A five-year follow-up among older people after an outdoor environment intervention

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ABSTRACT

This study investigates older inhabitants' appreciation of environmental measures taken in their residential area and the effect on perceived difficulty as pedestrians and in outdoor activity. The study is based on data collected with a mailed questionnaire at baseline and at a 5-year follow-up (after intervention) posted to 195 people aged 65+ in a residential area in a medium-sized Swedish town, rather typical for Northern Europe. Appreciation of the environment was analyzed overall and in sub-groups. Overall appreciation was higher for women, in particular as regards longer green time at signalised crossings, and for those reporting better perceived health, in particular concerning separation between bicyclists and pedestrians. As concerns changes in perceived difficulty as pedestrians and in outdoor activity, no differences were found, either overall or in sub-groups. However, the study identifies which environmental measures older people appreciate, indicating that certain sub-groups may benefit more from interventions in the outdoor environment.

Keywords: Neighborhood, walkability, retirement, usability, older adults

1. Introduction

Designing a barrier-free society for older people and people with disabilities has been high on the agenda for decades, and has gained continued interest on both international and national levels. Within the transport sector, governments and experts from different countries have worked together and exchanged ideas in order to achieve barrier-free travel for older people and people with disabilities (ECMT 2000a; 2000b; 2006). From a policy perspective, legislation to improve accessibility ranges from strongly proactive countries to those where few measures have been carried out, with much yet to achieve (Euro Access, 2008). The international and national requirements on public outdoor environments to be accessible for all citizens impose new challenges on society at large as well as on the actors involved in trial implementation. The present study was based on a 5-year Swedish intervention project targeting accessibility/usability and safety/security in outdoor environments for older people (Ståhl et al., 2008).

At the turn of the century, the Swedish Parliament adopted the governmental proposition "From patient to citizen" (Prop. 1999/2000:79), with one of the major goals being to make public environments accessible to people with disabilities regardless of age. This national plan underlies the current Swedish accessibility legislation that requires municipalities to identify and eliminate predefined types of barriers, so-called "easily removed barriers", in public environments before 2015. This legislation is retroactive, requiring not only new constructions to be accessible, but also eliminating existing barriers in, for example, outdoor environments. To facilitate trial implementation, directives for planning are available, backed by guidelines used in municipal policy and planning.

Overall, there is growing evidence that the environment in which an individual lives may have an influence on health (Beard et al., 2009). Such influences are more important for people with reduced functional capacity, as described in the ecological theory of ageing (ETA) (Lawton and Nahemow, 1973). According to the ETA, individuals with low functional capacity are much more vulnerable to environmental demands than those with high functional capacity, and environmental details are critical for what they can manage in their everyday lives. The ETA underscores the notion that it is the fit between personal competencies and needs and the environmental conditions, rather than personal and environmental factors separately, that is the key to understanding person-environment (P-E) relations as people age (Iwarsson., 2005). Old age is characterised by marked heterogeneity, in terms of age, sex, functional capacity, use of mobility devices, etc. Even though such facts are obvious, these issues are seldom targeted in planning of the outdoor environment despite progressive legislation, directives and guidelines (Wennberg et al., 2009a). Further, in spite of the significance of outdoor environments for older people's health, little research has been conducted in this field (Sugiyama and Ward Thompson, 2007). More knowledge about the benefit of measures taken to eliminate environmental barriers, as well as evidence-based research targeting different groups in society on the benefit of such measures, might speed up implementation in municipal planning.

For a large proportion of older people, especially the oldest old, walking is inevitable and becomes more important with increasing age (Wennberg et al., 2010, 2009b; Whelan et al., 2006; Tacken, 2004). According to the OECD (2001), in many countries 30-50% of older people's journeys are made as pedestrians. Walking outdoors is not only important for basic mobility, but facilitates physical functioning and overall health in old age (Borst et al., 2008). Therefore, the provision of good outdoor environments is an important precondition for many people to stay mobile and independent in old age (Michael et al., 2006; Mollenkopf et al., 2004; Burkhardt et al., 1998). This in turn might have a positive impact on society in terms of less need of support such as special transport services (Ståhl, 1998; Euro Access, 2008).

Thus, well-designed outdoor environments in residential areas are important prerequisites for older people in order for them to be able to conduct their everyday activities independently and safely, and to enhance mobility. Most important, use of mobility devices is frequent in old age, and the physical environment is often perceived as hindering outdoor mobility (Iwarsson et al., 2012; Leslie et al., 2005; Löfqvist et al., 2005; Brandt et al., 2003). Previous studies on outdoor environments report barriers due to poor design and maintenance, and their implication on older people's possibilities for outdoor activities (Wennberg et al., 2010, 2009b; Ståhl et al., 2008; Lavery et al., 1996). Such barriers include narrow pavements, poor crossing facilities, high curbs, uneven or slippery surfaces, stairs without handrails, lack of benches, poor lighting, etc. Further, the literature also emphasizes that experienced security and safety may cause mobility-restricting behavior for older people, especially in evenings and at night (Wennberg et al., 2010; Risser et al., 2010; Carreno and Stradling, 2007; SIZE, 2006; Mollenkopf et al., 2004). It is also stresses that these issues must be addressed in planning. For example, Wennberg et al. (2010) reported that a majority of the older population in a residential area felt unsafe or afraid when walking in the area, and as many as two thirds avoided walking. Fear of crime such as robbery, assault and threat as well as vandalism and lack of service and police staff were mentioned as the causes for such fears. Other scientific literature in this field based on census data on older people and outdoor environment aspects concerns neighbourhood qualities such as land use, crime, the age of the housing stock, etc., predominantly from the U.S. and Australia (Beard et al., 2009; Balfour and Kaplan, 2002).

Such knowledge is of course important, but in order to understand and address the challenges of mobility disability in old age, more detailed information on neighbourhood design is necessary. Data on the subjective perceptions of older people themselves would help to clarify the mechanisms of disablement (Bowling and Stafford, 2007; Clarke and George, 2005). There are a few longitudinal studies that reported on “neighbourhood problems” as related to functional deterioration in older adults. Those have not, however, been able to identify specific features of the built environment that may exert health effects in terms of reducing disability in old age (Beard et al., 2009; Balfour and Kaplan, 2002). Virtually no studies on such effects of measures taken in outdoor environments have been published. Summing this up, the literature search conducted at the outset of the current study identified a lack of studies reporting environmental interventions that target outdoor environments and older people’s experiences of the measures taken. In order to facilitate prioritization needed in planning, more knowledge on the benefit of different measures taken, overall as well as for different groups of older people and people with disabilities, is called for. Therefore, the objective of the current study is to contribute new knowledge on these issues.

The overarching objective of this study was to deepen our knowledge about what measures taken in the outdoor environment mean to an aging population, overall and related to age, sex, perceived health, and the use of mobility devices and mode of transport. One specific aim was to investigate older peoples’ appreciation of environmental measures taken in their residential area, and another was to follow changes in perceived difficulty as pedestrians and self-reported outdoor activity.

2. Materials and methods

2.1. Project Context and Design

This study constitutes one facet of a larger intervention project (Ståhl et al., 2008) initiated by the Swedish Transport Administration in order to improve knowledge about what measures taken in the outdoor environment, in order to live up to Swedish policy and legislation (Prop.1999/2000:79), mean to an ageing population. An important part of the project was the implementation of concrete measures in the outdoor environment over a period of three years. The intervention project included several sub-studies applying different methodologies, and involved older inhabitants in a defined geographic area as well as public actors and stakeholders engaged in the physical planning of outdoor environments (Ståhl et al., 2008). The current study is based on data collected with a pre and post mailed questionnaire, following a sample of older inhabitants over five years (from 2002 (T1) to 2007 (T2)). The Ethics Committee, Lund University, Sweden, approved the study.

2.2. Study Area

The study took place in Kristianstad, a typical medium-sized town in Southern Sweden, situated approximately 100 km northeast of Malmö, the third largest city in Sweden, and 120 km north of Copenhagen, the capital of Denmark. The town has a population of approximately 30,000 inhabitants. The local authorities had demonstrated commitment to invest money for concrete outdoor environment improvements, based on the results generated during the problem identification phases of the project (Ståhl et al., 2008). The proportion of people aged 65+ in the population represented the current average for Northern Europe. Likewise, the diversity of housing types, walking distances from home to key destinations in the town centre, and the availability of public transportation were similar to other towns of similar sizes in Northern Europe.

Approximately 3,000 people lived in the geographically defined study area; 20% were aged 65+ and the vast majority was native Swedish citizens. As to type of industry, the town is characterised by trade and business, in particular food industry and clothing. Thus, many older people had been employed in such types of business. As to transportation, private car traffic is dominant in the municipality overall, while the town is served by local as well as regional public transportation services in the form of bus and train traffic.

The study area was close to the town centre and consisted of three connected housing districts with single-family houses and apartment blocks built during the mid or late 20th century. The street system was varied. In line with Swedish planning regulations, the intersections in streets designed for through traffic were usually regulated by traffic lights, while the more local streets were narrower and lacked designated pedestrian crossings. Pedestrian path surface materials were of mixed material and standards and in need of maintenance (Ståhl et al., 2008). Within the study area, there was one small local shop for groceries, newspapers, etc., and just outside a major shopping mall for groceries, clothing, kitchen utensils, garden products, etc. was situated. The study area could be considered as specific in the sense that it comprised facilities such as a sports arena and an exhibition centre.

2.3. The intervention

The synthesis of the results of the sub-studies of the intervention project was used to develop an intervention program targeting the different kinds of environmental barriers and risk factors older inhabitants in the study area were confronted with (Ståhl et al., 2008). This was attained by means of strong user involvement. The intervention program took its point of departure in the barriers reported at T1, with the overriding strategy that the environmental interventions should improve accessibility and usability along pedestrian routes identified as important, and benefit as many inhabitants as possible by facilitating walking for people using rollators (wheeled walkers) as the main focus. In practice this meant that the intervention focused on those streets in the study area that were in most need of improvements.

The environmental improvements were both general traffic engineering measures and maintenance-related measures, divided into two types:

1) General improvements (meaning that measures should be taken in the whole study area):
   - Separation of pedestrians and people using bicycles and mopeds
   - Longer green time in traffic signals
   - Improved snow removal and non-skid surfaces (improved standards)
2) Selected measures at specific locations (meaning that measures should be taken where needed in the study area):
   - Wider sidewalks
   - Lightness contrasts, especially between street and sidewalk
   - Lower curbs at pedestrian crossings and other strategic locations
   - More even surfaces on sidewalks, especially along specified stretches

Subsequently during the three-year intervention phase, the improvements were effectuated by the highway engineering office in the municipality, in close cooperation with a senior scientist (first author) and a practising architect with expertise in traffic planning and accessibility issues.

2.4 Study population

The population targeted was all inhabitants in the study area, aged 65 years or more, who responded to a mailed questionnaire in 2002 (T1) and 2007 (T2). At T1, all persons aged 65+ registered as living permanently within the study area (N=556) received a mailed questionnaire. In all, 330 persons (59%) responded. At T2, again all persons aged 65+ registered as living permanently within the study area (N=526) were mailed a follow-up questionnaire; 347 persons (66%) responded. Of these 195 responded at both T1 and T2, and they constitute the sample for the present study. The most common reasons for dropout at T2 were death, relocation to outside the study area during the five-year follow-up period, refusal to participate without giving any reason, and health problems.

At T1, the median age of the sample was 78 years; 61% were women (Table 1). The median number of functional limitations increased from 1 to 2 between T1 and T2 ($p<0.001$), and the prevalence of difficulty interpreting information, severe loss of sight, poor balance, limitations of stamina, and difficulty in bending or kneeling changed significantly from T1 to T2 (p-values, range <.001 to .017) (Table 1). It is important to observe that fewer people had difficulty moving arms and head at T2 relative to T1 and that fewer people reported complete loss of sight at T2. One explanation might be that the difficulty was an effect of a temporary complaint and/or that the functional limitation had disappeared due to surgery. Furthermore, the proportion of rollator users increased significantly (p=0.007). Perceived health was positively rated, with no significant difference between T1 and T2 (p=0.053) (Table 2) (for instruments, see below).

TABLE 1 IN HERE

2.5 Pre and post mailed questionnaire

Based on previous research and experience, the research team developed a semi-structured mailed questionnaire for T1. In order to arrive at an instrument fulfilling basic face and content validity requirements, the development of the questionnaires involved the project actors in an iterative revision process, including a pilot test (Ståhl et al., 2008).

The mailed questionnaire comprised 47 structured and five open-ended questions (Ståhl et al 2008; Leslie et al., 2005; Lavery et al., 1996). Participant *characteristics* (age, sex, and self-reporting of specific functional limitations) were studied according to the Housing Enabler (Iwarsson and Slaug, 2010). Other variables studied were a global question on *perceived health* ("How do you rate your health?", positively rated from 1-7), a question about the *use of types of mobility devices* ("Do you use any walking aid and/or a wheelchair when outdoors?", categorical variable with five defined categories, and one open category, "no use of any walking aid/stick or crunch/rollator/manual wheelchair/electric wheelchair"). Participants were also asked about their *use of different modes of transport* at the time of the data collection; by car as a driver, walking, biking, by public transport, by car as passenger and by special transport service (STS) (ordinal variables with seven response alternatives ranging from "daily" to "seldom/never"). For the analyses of *mode of transport*, a variable with two categories was constructed: "no use of car and/or bus and/or special transport service (STS)", and "use of car and/or bus and/or STS"

(Wennberg et al. 2010; 2009b). Furthermore, a variable on *perceived difficulty as a pedestrian* (yes/no) was included, and two variables on *frequency of outdoor activity: in the town overall* and *in the residential area as a pedestrian* (ordinal variables with seven response alternatives ranging from "daily" to "seldom/never").

A corresponding version of the questionnaire, extended with twelve questions concerning *appreciation of the environmental measures taken* (positively rated from 1-5), overall as well as for specific measures, was used at T2. Data on both overall appreciation and the seven specific measures most consistently implemented in the study area (even pavements; wider pavements; separation bicyclists/pedestrians; lower curbs; longer green time at zebra crossings; marking of contrasts in lightness) were used.

2.6 Data analysis and statistics

Appreciations of environmental improvements made, overall and for specific measures, are presented by their medians and interquartile ranges. Bivariate relations at T2 between age and perceived health on the one hand and appreciation of the measures taken of the environmental barriers on the other, were studied by means of Spearman correlation coefficients; the relations between sex, use of cane/crutch, use of rollator, and mode of transport on the one hand and appreciation of the measures taken on the other were tested by the Mann-Whitney two-sample test. Multivariately, the influence on the appreciations was investigated by means of ordinal regression analyses (Ananth and Kleinbaum, 1997), with one model for each appreciation.

For changes from T1 to T2 the variable *change in perceived health* was constructed to have three ordered categories: worse, unchanged, and better; the variable *change in mode of transport* was constructed to have four categories: no use, use only at T1, use only at T2, and use at T1 and T2.

The constructed variable *change in difficulty as a pedestrian* contained four categories of participants: those who did not experience any difficulty as pedestrians, those who did so only at T1, those who did so only at T2, and finally those who did so at both occasions. This change variable was related to sex, age, *change in mode of transport* using Chi-square tests, and *change in perceived health* using the Kruskal-Wallis test. In addition, the variables *change in frequency of outdoor activity*, both generally in the town overall and in the residential area as a pedestrian, were each constructed to contain three categories of participants: those who decreased in activity from T1 to T2, those who remained unchanged, and those who increased in activity at T2. These variables were related to gender, age, *change in mode of transport* by Chi-square tests, and *change in perceived health* by the Spearman correlation coefficient.

TABLE 2 IN HERE

3. Results

The *overall appreciation* of environmental measures taken in the study area was scored as moderate to high, as was the evaluation of each of the specific environmental measures (all medians = 4; all interquartile ranges 3 to 5). Regarding relations between the overall appreciation of the environmental measures taken and participant characteristics/topical variables (Tables 1, 2), none was bivariately associated, while in the multivariate regression model, significant relations were found for sex and perceived health ($p=0.013$ and 0.025, respectively). Women evaluated the overall environmental measures more highly than men did, and the better the perceived health, the higher the overall appreciation of the environmental measures that had been taken.

TABLE 3 IN HERE

Turning to the relations between the appreciation of the specific environmental measures taken and participant characteristics/topical variables, none of the variables age, sex, perceived health, use of cane/crutch, use of rollator, and mode of transport was bivariately associated with the appreciation of *more even pavements*. In the multivariate regression model, the use of rollator alone was significantly related to the appreciation outcome (p=0.049), i. e. rollator users evaluated *more even pavements* higher, but for the *width of pavements*, none of the variables was associated with the appreciation, either bivariately or multivariately. None of the variables was bivariately associated with the appreciation of *separation of pedestrians and bicyclists*. In the multivariate regression model, use of rollator and perceived health were significantly related to the appreciation (p=0.012 and 0.018, respectively). Rollator users evaluated this environmental measure higher, and the better health was perceived, the higher the appreciation. Bivariately, age was significantly positively correlated with the appreciation of *lowered curbs* (r=0.245; p=0.002). Older people tended to appraise lowered curbs more highly. Also rollator users evaluated this environmental measure higher (p=0.035). In the regression model, only *use of rollator* was significantly related to the appreciation (p=0.025). Rollator users appreciated lowered curbs more than those who did not use these devices. Bivariately, age was significantly positively correlated with the appreciation of *longer green time* (r=0.175; p=0.032), and women evaluated this measure higher (p=0.020). In the regression model, sex alone was significantly related to the appreciation (p=0.006); women appreciated longer green time at signalised crossings more than men did. None of the variables was associated with the appreciation of *marking of contrast* or of *more benches*, either bivariately or multivariately.

As concerns the variables *change in difficulty of walking*, *change in activity in the town overall*, and *change in activity in the residential area as a pedestrian*, there were no significant differences with regard to the participant characteristics/topical variables.

Summing up these results, older people's appreciation of environmental measures taken in their residential area was positive, with women reporting higher appreciation, in particular regarding longer green time at signalised crossings (Table 3). Likewise, overall appreciation was higher for those reporting better perceived health, in particular concerning separation between bicyclists and pedestrians. Use of mobility devices (rollators) also influenced the appreciation of specific environmental measures. As concerns the three variables capturing change in walking difficulty/outdoor activity, no sub-group differences were found.

4. Discussion

Based on a Swedish 5-year intervention project targeting accessibility, usability, safety and security in outdoor environments for older people (Ståhl et al., 2008), the results of the current study show that overall, older people's appreciation of environmental measures taken in their residential area is positive. While this result is not surprising, the main contribution of the study is on the one hand the identification of which environmental measures in outdoor environments older people appreciate, on the other the identification of participant characteristics influencing their appreciation. Despite the fact that the overall appreciation of the measures taken was positive, there was no significant change in the perceived difficulty as pedestrians. Furthermore, the outdoor activity decreased, overall as well as in sub-groups. Even though these results may be disappointing at a first glance, it is important to remember that they reflect the situation of a population that aged five years during the study period. While more research of this kind is certainly called for, not the least from different types of residential areas in different national contexts, our study produced important knowledge that contributes to filling the gap of knowledge identified by other authors (Wennberg et al. 2010; Beard et al., 2009; Bowling and Stafford, 2007; Clarke and George, 2005; Wilcox et al. 2003). Most important, the study highlights the heterogeneity in the aging population, hitherto not often taken into account in physical planning.

On a general level, the overall positive appreciation of the environmental measures taken is congruent with the results of others (Wennberg et al., 2010; Ståhl and Berntman, 2007; Humpel et al., 2002). As concerns the appreciation of specific measures taken in outdoor environments, we only found one previous investigation to compare our findings with, that conducted by Wennberg et al. (2010). Bearing in mind that their follow-up period was only two years, their results are similar to those of the present study. That is, older peoples' overall satisfaction with the outdoor environment had increased after implementation, but their mobility was unchanged.

The fact that all specific measures were very positively appraised is encouraging but not surprising, since the data used were collected by means of questions targeting the seven specific measures most consistently implemented in the study area. For example, based on the inhabitants' identification of the overall lack of benches, a substantial number of benches were placed all over the study area, resulting in an overall positive appreciation of this measure. This result indicates that the basic notion of the project, i.e. to implement changes based on inhabitant prioritisations, had been realised (Ståhl et al., 2008). Another aspect worth mentioning is that during the course of the project, inhabitants contacted stakeholders to inform them that some of the environmental measures were not evenly distributed in the study area (Ståhl et al., 2008). Consequently, not all participants were in a position to be able to report their appreciation of all the measures taken.

The reported differences in appreciation of measures between sub-groups are noteworthy and hitherto unknown. The reasons behind the fact that women as well as those rating their health as better reported a more positive appreciation remain to be investigated. Likewise, we can only state that women appreciate longer green time at signalised crossings higher than men. However, earlier research indicates that a greater proportion of men than women are physically active and have access to a car, even if this is likely to change in the future, and therefore, in order to promote mobility and activity among older women, more knowledge of their situation is needed (Rosenbloom & Herbel, 2009; Whelan et al., 2006; Wilcox et al., 2003; Booth et al., 2000).

While it is well known that the separation of bicyclists and pedestrians, even pavements and lower curbs are environmental measures commonly wished for among older people, our result identifies the fact that it is mainly users of mobility devices that appreciate such measures (Wennberg et al., 2009a; Ståhl et al., 2008). As reported in our previous study from the same project, older inhabitants in the study area prioritised measures facilitating mobility for rollator users, such as those just mentioned, requiring only minor and not very costly measures (Ståhl et al., 2008). In order to support activity, participation and health among older people, physical planning of outdoor environments must take such results into consideration. Overall, these findings are in line with those of other recent studies (Wennberg et al., 2010, 2009b; Sugiyama and Ward Thompson, 2007; Schootman et al., 2006), but with the attention to specific sub-groups as a new contribution to the existing knowledge in this field.

However, this type of result is an obvious example of aspects where potential cross-national differences deserve consideration. The rollator is a mobility device typical for the Nordic countries (Brandt et al., 2003), and most likely this fact was mirrored by our results, based on data from Sweden. According to previous studies, there are pronounced differences between European countries as concerns the most common types of mobility devices in use (Löfqvist et al., 2005; Brandt et al., 2003), and thus our results should not be generalised to older people in other countries. Another cross-national difference worth mentioning is the proportion of older people holding a driver's license and having access to a car, since especially among women there are pronounced differences among European countries and certainly between Europe and the U.S. (OECD, 2001). The importance of well-designed and maintained outdoor environments may therefore have more implications for countries where access to a car among the older population is less common.

Even though we studied sub-groups of older people with specific characteristics, it should be noted that our intervention only targeted the environmental and not the personal component of P-E fit. A fully successful intervention should also include well-targeted and systematic rehabilitation efforts, including the provision of - and training with - mobility devices. To the best of our knowledge, active integration of rehabilitation efforts and planning of outdoor environments seldom occurs, and to the best of our knowledge, no studies based on such complex interventions have been reported in the scientific literature. Reflecting further on the results in relation to the ETA (Lawton and Nahemow, 1973), the fact that users of mobility devices in our study reported higher appreciation is in line with the notion that individuals with low functional capacity are more vulnerable to environmental demands than those with high functional capacity. That is, environmental details are critical for what they can manage in their everyday lives.

Even if the appreciation of measures taken was positive, the absence of positive changes in perceived difficulty as pedestrians or frequency of outdoor activity identified deserves attention. From a methodological point of view, it might not be optimal to construct a variable in targeting difficulty as a pedestrian allowing only for dichotomous response alternatives, since it potentially reduces the variable's sensitivity to change. Regarding the fact that there were individual characteristics that were significantly related to the appreciation only in the multivariate models illustrates that also additional information of characteristics contains important information. Moreover, as already discussed the measures were not consistently implemented in the study area, and the implementation phase was extended over a long period of time. Besides the obvious fact that the inhabitants grew older and reported more functional limitations at follow-up five years later (Table 1), the long implementation time also implies a gradual adjustment to the environmental improvements (Booth et al., 2000). All in all, there are several factors that have to be kept in mind when interpreting this facet of the results.

A further issue worth mentioning is the fact that our study did not include perceived safety and security as mobility-restricting causes. We do recognize that these aspects are of importance for outdoor mobility, and represent predictors of physical activity that have been reported in previous research (Wennberg et al., 2010; Risser et al., 2010; SIZE, 2006; Wilcox et al., 2003). Fear of being outdoors is common among older people, in particular among women, and considerably increases the risk of developing self-reported difficulties as pedestrians. According to recent research (Rantakokko et al., 2009), environmental factors such as poor street conditions and slopes in outdoor environments are related to such fears. While such data were collected in the project (Ståhl et al., 2008), with the main focus on the benefit of measures taken in the outdoor environment, these aspects were not highlighted in the present study.

In addition to the challenges just discussed, the study design applied has limitations. Our focus on older people's perceptions of specific outdoor environmental barriers and measures is unusual compared to the existing literature in the field. Like other authors, we are well aware of the value of including perceived as well as objective aspects of the outdoor environment in studies of P-E fit and aspects of health (Bowling and Stafford, 2007; Oswald et al., 2007; Wilcox et al., 2003). In forthcoming studies based on the project, such aspects will be taken into account. According to recent research, for example, neighbourhood socio-economic status, residential instability, ethnic composition of the population, as well as social support, self-efficacy and regular contacts with friends are related to physical activity and outdoor mobility (Beard et al., 2009, Wilcox et al., 2003; Booth et al., 2000). Further, and most important, the lack of a control district means that conclusions regarding difficulty as pedestrians and activity as effects of the intervention cannot be drawn. Overall, population-based interventions imply a range of methodological challenges. In particular, complex interventions require many considerations (Medical Research Council, 2008; McClure et al., 2005). Unfortunately, due to budget limitations, the main focus and complexity of the project process overall, and the challenges in finding a control district matching the intervention districts on aspects of the P as well as the E component, we ended up with a before-after design (Ståhl et al., 2008). One way to compensate for this is to find ways to compare the changes in topical and outcome variables over time with equivalent data in other existing databases.

The main contribution of the current study is on the one hand the identification of which environmental measures older people appreciate, and on the other hand the identification of participant characteristics that influence the appreciation. The investment in improved design of physical outdoor environments enhances the possibility for older people to live independently. Outdoor environments that offer support for activity and participation will also support health and quality of life (Sugiyama and Ward Thompson, 2007; Banister and Bowling, 2004; Schootman et al., 2006; Gabriel and Bowling, 2004). It seems as if women may benefit more than men from this kind of intervention in outdoor environments, and people using mobility devices may benefit more than non-users. Further, small-scale, low-cost measures such as even pavements and lower curbs may support activity, participation and health in old age. Since walking in itself is a protection against unhealthy outcomes, environmental improvements may be effective for health promotion in general (Beard et al., 2009; Hallal et al., 2005; King et al., 2005; Suminiski et al., 2005; Owen et al., 2004). This study not only produces knowledge about the importance of good walking conditions for keeping especially the oldest old mobile (Michael et al., 2006; Mollenkopf et al., 2004; Burkhardt et al., 1998), it also gives important input to physical planning of outdoor environments by identifying which measures benefit most, and for whom.

The finding that it is the most vulnerable users that benefit most from measures taken is valuable knowledge also on the policy level, as is the knowledge about what measures are considered as most important, because many countries are in a phase of legislating on such issues, and detailed knowledge on the benefit of different measures is called for (Euro Access, 2008: ECMT 2006). In a time when many countries have limited financial resources to spend on increasing the accessibility of outdoor environments, not the least to prioritise maintenance, it is of great value for policy-makers to know what measures are most important for different sub-groups of the ageing population. Also at the executive level, that is, in the highway departments in cities or municipalities, such knowledge is valuable, both in order to make cost-effective prioritization and to be able to demand and argue for such measures to be implemented (Grönvall, 2004).

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Table 1

Participant characteristics at T1 (2002) and T2 (2007), N=195.*

Characteristic	T1 (2002) n (%)	T2 (2006) n (%)	P-value†
Age in years, median (q1-q3)	78 (73-83)		
Age group			
65-74 years	113 (59.5)		
75- w, years	77 (40.5)		
Sex, women	119 (61)		
Difficulty interpreting information	5‡ (2.6)	10‡ (7.5)	0.016
Complete loss of sight	2‡ (1.0)	1‡ (0.7)	1.000
Severe loss of sight	12‡ (6.3)	25‡ (18.7)	0.017
Severe loss of hearing	37‡ (19.4)	42‡ (31.3)	0.180
Poor balance	21‡ (11.0)	35‡ (26.1)	0.007
Limitations of stamina	30‡ (15.7)	56‡ (41.8)	<0.001
Difficulty in moving head	18‡ (9.4)	15‡ (11.2)	0.824
Difficulty in reaching with arms	16‡ (8.4)	13‡ (9.7)	0.774
Difficulty bending, kneeling	50‡ (26.2)	59‡ (44.0)	0.043
Difficulty in handling and fingering	14‡ (7.3.1)	18‡ (13.4)	0.424
Extremes of size and weight	13‡ (6.8)	18‡ (13.4)	0.302

* Due to internal missing, n varies between 195 and 118.

† Sign test.

‡ Iwarsson and Slaug (2010).

Table 2

Topical variables at T1 (2002) and T2 (2007), and the constructed change variables, N=195.[*]

Topical variable	T1 n (%)	T2 n (%)	Change variable n (%)		P-value[†]
Perceived health, median (q1-q3) [†, §]	5 (4-6)	5 (4-6)	Worse:	64 (35.4)	0.053
			Unchanged:	74 (40.9)	
			Better:	43 (23.8)	
Cane/crutch[‡]			Not used:	94 (79.7)	1.000
User	16 (11.8)	17 (10.6)	Used only T1:	8 (6.8)	
No-user	120 (88.2)	143 (89.4)	Used only T2:	9 (7.6)	
			Used both T1 and T2:	7 (5.9)	
Rollator[‡]			Not used:	83 (70.3)	0.007
User	17 (12.5)	35 (21.9)	Used only T1:	5 (4.2)	
No-user	119 (87.5)	125 (78.1)	Used only T2:	19 (16.1)	
			Used both T1 and T2:	11 (9.3)	
Mode of transport [‡,¶]			Not used:	4 (2.2)	1.000

No-user	15 (6.8)	15 (7.9)	Used only T2:	9 (4.8)	
			Used both T1 and T2:	163 (87.6)	
Difficulty as a pedestrian‡			No difficulty:	117 (68.8)	0.766
Yes	36 (19.6)	32 (17.8)	Difficulty only T1:	24 (14.1)	
No	148 (80.4)	148 (82.2)	Difficulty only T2:	21 (12.4)	
			Difficulty both T1 and T2:	8 (4.7)	
Activity, median (q1-q3) †	2 (1-3)	2 (1-3)	Decreased activity:	67 (38.1)	<0.001
			Unchanged activity:	83 (47.2)	
			Increased activity:	26 (14.8)	
Outdoor activity, median (q1-q3) †	1 (1-1)	1 (1-2)	Decreased activity:	58 (32.2)	<0.001
			Unchanged activity:	110 (61.1)	
			Increased activity:	12 (6.7)	

* n varies, due to internal missing, between 136 and 184.

Note: For each topical variable, differences between the two time points were tested by means of the † Wilcoxon Signed Rank Test or ‡ McNemar's test.

§ Ananth and Kleinbaum, 1997.

¶ Mode of transport categorised as follows: “no use of car and/or bus and/or special transport service“ and “use of car and/or bus and/or and/or special transport service”.

Table 3

Variables significantly related to appraisal of environmental measures taken, N= 195.*

Measure taken / Variable	Overall	Even pavements	Wider pavements	Separation bicyclists/ pedestrians	Lower curbs	Green time	Marking of contrasts	Benches
Sex	Women appreciated more (p=0.025)					Women appreciated more (p=0.006)		
Perceived health	Individuals with better health appreciated more (p=0.013)			Individuals with better health appreciated more (p=0.018)				

Rollator	Rollator users appreciated more (p=0.049)	Rollator users appreciated more (p=0.012)	Rollator users appreciated more (p=0.025)

[*] Due to internal missing, n varied between 134 and 17