Author(s): Sakari, Ritva; Rantakokko, Merja; Portegijs, Erja; Iwarsson, Susanne; Sipilä, Sarianna; Viljanen, Anne; Rantanen, Taina

Title: Do Associations Between Perceived Environmental and Individual Characteristics and Walking Limitations Depend on Lower Extremity Performance Level?

Year: 2017

Version:

Please cite the original version:

Sakari, R., Rantakokko, M., Portegijs, E., Iwarsson, S., Sipilä, S., Viljanen, A., & Rantanen, T. (2017). Do Associations Between Perceived Environmental and Individual Characteristics and Walking Limitations Depend on Lower Extremity Performance Level?. Journal of Aging and Health, 29(4), 640-656. https://doi.org/10.1177/0898264316641081

Do associations between perceived environmental and individual characteristics and walking limitations depend on lower extremity performance level?

Ritva Sakari, PhD[1], Merja Rantakokko, PhD[1], Erja Portegijs, PhD[1], Susanne Iwarsson, PhD[2], Sarianna Sipilä, PhD[1], Anne Viljanen, PhD[1], Taina Rantanen, PhD[1]

[1]Gerontology Research Center and Department of Health Sciences, University of Jyvaskyla, Finland

[2]Department of Health Sciences, Lund University, Sweden

Corresponding author:

Ritva Sakari

Dept. of Health Sciences

P.O.Box 35

40014 University of Jyvaskyla

Finland

tel. +358 40 805 3591

e-mail: ritva.sakari@jyu.fi

Running head: Perceived environment and mobility

Do associations between perceived environmental and individual characteristics and walking limitations depend on lower extremity performance level?

Abstract

Objectives. The aim of this study was to analyze if the associations between perceived environmental and individual characteristics and perceived walking limitations in older people differ between those with intact and those with poorer lower extremity performance.

Methods. Persons aged 75 to 90 (n=834) participated in interviews and performance tests in their homes. Standard questionnaires were used to obtain walking difficulties, environmental barriers to and, facilitators of, mobility, and perceived individual hindrances to outdoor mobility. Lower extremity performance was tested using Short Physical Performance Battery (SPPB).

Results. Among those with poorer lower extremity performance, the likelihood for advanced walking limitations was, in particular, related to perceived poor safety in the environment, and among those with intact performance to perceived social issues, such as lack of company, as well as to long distances.

Discussion. The environmental correlates of walking limitations seem to depend on the level of lower extremity performance.

Key words: mobility, walking, environment, aging

Do associations between perceived environmental and individual characteristics and walking limitations depend on lower extremity performance level?

Introduction

Perceived difficulty in walking increases with increasing age (Sainio et al., 2006; Simonsick EM. Newman AB. Visser M. Goodpaster B. Kritchevsky SB. Rubin S. Nevitt MC. Harris TB. Health,Aging and Body Composition Study, 2008) and may threaten participation in terms of running errands or engaging in social, cultural or physical activities (Hovbrandt, Stahl, Iwarsson, Horstmann, & Carlsson, 2007; Rantanen, 2013). Typically, mobility gradually declines with age, following a pattern where performance of the most strenuous tasks, such as walking longer distances, deteriorates first (Rantanen, 2013). These kinds of early mobility limitations increase the risk for more advanced mobility limitations (Manty et al., 2007). Eventually, when no longer able to walk a few hundred meters, the individual's independent community mobility becomes threatened (Andrews et al., 2010).

The neighborhood environment in which older people most often move may affect their walking ability. Applying the rationale of the person-environment (P-E) fit model (Lawton & Nahemow, 1973), an imbalance between the person and the environment can be assumed to underlie perceived difficulties in walking. Earlier follow-up studies have shown that environmental deficits, such as long distance to services and lack of resting places (Rantakokko, Iwarsson, Manty, Leinonen, & Rantanen, 2012), or reporting two or more such deficits (poor lighting, heavy traffic, poor access to public transportation, excessive noise) (Balfour & Kaplan, 2002) may explain incident difficulties in mobility functions. Individual factors, such as fear of falling, may also have negative effect on mobility in old age (Donoghue, Cronin, Savva, O'Regan, & Kenny, 2013; Viljanen et al., 2012). Conversely, outdoor recreational facilities that are easy to access and located within walking distance from home may delay mobility decline among older community-dwelling people (Eronen, von Bonsdorff, Rantakokko, & Rantanen, 2014).

In the above-mentioned studies, however, the participants were studied as one group in spite of the wide variation in functional capacity and mobility generally found in older people. In addition, most studies that have investigated the relationship between environmental factors and mobility have relied on self-assessments of mobility (Balfour & Kaplan, 2002; Clarke & Nieuwenhuijsen, 2009). Self-reports of mobility are typically based on the individual's experiences when doing the task in his/her actual living environment, and thus have face validity in relation to everyday life. In turn, performance-based tests of mobility describe the individual's motor capacity to function optimally in standardized circumstances (Mannerkorpi, Svantesson, & Broberg, 2006; Sainio et al., 2006). It is necessary to evaluate whether the information obtained with performance-based tests of motor functioning, allowing classification of the subjects to mobility performance subgroups, would add anything important to the relationship between environment and self-assessed mobility.

The aim of this study was to analyze the associations between perceived environmental and individual characteristics and perceived walking difficulties in older people. We studied the correlates for early and advanced walking limitations so as to distinguish between minor and more severe perceived difficulties. In addition, we wanted to find out to what extent the associations between neighborhood environment and perceived walking limitations are linked to objectively measured mobility performance level. Our hypothesis was that the associations would differ for people with intact or poorer lower extremity performance.

Methods

Study design and participants

This study is part of the Life-Space Mobility in Old Age (LISPE) project, a 2-year follow-up study examining how the characteristics of home and neighborhood influence older people's health, functioning, quality of life and life space mobility (Rantanen et al., 2012). In short, 2,550 persons aged 75-89 years and resident in the municipalities of Jyväskylä or Muurame in central Finland were drawn from the population register. This was done in three samples of 850 persons from each five-year age group (persons aged 75-79, 80-84 and 85-89). Inclusion criteria were community-living, ability to communicate, living in the research district, and willingness to participate. The present study was a cross-sectional analysis of the baseline data for all those who met the inclusion criteria, in total 848 participants. The data used for the present analyses were collected through interviews and performance tests in the participants' homes. Due to internal missing values on the mobility performance test (Short Physical Performance Battery, SPPB), nine subjects were excluded. In addition, four persons had missing values in the question concerning the ability to walk 2 km and were excluded, as well as one person due to inconsistency in mobility questions. Thus the final sample was 834 participants from three age groups (75-79-year-olds, n=352; 80-84-year-olds, n=279; 85-89-year-olds, n=203). Data quality was good, with less than 2% of the data missing for all the variables in the present data base. The study was approved by the University of Jyväskylä Ethical Committee, and all participants gave their informed consent in writing.

Assessments

Mobility. Early and advanced mobility limitations were assessed as perceived difficulty in walking 2 km and 0.5 km. The respondents were asked “Are you able to walk about 2 km (0.5 km)?” The response alternatives were 0=yes, without difficulties, 1=yes, but with some difficulty, 2=yes, but with a great deal of difficulty, 3=not without help of another person, and 4=unable. The variables were dichotomized into those without difficulties (category 0) and those with difficulties (categories 1-4). We created a three-category variable as follows: no walking limitation (no difficulty in walking 2 km and 0.5 km), early walking limitations (difficulty in walking 2 km), and advanced walking limitations (difficulty in walking) 2 km and 0.5 km. The categorization was valid with the exception of one participant who reported difficulties in walking 0.5 km but not 2 km, and who was thus excluded due to miscoding.

Intact and poorer lower extremity performance was determined with the Short Physical Performance Battery (SPPB) (Guralnik et al., 1994), which includes timed measurements of self-paced walking for 2.44 m, five chair stands and standing in three different positions, each with a narrower base of support. The different tests were scored from 0 to 4 and added to form a summary score ranging from 0 to 12, with higher scores indicating better performance. The sample was divided into those with intact lower extremity performance (SPPB = 10-12) and those with poorer lower extremity performance (SPPB = 9 or below), using a previously validated cut-off (Bandinelli S et al., 2006; Vazzana et al., 2010).

Environmental barriers to and facilitators of mobility. The participants were asked what environmental barriers to and facilitators of mobility they perceived in their neighborhood. The self-rated barriers were recorded using the "Checklist for perceived environmental barriers to outdoor mobility" (PENBOM) (Rantakokko M et al., 2014). The checklist comprises 15 items and one open-ended question about the environmental barriers that people perceive as hindering their possibilities for outdoor mobility, such as street conditions, high curbs, long distance to services, lack of resting places, snow and ice in winter, etc. Another checklist of self-rated facilitators of mobility (PENFOM) (Rantakokko M, Iwarsson S, Portegijs E, Viljanen A, & Rantanen T, 2015) included 16 items, such as the existence of a park nearby, good walking routes, beautiful landscape, familiar surroundings, good lighting, other walkers whose example inspires one to be active, etc. Each item was marked as present or absent.

Individual reasons that hinder outdoor mobility. The participants were also asked to state what are the reasons that hinder or prevent them from outdoor physical activity, such as walking for fitness or walking to a store. This was done using the Barriers to Outdoor Physical Activity Questionnaire (BOPA; Eronen, Bonsdorff, Tormakangas et al., 2014). Fifteen items were listed under the themes of health, fear and negative experiences, ambient conditions, and lack of knowledge and negative attitude. From the list, the participants picked out all the items that they felt described their situation. Two items were omitted from the original list of 17 items, as they overlapped with the questions on walking difficulties and self-rated health.

The covariates. The covariates used in the multivariate analyses were factors that may affect mobility and included age group, sex, education level (higher than primary school vs.

primary school or less), self-rated health (good and very good vs. satisfactory, poor and very poor), self-reported chronic conditions (number of physician-diagnosed diseases according to a list of 22 chronic conditions and an additional open-ended question), Body Mass Index (BMI, kg/m2, based on self-reported height and weight), cognitive function according to the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) and depressive symptoms assessed with the Center for Epidemiologic Studies Depression scale (CES-D) (Radloff, 1977). The number of years lived at the current address was obtained from the population register data. This information was missing for 29 subjects (of these, 19 had intact and 10 had poorer performance of lower extremities).

Statistical analyses

Polytomous logistic regression, which allows use of an outcome variable with more than two categories, was used with the three-category walking difficulties variable. The outcome variable was used as a nominal scale variable, with the group without walking difficulties as the reference group. The independent variables were perceived environmental barriers to and facilitators of outdoor mobility and the individual reasons that hinder outdoor mobility. From each questionnaire, the items that had significant or near significant bivariate associations to the outcome variable were chosen ($p \leq 0.100$ in chi-square test, see Table 1). Possible confounding variables included in the models were sex, age, self-rated health, number of chronic conditions, Body Mass Index, cognitive function (MMSE) and depressive symptoms (CES-D). Two models were created, one for those with intact and another for those with poorer lower extremity performance (SPPB scores 10-12, n=526, and 0-9, n=308, respectively). Due to the sampling technique, the oldest age group was overrepresented and the youngest age group underrepresented. Thus in the analyses, where all three age groups were included simultaneously, the data were weighted by the coefficients 1.30 in the age group 75-79, 1.04 in the age group 80-84 and by 0.66 in the age group 85-89.

Results

Those with intact lower extremity performance (SPPB score 10-12) reported fewer chronic conditions and better self-rated health, had better cognitive function (higher MMSE score) and less depressive symptoms (lower CES-D score), perceived fewer environmental barriers to mobility and individual barriers to outdoor physical activity as well as less walking difficulties than those with poorer lower extremity performance (SPPB score 0-9; $p < .001$ for all comparisons; Table 2).

The factors associated with early and advanced walking limitations among those with intact and poorer lower extremity performance, respectively, are shown in Table 3. In general, perceiving environmental barriers to outdoor mobility and reporting personal reasons that hinder outdoor mobility increased the odds for early and advanced walking limitations. In contrast, perceiving environmental facilitators for mobility decreased the odds of walking limitations among participants with intact as well as poorer lower extremity performance.

Among those with intact lower extremity performance, perceiving environmental barriers related to distances (long distances to the community amenities, lack of resting places) as well as lack of interest and company for outdoor mobility increased the odds for walking difficulties. In contrast, reporting good lighting on walking routes, shops and services nearby and other walkers' inspiring example lowered the odds. Among those with poorer lower extremity performance, perceiving snow and ice as barriers and reporting fear of falling and feelings of insecurity when walking outdoors increased the odds for walking limitations, while perceiving familiar surroundings and reporting having a park or a green area nearby lowered the odds.

Discussion

This study showed that overall, perceived neighborhood environmental characteristics were associated with walking limitations among older community-living people. Among those with poorer lower extremity performance the likelihood for advanced walking limitations was related, in particular, to safety issues, and among those with intact lower extremity performance to social factors and long distances.

The P-E fit model (Lawton & Nahemow, 1973) suggests that individuals with low competence are more sensitive to environmental characteristics than those with high competence. This has been confirmed in several longitudinal studies (Balfour & Kaplan, 2002; Rantakokko et al., 2012) and is also evident from the results of the present cross-sectional study. Moreover, earlier research has reported that aspects of the physical environment affect mobility more among those with existing mobility impairments than those without (Shumway-Cook et al., 2003; Yang & Sanford, 2012); however, this finding was not supported in the present study. Instead, the environmental characteristics that were associated with walking limitations were different among those with poorer mobility performance than those with intact mobility performance. This was a new finding, and it is supported by some earlier studies in which different functional limitations have been associated with different environmental barriers (Slaug, Schilling, Iwarsson, & Carlsson, 2011).

The finding that perceiving snow and ice in winter as environmental barriers to outdoor mobility increased the likelihood of walking limitations in participants with poorer lower extremity performance indicates that winter conditions, in particular, hamper outdoor activities among those whose prerequisites for safe locomotion are compromised. During winter, existing problems with walking seem to intensify due to snow and ice, often resulting in reduced outdoor mobility (Hjorthol, 2013). Older people themselves also report that snow and ice hamper their walking in wintertime (Van Cauwenberg et al., 2012) and regard the prevention of ice and slipperiness as highly important (Wennberg, Stahl, & Hyden, 2009). In the Nordic countries, falls in wintertime occur most often when walking surfaces consist of ice covered with snow (Gao, Holmer, & Abeysekera, 2008) or when the weather conditions are favorable for the formation of ice (Morency, Voyer, Burrows, & Goudreau, 2012). From the viewpoint of the mobility of older people, this means that more should be done to keep the environment safe for walking in wintertime.

The lack of resting places in winter increased the likelihood of walking limitations among those with intact lower extremity performance, a factor which also is related to weather conditions in the Nordic countries. In wintertime, benches may not be accessible due to snow and ice, or they have been removed to make way for (snow) ploughing. Earlier studies have shown that older people find benches and resting places very important for the usability of their outdoor environment (Hovbrandt, Fridlund, & Carlsson, 2007; Wennberg et al., 2009), including wintertime (Wennberg et al., 2009). Long distances and lack of resting places may even increase the probability for developing difficulties in walking (Rantakokko et al., 2012).

In the participants with poorer lower extremity performance, familiarity with their surroundings decreased the risk for advanced walking limitations, while fear of falling and feelings of insecurity increased it. In combination with the weather conditions mentioned above, these findings show that safety aspects are particularly significant for mobility, if performance in basic mobility tasks requiring balance control, coordination and muscle force is impaired. Balance and other sensorimotor functions are important determinants of mobility performance (Sakari et al., 2010), and controlling these functions during locomotion is probably more difficult if extra attention has to be paid to the environment. Associations between balance problems, alone or in combination with other sensory difficulties, and fear of falling have been shown earlier (Austin, Devine, Dick, Prince, & Bruce, 2007; Viljanen et al., 2013).

The finding that having services or shops near increased the risk for early walking difficulties in those with poorer lower extremity performance was unexpected and difficult to explain. It might be possible that these persons had already moved near the services due to their worsening health condition.

Among the participants with intact lower extremity performance, walking difficulties were explained by lack of company and lack of interest. Lack of company has often been reported to be one reason for not being sufficiently physically active in old age (Moschny, Platen, Klaassen-Mielke, Trampisch, & Hinrichs, 2011; Reichert, Barros, Domingues, & Hallal, 2007) and to hinder physical activity, particularly among those with mobility difficulties (Rasinaho, Hirvensalo, Leinonen, Lintunen, & Rantanen, 2007). Lack of interest has been shown earlier to be an important barrier to physical activity (Moschny et al., 2011). Here, the importance of social factors for mobility was also evident in the association found between other walkers' inspiring example and lower risk for advanced walking limitations in those with intact lower extremity performance. It is likely that the relationship of social factors and lack of interest with walking limitations is explained indirectly by the effects of these factors on physical activity.

Strengths and limitations of the study. The strength of this study is the large population sample with a very small amount of missing data. Overall, the participants had lived at the same address for a long time, which indicates that the associations found were not due to recent changes in their living environment. Measuring mobility performance with the SPPB test was useful as it enabled splitting the sample according to the motor capacity of the participants. The analyses were, however, carried out in small sub-groups, which may have somewhat underestimated the true associations.

The data on environmental factors and walking difficulties based on self-reports. Self-reports are often thought to be unreliable and some studies have shown considerable discrepancy between subjective and objective measurements of the environment (Kirtland et al., 2003) and mobility of older people (Sainio et al., 2006). However, from the point of view of prevention, the subjective view is important. For example, if an older person does not perceive the distance to shops to constitute a barrier to mobility, he or she may walk there, which promotes walking ability. On the other hand, if the actual distance is short and the older person experiences it as long and harmful, some rehabilitative actions are definitely needed.

Conclusions. Clearly, older people with poorer mobility performance—which indicates less than optimal physical prerequisites for walking, and possibly also balance problems—are more vulnerable to insecurity aspects in their neighborhood environment than older people with intact mobility performance. In addition to rehabilitative actions, increasing the safety of the walking environment and arranging for official or unofficial company on walking trips would probably be beneficial. On the other hand, older people with good mobility performance might benefit from better support in the environment for walking recreation. This could be achieved, for example, by increasing possibilities to socialize and rest in connection with walking trips. The possible barriers to, and facilitators of, mobility in older people's neighborhood environments should be systematically evaluated in connection with mobility assessments. The environmental aspects that are important for mobility should be taken into account in urban planning and street maintenance, particularly in city areas with a high density of older residents.

Declaration of Conflicting interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the Academy of Finland (the

Future of Living and Housing Program; grants 255403, 263729); Finnish Ministry of Education and Culture; and the Ribbingska Foundation in Lund, Sweden.

References

Andrews, A. W., Chinworth, S. A., Bourassa, M., Garvin, M., Benton, D., & Tanner, S. (2010). Update on distance and velocity requirements for community ambulation. *Journal of Geriatric Physical Therapy, 33*(3), 128-134.

Austin, N., Devine, A., Dick, I., Prince, R., & Bruce, D. (2007). Fear of falling in older women: A longitudinal study of incidence, persistence, and predictors. *Journal of the American Geriatrics Society, 55*(10), 1598-1603.

Balfour, J. L., & Kaplan, G. A. (2002). Neighborhood environment and loss of physical function in older adults: Evidence from the alameda county study. *American Journal of Epidemiology, 155*(6), 507-515.

Bandinelli S, Lauretani F, Boscherini V, Gandi F, Pozzi M, Corsi AM, . . . Ferrucci L. (2006). A randomized, controlled trial of disability prevention in frail older patients screened in primary care: The FRASI study. design and baseline evaluation. *Aging-Clinical & Experimental Research, 18*(5), 359-366.

Clarke, P., & Nieuwenhuijsen, E. R. (2009). Environments for healthy ageing: A critical review. *Maturitas, 64*(1), 14-19.

Donoghue, O. A., Cronin, H., Savva, G. M., O'Regan, C., & Kenny, R. A. (2013). Effects of fear of falling and activity restriction on normal and dual task walking in community dwelling older adults. *Gait & Posture, 38*(1), 120-124.

Eronen, J., von Bonsdorff, M. B., Tormakangas, T., Rantakokko, M., Portegijs, E., Viljanen, A., & Rantanen, T. (2014). Barriers to outdoor physical activity and unmet physical activity need in older adults. *Preventive Medicine, 67*, 106-111. doi:10.1016/j.ypmed.2014.07.020

Eronen, J., von Bonsdorff, M., Rantakokko, M., & Rantanen, T. (2014). Environmental facilitators for outdoor walking and development of walking difficulty in community-dwelling older adults. *European Journal of Ageing, 11*(1), 67-75. doi:10.1007/s10433-013-0283-7

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*(3), 189-198.

Gao, C., Holmer, I., & Abeysekera, J. (2008). Slips and falls in a cold climate: Underfoot surface, footwear design and worker preferences for preventive measures. *Applied Ergonomics, 39*(3), 385-391.

Guralnik, J. M., Simonsick, E. M., Ferrucci, L., Glynn, R. J., Berkman, L. F., Blazer, D. G., . . . Wallace, R. B. (1994). A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. *Journal of Gerontology, 49*(2), M85-94.

Hjorthol, R. (2013). Winter weather – an obstacle to older people's activities? *Journal of Transport Geography, 28*(0), 186-191. doi:http://dx.doi.org/10.1016/j.jtrangeo.2012.09.003

Hovbrandt, P., Fridlund, B., & Carlsson, G. (2007). Very old people's experience of occupational performance outside the home: Possibilities and limitations. *Scandinavian Journal of Occupational Therapy, 14*(2), 77-85.

Hovbrandt, P., Stahl, A., Iwarsson, S., Horstmann, V., & Carlsson, G. (2007). Very old people's use of the pedestrian environment: Functional limitations, frequency of activity and environmental demands. *European Journal of Ageing, 4*(4), 201-211. doi:10.1007/s10433-007-0064-2

Kirtland, K. A., Porter, D. E., Addy, C. L., Neet, M. J., Williams, J. E., Sharpe, P. A., . . . Ainsworth, B. E. (2003). Environmental measures of physical activity supports: Perception versus reality. *American Journal of Preventive Medicine, 24*(4), 323-331.

Lawton, M. P., & Nahemow, L. (1973). Ecology and aging process. In C. Eisdorfer, & M. P. Lawton (Eds.), *The psychology of adult development and aging* (pp. 619-674). Washington, D.C.: American Psychological Association.

Mannerkorpi, K., Svantesson, U., & Broberg, C. (2006). Relationships between performance-based tests and patients' ratings of activity limitations, self-efficacy, and pain in fibromyalgia. *Archives of Physical Medicine & Rehabilitation, 87*(2), 259-264.

Manty, M., Heinonen, A., Leinonen, R., Tormakangas, T., Sakari-Rantala, R., Hirvensalo, M., . . . Rantanen, T. (2007). Construct and predictive validity of a self-reported measure of preclinical mobility limitation. *Archives of Physical Medicine & Rehabilitation, 88*(9), 1108-1113.

Morency, P., Voyer, C., Burrows, S., & Goudreau, S. (2012). Outdoor falls in an urban context: Winter weather impacts and geographical variations. *Canadian Journal of Public Health.Revue Canadienne De Sante Publique, 103*(3), 218-222.

Moschny, A., Platen, P., Klaassen-Mielke, R., Trampisch, U., & Hinrichs, T. (2011). Barriers to physical activity in older adults in germany: A cross-sectional study. *International Journal of Behavioral Nutrition & Physical Activity, 8*, 121.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385-401. doi:10.1177/014662167700100306

Rantakokko M, Iwarsson S, Portegijs E, Viljanen A, & Rantanen T. (2015). Associations between environmental characteristics and life-space mobility in community-dwelling older people. *Journal of Aging & Health, 27*(4), 606-621.

Rantakokko M, Iwarsson S, Vahaluoto S, Portegijs E, Viljanen A, & Rantanen T. (2014). Perceived environmental barriers to outdoor mobility and feelings of loneliness among community-dwelling older people. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences, 69*(12), 1562-1568.

Rantakokko, M., Iwarsson, S., Manty, M., Leinonen, R., & Rantanen, T. (2012). Perceived barriers in the outdoor environment and development of walking difficulties in older people. *Age & Ageing, 41*(1), 118-121.

Rantanen, T. (2013). Promoting mobility in older people. *Journal of Preventive Medicine & Public Health / Yebang Uihakhoe Chi, 46*(Suppl 1), S50-4.

Rantanen, T., Portegijs, E., Viljanen, A., Eronen, J., Saajanaho, M., Tsai, L., . . . Rantakokko, M. (2012). Individual and environmental factors underlying life space of older people - study protocol and design of a cohort study on life-space mobility in old age (LISPE). *Bmc Public Health, 12*, 1018. doi:10.1186/1471-2458-12-1018

Rasinaho, M., Hirvensalo, M., Leinonen, R., Lintunen, T., & Rantanen, T. (2007). Motives for and barriers to physical activity among older adults with mobility limitations. *Journal of Aging & Physical Activity, 15*(1), 90-102.

Reichert, F. F., Barros, A. J., Domingues, M. R., & Hallal, P. C. (2007). The role of perceived personal barriers to engagement in leisure-time physical activity. *American Journal of Public Health, 97*(3), 515-519.

Sainio, P., Koskinen, S., Heliovaara, M., Martelin, T., Harkanen, T., Hurri, H., . . . Aromaa, A. (2006). Self-reported and test-based mobility limitations in a representative sample of finns aged 30+. *Scandinavian Journal of Public Health, 34*(4), 378-386.

Sakari, R., Era, P., Rantanen, T., Leskinen, E., Laukkanen, P., & Heikkinen, E. (2010). Mobility performance and its sensory, psychomotor and musculoskeletal determinants from age 75 to age 80. *Aging-Clinical & Experimental Research, 22*(1), 47-53.

Shumway-Cook, A., Patla, A., Stewart, A., Ferrucci, L., Ciol, M. A., & Guralnik, J. M. (2003). Environmental components of mobility disability in community-living older persons. *Journal of the American Geriatrics Society, 51*(3), 393-398.

Simonsick EM. Newman AB. Visser M. Goodpaster B. Kritchevsky SB. Rubin S. Nevitt MC. Harris TB. Health,Aging and Body Composition Study. (2008). Mobility limitation in self-described well-functioning older adults: Importance of endurance walk testing. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences, 63*(8), 841-847.

Slaug, B., Schilling, O., Iwarsson, S., & Carlsson, G. (2011). Defining profiles of functional limitations in groups of older persons: How and why?. *Journal of Aging & Health, 23*(3), 578-604.

Van Cauwenberg, J., Van Holle, V., Simons, D., Deridder, R., Clarys, P., Goubert, L., . . . Deforche, B. (2012). Environmental factors influencing older adults' walking for transportation: A study using walk-along interviews. *International Journal of Behavioral Nutrition & Physical Activity, 9*, 85.

Vazzana, R., Bandinelli, S., Lauretani, F., Volpato, S., Lauretani, F., Di Iorio, A., . . . Ferrucci, L. (2010). Trail making test predicts physical impairment and mortality in older persons. *Journal of the American Geriatrics Society, 58*(4), 719-723.

Viljanen, A., Kulmala, J., Rantakokko, M., Koskenvuo, M., Kaprio, J., & Rantanen, T. (2012). Fear of falling and coexisting sensory difficulties as predictors of mobility decline in older women. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences, 67*(11), 1230-1237.

Viljanen, A., Kulmala, J., Rantakokko, M., Koskenvuo, M., Kaprio, J., & Rantanen, T. (2013). Accumulation of sensory difficulties predicts fear of falling in older women. *Journal of Aging & Health, 25*(5), 776-791.

Wennberg, H., Stahl, A., & Hyden, C. (2009). Older pedestrians' perceptions of the outdoor environment in a year-round perspective. *European Journal of Ageing, 6*(4), 277-290. doi:10.1007/s10433-009-0123-y

Yang, H. Y., & Sanford, J. A. (2012). Home and community environmental features, activity performance, and community participation among older adults with functional limitations. *Journal of Aging Research, 2012*, 625758. doi:10.1155/2012/625758; 10.1155/2012/625758

Table 1. Bivariate associations between perceived environmental and individual barriers to and environmental facilitators for outdoor mobility and walking limitations.

	No walking limitations (n=485) n (%)	Early limitations (n=140) n (%)	Advanced limitations (n=209) n (%)	p
Perceived environmental barriers to outdoor mobility reported by the participants				
Poor street conditions	71 (14.6)	27 (19.3)	59 (28.2)	< .001
High curbs	12 (2.5)	18 (12.9)	32 (15.3)	< .001
Hills in nearby environment	76 (15.7)	40 (28.6)	80 (38.3)	< .001
Long distances to services	26 (5.4)	14 (10.0)	54 (25.8)	< .001
Lack of benches	42 (8.7)	29 (20.7)	59 (28.2)	< .001
Lack of benches in winter	50 (10.3)	37 (26.4)	67 (32.1)	< .001
Noisy environment	15 (3.1)	4 (2.9)	12 (5.7)	.201
Busy traffic	30 (6.2)	11 (7.9)	29 (13.9)	.004
Dangerous crossroads	35 (7.2)	17 (12.1)	25 (12.0)	.060
Cyclists on walkways	86 (17.7)	25 (17.9)	47 (22.5)	.320
Insecurity due to other pedestrians	20 (4.1)	10 (7.1)	14 (6.7)	.211
Snow and ice in winter	208 (42.9)	92 (65.7)	142 (67.9)	< .001
Poor lighting	16 (3.3)	4 (2.9)	8 (3.8)	.880
Lack of sidewalks	12 (2.5)	3 (2.1)	11 (5.3)	.117

Perceived environmental facilitators for outdoor mobility reported by the participants				
Park or other green area	210 (43.3)	46 (32.9)	83 (39.7)	.082
Walking trail, skiing track	331 (68.2)	75 (53.6)	74 (35.4)	< .001
Nature, lakeside	380 (78.4)	99 (70.7)	126 (60.3)	< .001
Familiar surroundings	328 (67.6)	87 (62.1)	113 (54.1)	.003
Appealing scenery	351 (72.4)	96 (68.6)	117 (56.0)	< .001
Own yard	267 (55.1)	86 (61.4)	123 (58.9)	.339
Other walker's example inspires	117 (24.1)	27 (19.3)	32 (15.3)	.028
Good lighting on walking routes	206 (42.5)	55 (39.3)	50 (23.9)	< .001
Peaceful and good quality walkways	265 (54.6)	68 (48.6)	87 (41.6)	.006
Even sidewalks	136 (28.0)	48 (34.3)	63 (30.1)	.355
Resting places by the walking route	86 (17.7)	32 (22.9)	50 (23.9)	.119
Walkways without steep hills	57 (11.8)	24 (17.1)	28 (13.4)	.246
Services, shops near	229 (47.2)	66 (47.1)	70 (33.5)	.003
No car traffic	75 (15.5)	20 (14.3)	15 (7.2)	.011
No cyclists on walkways	27 (5.6)	7 (5.0)	6 (2.9)	.310
Safe crossings: traffic lights, zebra crossing etc.	132 (27.2)	33 (23.6)	34 (16.3)	.009
Individual reasons that hinder outdoor mobility reported by the participants				
Poor vision	4 (0.8)	10 (7.1)	19 (9.1)	< .001
Fear of falling when moving outdoors	46 (9.5)	38 (27.1)	82 (39.2)	< .001
Fear of falling victim to crime	26 (5.4)	7 (5.0)	16 (7.7)	.444
Feeling insecure when walking outdoors	12 (2.5)	9 (6.4)	23 (11.0)	< .001

Lack of company	16 (3.3)	12 (8.6)	24 (11.5)	< .001
Poor weather	185 (38.1)	82 (58.6)	131 (62.7)	< .001
Slippery roads	142 (29.3)	79 (56.4)	126 (60.3)	< .001
Darkness prevents walking outdoors	75 (15.5)	46 (32.9)	78 (37.3)	< .001
Not interested in walking outdoors	7 (1.4)	4 (2.9)	15 (7.2)	< .001

NOTE Seven barriers are not shown and were excluded from further analyses due to low reporting rate (>20% of cells in cross-tabulation had expected count less than 5). These were: vehicles on walkways, hearing problems, fear of getting hit by a car, environment around home not suitable for walking, health care personnel or relatives have told not to go walking outdoors, too old for outdoor walking and not used to do outdoor activities.

Table 2. Participant characteristics according to lower extremity performance assessed with the SPPB (N=834).

Variable	Intact SPPB (score 10-12) n=526	Poorer SPPB (score 0-9) n=308	p*
Sex (n, %)			
Men	206 (39.2%)	110 (35.7%)	.322
Women	320 (60.8%)	198 (64.3%)	
Age group (n, %)			
75-79	240 (45.6%)	112 (36.4%)	.009
80-84	174 (33.1%)	105 (34.1%)	
85-89	112 (21.3%)	91 (29.5%)	
Education (n, %)			
Primary school or less	176 (33.6%)	133 (43.2%)	.006
Higher than primary school	348 (66.4%)	175 (56.8%)	
Self-rated health (n, %)			
Good/very good	241 (46.0%)	58 (18.8%)	< .001
Satisfactory /poor/very poor	283 (54.0%)	250 (81.2%)	
No. of chronic conditions (mean ± SD)	4.0 ± 2.3	5.1 ± 2.5	< .001
MMSE score (mean ± SD)	26.5 ± 2.6	25.6 ± 3.0	< .001
BMI kg/m^2 (mean ± SD)	26.0 ± 3.8	26.6 ± 4.3	.030
CES-D score (mean ± SD)	8.6 ± 6.2	11.5 ± 7.4	< .001
Years living at current address*	23.8 ± 14.7	23.0 ± 15.0	.462

No. of perceived environmental barriers to outdoor mobility (max. 15, mean ± SD)	1.7 ± 1.9	2.6 ± 2.3	< .001
No. of perceived environmental facilitators for outdoor mobility (max. 16, mean ± SD)	6.2 ± 3.5	6.1 ± 3.8	.603
No. of individual reasons that hinder outdoor mobility (max. 15, mean ± SD)	1.3 ± 1.5	2.3 ± 1.8	< .001
Early and advanced walking limitations (n, %)			
No walking limitation	376 (71.5%)	109 (35.4%)	< .001
Early walking limitations	79 (15.0%)	61 (19.8%)	
Advanced walking limitations	71 (13.5%)	138 (44.8%)	

Notes: *p value for chi-square and t-tests; SPPB = Short Physical Performance Battery; MMSE = Mini-Mental State Examination; BMI = Body Mass Index; CES-D = Center for Epidemiologic Studies Depression Scale; SD = Standard Deviation

Table 3. Polytomous logistic regression models for early and advanced walking limitations in participants with intact (Model 1) and poorer (Model 2) SPPB.

Independent variable	Intact SPPB (score 10-12, n=526)				Poorer SPPB (score 0-9, n=308)			
	Early (n=79) vs. no walking limitations (n=376)		Advanced (n=71) vs. no walking limitations (n=376)		Early (n=61) vs. no walking limitations (n=109)		Advanced (n=138) vs. no walking limitations (n=109)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex (men vs. women)	0.9	0.47-1.55	0.5	0.25-1.16	0.8	0.38-1.78	1.1	0.56-2.32
Age (years)	**1.2**	**1.08-1.25**	**1.2**	**1.12-1.33**	1.1	1.01-1.22	**1.2**	**1.09-1.31**
Education (primary school or less vs. higher)	0.9	0.51-1.78	1.7	0.85-3.53	0.8	0.36-1.73	0.7	0.33-1.43
No. of chronic conditions	0.9	0.82-1.07	1.1	0.92-1.24	**1.4**	**1.15-1.62**	**1.4**	**1.18-1.64**
Self-rated health (poor/moderate vs. good)	**5.4**	**2.75-10.58**	**4.7**	**2.09-10.43**	2.0	0.80-4.83	**11.1**	**3.33-36.83**
BMI	1.1	0.99-1.15	**1.2**	**1.14-1.36**	1.1	0.96-1.15	1.1	0.98-1.17
MMSE	1.0	0.93-1.18	1.0	0.90-1.18	1.0	0.86-1.10	0.9	0.84-1.06
CES-D	1.0	0.96-1.05	1.1	1.00-1.11	1.0	0.94-1.05	1.0	0.96-1.06

Perceived environmental barriers to outdoor mobility								
Long distances to services	0.8	0.26-2.55	**3.1**	**1.19-8.19**				
Snow and ice in winter					**3.0**	**1.36-6.59**	**2.5**	**1.22-5.22**
Lack of benches in winter	**2.5**	**1.20-5.32**	**3.1**	**1.35-7.04**				
Perceived environmental facilitators of outdoor mobility								
Park or other green area					**0.3**	**0.14-0.72**	0.9	0.42-1.95
Familiar surroundings					0.8	0.36-1.94	**0.3**	**0.14-0.70**
Other walkers' example inspires	0.6	0.29-1.28	**0.4**	**0.13-0.97**				
Good lighting on walking routes	0.7	0.38-1.25	**0.3**	**0.12-0.60**				
Services, shops near	**0.5**	**0.27-0.92**	0.6	0.27-1.14	**2.4**	**1.11-5.07**	1.0	0.48-1.99
Individual reasons that hinder outdoor mobility								
Fear of falling when moving outdoors	**2.8**	**1.27-5.95**	2.1	0.88-5.18	2.3	0.90-5.79	**3.8**	**1.58-9.03**
Not interested in walking outdoors	3.9	0.81-19.15	**7.3**	**1.52-35.30**				
Lack of company	**4.1**	**1.16-14.44**	**5.1**	**1.33-19.31**				
Feeling insecure when walking outdoors					3.7	0.53-26.50	**6.7**	**1.03-43.31**

Notes: The two models include different variables; the OR's and CI's of all the variables that were included in each model are shown . The bold figures indicate statistically significant ORs. OR = Odds Ratio, CI = Confidence Interval; Early mobility limitation: difficulty walking 2 km; Advanced mobility limitation: difficulty walking 2km and 0.5 km; SPPB = Short Physical Performance Test; MMSE = Mini-Mental State Examination; BMI = Body Mass Index;

CES-D = Center for Epidemiologic Studies Depression Scale