Original Article

Relationships between neighborhood attributes and subjective well-being among the Chinese elderly: Data from Shanghai

Junling Gao[1], Scott R. Weaver[2], Hua Fu[1,*], Yingnan Jia[1], Jiang Li[1]

[1] *Institute of Health Communication, School of Public Health, Fudan University, Shanghai, China;*
[2] *School of Public Health, Georgia State University, Atlanta, GA, USA.*

Summary	It has been hypothesized that subjective well-being (SWB) is determined by a combination of individual characteristics, social environment, and physical environment. However, few studies have simultaneously examined the relationships of the social and physical attributes of a neighborhood with SWB. Accordingly, the present study aimed to examine these relationships among Chinese elders. A total of 2,719 elders aged 60 years or older were recruited from 47 neighborhoods in the Xinhua subdistrict of Shanghai by two-stage stratified random sampling and interviewed between July and September 2014. The social and physical attributes of each neighborhood were assessed using validated and psychometrically tested measures. The Chinese version of the international Personal Wellbeing Index was used to assess SWB. Control variables included sex, age, marital status, education level, years living in the neighborhood, self-rated health, chronic conditions, and leisure-time physical activity. Multilevel linear regression analysis was conducted to explore whether social and physical attributes were associated with SWB. The average level of SWB was 74.2 ± 15.7% of the scale maximum. After controlling for individual covariates, individual-level social cohesion and social interaction were positively correlated with SWB, and both individual-level and neighborhood-level aesthetic quality was positively correlated with SWB. In conclusion, both social and physical attributes of neighborhoods were associated with SWB among Chinese elderly. These findings suggest that creating aesthetic and cohesive neighborhoods may encourage Chinese elders to participate in social activities and promote their SWB.

Keywords: Neighborhood attributes, social capital, subjective wellbeing, aging

1. Introduction

Regarded as a key dimension of quality of life, subjective well-being (SWB) has been defined as "good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences" (*1*). Based on a substantial body of research that has found strong associations of this characteristic with longer survival and several other health indicators (*2,3*), SWB has been designated as

an important indicator of societal progress and a target for improvement by health care systems (*2,4*). As the prevalence of chronic illness increases with advancing age and treatments for life-threatening disease become more effective, the issue of maintaining well-being at advanced ages is growing in importance (*2*). This has led to increased efforts to develop appropriate measures of SWB and gain an increased understanding of determinants of well-being worldwide.

SWB is thought to be determined by a multitude of individual factors as well as social and physical environmental factors (*5,6*). Several studies have focused on demographic factors that may affect SWB – such as gender, age, income, and marital status – but they have found that these factors generally explain less than 20% of the variance in SWB (*7*). Furthermore, the relationships found between demographic factors and SWB were not consistent. For example, the quadratic

relationship between SWB and age in high-income English-speaking countries was not replicated in other regions (*2*). Studies of SWB have also examined its association with environmental factors, with an emphasis on the importance of the geographically proximal environment for older adults, particularly those who are retired or becoming frail and therefore likely to be spending more time in their immediate neighborhood (*8*). Several studies showed that certain physical attributes of the neighborhood, such as quality public transportation (*9*) and access to green/recreational areas (*10,11*), were positively associated with higher levels of SWB.

There is limited evidence on the relationship between perceived aspects of the neighborhood and mental health in older people, but findings from a few studies have linked self-reported neighborhood problems (*12*), poor social environment in a neighborhood (*13*), and low sense of belonging to a neighborhood (*14*) with psychological distress in older people. This suggests that how individuals feel about the physical and social environment in which they live may be associated with their mental health just as strongly as objective, area-level measures of neighborhood deprivation (*15*). These associations with mental health could be expected to extend to SWB. This has been supported by cross-sectional studies, which have found that perceived neighborhood cohesion was positively associated with SWB among elders (*8,15,16*), and a longitudinal study in England (*17*), which found that negative neighborhood perceptions were associated with poorer SWB. Another longitudinal study in the Netherlands (*18*) found that social cohesion and social belonging were positively associated with SWB.

Physical and social environments are thought not only to influence health outcomes and health behaviors, but also to be interrelated and influence each other (*19,20*). One study (*21*) found that adults living in high-walkable neighborhoods reported higher levels of knowing their neighbors, political participation, trust in other people, and social participation compared to participants living in low-walkable neighborhoods. Other studies have also supported the hypothesis that pedestrian-friendly environments are related to increased social capital (*22,23*). However, few studies have simultaneously examined the unique effects of individual, physical, and social neighborhood characteristics on SWB among elders.

While some studies have found individual characteristics (such as gender, age, and education) (*24-26*), social support (*26,27*), social belonging (*28*), economic openness (*29*), and atmospheric pollution (*30*) to be associated with SWB among urban Chinese people, research focusing specifically on the neighborhood environment and SWB among elders in China has been limited. In fact, we could only find one such study (*27*), and this study did not

examine individual, physical, and social environmental characteristics simultaneously. The objective of the present study is to address a gap in the SWB literature with a cross-sectional study examining the effects of neighborhood social cohesion, social interaction, aesthetic quality (AQ), and walkability on SWB in a sample of elders from Shanghai, China.

2. Methods

2.1. *Participants and study design*

The present study was conducted in the Xinhua subdistrict of Shanghai from July to September 2014. The Xinhua subdistrict with mature physical structure is aging subdistrict of approximately 2.2 km^2 located in southwest Shanghai. It consists of 198 neighborhoods with approximately 78,000 residents, of whom 16% are over 65 years old (*http://www.xhjd.org/*). The subdistrict has a stable population structure and built environment, which make it a suitable place to examine the effects of the perceived social and physical attributes of a neighborhood on health. The study design and sampling approach has been described previously (*31*). Briefly, the first stage consisted of the selection of 47 neighborhoods by purposive sampling that took into account environmental factors such as accessibility to services, aesthetics, and street connectivity. In the second stage, we randomly sampled 120 elders aged 60 years or older from each neighborhood that had more than 120 elders; in neighborhoods with fewer than 120 elders, all elders living in the neighborhood were selected. In total, 2,839 elders were sampled from 47 neighborhoods; however, 120 elders were excluded from analysis because of incomplete data, resulting in a final analytic sample consisting of 2,719 elders for the current study.

Informed consent was obtained from all participants, and face-to-face interviews were used to collect data. The study was approved by the Institutional Review Board of the School of Public Health at Fudan University.

2.2. *Measurements*

2.2.1. *Subjective well-being*

The Chinese version of the Personal Wellbeing Index (CPWI) (*32*) was used to measure subjective well-being. The CPWI used in the current study consisted of seven core domains (standard of living, health, life achievement, personal relationships, personal safety, feeling part of the community, and future security), measured on an 11-point Likert-type scale, with numerical ratings ranging from 0 (*extremely dissatisfied*) to 10 (*extremely satisfied*). A previous study found the CPWI to have acceptable reliability, Cronbach's $\alpha = 0.81$ (*24*). In the present study, Crobnach's $\alpha = 0.92$ for our

sample. The Likert scale data were standardized into units of percentage of scale maximum (% SM) on a 0-100 distribution using the equation

$$\frac{X - K^{min}}{K^{max} - k^{min}} \times 100 \qquad (32),$$

where X is the score to be converted, $K^{min} = 0$ (the minimum score possible on the scale), and $K^{max} = 10$ (the maximum score possible on the scale).

2.2.2. *Attributes of neighborhood*

In the present study, we mainly focused on two physical dimensions of neighborhoods (aesthetic quality and walkability) and two social dimensions (social interaction with neighbors and social cohesion). The scales used to measure these dimensions were developed by Mujahid and colleagues (*33*). As described in detail previously (*31*), the original scale was initially translated into Chinese, and the Chinese version was then translated back into English to verify that the content of the original scale was maintained. The aesthetic quality (AQ) subscale consisted of 5 items, the walkability subscale consisted of 7 items, the social interaction with neighbors subscale consisted of 5 items, and the social cohesion subscale consisted of 4 items. The Cronbach's αs for these subscales in our sample were 0.74, 0.81, 0.87, and 0.88, respectively.

Due to the relationship between neighborhood characteristics and individual-level characteristics (*33,34*), with varying perceptions of the same reality by different individuals, the averaging of responses across multiple persons within a neighborhood reduces measurement error due to individual subjectivity (*33*). In the present study, all attributes of the neighborhood were assessed in two alternative ways: (a) individual-level attributes were assessed by calculating the mean score of each individual's own assessments on the corresponding scale's items; (b) neighborhood-level attributes for participant *i* were measured as the mean perceived individual-level attributes for all participants from the same neighborhood as participant *i*, excluding participant *i*. Previous studies indicated that objective neighborhood measures were significantly correlated with subjective perceptions of neighborhood quality (*35*) – for example, a participant with higher neighborhood-level AQ would generally indicate that she/he lived in a more aesthetic neighborhood. For analysis, both individual and neighborhood-level attribute scores were converted into quartiles, with the highest quartile indicating the highest level of neighborhood attributes.

2.2.3. *Covariates*

We selected the following variables as potential confounders for statistical control: sex, age (categorized in 5-year intervals), marital status (married or cohabiting *vs*. other), education level (elementary school, junior high school, senior high school, and university or higher), and years living in the neighborhood (categorized in 10-year intervals). Additionally, a previous study indicated that both comorbidity and self-rated health were associated with SWB (*36*); therefore, we also controlled for the number of self-reported chronic diseases (0, 1, 2 or more) and self-rated health. Self-rated health was assessed by the single item, "Would you say that in general your health is excellent, very good, good, fair, or poor?" From this item, we created a dichotomous measure (0 = fair or poor; 1 = excellent, very good, or good). Finally, we controlled for leisure-time physical activity (LTPA), which was assessed by the Chinese long form of the International Physical Activity Questionnaire (*37*). Consistent with previous research (*38*), self-reported minutes of recreational walking and moderate- and vigorous-intensity physical activity in the past week were used to estimate a LTPA score, which was dichotomized into high or low. High LTPA was defined as at least 150 minutes of leisure-time physical activity per week. This criterion is in accordance with the current recommendations for physical activity (*39*).

2.2.4. *Statistical analyses*

Our data had a multilevel structure comprising elders (the first level) nested within neighborhoods (the second level). We fitted the data using multilevel linear regression models, adjusting for both individual- and neighborhood-level variables as fixed effects and allowing for a random intercept for SWB. The analyses of the relationships between attributes of a neighborhood and SWB involved estimating multiple sequential models (*40*). After examining the neighborhood-level variance in SWB without including any explanatory variables (empty model), we examined the relationship between individual- and neighborhood-level attributes of the neighborhood with SWB (Models 1 and 2, respectively) after controlling for individual covariates. Finally, we modeled all individual- and neighborhood-level variables simultaneously (Model 3). We used −2 log likelihood (−2LL) and Akaike information criterion (AIC) to compare the goodness of fit of each model (*40*). STATA version 13.1 was used for all analyses (StataCorp, Texas, USA). For all models, the unstandardized coefficient (*B*) and corresponding 95% confidence interval were reported. Results were considered statistically significant if the two-sided *p* values were < 0.05.

3. Results

3.1. *Demographic characteristics and subjective well-being of the sample*

The demographic characteristics of the sample and univariate relationships between demographic

Table 1. Demographic differences in subjective well-being

Items	N, %	Subjective well-being (mean and *SD*)	*p* value
Overall	2,719	74.2 (15.7)	
Sex			
Men	1,124 (41.3)	74.8 (14.8)	0.082
Women	1,595 (58.7)	73.8 (15.2)	
Age (years)			
60-64	722 (26.6)	75.2 (14.5)	0.023
65-69	590 (21.7)	74.8 (14.0)	
≥ 70	1,407 (51.8)	73.5 (15.7)	
Education level			
Elementary school	844 (31.0)	71.2 (16.4)	< 0.001
Junior high school	963 (35.4)	74.3 (14.1)	
Senior high school	473 (17.4)	76.5 (13.1)	
University	439 (16.2)	77.4 (15.2)	
Marital status			
Married or cohabiting	2,183 (80.3)	74.9 (14.7)	< 0.001
Other	536 (19.7)	71.4 (15.8)	
Self-rated health			
Poor	1,785 (65.7)	73.2 (15.1)	< 0.001
Good	934 (34.4)	76.3 (14.7)	
Number of chronic diseases			< 0.001
None	640 (23.5)	77.8 (13.2)	
One	1,093 (40.2)	74.7 (14.8)	
Two or more	986 (36.5)	71.3 (15.7)	
Years living in the neighborhood			
< 10	305 (11.2)	68.5 (15.7)	< 0.001
10-19	1,141 (42.0)	73.3 (14.7)	
20-29	582 (21.4)	76.0 (14.3)	
30-39	342 (12.6)	76.7 (15.4)	
≥ 40	349 (12.8)	77.0 (14.9)	
Leisure-time physical activity			
Low	1,281 (47.1)	71.7 (15.4)	< 0.001
High	1,438 (52.9)	76.4 (14.3)	

Table 2. Univariate relationships between perceived neighborhood attributes and subjective well-being

Items	N, %	Subjective well-being (mean and *SD*)	*p* value
Physical characteristics			
Aesthetic quality			
1st quartile	641 (23.6)	70.6 (15.0)	< 0.001
2nd quartile	612 (22.5)	71.2 (15.7)	
3rd quartile	649 (23.9)	74.0 (12.6)	
4th quartile	817 (30.1)	79.6 (14.8)	
Walking environment			
1st quartile	666 (24.5)	72.7 (15.2)	< 0.001
2nd quartile	661 (24.3)	72.0 (15.0)	
3rd quartile	693 (25.5)	73.8 (13.8)	
4th quartile	699 (25.7)	78.2 (15.4)	
Social characteristics			
Social cohesion			
1st quartile	670 (24.6)	68.6 (16.4)	< 0.001
2nd quartile	480 (17.7)	71.9 (13.6)	
3rd quartile	481 (17.7)	73.9 (14.7)	
4th quartile	1088 (40.0)	78.9 (13.4)	
Social interaction			
1st quartile	646 (23.8)	71.0 (15.7)	< 0.001
2nd quartile	544 (20.0)	72.9 (15.0)	
3rd quartile	677 (24.9)	74.5 (13.8)	
4th quartile	852 (31.3)	77.4 (14.8)	

characteristics and SWB are shown in Table 1. Overall, 58.7% of the subjects were women, and more than half (51.8%) were 70 years old or older. Only 16.2% had graduated from university. More than 70% reported having at least one chronic disease, and 65.7% reported poor self-rated health. More than half of subjects had lived in the neighborhood for 20 years or longer. The average level of SWB was 74.2 ± 15.7% SM. SWB was significantly higher among those who were married/ cohabiting (74.9 ± 14.7% SM) than among their unmarried counterparts (71.4 ± 15.8% SM); it was also significantly higher among those with higher education levels ($p < 0.001$). Subjects with good self-rated health also reported significantly higher levels of SWB than subjects with poor self-rated health. Additionally, SWB was significantly higher among people with high LTPA (76.7 ± 14.4% SM) than among their low-LTPA counterparts (72.0 ± 15.2% SM). SWB was negatively correlated with age group and number of chronic diseases (both $p < 0.05$), and positively correlated with years living in the neighborhood ($p < 0.05$).

3.2. Univariate analysis of neighborhood attributes and SWB

Univariate analyses showed that SWB increased significantly with higher individual perceptions of AQ, walkability, social cohesion, and social interaction (Table 2). For example, the SWB levels among participants in the first (lowest), second, third, and fourth (highest) quartiles of perceived neighborhood AQ were 70.6 ± 15.0% SM, 71.2 ± 15.7% SM, 74.0 ± 12.6% SM, and 79.6 ± 14.8% SM, respectively.

3.3. Multilevel linear regressions of the relationship between neighborhood attributes and SWB

The results of the multilevel linear regression models are shown in Table 3. The empty model (not shown in Table 3) indicated that there was significant variation in SWB across neighborhoods ($\chi^2 = 149.78$, $p < 0.001$); the interclass correlation coefficient (ICC) was 0.084, indicating that 8.4% of the variance in SWB was explained by a random effect for neighborhoods.

Model 1 indicated that individual-level social cohesion, social interaction, and AQ were positively associated with SWB, but individual-level walkability was not associated with SWB after controlling for individual covariates. For example, compared with participants in the lowest quartile of social cohesion, the regression coefficients of participants in the second, third, and fourth quartiles were 2.34 (95% CI: 0.71-3.98), 3.03 (95% CI: 1.32-4.73), and 6.90 (95% CI: 5.38-8.42), respectively. However, Model 2, which included the neighborhood-level attributes and individual covariates, found that only neighborhood-level AQ was significantly and positively correlated with SWB after controlling for individual covariates.

Table 3. Multilevel regression models of relationships between neighborhood attributes and subjective well-being*

Items	Model 1: B, 95%CI	Model 2: B, 95%CI	Model 3: B, 95%CI
Fixed effects			
Individual-level variables			
Social cohesion			
1st quartile	Reference		Reference
2nd quartile	2.34 (0.71-3.98)		2.31 (0.68-3.95)
3rd quartile	3.03 (1.32-4.73)		2.87 (1.15-4.59)
4th quartile	6.90 (5.38-8.42)		6.79 (5.24-8.33)
Social interaction			
1st quartile	Reference		Reference
2nd quartile	1.20 (0.76-1.36)		1.17 (0.73-1.40)
3rd quartile	1.90 (0.98-2.46)		1.04 (0.53-2.61)
4th quartile	2.76 (1.16-4.36)		2.72 (1.14-4.23)
Aesthetic quality			
1st quartile	Reference		Reference
2nd quartile	0.43 (0.09-1.95)		0.46 (0.15-1.98)
3rd quartile	1.63 (0.07-3.18)		1.69 (0.12-3.26)
4th quartile	4.50 (2.86-6.14)		4.59 (2.81-6.17)
Walkability			
1st quartile	Reference		Reference
2nd quartile	− 0.10 (− 1.61-1.41)		0.18 (− 1.34-1.70)
3rd quartile	− 0.90 (− 2.44-0.63)		− 0.64 (− 2.20-0.91)
4th quartile	1.44 (− 0.18-3.07)		1.70 (− 0.04-3.36)
Neighborhood level variables			
Social cohesion			
1st quartile		Reference	Reference
2nd quartile		0.55 (− 2.44-3.54)	− 0.02 (− 2.95-2.91)
3rd quartile		2.81 (− 0.17-5.78)	1.45 (− 1.48-4.37)
4th quartile		2.95 (− 0.43-6.33)	0.16 (− 3.20-3.52)
Social interaction			
1st quartile		Reference	Reference
2nd quartile		− 1.34 (− 4.21-1.53)	− 2.18 (− 4.99-0.62)
3rd quartile		− 1.49 (− 4.27-1.30)	− 2.11 (− 4.85-0.62)
4th quartile		− 2.07 (− 5.05-0.91)	− 3.42 (− 6.37-0.47)
Aesthetic quality			
1st quartile		Reference	Reference
2nd quartile		1.06 (0.64-1.21)	1.03 (0.64-1.16)
3rd quartile		1.24 (1.15-1.67)	1.17 (1.08-1.47)
4th quartile		2.76 (1.46-3.98)	2.38 (1.38-3.58)
Walkability			
1st quartile		Reference	Reference
2nd quartile		− 2.24 (− 5.26-0.78)	− 2.66 (− 5.62-0.29)
3rd quartile		− 2.22 (− 5.29-0.84)	− 2.29 (− 5.31-0.73)
4th quartile		− 1.30 (− 4.18-1.58)	− 2.29 (− 5.16-0.59)
Random effects			
Neighborhood-level variance (*SE*)	11.11 (3.11)	6.55 (2.23)	6.33 (2.10)
ICC (SE)	0.06 (0.02)	0.03 (0.01)	0.03 (0.01)
Model fit			
−2LL	21841.61	22060.48	21824.16
AIC	21887.61	22106.48	21894.16

-2LL: -2 Log Likelihood (smaller is better); AIC: Akaike information criterion (smaller is better); *Gender, age, marital status, educational attainment, self-reported chronic diseases, self-rated health, number of years in the neighborhood and leisure-time physical activity were adjusted in all models.

In Model 3, the individual- and neighborhood-level attributes of each neighborhood were entered simultaneously. After controlling for individual-level covariates, individual-level social cohesion, social interaction, and AQ were still positively correlated with SWB. However, the regression coefficients of individual-level social cohesion and social interaction in Model 3 were slightly lower than those in Model 2, and the regression coefficient of individual-level AQ was slightly higher than that in Model 2. For example, compared with participants in the lowest quartile of social cohesion, the regression coefficients of participants in the second, third, and fourth quartiles were 2.31 (95% CI: 0.68-3.95), 2.87 (95% CI: 1.15-4.59), and 6.79 (95% CI: 5.24-8.33), respectively. Meanwhile, neighborhood-level AQ was also positively correlated with SWB; compared with participants in the lowest quartile, the regression coefficients of participants in the second, third, and fourth quartiles were 1.03 (95% CI: 0.64-1.16), 1.17 (95% CI: 1.08-1.47), and 2.38 (95% CI: 1.38-3.58), respectively.

4. Discussion

With the largest and most rapidly growing aging population in the world (*41*), China is undergoing a rapid transition from a rural to an urban society. The growth of the aging population coupled with rapid urbanization simultaneously presents challenges and opportunities for maintaining the well-being of elders in China (*42*). Because elders spend a greater proportion of their lives in their neighborhoods than younger adults, neighborhood environments are critical sources of support systems for elders, whose declining health may lead to frailty, social isolation, as well as limited mobility, financial strain, and/or limited access to transportation. Exploring the unique effects of neighborhood attributes on elders' well-being could be helpful to urban planners and public health officials in their efforts to build age-friendly neighborhoods and cities.

Accumulating evidence suggests that the physical and social attributes of the neighborhood play a role in the health of older individuals. However, research on the relationship between subjective well-being and individual perceptions of the neighborhood is limited (*43*). To our knowledge, this is the first study in China to simultaneously examine the effects of the perceptions of the social and physical attributes of one's neighborhood on well-being among older adults.

Neighborhood aesthetic quality has been shown to influence health behaviors such as physical activity (*44,45*) and fruit and vegetable consumption (*46*). Another study in Taiwan (*47*) found that high fruit and vegetable consumption combined with high LTPA could reduce the likelihood of developing new depressive symptoms among elders. Our study also found that high LTPA was associated with high SWB, which is consistent with previous studies (*48,49*). After accounting for demographic characteristics, years living in the neighborhood, physical activity, comorbidity, and self-reported health, we found that good perceived aesthetic quality of one's neighborhood was associated with high SWB, which is consistent with the finding of another study that the mental well-being of residents of deprived areas in Glasgow was higher when the respondents considered their neighborhood to have very good aesthetic qualities (*50*). Furthermore, we also found that high neighborhood-level aesthetic quality was associated with high SWB. These findings suggest that building aesthetic neighborhoods may promote better SWB among elders, which should be considered during urban planning and construction in China.

Our study also found that perceived social cohesion and social interaction were positively associated with SWB, which was consistent with our hypotheses and previous studies (*16,18,51,52*). Social cohesion and social interaction may influence elders' SWB in several ways. First, social cohesion positively impacts the strength of relationships and social interaction as well as collective attachment to the neighborhood, and is thus expected to enhance individuals' well-being (*53*). Second, elders living in more cohesive communities may receive more instrumental and affective support (*16*), which are resources that can contribute to SWB (*49,51*). Third, neighborhood social cohesion and social interaction may promote physical activity among elders (*45,54*). Previous studies (*48,55*) and our study have found physical activity to be positively associated with SWB.

No neighborhood-level social attributes were found to be associated with elders' SWB in our study. Research has shown Chinese people to be more collectivistic (*56*) than Westerners, but social capital in China resides largely in families and other narrow circles of social relationships, which implies that people may only trust those who belong to the same in-group and may not participate social activities outside of their circles (*57*). When individual-level social interaction and social cohesion are aggregated to the neighborhood level, their effect on SWB may become diluted and less relevant. Hence, there was no relationship between neighborhood-level social interaction or social cohesion and SWB.

This study is not without limitations. First, the direction of causality could not be addressed due to the cross-sectional study design. Second, neighborhood attributes were measured by validated self-reported questionnaires (*33*) rather than independent neighborhood measures. However, prior research has found that perceptions of one's neighborhood are more strongly related to health than objective neighborhood measures (*58*). Finally, a large sample from 47 neighborhoods was used, but the study was conducted in only one administrative district of Shanghai, which may not be representative of the overall elderly population or other neighborhoods in China. Well-designed, multicenter prospective studies of the neighborhood correlates of SWB should be conducted in the future.

In conclusion, despite the aforementioned limitations, this study provides new findings on the relationships between the social and physical attributes of neighborhoods and SWB among the Chinese elderly. Building aesthetic and cohesive neighborhoods may facilitate the participation of Chinese elders in the social activities of their neighborhoods and thereby enhance their SWB.

Acknowledgements

References

1. OECD. OECD Guidelines on Measuring Subjective Well-being. OECD Publishing, Paris, France, 2013. *http://dx.doi.org/10.1787/9789264191655-en* (accessed July 14, 2017).
2. Steptoe A, Deaton A, Stone AA. Subjective wellbeing, health, and ageing. Lancet. 2015; 385:640-648.
3. Wang X, Jia X, Zhu M, Chen J. Linking health states to subjective well-being: An empirical study of 5854 rural residents in China. Public Health. 2015; 129:655-666.
4. Stiglitz JE, Sen A, Fitoussi J-P. Report by the Commission on the Measurement of Economic Performance and Social Progress. *http://www.uio.no/studier/emner/sv/oekonomi/ECON4270/h09/Report%20in%20English.pdf* (accessed July 10, 2017).
5. Lorenc T, Clayton S, Neary D, Whitehead M, Petticrew M, Thomson H, Cummins S, Sowden A, Renton A. Crime, fear of crime, environment, and mental health and wellbeing: Mapping review of theories and causal pathways. Health Place. 2012; 18:757-765.
6. Nguyen-Viet H, Zinsstag J, Schertenleib R, Zurbrugg C, Obrist B, Montangero A, Surkinkul N, Kone D, Morel A, Cisse G, Koottatep T, Bonfoh B, Tanner M. Improving environmental sanitation, health, and well-being: A conceptual framework for integral interventions. Ecohealth. 2009; 6:180-191.
7. Wang P, Vanderweele TJ. Empirical research on factors related to the subjective well-being of Chinese urban residents. Soc Indic Res. 2011; 101:447-459.
8. Elliott J, Gale CR, Parsons S, Kuh D; HALCyon Study Team. Neighbourhood cohesion and mental wellbeing among older adults: A mixed methods approach. Soc Sci Med. 2014; 107:44-51.
9. Green J, Jones A, Roberts H. More than A to B: The role of free bus travel for the mobility and wellbeing of older citizens in London. Ageing Soc. 2014; 34:472-494.
10. Mitchell RJ, Richardson EA, Shortt NK, Pearce JR. Neighborhood environments and socioeconomic inequalities in mental well-being. Am J Prev Med. 2015; 49:80-84.
11. Marselle MR, Irvine KN, Lorenzo-Arribas A, Warber SL. Moving beyond green: Exploring the relationship of environment type and indicators of perceived environmental quality on emotional well-being following group walks. Int J Environ Res Public Health. 2014; 12:106-130.
12. Schieman S, Meersman SC. Neighborhood problems and health among older adults: Received and donated social support and the sense of mastery as effect modifiers. J Gerontol B Psychol Sci Soc Sci. 2004; 59:S89-S97.
13. Brown SC, Mason CA, Spokane AR, Cruza-Guet MC, Lopez B, Szapocznik J. The relationship of neighborhood climate to perceived social support and mental health in older Hispanic immigrants in Miami, Florida. J Aging Health. 2009; 21:431-459.
14. Young AF, Russell A, Powers JR. The sense of belonging to a neighbourhood: Can it be measured and is it related to health and well being in older women? Soc Sci Med. 2004; 59:2627-2637.
15. Gale CR, Dennison EM, Cooper C, Sayer AA. Neighbourhood environment and positive mental health in older people: The Hertfordshire Cohort Study. Health Place. 2011; 17:867-874.
16. Cramm JM, van Dijk HM, Nieboer AP. The importance of neighborhood social cohesion and social capital for the well being of older adults in the community. Gerontologist. 2013; 53:142-152.
17. Toma A, Hamer M, Shankar A. Associations between neighborhood perceptions and mental well-being among older adults. Health Place. 2015; 34:46-53.
18. Cramm JM, Nieboer AP. Social cohesion and belonging predict the well-being of community-dwelling older people. BMC geriatrics. 2015; 15:30.
19. Alfonzo MA. To walk or not to walk? The hierarchy of walking needs. Environment & Behavior. 2005; 37:808-836.
20. Dannenberg AL, Howard F, Jackson RJ. Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press, Washington, USA, 2011.
21. Leyden KM. Social capital and the built environment: The importance of walkable neighborhoods. Am J Public Health. 2003; 93:1546-1551.
22. Lund H. Testing the claims of new urbanism: Local access, pedestrian travel, and neighboring behaviors. J Am Plann Assoc. 2003; 69:414-429.
23. Rogers S, Halstead J, Gardner K, Carlson C. Examining walkability and social capital as indicators of quality of life at the municipal and neighborhood scales. Applied Research in Quality of Life. 2011; 6:201-213.
24. Smyth R, Nielsen I, Zhai Q. Personal well-being in urban China. Soc Indic Res. 2010; 95:231-251.
25. Wang P, Vanderweele TJ. Empirical research on factors related to the subjective well-being of Chinese urban residents. Soc Indic Res. 2011; 101:447-459.
26. Hsu HC, Chang WC, Chong YS, An JS. Happiness and social determinants across age cohorts in Taiwan. J Health Psychol. 2016; 21:1828-1839.
27. Deng J, Hu J, Wu W, Dong B, Wu H. Subjective well-being, social support, and age-related functioning among the very old in China. Int J Geriatr Psychiatry. 2010; 25:697-703.
28. Mak WW, Cheung RY, Law LS. Sense of community in Hong Kong: Relations with community-level characteristics and residents' well-being. Am J Community Psychol. 2009; 44:80-92.
29. Smyth R. Economic openness and subjective well-being in China. China & World Economy. 2010; 18:22-40.
30. Smyth R, Mishra V, Qian X. The environment and well-being in urban China. Ecological Economics. 2008; 68:547-555.
31. Gao J, Fu H, Li J, Jia Y. Association between social and built environments and leisure-time physical activity among Chinese older adults--a multilevel analysis. BMC public health. 2015; 15:1317.
32. International Wellbeing Group. Personal Wellbeing Index-Adult (Cantonese). The Australian Centre on Quality of Life, Deakin University, Australia, 2006. *http://www.deakin.edu.au/research/acqol/instruments/wellbeing-index.htm* (accessed July 10, 2017).
33. Mujahid MS, Diez Roux AV, Morenoff JD, Raghunathan T. Assessing the measurement properties of neighborhood scales: From psychometrics to ecometrics. Am J Epidemiol. 2007; 165:858-867.
34. Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. Science. 1997; 277:918-924.
35. Wen M, Hawkley LC, Cacioppo JT. Objective and perceived neighborhood environment, individual SES and psychosocial factors, and self-rated health: An analysis of

older adults in Cook County, Illinois. Soc Sci Med. 2006; 63:2575-2590.

36. Iecovich E, Cwikel J. The relationship between well-being and self-rated Health among middle-aged and older women in israel. Clinical Gerontologist. 2010; 33:255-269.

37. Macfarlane D, Chan A, Cerin E. Examining the validity and reliability of the Chinese version of the International Physical Activity Questionnaire, long form (IPAQ-LC). Public Health Nutr. 2011; 14:443-450.

38. Branco JC, Jansen K, Oses JP, de Mattos Souza LD, da Silva Alves Gdel G, Lara DR, da Silva RA. Practice of leisure-time physical activities and episodes of mood alteration amongst men and women. J Affect Disord. 2014; 169:165-169.

39. Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C, American College of Sports M, American Heart A. Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. Circulation. 2007; 116:1094-1105.

40. Wang J, Xie H, Jiang F. Multilevel models: Methods and aplications. Hiher Education Press, Beijing, China, 2008. (in Chinese).

41. WHO. Good health adds life to years Global brief for World Health Day 2012. WHO Publisher, Geneva, 2012.

42. Zhu YG, Ioannidis JP, Li H, Jones KC, Martin FL. Understanding and harnessing the health effects of rapid urbanization in China. Environ Sci Technol. 2011; 45:5099-5104.

43. Toma A, Hamer M, Shankar A. Associations between neighborhood perceptions and mental well-being among older adults. Health Place. 2015; 34:46-53.

44. Ball K, Bauman A, Leslie E, Owen N. Perceived environmental aesthetics and convenience and company are associated with walking for exercise among Australian adults. Prev Med. 2001; 33:434-440.

45. Cerin E, Lee KY, Barnett A, Sit CH, Cheung MC, Chan WM. Objectively-measured neighborhood environments and leisure-time physical activity in Chinese urban elders. Prev Med. 2013; 56:86-89.

46. Litt JS, Soobader MJ, Turbin MS, Hale JW, Buchenau M, Marshall JA. The influence of social involvement, neighborhood aesthetics, and community garden participation on fruit and vegetable consumption. Am J Public Health. 2011; 101:1466-1473.

47. Chi SH, Wang JY, Tsai AC. Combined association of leisure-time physical activity and fruit and vegetable consumption with depressive symptoms in older Taiwanese: Results of a national cohort study. Geriatr Gerontol Int. 2016; 16:244-251.

48. Fox K, Stathi A, McKenna J, Davis M. Physical activity and mental well-being in older people participating in the better ageing project. Eur J Appl Physiol. 2007; 100:591-602.

49. McAuley E, Blissmer B, Marquez DX, Jerome GJ, Kramer AF, Katula J. Social relations, physical activity, and well-being in older adults. Preventive medicine. 2000; 31:608-617.

50. Bond L, Kearns A, Mason P, Tannahill C, Egan M, Whitely E. Exploring the relationships between housing, neighbourhoods and mental wellbeing for residents of deprived areas. BMC public health. 2012; 12:48.

51. Lee GR, Ishii-Kuntz M. Social interaction, loneliness, and emotional well-being among the elderly. Res Aging. 1987; 9:459-482.

52. Nezlek JB, Richardson DS, Green LR, Schatten-Jones EC. Psychological well-being and day-to-day social interaction among older adults. Personal Relationships. 2002; 9:57-71.

53. Sampson RJ. Local friendship ties and community attachment in mass society: A multilevel systemic model. American Sociological Review. 1988; 53:766-779.

54. Mendes de Leon CF, Cagney KA, Bienias JL, Barnes LL, Skarupski KA, Scherr PA, Evans DA. Neighborhood social cohesion and disorder in relation to walking in community-dwelling older adults: A multilevel analysis. J Aging Health. 2009; 21:155-171.

55. Mcauley E, Rudolph D. Physical activity, aging, and psychological well-being. J Aging Phys Act. 1995; 3:67-96.

56. Oyserman D, Coon HM, Kemmelmeier M. Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses. Psychol Bull. 2002; 128:3-72.

57. Allik J, Realo A. Individualism-collectivism and social capital. J Cross Cult Psychol. 2004; 35:29-49.

58. Weden MM, Carpiano RM, Robert SA. Subjective and objective neighborhood characteristics and adult health. Soc Sci Med. 2008; 66:1256-1270.