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Is neighborhood social cohesion associated with subjective wellbeing for older Chinese people? The neighborhood social cohesion study

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Abstract

Objectives: We aimed to adapt the Neighborhood Cohesion Instrument (NCI) to a Hong Kong version (HK-NCI) that is linguistically valid for older Chinese, to evaluate the psychometric properties of HK-NCI, and to examine whether neighborhood social cohesion as measured using HK-NCI would be associated with three aspects of subjective wellbeing, including evaluative wellbeing (life satisfaction), hedonic wellbeing (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life).

Design: A cross-sectional study

Setting: Communities in two districts in Hong Kong

Participants: We recruited 301 community-dwelling Chinese people aged 60 years and older.

Outcome measures: Neighborhood social cohesion was measured using the HK-NCI. Three aspects of subjective wellbeing were measured including evaluative wellbeing (life satisfaction), hedonic wellbeing (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life). Linear regression models were used to examine the associations of two dimensions of neighborhood social cohesion (social cohesion and neighborhood belonging) with life satisfaction, feelings of happiness and sense of purpose and meaning in life.

Results: While social cohesion was positively associated with life satisfaction and sense of purpose and meaning in life ($p<0.05$) but not with feelings of happiness, neighborhood belonging was positively associated with all measures of subjective wellbeing ($p<0.01$). Associations were independent of socio-demographics, lifestyle, medical history and perceived neighborhood environments. Stratified analyses indicated that neighborhood social cohesion was more strongly associated with subjective wellbeing in young-old (60-69 years) and in women.

Conclusions: Enhancing neighborhood social cohesion is promising for promoting subjective wellbeing of older people. Neighborhood-based initiatives aiming to strengthen social cohesion and neighborhood belonging are expected to benefit subjective wellbeing among older people, especially as dependence on neighborhood resources increases with age.

Strengths and limitations of this study:

1. The ability to examine multiple measures of subjective wellbeing (evaluative, hedonic, and eudemonic wellbeing) using a sample of older Chinese.
2. The availability of a variety of potential confounders including socio-demographic, lifestyle factors, and perceived neighborhood friendliness.
3. The study was cross-sectional and therefore impossible to establish casual associations between neighborhood social cohesion and subjective wellbeing.
4. The results were subject to selection bias as sociable people might be more likely to participate in this study.
5. Self-reported and subjective measurements might cause information bias.

Keywords: Social cohesion, neighborhood belonging, life satisfaction, feelings of happiness, sense of purpose and meaning in life.

1. Introduction

Although life expectancy has been increasing in recent decades, it raises serious concerns about the consequences of longer lives, which are often related to negative outcomes such as multi-morbidity,[1] frailty,[2] disability,[3] mental disorders[4] and dependency.[5] However, population ageing will also be associated with positive outcomes and opportunities if the added years are lived in good health and high levels of wellbeing. A number of studies have also suggested that maintaining psychological wellbeing might be a protective factor for health, reducing the risk of chronic physical illness, maintaining function and independence and even promoting longevity.[6-9] Therefore, enhancing psychological wellbeing at advanced ages is important not only because it is thought to be a component of human flourishing, it may play an important role in maintaining health and physical function among older people.

Psychological wellbeing exists in two dimensions, subjective and objective, which comprises an individual's experience of their life as well as a comparison of life circumstances with social norms and values;[10] whereas subjective wellbeing consists of three major dimensions namely evaluative (life satisfaction), hedonic (emotions and feelings) and eudemonic (sense of purpose and meaning in life).[11] Numerous studies have examined the associations between determinants of subjective wellbeing. In general, socioeconomic status and health conditions are correlated more strongly with life satisfaction. Supportive relationships, particularly family relationships, are correlated more strongly with pleasant emotions.[12 13]

In recent years, the role of neighborhood environment, particularly neighborhood social cohesion, has gained much prominence in the public health literature because of its associations with various health outcomes, such as self-rated health,[14] stroke,[15] frailty[16] and mortality.[17 18] Several conceptual models have also suggested the importance of environmental determinants of health and wellbeing

among older people.[19 20] Distinguished from individual level social network, neighborhood social cohesion can be understood as patterns of social interaction among neighbors and the associated process of building shared values,[21 22] and that neighborhoods with high levels of social cohesion are expected to generate values such as interpersonal trust and norms of reciprocity,[21] which may be beneficial to the health and wellbeing of older people of the neighborhoods.

Neighborhood social cohesion, wellbeing[23-26] and mental health[27 28] are also related. Furthermore, neighborhood social cohesion could promote neighborhood resilience, and hence has been suggested to act as buffer against the adverse effects of living in deprived neighborhoods.[21 29] However, these studies have mostly been conducted in western countries and not focused in older people, who usually spend more time in their neighborhoods, as dependence on neighborhood resources increases with age.[30 31] Furthermore, it is still not known whether neighborhood social cohesion has any role in promoting psychological wellbeing in older Chinese people, who may differ significantly from Caucasians in terms of culture, lifestyle and body physiology. More importantly, several studies have demonstrated that life satisfaction declines in older age.[32 33] A recent study conducted in Hong Kong has also found that only a small proportion of the elderly participants found their life purposeful or meaningful,[34] although people in Hong Kong enjoy the highest life expectancy in the world. As such, examining the levels of perceived neighborhood social cohesion and their relationships with psychological wellbeing, taking into account of personal factors and neighborhood conditions simultaneously, will provide insight into what neighborhood attributes contributes to wellbeing among older people.

To study perceived neighborhood social cohesion and its relationships with psychological wellbeing in older Chinese population, relevant measures that are culturally appropriate are needed. Although measures of perceived neighborhood social cohesion relevant to general population (e.g.,

neighborhood cohesion instrument, NCI;[35] the Warwick-Edinburgh Mental Well-being Scale [36]) are available; these measures have not been adapted for an older Chinese population. In this study, we aimed to adapt the NCI to a Hong Kong version (HK-NCI) that is linguistically valid for older Chinese, to evaluate the psychometric properties of HK-NCI, and to examine whether neighborhood social cohesion as measured using HK-NCI would be associated with three aspects of subjective wellbeing, including evaluative wellbeing (life satisfaction), hedonic wellbeing (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life). Findings could be used as reference to inform interventions aiming to strength neighborhood social cohesion among older adults within neighborhoods, which in turn improve their health and wellbeing.

2. Materials and Methods

2.1 Translation of the NCI

In the present study, the NCI was translated from English to Cantonese. This involves two independent forward translations from English to Cantonese, after which a Cantonese native speaker reconciles these two Cantonese translated versions. A back translation was then performed from Cantonese to English. The original English version and the back translated version was examined by a group of bilingual experts examined resolve discrepancies in the meaning of the scale items. In addition, a pilot test was conducted among 10 older people with the trial Hong Kong version of NCI (HK-NCI), and modifications were made according to the participants' feedback on the items.

2.2 Participants

To evaluate the psychometric properties of the HK-NCI and to examine the associations between neighborhood social cohesion and subjective wellbeing, a community survey was conducted in two selected districts of Hong Kong, including Sha Tin and Tai Po. The two districts are located in the New Territories of Hong Kong, with their population estimated at 659,794 and 303,926 in 2016, respectively.[37] They were chosen for the study because they have a mix of neighborhood types ranging from mixed-use town centers to areas covering traditional villages. For this study, a neighborhood was defined as a spatial unit within which urban residents share similar socioeconomic and cultural identities. Neighborhood boundaries were delineated using the government web map portal, GeoInfo Map (http://www1.map.gov.hk/gih3/view/index.jsp). Major roads and waterways served as barriers to movement and communication and therefore served as logical boundaries of the neighborhood.

Three hundred and one community-dwelling Chinese men and women aged 60 years and older were recruited in the survey between June and August 2017. Participants were recruited by placing

recruitment notices in housing estates and elderly community centres. Several talks were also given at the centres explaining the purpose and interviews to be carried out. An age-stratified sample of volunteers was recruited, so that approximately 50% of the participants would be aged 60–69, 30% would be aged 70–79, and 20% would be aged 80 years and older, according to the age structure of the mid-year population (aged 60 years and older) of Hong Kong, 2016. To be eligible to take part in the survey, participants needed to be aged 60 years and older, able to walk, and able to speak Cantonese. A team of trained research assistants administered the questionnaire for each participant face-to-face. All participants gave written consent, and the study was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong (026-16). The study was performed in compliance with the declaration of Helsinki.

2.3 Study instruments, outcome measures, and covariates

Neighborhood cohesion instrument

Neighborhood social cohesion was measured using the 15-item HK-NCI which was originally developed by Buckner et al.,[35] and modified by Fone et al.[21 38] HK-NCI (listed in supplementary table 1) consists of two sub-scales measuring social cohesion (8 items) and neighborhood belonging (7 items). Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores of HK-NCI were computed by taking the average of the 15 items (items 7 and 11 were reverse scored). Higher scores on the HK-NCI represent higher degrees of perceived neighborhood social cohesion. The original 18-item NCI (developed by Buckner et al.) and the 15-item (modified by Fone et al.) versions have been used cross-culturally and has demonstrated good internal consistency (Cronbach's alpha: 0.84 – 0.95).[16 35 39]

Social cohesion scale

The five-item Social Cohesion Scale (SCS) was also used to measure neighborhood social cohesion.[40] Participants were asked how strongly they agreed that "people around here are willing to help their neighbors", "this is a close-knit neighborhood", "people in this neighborhood can be trusted", "people in this neighborhood generally do not get along with each other", "people in this neighborhood do not share the same values". Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores were computed by taking the average of the five items (the last two statements were reverse coded). Higher scores on the SCS represent higher degrees of perceived neighborhood social cohesion.

Brief sense of community scale

Sense of community was measured by an eight-item Brief Sense of Community Scale (BSOC),[41] which was designed to assess the dimensions of needs fulfillment, group membership, influence, and emotional connection defined in the McMillan and Chavis' (ibid) model. Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores were computed by taking the sum of the eight items. Higher scores on the BSOC represent higher degrees of perceived sense of community.

Subjective wellbeing

Three aspects of subjective wellbeing were measured including evaluative wellbeing (life satisfaction), hedonic wellbeing (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life). Life satisfaction was measured with a single item, "Overall, how satisfied are you with life as a whole these days?" which participants rated on a scale from 0 as "not at all satisfied" to 10 as "completely satisfied".[42] Feelings of happiness was measured with a single item, "How happy did you feel yesterday?" which participants rated on a scale from 0 as "not at all happy" to 10 as "completely happy".[42] Sense of purpose and meaning in life was measured with a single

item, "Do you feel your life has an important purpose or meaning?" which participants rated on a scale from 0 as "not at all worthwhile" to 10 as "completely worthwhile".[42]

Covariates

Socio-demographics characteristics (age, sex, marital status, education, employment status, income financial difficulties, type of housing, and length of residence), health conditions (number of doctor-diagnosed chronic diseases), and lifestyle and health behaviors (physical activity, smoking, and alcohol intake) were collected. Participants were also asked to report their perceived neighborhood friendliness based on 14 items covering eight neighborhood dimensions: outdoor spaces and buildings (2 items), transportation (2 items), housing (2 items), social participation (1 item), respect and social inclusion (2 items), civic participation and employment (3 items), communication and information (1 item), and community support and health services (1 item), with reference to the checklist of the essential features of age-friendly cities developed by the World Health Organization.[43] Participants indicated agreement with items on a 6-point Likert scale (1 strongly disagree to 6 strongly agree) and the mean score was calculated, with higher the score, the higher level of perceived neighborhood friendliness.

2.4 Data analysis

Continuous variables are presented as mean values and standard deviation, and the categorical variables are presented as number and percentage. Internal consistency analyses (Cronbach's α) were conducted to test homogeneity of the HK-NCI scale and its 2 subscales. The stability (test-retest reliability) of the HK-NCI scale was determined by intra-class correlation coefficients (ICC). Construct validity was estimated by Pearson's correlation coefficients between total score and sub-scores of HK-NCI and total score of SCS, as well as between total score and sub-scores of HK-NCI and total score of BSOC. Multivariate regression models were used to examine associations between

neighborhood social cohesion and wellbeing (life satisfaction, feelings of happiness, and sense of purpose and meaning in life). These associations were adjusted for personal characteristics and perceived neighborhood friendliness. Participants were excluded if there are observations missing for any outcome measure. A P <0.05 will be used to denote significant difference. All analyses will be performed with SPSS version 24.0 (SPSS Inc, Chicago, IL, USA).

3. Results

Characteristics of participants

Table 1 presents characteristics of participants. The mean age of the participants was 72 years, with the majority aged from 60 to 69 (46.5%). The proportion of women was 59.8%, and 68.0% were married. Participants who lived in village, who knew more than five of their neighbors by name, perceived their neighborhood friendly, and were being more physical active had a significantly higher level of neighborhood social cohesion ($P < 0.05$ – <0.001.)

Psychometric properties of the HK-NCI

The mean score of entire HK-NCI was 3.80, with higher sub-scores in 'neighborhood belonging' (4.15), but lower sub-score in 'social cohesion' (3.49). For homogeneity, internal reliabilities of total 15-item HK-NCI (α = 0.813), HK-NCI-SC (α = 0.763), HK-NCI-NB (α = 0.715) were all good. For stability (test-retest reliability), the averages of mean scores of the 15 items suggested an acceptable repeatability with an ICC = 0.701 (n = 38, 95% CI = 0.497, 0.832) (Table 2).

The Pearson's correlation coefficients between total score and sub-scores of C-NCI and total scores of SCS and BSOC are shown in Table 3. There were positive correlations between total score and

sub-scores of HK-NCI and total scores of SCS (P <0.001, r = 0.515 to 0.635), as well as between total score and sub-scores of HK-NCI and total score of BSOC (P <0.001, r = 0.500 to 0.612). HK-NCI scores were also positively associated with number of neighbors (P <0.001).

Associations between neighborhood social cohesion and subjective wellbeing

Table 4 shows the results of the associations of HK-NCI with measures of subjective wellbeing. In Model 1 (crude model), neighborhood social cohesion (total score) was significantly associated with all measures of subjective wellbeing. Adjustment for socio-demographics (Model 2) did not alter the results. Controlling for the additional covariates of lifestyle factors and medical history did not attenuate the associations of cohesion with measures of subjective well-being. An additional model that included n = 225 (74.75%) of subjects with data regarding perceived neighborhood friendliness also showed a strong and positive association (P = 0.004 - 0.001).

Table 4 also shows the associations of each HK-NCI sub-score with measures of well-being. After multivariable adjustments (Model 4), social cohesion sub-score was positively associated with life satisfaction and sense of purpose and meaning in life (both P<0.05), but not with feelings of happiness. Neighborhood belonging sub-score was positively associated with all measures of wellbeing (all P <0.01).

We also stratified our participants according to age-group and sex (Table 5). In the age-stratified analysis, the association between neighborhood social cohesion and measures of wellbeing remained significant in young-old (all P<0.05), but not in old-old. In the sex-stratified analysis, the association between neighborhood social cohesion and life satisfaction remained significant in both men and women (P<0.05). However, the associations of cohesion with feelings of happiness and sense of purpose and meaning in life remained significant in women (P<0.01), but not in men.

4. Discussion

Neighborhood environment has been identified as an important aspect of older people's health and wellbeing. However, research on the effects of neighborhood social cohesion on older people's wellbeing is in its infancy. We examined the psychometric properties of the Hong Kong version of the NCI (HK-NCI), and related it with three dimensions of subjective wellbeing including life satisfaction, feelings of happiness and sense of purpose and meaning in life in a survey among community-dwelling older Chinese people. Input from a panel of experts and elderly volunteers indicated that all translated items of the HK-NCI were well understood. Psychometric testing supported the reliability and validity of the HK-NCI. Overall, our findings suggested that HK-NCI is appropriate for use in the measurement of neighborhood social cohesion in future studies in older Chinese people.

The present study also found that neighborhood social cohesion was positively associated with the three dimensions of subjective wellbeing, consistent with results of other studies that have also investigated the associations of neighborhood social cohesion with wellbeing[23-26] and mental disorders.[27 28] The associations between neighborhood social cohesion and measures of wellbeing being observed in the present study were independent of personal factors, suggesting that neighborhood social cohesion captured a phenomenon distinct from individual-level attributes. Even after adjusting for perceived neighborhood friendliness, which influences neighborhood social cohesion and the potential pathways by which perceived neighborhood social cohesion may protect against psychological wellbeing, neighborhood social cohesion was positively associated with the three dimensions of subjective wellbeing. When we repeated the analyses by using the social cohesion and the neighborhood belonging sub-scores, both social cohesion and neighborhood

belonging were positively associated with life satisfaction and a sense of purpose and meaning in life, with neighborhood belonging showing stronger associations.

There are several pathways that may link neighborhood social cohesion to improved psychological wellbeing. For example, perceived neighborhood social cohesion, particularly relationships with neighbors could be viewed as a type of social support, which might affect health outcomes and psychological wellbeing by facilitating access to health information and services.[44] Neighborhood social cohesion might also influence wellbeing through the enhancement of mutual trust and emotional support.[40 45] A number of qualitative studies have indicated that neighbors can serve as a central source of support and meaning in adults' lives,[46] in particular people who experience a sense of loss.[47] Furthermore, helping with the neighbors may increase the sense of meaning. Supplementary analyses of our data revealed that participants with higher score on "I borrow things and exchange favors with my neighbor" had a higher score of sense of purpose and meaning in life (data not shown). Findings based on an American study of successful ageing has also demonstrated that factors related to contributions (i.e., volunteering, informal helping of the neighbors) likely increases social connectedness that have been consistently found to be associated with psychological wellbeing.[48] The sense of neighborhood belonging may also provide a positive identity and a sense of inclusion for older adults that are responsible for the beneficial effect on wellbeing, in particular eudemonic wellbeing.[49] However, our findings demonstrated that only the neighborhood belonging sub-score but not the social cohesion sub-score was associated with feelings of happiness. This may partially reflect that relationships with neighbors might not be as psychologically central as other relationships with family and friends that influence hedonic wellbeing.

Although our findings demonstrated significant associations between neighbor relationships and subjective wellbeing concerning life satisfaction and sense of purpose and meaning in life, getting acquainted with neighbors is not a common practice in Hong Kong nowadays. Therefore, our findings provide support for the development of neighborhood-based initiatives or interventions that focus on developing and strengthening relationships with neighbors and sense of belonging to promote psychological wellbeing in advanced ages. Furthermore, it may be important to consider not just how older people perceived supports but also how they contribute to their neighborhoods, given the preliminary association observed between "helping with the neighbors" and sense of purpose and meaning in life.

Our findings also demonstrated that neighborhood social cohesion was more strongly associated with measures of subjective wellbeing in young-old and in women. One possible explanation for these findings may be due to those in the younger age groups and women were more likely to participate in locally organized groups and community activities, and more often offer support to neighbors; and therefore benefit more from cohesion / social network than those in the older age groups or men do. Therefore, it is important to take age group and sex into account when considering any associations of neighborhood social cohesion with wellbeing. Neighborhood-based interventions need to be tailored to the demographic characteristics of participants, and also their preferences and requirements, since young-old and old-old as well as men and women may experience and respond to community services/activities in different ways. Additionally, supplementary analyses of our data found that individuals with a higher perceived neighborhood friendliness score had a higher neighborhood belonging sub-score and a higher sense of meaning in life (data not shown). These findings could inform planning policy relating to neighborhood design in enhancing wellbeing in ageing populations.

A major strength of this study was the ability to examine multiple measures of subjective wellbeing (evaluative, hedonic, and eudemonic wellbeing) using a sample of older Chinese. A further strength of this study is the availability of a variety of potential confounders including socio-demographic, lifestyle factors, and perceived neighborhood friendliness. Nevertheless, the present study has several limitations. First of all, the study was cross-sectional and therefore impossible to establish casual associations between neighborhood social cohesion and subjective wellbeing. We could not conclude whether neighborhood social cohesion results in better subjective wellbeing or vice versa. Secondly, the results were subject to selection bias as sociable people might be more likely to participate in this study. Individuals that are most frail and who consider themselves to be in a very poor state of health might have been neglected as these individuals are more likely to remain at home than those that are in a better state of physical and mental health. Thirdly, self-reported and subjective measurements might cause information bias. People with poor health and wellbeing might view the world pessimistically and report their neighborhood cohesion level lower than actual level. In addition, the Hong Kong version of NCI validated in this study translated the term 'neighborhood' into 'community' in Chinese (item 2-3, 6, 8-15), but the word 'neighbor' was literally translated. However, this modification was common place among researchers since respondents could think more about 'community' instead of simply several specific neighboring behaviors surrounding.[50]

In conclusion, our findings suggested that the HK-NCI has adequate levels of internal consistency and test-retest reliability and can be used in studies of neighbourhood social cohesion in older Chinese. The results of our study have also shown that neighbourhood social cohesion is linked to three aspects of subjective wellbeing amongst the elderly, demonstrating the importance of neighbourhood social cohesion for psychological wellbeing among community-dwelling older

people. These findings could have important implications towards improving psychological wellbeing of the increasing ageing population in Hong Kong by showing in details what aspects of neighbourhood environment could have effects upon subjective wellbeing for older people. Our findings also allow us to refine ideas about the processes by which neighbourhood social cohesion may be linked to subjective wellbeing. Our findings lay a path for further research to examine the potential pathways by which perceived neighbourhood social cohesion may enhance subjective wellbeing, which would promote positive ageing, reduce the growing burden on health and community services and help older people remain in their communities.

Conflicts of interests

The authors declare that they have no completing interest.

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Author Statement

RY wrote the manuscript. OC and JC participated in the data collection and analysis. RY and JW designed the study. All authors read and approved the manuscript.

Data sharing statement

No additional unpublished data.

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Table 1 Baseline characteristics (N = 301)

Variables	N (%)	HK-NCI score Mean ± SD	*P*[a]
Age group, years (Range: 60–95)			
60–69	140 (46.51)	3.82 ± 0.47	0.889
70–79	94 (31.23)	3.78 ± 0.52	
≥80	67 (22.26)	3.79 ± 0.62	
Sex			
Men	121 (40.20)	3.73 ± 0.58	0.067
Women	180 (59.80)	3.84 ± 0.47	
Marital status			
Married	204 (68.00)	3.78 ± 0.52	0.261
Never/widowed/divorced/separated	96 (32.00)	3.85 ± 0.51	
Education			
Uneducated/pre-school/primary education	166 (55.15)	3.83 ± 0.55	0.256
Secondary/tertiary education	135 (44.85)	3.76 ± 0.48	
Employment			
Unemployed	277 (92.33)	3.80 ± 0.52	0.719
Employed (part-time/full-time)	23 (7.67)	3.84 ± 0.58	
Income, Hong Kong dollars			
<4000	91 (30.74)	3.83 ± 0.51	0.341
4000–7999	98 (33.11)	3.74 ± 0.50	
≥8000	107 (36.15)	3.84 ± 0.51	
Housing type			
Private high-rise housing	76 (25.25)	3.67 ± 0.42	<0.001
Tenement housing	30 (9.97)	3.61 ± 0.56	
Subsidized housing	43 (14.29)	3.72 ± 0.48	
Public housing	120 (39.87)	3.87 ± 0.50	
Village housing	32 (10.63)	4.13 ± 0.64	
Living arrangement			
Living with others	244 (81.06)	3.80 ± 0.50	0.839
Living alone	57 (18.94)	3.79 ± 0.60	
Length of residence, years (Range: 0.5–78)			
<10	47 (15.61)	3.69 ± 0.60	0.059
10–19	37 (12.29)	3.66 ± 0.64	
20–29	100 (33.22)	3.85 ± 0.44	
30–39	85 (28.24)	3.89 ± 0.47	
≥40	32 (10.63)	3.72 ± 0.56	
Number of neighbor with known names (Range: 0–55)			
0	45 (15.10)	3.46 ± 0.62	<0.001[b]
1–4	98 (32.89)	3.64 ± 0.48	
≥5	155 (52.01)	4.00 ± 0.41	
Perceived neighborhood friendless			
1st tertile	76 (33.04)	3.78 ± 0.65	0.030[b]
2nd tertile	77 (33.48)	3.81 ± 0.40	
3rd tertile	77 (33.48)	3.98 ± 0.41	
Current smoker			
No	284 (94.67)	3.81 ± 0.52	0.299
Yes	16 (5.33)	3.67 ± 0.56	
Current drinker			
No	263 (87.67)	3.80 ± 0.52	0.706
Yes	37 (12.33)	3.83 ± 0.49	
Physical activity			
<1 hour/day	155 (51.50)	3.69 ± 0.54	<0.001
≥1 hour/day	146 (48.50)	3.92 ± 0.47	
Medical history			
<5 diseases	258 (85.71)	3.81 ± 0.52	0.230
≥5 diseases	43 (14.29)	3.71 ± 0.52	

[a] *P*-values refer to HK-NCI score with *t*-test between binary groups, and ANOVA test between ≥3 groups.
[b] *P*-values refer to HK-NCI score with linear test between 3 groups.

Table 2 Reliability of HK-NCI by internal consistency and test-retest reliability

HK-NCI total and sub-scores	Mean ± SD	Internal consistency Cronbach's alpha	Test-retest reliability[a] Intra-class correlation (95% CI)
HK-NCI-Total	3.80 ± 0.52	0.813	0.701 (0.497, 0.832)
HK-NCI-SC	3.49 ± 0.67	0.763	-
HK-NCI-NB	4.15 ± 0.52	0.715	-

Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion (item 1, 2, 3, 4, 5, 6, 7, 8); NB, neighborhood belonging (item 9, 10, 11, 12, 13, 14, 15).

[a] Sample size for test-retest reliability is n = 38.

Table 3 Construct validity of HK-NCI by Pearson's correlations between HK-NCI, SCS and BSOC

	Pearson's correlation coefficients	
HK-NCI total and sub-scores	**SCS**	**BSOC**
HK-NCI-Total	0.635***	0.612***
HK-NCI-SC	0.575***	0.500***
HK-NCI-NB	0.515***	0.576***

***P-value <0.001.

Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion; NB, neighborhood belonging; SCS, Social cohesion scale; BSOC, Brief sense of community scale.

Table 4 Association of Subjective well-being and HK-NCI total and sub-scores

HK-NCI total and sub-scores	Subjective well-being	Model 1 β (*P*)	Model 2 β (*P*)	Model 3 β (*P*)	Model 4 β (*P*)
HK-NCI-Total	Life satisfaction	1.038 (<0.001)	1.085 (<0.001)	1.090 (<0.001)	0.870 (0.002)
	Happiness	1.030 (<0.001)	1.069 (<0.001)	1.095 (<0.001)	0.886 (0.004)
	Sense of purpose and meaning in life	0.874 (<0.001)	0.772 (<0.001)	0.790 (<0.001)	0.830 (0.001)
HK-NCI-SC	Life satisfaction	0.568 (0.001)	0.641 (<0.001)	0.637 (<0.001)	0.493 (0.023)
	Happiness	0.424 (0.018)	0.511 (0.007)	0.523 (0.007)	0.371 (0.113)
	Sense of purpose and meaning in life	0.459 (0.002)	0.445 (0.004)	0.458 (0.004)	0.544 (0.003)
HK-NCI-NB	Life satisfaction	1.155 (<0.001)	1.098 (<0.001)	1.097 (<0.001)	0.797 (0.003)
	Happiness	1.418 (<0.001)	1.314 (<0.001)	1.327 (<0.001)	1.045 (<0.001)
	Sense of purpose and meaning in life	1.010 (<0.001)	0.801 (<0.001)	0.802 (<0.001)	0.628 (0.007)

Model 1: Crude model.
Model 2: Linear regression model adjusted for age, sex, marital status, education, employment status, income, type of housing and length of residence.
Model 3: Linear regression model adjusted for age, sex, marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities and medical history.
Model 4: Linear regression model adjusted for age, sex, marital status, education, employment status, income, type of housing, length of residence, physical activities, current smoker, current drinker, medical history and perceived neighborhood friendliness.
Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion; NB, neighborhood belonging.

Table 5 Association of Subjective well-beingand HK-NCI score by age group and sex

Sub-groups	Subjective well-being	Model 1 β (*P*)	Model 2 β (*P*)	Model 3 β (*P*)	Model 4 β (*P*)
Young-old (n = 140)	Life satisfaction	1.360 (<0.001)	1.347 (<0.001)	1.240 (<0.001)	1.058 (0.005)
	Happiness	1.233 (<0.001)	1.300 (0.001)	1.288 (0.001)	1.245 (0.008)
	Sense of purpose and meaning in life	1.073 (<0.001)	0.926 (0.002)	0.878 (0.003)	0.843 (0.014)
Old-old (n = 161)	Life satisfaction	0.846 (0.005)	0.930 (0.005)	0.963 (0.005)	0.599 (0.176)
	Happiness	0.918 (0.003)	0.911 (0.007)	0.942 (0.007)	0.393 (0.379)
	Sense of purpose and meaning in life	0.768 (0.003)	0.718 (0.010)	0.707 (0.013)	0.690 (0.053)
Men (n = 121)	Life satisfaction	1.349 (<0.001)	1.226 (<0.001)	1.146 (0.001)	0.927 (0.041)
	Happiness	1.280 (<0.001)	0.988 (0.003)	1.014 (0.004)	0.813 (0.073)
	Sense of purpose and meaning in life	0.771 (0.003)	0.502 (0.057)	0.467 (0.091)	0.436 (0.215)
Women (n = 180)	Life satisfaction	0.757 (0.015)	1.017 (0.002)	1.076 (0.001)	0.975 (0.019)
	Happiness	0.743 (0.031)	1.112 (0.002)	1.157 (0.002)	1.090 (0.017)
	Sense of purpose and meaning in life	0.934 (0.001)	1.040 (0.001)	1.080 (<0.001)	1.310 (<0.001)

Model 1: Crude model.
Model 2: Linear regression model adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, and length of residence.
Model 3: Linear regression model adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities and medical history.
Model 4: Linear regression model adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, length of residence, physical activities, current smoker, current drinker, medical history and perceived neighborhood friendliness.

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Is neighborhood social cohesion associated with subjective wellbeing for older Chinese people? The neighborhood social cohesion study

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Is neighborhood social cohesion associated with subjective wellbeing for older Chinese people? The neighborhood social cohesion study

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Abstract

Objectives: To evaluate the psychometric properties of the Hong Kong version of Neighborhood Cohesion Instrument (HK-NCI) and examine whether neighborhood social cohesion as measured using HK-NCI would be associated with evaluative, hedonic, and eudemonic wellbeing.

Design: A validation analysis followed by a cross-sectional analysis of a community-based survey

Setting: Communities in two districts (Sha Tin and Tai Po) in Hong Kong

Participants: We recruited 301 community-dwelling Chinese men and women aged 60 years and older normally residing in Sha Tin or Tai Po for not less than six consecutive months at the time of participation in the study.

Measurements: Neighborhood social cohesion was measured using the 15-item HK-NCI. The Social Cohesion Scale (SCS) and the Brief sense of community scale (BSCS) were administered for assessing the validity of the HK-NCI. Evaluative (life satisfaction), hedonic (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life) were measured. Sociodemographic characteristics, lifestyle and health behaviors, and medical history were collected as covariates.

Results: For homogeneity, internal reliability of HK-NCI (α=0.8) was good. For stability (test-retest reliability), the averages of mean scores of the 15 items suggested an acceptable repeatability with an ICC=0.7 (95% CI=0.5-0.8). HK-NCI was correlated with SCS (r=0.515-0.635, p<0.001) and BSCS (r=0.500-0.612, p<0.001). Neighborhood social cohesion as measured by the HK-NCI was positively and independently associated with life satisfaction, feelings of happiness, and sense of purpose and meaning in life (all p<0.05). Stratified analyses indicated that neighborhood social cohesion was more strongly associated with sense of purpose and meaning in life in women.

Conclusion: The HK-NCI has adequate levels of internal consistency and test-retest reliability. In addition, greater neighborhood social cohesion is associated with better subjective wellbeing amongst the elderly.

Strengths and limitations of this study:

1. The ability to examine multiple measures of subjective wellbeing (evaluative, hedonic, and eudemonic wellbeing) using a sample of older Chinese.
2. The availability of a variety of potential confounders including socio-demographic, lifestyle and health behaviors, and medical history.
3. The study was cross-sectional and therefore impossible to establish casual associations between neighborhood social cohesion and subjective wellbeing.
4. The results were subject to selection bias as sociable people might be more likely to participate in this study.
5. Self-reported and subjective measurements might cause information bias.

Keywords: Social cohesion, neighborhood belonging, life satisfaction, feelings of happiness, sense of purpose and meaning in life, ageing.

1. Introduction

Although advancing age is often associated with physical and cognitive decline, which are negatively associated with wellbeing;[1] impaired wellbeing is also associated with the development of poor health. For example, results from longitudinal studies suggest that lower levels of wellbeing were associated with frailty,[2] mild cognitive impairment and Alzheimer's disease,[3] and mortality.[4] Therefore, understanding factors that contribute to wellbeing of older people is important, as this might allow appropriate interventions to be implemented.

Among the contributory factors of wellbeing, socioeconomic characteristics (e.g., marital status, income, and socioeconomic status) have been mostly studied and their contributions to wellbeing are well established;[5] however, the role of contextual and environmental factor, such as neighborhood social cohesion, remains understudied. Distinguished from individual level social network, neighborhood social cohesion characterizes the entire community and exerts impacts on the whole neighborhood. There is no consensus regarding the definition of neighborhood social cohesion. However, neighborhood social cohesion can be understood as patterns of social interaction among neighbors and the associated process of building shared values;[6 7] or a state of affairs concerning both the vertical and the horizontal interactions among members of society as characterized by a set of attitudes and norms that includes trust, a sense of belonging and the willingness to participate and help, as well as their behavioral manifestations.[8] Hence, neighborhoods with high levels of social cohesion are expected to generate values such as interpersonal trust and norms of reciprocity,[6] which may be beneficial to the health and wellbeing of older people of the neighborhoods.

In recent years, the role of neighborhood social cohesion has gained much prominence in the public health literature because of its associations with various health outcomes, such as self-rated health,[9] myocardial infarction,[10] stroke,[11] frailty,[12] and mortality.[13 14] Furthermore, neighborhood social cohesion has been associated with mental health and wellbeing,[15-20] with low levels of neighborhood social cohesion associated with increased depression, stress, and anxiety, whereas high levels of neighborhood social cohesion associated with improved wellbeing, independent of individual-level characteristics. These findings suggest that positive wellbeing is attributable to neighborhood social cohesion and not to the absence of diseases.

Although the exact mechanisms responsible for the associations between neighborhood social cohesion and positive wellbeing are unknown, there are several pathways that may link neighborhood social cohesion to positive wellbeing. For example, perceived neighborhood social cohesion, particularly relationships with neighbors could be viewed as a type of social support, which might affect health outcomes and wellbeing by facilitating access to health information and services.[21] Neighborhood social cohesion might also influence wellbeing through the enhancement of mutual trust and emotional support.[22 23] A number of qualitative studies have indicated that neighbors can serve as a central source of support and meaning in adults' lives,[24] in particular people who experience a sense of loss.[25] Furthermore, neighborhood social cohesion plausibly can offset the negative effects of stressors on mental health by facilitating access to networks and services that influence health, social and emotional support. For example, in a Japanese prospective study, high neighborhood cohesion partially reduced the deleterious effect of anticipated daily stressors on older residents' depressive mood.[26] Evidence from a British longitudinal cohort study has also suggested that the adverse effect of neighborhood deprivation on mental health was significantly reduced in high social cohesion neighborhoods.[6 27] However, the

majority of the studies examining the link between neighborhood social cohesion and wellbeing have not focused on older people, who usually spend more time in their neighborhoods, as dependence on neighborhood resources increases with age.[28 29]

Compared to other countries, Hong Kong has the longest life expectancy. The lengthening of life is partially contributed by Hong Kong's medical system and elderly welfare. However, levels of wellbeing (as measured by a sense of purpose and meaning in life) of older people in Hong Kong were relatively low, based on a comparative analysis of a multi-dimensional index assessing the social and economic wellbeing of elderly populations in over 90 countries.[30] The low level of wellbeing could possibly be explained by the low level of neighborhood social cohesion.

In order to examine the association between neighborhood social cohesion and wellbeing in older Chinese people, relevant measures of neighborhood social cohesion that are culturally appropriate are needed. A literature search on the measurement of perceived neighborhood social cohesion found various validated inventories and scales, for example, the Neighborhood Cohesion Instrument (NCI),[31] the Social Cohesion Scale (SCS),[22] and the 4-item scale developed and tested for use in two nationally representative studies of older adults (the Health and Retirement Study and the English Longitudinal Study of Aging).[32] However, these inventories or scales have not been adapted for an older Chinese population.

Therefore, the objectives of the present study were: 1) to adapt the NCI to a Hong Kong version (HK-NCI) that is linguistically valid for older Chinese and to evaluate the psychometric properties of HK-NCI, 2) to examine whether neighborhood social cohesion (including its two domains: social cohesion

and neighborhood belonging) as measured using HK-NCI would be associated with three aspects of subjective wellbeing, including evaluative wellbeing (life satisfaction), hedonic wellbeing (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life), even after adjusting for individual-level factors such as sociodemographic characteristics, lifestyle and health behaviors, and medical history and 3) to examine whether the association between neighborhood social cohesion and subjective wellbeing varied by age and sex. This is because previous studies have indicated that wellbeing does not necessarily decrease with age.[33] For example, a review of cross-sectional data from 63 countries revealed that life satisfaction is relatively stable across age groups in most societies.[34] Similarly, a study of 60 countries finds a U-shaped relationship between life satisfaction and age.[35] Furthermore, older men and women differ with respect to subjective wellbeing,[36] possibly because older women are older and more likely to be widowed.

2. Methods

2.1 Sampling

The neighborhood cohesion study was established in order to investigate the impact of neighborhood social cohesion on health and wellbeing of older people. A cross-sectional survey of older people was conducted between June and August 2017 to validate HK-NCI and to examine the association between neighborhood social cohesion and subjective wellbeing. A convenience sampling method was employed and the survey was designed to interview approximately 150 community-dwelling local residents aged 60 years and above from each of the two districts (Sha Tin and Tai Po) of Hong Kong, where the whole territory is divided into 18 districts at present. Both Sha Tin and Tai Po are located in the New Territories of Hong Kong, with their population estimated at 659,794 and 303,926 in 2016, respectively.[37] Considering the geographical heterogeneity in terms of socioeconomic characteristics, seven neighborhoods in the two districts were chosen according to the neighborhood types (ranging from mixed-use town centers to areas covering traditional villages) and the predominant type of housing (ranging from private housing to public housing) therein as proxy of socioeconomic status. The seven neighborhoods were Sha Tin Town Centre, Lek Yuen & Wo Che, Ma On Shan Town Centre, Yee Fu & Kwong Fuk, Tai Po Centre, Tai Po Hui & Old Market, and Lam Tsuen Valley, which are represented by a range of typical housing types in different settings (private/subsided/public housing in town centers, tenement housing in old urban core, village house in low-to mid-density areas). For example, Sha Tin Town Centre, Ma On Shan, Town Centre, and Tai Po Centre are areas which accommodate private, subsided, and public housing, supplemented with commercial and open space to form a mixed-use development pattern. Lek Yuen & Wo Che and Yee Fu & Kwong Fuk are areas which accommodate predominantly public rental housing supported by essential infrastructure and community facilities. Tai Po Hui & Old Market are clustered around tenement housing. Lam Tsuen Valley is situated in the west

of Tai Po, an area covering both traditional villages and new residential housing. Hence, the study population would include older people living in both urban and rural areas with different socioeconomic profiles. For this study, a neighborhood was defined as a spatial unit within which residents share similar socioeconomic and cultural identities. Neighborhood boundaries were delineated using the government web map portal, GeoInfo Map (http://www1.map.gov.hk/gih3/view/index.jsp). Major roads and waterways served as barriers to movement and communication and therefore served as logical boundaries of the neighborhood.

2.2 Participants

Three hundred and one community-dwelling Chinese men and women aged 60 years and older were recruited in the survey. Participants were recruited by placing recruitment notices in housing estates and elderly community centres. Several talks were also given at the centres explaining the purpose and interviews to be carried out. An age-stratified sample of volunteers was recruited, so that approximately 50% of the participants would be aged 60–69, 30% would be aged 70–79, and 20% would be aged 80 years and older, according to the age structure of the mid-year population (aged 60 years and older) of Hong Kong, 2016. To be eligible to take part in the survey, participants needed to be aged 60 years and older, able to walk, able to speak Cantonese, and normally residing in Sha Tin or Tai Po for not less than six consecutive months at the time of participation in the study. Institutionalized persons, foreign domestic helpers, and individuals who were mentally incapable to communicate were excluded. A team of trained research assistants administered the questionnaire for each participant face-to-face. All participants gave written consent, and the study was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong (026-16). The study was performed in compliance with the declaration of Helsinki.

2.3 Adaptation of the neighborhood cohesion inventory

The NCI, originally developed by Buckner et al.[31] and modified by Fone et al.,[6 38] has been used cross-culturally with good internal consistency (Cronbach's alpha: 0.84 – 0.95).[10 29 39] In the present study, the NCI was translated from English to Cantonese involving two independent forward translations (from English to Cantonese), after which a Cantonese native speaker reconciled the two Cantonese translated versions. A back translation was then performed from Cantonese to English. The original English version and the back translated version were examined by a group of bilingual experts examined resolve discrepancies in the meaning of the scale items. A pilot test was conducted among 10 older people with the trial Hong Kong version of NCI (HK-NCI), and modifications were made according to the participants' feedback on the items.

The HK-NCI consists of two sub-scales measuring social cohesion (8 items, HK-NCI-SC) and neighborhood belonging (7 items, HK-NCI-NB). All items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores of HK-NCI were computed by taking the average of the 15 items (items 7 and 11 were reverse scored). Higher scores on the HK-NCI represent higher degrees of perceived neighborhood social cohesion.

To assess the construct validity of the HK-NCI, the Social Cohesion Scale (SCS)[22] and the Brief sense of community scale (BSCS)[40] were administered to each participants at the same interview. The five-item SCS was designed to measure neighborhood social cohesion. Participants were asked how strongly they agreed that "people around here are willing to help their neighbors", "this is a close-knit neighborhood", "people in this neighborhood can be trusted", "people in this neighborhood generally do not get along

with each other", "people in this neighborhood do not share the same values". Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores were computed by taking the average of the five items (the last two statements were reverse coded). Higher scores on the SCS represent higher degrees of perceived neighborhood social cohesion. The eight-item BSCS was designed to assess the dimensions of needs fulfillment, group membership, influence, and emotional connection defined in the McMillan and Chavis' (ibid) model. Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores were computed by taking the sum of the eight items. Higher scores on the BSCS represent higher degrees of perceived sense of community. Furthermore, a random sub-sample of 38 participants was re-interviewed over the telephone for a reliability test with a 4-week interval.

2.4 Measures of subjective wellbeing

To examine the association between neighborhood social cohesion and subjective wellbeing, three aspects of subjective wellbeing including evaluative wellbeing (life satisfaction), hedonic wellbeing (feelings of happiness), and eudemonic wellbeing (sense of purpose and meaning in life) were measured. Life satisfaction was measured with a single item, "Overall, how satisfied are you with life as a whole these days?" which participants rated on a scale from 0 as "not at all satisfied" to 10 as "completely satisfied".[41] Feelings of happiness was measured with a single item, "How happy did you feel yesterday?" which participants rated on a scale from 0 as "not at all happy" to 10 as "completely happy".[41] Sense of purpose and meaning in life was measured with a single item, "Do you feel your life has an important purpose or meaning?" which participants rated on a scale from 0 as "not at all worthwhile" to 10 as "completely worthwhile".[41]

2.5 Covariates

Sociodemographic characteristics (age, sex, marital status, education, employment status, income financial difficulties, type of housing, and length of residence), lifestyle and health behaviors (physical activity, smoking, and alcohol intake), and medical history (number of self-reported chronic health conditions) were collected.

2.6 Data analysis

Continuous variables are presented as mean values and standard deviation, and the categorical variables are presented as number and percentage. To evaluate the psychometric properties of HK-NCI, first, internal consistency analyses (Cronbach's α) were conducted to test homogeneity of the HK-NCI scale and its 2 subscales. Second, the stability (test-retest reliability) of the HK-NCI scale was determined by intra-class correlation coefficients (ICC). Third, construct validity was estimated by Pearson's correlation coefficients of total and sub-scores of HK-NCI with total scores of SCS and BSCS. To examine whether neighborhood social cohesion as measured using HK-NCI would be associated with subjective wellbeing, multiple linear regressions were performed, with model 1 being the crude model, model 2 adjusting for sociodemographic characteristics (age, sex, marital status, education, employment status, income financial difficulties, type of housing, and length of residence), and model 3 adjusting for the covariates included in model 2 with additional adjustments for lifestyle and health behaviors (physical activity, smoking, and alcohol intake), and medical history (number of self-reported chronic health conditions). Unstandardized regression coefficients and p-values were reported. Participants were excluded if there are observations missing for any outcome measure. A P <0.05 will be used to denote significant difference. All analyses will be performed with SPSS version 24.0 (SPSS Inc, Chicago, IL, USA).

Patient and Public Involvement

This research was done with public involvement. PPI representatives were invited to comment on the research instrument and were consulted to develop the revised version (Hong Kong – Neighborhood Cohesion Instrument). However, PPI were not invited to contribute to the writing or editing of this document for readability or accuracy.

Results

Characteristics of participants

Table 1 presents characteristics of participants. A total of 301 Chinese men and women aged between 60 years and 95 years have been interviewed. The mean age of the participants was 72 years, with the majority aged from 60 to 69 (46.5%). Among these participants, 59.8% were women, 68.0% were married, and 44.9% received at least secondary education. In terms of type of housing, most participants (89.4%) lived in urban areas while only 10.6% lived in rural areas (village housing). The mean HK-NCI total score and the sub-scores for social cohesion and neighborhood belonging were 3.8, 3.5, and 4.2, respectively. The mean scores of life satisfaction, feelings of happiness, and sense of purpose and meaning in life were 7.4, 7.8, and 7.9, respectively.

Psychometric properties of the HK-NCI

The mean score of HK-NCI was 3.80, with higher sub-scores in 'neighborhood belonging' (4.15), but lower sub-score in 'social cohesion' (3.49). For homogeneity, internal reliabilities of total 15-item HK-NCI ($\alpha = 0.813$), HK-NCI-SC ($\alpha = 0.763$), HK-NCI-NB ($\alpha = 0.715$) were good. For stability (test-retest reliability), the averages of mean scores of the 15 items suggested an acceptable repeatability with an ICC = 0.701 (n = 38, 95% CI = 0.497, 0.832) (Table 2). There were positive correlations of total and sub-scores of HK-NCI with total score of SCS ($P < 0.001$, $r = 0.515$ to 0.635) and total score of BSCS ($P < 0.001$, $r = 0.500$ to 0.612) (Table 3).

Associations between neighborhood social cohesion and subjective wellbeing

In Model 1 (crude model), neighborhood social cohesion (total score) was significantly and positively associated with all measures of subjective wellbeing. Adjustment for sociodemographic characteristics

(Model 2) did not alter the results. Controlling for the additional covariates of lifestyle and health behaviors, and medical history did not attenuate the associations of cohesion with measures of subjective well-being (Table 4).

Table 4 also shows the associations of each HK-NCI sub-score with measures of well-being. After multivariable adjustments (Model 4), social cohesion sub-score and neighborhood belonging sub-score were positively associated with all measures of wellbeing (all P <0.01).

In the age-stratified analysis, the association between neighborhood social cohesion and measures of wellbeing remained significant in both young-old and old-old (all P <0.05). In the sex-stratified analysis, the associations of neighborhood social cohesion with life satisfaction and feelings of happiness remained significant in both men and women (P <0.05). However, the association between neighborhood social cohesion and sense of purpose and meaning in life remained significant in women (P <0.01), but not in men (Table 5).

3. Discussion

Research on the effects of neighborhood social cohesion on older people's wellbeing is in its infancy. Therefore, we examined the psychometric properties of the Hong Kong version of the NCI (HK-NCI), and related it with three dimensions of subjective wellbeing including life satisfaction, feelings of happiness and sense of purpose and meaning in life in a survey among community-dwelling older Chinese people. Input from a panel of experts and elderly volunteers indicated that all translated items of the HK-NCI were well understood. Psychometric testing supported the reliability and validity of the HK-NCI. Therefore, our findings suggested that HK-NCI is appropriate for use in the measurement of neighborhood social cohesion in future studies in older Chinese people. Furthermore, neighborhood social cohesion, as measured by the HK-NCI, was positively associated with the three dimensions of subjective wellbeing, independent of sociodemographic characteristics, lifestyle and health behaviors, and medical history, suggesting that neighborhood social cohesion captured a phenomenon distinct from individual-level attributes.

Our findings are consistent with previous studies that found associations between neighborhood social cohesion with wellbeing.[17-20] Although evidence linking neighborhood social cohesion and wellbeing is accumulating, the underlying mechanisms that enable neighborhood social cohesion to promote wellbeing are largely unknown. A previous study reports that the sense of neighborhood belonging may provide a positive identity and a sense of inclusion for older adults that are responsible for the beneficial effect on wellbeing, in particular eudemonic wellbeing.[42] Therefore, we speculate that when older people in a neighborhood have a strong sense that their neighborhood are cohesive, it may increase their will to interact among neighbors;[43] and such actions may establish a societal structure that may be able

to enhance trust, reciprocity, and support, which in turn, improve wellbeing. Supplementary analyses of our data also revealed that participants with higher score on "I borrow things and exchange favors with my neighbor" had a higher score of sense of purpose and meaning in life (data not shown). Findings based on an American study of successful ageing has also demonstrated that factors related to contributions (i.e., volunteering, informal helping of the neighbors) likely increases social connectedness that have been consistently found to be associated with psychological wellbeing.[44]

Previous studies suggest the wellbeing paradox but this phenomenon was not observed in the study. No correlation was found between age and wellbeing (data not shown). Results from the age-stratified analyses also reveal that there were no significant age difference in the association between neighborhood social cohesion and the measures of subjective wellbeing. However, a gender difference was observed in the association between neighborhood social cohesion and sense of purpose and meaning in life, with the significant relationship observed in women only. One possible explanation for these findings may be due to men and women may experience and respond to community services/activities in different ways; women were more likely to participate in locally organized groups and community activities, and more often offer support to neighbors; and therefore benefit more from cohesion / social network than men do.

Given the results of our study and the growing research demonstrating that neighborhood social cohesion contributes to positive wellbeing, more research on interventions, particularly those are tailored to gender of participants, that increase neighborhood social cohesion, or specifically strengthen

relationships with neighbors and sense of belong, is warranted, since a gender difference was observed in the association between neighborhood social cohesion and subjective wellbeing.

A major strength of this study was the ability to examine multiple measures of subjective wellbeing (evaluative, hedonic, and eudemonic wellbeing) using a sample of older Chinese people. A further strength of this study is the availability of a variety of potential individual-level confounders including sociodemographic characteristics, lifestyle and health behaviors, and medical history. Nevertheless, the present study has several limitations. First of all, the study was cross-sectional and therefore impossible to establish casual associations between neighborhood social cohesion and subjective wellbeing. We could not conclude whether neighborhood social cohesion results in better subjective wellbeing or vice versa. Secondly, the results were subject to selection bias as sociable people might be more likely to participate in this study. Individuals that are most frail and who consider themselves to be in a very poor state of health might have been neglected as these individuals are more likely to remain at home than those that are in a better state of physical and mental health. Thirdly, self-reported and subjective measurements might cause information bias. People with poor health and wellbeing might view the world pessimistically and report their neighborhood cohesion level lower than actual level. In addition, the Hong Kong version of NCI validated in this study translated the term 'neighborhood' into 'community' in Chinese (item 2-3, 6, 8-15), but the word 'neighbor' was literally translated. However, this modification was common place among researchers since respondents could think more about 'community' instead of simply several specific neighboring behaviors surrounding.[45] Finally, information on levels of perceived social support (such as patterns of contact among friends, families, and spouses) that may affect wellbeing at older ages was not available.

In conclusion, our findings suggested that the HK-NCI has adequate levels of internal consistency and test-retest reliability and can be used in studies of neighbourhood social cohesion in older Chinese people. The results of our study have also shown that neighbourhood social cohesion is linked to three aspects of subjective wellbeing amongst the elderly, demonstrating the importance of neighbourhood social cohesion for wellbeing among community-dwelling older people, and suggesting that neighbourhood social cohesion may be a beneficial target for intervention. Hence our findings could have important implications towards improving psychological wellbeing of the increasing ageing population in Hong Kong. In addition, our findings indicate a gender difference in the association between a neighbourhood social cohesion and eudemonic wellbeing, with the association found in women only. This observation certainly warrants further research but our findings suggest that gender should be considered as a factor important to wellbeing promotion. Finally, while the cross-sectional analyses do not provide direct insights into the mechanisms underlying the results of the present study, the results lay a path for further research to examine the potential pathways by which perceived neighbourhood social cohesion may enhance subjective wellbeing, which would promote positive ageing, reduce the growing burden on health and community services and help older people remain in their communities.

Conflicts of interests

The authors declare that they have no completing interest.

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Author Statement

RY wrote the manuscript. OC participated in data collection and analysis. JC participated in literature review. RY, OC, and JW designed the study. All authors read and approved the manuscript.

Data sharing statement

The datasets generated during and/or analyzed during the current study are not publicly available

Table 1 Characteristics of the study population (N = 301)

Variables	Mean ± SD, N (%)	HK-NCI score	
		Mean ± SD	*P*[a]
Age group, years (Range: 60–95)			
60–69	140 (46.51)	3.82 ± 0.47	0.889
70–79	94 (31.23)	3.78 ± 0.52	
≥80	67 (22.26)	3.79 ± 0.62	
Sex			
Men	121 (40.20)	3.73 ± 0.58	0.067
Women	180 (59.80)	3.84 ± 0.47	
Marital status			
Married	204 (68.00)	3.78 ± 0.52	0.261
Never/widowed/divorced/separated	96 (32.00)	3.85 ± 0.51	
Education			
Uneducated/pre-school/primary education	166 (55.15)	3.83 ± 0.55	0.256
Secondary/tertiary education	135 (44.85)	3.76 ± 0.48	
Employment			
Unemployed	277 (92.33)	3.80 ± 0.52	0.719
Employed (part-time/full-time)	23 (7.67)	3.84 ± 0.58	
Income, Hong Kong dollars			
<4000	91 (30.74)	3.83 ± 0.51	0.341
4000–7999	98 (33.11)	3.74 ± 0.50	
≥8000	107 (36.15)	3.84 ± 0.51	
Housing type			
Private high-rise housing	76 (25.25)	3.67 ± 0.42	<0.001
Tenement housing	30 (9.97)	3.61 ± 0.56	
Subsidized housing	43 (14.29)	3.72 ± 0.48	
Public housing	120 (39.87)	3.87 ± 0.50	
Village housing	32 (10.63)	4.13 ± 0.64	
Living arrangement			
Living with others	244 (81.06)	3.80 ± 0.50	0.839
Living alone	57 (18.94)	3.79 ± 0.60	
Length of residence, years (Range: 0.5–78)			
<10	47 (15.61)	3.69 ± 0.60	0.059
10–19	37 (12.29)	3.66 ± 0.64	
20–29	100 (33.22)	3.85 ± 0.44	
30–39	85 (28.24)	3.89 ± 0.47	
≥40	32 (10.63)	3.72 ± 0.56	
Number of neighbor with known names (Range: 0–55)			
0	45 (15.10)	3.46 ± 0.62	<0.001[b]
1–4	98 (32.89)	3.64 ± 0.48	
≥5	155 (52.01)	4.00 ± 0.41	
Current smoker			
No	284 (94.67)	3.81 ± 0.52	0.299
Yes	16 (5.33)	3.67 ± 0.56	
Current drinker			
No	263 (87.67)	3.80 ± 0.52	0.706
Yes	37 (12.33)	3.83 ± 0.49	
Physical activity			
<1 hour/day	155 (51.50)	3.69 ± 0.54	<0.001
≥1 hour/day	146 (48.50)	3.92 ± 0.47	
Medical history			

<5 diseases	258 (85.71)	3.81 ± 0.52	0.230
≥5 diseases	43 (14.29)	3.71 ± 0.52	
Subjective wellbeing			
Life satisfaction	7.4 ± 1.9	/	/
Feelings of happiness	7.8 ± 2.1	/	/
Sense of purpose and meaning in life	7.9 ± 1.7	/	/

[a] *P*-values refer to HK-NCI score with *t*-test between binary groups, and ANOVA test between ≥3 groups.
[b] *P*-values refer to HK-NCI score with linear test between 3 groups.

Table 2 Reliability of HK-NCI by internal consistency and test-retest reliability

HK-NCI total and sub-scores	Mean ± SD	Internal consistency Cronbach's alpha	Test-retest reliability[a] Intra-class correlation (95% CI)
HK-NCI-Total	3.80 ± 0.52	0.813	0.701 (0.497, 0.832)
HK-NCI-SC	3.49 ± 0.67	0.763	-
HK-NCI-NB	4.15 ± 0.52	0.715	-

Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion (item 1, 2, 3, 4, 5, 6, 7, 8); NB, neighborhood belonging (item 9, 10, 11, 12, 13, 14, 15).

[a] Sample size for test-retest reliability is n = 38.

Table 3 Construct validity of HK-NCI by Pearson's correlations between HK-NCI, SCS and BSCS

	Pearson's correlation coefficients	
HK-NCI total and sub-scores	**SCS**	**BSCS**
HK-NCI-Total	0.635***	0.612***
HK-NCI-SC	0.575***	0.500***
HK-NCI-NB	0.515***	0.576***

***P-value <0.001.

Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion; NB, neighborhood belonging; SCS, Social cohesion scale; BSCS, Brief sense of community scale.

Table 4 Association of Subjective well-being and HK-NCI total and sub-scores

HK-NCI total and sub-scores	Subjective well-being	Model 1 β (*P*)	Model 2 β (*P*)	Model 3 β (*P*)
HK-NCI-Total	Life satisfaction	1.038 (<0.001)	1.085 (<0.001)	1.090 (<0.001)
	Happiness	1.030 (<0.001)	1.069 (<0.001)	1.095 (<0.001)
	Sense of purpose and meaning in life	0.874 (<0.001)	0.772 (<0.001)	0.790 (<0.001)
HK-NCI-SC	Life satisfaction	0.568 (0.001)	0.641 (<0.001)	0.637 (<0.001)
	Happiness	0.424 (0.018)	0.511 (0.007)	0.523 (0.007)
	Sense of purpose and meaning in life	0.459 (0.002)	0.445 (0.004)	0.458 (0.004)
HK-NCI-NB	Life satisfaction	1.155 (<0.001)	1.098 (<0.001)	1.097 (<0.001)
	Happiness	1.418 (<0.001)	1.314 (<0.001)	1.327 (<0.001)
	Sense of purpose and meaning in life	1.010 (<0.001)	0.801 (<0.001)	0.802 (<0.001)

Model 1: Crude model.
Model 2: Linear regression model adjusted for age, sex, marital status, education, employment status, income, type of housing and length of residence.
Model 3: Linear regression model adjusted for age, sex, marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities and medical history.

Table 5 Association of Subjective well-beingand HK-NCI score by age group and sex

		Model 1	Model 2	Model 3
Sub-groups	**Subjective well-being**	**β (*P*)**	**β (*P*)**	**β (*P*)**
Young-old (n = 140)	Life satisfaction	1.360 (<0.001)	1.347 (<0.001)	1.240 (<0.001)
	Happiness	1.233 (<0.001)	1.300 (0.001)	1.288 (0.001)
	Sense of purpose and meaning in life	1.073 (<0.001)	0.926 (0.002)	0.878 (0.003)
Old-old (n = 161)	Life satisfaction	0.846 (0.005)	0.930 (0.005)	0.963 (0.005)
	Happiness	0.918 (0.003)	0.911 (0.007)	0.942 (0.007)
	Sense of purpose and meaning in life	0.768 (0.003)	0.718 (0.010)	0.707 (0.013)
Men (n = 121)	Life satisfaction	1.349 (<0.001)	1.226 (<0.001)	1.146 (0.001)
	Happiness	1.280 (<0.001)	0.988 (0.003)	1.014 (0.004)
	Sense of purpose and meaning in life	0.771 (0.003)	0.502 (0.057)	0.467 (0.091)
Women (n = 180)	Life satisfaction	0.757 (0.015)	1.017 (0.002)	1.076 (0.001)
	Happiness	0.743 (0.031)	1.112 (0.002)	1.157 (0.002)
	Sense of purpose and meaning in life	0.934 (0.001)	1.040 (0.001)	1.080 (<0.001)

Model 1: Crude model.

Model 2: Linear regression model adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, and length of residence.

Model 3: Linear regression model adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities and medical history.

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Is neighborhood social cohesion associated with subjective well-being for older Chinese people? The neighborhood social cohesion study

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Abstract

Objectives: To evaluate the psychometric properties of the Hong Kong version of Neighborhood Cohesion Instrument (HK-NCI) and examine whether neighborhood social cohesion as measured using HK-NCI would be associated with evaluative, hedonic, and eudemonic well-being.

Design: A validation analysis followed by a cross-sectional analysis of a community-based survey

Setting: Communities in two districts (Sha Tin and Tai Po) in Hong Kong

Participants: 301 community-dwelling Chinese men and women aged 60 years and older normally residing in Sha Tin or Tai Po for not less than six consecutive months at the time of participation in the study were interviewed.

Measurements: Neighborhood social cohesion was measured using the 15-item HK-NCI. The Social Cohesion Scale (SCS) and the Brief Sense of Community Scale (BSCS) were administered for assessing the validity of the HK-NCI. Evaluative (life satisfaction), hedonic (feelings of happiness), and eudemonic well-being (sense of purpose and meaning in life) were examined. Socio-demographic characteristics, lifestyle and health behaviors, medical history, and neighborhood characteristics were used as covariates.

Results: For homogeneity, internal reliability of HK-NCI (α=0.8) was good. For stability (test-retest reliability), the averages of mean scores of the 15 items suggested an acceptable repeatability with an ICC=0.7 (95% CI=0.5-0.8). HK-NCI was correlated with SCS (r=0.515-0.635, p<0.001) and BSCS (r=0.500-0.612, p<0.001). Neighborhood social cohesion was positively and independently associated with life satisfaction, feelings of happiness, and sense of purpose and meaning in life (all *P-values*<0.05). Stratified analyses indicated that neighborhood social cohesion was more strongly associated with subjective well-being in 'young-old' sub-group, and with sense of purpose and meaning in life for women.

Conclusion: The HK-NCI has adequate levels of internal consistency and test-retest reliability. In addition, higher levels of neighborhood social cohesion were associated with better subjective well-being amongst older Chinese people.

Strengths and limitations of this study:

1. The ability to examine multiple dimensions of subjective well-being (evaluative, hedonic, and eudemonic well-being) using a sample of older Chinese.
2. The availability of a variety of potential confounding factors including socio-demographic, lifestyle and health behaviors, medical history, and neighborhood characteristics.
3. The study was cross-sectional and therefore impossible to establish casual associations between neighborhood social cohesion and subjective well-being.
4. The results were subject to selection bias as sociable people might be more likely to participate in this study.
5. Self-reported and subjective measurements might cause information bias.

Keywords: Neighborhood Cohesion Instrument, social cohesion, neighborhood belonging, life satisfaction, feelings of happiness, sense of purpose and meaning in life.

1. Introduction

While advancing age is often accompanied by functional decline, which is negatively associated with well-being, the effect of well-being on health is also substantial. Research evidence has demonstrated that low levels of well-being are associated with increased risk of adverse health outcomes, such as frailty,[1] Alzheimer's disease,[2] and mortality,[3] whereas high levels of well-being cause better health and longevity.[4] Therefore, understanding factors that contribute to well-being of older people is important, as this might allow appropriate interventions to be implemented.

Among the contributory factors of well-being, socioeconomic characteristics (e.g., marital status, income, subjective social status) have been most studied and their contributions to well-being are well established.[5] However, the role of social contextual factors, in particular social cohesion, remains understudied. To date, there is no consensus regarding the definition of social cohesion. Nevertheless, social cohesion can be understood as 'the extent of connectedness and solidarity among groups in society'.[6] In an extensive review, social cohesion has been redefined as 'a state of affairs concerning both the vertical (the relationship between the state and society) and the horizontal (the interactions among different individuals and groups in society) interactions among members of society as characterized by a set of attitudes and norms that includes trust, a sense of belonging and the willingness to participate and help, as well as their behavioral manifestations'.[7] Recently, three essential dimensions of social cohesion including social relations, identification with the geographical unit, and orientation towards the common good have also been suggested.[8] In a nutshell, neighborhoods with high levels of social cohesion are expected to generate values such as interpersonal trust and norms of reciprocity, which may be beneficial to the health and well-being of people within the neighborhoods.

In recent years, the role of neighborhood social cohesion has gained much prominence in the public health literature because of its associations with various health outcomes, such as self-rated health,[9] frailty,[10] myocardial infarction,[11] stroke,[12] and mortality.[13] Furthermore, neighborhood social cohesion has been associated with mental health and well-being, with low levels of neighborhood social cohesion associated with increased depression, stress, and anxiety,[14 15] whereas high levels of neighborhood social cohesion are associated with better well-being.[16-20] However the mechanisms responsible for the association between neighborhood social cohesion and well-being are not certain. There are several pathways that may link neighborhood social cohesion to positive well-being. For example, perceived neighborhood social cohesion, particularly relationships with neighbors could be viewed as a type of social support, which might affect health outcomes and well-being by facilitating access to health information and services.[21] Neighborhood social cohesion might also influence well-being through the enhancement of mutual trust and emotional support.[22] A number of qualitative studies have indicated that neighbors can serve as a central source of support and meaning in adults' lives,[23] in particular for people who have experienced a sense of loss.[24] Furthermore, neighborhood social cohesion can offset the negative effects of stressors on mental health by facilitating access to networks and services that influence health, social and emotional support. For example, in a Japanese prospective study, high neighborhood cohesion partially reduced the deleterious effect of anticipated daily stressors on older residents' depressive mood.[25] Evidence from a British longitudinal cohort study has also suggested that the adverse effect of neighborhood deprivation on mental health was significantly reduced in high social cohesion neighborhoods.[26] However, the majority of the studies examining the link between neighborhood social cohesion and well-being have not focused on older people, who usually spend more time in their neighborhoods, as dependence on neighborhood resources increases with age.[27 28]

Maintaining well-being at advanced ages is growing in importance as well-being is relative to health and quality of life as people age.[29] However, levels of well-being of older people in Hong Kong were relatively low, based on a comparative analysis of a multi-dimensional index assessing the social and economic well-being of elderly populations in over 90 countries.[30] Therefore, it is important to examine whether levels of neighborhood social cohesion are one factor contributing to low levels of well-being among older people living in Hong Kong.

In order to examine the association between neighborhood social cohesion and well-being in older Chinese people, relevant measures of neighborhood social cohesion that are culturally appropriate are needed. A literature search on the measurement of perceived neighborhood social cohesion found various validated inventories and scales, for example, the Neighborhood Cohesion Instrument (NCI),[31] the Social Cohesion Scale (SCS),[32] and the 4-item scale developed and tested for the use in two nationally representative studies of older adults (the Health and Retirement Study and the English Longitudinal Study of Aging).[33] However, these inventories or scales have not been adapted for an older Chinese population.

In the present study, we attempted to adapt the NCI to a Hong Kong version (HK-NCI) that is linguistically valid for older Chinese and to evaluate the psychometric properties of HK-NCI. We also examined whether neighborhood social cohesion and its two domains (social cohesion and neighborhood belonging) as measured using HK-NCI would be associated with three dimensions of subjective well-being, including evaluative (life satisfaction), hedonic (feelings of happiness), and eudemonic well-being (sense of purpose and meaning in life) in sample of community-dwelling older Chinese people living in seven selected neighborhoods in Hong Kong, controlling for individual-level and neighborhood-level characteristics. Furthermore, it has been suggested that age and gender differences exist in the association between social participation and health,[34] both of

which are factors associated with neighborhood social cohesion and subjective well-being. Therefore, it is plausible that age and gender differences may also exist in the association between neighborhood social cohesion and subjective well-being. Hence, we also examined whether the association between neighborhood social cohesion and subjective well-being varied by age and gender.

2. Methods

2.1 Sampling

The study was established in order to investigate the impact of neighborhood social cohesion on health and well-being of older people. A cross-sectional survey of older people was conducted between June and August 2017 to validate HK-NCI, and to examine the association between neighborhood social cohesion and subjective well-being. The sampling method has been described by Yu et al.[35] In brief, a convenience sampling method was employed and the survey was designed to interview approximately 150 community-dwelling local residents aged 60 years and above from each of the two districts (Sha Tin and Tai Po) of Hong Kong, where the whole territory is divided into 18 districts at present. Both Sha Tin and Tai Po are located in the New Territories of Hong Kong, with their population estimated at 659,794 and 303,926 in 2016, respectively.[36] Considering the socio-economic heterogeneity across these geographic regions, seven neighborhoods in the two districts were chosen according to the neighborhood types (ranging from mixed-use town centers to areas covering traditional villages) and the predominant type of housing (ranging from private housing to public housing) therein as proxy of socioeconomic status. The seven neighborhoods were 1) Sha Tin Town Centre, 2) Lek Yuen and Wo Che, 3) Ma On Shan Town Centre, Yiu On, and Heng On, 4) Yee Fu and Kwong Fuk, 5) Tai Po Cental, 6) Tai Po Hui and Old Market, and 7) Lam Tsuen Valley, which are represented by a range of typical housing types in different settings (private/subsided/public housing in town centers, tenement housing in old urban core, village house in low-to mid-density areas). For example, Sha Tin Town Centre, Ma On Shan Town Centre, and Tai Po Cental are areas which accommodate private, subsided, and public housing, supplemented with commercial and open space to form a mixed-use development pattern. Lek Yuen, Wo Che, Yiu On, Heng On, Yee Fu, and Kwong Fuk are areas which accommodate predominantly public rental housing supported by essential infrastructure and community facilities. Tai Po Hui and Old Market are clustered around tenement housing. Lam Tsuen Valley is situated in the west of Tai Po, an area

covering both traditional villages and new residential housing. Hence, the study population would include older people living in both urban and rural areas with different socioeconomic profiles. For this study, a neighborhood was defined as a spatial unit within which residents share similar socioeconomic and cultural identities. Neighborhood boundaries were delineated using the government web map portal, GeoInfo Map (http://www1.map.gov.hk/gih3/view/index.jsp). Major roads and waterways served as barriers to movement and communication and therefore served as logical boundaries of the neighborhood.

2.2 Participants

Three hundred and one community-dwelling Chinese men and women aged 60 years and older were recruited in the survey. Participants were recruited by placing recruitment notices in housing estates and elderly community centres. Several talks were also given at the centres explaining the purpose of the study and the interviews to be carried out. An age-stratified sample of volunteers was recruited, so that approximately 50% of the participants would be aged 60–69, 30% would be aged 70–79, and 20% would be aged 80 years and older, according to the age structure of the mid-year population (aged 60 years and older) of Hong Kong in 2016. To be eligible to take part in the survey, participants needed to be aged 60 years and older, able to walk, able to speak Cantonese, and normally residing in Sha Tin or Tai Po for not less than six consecutive months at the time of participation in the study. Institutionalized persons, foreign domestic helpers, and individuals who were mentally unable to communicate were excluded. A team of trained research assistants administered the questionnaire face-to-face for each participant. All participants gave written consent, and the study was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong (026-16). The study was performed in compliance with the declaration of Helsinki.

2.3 Adaptation of the neighborhood cohesion inventory

The NCI, originally developed by Buckner et al.[31] and modified by Fone et al.,[37 38] has been used cross-culturally with good internal consistency (Cronbach's alpha: 0.84 – 0.95).[11 28 39] In the present study, the NCI was translated from English to Cantonese involving two independent forward translations (from English to Cantonese), after which a Cantonese native speaker reconciled the two Cantonese translated versions. A back translation was then performed from Cantonese to English. The original English version and the back translated version were examined by a group of bilingual experts whom examined resolve discrepancies in the meaning of the scale items. A pilot test was conducted among 10 older people with the trial Hong Kong version of NCI (HK-NCI), and modifications were made according to the participants' feedback on the items.

The HK-NCI consists of two sub-scales measuring social cohesion (8 items, HK-NCI-SC) and neighborhood belonging (7 items, HK-NCI-NB). All items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores of HK-NCI were computed by taking the average of the 15 items (items 7 and 11 were reverse scored). Higher scores on the HK-NCI represent higher degrees of perceived neighborhood social cohesion.

To assess the construct validity of the HK-NCI, the Social Cohesion Scale (SCS)[32] and the Brief Sense of Community Scale (BSCS)[40] were administered to each participant during the same interview. The five-item SCS was designed to measure neighborhood social cohesion. Participants were asked how strongly they agreed with the following statements: 'people around here are willing to help their neighbors', 'this is a close-knit neighborhood', 'people in this neighborhood can be trusted', 'people in this neighborhood generally do not get along with each other', and 'people in this neighborhood do not share the same values'. Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores were computed by taking the average of the

five items (the last two statements were reverse coded). Higher scores on the SCS represent higher degrees of perceived neighborhood social cohesion. The eight-item BSCS was designed to assess the dimensions of needs fulfillment, group membership, influence, and emotional connection defined in the McMillan and Chavis' (ibid) model. Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Total scores were computed by taking the sum of the eight items. Higher scores on the BSCS represent higher degrees of perceived sense of community. Furthermore, a random sub-sample of 38 participants was re-interviewed over the telephone for a reliability test after a 4-week interval.

2.4 Measures of subjective well-being

To examine the association between neighborhood social cohesion and subjective well-being, three aspects of subjective well-being including evaluative well-being (life satisfaction), hedonic well-being (feelings of happiness), and eudemonic well-being (sense of purpose and meaning in life) were measured. Life satisfaction was measured with a single item, 'Overall, how satisfied are you with life as a whole these days?' which participants rated on a scale from 0 as 'not at all satisfied' to 10 as 'completely satisfied'.[41] Feelings of happiness was measured with a single item, 'How happy did you feel yesterday?' which participants rated on a scale from 0 as 'not at all happy' to 10 as 'completely happy'.[41] Sense of purpose and meaning in life were measured with a single item, 'Do you feel your life has an important purpose or meaning?' which participants rated on a scale from 0 as 'not at all worthwhile' to 10 as 'completely worthwhile'.[41]

2.5 Covariates

Individual-level characteristics include socio-demographics (age, gender, marital status, education, employment status, income financial difficulties, type of housing, and length of residence), lifestyle and health behaviors (physical activity, smoking, and alcohol intake), and medical history (number

of self-reported chronic health conditions). Neighborhood-level characteristics include geographic size, number of older persons, and number of elderly and social centres in each of the selected neighborhoods.

2.6 Data analysis

Continuous variables are presented as mean values and standard deviation, and the categorical variables are presented as number and percentage. To evaluate the psychometric properties of HK-NCI, first, internal consistency analyses (Cronbach's α) were conducted to test homogeneity of the HK-NCI scale and its 2 subscales. Second, the stability (test-retest reliability) of the HK-NCI scale was determined by intra-class correlation coefficients (ICC). Third, construct validity was estimated by Pearson's correlation coefficients of total and sub-scores of HK-NCI with total scores of SCS and BSCS. To examine whether neighborhood social cohesion and its two domains 'social cohesion' and 'neighborhood belonging' as measured using HK-NCI would be associated with the three dimensions of subjective well-being, two-level hierarchical linear regressions of individual subjects at level 1 and the 7 neighborhoods at level 2 were performed, with model 1 being the crude model, model 2 adjusting for socio-demographic characteristics (age, gender, marital status, education, employment status, income financial difficulties, type of housing, and length of residence), model 3 adjusting for the covariates included in model 2 with additional adjustments for lifestyle and health behaviors (physical activity, smoking, and alcohol intake), and medical history (number of self-reported chronic health conditions), and model 4 further adjusting for neighborhood characteristics (geographic size, number of older persons, and number of elderly centres in each of the selected neighborhoods). Unstandardized regression coefficients and p-values were calculated by using mixed-effect model, putting neighborhood as random effect. The analyses described above were repeated stratified by age group (60-69, 70+) and gender. Participants were excluded if there are observations missing for any outcome measure. A P <0.05 will be used to denote significant

difference. All analyses were performed with SPSS version 24.0 (SPSS Inc, Chicago, IL, USA) and the statistical package SAS, version 9.4 (SAS Institute, Inc., Cary, NC).

2.7 Patient and Public Involvement (PPI)

This research was done with public involvement. PPI representatives were invited to comment on the research instrument and were consulted to develop the revised version (Hong Kong – Neighborhood Cohesion Instrument). However, PPI was not invited to contribute to the writing or editing of this document for readability or accuracy.

3. Results

Characteristics of the participants

Table 1 presents characteristics of the participants. A total of 301 Chinese men and women aged between 60 years and 95 years have been interviewed. The mean age of the participants was 72 years, with the majority aged from 60 to 69 (46.5%). Among these participants, 59.8% were women, 68.0% were married, and 44.9% received at least secondary education. In terms of type of housing, most participants (89.4%) lived in urban areas while only 10.6% lived in rural areas (village housing). The mean scores of life satisfaction, feelings of happiness, and sense of purpose and meaning in life were 7.4, 7.8, and 7.9, respectively.

Psychometric properties of the HK-NCI

The mean score of HK-NCI was 3.8, with higher sub-scores in 'neighborhood belonging' (4.2), but lower sub-score in 'social cohesion' (3.5). For homogeneity, internal reliabilities of total 15-item HK-NCI ($\alpha = 0.813$), HK-NCI-SC ($\alpha = 0.763$), HK-NCI-NB ($\alpha = 0.715$) were good. For stability (test-retest reliability), the averages of mean scores of the 15 items suggested an acceptable repeatability with an ICC = 0.701 (n = 38, 95% CI = 0.497, 0.832) (Table 2). There were positive correlations of the total and the sub-scores of HK-NCI with the total score of SCS (P <0.001, r = 0.515 to 0.635) and the total score of BSCS (P <0.001, r = 0.500 to 0.612) (Table 3).

Associations between neighborhood social cohesion and subjective well-being

In Model 1 (crude model), neighborhood social cohesion (total score of HK-NCI) was positively associated with all three dimensions of subjective well-being (all *P-values*<0.0001). Adjustments for socio-demographic characteristics (Model 2) and lifestyle and health behaviors, as well as medical history (Model 3) did not alter the results (all *P-values*<0.0001). Controlling for the additional neighborhood characteristics including geographic size, number of older persons, and number of

elderly centres in each of the selected neighborhoods did not attenuate the associations of neighborhood social cohesion and subjective well-being (all *P-values*<0.0001, Model 4). Furthermore, the associations of neighborhood social cohesion with life satisfaction (β=1.079, *P-value*<0.0001) and feelings of happiness (β=1.080, *P-value*<0.0001) were stronger than that with sense of purpose and meaning in life (β=0.792, *P-value*=0.0001). When the two domains of neighborhood social cohesion were considered separately, both domains were positively associated with subjective well-being. Nevertheless, 'neighborhood belonging' was more strongly associated with subjective well-being (β=0.780-1.308, *P-values*=0.0001-<0.0001) than 'social cohesion' (β=0.475-0.641, *P-values*=0.0028-0.0004) (Table 4).

There were no significant age and sex differences on the three dimensions of subjective well-being. Stratified analyses indicated that the association between neighborhood social cohesion and subjective well-being remained significant for all sub-groups ('young-old' or 'old-old', men vs. women, all *P-values*<0.05). Nevertheless, neighborhood social cohesion was more strongly associated with all three dimensions of subjective well-being in 'young-old' sub-group, and with sense of purpose and meaning in life for women (Table 5).

4. Discussion

Research on the effects of neighborhood social cohesion on older people's well-being is in its infancy. Therefore, we examined the psychometric properties of the Hong Kong version of the NCI (HK-NCI), and related it to three dimensions of subjective well-being including life satisfaction, feelings of happiness, and sense of purpose and meaning in life in a survey among community-dwelling older Chinese people. Input from a panel of experts and elderly volunteers indicated that all translated items of the HK-NCI were well understood. Psychometric testing supported the reliability and validity of the HK-NCI. Furthermore, neighborhood social cohesion, as measured by the HK-NCI, was positively associated with the three dimensions of subjective well-being, after controlling the effects of individual-level and neighborhood-level characteristics.

Consistent with previous studies that found associations between neighborhood social cohesion and well-being,[16-20] the results of this study reinforce the importance of neighborhood social cohesion, a social contextual factor, in enhancing subjective well-being in older people. When we examined the associations of neighborhood social cohesion with each of the dimension of subjective well-being, we found that the impact of neighborhood social cohesion on life satisfaction and feelings of happiness was stronger than that on sense of purpose and meaning in life. These findings, however, are in contrast to the findings of a recent European study suggesting that physiological functioning is more strongly influenced by cohesion than life satisfaction and feelings of happiness.[20] The differences between the results could be related to the cross-cultural differences in social participation, psychological beliefs, and subjective well-being of the study populations. Nevertheless, our findings and those in the literature emphasize the importance of considering cross-cultural differences in the role of neighborhood social cohesion on subjective well-being in older people.

When we examined the associations of the two domains of neighborhood social cohesion (i.e., social cohesion and neighborhood belonging) and the three dimensions of subjective well-being, we found that both domains of neighborhood social cohesion were associated with subjective well-being. Furthermore, the association between neighborhood belonging (compared to social cohesion) and subjective well-being was stronger. It has been suggested that feelings of belonging would influence individual's identity and the extent to which they feel accepted, valued, respected, socially included, and able to take on a role in society, which have been suggested as important predictors of overall health and well-being for older people.[42] In a recent study examining the relationship between the perceived 'age-friendliness' with the eight age-friendly environment domains and self-rated health, 'respect and social inclusion' was the social domain most strongly associated with self-rated health in older people in Hong Kong.[43] Therefore, interventions that promote sense of belonging, respect, and inclusion for older people have the potential to significantly improve older people's well-being.

Another important finding is that consistent associations of neighborhood social cohesion and subjective well-being were found in both 'young-old' and 'old-old' sub-groups and in both men and women. In other words, neighborhood social cohesion is beneficial to all sub-groups, be it 'young-old' or 'old-old', men or women. However, some differences in the magnitude of the associations were found between the sub-groups. The 'young-old' sub-group benefited more from higher levels of neighborhood social cohesion than the 'old-old' sub-group in all dimensions of subjective well-being. On the other hand, women benefited more from higher levels of neighborhood social cohesion than men in eudemonia well-being. A possible explanation for these findings could be that 'young-old' persons and women are more likely than 'old-old' persons (particularly those who are frail) and men to participate in community activities, which can bring numerous benefits (e.g., enhancing social network and sense of competence and control, providing opportunities to learn new things),[44] and thereby resulting in greater socially cohesive attitudes and subjective well-being. Our results are

consistent with the results of a previous study where the buffering effect of neighborhood cohesion on daily stress were stronger in younger adults when compared to the middle-age and older adults living in the United States.[17] Statistics from a baseline assessment of the age-friendliness of Sha Tin and Tai Po districts in Hong Kong with over 700 respondents aged 60 and above revealed that women were found to be more likely to attend elderly community centers than men (52.8% vs. 28.4%).[45 46] Qualitative data regarding older people's perspectives on social participation also revealed that older men are more reluctant to participate in community activities because they considered that the activities tend to be more appealing to women (unpublished data). Therefore, strategies to promote neighborhood social cohesion among older people should take the potential age and gender differences into consideration.

The strength of this study lies in the multiple dimensions of subjective well-being measured including evaluative, hedonic, and eudemonic well-being and the ability to control for a broad range of individual-level and neighborhood-level confounding factors. Nevertheless, the present study has several limitations. The study was cross-sectional in design and therefore unable to establish casual associations between neighborhood social cohesion and subjective well-being. The results were subject to selection bias as sociable people might be more likely to participate in this study. Individuals that are most frail and who consider themselves to be in a very poor state of health might have been neglected as these individuals are more likely to remain at home than those that are in a better state of physical and mental health. Self-reported and subjective measurements might cause information bias. People with poor health and well-being might view the world pessimistically and report their neighborhood cohesion level lower than actual level. Finally, information on levels of perceived social support (such as patterns of contact among friends, families, and spouses) that may affect subjective well-being at older ages were not available.

In conclusion, our findings suggest that the HK-NCI has adequate levels of internal consistency and test-retest reliability and can be used in studies of neighbourhood social cohesion in older Chinese people. Additionally, neighbourhood social cohesion was associated with better life evaluation, more positive emotions, and higher levels of purpose and meaning in life, demonstrating the importance of neighbourhood social cohesion for subjective well-being among community-dwelling older Chinese people living in Hong Kong. Therefore, high levels of neighbourhood social cohesion may be one of the best ways of promoting subjective well-being in older people. The results of this study also pave the path for further research to examine the potential pathways by which perceived neighbourhood social cohesion may enhance subjective well-being. Further studies should also explore the determinants of neighbourhood social cohesion in an attempt to identify effective strategies to improve subjective well-being in older people.

Conflicts of interests

The authors declare that they have no completing interest.

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Author Statement

R.Y.: conceptualization, data analysis, and manuscript writing. O.C.: data collection and data analysis. J.L.: data analysis. C.T.: data acquisition and manuscript review. K.L.: data acquisition. J.T.K. C.: literature review. J. W. conceptualization and manuscript review. All authors read and approved the manuscript.

Data sharing statement

The datasets generated during and/or analyzed during the current study are not publicly available

Table 1 Characteristics of the study population (N = 301)

Variables	Mean ± SD, N (%)	HK-NCI score	
		Mean ± SD	*P*[a]
Age group, years (Range: 60–95)			
60–69	140 (46.5)	3.8 ± 0.5	0.889
70–79	94 (31.2)	3.8 ± 0.5	
≥80	67 (22.3)	3.8 ± 0.6	
Gender			
Men	121 (40.2)	3.7 ± 0.6	0.067
Women	180 (59.8)	3.8 ± 0.5	
Marital status			
Married	204 (68.0)	3.8 ± 0.5	0.261
Never/widowed/divorced/separated	96 (32.0)	3.9 ± 0.5	
Education			
Uneducated/pre-school/primary education	166 (55.2)	3.8 ± 0.6	0.256
Secondary/tertiary education	135 (44.9)	3.8 ± 0.5	
Employment			
Unemployed	277 (92.3)	3.8 ± 0.5	0.719
Employed (part-time/full-time)	23 (7.7)	3.8 ± 0.6	
Income, Hong Kong dollars			
<4000	91 (30.7)	3.8 ± 0.5	0.341
4000–7999	98 (33.1)	3.7 ± 0.5	
≥8000	107 (36.2)	3.8 ± 0.5	
Housing type			
Private high-rise housing	76 (25.3)	3.7 ± 0.4	<0.001
Tenement housing	30 (10.0)	3.6 ± 0.6	
Subsidized housing	43 (14.3)	3.7 ± 0.5	
Public housing	120 (39.9)	3.9 ± 0.5	
Village housing	32 (10.6)	4.1 ± 0.6	
Living arrangement			
Living with others	244 (81.1)	3.8 ± 0.5	0.839
Living alone	57 (18.9)	3.8 ± 0.6	
Length of residence, years (Range: 0.5–78)			
<10	47 (15.6)	3.7 ± 0.6	0.059
10–19	37 (12.3)	3.7 ± 0.6	
20–29	100 (33.2)	3.9 ± 0.4	
30–39	85 (28.2)	3.9 ± 0.5	
≥40	32 (10.6)	3.7 ± 0.6	
Number of neighbor with known names (Range: 0–55)			
0	45 (15.1)	3.5 ± 0.6	<0.001[b]
1–4	98 (32.9)	3.6 ± 0.5	
≥5	155 (52.0)	4.0 ± 0.4	
Current smoker			
No	284 (94.7)	3.8 ± 0.5	0.299
Yes	16 (5.3)	3.7 ± 0.6	
Current drinker			
No	263 (87.7)	3.8 ± 0.5	0.706
Yes	37 (12.3)	3.8 ± 0.5	
Physical activity			
<1 hour/day	155 (51.5)	3.7 ± 0.5	<0.001
≥1 hour/day	146 (48.5)	3.9 ± 0.5	
Medical history			
<5 diseases	258 (85.7)	3.8 ± 0.5	0.230
≥5 diseases	43 (14.3)	3.7 ± 0.5	
Subjective well-being			
Life satisfaction	7.4 ± 1.9	/	/

Feelings of happiness	7.8 ± 2.1	/	/
Sense of purpose and meaning in life	7.9 ± 1.7	/	/

[a] *P*-values refer to HK-NCI score with *t*-test between binary groups, and ANOVA test between ≥3 groups.
[b] *P*-values refer to HK-NCI score with linear test between 3 groups.

Table 2 Reliability of HK-NCI by internal consistency and test-retest reliability

HK-NCI total and sub-scores	Mean ± SD	Internal consistency Cronbach's alpha	Test-retest reliability[a] Intra-class correlation (95% CI)
HK-NCI-Total	3.8 ± 0.5	0.813	0.701 (0.497, 0.832)
HK-NCI-SC	3.5 ± 0.7	0.763	-
HK-NCI-NB	4.2 ± 0.5	0.715	-

Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion (item 1, 2, 3, 4, 5, 6, 7, 8); NB, neighborhood belonging (item 9, 10, 11, 12, 13, 14, 15).

[a] Sample size for test-retest reliability is n = 38.

Table 3 Construct validity of HK-NCI by Pearson's correlations between HK-NCI, SCS and BSCS

	Pearson's correlation coefficients	
HK-NCI total and sub-scores	**SCS**	**BSCS**
HK-NCI-Total	0.635***	0.612***
HK-NCI-SC	0.575***	0.500***
HK-NCI-NB	0.515***	0.576***

***P-value <0.001.

Abbreviations: HK-NCI, Hong Kong version of NCI (15 items); SC, social cohesion; NB, neighborhood belonging; SCS, Social cohesion scale; BSCS, Brief sense of community scale.

Table 4 Association of Subjective well-being and HK-NCI total and sub-scores

HK-NCI total and sub-scores	Subjective well-being	Model 1 β (*P*)	Model 2 β (*P*)	Model 3 β (*P*)	Model 4 β (*P*)
HK-NCI-Total	Life satisfaction	1.146 (<.0001)	1.091 (<.0001)	1.088 (<.0001)	1.079 (<.0001)
	Happiness	1.149 (<.0001)	1.069 (<.0001)	1.095 (<.0001)	1.080 (<.0001)
	Sense of purpose and meaning in life	0.942 (<.0001)	0.794 (<.0001)	0.795 (<.0001)	0.792 (0.0001)
HK-NCI-SC	Life satisfaction	0.645 (0.0001)	0.646 (0.0003)	0.638 (0.0004)	0.641 (0.0004)
	Happiness	0.476 (0.009)	0.511 (0.0072)	0.524 (0.0072)	0.522 (0.0076)
	Sense of purpose and meaning in life	0.502 (0.0009)	0.469 (0.0024)	0.469 (0.0031)	0.475 (0.0028)
HK-NCI-NB	Life satisfaction	1.183 (<.0001)	1.100 (<.0001)	1.094 (<.0001)	1.079 (<.0001)
	Happiness	1.456 (<.0001)	1.314 (<.0001)	1.327 (<.0001)	1.308 (<.0001)
	Sense of purpose and meaning in life	1.034 (<.0001)	0.806 (<.0001)	0.797 (<.0001)	0.780 (0.0001)

Model 1: Crude model of hierarchical linear regression (clustering for 7 neighborhoods).
Model 2: Hierarchical linear regression model (clustering for 7 neighborhoods) adjusted for age, sex, marital status, education, employment status, income, type of housing and length of residence.
Model 3: Hierarchical linear regression model (clustering for 7 neighborhoods) adjusted for age, sex, marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities and medical history.
Model 4: Hierarchical linear regression model (clustering for 7 neighborhoods) adjusted for age, sex, marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities, medical history, geographic size, number of older persons, number of elderly and social centres.

Table 5 Association of Subjective well-being and HK-NCI score by age group and sex

			Model 1	Model 2	Model 3	Model 4
Sub-groups	**Subjective well-being**	**Mean ± SD**	**β (*P*)**	**β (*P*)**	**β (*P*)**	**β (*P*)**
Young-old (n = 140)	Life satisfaction	7.4 ± 1.7	1.367 (<.0001)	1.355 (<.0001)	1.249 (0.0002)	1.260 (0.0002)
	Happiness	7.7 ± 2.0	1.240 (0.0004)	1.332 (0.0004)	1.341 (0.0007)	1.373 (0.0007)
	Sense of purpose and meaning in life	7.7 ± 1.6	1.071 (0.0001)	0.926 (0.0016)	0.880 (0.0033)	0.899 (0.0032)
Old-old (n = 161)	Life satisfaction	7.4 ± 2.2	0.965 (0.0018)	0.928 (0.0053)	0.945 (0.0057)	0.902 (0.0093)
	Happiness	7.9 ± 2.2	0.954 (0.0021)	0.917 (0.0068)	0.950 (0.0066)	0.890 (0.0125)
	Sense of purpose and meaning in life	8.0 ± 1.9	0.912 (0.0006)	0.727 (0.0091)	0.694 (0.0148)	0.685 (0.0173)
Men (n = 121)	Life satisfaction	7.5 ± 2.0	1.349 (<.0001)	1.226 (0.0002)	1.146 (0.0008)	1.208 (0.0005)
	Happiness	7.7 ± 2.0	1.321 (<.0001)	1.034 (0.0016)	1.055 (0.0024)	1.140 (0.0011)
	Sense of purpose and meaning in life	7.7 ± 1.7	0.807 (0.002)	0.532 (0.0419)	0.499 (0.0703)	0.575 (0.0386)
Women (n = 180)	Life satisfaction	7.4 ± 1.9	0.803 (0.0103)	1.017 (0.0025)	1.076 (0.0014)	1.051 (0.002)
	Happiness	7.9 ± 2.1	0.835 (0.0163)	1.112 (0.0023)	1.157 (0.0017)	1.119 (0.0026)
	Sense of purpose and meaning in life	8.0 ± 1.8	0.966 (0.0006)	1.037 (0.0005)	1.066 (0.0004)	1.062 (0.0005)

Model 1: Crude model of hierarchical linear regression (clustering for 7 neighborhoods).
Model 2: Hierarchical linear regression model (clustering for 7 neighborhoods) adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, and length of residence.
Model 3: Hierarchical linear regression model (clustering for 7 neighborhoods) adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities and medical history.
Model 4: Hierarchical linear regression model (clustering for 7 neighborhoods) adjusted for sex (for the age-stratified analysis only), age (for the sex-stratified analysis only), marital status, education, employment status, income, type of housing, length of residence, current smoker, current drinker, physical activities, medical history, geographic size, number of older persons, number of elderly and social centres.

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