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Environmental facilitators for outdoor walking and development of walking difficulty in community-dwelling older adults

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Abstract

Older adults who report environmental barriers in their neighborhood have a higher risk for walking difficulty. However, environmental facilitators that protect against walking difficulty are not well known. The objective of this study was to identify the effect of environmental facilitators for outdoor walking on development of walking difficulty in community-dwelling older people. This was a prospective study with a 3.5-year follow-up time on 261 community-dwelling people aged 75-81 years who at baseline were able to walk 0.5 km without difficulty. Environmental facilitators for outdoor walking were self-reported with standardized questionnaires, including having features in one's home which make it easy to access the outdoors, having a park or other green area within a walking distance from home, having outdoor recreational facilities within a walking distance from home, having features in the nearby environment which attract for outdoor activities, and perceiving the surrounding environment or facilities nearby as motivating for physical activity. Self-reported difficulty in walking 0.5 km was assessed every six months. Of the participants, 46% developed walking difficulty during the follow-up. Having a park or other green area within a walking distance from home was the most frequently reported facilitator. Environmental facilitators decreased the risk for development of walking difficulty, hazard ratio per item 0.86, (95% confidence interval 0.73-1.02). The results indicate that the mobility of older community-dwelling people may be promoted with outdoor recreational facilities that are easy to access and located within a walking distance from home.

Key words: Environmental facilitators, Outdoor walking, Walking difficulty, Mobility

Introduction

Home and its close surroundings comprise the environment where most of the daily activities of older people take place. In the ecological model of ageing, the well-being of older people is considered to be a combination of the capacities they possess and the environment they live in (Lawton and Nahemow 1973). The interaction between the competencies of older people and the demands of their living environments is referred to as person-environment fit.

Mobility is a corner stone of independent living among older people. Mobility covers human movement in various different forms: it can be getting up from a chair, walking, riding a bus or driving. Satariano and colleagues (2012) define optimal mobility as "being able to safely and reliably go where you want to go, when you want to go, and how you want to get there". Walking is only one form of mobility, but among older people it is an integral one as it can be a prerequisite for many other forms of mobility, such as for using public transport. Physical activity, defined as bodily movement resulting from the contraction of skeletal muscle that increases energy expenditure above the basal level (Caspersen 1989), can cover any intentional activity which is performed for leisure or as part of other activities, at chosen form and intensity. Among older people, outdoor walking is one of the most popular forms of physical activity along with home calisthenics (Lim and Taylor 2005; Mäkilä et al. 2010). Even though physical activity and mobility correlate, they do not always overlap. Some people with mobility limitations may be active, while some people without mobility limitations can be sedentary (Hirvensalo et al., 2000).

Preserving the ability to walk outdoors is one of the main priorities for older peoples' well-being and independence and it is also a significant way to maintain mobility in general. Several studies have shown the benefits of physical activity in older people, among other things in reducing the incidence of mobility disability (Guralnik et al. 1995; Keysor and Jette 2001; Liu and Latham 2009; Manini and Pahor 2009). In addition to being a popular form of physical activity, outdoor walking is of essential importance for older people in order to run errands, to go outdoors for recreation and to participate in community life and social events. The adequate amount of physical activity that is beneficial for maintaining mobility can be quite low: even short walks or going outdoors more than once a week may protect from further mobility decline (Simonsick et al. 2005) or difficulty in activities of daily living (ADL) and instrumental activities of daily living (IADL) (Shimada et al. 2010).

The features of the surrounding environment can be crucial in maintaining the ability to walk outdoors. Avoiding walking in an environment which is perceived as including barriers or causing fear may reduce habitual physical activity and lead to sedentariness and further to mobility decline. Environmental barriers can play a significant role in the development of mobility difficulty. Our recent study showed that barriers in the outdoor environment predisposed older people to mobility decline, a reduction in physical activity being one of the underlying mechanisms (Rantakokko et al. 2012). Poor street conditions, hills in the nearby environment and noisy traffic correlate with fear of moving outdoors, which in turn also increases the risk for developing walking difficulty (Rantakokko et al. 2009), thus threatening the autonomy of older people and increasing the risk for further mobility problems. When

walking becomes difficult, outdoor walking is usually the first to be affected (Shumway-Cook et al. 2003) and challenges in the environment can reduce it even further.

However, environment is not only barriers between people and their potential for being physically active. Environment in itself can provide a means for restorative experiences (Korpela et al. 2010), increase quality of life among older people (Bossen 2010) and motivate older people for outdoor walking (Day 2008). Sidewalks in good condition, availability of resting places, good lighting, and easy access and short distances to services, parks and walking areas have in particular been reported as environmental facilitators for walking and physical activity among older adults (Duncan et al. 2005; Lockett et al. 2005; White et al., 2010; Sawchuk et al. 2011; Stathi et al. 2011; Mahmood et al. 2012). Nevertheless, the association between facilitating environmental features and development of walking difficulty is not well known.

As Verbrugge and Jette (1994) point out in describing the disablement process, disability can be alleviated not only by increasing the person's capacity but also by reducing the physical demand of the environment. It has also been argued that the person-environment fit model doesn't take sufficiently into account the fact that environment can be a resource which encourages people to be active and promotes healthy ageing (Satariano 2006). In this study we consider the person-environment fit (Adler and Newman 2002; Blazer et al. 2005; Barton and Pretty 2010) from the point of view, how environmental facilitators may slow down the progression of walking difficulty which represents the failure in adaptation of the person to the environment. Most studies which have investigated the association between environment and mobility have examined features of the broader neighborhood, such as traffic, land-use patterns, safety and

lightning (Clarke et al. 2009; Shumway-Cook et al. 2002). In this study, we investigated the facilitators in the close surroundings of the home and also included the home entrance in the inspection, in order to gain more knowledge on the factors that affect the everyday mobility of older home-dwelling people (Yen et al. 2009). In addition to easy access to outdoors and short distances, we were also interested in the environmental characteristics which attract for outdoor walking and other outdoor activities. The aim of this study is to identify the effect of environmental facilitators on the development of walking difficulty in community-dwelling older people. We hypothesized that environmental facilitators for outdoor mobility and nearby facilities which attract for physical activity will protect older people from developing walking difficulty.

Materials and methods

We report results of a 3.5-year follow-up study with semi-annual assessments on walking difficulty. The participants included in the current analyses come from the control group of a randomized controlled trial entitled “Screening and Counseling for Physical Activity and Mobility” (SCAMOB, ISRCTN 07330512). The SCAMOB study investigated the effects of physical activity counseling in community-living older people in Finland. The original target population included all 75-81-year-old persons living in Jyväskylä city centre area in 2003 (N=1310). The initial screening and recruitment process is described in detail elsewhere (Leinonen et al. 2007). Briefly, the goal was to select people who would best benefit from physical activity counseling. Therefore we included participants who were at most moderately active or sedentary (at most 4 hours of walking or 2 hours of other exercise weekly (Grimby

1986)), had no severe cognitive impairment i.e. Mini-Mental State Examination (MMSE) score over 21 (Folstein et al. 1975), no medical contraindications for physical activity and signed an informed consent to participate, which resulted in 632 persons. For the current observational analyses we further excluded people who were randomized to the intervention group (n=318) and ended up having 314 persons. Of them we excluded those participants who at baseline had reported having difficulty in walking 0.5 km and thus the final study group included 261 community-dwelling older adults. The Ethical Committee of the Central Finland Central Hospital approved the SCAMOB study.

Measurements

The incidence of walking difficulty was assessed by asking the participants if they perceived any difficulty in walking 0.5 km. The response options were 1) able to manage without difficulty, 2) able to manage with some difficulty, 3) able to manage with great deal of difficulty, 4) able to manage only with help from another person, and 5) unable to manage even with help. People were considered as having developed walking difficulty if they at some point of the follow-up reported some or a great deal of difficulty, needing help from another person or being unable to walk 0.5 km. For additional analysis, we set the outcome as reporting walking difficulty at two consecutive time points.

Environmental facilitators for outdoor walking were self-reported in face-to-face interviews with standardized questionnaires. We report secondary analyses of an exploratory study and therefore the environmental facilitators were gathered from the data available for us. The items that we

choose were in part similar to those that are included in the Neighborhood Environment Walkability Scale (NEWS) (Saelens et al. 2003) and Physical Activity Neighborhood Environment Scale (PANES) (Sallis et al. 2010). Five items from our questionnaire were included in the summary score: 1) having features in one's home which make it easy to access the outdoors, such as automatic doors or no doorsteps, 2) having a park or other green area for physical activity within a walking distance from home, 3) having outdoor recreational facilities, such as walking routes or ski tracks within a walking distance from home, 4) having features in the nearby environment which attract for outdoor activities, such as a walking trail with a beautiful view, a lakeside or an even pathway, and 5) perceiving the surrounding environment or facilities nearby as motivating for physical activity. Each item was scored as 0 for not present and 1 for present. A summary score for environmental facilitators for out-of-home activities was calculated and it ranged from 0 to 5, with 0 indicating having none of the items and 5 having them all present.

The level of physical activity was assessed by a standardized question which was modified from the classification of physical activity among elderly people by Grimby (Grimby 1986). The question was framed as "If you think about the past year, which of the following alternatives describes best the level of physical activity you have engaged in" and it included seven alternative responses: 1) mainly resting or only minimal physical activity, 2) most activities performed sitting down, 3) light physical activity, 4) moderate physical activity about 3 h a week, 5) moderate physical activity at least 4 h a week or heavy physical activity \leq 4 h a week, 6) physical exercise several times a week or heavy leisure time working at least 3 h a week and 7) competitive sports several times a week. As part of the initial study design, the participants who

belonged to the two highest activity categories (doing physical exercise or competitive sports several times a week) were excluded from the study (Leinonen et al. 2007).

Background characteristics included age, sex, living arrangements (alone or with someone), years of education, using a walking aid such as a cane or a walker in everyday life, maximal walking speed over ten meters, cognitive capacity, depressive symptoms and physician-diagnosed chronic conditions. Maximal walking speed was measured in the study-center corridor. Participants were allowed 2-3 meters acceleration before the start-line and they were encouraged to walk as fast as possible without risking their health. Only one attempt was measured and timing was done using a stop-watch. The repeatability of the assessment of walking speed in our research center was less than 5 percent (Pajala et al. 2005). Participants wore walking shoes or sneakers, and use of a walking aid was allowed if needed. Cognitive capacity was assessed using MMSE (Folstein et al. 1975). The maximum MMSE score is 30 and scores of 24 or lower are considered as an indication of dementia (Haubois et al. 2011). Depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff 1977), in which the scores range from 0 to 60, and scores of 16 or higher are considered as signs of depressive symptoms (Lewinsohn et al. 1997). Physician-diagnosed chronic conditions were first self-reported and later checked by a nurse examiner at the study center, and for this study, the presence of lung, cardiovascular and musculoskeletal diseases was analyzed.

Statistical analyses

Baseline differences between those who developed difficulty in walking 0.5 km during follow-up and those who did not were compared using chi-square test for categorized variables and *t*-test and Mann-Whitney U-test for continuous variables. T-test was used for normally distributed and Mann-Whitney U-test for non -normally distributed variables.

The incidence of walking difficulty was calculated for reporting 0-2, 3, 4, and 5 environmental facilitators and expressed as the number of cases per 100 person years. The association of individual facilitators with walking difficulty was studied with logistic regression analyses. Time to walking difficulty was calculated as days from the beginning of the study until the day of the interview when the participant first reported difficulty. Participants were censored on the latest day of interview before they died or declined or at the end of the follow-up, whichever happened first. Cox regression models were used to investigate the association between environmental facilitators and incident walking difficulty. The model was adjusted for age, sex and level of physical activity. Results are reported as hazard ratios (HRs) and 95 % confidence intervals (CI). When the 95% confidence intervals (CIs) did not include one, or $p < .05$, the differences were regarded as statistically significant. Statistical analyses were performed using IBM SPSS Statistics Version 19.

Results

The baseline characteristics of the participants according to walking difficulty at follow-up are presented in Table 1. Individuals who did not develop difficulty in walking 0.5 km were younger, had lower scores on the depression scale and suffered less often from lung and musculoskeletal diseases at baseline than people who developed walking difficulty. Additionally, people who did not develop difficulty less frequently used a walking aid, had faster walking speed, were more physically active and reported more environmental facilitators for outdoor walking at baseline.

The most common perceived environmental facilitator for outdoor walking was having a park or other outdoor area within a walking distance from home, which was reported by 93.5% (n=244) of the participants. Having outdoor recreational facilities, such as walking routes or ski tracks within a walking distance from home was almost as common with 92% (n=240) of the participants reporting it. Attractive features in the nearby environment for outdoor activities was reported by 64.8% (n=169), perceiving the surrounding environment or facilities nearby as motivating for physical activity was reported by 60.5% (n=158) and having features in one's home which make it easy to access the outdoors was reported by 37,5% (n=98) of the participants. The results of logistic regression analyses, in which each facilitator was analyzed separately, show that facilitators were slightly less often reported by people who subsequently developed walking difficulty; however, none of the differences were statistically significant, see Table 2. The number of environmental facilitators and CES-D -score showed only low correlation ($r = -0.146$, $p = 0.019$), indicating that depressive symptoms did not lead into underreporting the presence of environmental facilitators.

The mean follow-up time until reporting walking difficulty was 2.68 (\pm SD 1.24) years with a range of 0.58-3.76 years. Of the 261 participants who at baseline had no difficulty in walking 0.5 km, 118 (46%) developed difficulty during the follow-up. The incidence rates of developing difficulty in walking 0.5 km during follow-up decreased from 23.6/ 100 person years for 0-2 facilitators to 12.8/ 100 person years for 5 facilitators, indicating that a higher number of perceived environmental facilitators was related to walking abilities remaining intact (Table 3).

Among the participants who at baseline had no difficulty in walking 0.5 km, the perceived environmental facilitators for outdoor walking decreased the risk for developing difficulty in walking 0.5 km by almost 20% for each additional facilitator during the 3.5-year follow up in the fully adjusted model (hazard ratio [HR] 0.86, 95% confidence interval [CI] 0.73-1.02), see Table 3. When the environmental facilitators were categorized into 0-2, 3, 4 or 5 facilitators, the analysis showed that the reduction wasn't strictly linear: compared to the participants who had 0-2 facilitators, having 3 facilitators decreased the risk of walking difficulty to HR 0.56 (95 % CI 0.33-0.96), having 4 facilitators to HR 0.68 (CI 0.42-1.11) and having 5 facilitators to HR 0.41 (CI 0.21-0.84) during the follow-up. Further adjustment for lung, cardiovascular and musculoskeletal diseases, depression, cognitive status, maximal walking speed and years of education did not change the results. The results were parallel for walking 2 km (data not shown). Also, excluding participants who had CES-D scores of 16 or higher or MMSE scores lower than 24 did not materially change the results, indicating that depressive symptoms or cognitive status did not have an effect on reporting the presence of the environmental facilitators or the onset of walking difficulty.

When the outcome of the study was set as reporting walking difficulty at two consecutive time points, 57 (21.8%) out of the 261 participants developed difficulty during the follow-up. In the age and sex adjusted model, the hazard ratio was 0.69 (95 % CI 0.56-0.85) and in the model adjusted for age, sex and physical activity, HR was 0.74 (95% CI 0.60-0.93).

Discussion

Our study showed that the perceived environmental facilitators for outdoor walking decrease the risk for developing walking difficulty among older community-dwelling individuals. In our previous study we found that perceived environmental barriers precede mobility decline in older community-living people (Rantakokko et al. 2012). When investigating the onset of walking difficulty from a new point of view, we were able to show that environmental facilitators potentially reduce the risk of mobility decline. Compared with the participants who reported 0-2 environmental facilitators, the participants who reported three facilitators had a significantly lower risk for development of walking difficulty. The risk was further decreased among the participants who reported all five facilitators being present. The risk for development of walking difficulty among the participants who reported four environmental facilitators was decreased somewhat less than what it was for the participants who reported three facilitators, which may be explained by the group reporting four facilitators being the largest group. It is also possible that three facilitators are a sufficient amount needed for preventing walking difficulty. We do not have more facilitators in order to investigate if the association is linear.

Adjusting for physical activity attenuated the risk for developing walking difficulty but did not eliminate it. This suggested that older people who report more facilitators in their environment were more often physically active and thus less likely to develop walking difficulty. However, it seemed that physical activity was not the only explanation for maintaining walking ability, but that environmental facilitators also played a significant role. Physically active older people may perceive the parks and other outdoor areas in their neighborhoods as facilitators more often than

the ones who are unable to use those facilities, but even the close location of outdoor recreational areas isn't always a facilitator for older people with mobility difficulty, especially if the environment outdoors is challenging (Shumway-Cook et al. 2005).

Close location of outdoor areas and recreational facilities were the most frequently reported environmental facilitators in this study. This may indicate the significance of short distances to outdoor recreational facilities being crucial in maintaining walking and mobility. The present findings are in line with previous studies which showed that close distances to outdoor recreational areas and services promote physical activity among older people (Stathi et al. 2011). Among older people access to outdoors as a whole is important as it gives the opportunity to go and run errands, to enjoy fresh air and to go for a walk. In our study, however, having features in one's home which make it easy to access the outdoors, such as automatic doors or no doorsteps was the least frequently reported facilitator. This was understandable as people who were included in this study did not have difficulty in walking at baseline and problems in accessing the outdoors may rise only as mobility declines.

In the logistic regression analyses, none of the individual facilitators reached significance. It seemed that people who maintained their walking ability were those who experienced their environment as including several different facilitators and also were able to make the most out of them. It has been suggested that an environment with facilitators contributes to the health and well-being of older people but also to opportunities for social interaction (Sugiyama and Thompson 2006). In addition to those, habitual physical activity such as walking to grocery

stores and other services is a significant form of physical activity for older people as it in addition to the benefits for health and mobility also helps to maintain autonomy.

The results of this study have implications for taking into account the location and accessibility of outdoor recreational areas in urban planning and development. Designing and repairing streets, public areas, buildings and homes, keeping in mind people in all age groups, can have a positive impact in creating an accessible and walkable environment. Street maintenance and cleaning are essential not only for the pleasantness and attractiveness of the environment, but also for the safety reasons. This study also supports encouraging older people to go out and be active in their environments. Going out and being active depends largely on the person but the importance of the aesthetics and attractiveness of the environment should not be underestimated (Day 2008).

Strengths and limitations

This was a prospective study conducted among community-living participants. A long total follow-up time with telephone follow-up interviews at six month intervals provided us regular information on the naturally occurring changes in mobility. Using Cox regression analyses gave us information about the temporal order of perceived environmental facilitators and walking difficulty; however, we do not know whether persons who reported walking difficulty at some point of follow-up recovered from it later on. We also run analysis with setting the outcome as reporting walking difficulty at two consecutive time points, which reduced the number of people who were categorized as having developed walking difficulty, but the effect of the facilitators was stronger. This shows that walking ability and difficulty can fluctuate.

As for the limitations; the participants of this study were living in the city center area, so the results cannot be generalized as far as people living in rural areas are concerned. We also cannot rule out that persons with better mobility move more and are more aware of the facilitators, but we don't believe that it explains the results. The truncated distribution of the study population may potentially lead to the underestimation of the strength of the associations.

It should also be noted that this was an exploratory study with secondary data analyses and the environmental facilitators for outdoor walking were not measured on a validated scale, but were gathered from the data available for us. For the summary score of environmental facilitators, we used information about the outdoor environment and recreational facilities, and in addition to those, also about the perceived access to outdoors, which is not included in validated scales such as the NEWS (Saelens et al. 2003). However, we think that if we had used a validated scale for measuring the perceived environmental facilitators for outdoor mobility, the results would have become stronger (Owen et al. 2004).

In this study, difficulty in walking 0.5 km were self-reported. Self-reported preclinical or manifest mobility limitations correlate with objectively measured limitations in mobility and predict future disability (Fried et al. 2001; Manty et al. 2007; Young et al. 2010). Self-reported mobility difficulty provides valuable information on how the person manages in his/her living environment and in everyday tasks. Also the environmental facilitators were self-reported by a questionnaire and no objective observation was done; therefore the facilitators were reported as personally perceived by the participants. In studies conducted on adults, it has been shown that both objective and perceived measures of environment correlate with physical activity (Hoehner

et al. 2005; McGinn et al. 2007) and perceived measures have even shown stronger associations than objective measures (Yen et al. 2009). Because the same environmental characteristics can have facilitating or hindering effect on mobility in different individuals, depending on the type and degree of disability, both objective and perceived measures of environment are needed in studying various populations (Noreau and Boschén 2010).

In conclusion, the results of this study indicate that environmental facilitators for outdoor mobility may prevent development of walking difficulty in older people and thus protect from more severe mobility difficulty. The topic of this study has not yet been widely studied and to confirm these results, further research is needed. Using a validated scale for the perceived environmental facilitators would be useful and could provide stronger research results, especially if access to outdoors is also taken into account. Further studies on environment and mobility should also include older adults living in suburban and rural areas.

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Table 1. Baseline characteristics of people who had no walking difficulty at baseline, according to development of difficulty during 3.5 year follow-up

Variable	No difficulty (n=143) Mean (\pm SD)	Difficulty (n=118) Mean (\pm SD)	p-value*
Age	77.4 (\pm 1.8)	78.0 (\pm 2.0)	0.008
MMSE	27.26 (\pm 2.16)	26.92 (\pm 2.25)	0.214
CES-D	7.93 (\pm 5.74)	11.08 (\pm 7.84)	0.001
Walking speed (m/s)	1.51(\pm 0.32)	1.26 (\pm 0.33)	<0.001
Education in years	9.6 (\pm 4.6)	9.0 (\pm 4.4)	0.223
Number of facilitators	3.62 (\pm 1.00)	3.32 (\pm 1.10)	0.035
	%	%	
Level of physical activity (Grimby)			
Mainly resting	0	0	
Most activities performed sitting down	0.7	0.8	0.891
Light physical activity 1-2 h a week	14.7	25.4	0.029
Moderate physical activity 3 h a week	46.9	55.1	0.186
Moderate physical activity \geq 4 h a week	37.8	18.6	0.001
Women	74.8	76.3	0.787
Lives alone	51.7	53.4	0.792
Lung diseases	9.1	17.8	0.038
Musculoskeletal diseases	37.8	54.2	0.008
Cardiovascular diseases	66.4	73.7	0.202
Use of a walking aid	14.0	34.7	<0.001

**t*-test (walking speed), Mann-Whitney *U*-test (age, MMSE, CES-D, education in years and number of facilitators) and chi square test (level of physical activity, sex, living status, presence of lung, cardiovascular and musculoskeletal diseases and use of a walking aid)

SD= standard deviation

Table 2. Prevalencies of facilitators at baseline according to developing difficulty during follow-up and associations of single facilitators with development of walking difficulty.

Facilitator	All participants (n=261) %	No difficulty (n=143) %	Difficulty (n=118) %	OR	CI
1. Having features in one's home which make it easy to access the outdoors	37.5	39.9	34.7	0.80	0.49-1.33
2. Having a park or other green area within a walking distance from home	93.5	95.8	90.7	0.43	0.15-1.19
3. Having outdoor recreational facilities within a walking distance from home	92.0	93.7	89.8	0.59	0.24-1.46
4. Attractive features in the nearby environment for outdoor activities	64.8	69.2	59.3	0.65	0.39-1.08
5. Perceiving the surrounding environment or facilities nearby as motivating for physical activity	60.5	63.6	56.8	0.75	0.46-1.24

Table 3. Development of difficulty in walking 0.5 km in older people without walking difficulty according to the number of facilitators for outdoor mobility at baseline.

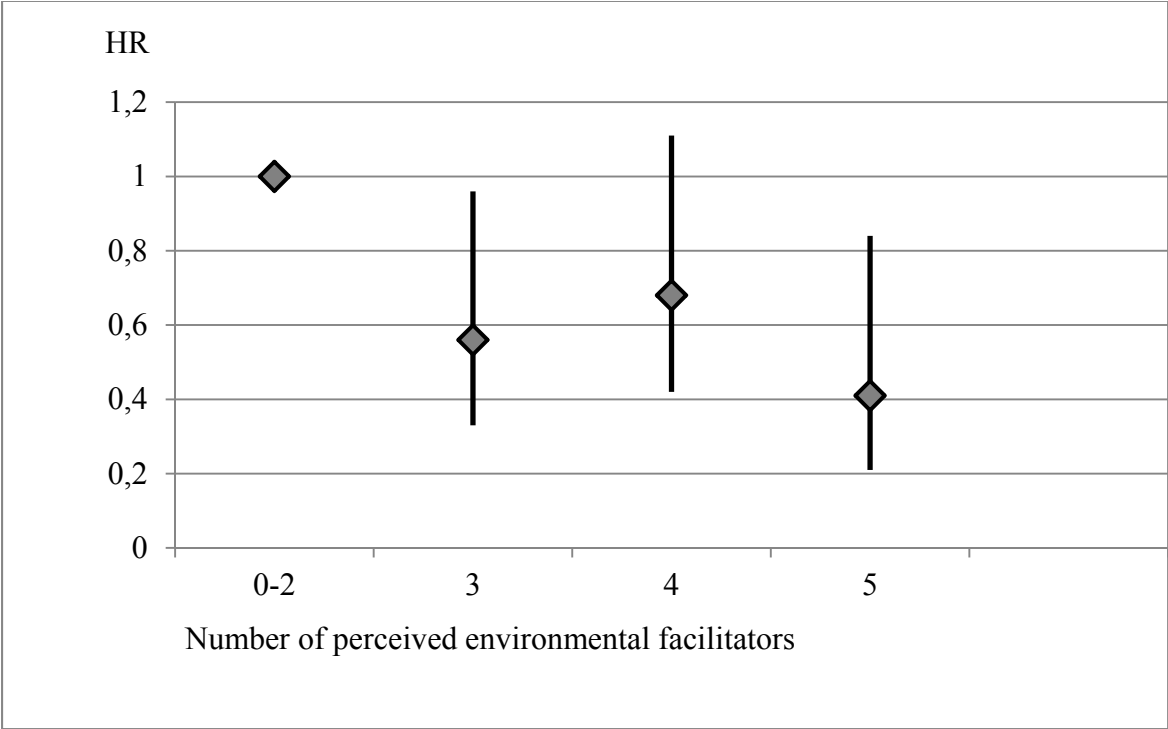
Number of facilitators	n	Rates of incident walking disability /100 person years	Model 1		Model 2	
			HR	CI	HR	CI
0-5*	261		0.82	0.70-0.97	0.86	0.73-1.02
Categorized						
0-2	41	23.6	1		1	
3	78	13.5	0.48	0.29-0.81	0.56	0.33-0.96
4	103	14.1	0.61	0.38-0.97	0.68	0.42-1.11
5	39	12.8	0.34	0.18-0.68	0.41	0.21-0.84

Model 1 adjusted for age and sex

Model 2 adjusted for age, sex and level of physical activity (Grimby)

* Summary score, including all five facilitators (having features in one's home which make it easy to access the outdoors, having a park or other green area within a walking distance from home, having outdoor recreational facilities within a walking distance from home, having features in the nearby environment which attract for outdoor activities, and perceiving the surrounding environment or facilities nearby as motivating for physical activity.)

Figure 1. Hazard ratios (HR) and confidence intervals for development of walking difficulty in older adults according to the number of perceived environmental facilitators.



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