16. Carr-Hill R, Jenkins-Clarke S, Dixon P, Pringle M. Do minutes count? Consultation lengths in general practice. J Health Serv Res Policy 1998; 3: 207–13.
17. Rothwell PM, Giles MF, Chandratheva A *et al*. Effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS study): a prospective population-based sequential comparison. Lancet. 2007; 370: 1432–42.
18. Wasserman J, Perry J, Dowlatshahi D *et al*. Stratified, urgent care for transient ischemic attack results in low stroke rates. Stroke 2010; 41: 2601–5.

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Perceived barriers in the outdoor environment and development of walking difficulties in older people

SIR—Older people with mobility limitations often report more barriers in their outdoor environment than people with intact mobility [1]. However, it is uncertain whether older people perceive their environment as problematic because of their mobility limitations or whether the environmental barriers precede incident mobility limitation, as most studies have been limited to cross-sectional analyses [2–5]. Only a few longitudinal studies have shown that barriers in the outdoor environment, such as poor street conditions, poor lighting and heavy traffic, increase the risk for overall functional loss [6, 7] and decrease physical activity participation [8]. More knowledge is needed about the characteristics of outdoor environments that threaten the mobility of older people [9].

The aim of the study reported in this letter was to explore whether perceived barriers in the outdoor environment predict development of difficulties in advanced and basic mobility among community-dwelling people who did not have walking difficulties at baseline.

Methods

Study design

This study is based on prospective semi-annual follow-up data over a 3.5-year period on the control group recruited for a randomised controlled trial entitled Screening and counselling for physical activity and mobility in older people (SCAMOB, ISRCTN 07330512) [10]. The study was approved by the Ethical Committee of the Central Finland Central Hospital. Participants were recruited from the population register and selected based on that they were community-dwelling, aged 75–81-years, living in the city centre of Jyväskylä, Finland, were able to walk 500 m without help from another person, were moderately physically active or sedentary, had a Mini-Mental State Examination (MMSE) score >21 and no medical contraindications for physical activity [10]. The study design has been described in detail elsewhere [10]. Of 632 people included in a randomised controlled trial, 314 (the control group) were followed up at 6-month intervals for the naturally occurring changes in mobility for 3.5 years. Of them, at baseline 100 people had difficulty walking 2 km and were excluded, leaving 214 people for the analysis on incident difficulty in 2-km walking. The corresponding figures for 0.5-km walking were 48 and 266, respectively. Over the 3.5-year follow-up, among those without difficulties in walking 2 km, 28 dropped out and among those without difficulties in walking 0.5 km, 35 dropped out.

Measurements

Walking difficulty

It was assessed as perceived difficulties in walking 2 km (advanced mobility) and 0.5 km (basic mobility) semi-annually over the 3.5-year follow-up period. The questions were formulated as follows: 'Do you have difficulty in walking 2 km/0.5 km?' with the response options: (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 the help of another person and (5) unable to manage even with help. For the analyses, options were dichotomised as 'no difficulty' (1) and 'difficulty' (2–5).

Barriers in the outdoor environment

The participants were asked whether there were barriers in the outdoor environment which encumbered their possibilities for moving independently outdoors (yes/no). The barriers studied were lack of resting places and long distances that were combined and recoded into the dichotomised variable *Distances*; noisy traffic and dangerous crossroads into the variable *Traffic* and hilly terrain and streets in poor condition into the variable *Terrain*. For each of the three constructed variables, 0 indicates that neither of the barriers was reported and 1 that either one or both were present.

Background characteristics

The sociodemographic indicators studied were age, years of education and perceived financial position. Information on chronic conditions was elicited as self-reported physician-diagnosed chronic conditions which were later confirmed by the nurse examiner in the clinical examination and then categorised into cardiovascular, musculoskeletal and lung diseases. Cognitive functioning was assessed with the MMSE [11] and depressive symptoms with the Center for Epidemiologic Studies Depression Scale (CES-D) [12]. Habitual physical activity was self-reported [13].

Statistical analysis

Differences between those who developed difficulty in walking 2 km and those who did not were compared using chi-square tests for categorised variables and *t*-tests for continuous variables.

The incidence rate of walking difficulty was calculated for each environmental barrier and expressed as the number of cases per 10 person years. Cox regression models were used to assess the association between environmental barriers and incident walking difficulty. Analyses were performed first separately for men and women, and for the final analyses men and women were combined since the associations were virtually identical for both sexes. All analyses were performed separately for perceived difficulty in walking 2 and 0.5 km. For cases with missing values in perceived walking difficulties over the 3.5-year follow-up, data were imputed with the multiple imputation procedure [14] implemented in SAS (version 9.1 ,SAS Institute, Inc., Cary, NC, USA) by using information on other mobility tasks and correlates of mobility such as number of long-term diseases, body mass index, MMSE [11] and CES-D score [12]. The sensitivity analyses performed suggested no differences in effects due to imputation. Results are reported as hazard ratios (HRs) and 95% confidence intervals (CI). When the 95% CIs did not include one, or $P < 0.05$, the differences were regarded as statistically significant.

Results

Those who developed walking difficulty during the 3.5-year follow-up reported Distances and Terrain as barriers to outdoor mobility at baseline more often than those who did not develop walking difficulty. Additionally, they were older, had more depressive symptoms and were less physically active than persons who did not develop walking difficulty during the follow-up (Table 1).

The cumulative incidence over 3.5-year follow-up for difficulties in walking 2 km was 59% and for walking 0.5 km 45%. The rate of walking difficulty ranged from 1.4 to 5.4 per 10 person years according to the presence of barriers in the outdoor environment and the mobility task in question. Barriers in the outdoor environment increased the risk of new walking difficulty up to almost threefold. Differences in socio-demographics, health and physical activity explained a substantial part of the increased risk, but not all of it (Table 2).

Table 1. Baseline characteristics of the 75- to 81-year-old participants ($n = 214$) who had no walking difficulty at baseline, according to development of perceived difficulty in walking 2 km during 3.5-year follow-up

	Development of perceived difficulty in walking 2 km		*P*-value*
	Yes ($n = 124$)	No ($n = 90$)	
	Mean (SD)	Mean (SD)	
Age	77.7 (1.7)	77.1 (2.0)	0.019
Education in years	9.0 (5.0)	9.9 (4.4)	0.181
CES-D	9.7 (6.0)	7.0 (5.7)	0.002
MMSE	27.0 (2.2)	27.3 (2.3)	0.312
	%	%	
Women	73	70	0.566
Financial situation			
Bad or moderate	57	53	0.671
Good or very good	43	47	
Cardiovascular disease	70	64	0.344
Musculoskeletal disease	43	33	0.136
Lung disease	15	7	0.066
Physical activity			0.003
Mainly resting	0	0	
Most activities performed sitting down	1	0	
Light physical activity, 1–2 h/week	23	8	
Moderate physical activity, 3 h/week	52	48	
Moderate physical activity, ≥4 h/week	25	44	
Barriers in the outdoor environment			
Distances	16	4	0.004
Terrain	35	17	0.006
Traffic	21	21	0.971

Environmental barriers studied were lack of resting places and long distances (Distances), hilly terrain and poor street condition (Terrain) and noisy traffic and dangerous crossroads (Traffic).
CES-D, Center for the Epidemiologic Studies Depression Scale; MMSE, Mini-Mental State Examination.
*Chi-square test and *t*-test.

Discussion

This study shows that perceiving barriers to mobility in the outdoor environment precedes the mobility decline among community-dwelling older people. The findings of the present study are in line with the model of the disablement process [15], in which negative features of the environment are seen as risk factors for functional limitations. Parallel findings have been reported by Balfour and Kaplan [6] and Schootman *et al.* [7].

Long distances and difficult terrain may restrict out-of-home activities in older people, leading to physical inactivity [8] and eventually further decline in functional capacity [16–18]. In the present study, adjusting the models for physical activity attenuated the odds ratios, which indicates that physical activity decline is one of the underlying mechanisms explaining the association between environmental barriers and perceived walking difficulties. It is also possible that starting to perceive barriers in the environment may reflect early decline in mobility which has not yet developed into manifest mobility limitation [19, 20].

The strengths of this study are the population-based sample and longitudinal data analyses on a topic that has not been widely studied earlier but which is important [2–5]. Longitudinal analyses allowed us to make inferences on the temporal order in the association between barriers in

Table 2. The rates of incident walking difficulty in groups based on perceived barriers in the outdoor environment and Cox regression model of the effects of barriers in the outdoor environment on the development of perceived difficulties in walking 2 km ($n = 214$) and 0.5 km ($n = 266$) among 75- to 81-year-old community-dwelling people without walking difficulties at baseline over 3.5-year follow-up

Environmental barrier	Rate/10 person years[a]	Base model[b]		Adjusted model[c]	
		HR	95% CI	HR	95% CI
Perceived difficulties in walking 2 km					
Distances					
Present	5.41	2.66	1.62–4.37	2.19	1.31–3.64
Absent	2.33				
Terrain					
Present	4.14	2.00	1.37–2.90	1.44	0.96–2.18
Absent	2.13				
Traffic					
Present	2.86	1.32	0.84–2.06	1.28	0.80–2.05
Absent	1.74				
Perceived difficulties in walking 0.5 km					
Distances					
Present	3.35	2.43	1.04–3.77	1.90	1.18–3.03
Absent	1.46				
Terrain					
Present	2.32	1.62	1.11–2.36	1.15	0.76–1.74
Absent	1.44				
Traffic					
Present	1.74	1.57	1.02–2.42	1.51	0.96–2.38
Absent	1.57				

Environmental barriers studied were lack of resting places and long distances (Distances), hilly terrain and poor street condition (Terrain) and noisy traffic and dangerous crossroads (Traffic).

[a]The rates of incident walking difficulty in groups based on perceived barriers in the outdoor environment among community-dwelling people aged 75- to 81-years without difficulties in walking at baseline.

[b]Bivariate associations, adjusted for age and sex.

[c]Adjusted for age, sex, physical activity, education in years, financial situation, cardiovascular-, lung- and musculoskeletal diseases, cognitive status and depressive symptoms.

the outdoor environment and development of walking difficulties.

We acknowledge the possible limitation of Cox regression models, where the participant was censored when she/he first reported difficulties in walking. It is possible that people who first report walking difficulties recover from the difficulty and do not report it onwards which is not taken into account in the current analyses. However, Cox regression analyses provide us with information about the temporal order of the association between perceived barriers in the outdoor environment and subsequent walking difficulties. Second, we used standardised questionnaires in examining the barriers in the outdoor environment; thus it is possible that there are other important features in the environment that were not reported and thus not taken into account in our analyses [21]. Third, we studied perceptions of barriers in the environment instead of objective measures of the environment. However, self-reports of persons with recent experiences about their outdoor environment resemble those of professional assessments [22]. In the present study, at baseline all the participants were able to move independently outdoors and had current experiences of their environments, thereby adding to the validity of their self-reports on the environment. Fourth, our study took place in a small town in central Finland, and thus the results may not be valid in rural areas or in larger cities and there might also be national differences [23], which would repay further study.

This study indicated that reporting barriers in the outdoor environment at a phase in the process of ageing when mobility still is unaffected, increases the risk of mobility decline at a later stage. In addition to interventions improving individual fitness, reducing barriers in the outdoor environment may help to prevent the development of mobility disability and to support older people to maintain mobility.

Key points

- Reporting long distances and lack of resting places as barriers in the outdoor environment doubled the risk of incident difficulty in walking 2 and 0.5 km.
- Reporting barriers in the outdoor environment
  - precedes the onset of mobility limitation among older people.
  - may reflect early decline in mobility.
  - may reduce outdoor physical activity and thus increase walking difficulties.

Conflicts of interest

None declared.

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References

1. Shumway-Cook A, Patla A, Stewart A, Ferrucci L, Ciol MA, Guralnik JM. Environmental components of mobility disability in community-living older persons. J Am Geriatr Soc 2003; 51: 393–8.
2. Wahl HW, Fänge A, Oswald F, Gitlin LN, Iwarsson S. The home environment and disability-related outcomes in aging individuals: what is the empirical evidence? Gerontologist 2009; 49: 355–67.
3. Clarke P, Ailshire JA, Bader M, Morenoff JD, House JS. Mobility disability and the urban built environment. Am J Epidemiol 2008; 168: 506–13.
4. White DK, Jette AM, Felson DT *et al*. Are features of the neighborhood environment associated with disability in older adults? Disabil Rehabil 2010; 32: 639–45.
5. Keysor JJ, Jette AM, Lavalley MP *et al*. Community environmental factors are associated with disability in older adults with functional limitations: the MOST study. J Gerontol A Biol Sci Med Sci 2010; 65A: 393–9.
6. Balfour JL, Kaplan GA. Neighborhood environment and loss of physical function in older adults: evidence from the Alameda County Study. Am J Epidemiol 2002; 155: 507–15.
7. Schootman M, Andresen EM, Wolinsky FD, Malmstrom TK, Miller JP, Miller DK. Neighborhood conditions and risk of incident lower-body functional limitations among middle-aged African Americans. Am J Epidemiol 2006; 163: 450–8.
8. Booth ML, Owen N, Bauman A, Clavisi O, Leslie E. Social-cognitive and perceived environment influences associated with physical activity in older Australians. Prev Med 2000; 31: 15–22.
9. Yen IH, Michael YL, Perdue L. Neighborhood environment in studies of health of older adults: a systematic review. Am J Prev Med 2009; 37: 455–63.
10. Leinonen R, Heikkinen E, Hirvensalo M *et al*. Customer-oriented counseling for physical activity in older people: Study protocol and selected baseline results of a randomized-controlled trial (ISRCTN 07330512). Scand J Med Sci Sports 2007; 17: 156–64.
11. Folstein MF, Folstein SE, McHugh PR. Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12: 189–98.
12. Radloff LS. The CES-D scale: a self-reported scale for research in the general population. Appl Psychol Measur 1977; 1: 385–401.
13. Grimby G. Physical activity and muscle training in the elderly. Acta Med Scand Suppl 1986; 711: 233–7.
14. Rubin DB. Multiple Imputation for Nonresponse in Surveys. Hoboken, NJ, USA: John Wiley & Sons, 2008.
15. Verbrugge LM, Jette AM. The disablement process. Soc Sci Med 1994; 38: 1–14.
16. Boyle PA, Buchman AS, Wilson RS, Bienias JL, Bennett DA. Physical activity is associated with incident disability in community-based older persons. J Am Geriatr Soc 2007; 55: 195–201.
17. Buchner DM. Physical activity to prevent or reverse disability in sedentary older adults. Am J Prev Med 2003; 25: 214–5.
18. Gill TM, Allore H, Guo Z. Restricted activity and functional decline among community-living older persons. Arch Intern Med 2003; 163: 1317–22.
19. Mänty M, Heinonen A, Leinonen R *et al*. Construct and predictive validity of a self-reported measure of preclinical mobility limitation. Arch Phys Med Rehabil 2007; 88: 1108–13.
20. Mänty M, Heinonen A, Viljanen A *et al*. Self-reported preclinical mobility limitation and fall history as predictors of future falls in older women: prospective cohort study. Osteoporos Int 2010; 21: 689–93.
21. Wennberg H, Ståhl A, Hydén C. Older pedestrians' perceptions of the outdoor environment in a year-round perspective. Eur J Ageing 2009; 6: 277–90.
22. Fänge A, Iwarsson S. Accessibility and usability in housing: construct validity and implications for research and practice. Disabil Rehabil 2003; 25: 1316–25.
23. Mollenkopf H, Marcellini F, Ruoppila I, Széman Z, Tacken MWahl HW. Social and behavioural science perspectives on out-of-home mobility in later life: findings from the European project MOBILATE. Eur J Ageing 2004; 1: 45–53.

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Wearing hip protectors does not reduce health-related quality of life in older people

SIR—Fall-related injuries in older people may lead to loss of function, anxiety, depression or impaired rehabilitation reducing quality of life (QoL) [1], and the wearing of hip protectors may help protect older people from hip fractures due to a fall. Although the extent of their effectiveness is still uncertain, their use has been promoted by various researchers and involved parties [2]. So far, the utilisation of hip protectors has had limited success because a high level of adherence is rarely achieved.

Factors frequently reported which contribute to poor adherence with hip protectors are lack of comfort (too tight/poor fit), the extra effort and time needed to put them on, urinary incontinence and physical difficulties/illnesses [3, 4]. These factors may decrease QoL to a point that results in non-adherence. For those who are adherent to wearing hip protectors, it is also important to evaluate if they also perceive a decrease in their QoL due to these factors, notwithstanding the perceived benefits of wearing hip protectors.

Previously, we reported on three intervention trials investigating the effectiveness of an intervention to increase adherence to wearing hip protectors among older people living in institutions and the community [5, 6]. The main