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RESEARCH PAPER

Loneliness as a mediator of the impact of social isolation on cognitive functioning of Chinese older adults

Rumei Yang[1], Haocen Wang[2], Linda S. Edelman[3], Eunjin L. Tracy[4], George Demiris[5], Katherine A. Sward[6], Gary W. Donaldson[7]

[1]School of Nursing, Nanjing Medical University, Nanjing, Jiangsu, China
[2]Department of Health and Kinesiology, College Station, Texas A and M University, TX, USA
[3]Health Systems and Community Based Care Division, University of Utah College of Nursing, Salt Lake City, UT, USA
[4]Department of Psychology, University of Utah, Salt Lake City, UT, USA
[5]University of Utah College of Nursing, Salt Lake City, UT, USA
[6]University of Pennsylvania School of Nursing, Philadelphia, PA, USA
[7]Department of Anesthesiology, School of Medicine, Pain Research Center, University of Utah, Salt Lake City, UT, USA

Address correspondence to: Rumei Yang, School of Nursing, Nanjing Medical University, 101 Longmian Avenue, Jiangning District, Nanjing, Jiangsu 211166, China. Tel: (+86) 181 1451 7518. Email: rumeiyang@njmu.edu.cn

Abstract

Background and Objective:: older adults have increased risk of social isolation, loneliness and cognitive functioning impairment, but the relationships among these factors are not conclusive. We investigated the potential mediation mechanism of loneliness on the association between social isolation and cognitive functioning among Chinese older adults within their cultural context.

Design:: secondary analysis of the baseline wave (2011–12) of the harmonised China Health and Retirement Longitudinal Study.

Setting and Subjects:: community-dwelling older adults in China ($N = 7{,}410$ participants aged 60–101 years).

Methods:: we applied a multiple indicator multiple cause approach to determine whether the construct of social isolation is well defined by four indicators (social activity engagement, weekly adult children contact, caregiving for grandchildren and living alone) and used structural equation modelling to examine the direct and indirect effects among variables of interest.

Results:: the results demonstrated that social activity engagement, weekly adult children contact and caregiving for grandchildren were significantly related to social isolation ($\beta = -0.26$ to -0.28) (Living alone was fixed to 1 for model identification.) The indirect effect of social isolation on cognitive functioning through loneliness was significant ($\beta = -0.15$), indicating loneliness was an important mediator. However, the direct effect of social isolation on cognitive functioning also remained significant ($\beta = -0.83$), suggesting a partial mediation effect.

Conclusions:: our study highlights the mediation role of loneliness in the relationship between social isolation and cognitive functioning among Chinese older adults. The findings support the beneficial effects of maintaining social relations and coping with feelings of loneliness on older adults' cognitive functioning.

Keywords: Chinese older adults, cognitive functioning, loneliness, social isolation, ageing

Key points

- A socially isolated person does not necessarily feel lonely and a lonely person is not necessarily socially isolated.
- Research is needed to understand how social isolation and loneliness are related to cognitive functioning among older adults.

- Weekly contact with adult children is a less important indicator of social isolation when compared with other factors.
- Loneliness is a significant mediator on the association between social isolation and cognitive functioning for Chinese older adults.

Introduction

Cognitive functioning is important for older adults' ability to safely age in place [1]. Social isolation and loneliness, common social-network measures, are risk factors for cognitive functioning impairment, which have gained increasing attention after a seminal study by Fratiglioni *et al.* [2] demonstrating that one's social network can predict the onset of dementia. Social isolation and loneliness are prevalent in older adults [3,4] who may experience loss of intimate relationships (e.g. spouse or romantic partner) and changes in health and social status [5]. However, the association between social isolation, loneliness and cognitive functioning is inconclusive [1]. For example, analyses from the English Longitudinal Study of Ageing project found that social isolation and loneliness are associated with poor cognitive functioning [6]. However, analyses from the Lothian Birth Cohort study failed to confirm the link between loneliness and cognitive functioning [7]. Similarly, social isolation measured by marital status [8], network size [8] and social activity [1] was not associated with cognitive functioning in other studies. One possible reason for lack of congruity between studies may be due to the interchangeable use of social isolation and loneliness [9] and the complex interplay between them [10].

Conceptually, social isolation is the objective absence or near-absence of social contact [11], including living alone, having a small social network and lack of interactions with family and friends [4,6]. In contrast, loneliness refers to subjective appraisals of the extent of social relationships as unsatisfactory or undesirable [12]. Loneliness is premised to be the natural outcome of social isolation [4,13] although some evidence contradicts this premise. For example, socially isolated individuals do not necessarily feel lonely and lonely individuals are not necessarily socially isolated [12]. Furthermore, people with similar social resources may have different perceptions of loneliness [14]. Simply asking about social relationships fails to adequately account for the meaning of these relationships [2,11,15].

Previous studies on the association between social isolation, loneliness and cognitive functioning among Western older adults are abundant although not conclusive. However, there is little evidence of the effect of social isolation and loneliness on cognitive functioning among older adults living in China [3]. Even fewer studies consider these concepts simultaneously [16] or elucidate possible mechanisms, i.e. whether social isolation affects cognitive functioning directly or indirectly via loneliness. Compared with Western individualism emphasising independence and personal responsibility, the Chinese culture of collectivism values interpersonal relationships and family support [3]. Prior research suggests that people from a collectivism culture are more sensitive to social isolation and are more vulnerable to loneliness [11]. Therefore, we conjectured that social isolation and loneliness might have a comparable or even higher impact on cognitive function in Chinese older adults as compared with Western older adults.

Chinese older adults experience unique characteristics of social isolation that are deeply engrained in Chinese cultural and social contexts and can include a new living arrangement, extensive caregiving for grandchildren and frequent adult children contacts [2]. Chinese older adults traditionally relied on close family ties for support, and consider living with adult children and grandchildren as the core of quality of life in old age (called '承欢膝下 [cheng huan xi xia]'). However, due to dramatic declines in fertility and rapid rate of urbanisation over the last 30 years, Chinese older adults increasingly reside alone, the so-called 'empty nest family' [3] accounting for 25–35% of Chinese households [3]. These older adults report high rates of loneliness, depression and poor quality of life [3].

Because of the one-child family policy and cultural norms that emphasise reciprocal caregiving responsibility between children and parents [17], grandparents caring for grandchildren is common in China [17] and is associated with better mental health and possibly better cognitive functioning compared with non-grandparent caregivers [18,19]. The underlying assumption is that caregiving is one type of social activity that might stimulate mental function through meaningful intellectual interactions with grandchildren (e.g. reading and doing homework) [19].

Adult children who live far away have a moral responsibility to contact their parents and ensure their needs are met. This responsibility is legally required by the Chinese 'Law of Protection of Rights and Interests of the Aged' amended in 2013 to protect elder abuse or neglect. While no studies have examined the effect of adult children contact on mental health or cognitive functioning among Chinese older adults, research on Korean older adults demonstrates that contact with adult children has a protective effect on depression that is independent of modes of contact such as in person or phone contact [20].

To better understand the possible mechanism underlying the association between social isolation and cognitive functioning, we proposed a mediation model based on previous evidence to explore whether loneliness serves as a mediator of the association between social isolation and cognitive functioning in Chinese older adults (Figure 1).

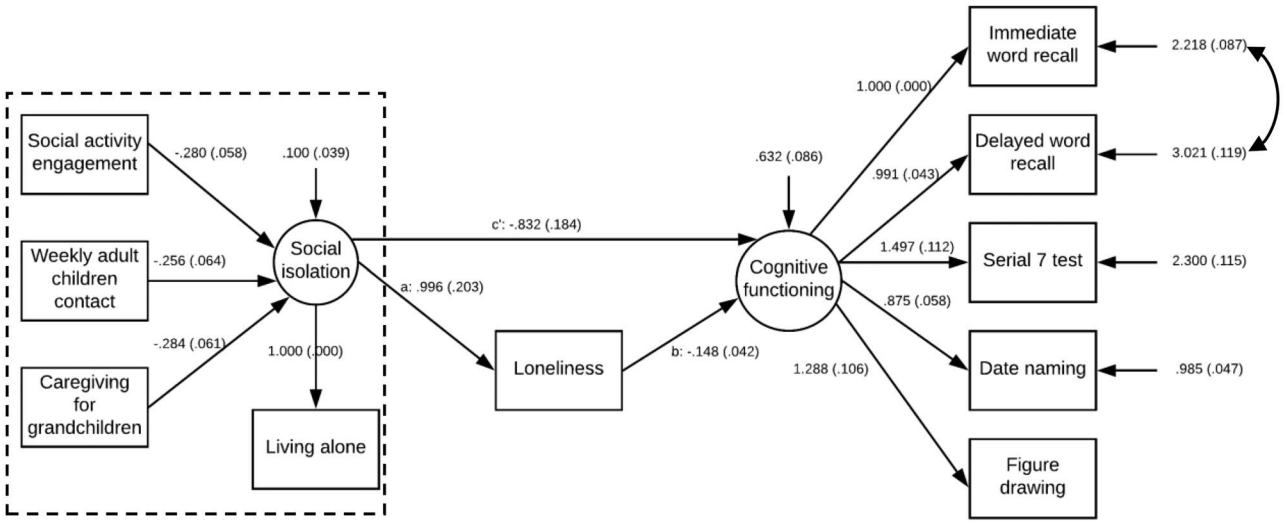

Figure 1. Unstandardised solution of the MIMIC mediation model. Note: Model fit indices: $\chi^2 = 135.76$, $P < 0.05$, RMSEA = 0.03 (90% CI = 0.02, 0.03), CFI = 0.91 and TLI = 0.87. All paths are significant ($P < 0.05$). The highlighted area representing MIMIC model to capture the latent construct of social isolation.

Methods

Data source

This study utilised data from the 2011 to 2012 wave of the harmonised China Health and Retirement Longitudinal Study (CHARLS) Version B.4; a national longitudinal study of Chinese community-dwelling adults conducted by Peking University [21]. Older adults were defined as persons aged 60 years or older. Our analysis included individuals aged 60+ years ($n = 7{,}410$) with a range from 60 to 101 years. The institutional review board at Peking University in China approved the original CHARLS study.

Measurement

Measurement was constrained by the variables in the CHARLS study data set. 'Social isolation' was measured using the following variables.

Living alone

Household size was coded as 1 (living alone) if household size = 1, and 0 (living with others) if household size > 1.

Social activity engagement

Participants were asked whether they were involved in any of following social activities in the last month: (i) interacted with friends; (ii) played Ma-jong, chess, cards or went to community club; (iii) went to sport, social or other kind of club; (iv) engaged in a community-related organisation; (v) engaged in voluntary or charity work; and (vi) attended an education or training course. These activities were not mutually exclusive. We dichotomized with a code of 1 indicating engagement in any of these activities and a code of 0 otherwise.

Weekly contact with adult children

Participants were asked whether they have weekly contact with any of their adult children by any means (in person, phone, email, etc.). A code of 1 indicated weekly contact with adult children by any mode and a code of 0 otherwise.

Caregiving for grandchildren

Participants were asked whether they had provided care to their grandchildren in the past year, with a code of 1 indicating they provided care and a code of 0 otherwise.

'Loneliness', consistent with one previous study [22], was assessed using one item from the Center for Epidemiologic Studies Depression Scale short form (CESD-10) [23] that asked 'how often you have felt lonely during the past week' on a four-point scale ranging from 1 = 'rarely or none of the time < 1 day' to 4 = 'most or all of the time 5–7 days'.

'Cognitive functioning' was assessed by orientation and attention measured by Telephone Interview of Cognitive Status (TICS), episodic memory measured by immediate and delayed word recall, and visuospatial functioning measured by figure drawing. Specific details have been previously reported (reference was omitted here for peer review).

'Covariates' were age, gender, marital status and self-reported comorbidity assessed as the total number of diagnosed chronic health conditions and ranged from 0 to 13.

Data analyses

We used the multiple indicator multiple cause (MIMIC) mediation model for the latent construct of social isolation, with three formative indicators (social activity engagement, weekly adult children contact and caregiving for grandchildren) and one reflective indicator (living alone, the box outlined with a dashed line in Figure 1) [24]. We assumed

Table 1. Demographic characteristics of participants by living situation

	Overall ($n = 7,410$)	Living with others ($n = 6,644$)	Living alone ($n = 766$)	P
Age (years), mean (SD)	68.38 (7.00)	67.94 (6.78)	72.17 (7.74)	<0.05
Female (%)	3,684 (49.7)	3,219 (48.5)	465 (60.7)	<0.05
Education (%)				0.786
Less than lower secondary	6,882 (93.0)	6,169 (92.9)	713 (93.6)	
Upper secondary and vocational training	374 (5.1)	339 (5.1)	35 (4.6)	
Tertiary	147 (2.0)	133 (2.0)	14 (1.8)	
Married (%)	5,750 (77.6)	5,667 (85.3)	83 (10.8)	<0.05
Comorbidity, mean (SD)	1.65 (1.49)	1.67 (1.49)	1.56 (1.49)	0.058
Social activity engagement (%)	3,056 (44.3)	2,702 (43.7)	354 (49.2)	0.005
Weekly adult children contact (%)	6,536 (90.5)	5,997 (91.6)	539 (79.6)	<0.05
Caregiving for grandchildren (%)	1,997 (41.8)	1,933 (43.4)	64 (19.6)	<0.05
Loneliness, mean (SD)	0.63 (1.01)	0.57 (0.96)	1.15 (1.23)	<0.05
Immediate word recall, mean (SD)	3.60 (1.72)	3.62 (1.72)	3.39 (1.77)	0.002
Delayed word recall, mean (SD)	2.61 (1.92)	2.63 (1.92)	2.42 (1.87)	0.015
Serial seven test, mean (SD)	2.48 (2.04)	2.53 (2.04)	1.99 (2.00)	<0.05
Date naming (orientation), mean (SD)	2.71 (1.29)	2.72 (1.29)	2.65 (1.30)	0.208
Figure drawing (%)	3,559 (52.9)	3,255 (54.0)	304 (43.8)	<0.05

that the latent construct of social isolation manifests in living alone (reflective indicator) but can be modified by the degree of family or social contact (formative indicators as mentioned above). Mediation effects were defined as the product of path a and path b (see Figure 1) and were estimated using both delta test and bootstrap methods (with 10,000 bootstrap samples). These two methods resulted in the consistent results (see Appendix 1 in Supplementary Data).

Model estimates and standard errors were computed taking into account the complex survey design with clustered samples and nonresponse rate using the replicate weights method. The maximum likelihood estimation was used to handle missing data. Model fit indices including χ^2 ($P > 0.05$), root mean square error of approximation (RMSEA < 0.05), Tucker-Lewis index (TLI > 0.95) and comparative fit index (CFI > 0.95) to evaluate model performance following Hu and Bentler [25] criteria. Results were presented using unstandardised (β) and standardszed path coefficients (b). Significance level was set at $P < 0.05$. We also adjusted for age, gender and socioeconomic status in the analysis and obtained similar results (see Appendix 1 in Supplementary Data; Appendix 2 in Supplementary Data displays the results from the adjusted multiple indicator multiple cause (MIMIC) mediation model (depression as the mediator)). Thus, for easy interpretation of model, we did not include age and gender in the final model.

Results

Participant characteristics

Participant demographic characteristics are presented in Table 1. Most were married (77.6%) and had less than lower secondary education (93.0%). About 10% of participants ($n = 766$) lived alone. There were significant differences in living alone status related to demographic characteristics, social isolation, loneliness and cognitive function. Participants who lived alone were more likely to be older, female, engage in social activity, feel lonely or have poorer cognitive functioning than those who lived with others. Conversely, those who lived alone were less likely to be married, contact their adult children or take care of grandchildren.

MIMIC mediation model results

Table 2 and Figure 1 decompose the MIMIC mediation model effects in terms of standardised and unstandardised coefficients. The model had relatively good fit indices: χ^2 (29) = 135.76, $P < 0.05$; the CFI, TLI and RMSEA values were 0.91, 0.87 and 0.03 (90% confidence interval [CI] for RMSEA is 0.02 and 0.03), respectively.

Social isolation was treated as a latent variable with three formative indicators, including social activity engagement, weekly adult children contact and caregiving for grandchildren (the fourth indicator, living alone, was reflective and fixed for identification). The results showed these indicators were significant ($b = -0.19$ to -0.37). Weekly contact with adult children contributed the least ($b = -0.19$). Similarly, analysis of the latent factor of cognitive functioning along with the reflective indicators of this construct (word recall, etc.) was also significant ($b = 0.45$–0.75), indicating the measured indicators were conceptually linked to the presumed latent variable of cognitive functioning.

There was a significant indirect effect ($b = 0.38$ for path a; $b = -0.17$ for path b; $\beta = -0.15$ for $a \times b$) (Table 2), indicating loneliness was a mediator of the relationship between social isolation and cognitive functioning. After controlling for the indirect effect of loneliness, the direct effect of social isolation on cognitive functioning still remained significant ($b = -0.36$ for path c'). The total effect of social isolation on cognitive functioning was also significant ($\beta = -0.98$ for $a \times b + c'$). All these results suggested a partial mediation

Table 2. Results from the MIMIC mediation model

	β	SE	b	P
Social isolation → loneliness (path a)	0.996	0.20	0.38	<0.05
Loneliness → cognitive functioning (path b)	−0.15	0.04	−0.17	<0.05
Social isolation → cognitive functioning (path c')	−0.83	0.18	−0.36	<0.05
Indirect effect via loneliness ($a \times b$)	−0.15	0.04	—	<0.05
Total effect ($a \times b + c'$)	−0.98	0.19	—	<0.05
Social isolation ~				
Social activity engagement	−0.28	0.06	−0.36	<0.05
Weekly adult children contact	−0.26	0.06	−0.19	<0.05
Caregiving for grandchildren	−0.28	0.06	−0.37	<0.05
Cognitive functioning ~				
Delayed word recall	0.99	0.04	0.45	<0.05
Serial seven test	1.50	0.11	0.66	<0.05
Orientation	0.88	0.06	0.62	<0.05
Figure draw	1.29	0.11	0.75	<0.05

β = unstandardised estimate; b = standardised estimate. Living alone and immediate word recall were all fixed to 1.0 for model identification.

effect of loneliness in the association between social isolation and cognitive functioning.

Discussion

This is the first known study to partition the effects of social isolation on cognitive functioning into direct effects and indirect effects (mediated by loneliness) among Chinese older adults. Two main results emerged from this study.

First, we found a partial mediating effect of loneliness on the association between social isolation and cognitive functioning. In other words, social isolation can be negatively related to cognitive functioning through people's perceptions of loneliness, indicating that loneliness may serve as an important intervening target and that reversing loneliness might be related to less cognitive function impairment. However, future studies using longitudinal data are needed to confirm this speculation. The partial mediation effect suggests that other mechanisms could also explain why social isolation makes Chinese older adults more vulnerable to cognitive function impairment. Social isolation may be particularly detrimental when it affects the perceptions of affiliation, worthiness, fulfilment and purpose of life [10,11,26]. The nature of these factors might not be sufficiently captured by the concept of loneliness. In addition, there are occasions where people intentionally retain a small network to avoid undesired social interactions [27]. Therefore, it is not simply the absence of relationships [26] or the frequency of social contacts [10] but the quality of interactions [10,26] that might affect cognitive functioning. Further research to explore the complex interplay between these variables is suggested.

Secondly, we found that culturally relevant features of social isolation, including weekly contact with adult children, social activity engagement and caregiving for grandchildren, are good measures of social isolation among Chinese older adults. Compared with previous studies where social isolation is measured in terms of size and frequency [1], the inclusion of caregiving for grandchildren is a culturally significant value for Chinese older adults. Unlike other types of family caregiving relationships (e.g. spousal caregiving or adult children caregiving) which can be distressing, caring for grandchildren is a positive contributor to health for Chinese older adults [18]. Future research comparing the types of relationships that define social isolation across different cultural contexts is needed.

Although frequent contact with adult children has been included in previous studies [28], it has different implications for Chinese older adults because Chinese adult children are both morally and legally bound to take care of their parents. As the law did not quantify the word 'frequent', the implications of this regulation have been debated and there is a lack of empirical evidence on how it affects older adult health. Our results suggest that, compared with other indicators, weekly contact with adult children contributes least to social isolation in terms of the standardised coefficient (b). Future studies considering the effect of different modes and levels of contacts on the social isolation are needed, and thus the findings can inform the current policy.

This study has some limitations. First, the definition of social isolation was only measured by four features, and other measures such as the types of relationships (e.g. friends), attachment style and relationship strain were not included [29]. Second, mediation analysis may suggest a causal hypothesis but does not prove causality. Third, a single-item measure of loneliness might attenuate relationships among variables due to measurement error. Nevertheless, statistical significance persists even with one item measurement.

In conclusion, loneliness can serve as an important clinical target that appears to be positively linked to social isolation and poor cognitive functioning in Chinese older adults. Maintaining social relations and coping with feelings of loneliness in old age are beneficial for cognitive functioning. The interplay between social isolation, loneliness and cognitive functioning may be more fully explained by factors such as sense of fulfilment that can potentially enhance our understanding of the complex association between social isolation and cognitive functioning and guide future interventions.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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References

1. Kelly ME, Duff H, Kelly S *et al.* The impact of social activities, social networks, social support and social relationships on the cognitive functioning of healthy older adults: a systematic review. Syst Rev 2017; 1: 259. doi: 10.1186/s13643-017-0632-2.
2. Fratiglioni L, Wang HX, Ericsson K, Maytan M, Winblad B. Influence of social network on occurrence of dementia: a community-based longitudinal study. Lancet 2000; 9212: 1315–9. doi: 10.1016/s0140-6736(00)02113-9.
3. Luo Y, Waite LJ. Loneliness and mortality among older adults in China. J Gerontol B Psychol Sci Soc Sci 2014; 4: 633–45. doi: 10.1093/geronb/gbu007.
4. Syed MA, McDonald L, Smirle C, Lau K, Mirza RM, Hitzig SL. Social isolation in Chinese older adults: scoping review for age-friendly community planning. Can J Aging 2017; 2: 223–45. doi: 10.1017/s0714980817000101.
5. Boss L, Kang DH, Branson S. Loneliness and cognitive function in the older adult: a systematic review. Int Psychogeriatr 2015; 4: 541–53. doi: 10.1017/s1041610214002749.
6. Shankar A, Hamer M, McMunn A, Steptoe A. Social isolation and loneliness: relationships with cognitive function during 4 years of follow-up in the English longitudinal study of ageing. Psychosom Med 2013; 2: 161–70. doi: 10.1097/PSY.0b013e31827f09cd.
7. Gow AJ, Corley J, Starr JM, Deary IJ. Which social network or support factors are associated with cognitive abilities in old age? Gerontology 2013; 5: 454–63. doi: 10.1159/000351265.
8. Amieva H, Stoykova R, Matharan F, Helmer C, Antonucci TC, Dartigues JF. What aspects of social network are protective for dementia? Not the quantity but the quality of social interactions is protective up to 15 years later. Psychosom Med 2010; 9: 905–11. doi: 10.1097/PSY.0b013e3181f5e121.
9. Ben-Zur H. Loneliness, optimism, and well-being among married, divorced, and widowed individuals. J Psychol 2012; 1-2: 23–36. doi: 10.1080/00223980.2010.548414.
10. Berkman LF. Which influences cognitive function: living alone or being alone? Lancet 2000; 9212: 1291–2. doi: 10.1016/s0140-6736(00)02107-3.
11. de Jong Gierveld J, van Tilburg TG, Dykstra PA. Loneliness and social isolation. In: Perlman D, Vangelisti A, eds. The Cambridge Handbook of Personal Relationships. Cambridge, UK: Cambridge University Press, 2006; 485–500.
12. McHugh JE, Kenny RA, Lawlor BA, Steptoe A, Kee F. The discrepancy between social isolation and loneliness as a clinically meaningful metric: findings from the Irish and English longitudinal studies of ageing (TILDA and ELSA). Int J Geriatr Psychiatry 2017; 6: 664–74. doi: 10.1002/gps.4509.
13. Luo Y, Hawkley LC, Waite LJ, Cacioppo JT. Loneliness, health, and mortality in old age: a national longitudinal study. Soc Sci Med 2012; 6: 907–14. doi: 10.1016/j.socscimed.2011.11.028.
14. Utz RL, Swenson KL, Caserta M, Lund D, deVries B. Feeling lonely versus being alone: loneliness and social support among recently bereaved persons. J Gerontol B Psychol Sci Soc Sci 2014; 1: 85–94. doi: 10.1093/geronb/gbt075.
15. Perissinotto CM, Covinsky KE. Living alone, socially isolated or lonely–what are we measuring? J Gen Intern Med 2014; 11: 1429–31. doi: 10.1007/s11606-014-2977-8.
16. Routasalo PE, Savikko N, Tilvis RS, Strandberg TE, Pitkala KH. Social contacts and their relationship to loneliness among aged people - a population-based study. Gerontology 2006; 3: 181–7. doi: 10.1159/000091828.
17. Chen F, Liu G, Mair CA. Intergenerational ties in context: grandparents caring for grandchildren in China. Soc Forces 2011; 2: 571–94. doi: 10.1093/sf/sor012.
18. Liu H, Lou WQV. Continuity and changes in three types of caregiving and the risk of depression in later life: a 2-year prospective study. Age Ageing 2017; 5: 827–32. doi: 10.1093/ageing/afx032.
19. Arpino B, Bordone V. Does grandparenting pay off? The effect of child care on grandparents' cognitive functioning. J Marriage Fam 2014; 2: 337–51.
20. Roh HW, Lee Y, Lee KS *et al.* Frequency of contact with non-cohabitating adult children and risk of depression in elderly: a community-based three-year longitudinal study in Korea. Arch Gerontol Geriatr 2015; 1: 183–9. doi: 10.1016/j.archger.2014.09.007.
21. Zhao Y, Hu Y, Smith JP, Strauss J, Yang G. Cohort profile: the China health and retirement longitudinal study (CHARLS). Int J Epidemiol 2014; 1: 61–8. doi: 10.1093/ije/dys203.
22. Donovan NJ, Wu Q, Rentz DM, Sperling RA, Marshall GA, Glymour MM. Loneliness, depression and cognitive function in older U.S. adults. Int J Geriatr Psychiatry 2017; 5: 564–73. doi: 10.1002/gps.4495.
23. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). Am J Prev Med 1994; 2: 77–84.
24. Donaldson GW. Structural equation models for quality of life response shifts: promises and pitfalls. Qual Life Res 2005; 10: 2345–51. doi: 10.1007/s11136-005-3977-2.
25. Lt H, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Model Multidiscip J 1999; 1: 1–55.
26. Beland F, Zunzunegui MV, Alvarado B, Otero A, Del Ser T. Trajectories of cognitive decline and social relations. J Gerontol B Psychol Sci Soc Sci 2005; 6: 320–30.
27. Lou VW, Ng JW. Chinese older adults' resilience to the loneliness of living alone: a qualitative study. Aging Ment Health 2012; 8: 1039–46. doi: 10.1080/13607863.2012.692764.
28. Cornwell EY, Waite LJ. Measuring social isolation among older adults using multiple indicators from the NSHAP study. J Gerontol B Psychol Sci Soc Sci 2009; 64B: i38–46. doi: 10.1093/geronb/gbp037.
29. Holt-Lunstad J, Robles TF, Sbarra DA. Advancing social connection as a public health priority in the United States. Am Psychol 2017; 6: 517–30. doi: 10.1037/amp0000103.

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