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Environmental Features Associated with Older Adults' Physical Activity in Different Types of Urban Neighborhoods

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Environmental Features Associated with Older Adults' Physical Activity in Different Types of Urban Neighborhoods

Abstract

We studied associations of nature- and infrastructure-based features with physical activity (PA) in different urban neighborhood types. 848 community-dwelling people aged 75-90 years reported PA and three perceived nature-based destinations and seven infrastructure-based features as outdoor mobility facilitators. Neighborhood type was defined using a geographic information system based on proximity to central service areas and residential density (city center, subcenter, and dense and dispersed areas outside centers). PA was higher in dense areas and city center. Binary logistic regression showed that perceiving nature-based destinations increased the odds for higher PA in the city center and areas outside centers. In dispersed areas, perceived infrastructure-based facilitators were especially associated with higher PA. Environmental features were not associated with PA in subcenters. Higher residential density, as proxy for higher amount of infrastructure, rather than center proximity may underlie older peoples' PA. Spatial context should be acknowledged in studies on environment–PA associations.

Keywords: aging, outdoor mobility, nature, infrastructure, GIS

Introduction

Urban neighborhoods are increasingly becoming the most common residential locations (United Nations, 2018). At the same time, the proportion of people aged 60 or above in the general population is already substantial and is forecasted to increase markedly in the coming decades (United Nations, 2017). These concurrent trends of urbanization and aging, together with climate change, present challenges for urban planners in designing inspiring urban neighborhoods supporting an active and low-carbon lifestyle. For older people, neighborhood environmental features are especially important, as their physical activity (PA) mostly takes place close to their homes (Chaudhury, Campo, Michael, & Mahmood, 2016). Being physically active is important for the functional capability, health, and life satisfaction of older people, and thus should be encouraged.

Recent systematic reviews and meta-analysis have presented evidence on the close associations of various environmental features with total PA in older adults (Barnett et al., 2017), walking for transport (Cerin, Nathan, van Cauwenberg, Barnett, & Barnett, 2017), and leisure-time walking (Van Cauwenberg et al., 2018). The availability and range of different destinations, such as recreational facilities, parks and public open spaces (Barnett et al., 2017; Van Cauwenberg et al., 2018; Cerin et al., 2017), and the availability of public transport (Barnett et al., 2017; Van Cauwenberg et al., 2018) were associated with higher levels of PA. PA was also higher in the presence of favorable features of the pedestrian infrastructure, including the availability of resting places (Cerin et al., 2017), higher residential density/urbanization and street connectivity (Cerin et al., 2017), a walk- or pedestrian-friendly infrastructure (Barnett et al., 2017; Cerin et al., 2017), and higher walkability (Barnett et al., 2017; Cerin et al., 2017; Van Cauwenberg et al., 2018). Walkability is a composite index of residential and intersection density and the evenness of land-use distribution for residential, commercial, and office purposes (Frank, Schmid, Sallis, Chapman, & Saelens, 2005).

The person-environment fit model posits that the balance between personal capabilities and environmental demands is an important factor underlying a person's possibilities to act in his or her surroundings (Lawton & Nahemow, 1973). For example, an older person's walking capability, chronic conditions or socioeconomic status may affect the way neighborhood environmental features are perceived and how they relate to PA (Portegijs et al., 2013; Barnett et al., 2016; Koohsari et al. 2017; Sugiyama et al., 2017). However, whether neighborhood characteristics moderate the associations of environmental features with older adults' PA is less clear. Several recent reviews have found the evidence either inconclusive or inconsistent (Barnett et al., 2017; Cerin et al., 2017; Van Cauwenberg et al., 2018).

In previous studies, neighborhoods have been characterized as urban/rural (Lee & Park, 2015), urban/suburban/rural (Hanibuchi, Kawachi, Nakaya, Hirai, & Kondo, 2011; Maisel, 2016), based on residential density (Troped et al., 2014) and perceived distance to services (Van Cauwenberg et al., 2013), or, utilizing measures of walkability (Orstad et al. 2018, Bracy et al. 2014), perceived neighborhood walkability (Merom et al. 2015), number of intersections (Li et al. 2005), and perceived pedestrian (Bracy et al. 2014) and traffic safety (Li, Fisher, Brownson, & Bosworth, 2005). To the best of our knowledge, no previous study among older adults has categorized neighborhood types as a single measure combining objective environmental characteristics with spatial relations, that is, residential density and proximity to a center. Here, a center was defined as a central area offering a wide variety of services. Inclusion of an indicator of environmental context in research on associations between environmental features and PA might yield new knowledge on the factors underlying older adults' perceptions of environmental outdoor mobility facilitators and the influence of these on their PA. Categorizing neighborhoods into city center, subcenters, and dense and disperse areas outside centers could also enhance the value of research results for urban planning. Moreover, viewing neighborhood types as separate spatial entities enables their further characterization by the addition of environmental features.

The research questions were as follows:

1. Do neighborhood types in an urban structure differ in the proportions of people reporting destinations in nature and features of the infrastructure as perceived facilitators of outdoor mobility?
2. How are different nature- and infrastructure-based facilitators associated with PA in different neighborhood types?

Methods

Study Design

This study forms part of the project “Geographic characteristics, outdoor mobility and physical activity in old age” (GEOage) (Portegijs et al., 2017). In this study, we combine self-reported participant data with objectively defined data such as that on urban structure. Data on urban structure and on objective environmental characteristics were retrieved from openly available geospatial datasets and studied in relation to participant data. Participant data, including physical activity and perceived environmental features of the neighborhood, collected from community-dwelling older adults, were drawn from the data gathered for the “Life-Space Mobility in Old Age” (LISPE) project described earlier (Rantanen et al., 2012). To enable objectively defining neighborhood type and neighborhood characteristics for each participant, participants’ home addresses were geocoded using the Digiroad dataset (Finnish Transport Agency, 2013) in Geographic Information System (GIS) software ArcMap 10.3 (ESRI, Redlands, USA).

Briefly, study participants were 75 to 90 years old and living in two Finnish neighboring municipalities, Jyväskylä and Muurame, both located within the same urban structure. In the year 2012, Muurame had about 9 500 inhabitants and Jyväskylä, the 7th largest city in Finland, about 133 500 inhabitants (Statistics Finland, 2019). The main city center and subcenters form compact areas for business, services, and residence, while areas outside the centers form an urban fabric with varying residential density. A random sample of 2 550 people was drawn from the national population register and informed about the study. Participants not willing to participate, not living independently, unable to communicate, or residing outside recruitment area were excluded. Eventually, 848 people participated in the face-to-face interviews, conducted in their own homes using a structured questionnaire.

All participants signed a written informed consent before the interview. The study was conducted in accordance with the Declaration of Helsinki. Ethical approvals were granted for the LISPE project on 2 November 2011 and for the GEOage project on 2 September 2014 by the Ethical Committee of the University of Jyväskylä, Finland.

Study Measures

Physical activity. Physical activity was assessed with one self-reported question "Thinking of the past half year, which of the following best describes your physical activity?" Response options (modified from Grimby, 1986) were (a) mostly resting, hardly any activity, (b) mostly sitting, with PA confined to activities of daily living (grooming, dressing), (c) light PA, such as light housework or light gardening or going for a walk two or three times a week, (d) moderate PA about 3 hours a week, (e) moderate PA at least 4 hours a week or heavier PA up to 4 hours a week, (f) engaging in active sports several times a week or heavy gardening or leisure-time activities, at least 3 hours a week, and (g) participating in competitive sports. For the analysis, we dichotomized PA into light PA only (a-c) and at least moderate PA (d-g). The validity of the question on self-reported PA and its categorization have been found adequate for assessing PA levels in older people (Portegijs, Sipilä, Viljanen, Rantakokko, & Rantanen, 2016).

Perceived environmental facilitators for outdoor mobility. For each item on the checklist of perceived environmental facilitators of outdoor mobility (PENBOM) (Rantakokko, Iwarsson, Portegijs, Viljanen, & Rantanen, 2015), participants reported whether they perceived it as a facilitator of outdoor mobility in their neighborhood. Of the 16 facilitators listed, three items concerned nature-based destinations (nature and lakeside, walking trail and skiing track, and park or other green area) and seven concerned features of the infrastructure (peaceful walkways, services close, good lighting, safe crossings, even sidewalks, resting places by walking route, walkways without steep hills) as facilitators of outdoor mobility. We omitted six items from the current analyses as they addressed subjective social and safety aspects of outdoor mobility (e.g., other people as motivators of outdoor mobility, familiar environment) and thus were beyond the scope of this study. Furthermore, for the analyses, separate counts were made of nature-based destinations and infrastructure-based facilitators and the result divided into tertiles; for the nature-based facilitators the tertiles were 0-1, 2, and 3, and for the infrastructure-based facilitators 0-1, 2-3, ≥4.

Neighborhood type. Using GIS, we first located the main city center and subcenter areas (six in total) using the dataset Downtown areas and shopping areas (Finnish Environment Institute, 2015) which comprises areas characterized by a higher availability and variety of spatially connected service locations, considerably higher density of workplaces in services and retail, and higher residential density than surrounding areas. Buffer zones with a radius of 500 meters were drawn up around each center area and participants living in these buffered center areas were assigned to the corresponding neighborhood type (Figure 1). In research on older peoples’ PA, buffer zones of a 400- or 500-meter radius are commonly used to delineate neighborhood areas (Barnett et al., 2017; Cerin et al., 2017; Van Cauwenberg et al., 2018). Moreover, the European Commission (2001) proposes 500 meters as the maximum walking distance to public open spaces. For participants who lived outside these buffered center areas, neighborhood type was defined based on the mean residential density within a 500-meter radius of the participant's home location. To enable mean residential density to be calculated from the Population grid data 2012 (Official Statistics of Finland, 2015), the original 1 kilometer x 1 kilometer grid data were transformed to a raster with a cell size of 100 meters x 100 meters. The median value of the mean residential densities in participants' home buffer zones was applied as a cut-point to divide participants' neighborhood types into dense (> 961 persons/km2) and dispersed (≤ 961 persons/km2) areas outside centers. Thus, based on center proximity and residential density four neighborhood types were defined: city center, subcenter, dense areas outside centers, and dispersed areas outside centers.

Covariates

Neighborhood characteristics. We used residential and intersection densities (Frank et al., 2005) to approximate the amount of infrastructure supporting outdoor mobility in the neighborhood. We calculated average residential density within a 500-meter radius of each participant's home, based on Population grid data as described earlier. The Topographic Database 2013 (National Land Survey of Finland, 2013) in GIS was used to calculate intersection density for each participant. We merged intersections within a 10-meter distance of one another and, based on road data, counted the total number of crossings comprising a minimum of three roads, which were suitable for year-round walking located within 500 meters of each participant's home. Intersection density was the road intersection count divided by the home buffer zone surface area. Higher residential and intersection densities indicate reflect a higher amount of infrastructure.

As an index of overall greenness (Weier & Herring, 2000), we calculated a normalized difference vegetation index (NDVI) using Landsat 5 satellite images taken in July 2010 available from the U.S. Geological Survey (2014) and processed for surface reflectance as 30 x 30-meter raster datasets. We removed waterbodies (National Land Survey of Finland, 2013) from the raster dataset, as previously suggested (Ekkel & de Vries, 2017), and calculated the mean NDVI within a 500-meter radius of each raster cell in GIS. We assigned each participant the mean NDVI value of the raster cell in the participant's home location (range -1 and 1, with higher values indicating higher greenness).

Participant characteristics. To account for personal and socioeconomic differences, we used age, sex, difficulty in walking 500 meters, number of chronic conditions, and years of education as covariates (Barnett et al, 2017; Cerin et al., 2017; Van Cauwenberg et al., 2018) in the statistical analysis. In addition, to control for familiarity with the neighborhood environment we adjusted the models for length of time lived in the current home. Age, sex, and the latest change of address used for calculating the time lived in the current home were retrieved from national population register data. We calculated a sum of self-reported physician-diagnosed chronic conditions based on responses to a list of 22 chronic conditions (yes/no) and an additional open-ended question (Rantanen et al., 2012). Self-reported years of education was used as an indicator of socioeconomic status.

Analyses

We had few missing data. Perceiving safe crossings as a facilitator of outdoor mobility data was missing for one participant, which also resulted in one missing case in the count of infrastructure-based facilitators. For years of education, data were missing for eight participants and no imputation was conducted. The last change of address was missing for 30 participants and these values were imputed as the sample average of the time lived in the current home.

Intraclass correlation coefficient (ICC) of PA values between the four neighborhood types were computed using R 3.5.2 software (R Core Team, 2018) package lme4_1.1-19 (Bates, Maechler, Bolker, & Walker, 2015). Based on this method of calculation, the ICC was 0.017, which meant that belonging to a certain neighborhood type explained 1.7% of the PA level. As the ICC value showed that the PA data was only marginally clustered, we chose to use binary logistic regression as the analysis method in studying the associations between perceived environmental facilitators and PA.

Differences in participant and environmental characteristics between participants living in different types of neighborhoods were tested using the Kruskal-Wallis test or Pearson's Chi-Square test. Binary logistic regression analysis with PA as the outcome variable was used to capture significant PA facilitators in each neighborhood type. Analyses were conducted separately for each facilitator in each neighborhood type. In addition, we compared the odds for reporting higher PA according to tertiles of perceived nature- or infrastructure-based facilitators in each neighborhood type. All models were first adjusted for age and sex and then additionally adjusted for difficulty in walking 500 meters, number of chronic conditions, years of education, and time in current home. First, we added covariates into the models one at a time (data not shown) and then adjusted the models for all covariates simultaneously. We used IBM SPSS Statistics 24 software and considered 0.05 as the cutoff for statistical significance in all analyses.

Results

The mean age of the 848 participants was 80.6 years, 62% of the participants were women, and 64% reported at least moderate PA (Table 1). Participants were distributed by location as follows: 229 lived in the city center, 144 in subcenters, 237 in dense areas outside centers, and 238 in dispersed areas outside centers.

City center participants were on average older than participants living in the other areas (p=0.002), and, together with participants living in dense areas outside centers, had received more years of education (p=0.002; Table 1). The proportion of women was higher in the city center and subcenters than in areas outside centers (p<0.001). At least moderate PA was more commonly reported in dense areas outside centers than in the other areas (p=0.002). The city center had the highest residential and intersection densities but the lowest amount of greenness; conversely, the lowest residential and intersection densities but highest amount of greenness was observed in dispersed areas outside centers, leaving the other areas somewhere in between (each p<0.001).

Reports of Perceived Nature- And Infrastructure-Based Facilitators for Outdoor Mobility by Neighborhood Type

Nature and lakeside, walking trail and skiing track, and peaceful walkways were perceived as outdoor mobility facilitators by more than half of all the respondents, and they were among the five most reported facilitators of outdoor mobility in each neighborhood type (Figure 2). Generally, infrastructure-based facilitators were more frequently reported in areas around centers or areas with higher population density, while nature-based facilitators (except for park and other green area) were more evenly reported. Park or other green area (p<0.001) and services in close proximity (p<0.001) were reported as facilitators of outdoor mobility by approximately 60% of those living in the city center and by less than 30% of those living in dispersed areas outside centers (Figure 2). The number of nature-based destinations (p<0.001) and infrastructure-based facilitators for outdoor mobility (p<0.001) reported by participants was statistically significantly lower for participants living in dispersed areas outside centers than for the others (Table 2).

Associations of Perceived Facilitators of Outdoor Mobility with Higher PA by Neighborhood Type

The associations of outdoor mobility facilitators and physical activity differed between the neighborhood types (Table 3). Relatively similar associations were observed for participants living in city centers and dense areas outside centers. For them nature and lakeside and walking and skiing trails were associated with two- to fourfold higher odds for reporting at least moderate vs. only light PA. Moreover, two-fold odds for higher PA were found for walkways without steep hills, good lighting in city centers, and safe crossings in dense areas. Participants living in dispersed areas reported parks as outdoor mobility facilitators less often than participants living in the other neighborhood types; however, those who did so had two-fold higher odds for at least moderate PA than those who did not. In this neighborhood type, peaceful walkways, good lighting and even sidewalks, although reported as facilitators less often than in the other neighborhood types, also correlated with higher PA. However, reporting a high number of infrastructure-based facilitators correlated with higher PA only among city center residents. Excepting participants living in subcenters, for whom no associations of outdoor mobility facilitators with physical activity were found, the more nature-based facilitators participants reported, the more likely they were to report at least moderate PA.

Discussion

The main findings of the present study were that physical activity levels, perceived environmental outdoor mobility facilitators, and the associations of the outdoor mobility facilitators with PA differed between the neighborhood types. These results emphasize the importance of considering the spatial context when studying the associations of environmental features with physical activity in older people.

Our analysis showed that the presence or absence of a center within a neighborhood did not explain which types of facilitators were associated with PA. Rather, neighborhood types with the highest population density (city center and dense areas outside the centers), that is, areas with the highest amount of infrastructure with or without a center, showed similarities in that several nature-based destinations, but only few infrastructure-based facilitators, were correlates of higher PA. Conversely, in dispersed areas outside centers, that is, areas with the lowest amount of infrastructure, perceived infrastructure-based facilitators were clearly associated with higher PA. Thus, it seems that, for older adults, the objectively evaluated amount of infrastructure supporting outdoor mobility in the neighborhood is more relevant than the proximity of a center.

In our study, infrastructure-based facilitators appeared to be of especial importance for older adults' PA in dispersed areas outside centers, where perceived peaceful walkways, good lighting, and even sidewalks were associated with PA. This differs from previous studies in which no significant associations were observed between similar facilitators and PA when the study samples were stratified into urban and rural (Lee & Park, 2015) and urban, suburban, and rural (Maisel, 2016). Moreover, in our study, multiple types of infrastructure-based facilitators showed higher associations with PA in the dispersed compared to the other neighborhood types. This result supports Hanibuchi et al. (2011), who found a higher number of significant associations between objective infrastructure indicators and older adults' PA in rural than urban and suburban areas, although the associations were positive for the frequency of sports activity and negative for total walking time, which is closer to the measure used in the current study. In the city center area, however, perceiving a high number of infrastructure-based facilitators compared to perceiving only one or none of these was associated with an increased likelihood of higher PA. This result parallels that of Van Cauwenberg et al. (2013), who found higher numbers of perceived infrastructure-based facilitators to be associated with increased likelihood for daily transportation walking among older adults in neighborhoods with self-reported medium distance to service destinations but not with short or long distances.

Perceiving nature-based destinations as a facilitator for outdoor mobility was associated with higher PA, especially when participants perceived several of these. For example, walking trails and skiing tracks were especially important facilitators in densely populated areas with or without a center, while parks were associated with increased likelihood for higher PA in dispersed areas outside centers, as also found by Lee and Park (2015). Only subcenters showed no association between any of the separate perceived nature-based destinations or combinations of these with PA level.

Troped et al. (2014) found several destination-based facilitators to be associated with higher PA in older women, but only in neighborhoods with the highest population density. Bracy et al. (2014) reported that the proximity of a recreation facility increased the likelihood of walking for leisure among older people who perceived the infrastructure as supporting pedestrian safety in their neighborhood but not among those who did not. In this connection, Yen and colleagues (2014) proposed that perception of safety is the central mechanism bridging environmental factors and older adults' decisions about mobility in their environment, and that safety may be reflected in perceived features as well as in objective measures. In fact, a recent systematic review and meta-analysis conducted by Van Cauwenberg et al. (2018) concluded that favorable walking environments, e.g., a suitable pedestrian infrastructure, provided the strongest evidence for an environmental factor to act as a moderator in the association between recreational facilities and older adults' leisure-time

PA. Moran et al. (2014), in their systematic review, also suggested that the pedestrian infrastructure is a factor underlying older adults' PA.

It has previously been reported that the level of PA and mobility capability of a person affects how environmental facilitators are perceived (Merom et al., 2015; Sakari et al., 2017). Physically active older people are more likely to move through their neighborhood and thus be more aware than their less active counterparts of the features in their environment that facilitate outdoor mobility (Portegijs et al., 2013) These environmental features then appear as perceived PA facilitators in the analysis. This may partly explain why we did not detect any associations between environmental facilitators and PA for participants living in subcenters, who were less physically active than those living in the other neighborhood types. However, it is also possible that the areas included in the subcenter category differed from each other more than the pooled areas in the other neighborhood types in potential characteristics not assessed in the study.

The strengths of our study include the use of a population-based sample of community-dwelling older adults in a spatially connected area comprising various neighborhood types. With this urban structure, we were able confidently to assign each participant to an objectively defined neighborhood type, thus achieving high reliability in the objective categorization of the participants according to neighborhood types. A further strength of our approach of taking urban structure as the basis for defining neighborhood types is the high applicability of our results to urban planning. We also had versatile data on participant-perceived facilitators for outdoor mobility, health, and socioeconomic characteristics with very little missing information, enabling us to take individual factors comprehensively into account in the analysis.

The use of self-reported PA instead of an objective PA might be considered as a limitation in our study, as self-reports have been criticized for recall errors and misunderstandings of questionnaire items (Rikli, 2000). However, the use of accelerometers in assessing PA objectively is not problem-free in older populations either. Furthermore, the PA question and cut-off point used here have been previously validated against objective accelerometer data (Portegijs et al., 2017) and thus we consider the use of self-reported PA appropriate in our study. Lack of standardized definitions of neighborhood types limits direct comparisons with previous studies.

The cross-sectional setting of this study means that conclusions cannot be drawn on causality or temporal order between perceived facilitators and PA in older people or assumptions made on the persistence of the associations of different PA facilitators with PA. Further, we are aware that several other factors in the home neighborhood's natural, built, and social environment may also have impacted the associations between environmental features and older adults' PA; however, knowledge on this topic is currently limited.

Conclusions

Our study contributes to the literature on nature-based destinations and infrastructural features as facilitators of outdoor mobility and their associations with older adults' PA in different neighborhood types in an urban structure. It seems that a higher amount of infrastructure in the neighborhood, rather than proximity to a center, better enables outdoor mobility and PA in older people. When an infrastructural facilitator appears in a neighborhood with generally low amount of infrastructure, an association with PA is likely to emerge. In a neighborhood with higher amount of infrastructure, the provision of nature-based destinations might inspire older people to increase the amount of their PA. Although our results clearly indicate the high importance of infrastructure as a precondition for older adults' PA, the hierarchies and moderating effects of environmental facilitators in different neighborhood types warrant further research. Information on PA locations and perceived environmental facilitators could help to create a more comprehensive picture of person-environment interaction in the PA behavior of older people. Furthermore, the lack of associations of perceived facilitators of outdoor mobility with PA in subcenter areas requires further study. In conclusion, in order to successfully develop strategies to increase older people's PA in different types of neighborhoods, it seems important to acknowledge the varying degrees of infrastructure that exist across urban structures.

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Table 1. Participant and neighborhood characteristics (mean ± standard deviation or %) according to neighborhood type.

	All (n=848)	City center (n=229)	Subcenters (n=144)	Dense areas outside centers (n=237)	Dispersed areas outside centers (n=238)	p
Participant characteristics						
Age (yrs)	80.6±4.2	81.4±4.2	80.6±4.3	80.4±4.1	80.0±4.2	**0.002**[a]
Chronic conditions (n)	4.4±2.4	4.3±2.4	4.8±2.6	4.3±2.4	4.3±2.4	0.229[a]
Education (yrs)	9.6±4.1	10.0±4.2	9.5±3.8	10.0±4.5	8.8±3.8	**0.002**[a]
Current home (yrs)	23.0±14.6	19.4±13.7	17.7±13.8	26.1±14.0	26.4±14.9	**<0.001**[a]
Women (%)	62	70	70	59	52	**<0.001**[b]
Walking difficulties (%)	26	28	28	20	28	0.177[b]
At least moderate PA (vs. Only light, %)	64	64	58	73	58	**0.002**[b]
Neighborhood characteristics						
Residential density (persons / km2)	1958±1491	4070±717	1377±687	1747±589	488±295	**<0.001**[a]
Intersection density (n/km2)	60±24	85±16	61±15	58±15	38±20	**<0.001**[a]
Greenness, NDVI (index -1…1)	0.39±0.12	0.24±0.08	0.40±0.05	0.44±0.05	0.48±0.07	**<0.001**[a]

[a] Kruskal-Wallis test; [b] Pearson's Chi-Square test

Table 2. Proportion of participants reporting nature- and infrastructure-based facilitators in each neighborhood type (n=848).

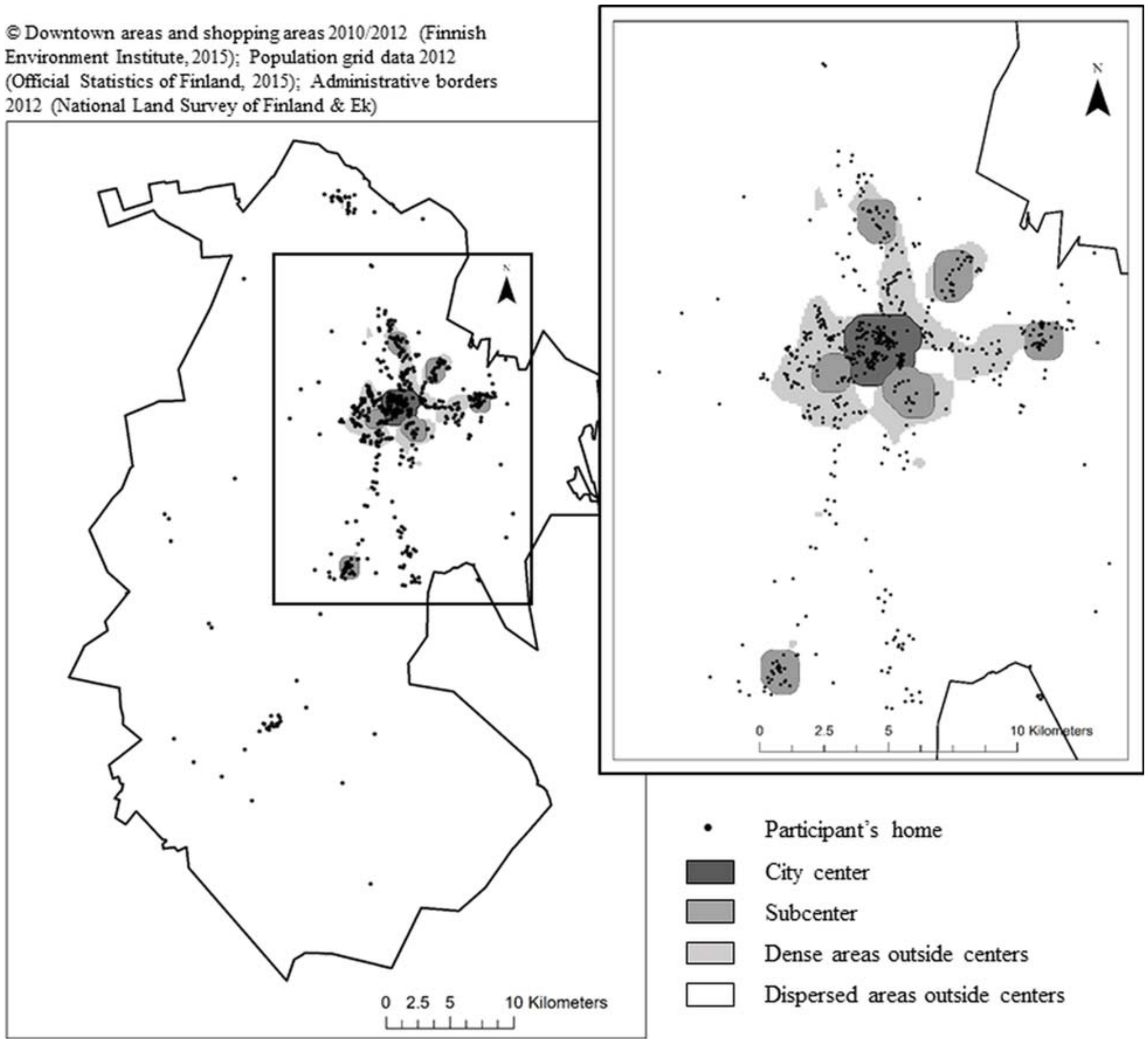
	All (n=848)	City center (n=229)	Subcenters (n=144)	Dense areas outside centers (n=237)	Dispersed areas outside centers (n=238)	p[#]
Counts of nature-based destinations as facilitators (%)						**<0.001**
≤ 1 facilitators	42	43	36	35	52	
2 facilitators	30	22	34	33	31	
3 facilitators	28	35	30	32	17	
Counts of infrastructure-based facilitators (%)						**<0.001**
≤ 1 facilitators	46	31	38	43	68	
2 or 3 facilitators	30	37	35	28	20	
≥ 4 facilitators	25	32	28	28	12	

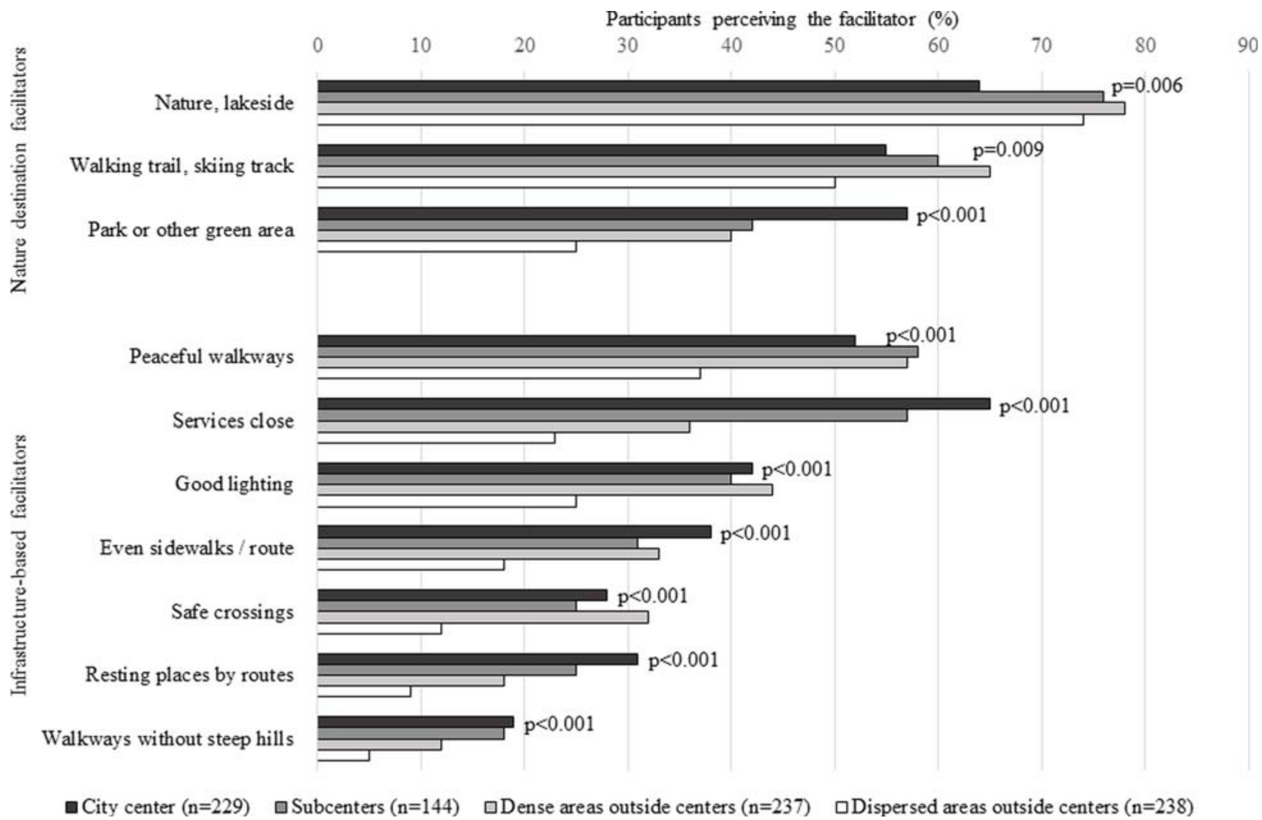
[#]Pearson's Chi-Square test

Table 3. Binary logistic regression of perceived facilitators of outdoor mobility and the odds (OR) for reporting at least moderate PA compared to only light PA. For the separate facilitators, reference group is those not perceiving the facilitator. For the sum of facilitators, reference group is those perceiving one or none of the facilitators. Analyses* were conducted separately for each neighborhood type.

	City center (n=229)		**Subcenter (n=144)**		**Dense areas outside centers (n=237)**		**Disperse areas outside centers (n=238)**	
	No OR	**Yes OR (95% CI)**	**No OR**	**Yes OR (95% CI)**	**No OR**	**Yes OR (95% CI)**	**No OR**	**Yes OR (95% CI)**
Nature-based destinations as facilitators								
Nature, lake-side	1.00	**2.58 (1.26-5.28)**	1.00	0.68 (0.22-2.06)	1.00	**2.33 (1.08-5.03)**	1.00	1.48 (0.70-3.16)
Walking trail, skiing track	1.00	**4.38 (2.15-8.93)**	1.00	1.07 (0.43-2.65)	1.00	**3.07 (1.53-6.15)**	1.00	1.65 (0.84-3.22)
Park or other green area	1.00	1.96 (0.97-3.96)	1.00	0.92 (0.38-2.21)	1.00	1.77 (0.87-3.60)	1.00	**2.41 (1.03-5.59)**
Infrastructure-based facilitators								
Peaceful walk-ways	1.00	1.35 (0.68-2.66)	1.00	1.25 (0.53-3.00)	1.00	1.06 (0.54-2.08)	1.00	**2.60 (1.26-5.33)**
Services close	1.00	1.46 (0.72-2.96)	1.00	1.73 (0.71-4.24)	1.00	0.98 (0.48-1.98)	1.00	0.52 (0.24-1.15)
Good lighting	1.00	**2.19 (1.07-4.49)**	1.00	0.70 (0.28-1.75)	1.00	0.99 (0.49-1.98)	1.00	**2.46 (1.08-5.59)**
Even sidewalks	1.00	1.98 (0.95-4.12)	1.00	0.82 (0.33-2.09)	1.00	1.10 (0.54-2.25)	1.00	**2.75 (1.08-7.01)**
Safe crossings	1.00	2.23 (0.98-5.06)	1.00	1.01 (0.38-2.70)	1.00	**2.52 (1.14-5.58)**	1.00	3.19 (0.91-11.09)
Resting places by routes	1.00	1.21 (0.59-2.50)	1.00	1.93 (0.67-5.52)	1.00	1.73 (0.70-4.30)	1.00	2.38 (0.66-8.61)
Walkways without steep hills	1.00	**2.63 (1.03-6.74)**	1.00	0.58 (0.19-1.80)	1.00	3.40 (0.96-12.09)	1.00	1.78 (0.40-7.86)
Sum of nature-based destinations as facilitators								
≤ 1 facilitators		1.00		1.00		1.00		1.00
2 facilitators		**3.56 (1.41-8.98)**		1.40 (0.48-4.06)		**2.32 (1.05-5.11)**		1.62 (0.77-3.43)
3 facilitators		**4.60 (1.94-10.94)**		0.98 (0.33-2.88)		**3.32 (1.37-8.04)**		**2.96 (1.08-8.17)**
Sum of infrastructure-based facilitators								
≤ 1 facilitators		1.00		1.00		1.00		1.00
2 or 3 facilitators		1.32 (0.59-2.97)		1.17 (0.42-3.25)		0.90 (0.41-1.97)		1.78 (0.76-4.15)
≥ 4 facilitators		**2.73 (1.12-6.65)**		1.14 (0.39-3.40)		1.99 (0.84-4.72)		2.13 (0.70-6.50)

*Univariable analyses adjusted for age, sex, difficulty in walking 500m, chronic conditions, education, and years in current home. OR= Odds Ratio. CI= Confidence Interval. Statistically significant associations are bolded.


© Downtown areas and shopping areas 2010/2012 (Finnish Environment Institute, 2015); Population grid data 2012 (Official Statistics of Finland, 2015); Administrative borders 2012 (National Land Survey of Finland & Ek)
N
0 2.5 5 10 Kilometers
Participant's home
City center
Subcenter
Dense areas outside centers
Dispersed areas outside centers


Participants perceiving the facilitator (%)
0
10
20
30
40
50
60
70
80
90
Nature destination facilitators
Infrastructure-based facilitators
Nature, lakeside
p=0.006
Walking trail, skiing track
p=0.009
Park or other green area
p<0.001
Peaceful walkways
p<0.001
Services close
p<0.001
Good lighting
p<0.001
Even sidewalks / route
p<0.001
Safe crossings
p<0.001
Resting places by routes
p<0.001
Walkways without steep hills
p<0.001
City center (n=229)
Subcenters (n=144)
Dense areas outside centers (n=237)
Dispersed areas outside centers (n=238)