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Title: Nature diversity and well-being in old age

Year: 2018

Version:

Please cite the original version:

Rantakokko, M., Keskinen, K. E., Kokko, K., & Portegijs, E. (2018). Nature diversity and well-being in old age. *Aging Clinical and Experimental Research*, 30(5), 527-532.
<https://doi.org/10.1007/s40520-017-0797-5>

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Nature diversity and well-being in old age

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ABSTRACT

Background: The research aim was to study the associations of nature diversity with quality of life (QoL) and depressive symptoms among older people, and whether physical activity explains the associations.

Methods: Community-dwelling people aged 75-90-years (n=848) living in Central Finland were interviewed in their homes. QoL was assessed with a short version of the World Health Organization Quality of Life Assessment (range 0-130, higher score indicates better QoL) and depressive symptoms with the Centre for Epidemiologic Studies Depression Scale (range 0-30, higher scores indicate more depressive symptoms). Self-reported physical activity was assessed by intensity and duration using a single question with seven response options ranging from mostly resting to competitive sports. Nature diversity (Shannon Diversity Index) was assessed objectively within a 500-m buffer around participants' homes using a geographic information system (GIS).

Results: Mean QoL was 100.3 (SD 11.8) and mean CES-D 9.6 (SD 6.8). Those in the highest nature diversity tertile had better QoL than those in the lowest tertile ($p=.022$). Physical activity did not explain the association between nature diversity and QoL. Adjustment for health indicators did not change the results. Nature diversity was not associated with depressive symptoms.

Conclusion: A diverse environment, especially when this includes elements of nature, is associated with better QoL. Good quality of the green infrastructure and adding natural elements to residential areas may enhance well-being among community-dwelling older people.

Keywords: Nature, diversity, environment, depression, quality of life, aging

INTRODUCTION

Improving and maintaining well-being in old age is an important public health goal. Some studies have shown that spending time in natural environments has beneficial effects on well-being [1], such as reducing depressive symptoms. Natural environments have good aesthetic qualities, and offer peacefulness and quietness [2]. Spending time in natural environments has been shown to lower blood pressure, lessen feelings of anxiety and promote restorative experiences, thereby improving well-being [3].

Physical activity is often seen as an important factor explaining the association between natural environments and well-being [4]. Positive features of the environment, such as the presence of parks and green areas, sidewalks, and appealing scenery may motivate people to move outdoors [5, 6]. Physical activity in natural environments has been found to have a stronger positive effect on well-being than physical activity indoors or in the built environment [3, 7]. However, even a visual contact with nature may enhance well-being (for review, see [8]), but most of the research on the topic has focused on middle-aged or younger people. Visual contact with the environment may become increasingly important for older people, as with increasing age people tend to spend most of the time in the close vicinity of the home, some without the possibility to move outdoors [9]. Thus, the opportunity to enjoy nature diversity and passively follow nature may have a positive impact on well-being in old age. However, whether diversity in nature is associated with quality of life and depressive symptoms among people over age 75 has not been studied. These two outcomes are of interest, as both are indicators of wellbeing, but from different perspectives: quality of life is a multidimensional concept capturing a wide range of life areas, while depressive symptoms reflect an individual's mood and emotions.

The purpose of this study was to examine the associations between the diversity of nature in the neighbourhood and well-being, specifically quality of life and depressive symptoms, among community-dwelling older people, and to find out whether physical activity mediates this association.

METHODS

Study design and participants

This study forms part of the ‘Geographic characteristics, outdoor mobility and physical activity of older people’ (GEOage) project [10]. In this project, freely available geographic information system (GIS) resources characterizing environmental features are linked to baseline participant data drawn from the “Life-space mobility in old age” (LISPE) project [11]. LISPE targets the individual and environmental determinants of life-space mobility and quality of life among community-dwelling older people in central Finland. The study protocol, methods and non-response analyses have been reported in detail previously [11]. Briefly, 848 75- to 90-year-old people were interviewed in their homes during spring 2012. Inclusion criteria were community-dwelling in the study area and ability to communicate.

The GEOage and LISPE projects were approved by the Ethical Committee of the University of Jyväskylä, Finland. Participants were informed about the project and they signed a written informed consent prior to the baseline interviews.

Measurements

Objective environmental assessment

Nature diversity was compiled using the Shannon Diversity Index (SHDI) [12] together with geospatial environmental data supplied by geographic information system (GIS). The locations of the participants' residences were geocoded [13] using Arcmap 10.3 software. The SHDI, describing heterogeneity in land use was calculated within a 500-meter circular buffer around participants' homes. The land use classification was based on Corine Land Cover (CLC) data supplied by the Finnish Environment Institute (SYKE) at a resolution of 20m*20m [14]. The level 3 CLC data were reclassified into 13 land use classes. Three of these applied to the built environment (Residential and service; Industry, transport and construction; Sport and leisure facilities) and ten to the natural environments (Cultivated fields; Fruit trees and berry plantations; Pastures; Uncultivated agricultural areas; Forests; Shrub and/or herbaceous vegetation; Open spaces with little/no vegetation; Wetlands; Swamps; and Water bodies). Since the selected classification produces high SHDI values in areas with several different types of natural land use classes, the SHDI may be used to reflect the diversity of the natural environments in a neighborhood. The SHDI has also shown to be correlated with visual landscape preferences [15, 16].

The SHDI value ranged from 0.40 to 1.98. The minimum SHDI value of 0 indicates the presence of only one land use class, and hence no diversity. The SHDI value increases along with the number of different land use classes and the evenness in the relative proportion of their areas within the study area. For the analyses, the SHDI values were divided into tertiles, with the lowest tertile (low diversity) as the reference group.

Well-being

Quality of life

Quality of life was assessed with the World Health Organization Quality of Life Assessment short version, WHOQOL-BREF [17]. This instrument measures individuals' perceptions in the context of their culture and value systems, and their personal goals, standards and concerns. The 26-item scale comprises four domains; physical health (7 items), psychological health (6 items), social relationships (3 items), and environment (8 items), and also includes one item on general health and one on overall QoL. A total QoL score (index) for all the domains combined was calculated. The index ranges from 0 to 130, higher scores indicating better quality of life [17].

Depressive symptoms

Depressive symptoms were assessed with the Centre for Epidemiologic Studies Depression Scale (CES-D) [18]. The CES-D scale is a widely used self-report measure in community samples. Its reliability and validity have been demonstrated in heterogeneous samples [19]. The CES-D assessment comprises 20 items for each of which the respondent rates the frequency of the listed symptoms experienced during the previous week. Scoring ranges from 0 to 60 with higher scores indicating more depressive symptoms [20].

Covariates

Age and gender were derived from national registers. Other information was obtained in face-to-face interviews. Cognitive functioning was assessed with the Mini-Mental State Examination (MMSE) [21]. The self-reported number of chronic conditions was calculated from a 22-item list plus an additional open-ended question about any other physician-diagnosed chronic conditions [11].

Physical activity was assessed on a seven-point scale combining frequency and intensity of common physical activities. Participants were categorized into “light PA” (at most light housework or gardening and short walks once or twice a week), “moderate PA” (at least moderate physical activity <3h/week), and “high PA” (moderate physical activity \geq 4h/week or strenuous physical activity). Self-reported PA has been shown to be valid in assessing the PA level of older people [22].

Statistical analyses

Characteristics of the participants are shown as means and standard deviation or percentages. Information on QoL was missing for three participants and on CES-D for five participants. These individuals were excluded from the corresponding analyses.

Linear regression analyses were used to study the associations of nature diversity with QoL and depressive symptoms. First, unadjusted analyses were conducted. Second, the models were first adjusted for age and gender (model 1). Third, physical activity was added (model 2). Finally, health indicators (MMSE score, number of chronic conditions) were added (model 3). The lowest tertiles of nature diversity was used as the reference group. Analyses were performed using IBM SPSS version 22.0 (SPSS Inc., Chicago, IL). A P value of <.05 was considered as statistically significant.

RESULTS

The mean age of the participants was 80.6 years, and 62% of them were women. On average, participants had 4.4 chronic conditions and good cognitive functioning (score of 26.2 points in the MMSE). There were no differences in participant characteristics between the nature diversity tertiles. (Table 1.)

The mean QoL score was 100.3 (SD 11.8) and the mean CES-D score was 9.6 (SD 6.8). When adjusted for age and gender, the linear regression analyses revealed an association between high nature diversity and better quality of life. Adding physical activity to the model did not change the association, but the model fit (R^2) improved. The association remained statistically significant even after additional adjustment for health indicators (Table 2). Nature diversity was not associated with depressive symptoms (Table 3).

DISCUSSION

This study showed that nature diversity is associated with better QoL, but not with depressive symptoms, among community-dwelling older people, even when controlled for level of physical activity, chronic conditions, and cognitive functioning.

Nature diversity provides information on variation in the landscape, a feature that people often rate as beautiful [15]. Areas with low diversity indicate a homogenous environment with only few types of land cover, and thus few possibilities to enjoy a varied landscape. Beautiful scenery within short distance from home may motivate people to move outdoors [23]. While physical activity in natural environments increases well-being [3, 7], it seems that to gain well-being benefits does not require people to be physically very active. A recent study reported that physical activity did not explain the association between green spaces and mental health [24], while in our study physical activity did not explain the association between nature diversity and quality of life. It is possible that the association found in our study may be due to the physiological response to spending time in a natural environment, as posited by the restoration theory [25]. Exposure to different types of natural environment is associated with, for example, enhanced immune functioning [26] and lower cortisol levels [4], and thus indirectly improve well-being. However, the amount of time spent in natural environments and its influence on well-being in old age warrant further study.

While it has been reported that having green areas in the neighbourhood is associated with fewer mental disorders, especially depression and anxiety [27], we found no association between nature diversity and depressive symptoms. A possible explanation is that people

with severe depressive symptoms may not go outdoors, and thus are not exposed to the natural environment. It is also likely that, to be able to ameliorate depressive symptoms, the presence of natural environment is not enough and a more dedicated approach is needed.

With aging, older people's life-space often becomes increasingly restricted, with people spending more time close to their home, potentially impacting negatively on their quality of life [28]. Remaining constantly in the home neighbourhood renders the availability of natural areas and environmental aesthetics close to home even more important. In our study, nature diversity was assessed within 500 m from home, targeting areas where most people are able to enjoy the diversity of nature at least visually if not actively moving around in it. Within such a small area, some of the natural or green areas may be too small for recreation, but nonetheless have aesthetic value by creating a pleasant visual and acoustic environment, which enhances restorative processes and thus well-being [29, 30]. Quiet areas promote good quality of life [31], and natural sounds may help recovery from stress [32], factors which may partly explain our present findings.

It should be noted that only minor differences in the QoL and CES-D scores were observed between the nature diversity tertiles, although for the QoL these were statistically significant. While the minimal clinically important difference in WHOQOL-BREF has not been established among older people, it may be argued that any difference in QoL has face value as it reports "individuals' perceptions in the context of their culture and value systems, and their personal goals, standards and concerns"[17]. Among women with early-stage breast cancer, a change of 1 point in the QoL score (WHOQOL-100 instrument; long version of the WHOQOL-Bref) was found to be clinically significant [33], supporting our assumption of the clinical relevance of even small differences.

The strengths of this study include large population-based sample of people over 75 years of age with very little missing information. Generally, missing information is a problem in ageing studies, and thus almost complete data with over 840 people is unique. We used an objective assessment of the environment, similar to those used in infrastructural planning and a measure that is easy to derive from open data sources. Another strength is the inclusion two different aspects of well-being, measured with validated tools. Well-being is a complex concept and it has been suggested that several dimensions, tapping both positive and negative aspects of well-being should be taken into account [34], as different dimensions of well-being have different correlates [35]. We were able to study both, positive (QoL) and negative (depressive symptoms) aspects in our study, and, indeed, found that the correlates differed. Thus focus only on, i.e. depressive symptoms would have underestimated the influence of nature diversity on well-being. On the other hand, focus only on QoL would have led to overestimation on the influence of nature diversity and well-being.

The study also has its limitations. The majority of the participants were rather well-functioning and all were living independently in their homes. This may influence the generalizability of the findings, as the most vulnerable individuals did not participate in the study. We also assume that depression may be more common among those not participating in the study, which may induce underestimation of the positive influence of the environment on well-being. It should also be noted that the influence of nature diversity may be dependent on the amount of time a person spends outdoors, a factor not accounted for in the analyses. Moreover, for those not moving outdoors, the association between the environment and well-being may also be underestimated.

To conclude, this study shows that nature diversity is associated with better quality of life in old age. The level of physical activity did not attenuate the association, suggesting that other aspects, such as visual or auditory enjoyment may be important factors. The quality of the green infrastructure and adding natural elements to residential areas would appear to be beneficial for well-being among older people.

Acknowledgements

Funding: This work was supported by the Finnish Ministry of Education and Culture (to MR and EP); and Academy of Finland [grant no 285747 (to MR)]. The study sponsors had no role in the study design; in the collection, analysis and interpretation of the data; in the writing of the report; or in the decision to submit the paper for publication.

Competing Interests: None declared.

References

- 1 Bowler DE, Buyung-Ali LM, Knight TM, Pullin AS (2010) A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health* 10:456. doi:2458-10-456.
- 2 Bond L, Kearns A, Mason P, Tannahill C, Egan M, Whitely E (2012) Exploring the relationships between housing, neighbourhoods and mental wellbeing for residents of deprived areas. *BMC Public Health* 12:48. doi:2458-12-48.
- 3 Pasanen TP, Tyrvaainen L, Korpela KM (2014) The Relationship between Perceived Health and Physical Activity Indoors, Outdoors in Built Environments, and Outdoors in Nature. *Appl Psychol Health Well Being* 6(3):324-46. doi:10.1111/aphw.12031.
- 4 Triguero-Mas M, Gidlow CJ, Martinez D, et al (2017) The effect of randomised exposure to different types of natural outdoor environments compared to exposure to an urban environment on people with indications of psychological distress in Catalonia. *PLoS One* 2017;12. doi:e0172200.
- 5 Gong Y, Gallacher J, Palmer S, Fone D (2014) Neighbourhood green space, physical function and participation in physical activities among elderly men: the Caerphilly Prospective study. *Int J Behav Nutr Phys Act* 11:40. doi:10.1186/1479-5868-11-40.
- 6 Hovbrandt P, Fridlund B, Carlsson G (2007) Very old people's experience of occupational performance outside the home: possibilities and limitations. *Scand J Occup Ther* 14:77-85. doi:10.1080/11038120600773013.
- 7 Mitchell R (2013) Is physical activity in natural environments better for mental health than physical activity in other environments? *Soc Sci Med* 91:130-4. doi:10.1016/j.socscimed.2012.04.012
- 8 Grinde B, Patil GG (2009) Biophilia: does visual contact with nature impact on health and well-being? *Int J Environ Res Public Health* 6:2332-43. doi:10.3390/ijerph6092332.
- 9 Cohen-Mansfield J, Shmotkin D, Hazan H (2012) Homebound older persons: prevalence, characteristics, and longitudinal predictors. *Arch Gerontol Geriatr* 2012;54:55-60. doi:10.1016/j.archger.2011.02.016
- 10 Portegijs E, Keskinen KE, Tsai LT, Rantanen T, Rantakokko M (2017) Physical Limitations, Walkability, Perceived Environmental Facilitators and Physical Activity of Older Adults in Finland. *Int J Environ Res Public Health* 14:10.3390/ijerph14030333.
- 11 Rantanen T, Portegijs E, Viljanen A, et al (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:2458-12-1018.
- 12 Magurran AE. *Ecological diversity and its measurement*. London: Croom Helm 1988.
- 13 Digiroad 2013. Finnish Transport Agency, [accessed 16 12 2014].

- 14 Finnish Environment Institute (SYKE)(partly Metla, Mavi, LIVI, VRK, MML Topographic Database 05/2012). Corine land cover 2012 national datasets (20m), 2012.
- 15 Frank S, Fürst C, Koschke L, Witt A, Makeschin F (2013). Assessment of landscape aesthetics—Validation of a landscape metrics-based assessment by visual estimation of the scenic beauty. *Ecol Ind* 23:222-31.
- 16 Dramstad WE, Tveit MS, Fjellstad WJ, Fry GLA (2006) Relationships between visual landscape preferences and map-based indicators of landscape structure, *Landscape Urban Plann* 78:465-74.
- 17 The WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment, *Psychol Med* 1998;28:551-8.
- 18 Radloff LS. The CES-D scale: A self-reported scale for research in the general population. *Applied Psychol Measurement* 1977;1:385-401.
- 19 Beekman ATF, Deeg DJ, van Limbeek J, Braam AW, de Vries MZ, van Tilburg W (1997). Criterion validity of the Center for Epidemiologic Studies Depression Scale (CES-D): results from a community-based sample of older subjects in the Netherlands. *Psychological Medicine* 27:231-5.
- 20 Radloff LS, Teri L (1986) Use of the Center for Epidemiologic Studies Depression Scale with older adults. *Clinical Gerontologist: The Journal of Aging and Mental Health* 5:119-36.
- 21 Folstein MF, Folstein SE, McHugh PR (1975) "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 12:189-98.
- 22 Portegijs E, Sipila S, Viljanen A, Rantakokko M, Rantanen, T (2016) Validity of a single question to assess habitual physical activity of community-dwelling older people. *Scand J Med Sci Sports* (e-pub ahead of print). doi:10.1111/sms.12782.
- 23 Rosenberg DE, Huang DL, Simonovich SD, Belza B (2013) Outdoor built environment barriers and facilitators to activity among midlife and older adults with mobility disabilities. *Gerontologist* 53:268-79. doi:10.1093/geront/gns119.
- 24 Triguero-Mas M, Dadvand P, Cirach M, et al (2015) Natural outdoor environments and mental and physical health: relationships and mechanisms. *Environ Int* 77:35-41. doi:10.1016/j.envint.2015.01.012.
- 25 Kaplan S (1995) The restorative benefits of nature: Toward an integrative framework. *J Environ Psychol* 15:169-82.
- 26 Kuo M (2015) How might contact with nature promote human health? Promising mechanisms and a possible central pathway. *Front Psychol* 6:1093. doi:10.3389/fpsyg.2015.01093.

- 27 Wu YT, Prina AM, Jones A, Matthews FE, Brayne C, MRC CFAS (2015) Older people, the natural environment and common mental disorders: cross-sectional results from the Cognitive Function and Ageing Study. *BMJ Open* 5:9. doi:e007936,2015-007936.
- 28 Rantakokko M, Portegijs E, Viljanen A, Iwarsson S, Kauppinen M, Rantanen T (2016) Changes in life-space mobility and quality of life among community-dwelling older people: a 2-year follow-up study. *Qual Life Res* 25:1189-97. doi:10.1007/s11136-015-1137-x.
- 29 Hartig T, Mang M, Evans GW (1991) Restorative effect of natural environmental experiences. *Environ Behav* 23:3-26.
- 30 Gidlöf-Gunnarsson A, Öhrström E (2010) Attractive “Quiet” Courtyards: A Potential Modifier of Urban Residents’ Responses to Road Traffic Noise? *Int J Environ Res Public Health* 7:3359-75.
- 31 Shepherd D, Welch D, Dirks KN, McBride D (2013) Do Quiet Areas Afford Greater Health-Related Quality of Life than Noisy Areas? *Int J Environ Res Public Health* 10:1284-303.
- 32 Alvarsson JJ, Wiens S, Nilsson ME (2010) Stress recovery during exposure to nature sound and environmental noise. *Int J Environ Res Public Health* 7:1036-46.
- 33 Den Ouden BL, Zijlstra WP, De Vries J (2013) The minimal clinically important difference in the World Health Organization Quality of Life instrument--100. *Support Care Cancer* 21:1295-301.
- 34 Kokko K, Korkalainen A, Lyyra A-L, Feldt T (2013) Structure and continuity of well-being in mid-adulthood: A longitudinal study. *Journal of Happiness Studies*, 14, 99–114.
- 35 Steptoe A, Deaton A, Stone AA (2015) Psychological wellbeing, health and ageing. *Lancet* 385: 640–648.

Table 1. Characteristics of the participants (n=848) by nature diversity tertiles

	Nature diversity				P-value
	Total	Low	Medium	High	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Age	80.6 (4.2)	80.6 (4.3)	80.8 (4.2)	80.4 (4.3)	.482
Quality of life	100.3 (11.8)	99.2 (12.2)	100.3 (11.5)	101.3 (11.5)	.113
Depressive symptoms, CES-D	9.6 (6.8)	9.7 (6.5)	9.8 (6.8)	9.5 (7.0)	.861
Number of chronic conditions	4.4 (2.4)	4.5 (2.5)	4.2 (2.3)	4.4 (2.5)	.209
Cognitive functioning, MMSE score	26.2 (2.8)	26.1 (2.9)	26.2 (2.7)	26.2 (2.8)	.888
	n (%)	n (%)	n (%)	n (%)	
Women	62 (526)	64 (182)	57 (162)	65 (182)	.104
Physical activity (PA)					.548
Light PA	36 (306)	35 (100)	36 (102)	37 (104)	
Moderate PA	30 (253)	28 (79)	33 (94)	29 (80)	
High PA	34 (289)	37 (104)	31 (88)	35 (97)	

SD, Standard Deviation

MMSE, Mini-Mental State Examination

CES-D, Center for Epidemiologic Studies Depression Scale

Table 2. Associations between nature diversity with quality of life among community-dwelling people aged 75- 90 years.

QUALITY OF LIFE													
		Unadjusted			Model 1			Model 2			Model 3		
		Unstand.			Unstand.			Unstand.			Unstand.		
		β	s.e.	P	β	s.e.	P	β	s.e.	P	β	s.e.	P
Nature diversity													
	Low	ref			ref.			ref.			ref.		
	Medium	1.03	.99	.298	1.05	.97	.278	1.25	0.89	.162	.59	.83	.477
	High	2.07	.99	.037	1.97	.97	.041	2.10	0.89	.018	1.91	.83	.022
		$R^2=.005$			$R^2=.061$			$R^2=.202$			$R^2=.307$		
Model 1 adjusted for age and sex													
Model 2 adjusted for age, sex, and physical activity													
Model 3 adjusted for age, sex, physical activity, number of chronic conditions and cognitive functioning													
se, standard error													

Table 3. Associations between nature diversity with depressive symptoms among community-dwelling people aged 75- 90 years.

		DEPRESSIVE SYMPTOMS											
		Unadjusted			Model 1			Model 2			Model 3		
		Unstand.		P	Unstand.		P	Unstand.		P	Unstand		
		β	s.e.		β	s.e.		β	s.e.		β	s.e.	P
Nature diversity													
Low		ref.			ref.			ref.			ref.		
Medium		.05	.57	.930	.14	.56	.807	.09	.56	.874	.29	.55	.595
High		-.24	.58	.672	-.22	.56	.701	-.25	.56	.656	-.18	.55	.746
		$R^2=.00$			$R^2=.044$						$R^2=.111$		
Model 1 adjusted for age and sex													
Model 2 adjusted for age, sex, and physical activity													
Model 3 adjusted for age, sex, physical activity, number of chronic conditions and cognitive functioning													
se, standard error													