sample (n = 47) reported use of mobility devices and among them almost half (n = 20) reported use of both crutch and rollator (Table 1). Among the 22 respondents using only one mobility device, a crutch was the most common (n = 12). The analysis showed that respondents using mobility devices went out significantly fewer times than those who did not (P = 0.001). When it comes to satisfaction with frequency of activity, no significant differences were found between users and non-users of mobility devices.

Discussion

This explorative study showed that very old people with current experiences of outdoor activities, living in an urban

Table 4 Distribution and differences in frequency of activity, satisfaction with frequency, perceived health, overall perception of neighbourhood environment and perceived problems in the pedestrian environment among very old people with different functional limitations (FL)

Variable	*P*-value	No FL	Movement-related FL	Perception/ cognition-related FL	Movement-and perception/ cognition-related FL
Frequency of activity, *n*	0.003[a]	(*n* = 22)	(*n* = 26)	(*n* = 15)	(*n* = 31)
Daily		10	4	9	12
3–4 times a week		6	5	5	5
1–2 times a week		4	8	1	5
3–4 times a month		1	2	0	1
1–2 times a month		1	4	0	4
3–4 times a year		0	1	0	2
Seldom/never		0	1	0	2
Satisfaction with frequency, n	0.007[b]	(*n* = 22)	(*n* = 25)	(*n* = 15)	(*n* = 32)
Yes		18	14	14	16
No		4	11	1	16
Perceived health	0.001[a]	(*n* = 22)	(*n* = 25)	(*n* = 16)	(*n* = 32)
Md (range)		5 (3–7)	4 (1–7)	6 (4–7)	4 (1–6)
Overall perception of neighbourhood environment	ns[a]	(*n* = 21)	(*n* = 24)	(*n* = 16)	(*n* = 32)
Md (range)		6 (3–7)	6 (3–7)	5 (3–7)	6 (3–7)
Perceived problems in the pedestrian environment, Md (range)		(*n* = 20)	(*n* = 24)	(*n* = 14)	(*n* = 31)
Anxiety and fear	0.040[a]	0 (0–2)	1 (0–3)	0 (0–3)	1 (0–4)
Risk for accident	Ns	0 (0–2)	1 (0–2)	0 (0–1)	1 (0–4)
Physical barriers	Ns	0 (0–2)	0 (0–2)	0.5 (0–2)	1 (0–2)
Lack of comfort	Ns	0 (0–1)	1 (0–1)	0 (0–1)	0 (0–1)
Risk for conflicts...	Ns	1 (0–2)	1 (0–2)	0.5 (0–2)	1 (0–2)

Note: Eight respondents did not report any perceived problems in the pedestrian environment, leaving us with reports from 89 persons. Due to internal drop-out, the numbers of respondents included in the analyses vary among the variables

[a] The Kruskal–Wallis test was used for testing differences between the groups of respondents

[b] The Chi-square test was used for testing differences between the groups of respondents

Table 5 Frequency of activity correlated with perceived health, overall perception of neighbourhood environment and categories of perceived problems in the pedestrian environment

Variable correlated with frequency of activity	*r*
Perceived health	0.179
Overall perception of neighbourhood environment	0.009
Categories of perceived problems in the pedestrian environment	
Anxiety and fear	−0.415**
Risk for accident	−0.042
Physical barriers	−0.236*
Lack of comfort	−0.181
Risk for conflicts with other unprotected road users	0.016

Note: The Spearman's rank correlation coefficients were used. $*P < 0.05$, $**P < 0.001$

area in Sweden, report a rather high frequency of activity outside home. The interpretation of this result must of course consider the fact that the study sample consisted only of those who reported outdoor activities. There were differences in frequency of activity between groups of participants according to movement-related FL and anxiety and fear when moving about outdoors, indicating that personal as well as environmental factors have an impact on activities outside home in very old age. The sample selection applied hampers the possibility to generalise our findings to other groups of very old people, but for our study purpose it was more important to gain knowledge based on highly valid self-reports in a defined study district, namely from respondents with current experiences of getting about in their outdoor environments as pedestrians. In order to provide societal planning with information that can be used to plan for concrete measures in outdoor

environments, close to where old and very old people live (Ståhl et al. 2007), the results of this study have potential to support development of environments to enhance very old people's activity performance and health.

The sample was limited in size, but still the variation in FL and functional capacity was considerable. Collecting data by means of a postal questionnaire imply that people with cognitive limitations most likely will be under-represented. In order to collect valid data in this respect, for future research other methods for data collection should be applied. Bearing this in mind while scrutinising our data on self-reported FL in some detail, in the group with only perception/cognition-related FL there were no respondents with either difficulty in interpreting information or complete loss of sight. Loss of hearing, which was frequent in this group, can cause problems such as less capacity for distinguishing between different types of sounds, and where sounds derive from (Stahl 1992), and might limit the activity performance in the pedestrian environment. This was, however, not obvious in our study. One reason to this might be that the variation in this group was minimal, as only two functional limitations were represented. The results suggest that perception/cognition-related FL does not impact on frequency of activity unless combined with movement-related FL, while this kind of interpretation has to be confirmed by future studies. Since respondents with perception/cognition-related FL had higher frequency of activity compared to the group with only movement-related FL it is possible that the higher frequency of activity reflects the negative influence low walking capacity has on activity as described by Giles-Corti and Donovan (2003). In other words, very old persons with only perception/cognition-related FL can move about more easily outdoors since their FL presumably does not affect their walking capacity. This conclusion is strengthened by the fact that respondents using mobility devices reported lower frequency of activity than those without. Even though mobility devices support people with reduced walking capacity, due to misfits between the person using mobility devices and environmental demands the outcome is not always positive (Brandt et al. 2003). Also, presumably those who use mobility devices have more severe mobility-related FL, while severity of impairment was not assessed in this study.

Walking is a prerequisite for getting from place to place, at least in urban areas (Suminski et al. 2005), but it can also be an important activity in itself (Legarth et al. 2005), improving physical activity (Hallal et al. 2005) and preventing falls (Delbaere et al. 2004). Thus, the ability to walk from home to other arenas for activities is vital, and as long as a person has the walking capacity to reach important places it is possible to perform activities outside home as much as wanted. As to the results of the present study, it might be that the users of mobility devices had the capacity to reach important places and perform activities outside home as wanted since they were satisfied with their frequency of activity. Alternatively, this may reflect an adapted behaviour due to low physical capacity and high environmental demands (Lawton and Nahemow 1973), resulting in a new activity pattern in a narrower arena close to home, which is in accordance with previous findings (Hovbrandt et al. 2007).

Findings demonstrating the impact of environmental factors on activity have been reported in previous studies (Humpel et al. 2004; Lavery et al. 1996; Stahl 1992; Valdemarsson et al. 2005), and the findings were confirmed by this study. Turning to the most frequent type of perceived problems when moving about outside home, fear of falling was the most common problem in the category anxiety and fear. Such feelings are justified by the fact that falls due to impediments in the pedestrian environment are common (Li et al. 2006). Fear affects negatively on how older people experience their possibilities for activity and therefore inhibit performance of activities (Ward-Griffin et al. 2004), resulting in even more decreased functional capacity (Delbaere et al. 2004). The findings in the present study are consistent with recent research demonstrating that concerns about safety and security limit activities outside home (Michael et al. 2006). Lack of comfort was not a determining factor for frequency of activity in the present study, whilst this problem has been described as important for activities outside home in some qualitative studies (Hovbrandt et al. 2007; Michael et al. 2006). In these recent studies, having benches to rest on in the pedestrian environment is an important prerequisite for activities such as walking and shopping. Further, our results showed that physical environmental problems were correlated to frequency of activity. This indicates that it is important to consider how to design pedestrian environments supporting activity. Very old persons tend to choose places for activities where they feel competent and confident (O'Brian et al. 2002). In contrast to findings by Agahi and Parker (2005), who argue that a more active older population may reflect that environments for leisure activities have become more accessible for people with disabilities, the present study does not support this argument. Perhaps today's older people are more active, but since our respondents reported substantial numbers of perceived problems our findings do not indicate sufficient accessibility and usability in the pedestrian environment in their neighbourhood. However, given the explorative character of our study, conducted in a small city in one North European country, further studies are needed to confirm the findings. Even so, as a substantial proportion of the respondents also reported that they were not satisfied with frequency of activity, indicating that perceived

problems in the pedestrian environment cause activity limitations for very old people with FL. The perceived problems in the pedestrian environment such as high kerbs, uneven pavements, few benches, and bikes on pavements are related to physical planning. Thus, in order to improve and support activities outside home for very old people, it is crucial to design the pedestrian environment in a more optimal way.

Since functional capacity is influenced by all FL present, the groups of respondents were constructed with respect to FL that was present in the total sample. There is of course conceptual reason to be critical of such an approach, and it is also a complex methodological issue to handle combinations of FL on group level in a valid way (Carlsson et al. 2002). A factor analysis indicated that the functional limitations concerned either movement or perception/cognition. However, the factor analysis could not justify a valid group construction, and therefore the result was compared to studies of relevant literature (Kielhofner 2004; WHO 2001), with the explanations of functional limitations in Housing Enabler (Iwarsson and Slaug 2001), and professional knowledge before grouping.

An alternative way to handle FL could have been to simply count the number present in each individual. However, in order to understand how FL impact on very old people's activity performance outside home, considerations about the type of FL is important. While previous research on the impact of FL on activity has mostly focused on individual FL (Leveille et al. 2002; Tinetti et al. 1995) attention to the complexity inherent in combinations and interrelations among FL is now increasing (Chan et al. 2005; Meinow et al. 2006). The small groups available in our study limit the value of the findings according to FL, while the results highlight the relevance of this kind of approach. Small sample sizes are yet not unusual (Shumway-Cook et al. 2002, 2003) but can still give valuable information for future research. Accordingly, in further studies the type, number, and severity of different types of FL should be investigated in order to understand the complex interrelationship between functional capacity, environmental demands, and activity in very old age. Another study limitation is that activity was considered only in terms of frequency and satisfaction with frequency of activity outside home, while data on actual activity performance is not possible to gather by means of a postal questionnaire.

The categorization of perceived problems also deserves comment. In the category anxiety and fear there were five items, ending up with a number of problems ranging from 0 to 5, while in the category lack of comfort there was one item with only two possible response alternatives. Even if only few respondents reported more than three problems in the category anxiety and fear, in this small study they may be responsible for the significant result. However, as confirmed by extensive previous research (Brandt et al. 2003; Carlsson 2004; Lavery et al. 1996; Michael et al. 2006; Stahl 1992), there is no doubt that these types of perceived problems are relevant for older people. Still, constructing a questionnaire with an equal number of items in each category is preferable, and prior to using our questionnaire in further studies this kind of revision is recommended.

In conclusion, even with a limited, selected sample of very old people living in a defined district in a small Swedish city, we succeeded in demonstrating how the complexity of FL and perceived problems in the outdoor environment in the close neighbourhood are related to activity performance outside home. The findings suggest that very old people with both movement- and perception/cognition-related FL are less satisfied with their frequency of activity and experience poorer health and more problems in moving about in the pedestrian environment than groups of very old people with less complex FL. Our findings can serve as an inspiration for further studies on FL as well as on how to capture perceived problems in order to create healthy communities with environments supporting activity and health in very old age. Improving activity is a major goal in health promotion, and the person–environment–activity perspective applied in this study can contribute to future knowledge development on the knowledge of such transactional relationships and how they impact on daily life in very old age.

Acknowledgments Thanks are due to all the local authorities and associations (the health care services, the public services administration, politicians, the public transportation authority, tenant associations, landlords) for their participation; to the regional Road Administration for financial support and participation; to Kristianstad municipality for supporting the project; to the Swedish Research Council and the Swedish Council for Working Life and Social Research (FAS) for additional financial support. The final preparation of this paper was accomplished in the context of the centre for Ageing and Supportive Environments at Lund University, financed by FAS.

References

Agahi N, Parker MG (2005) Are today's older people more active than their predecessors? Participation in leisure-time activities in Sweden in 1992 and 2002. Ageing Soc 25(6):925–942

Agüero-Torres H, Thomas V, Winblad B, Fratiglioni L (2002) The impact of somatic disorders on the functional status of the elderly. J Clin Epidemiol 55:1007–1012

Amann A, Reiterer B, Risser R, Haindl G (2006) SIZE, life quality of senior citizens in relation to mobility conditions. Retrieved May 19 2007. http://www.size-project.at/

Andersson Svidén G, Tham K, Borell L (2004) Elderly participants of social and rehabilitative day centres. Scand J Caring Sci 18:402–409

Atchley R (1998) Activity adaptations to the development of functional limitations and results for subjective well-being in later adulthood: a qualitative analysis of longitudinal panel data over a 16-year period. J Aging Stud 12(1):19–39

Banister D, Bowling A (2004) Quality of life for the elderly: the transport dimension. Trans Policy 11:105–115

Bowling A (1995) What things are important in people's lives? A survey of the public's judgements to inform scales of health related quality of life. Soc Sci Med 41(10):1447–1462

Brandt Å, Iwarsson S, Ståhl A (2003) User satisfaction with rollators. Disabil Rehabil 25(7):343–353

Carlsson G (2002) Catching the bus in old age. Methodological aspects of accessibility assessments in public transport. Doctoral Dissertation. Lund University, Lund, Sweden

Carlsson G (2004) Travelling by urban public transport. Exploration of usability problems in a travel chain perspective. Scand J Occup Ther 11(2):78–89

Carlsson G, Iwarsson S, Ståhl A (2002) The personal component of accessibility at group level: exploring the complexity of functional capacity. Scand J Occup Ther 9(3):100–108

Chan L, Shumway-Cook A, Yorkston K, Ciol M, Dudgeon B, Hoffman J (2005) Design and validation of a methodology using the International Classification of Diseases, 9th Revision, to identify secondary conditions in people with disabilities. Arch Phys Med Rehabil 86:1065–1069

Christiansen C, Baum C (eds) (2005) Occupational therapy performance participation, and well-being, 3rd edn. Slack Incorporated, Thorofare

Cohen J (1992) A power prime. Psychol Bull 112(1):155–159

Crews J, Campbell A (2001) Health conditions, activity limitations, and participation restrictions among older people with visual impairments. J Vis Impair Blind 95(8):453–468

Crombie I, Irvine L, Williams B, McGinnis A, Slane P, Alder E et al (2004) Why older people do not participate in leisure time physical activity: a survey of activity levels, beliefs and deterrents. Age Ageing 33(3):287–292

Dahlin-Ivanoff S, Sonn U (2005) Changes in the use of assistive devices among 90-year-old persons. Aging Clin Exp Res 17(3):246–251

Delbaere K, Crombez G, Vanderstraeten G (2004) Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort study. Age Ageing 33(4):368–374

Fange A, Iwarsson S (2003) Accessibility and usability in housing: construct validity and implications for research and practice. Disabil Rehabil 25(23):1316–1326

Ferruci L, Bandinelli S, Cavazzini C, Lauretani F, Corsi A, Bartali B et al (2004) Neurological examination findings to predict limitations in mobility and falls in older persons without a history of neurological disease. Am J Med 116:807–815

Giles-Corti B, Donovan R (2003) Relative influences of individual, social environment and physical environmental correlates of walking. Am J Public Health 93(9):1583–1589

Guralnik J, Ferruci L, Simonsick E, Salive M, Wallace R (1995) Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med 332(9):556–561

Hallal PC, Azevedo MR, Reichert FF, Siqueira FV, Araujo CLP, Victora CG (2005) Who, when, and how much? Epidemiology of walking in a middle-income country. Am J Prev Med 28(2):156–161

Heyl V, Wahl H-W, Mollenkopf H (2005) Visual capacity, out-of-home activities and emotional well-being in old age: basic relations and contextual variation. Soc Indic Res 74:159–189

Hovbrandt P, Fridlund B, Carlsson G (2007) Very old people's experience of occupational performance outside home: possibilities and limitations. Scand J Occup Ther (in press)

Humpel N, Owen N, Iverson D, Leslie E, Bauman A (2004) Perceived environment attributes, residential location, and walking for particular purposes. Am J Prev Med 26(2):119–125

Iwarsson S (2005) A long-term perspective on person–environment fit and ADL dependence among older Swedish adults. Gerontologist 45(3):327–336

Iwarsson S, Slaug B (2001) The housing enabler. An instrument for assessing and analysing accessibility problems in housing. Nävlinge & Staffanstorp: Veten & Skapen HB & Slaug Data Management

Iwarsson S, Ståhl A (2003) Accessibility, usability and universal design—positioning and definition of concepts describing person–environment relationships. Disabil Rehabil 25(2):57–66

Kielhofner G (2004) Conceptual foundations of occupational therapy, 3rd edn. F. A. Davis Company, Philadelphia

Krause N (2003) Neighbourhoods, health, and well-being in later life. In: Wahl H-W, Scheidt RJ, Windley PG (eds) Aging in context: socio-physical environments. Annual review of gerontology and geriatrics, vol 23. Springer, New York, pp 223–249

Lavery I, Davey S, Woodside A, Ewart K (1996) The vital role of street design and management in reducing barriers to older people's mobility. Landsc Urban Plann 35(2–3):181–192

Law M, Cooper B, Strong S, Stewart D, Rigby P, Letts L (1996) The person–environment–occupation model: a transactive approach to occupational performance. Can J Occup Ther 63:9–23

Lawton MP, Nahemow L (1973) Ecology and the aging process. In: Eisdorfer C, Lawton MP (eds) Psychology of adult development and aging. American Psychological Association, Washington DC

Lawton MP, Simon B (1968) The ecology of social relationships in housing for the elderly. Gerontologist 8:108–115

Legarth K, Ryan S, Avlund K (2005) The most important activity and the reasons for that experience reported by Danish population at age 75 years. Br J Occup Ther 68(11):501–508

Leslie E, Saelens B, Frank L, Owen N, Bauman A, Coffee N et al (2005) Residents' perception of walkability attributes in objectively different neighbourhoods: a pilot study. Health Place 11:227–236

Leveille S, Fried L, Guralnik J (2002) Disabling symptoms What do older women report? J Gen Intern Med 17(10):766–773

Li W, Keegan T, Sternfeld B, Sidney S, Quesenberry C, Kelsey J (2006) Outdoor falls among middle-aged and older adults: a neglected public health problem. Am J Public Health 96(7):1192–1200

Löfqvist C, Nygren C, Brandt Å, Oswald F, Iwarsson S (2007) Use of mobility devices and changes over 12 months among very old people in five European countries. Aging Clin Exp Res (in press)

Meinow B, Parker M, Kåreholt I, Thorslund M (2006) Complex health problems in the oldest old in Sweden 1992–2002. Eur J Ageing 3(2):98–106

Michael Y, Green M, Farquhar S (2006) Neighborhood design and active aging. Health Place 12:734–740

Mollenkopf H, Marcellini F, Ruoppila I, Flaschenträger P, Gagliardi C, Spazzafumo L (1997) Outdoor mobility and social relationships of elderly people. Arch Gerontol Geriatr 24:295–310

Mollenkopf H, Marcellini F, Ruoppila I, Széman Z, Tacken M, Wahl H-W (2004) Social and behavioural science perspectives on out-of-home mobility in later life: findings from the European project MOBILATE. Eur J Ageing 1(1):45–53

O'Brian P, Dyck I, Caron S, Mortenson P (2002) Environmental analysis: insights from sociological and geographical perspectives. Can J Occup Ther 69(4):229–238

Oswald F, Hieber A, Wahl H-W, Mollenkopf H (2005) Ageing and person–environment fit in different urban neighbourhoods. Eur J Ageing 2(2):88–97

Paterson D, Govindasamy D, Vidmar M, Cunningham D, Koval J (2004) Longitudinal study of determinants of dependence in an elderly population. J Am Geriatr Soc 52:1632–1638

Rantanen T, Guralnik J, Ferruci L, Penninx B, Leveille S, Sipilä S (2001) Coimpairments as predictors of severe walking disability in older women. J Am Geriatr Soc 49(1):21–27

Rowles GD (2000) Habituation and being in place. Occup Ther J Res 20:52S–67S

Rudinger G, Donaghy K, Poppelreuter S (2004) Societal trends, mobility behaviour and sustainable transport in Europe and North America: the European Union network STELLA. Eur J Ageing 1(1):95–101

Ruoppila I, Raitanen T (2004) Outdoor mobility and health. In: Mollenkopf H, Marcellini F, Ruoppila I, Raitanen T (eds) Ageing and outdoor mobility, vol 13. IOS Press, Amsterdam, pp 65–80

Sakari-Rantala R, Era P, Rantanen T, Heikkinen E (1998) Associations of sensory-motor functions with poor mobility in 75- and 80-year-old people. Scand J Rehabil Med 30(2):121–127

Shumway-Cook A, Patla A, Stewart A, Ferruci L, Ciol M, Guralnik J (2002) Environmental demands associated with community mobility in older adults with and without mobility disabilities. Phys Ther 82(7):670–681

Shumway-Cook A, Patla A, Stewart A, Ferruci L, Ciol M, Guralnik J (2003) Environmental components of mobility disability in community-living older persons. J Am Geriatr Soc 51(3):393–398

Silverstein M, Parker M (2002) Leisure activities and quality of life among the oldest old in Sweden. Res Aging 24(5):528–547

Simonsick EM, Guralnik JM, Volpato S, Balfour J, Fried L (2005) Just get out the door! importance of walking outside the home for maintaining mobility: findings from the women's health and aging study. J Am Geriatr Soc 53(2):198–204

Stahl A (1992) Mobility and accessibility for elderly and disabled people in Sweden. J Int Assoc Traffic Safety Sci 16(2):80–97

Ståhl A, Carlsson G, Hovbrandt P, Iwarsson S (2007) "Let's Go for a Walk!" User involvement when prioritizing measures to increase accessibility and safety for older people (submitted)

Steinfeld E, Danford S (1999) Theory as a basis for research on enabling environments. In: Steinfeld E, Danford S (eds) Enabling environments measuring the impact of environment on disability and rehabilitation. Kluwer/Plenum, New York

Suminski R, Carlos Poston W, Petosa R, Stevens E, Katzenmoyer L (2005) Features of the neighbourhood environment and walking by US adults. Am J Prev Med 28(2):149–155

Taylor SA (2001) Place identification and positive realities of aging. J Cross Cult Gerontol 16:5–20

Tibblin G, Tibblin B, Peciva S, Kullman S, Svärdsudd K (1990) "The Göteborg Quality of Life Instrument"—an assessment of wellbeing and symptoms among men born 1913 and 1923. Scand J Prim Health Care Suppl 1:33–38

Tinetti M, Inouye S, Gill T, Doucette J (1995) Shared risk factors for falls, incontinence, and functional dependence: unifying the approach to geriatric syndromes. JAMA 273(17):1348–1353

Townsend E, Stanton S, Law M, Polatajko H, Baptiste S, Thomson-Franson T et al (2002) Enabling occupation: an occupational therapy perspective, 2nd edn. CAOT Publications ACE, Ottawa

Valdemarsson M, Jernryd E, Iwarsson S (2005) Preferences and frequencies of visits to public facilities in old age - a pilot study in a Swedish town center. Arch Gerontol Geriatr 40(1):15–28

Ward-Griffin C, Hobson S, Melles P, Kloseck M, Vandervoort A, Crilly R (2004) Falls and fear of falls among community-dwelling seniors: the dynamic tension between exercising precaution and striving for independence. Can J Aging 4(23):307–318

WHO (1946) Constitution of the World Health Organization. Paper presented at the International Health Conference, New York

WHO (2001) ICF international classification of functioning, disability, and health. WHO, Geneva

Wressle E, Samuelsson K (2004) User satisfaction with mobility assistive devices. Scand J Occup Ther 11:143–150