

Special Issue: Aging in Context: Research Article

Associations of Environmental Factors With Quality of Life in Older Adults

Robbert J. J. Gobbens, RN, MScN, PhD^{1,2,*} and Marcel A. L. M. van Assen, PhD^{3,4}

¹Faculty of Health, Sports and Social Work, Inholland University of Applied Sciences, Amsterdam, the Netherlands. ²Zonnehuisgroep Amstelland, Amstelveen, the Netherlands. ³Department of Methodology and Statistics, Tilburg School of Social and Behavioral Sciences, Tilburg University, the Netherlands. ⁴Department of Sociology, Utrecht University, the Netherlands.

*Address correspondence to Robbert J. J. Gobbens, RN, MScN, PhD, Faculty of Health, Sports and Social Work, Inholland University of Applied Sciences, De Boelelaan 1109, 1081 HV Amsterdam, the Netherlands. E-mail: robbert.gobbens@inholland.nl

Received: September 9, 2016; Editorial Decision Date: April 6, 2017

Decision Editor: Nicholas G. Castle, PhD

Abstract

Purpose of the Study: Environmental factors play an important role in the quality of life of older people who often have difficulty maintaining physical, psychological, and social functioning. In this study, we aimed at (a) developing a measurement instrument assessing the factors of older adults' perceptions of their environment, (b) examining the associations of these environmental factors with quality of life domains physical health, psychological, social relations, and environmental, controlling for background characteristics.

Design and Methods: Associations between environmental factors and quality of life domains were examined in a cross-sectional study using a sample of 1,031 Dutch people aged 65 years and older. Participants completed a Web-based questionnaire, the "Senioren Barometer." Forty-two questions on environmental factors were asked, and quality of life domains were assessed by the WHOQOL-BREF.

Results: Seven scales (comprising 3–9 items) of environment were constructed—housing, facilities, nuisance, residents, neighborhood, stench/noise, and traffic. All quality of life domains (physical, psychological, social, environmental) were associated with at least one environmental scale. Housing, residents, and nuisance were associated with 4, 3, and 2 domains, respectively. Facilities, neighborhood, stench/noise, and traffic were associated only with quality of life environmental.

Implications: This study showed that multiple environmental factors are associated with quality of life in older people. To support independent living in older people health and social care professionals and policymakers may need to carry out interventions, in particular focusing on housing, residents, and nuisance.

Keywords: Environmental factors, Quality of life, Older people, Cross-sectional study, Factor analysis

It is projected that by 2050 33.2% and by 2100 36.6% of the population of the Netherlands will be 60 and over (United Nations, 2015). To cope with the challenges of this rapidly aging population, the Dutch government has changed their policy on the care for older people; older people are motivated to "aging in place," defined as remaining living in their own home and environment as long as possible, even if they are frail. This is favored by many older

people themselves (De Witte et al., 2012) and avoids the costly option of institutionalization, which is now restricted to severely dependent older people. To support independent living in older people, health and social care professionals may need to carry out interventions delaying hospitalization or institutionalization, or focusing on aspects of quality of life aiming to enhance well-being. Because people are supposed to live at home longer, it has been becoming

increasingly important to obtain insight into the effects of environmental factors on quality of life.

Quality of life has been defined by the World Health Organization Quality of Life Group as “an individual’s perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns” (WHOQOL Group, 1995, p. 1405). Several concepts are related to quality of life, including life satisfaction and well-being. It is suggested that well-being should include individuals’ moods, emotions, and cognitive evaluations of life satisfaction (Diener, Suh, Lucas, & Smith, 1999); life satisfaction has been equated with happiness (Fugl-Meyer, Bränholm, & Fugl-Meyer, 1991) and can be considered as a sub-theme of well-being and quality of life (Berglund, Hasson, Wilhelmson, Dunér, & Dahlin-Ivanoff, 2016).

Environmental factors play an important role in the quality of life of older people (Yabuwaki, Yamada, & Shigeta, 2008), who often have difficulty maintaining physical, psychological, and social functioning. According to the general ecological model of aging (Lawton & Nahemow, 1973), a person’s functioning is the result of their physical, psychological and social resources, environmental factors and the fit between ever-changing individuals and their ever-changing environments; both the individuals’ competencies and the demands of environmental factors change as part of the process of aging. One of these environmental factors is the built environment, defined as is the objective and perceived characteristics of the physical context in which people spend their time (e.g., home, neighborhood), including aspects of detailed design (e.g., sidewalks and seating), traffic density and speed, locations for physical activity (e.g., streets and parks), crime and safety (Van Cauwenberg et al., 2011). As people age, multimorbidity, disability, and frailty create special needs, but a responsive built environment can possibly reduce the impact of these conditions. The built environment may affect aging actively and remaining independent (Beard et al., 2009); for example, changes at home such as introducing mobility aids can enhance independence. The effect of the built environment on quality of life in older adults is particularly relevant since this age group spends more time at home in comparison to younger adults (Garin et al., 2014).

An essential environmental factor belonging to the built environment and strongly influencing the quality of life older people is the neighborhood (Buffel et al., 2012). Among perceived neighborhood characteristics, safety from traffic was positively associated with physical and mental dimensions of quality of life. Having positive perceptions of characteristics of neighborhood safety has also been related to a lower prevalence of mental health in older adults (Friedman, Parikh, Giunta, Fahs, & Gallo, 2012). Other studies demonstrated an association between neighborhood walkability and depressive symptoms in older men (Berke, Gottlieb, Moudon, & Larson, 2007) and an association between neighborhood context and late-life

cognitive function (Sheffield & Peek, 2009). The Alabama Country Study found that functionally healthy people aged 55 years and older who reported problematic neighborhood environments (e.g., heavy traffic, excessive noise, inadequate lighting) had a higher risk of functional deterioration over 1 year compared with those in better neighborhoods (Balfour & Kaplan, 2002).

Neighborhood characteristics requiring specific attention are social participation and engagement in the neighborhood, the key components of social capital, defined as social networks and norms of reciprocity and trustworthiness (Putman, 2000). Higher social capital is positively associated with the mental as well as the physical dimensions of quality of life (Lucumí, Gomez, Brownson, & Parra, 2015); in addition, higher social capital is shown to be important for health (Andrew & Keefe, 2014) and wellbeing (Cramm, van Dijk, & Nieboer, 2013) and has been associated with reduced mortality for persons 45–64 years (Lochner, Kawachi, Brennan, & Buka, 2003) and with a lower prevalence of mental health in older adults (Friedman et al., 2012).

In conclusion, previous research has shown the importance of environmental factors for quality of life in older adults (e.g., characteristics of the built environment, housing, neighborhood, indicators of social capital). The aim of the present study is twofold. First, we assess the dimensional structure of older adults’ perceptions of their environment, and construct scales for these environmental factors. Garin and colleagues (2014) concluded that among 19 articles using a subjective measure of environment, only one standardized scale was used: the Neighborhood Environment Walking Scale (NEWS). The NEWS is validated and involves nine environmental factors at the neighborhood level (e.g., neighborhood satisfaction, crime, and safety); however, elderly based validation is needed (Saelens, Sallis, Black, & Chen, 2003). Therefore, we decided to construct another instrument of environmental factors based on responses of adults of 50 years and older to 42 items concerning their living environment. Second, using the environmental factors derived from this newly developed instrument, we examine the associations of these environmental factors with quality of life domains physical health, psychological, social relations, and environmental, controlling for background characteristics. Our study is motivated by the realization that it is important for health and well-being promotion policies to take into account the complexity of the environmental context in which older people’s everyday lives are spent.

Methods

Study Population and Data Collection

The “Senioren Barometer,” initiated by the Academic Collaborative Center Policy for the Elderly and Informal Care (Tranzo, Tilburg University), is a web-based questionnaire to assess the opinion of a panel of Dutch older people (aged 50 years and older) about different aspects of

life. Older people can volunteer and participation is always without obligation. For more information concerning the “Senioren Barometer” we refer the reader to previous studies that have used this questionnaire (Gobbens, Luijckx, & van Assen, 2013; Gobbens, van Assen, & Schalk, 2014).

In the period December 2009 and January 2010, 1,942 people aged 50 years and older completed this questionnaire containing questions about environmental factors, frailty, disability, and quality of life. We excluded 450 cases from further analyses because of one or more missing values for environmental factors and quality of life, yielding a sample size of 1,492. Whereas all data were used in the factor analysis, only the data of individuals aged 65 years and older (1,031 cases) (Gobbens et al., 2013) were used for all other analyses.

The study was conducted according to the ethical guidelines laid down in the Declaration of Helsinki. Medical ethics approval was not necessary as particular treatments or interventions were not offered or withheld from respondents. The integrity of respondents was not encroached upon as a consequence of participating in the study, which is the main criterion in medical ethical procedures in the Netherlands (Central Committee on Research inv. Human Subjects, 2010). Informed consent, in terms of information-giving and maintaining confidentiality, was respected.

Measures

Quality of Life

Quality of life was assessed by the World Health Organization’s Quality of Life Instrument–Short Version (WHOQOL-BREF), a 26-item self-administered scale, covering four domains—physical health (seven items), psychological (six items), social relations (three items), environmental (eight items), and includes one overall QOL item and one general health item (WHOQOL Group, 1998). Since we were primarily interested in effects of environmental factors on quality of life domains, we used only the 24 domain items. All items were rated on a 5-point scale with a higher score indicating a higher quality of life. The scores ranged from 4 to 20 for each quality of life domain (WHOQOL Group, 1998). Studies in various countries have shown that the WHOQOL-BREF has suitable psychometric performance for measuring health-related quality of life in older people (Kalfoss, Low, & Molzahn, 2008; Skevington, Lotfy, & O’Connell, 2004).

Environmental Factors

The questionnaire contained 42 questions on participants’ perceptions of their environment. Because the Senioren Barometer was already in existence before we conducted our study, we had no influence on the questionnaire’s content. With the exception of two questions, these items and their response categories are summarized in the first column of the table in the Supplementary Appendix. The two items not included in the table of the Supplementary

Table 1. Participant Characteristics ($N = 1,031$)

Characteristic	n (%)
Age, mean \pm SD, range	73.4 \pm 5.8, 65–95
Sex, % of men	689 (66.8)
Marital status	
Married or cohabiting	733 (71.1)
Single	91 (8.8)
Divorced	51 (4.9)
Widowed	143 (13.9)
Living apart together	13 (1.3)
Ethnicity	
Dutch	991 (96.1)
Other	40 (3.9)
Education	
None	67 (6.5)
Primary	101 (9.8)
Secondary	443 (43.0)
Polytechnics and higher vocational training	329 (31.9)
University	91 (8.8)
Income ^a	
€999 or less	13 (1.4)
€1000–€1499	122 (13.4)
€1500–€1999	167 (18.3)
€2000–€2499	241 (26.4)
€2500–€2999	115 (12.6)
€3000–€3499	113 (12.4)
€3500–€3999	63 (6.9)
€4000–€4499	41 (4.5)
€4500 or more	37 (4.1)
Environmental factors, mean \pm SD, range	
Nuisance	16.2 \pm 4.8, 9–37
Housing	21.4 \pm 3.2, 5–25
Facilities	23.7 \pm 4.1, 7–35
Residents	29.9 \pm 4.8, 10–39
Neighborhood	15.0 \pm 2.7, 4–20
Stench/noise	3.8 \pm 1.3, 3–9
Traffic	7.3 \pm 2.7, 4–17
Quality of life domains, mean \pm SD, range	
Physical health	15.6 \pm 2.5, 6.9–20
Psychological	15.1 \pm 2.0, 8.7–19.3
Social relations	14.2 \pm 2.4, 5.3–20
Environmental	16.0 \pm 2.1, 8–20

^a119 missing values.

Appendix are “living in a house for sale or a rental property” and “satisfaction about neighborhood, expressed in a report rating.” These items were excluded because they could not be incorporated in the scales we created for the environmental factors (see below in the Results section).

Background Characteristics

The sociodemographic background characteristics considered were age (in years), sex, marital status (five categories), highest education attained (five categories) and net

income (with nine categories) (see Table 1 for the answering categories).

Analysis Strategies

First, descriptive statistics were provided for background characteristics and quality of life domains. Second, we used principal component analysis (PCA) to construct environmental factors based on responses to the 42 environment items. PCA is a technique to construct one or more relatively independent measurements based on commonalities of items, resulting in measurements that are more reliable than individual items. We used the responses of all 1,492 individuals of 50 years and older in the PCA. We used all data because the environmental factors should hold for older as well as middle-aged adults, and factor analysis and scale construction benefit from using as much relevant information as possible. However, because environmental factors may differ between relatively younger (age 50–65 years) and older (≥ 65 years) persons, we also briefly present the PCA and scaling results based on only the older persons.

Arguably the most important phase of PCA is factor retention. We applied three factor retention methods; the scree plot, parallel analysis (Horn, 1965), and the empirical Kaiser criterion (Braeken & van Assen, 2016). Parallel analysis has generally shown the best performance in simulation studies and is often recommended (Garrido, Abad, & Ponsoda, 2013). The empirical Kaiser criterion, however, outperforms parallel analysis when subscales are correlated and contain few items. For factor retention, we also applied a second recommended strategy, which is to only retain a factor having at least three items (i) with sufficiently high factor loadings (at least 0.3, preferably much higher if the number of items loading on the factor is small), and that (ii) load higher on this factor than on other factors (Velicer & Fava, 1998). Ultimately, we selected the maximum number of factors that each had at least three items, with the number of factors being equal to or smaller than those identified by the three factor retention methods. Items that did not satisfy the two requirements were discarded for scale construction. After identifying the scales of environmental factors, they were labeled using the content of the items of each scale, and total scores were computed for all scales.

Scales' (Cronbach's alpha) reliabilities and corrected-item-total total correlations as well as factor loadings (obtained with PCA using Oblimin rotation) were also computed and reported.

Variables were coded for analysis according to a previous study in which we used the "Senioren Barometer" (Gobbens et al., 2014); dummies were created for sex ("1" woman, "0" men), marital status ("1" married or cohabiting, "0" rest), and linear effects of age, education, and income were incorporated into the analyses. Ethnicity was excluded because of the low frequency of non-Dutch participants (3.8%).

After carrying out bivariate regression analyses, we tested our main hypotheses on the effects of environmental scales on quality of life by carrying out hierarchical regression analyses in two steps for each of the four quality of life domains. In the first step, only the background or control variables were entered, and second, all environmental scales were entered. Explained variances and increase thereof were tested and reported; we interpreted effect sizes of environment scales on quality of life using Cohen's f^2 (small is .02; medium is .15; large is .35) (Cohen, 1988). Unstandardized regression coefficients, as well as their standard errors and p values were reported.

For statistical analysis, IBM SPSS Statistics 22.0 (IBM, Armonk, NY) was used.

Results

Participant Characteristics

The participants' mean age was 73.4 years (standard deviation [SD] = 5.8); 66.8% were men and 71.1% were married or cohabiting. Table 1 presents the descriptive statistics of all the background characteristics and the means, standard deviations and range of the seven environmental factors, and the four quality of life domains, respectively. The reliabilities of the physical health, psychological, social relations, environment domains of the WHOQOL-BREF were .836, .751, .579, .781, respectively.

Scale Construction

Both the scree plot (Figure 1) as well as parallel analysis suggested retaining seven (7th eigenvalue = 1.365), whereas

Table 2. Correlations Between Environmental Scales

	Housing	Facilities	Residents	Neighborhood	Stench/noise	Traffic
Nuisance	-.281***	-.151***	-.503***	-.386***	.415***	.498***
Housing		.182***	.326***	.280***	-.179***	-.215***
Facilities			.218***	.305***	-.078*	-.204***
Residents				.373***	-.205***	-.293***
Neighborhood					-.229***	-.362***
Stench/noise						.366***

* $p < .05$. *** $p < .001$.

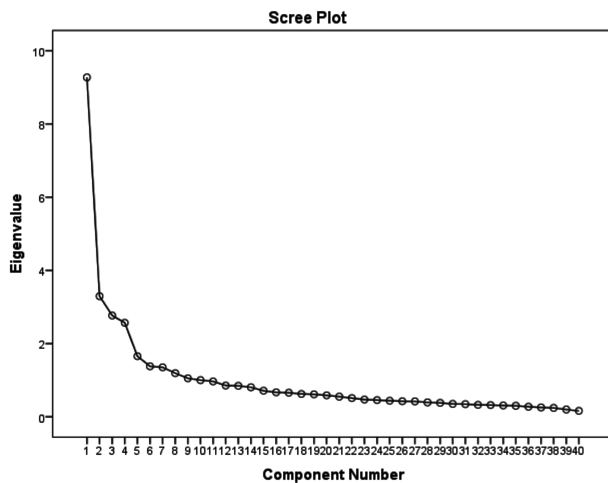


Figure 1. Scree plot of PCA on 40 items concerning older adults' (aged 50 years or older) perceptions of their environment.

the empirical Kaiser criterion suggested nine components (9th eigenvalue = 1.055). Because both the 8-component and 9-component solutions did not satisfy our requirements (i.e., one component contained less than three items loading highest on that component, with loadings higher than 0.3), we retained seven components. The seven components explained 56.8% of the variance of all 40 items. Supplementary Appendix reports scales for environmental factors, with items (wording and response categories) and their psychometric properties, and scale reliabilities. We also ran analyses on the subset of 1,031 persons (69.1%) of 65 years and older. The scree plot suggested seven, whereas parallel analysis and the empirical Kaiser criterion suggested 8 (8th eigenvalue = 1.191) and 10 components, respectively (10th eigenvalue = 1.001). Seven components explained 55.7% of the variance of 40 items. Using the same scales as for all 1,492 persons resulted in essentially similar reliabilities (at most 0.047 less for the older group than for the whole group), and all items had corrected-item total correlations larger than 0.3, which together demonstrate the validity of the seven environmental scales for the older group.

Table 2 shows the correlations between the seven environmental scales and their statistical significance. Nuisance had the strongest correlations with other environmental scales—0.503, 0.498, and 0.415 with residents, traffic, and stench/noise, respectively.

Regression Analyses: Effects of Environmental Scales on Quality of Life Domains

Table 3 presents the results of the bivariate regression analyses. Of the background variables higher age, marital status (being married or cohabiting), and higher income were associated with higher scores on all quality of life domains. Women had lower scores on quality of life domains physical health and psychological, whereas higher education

was associated with higher scores on physical health, psychological, and environmental. The results of the bivariate regression analyses also show that all seven environmental factors were associated with all four quality of life domains ($p \leq .01$).

Table 3 also presents the results of the hierarchical regression analyses. The lines " ΔR^2 " indicate how much of the variance of each quality of life domain was explained by all the predictors in the first block (background characteristics) and by all the predictors in the second block (environmental factors); R^2 total (last row) refers to the explained variance of the four quality of life domains by all 12 predictors together. R^2 total shows that 13.0% (social relations) to 38.9% (environmental) of the variance of the quality of life domains was explained by all the predictors together.

The background variables explained 4.1% to 15.4% (for social and environmental domain, respectively) of quality of life. Controlling for the effects of the other background variables, women on average had lower scores on the physical and higher scores on the social domain of quality of life. Age was negatively associated with the physical and environmental domain, and being married or cohabiting was positively associated with the social domain. Higher income was associated with higher scores on three domains (physical health, psychological, environmental), whereas education had no effect controlled for the other effects.

After controlling for the effect of the background variables, the seven environmental factors together explained a statistically significant ($p < .001$) part of the variance of the four quality of life domains. These effects amount to a large effect on environmental quality of life domain ($f^2 = .25$) and small to medium effects on the other domains ($f^2 = .047$ for social, $f^2 = .074$ for the psychological, and $f^2 = .101$ for the physical domain).

Housing, residents, and nuisance were associated with four, three, and two quality of life domains, respectively. Facilities, neighborhood, stench/noise, and traffic were associated only with the environmental domain. The effects of individual predictors, controlled for the other predictors, were generally small; the largest effect was of facilities on the environmental domain, with $f^2 = .036$.

Discussion

Previous research has shown that environmental factors play an important role in the quality of life in older adults (Garin et al., 2014). In the present study, we aimed to construct scales of environmental factors based on responses to 42 items, and examined the associations of these scales with four quality of life domains (physical health, psychological, social relations, environmental) in a Dutch sample of adults aged 65 years and older.

PCA and factor retention methods resulted in the following seven scales of environmental factors—housing, nuisance, facilities, residents, neighborhood, stench/noise, and traffic. The internal consistency reliability of all these scales

Table 3. Effect of Background Characteristics and Environmental Factors on Quality of Life Domains

	Physical health						Psychological						Social relations						Environmental					
	Bivariate			Multiple			Bivariate			Multiple			Bivariate			Multiple			Bivariate			Multiple		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Background characteristics																								
Sex (women)	-.602	.168	<.001	-.386	.185	.037	-.307	.133	.021	-.126	.146	.390	.086	.162	.594	.425	.184	.021	-.195	.137	.155	-.036	.131	.782
Age	-.067	.013	<.001	-.061	.013	.001	-.030	.011	.005	-.019	.011	.083	-.032	.013	.014	-.019	.013	.153	-.026	.011	.019	-.021	.010	.025
Marital status	.899	.173	<.001	.263	.199	.186	.635	.137	<.001	.273	.157	.083	.740	.167	<.001	.637	.198	.001	.524	.141	<.001	-.049	.140	.730
Education	.356	.080	<.001	.001	.090	.989	.307	.063	<.001	.031	.072	.663	.133	.078	.089	-.064	.090	.479	.481	.064	<.001	.020	.064	.753
Income	.321	.043	<.001	.155	.051	.002	.244	.034	<.001	.105	.040	.010	.190	.042	<.001	.080	.051	.114	.416	.033	<.001	.270	.036	<.001
ΔR ²	.083																							
Environmental factors																								
Housing	.199	.024	<.001	.026	.021	<.001	.180	.019	<.001	.094	.021	<.001	.165	.023	<.001	.067	.026	.010	.259	.018	<.001	.105	.018	<.001
Nuisance	-.156	.016	<.001	-.080	.021	<.001	-.115	.013	<.001	-.031	.017	.071	-.101	.015	<.001	-.009	.021	.676	-.188	.012	<.001	-.076	.015	<.001
Facilities	.090	.019	<.001	.038	.020	.061	.067	.015	<.001	.006	.016	.702	.080	.018	<.001	.012	.020	.561	.138	.015	<.001	.060	.014	<.001
Residents	.133	.018	<.001	.041	.021	.054	.135	.014	<.001	.071	.017	<.001	.162	.017	<.001	.108	.021	<.001	.183	.014	<.001	.060	.015	<.001
Neighborhood	.163	.029	<.001	.008	.034	.808	.139	.023	<.001	.016	.027	.547	.162	.028	<.001	.064	.034	.059	.260	.023	<.001	.063	.024	.009
Stench/noise	-.257	.061	<.001	-.017	.067	.794	-.254	.048	<.001	-.065	.053	.217	-.152	.058	.010	.054	.066	.416	-.412	.048	<.001	-.099	.047	.036
Traffic	-.206	.029	<.001	-.043	.034	.201	-.167	.023	<.001	-.052	.027	.054	-.161	.028	<.001	-.058	.034	.084	-.260	.022	<.001	-.054	.024	.024
ΔR ²	.093																							
R ² total	.176																							

Note: Two-tailed p-values <.05 are printed in bold.

was sufficient to good. As expected, hierarchical regression analyses showed a large effect of the seven environmental scales on quality of life domain environmental. However, we also found small to medium effects of the environmental scales on the other three quality of life domains, after controlling for background characteristics.

Comparing the results of our study with those of previous studies is complicated by the fact that we developed and used seven environmental scales that were assessed differently from other existing measures (e.g., they used different items), but may have used the same labels (e.g., “neighborhood”). When interpreting our results in relation to other studies’ findings below, we consider both contents and labels of other existing measures.

In our study, only environmental scale housing was associated with all quality of life domains, which agrees with previous findings. Oswald, Wahl, Mollenkopf, and Schilling (2003) concluded that housing-related variables explained a substantial portion of variance in life satisfaction of older adults (55–99 years old), and Jones-Rounds, Evans, and Braubach (2014) found that substandard housing quality contributed to lower psychological well-being, after controlling for socioeconomic status, employment status, gender, and marital status. Moreover, various studies found an association between the number of rooms in the house, satisfaction with housing, and housing quality on the one hand, and depression prevalence on the other hand (Chan, Malhotra, Malhotra, & Ostbye, 2011; Lai & Guo, 2011).

The residents scale was associated with quality of life domains psychological, social relations, and environmental. This scale contains items referring to social capital such as interactions between different groups and involvement of the local residents with their own neighborhood. Our findings concur with Dong and Bergren (2016) who found that a higher level of neighborhood cohesion was associated with higher quality of life in a community-dwelling U.S. Chinese population, and with a Dutch study among independently living older people aged ≥ 70 years showing the importance of social capital within the neighborhood for well-being (Cramm et al., 2013). Social capital within a neighborhood might influence well-being through psychosocial processes such as the provision of affective support and the enhancement of self-esteem and mutual respect (Cramm et al., 2013).

The nuisance scale was associated with quality of life physical health and environmental. This scale contains items referring to feeling safe or related expressions such as fear of crime, and social insecurity. Our findings are consistent with Amerio and Roccato (2005) who suggest that these feelings are related to the most serious problems afflicting individuals and communities, and with prior studies concluding that feelings of lack of safety among older people can have negative consequences in health (Jackson & Stafford, 2009) and lower psychological wellbeing (Van Dyck, Teychenne, McNaughton, De Bourdeaudhuij, & Salmon, 2015).

The facilities, neighborhood, stench/noise, and traffic scales were associated only with quality of life domain environmental. The facilities scale refers to a wide variety of facilities such as sport, recreation, shopping as well as public transport. Currently, findings about most of the effects of these facilities on quality of life in older people are still largely lacking. Because facilities are relevant for older people, we recommend more research into effects of facilities on quality of life in this age group.

Concerning neighborhood quality, Oswald, Jopp, Rott, and Wahl (2011) found that it explained life satisfaction of community-dwelling individuals aged 65–94 years, using a scale covering items such as having clean sidewalks and streets. Others studies demonstrated that access to green spaces was essential for quality of life; it improves mental wellbeing (Brown & Grant, 2007), and allows people to escape from the stress of everyday life (Mace, Bell, & Loomis, 1999). In general, quiet areas were found to have higher mean WHOQOL-BREF domain scores than noisy areas (Shepherd, Welch, Dirks, & McBride, 2013). As far as we know, no previous studies exist regarding the effects of coffee shops, the restaurant and bar market, and industry on quality of life in older people.

Traffic was also associated only with quality of life domain environmental. This finding is partly contradicting some previous studies (Parra et al., 2010; Welch, Shepherd, Dirks, McBride, & Marsh, 2013). For instance, Welch et al. (2013) showed that scores on all four quality of life domains of the WHOQOL-BREF (physical health, psychological, social relations, environmental) were lower in people living close to the motorway, and these scores correlated negatively with noise sensitivity in those who lived near motorways. A possible explanation for the different findings is the contextual and cultural differences between the countries involved; that is, Dutch traffic conditions may vary less within the country than in other countries, or countries’ citizens may react systematically differently to traffic across countries.

Some limitations of our study must be noted in interpreting the results of our study. First, the sample is not representative for the population of adults aged 65 years and older, due to possible selection bias because the questionnaire “Senioren Barometer” had to be completed via the internet. In addition, 66.8% of the sample consisted of men, while of the Dutch population aged 65 years and over, only 44.4% is men (Statistics Netherlands, 2012). Second, we developed our seven scales using a Dutch sample of older people; the scales may not all be equally relevant for populations of other countries or other age groups. Future research may validate the scales in other settings. Third, we used cross-sectional data, making the establishment of a causal link between environment and quality of life impossible; we recommend a longitudinal study focusing on the effects of environmental factors on quality of life.

Fourth, one may consider the fact that we did not control for frailty or disability in our analysis as a limitation

of our study. After careful deliberation, we decided not to control for frailty and disability in our prediction of quality of life, even though these variables are in our data set. We chose not to control for them because frailty and disability are together with quality of life affected by environmental factors, and these three dependent variables are likely quite strongly correlated. Hence, controlling for frailty and disability would remove a large part of quality of life from our analyses, a part we are also interested in to predict with the environmental factors. Nevertheless, we also ran our main analyses with controlling for both frailty and disability. As expected, total explained variances were much higher (between 0.204 for social relations and 0.538 for physical health). However, results on effects of environmental factors on quality of life domains were very similar to those presented in Table 3; environmental factors added to the explanation of all quality of life domains, housing and residents affected three domains, and all factors affected the environmental quality of life domain after controlling for frailty and disability. Thus, controlling for frailty and disability in our analyses does not affect our main conclusions.

Finally, in this study we used a self-report questionnaire for collecting data regarding environmental factors. Some other studies assessed environmental factors through the combination of objective and self-rated measures (Iwarsson, 2005; Parra et al., 2010), which may provide a more comprehensive assessment of environmental factors (Morris, McAuley, & Motl, 2008) and a broader perspective on associations between these factors and quality of life (Parra et al., 2010). Parra et al. (2010) found more associations between environmental perceptions and quality of life than associations with objective measures. However, some evidence suggest that objective and perceived (self-rated) measures capture different constructs of wellbeing (Gebel, Bauman, & Owen, 2009), and perceptions seem to be more closely related to mental and cognitive processes that directly influence quality of life (Parra et al., 2010). A final limitation refers to studies' different operationalization of the environmental factors, which complicates interpreting and comparing findings across studies. Research on the effect of environmental factors would profit from standardized measures of environment. Our study and seven scales may be considered a step in that direction.

In conclusion, we offer health and social care professionals, as well as policy makers, an instrument for measuring seven separate environmental factors. Our study has shown that in particular housing, residents, and nuisance influence quality of life in older adults. We therefore recommend focusing interventions primarily on these three environmental factors aiming to enhance quality of life of older people, thereby facilitating "aging in place," the preference of older people who are currently living in the community. Our results suggest that, for instance, home modifications such as a chair elevator as well as the use of smart home technology, may make a home more suitable for older persons, particularly if they are frail and disabled,

thereby improving their quality of life. In addition, reporting by older people of unsafe conditions in the neighborhood needs to be encouraged and facilitated. In the end, more research on effectiveness of interventions, and an integrated neighborhood approach is needed, characterized by collaboration among municipalities, health and social care organizations, and residents, aiming to use available neighborhood resources effectively and increase responsiveness to older people's specific needs (Van Dijk, Cramm, & Nieboer, 2016).

Supplementary Material

Supplementary data is available at *The Gerontologist* online.

References

- Amerio, P., & Roccato, M. (2005). A predictive model for psychological reactions to crime in Italy: An analysis of fear of crime and concern about crime as a social problem. *Journal of Community and Applied Social Psychology*, *15*, 17–28.
- Andrew, M. K., & Keefe, J. M. (2014). Social vulnerability from a social ecology perspective: A cohort study of older adults from the National Population Health Survey of Canada. *BMC Geriatrics*, *14*, 90. doi:10.1186/1471-2318-14-90
- Balfour, J. L., & Kaplan, G. A. (2002). Neighborhood environment and loss of physical function in older adults: Evidence from the Alameda County Study. *American Journal of Epidemiology*, *155*, 507–515.
- Beard, J. R., Blaney, S., Cerda, M., Frye, V., Lovasi, G. S., Ompad, D.,...Vlahov, D. (2009). Neighborhood characteristics and disability in older adults. *The Journal of Gerontology, Series B: Psychological Sciences and Social Sciences*, *64*, 252–257. doi:10.1093/geronb/gbn018
- Berglund, H., Hasson, H., Wilhelmson, K., Dunér, A., & Dahlin-Ivanoff, S. (2016). The impact of socioeconomic conditions, social networks, and health on frail older people's life satisfaction: A cross-sectional study. *Health Psychology Research*, *4*, 5578. doi:10.4081/hpr.2016.5578
- Berke, E. M., Gottlieb, L. M., Moudon, A. V., & Larson, E. B. (2007). Protective association between neighborhood walkability and depression in older men. *Journal of the American Geriatrics Society*, *55*, 526–533. doi:10.1111/j.1532-5415.2007.01108.x
- Braeken, J., & van Assen, M. A. (2016). An empirical Kaiser criterion. *Psychological Methods*. Advance online publication. doi:10.1037/met0000074
- Brown, C., & Grant, M. (2007). Natural medicine for planners. *Town and Country Planning*, *76*, 67–68.
- Buffel, T., Verté, D., De Donder, L., De Witte, N., Dury, S., Vanwing, T., & Bolsenbroek, A. (2012). Theorizing the relationship between older people and their immediate social living environment. *International Journal of Lifelong Education*, *31*, 13–32.
- Central Committee on Research inv. Human Subjects. (2010). *Does your study have to be reviewed?* Retrieved June 15, 2010, from <http://www.ccmo-online.nl> (Home>For investigators>Review step plan RC>WMO)

- Chan, A., Malhotra, C., Malhotra, R., & Ostbye, T. (2011). Living arrangements, social networks and depressive symptoms among older men and women in Singapore. *International Journal of Geriatric Psychiatry*, *26*, 630–639. doi:10.1002/gps.2574
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Assoc.
- Cramm, J. M., van Dijk, H. M., & Nieboer, A. P. (2013). The importance of neighborhood social cohesion and social capital for the well being of older adults in the community. *The Gerontologist*, *53*, 142–152. doi:10.1093/geront/gns052
- De Witte, N., Smetcoren, A.-S., De Donder, L., Dury, S., Buffel, T., Kardol, T., & Verté, D. (2012). *Een huis! Een thuis! Over ouderen en wonen*. Brugge: Vanden Broele.
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, *125*, 276–302.
- Dong, X., & Bergren, S. M. (2016). The associations and correlations between self-reported health and neighborhood cohesion and disorder in a community-dwelling U.S. Chinese population. *Gerontologist*. doi:10.1093/geront/gnw050
- Friedman, D., Parikh, N. S., Giunta, N., Fahs, M. C., & Gallo, W. T. (2012). The influence of neighborhood factors on the quality of life of older adults attending New York City senior centers: Results from the Health Indicators Project. *Quality of Life Research*, *21*, 123–131. doi:10.1007/s11136-011-9923-6
- Fugl-Meyer, A. R., Bränholm, I.-B., & Fugl-Meyer, K. S. (1991). Happiness and domain-specific life satisfaction in adult northern Swedes. *Clinical Rehabilitation*, *5*, 25–33.
- Garin, N., Olaya, B., Miret, M., Ayuso-Mateos, J. L., Power, M., Bucciarelli, P., & Haro, J. M. (2014). Built environment and elderly population health: A comprehensive literature review. *Clinical Practice and Epidemiology in Mental Health: CP & EMH*, *10*, 103–115. doi:10.2174/1745017901410010103
- Garrido, L. E., Abad, F. J., & Ponsoda, V. (2013). A new look at Horn's parallel analysis with ordinal variables. *Psychological Methods*, *18*, 454–474. doi:10.1037/a0030005
- Gebel, K., Bauman, A., & Owen, N. (2009). Correlates of non-concordance between perceived and objective measures of walkability. *Annals of Behavioral Medicine*, *37*, 228–238. doi:10.1007/s12160-009-9098-3
- Gobbens, R. J., Luijckx, K. G., & van Assen, M. A. (2013). Explaining quality of life of older people in the Netherlands using a multi-dimensional assessment of frailty. *Quality of Life Research*, *22*, 2051–2061. doi:10.1007/s11136-012-0341-1
- Gobbens, R. J., van Assen, M. A., & Schalk, M. J. (2014). The prediction of disability by self-reported physical frailty components of the Tilburg Frailty Indicator (TFI). *Archives of Gerontology and Geriatrics*, *59*, 280–287. doi:10.1016/j.archger.2014.06.008
- Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, *30*, 179–185.
- Iwarsson, S. (2005). A long-term perspective on person-environment fit and ADL dependence among older Swedish adults. *The Gerontologist*, *45*, 327–336.
- Jackson, J., & Stafford, M. (2009). Public health and fear of crime. A prospective cohort study. *British Journal of Criminology*, *49*, 832–847.
- Jones-Rounds, M. L., Evans, G. W., & Braubach, M. (2014). The interactive effects of housing and neighbourhood quality on psychological well-being. *Journal of Epidemiology and Community Health*, *68*, 171–175. doi:10.1136/jech-2013-202431
- Kalfoss, M. H., Low, G., & Molzahn, A. E. (2008). The suitability of the WHOQOL-BREF for Canadian and Norwegian older adults. *European Journal of Ageing*, *5*, 77–89.
- Lai, D. W. L., & Guo, A. (2011). Gender differences in depressive symptoms of aging Chinese in urban Jiangsu in China. *Clinical Gerontologist*, *34*, 190–206.
- Lawton, M. P., & Nahemow, L. (1973). Ecology and the aging process. In C. Eisdorfer & M. P. Lawton (Eds.), *The psychology of adult development and aging* (pp. 619–674). Washington, DC: American Psychological Association.
- Lochner, K. A., Kawachi, I., Brennan, R. T., & Buka, S. L. (2003). Social capital and neighborhood mortality rates in Chicago. *Social Science & Medicine* (1982), *56*, 1797–1805.
- Lucumí, D. I., Gomez, L. F., Brownson, R. C., & Parra, D. C. (2015). Social capital, socioeconomic status, and health-related quality of life among older adults in Bogotá (Colombia). *Journal of Aging and Health*, *27*, 730–750. doi:10.1177/0898264314556616
- Mace, B., Bell, P., & Loomis, R. (1999). Aesthetic, affective, and cognitive effects of noise on natural landscape assessment. *Social and Natural Resources*, *12*, 225–242.
- Morris, K. S., McAuley, E., & Motl, R. W. (2008). Self-efficacy and environmental correlates of physical activity among older women and women with multiple sclerosis. *Health Education Research*, *23*, 744–752. doi:10.1093/her/cym067
- Oswald, F., Jopp, D., Rott, C., & Wahl, H. W. (2011). Is aging in place a resource for or risk to life satisfaction? *The Gerontologist*, *51*, 238–250. doi:10.1093/geront/gnq096
- Oswald, F., Wahl, H. W., Mollenkopf, H., & Schilling, O. (2003). Housing and life satisfaction of older adults in two rural regions in Germany. *Research on Aging*, *25*, 122–143.
- Parra, D. C., Gomez, L. F., Sarmiento, O. L., Buchner, D., Brownson, R., Schimid, T.,...Lobelo, F. (2010). Perceived and objective neighborhood environment attributes and health related quality of life among the elderly in Bogotá, Colombia. *Social Science & Medicine* (1982), *70*, 1070–1076. doi:10.1016/j.socscimed.2009.12.024
- Putman, R. D. (2000). *Bowling alone. The collapse and revival of American community*. New York: Simon & Shuster.
- Saelens, B. E., Sallis, J. F., Black, J. B., & Chen, D. (2003). Neighborhood-based differences in physical activity: An environment scale evaluation. *American Journal of Public Health*, *93*, 1552–1558.
- Sheffield, K. M., & Peek, M. K. (2009). Neighborhood context and cognitive decline in older Mexican Americans: Results from the Hispanic established populations for epidemiologic studies of the elderly. *American Journal of Epidemiology*, *169*, 1092–1101. doi:10.1093/aje/kwp005
- Shepherd, D., Welch, D., Dirks, K. N., & McBride, D. (2013). Do quiet areas afford greater health-related quality of life than noisy areas? *International Journal of Environmental Research and Public Health*, *10*, 1284–1303. doi:10.3390/ijerph10041284
- Skevington, S. M., Lotfy, M., & O'Connell, K. A.; WHOQOL Group. (2004). The World Health Organization's WHOQOL-BREF quality of life assessment: Psychometric properties and results of the international field trial. A report from the

- WHOQOL group. *Quality of Life Research*, *13*, 299–310. doi:10.1023/B:QURE.0000018486.91360.00
- Statistics Netherlands. (2012). Retrieved November 14, 2012, from <http://statline.cbs.nl/Statweb/>
- United Nations. (2015). World population prospects. The 2015 revision. Key findings and advance tables. Working paper No. ESA/P/WP.241. New York: Department of Economic and Social Affairs. Population Division. Retrieved August 8, 2015, from http://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf
- Van Cauwenberg, J., De Bourdeaudhuij, I., De Meester, F., Van Dyck, D., Salmon, J., Clarys, P., & Deforche, B. (2011). Relationship between the physical environment and physical activity in older adults: A systematic review. *Health & Place*, *17*, 458–469. doi:10.1016/j.healthplace.2010.11.010
- Van Dijk, H. M., Cramm, J. M., & Nieboer, A. P. (2016). How to build an integrated neighborhood approach to support community-dwelling older people? *International Journal of Integrated Care*, *16*, 4. doi:10.5334/ijic.1596
- Van Dyck, D., Teychenne, M., McNaughton, S. A., De Bourdeaudhuij, I., & Salmon, J. (2015). Relationship of the perceived social and physical environment with mental health-related quality of life in middle-aged and older adults: Mediating effects of physical activity. *PLoS One*, *10*, e0120475. doi:10.1371/journal.pone.0120475
- Velicer, W. F., & Fava, J. L. (1998). Effects of variable and subject sampling on factor pattern recovery. *Psychological Methods*, *3*, 231–251.
- Welch, D., Shepherd, D., Dirks, K. N., McBride, D., & Marsh, S. (2013). Road traffic noise and health-related quality of life: A cross-sectional study. *Noise & Health*, *15*, 224–230. doi:10.4103/1463-1741.113513
- WHOQOL Group. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychological Medicine*, *28*, 551–558.
- The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. (1995). *Social Science & Medicine*, *41*, 1403–1409. doi:027795369500112K [pii]
- Yabuwaki, K., Yamada, T., & Shigeta, M. (2008). Reliability and validity of a Comprehensive Environmental Questionnaire for community-living elderly with healthcare needs. *Psychogeriatrics*, *8*, 66–72.