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**Perceived Barriers in the Outdoor Environment and Development of Walking  
Difficulties in Older People**

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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 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 randomized 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 signed an informed consent. Study design is described in detail elsewhere [10]. Briefly, participants were recruited from population register and selected based that they were

community-dwelling, aged 75-81-years living in the city centre of Jyväskylä, Finland, were able to walk 500 meters 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]. Of 632 people included in a randomized controlled trial, 314 (the control group) were followed up at 6-month intervals for the naturally occurring changes in mobility for 3.5-years.

The prospective analyses on the development of perceived difficulty in walking 2 km or 0.5 km were conducted for those participants who reported no difficulty in these tasks at baseline (walking 2 km, n=214; walking 0.5 km, n=266). 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 difficulties.* Walking difficulty 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 dichotomized 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 dichotomized 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 categorized 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 categorized 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 km and 0.5 km. 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. SPSS version 18.0 (SPSS Inc., Chicago, IL) was used for the statistical analyses.

For cases with missing values in perceived walking difficulties over the 3.5-year follow-up, data were imputed with the multiple imputation procedure implemented in SAS (version 9.1, SAS Institute, Inc., Cary, NC) 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**

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 three-fold. Differences in sociodemographics, health and physical activity explained a substantial part of the increased risk, but not all of it (Table 2).

## 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 [14], 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 and colleagues [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 [15-17]. In the present study, adjusting the models for physical activity attenuated the odds ratios, which indicates that physical activity 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 [18, 19] . .

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 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 standardized 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 taken into account in our analyses [20]. 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 [21]. 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, and thus the results may not be valid in rural areas or in bigger cities and there might also be national differences [22], 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 barriers in the outdoor environment precedes the onset of mobility limitation among older people
- Reporting long distances and lack of resting places as barriers in the outdoor environment doubled the risk of incident difficulty in walking 2 km and 0.5 km.
- Reporting barriers in the outdoor environment may reflect early decline in mobility among older people.
- Reporting barriers in the outdoor environment may reduce outdoor physical activity and thus increase walking difficulties.

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## **TABLE AND FIGURE LEGENDS**

**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.

**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.

**TABLE 1.**

	Development of Perceived Difficulty in Walking 2 km		<i>P</i> -value*
	Yes n=124	No n=90	
	Mean (SD)	Mean (SD)	
Age	77.7 (1.7)	77.1 (2.0)	.019
Education in years	9.0 (5.0)	9.9 (4.4)	.181
CES-D	9.7 (6.0)	7.0 (5.7)	.002
MMSE	27.0 (2.2)	27.3 (2.3)	.312
	%	%	
Women	73	70	.566
Financial situation			.671
Bad or moderate	57	53	
Good or very good	43	47	
Cardiovascular disease	70	64	.344
Musculoskeletal disease	43	33	.136
Lung disease	15	7	.066
Physical Activity			.003
Mainly resting	0	0	
Most activities performed sitting down	1	0	
Light physical activity, 1-2 h/wk	23	8	
Moderate physical activity, 3 h/wk	52	48	
Moderate physical activity, $\geq 4$ h/wk	25	44	
Barriers in the outdoor environment			
Distances	16	4	.004
Terrain	35	17	.006
Traffic	21	21	.971

\* Chi-square test and *t* test

CES-D= Center for the Epidemiologic Studies Depression Scale

MMSE= Mini-Mental State Examination

NOTE: 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).

**TABLE 2.**

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

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

†bivariate associations, adjusted for age and sex

‡ adjusted for age, sex, physical activity, education in years, financial situation, cardiovascular-, lung- and musculoskeletal diseases, cognitive status and depressive symptoms.

NOTE: 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).

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