

BMJ Open Relationship between socioeconomic status and social network with loneliness: a cross-sectional study of China older adults with activity of daily living disabilities

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ABSTRACT

Objectives The objective of this study is to explore the relationship between loneliness and socioeconomic status and social networks in older adults with activity of daily living (ADL) disabilities in China and investigate people who are more likely to feel lonely.

Design Cross-sectional study.

Setting This study was conducted in six districts of Nantong, Jiangsu, China.

Participants A total of 880 older adults with ADL disabilities who participated in long-term care insurance and had an ADL score of less than 40 were investigated by the convenient sampling method.

Primary outcome measures The UCLA Loneliness Scale (V.3) was used to assess loneliness.

Results Among 880 participants, the mean age was 80.64 years (SD 10.29) and 59.43% were females. The mean score of loneliness was 44.70 (SD=10.01), and the majority suffered from moderate (39.89%) or moderate to severe (40.11%) loneliness. Regression showed that lower loneliness was associated with being females ($\beta=-1.534$, 95% CI: -2.841 to -0.228), married ($\beta=-3.554$, 95% CI: -4.959 to -2.149), often communicating with children ($\beta=-3.213$, 95% CI: -4.519 to -1.908), having more than two friends ($\beta=-5.373$, 95% CI: -6.939 to -3.808) and receiving home-based rehabilitation once a day ($\beta=-3.692$, 95% CI: -5.642 to -1.743).

Participants who lived in rural areas ($\beta=1.926$, 95% CI: 0.658 to 3.193) and were unemployed before retirement ($\beta=4.691$, 95% CI: 1.485 to 7.898) experienced higher loneliness for older adults with ADL disability. The classification and regression tree model showed fewer friends and communication with children sometimes, and living in rural areas felt more lonely.

Conclusions The poorer socioeconomic status and social network among older adults with ADL disability perceived more loneliness. Attention should be paid to the loneliness status of such vulnerable people, particularly those with ADL disabilities living in rural areas and having fewer social networks.

INTRODUCTION

Loneliness is a painful emotional state caused by the discrepancy between the meaningful social relationships a person desires and the

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Examine the relationship between sociodemographic factors, socioeconomic status, social network and home-based rehabilitation with loneliness among older adults with activity of daily living disabilities in China.
- ⇒ The classification and regression tree models were used to estimate the subset of older adults who were more likely to become lonely.
- ⇒ This was a cross-sectional study with limited ability to establish causal relationships among variables.
- ⇒ The data were based on self-report and thus were susceptible to recall or reporting bias.

relationships they perceive they have.¹ It has been a prevalent health problem affecting 12% of the older population worldwide.² The prevalence of loneliness varies in different countries. A longitudinal population-based cohort study showed that the prevalence of loneliness in older adults ranged from 9.2% to 12.4% at wave 5 of the Survey of Health, Ageing, and Retirement in Europe project.³ The Chinese Longitudinal Healthy Longevity Survey (CLHLS) indicated that about 22.9% and 30.6% of older men and women suffer from loneliness.⁴ Existing research shows that older adults with activity of daily living (ADL) disabilities might be linked to an increased risk of experiencing loneliness.⁵ A cross-sectional study in the UK found that people with disability experienced loneliness at significantly higher rates than people without disability.⁶ The Health in Times of Transition survey in the Soviet Union showed that the severity of the disability was also crucial for loneliness.⁷ However, little is known about loneliness among older adults with ADL disabilities in China. Therefore, the loneliness of older adults with ADL disability in China is worthy of further study.



Loneliness in older adults is associated with various health risks, such as cardiovascular health risks, cognitive dysfunction and psychological issues (depression, anxiety, insomnia, and increased morbidity and mortality), resulting in reduced quality of life.^{8–11} In addition, socioeconomic status (SES) is related to loneliness in older adults. Variables such as income, education, employment and assets are treated as proxies for SES.¹² Studies have shown that lower education and living in rural areas are associated with more loneliness.^{13–14} As for older adults with ADL disabilities, the environment has a significant impact on their feelings of loneliness. Physical disabilities and cognitive impairments mean that their ability to perform daily activities is diminished, leading to a more significant psychological gap than before.⁷ In addition, the differences in age and gender can lead to varying degrees of loneliness, with women and older people feeling more lonely.^{4–15} These findings highlight the importance of studying the relationship between SES and loneliness in older adults with ADL disabilities.

Older adults inevitably undergo significant transitions in the size and composition of their social networks.¹⁶ The increase in loneliness in later life can largely be explained by network changes and waning social contacts due to unavoidable and intractable life events such as retirement, widowhood, loss of close relatives and chronic and functional limitations.¹⁷ Some studies have found a negative correlation between family size, the frequency of contact with family members and feelings of loneliness.¹⁸ Marital status is also associated with loneliness; married older adults reported lower feelings of loneliness than those who were widowed or divorced.¹⁹ The social network is also crucial to loneliness among older adults with ADL disabilities. Home-based rehabilitation has increased in many countries due to the increased ageing population.²⁰ Home-based rehabilitation provides the flexibility of place and time in rehabilitation therapy and can sustain independence and accommodate the preferences of older and disabled adults.²¹ No study has investigated a direct association between global social network properties and loneliness.¹⁶ In addition, little research has focused on the relationship between home-based rehabilitation and loneliness, especially among older adults. Hence, the relationship between social networks, family rehabilitation and loneliness deserves further study.

Although several studies have assessed loneliness and susceptibility among older adults in Western societies, little information is known about loneliness among older adults with ADL disabilities. This study aimed to examine loneliness among ADL-disabled older adults within Nantong, China. Furthermore, we verified the effects of SES, social networks and home-based rehabilitation on loneliness among older adults and explored gender differences in these relationships. The following hypotheses were made:

(1) SES, social network and home-based rehabilitation are related to loneliness in older adults with ADL disabilities and (2) there are gender differences among social

network, socioeconomic and home-based rehabilitation among older adults with ADL disabilities.

METHODS

Research design and participants

The cross-sectional study was conducted in six districts of Nantong, Jiangsu Province in eastern China, a pilot city for long-term care insurance (LTCI) systems in China. The LTCI systems in Nantong cover individuals with moderate and severe disabilities due to old age and disease as long as their score on the Assessment Scale for Activities of Daily Living (the Barthel Index Assessment Scale) is lower than 40.²² Insured individuals who are still unable to take care of themselves after at least 6 months of treatment can receive subsidised expenses related to a nursing home stay, assisted living facility or formal caretakers coming to your house. Although there are varied reimbursement catalogues, there is no threshold for treatment benefits.

The sample size was calculated by $n = \frac{Z_{\alpha}^2 \times p(1-p)}{d^2}$. In the formula, n represents the sample size, Z is the statistic for significance testing, p is the estimated prevalence rate and d is the allowable margin of error. The CLHLS indicated that about 22.9% and 30.6% of older men and women suffer from loneliness.⁴ Existing research shows that older adults with ADL disabilities might be linked to an increased risk of experiencing loneliness.⁵ This study set the loneliness rate among the elderly p at 30.6%. To ensure the accuracy of the sample size, α was set at 0.05, thus $Z_{0.05} = 1.96$. To ensure the precision of the sample size, this study allows for a margin of error $d=0.1p$. Substituting the above data into the formula yields the required sample size of 871. According to the 90% effective response rate, the sample size of this study should not be less than 968 participants. Convenience sampling was used to select 1000 older adults with ADL disabilities who participated in LTCI in Nantong to conduct a face-to-face questionnaire by formal home caretakers working in service institutions. The survey was conducted from January 2020 to March 2020 to explore the status of loneliness among older adults with ADL disabilities. Inclusion criteria included (1) individuals aged 60 years or above; (2) whose scores on the Assessment Scale for Activities of Daily Living are lower than 40 and (3) individuals who are long-term residents in the study area and able to communicate in Mandarin. Of the 1000 respondents, after removing 120 incomplete questionnaires, 880 valid questionnaires were collected, resulting in a response rate of 88%.

Measures

Dependent variable

Loneliness

The UCLA Loneliness Scale (V.3), a validated metric of the construct of loneliness, was used to assess the level of loneliness, the primary outcome variable.²³ UCLA is a 20-item Likert 4-level scale (1, never to 4, always)

consisting of 10 positively worded statements demonstrating satisfaction with social relationships and 10 negatively worded statements showing dissatisfaction with social relationships.²⁴ The summary of the scores of each item is the total score, with higher total scores indicating higher levels of loneliness. The scale has the lowest and highest total scores of 20 and 80, specifically mild loneliness (20–34), moderate loneliness (35–49), moderate to severe loneliness (50–64) and severe loneliness (65–80). The Cronbach's $\alpha=0.878$ suggested that the scale was reliable.

Independent variables

Socioeconomic status

A self-designed questionnaire evaluated SES based on four dimensions: residence (urban vs rural), educational level, work and monthly income (online supplemental additional file 1). The permanent residence information of participants was obtained through a home-based rehabilitation company. Additionally, the participants were asked to answer three questions regarding their SES: 'Could you tell me something about your educational background?' 'What did you do before you retired?' 'How much is your monthly household income (including government subsidies)?'. Participants answered according to the actual situation.

Social network

The social network is an independent variable that includes four dimensions: Marital status (single/divorced/widowed vs married), the number of children, communication status with children and the number of close friends. A self-designed questionnaire measured the participants' social network using the following questions: 'What is your current marital status?' 'How many kids do you have?' 'How many close friends do you have?'. In addition, the participants were asked about the frequency of visiting or chatting with their children daily (online supplemental additional file 1).

Home-based rehabilitation service

Long-term care and end-of-life care are crucial for older adults with ADL disabilities.²⁵ Home-based rehabilitation services (HBRSS) included in the LTCI care package can significantly improve the quality of life for older adults with ADL disabilities. These services support their physical well-being and enhance their sense of autonomy and fulfilment in their daily lives. Here, the time and frequency of receiving HBRSS service utilisation were used to assess the status of coverage of the LTCI care beneficial package (online supplemental additional file 1).

Covariates

Based on the findings of former research on the determinants of loneliness, some covariates, including age and gender, were controlled for sociodemographic variables related to loneliness.²⁶

Data analysis

Statistical analyses were conducted using STATA V.16.0. First, descriptive statistics were used to describe the basic characteristics of the study sample. Then, mean scores and SD of loneliness were calculated and compared according to t-tests or one-way analysis of variance. Second, the ordinary least squares (OLS) regression models were performed to predict loneliness among old adults with ADL disability by SES, social network and HBRSS utilisation. In additional analysis, OLS regression models were run separately for men and women to explore the gender differences in loneliness affected by these predictor variables. Finally, the interactive relationship between some indicators of SES and social network and home-based rehabilitation associated with loneliness was evaluated using the classification and regression tree (CART) model. To check for the multicollinearity, We calculated the variance inflation factor (VIF).²⁶ The VIF was <3 for all independents, indicating no problems with multicollinearity.

Patient and public involvement

None.

RESULTS

Participants characteristics

Characteristics of the study participants are presented in [table 1](#). The mean age of participants was 80.64 years (SD 10.29) and 59.43% were females. Nearly 49.77% of older adults with ADL disability reported that their average monthly income was less than 2000 yuan, 41.14% were unemployed or temporary and unpaid workers before retirement, 38.30% were living in rural areas and 43.41% had no education. The majority, 67.50%, were currently in marital status, communicated with their children often/frequently (55.79%) and had less than two close relationships with their friends (65.68%). Regarding home-based rehabilitation care service, 77.61% received this care once a month or below, and most received care time less than 10 min (92.39%).

The mean loneliness score was 44.70 (SD 10.01), and the majority of participants reported that they experienced moderate (39.89%) or moderate to severe (40.11%) loneliness. [Table 1](#) compares loneliness differences across various subgroups, including SES, social network and HBRSS utilisation.

OLS regression analysis

The results of OLS regression are presented in [table 2](#). Participants in low SES, living in rural areas ($\beta=3.496$, 95% CI: 2.171 to 4.821) and unemployed before retirement ($\beta=3.965$, 95% CI: 0.539 to 7.390) experienced more loneliness in model 1 (shown in [table 2](#)), which explained 7.4% of the variance in loneliness (Adj- $R^2=0.074$). From model 1 to model 2, social network variables were added to the model, which explained 14.4% of the variance in loneliness (Adj- R^2 changed from 0.074

**Table 1** Basic characteristics of the participants (N=880)

Variables	Mean±SD/n (%)	Loneliness scores	t/F	P value
Loneliness	44.70±10.01			
Mild loneliness	167 (18.98)	27.85±4.36		
Moderate loneliness	351 (39.89)	44.00±4.32		
Moderate to severe loneliness	353 (40.11)	52.76±2.84		
High loneliness	9 (1.02)	68.00±3.20		
Socioeconomic status				
Residence				
Urban	543 (61.70)	43.25±10.47	30.56	0.001
Rural	337 (38.30)	47.02±8.74		
Education level				
Illiteracy	382 (43.41)	45.14±10.52	1.80	0.126
Primary school	280 (31.82)	43.93±9.78		
Junior school	139 (15.80)	44.65±9.56		
Senior school	56 (6.36)	46.86±8.22		
Collage/bachelor and above	23 (2.61)	41.61±9.86		
Preretirement work				
Government personnel	69 (7.84)	44.64±8.78	10.63	0.001
Private sector personnel	187 (21.25)	43.42±10.04		
Individual businesses and peasants	262 (29.77)	45.91±9.13		
Temporary and unpaid workers	220 (25.00)	42.03±11.98		
Unemployed	142 (16.14)	48.28±6.92		
Monthly income (¥)				
<2000	438 (49.77)	45.59±10.05	2.46	0.031
2000–4000	244 (27.73)	43.28±10.54		
4000–6000	98 (11.14)	44.76±9.64		
6000–8000	51 (5.80)	45.92±7.79		
8000–10000	31 (3.52)	41.74±9.82		
>10000	18 (2.05)	43.28±6.74		
Social network				
Marital status				
Married	594 (67.50)	43.60±10.29	22.46	0.001
Others (single/divorced/widowed)	286 (32.50)	46.97±9.00		
Number of children				
≤2	506 (57.50)	44.62±10.09	0.06	0.807
≥3	374 (42.50)	44.79±9.91		
Communication status with children				
Sometimes	389 (44.20)	47.38±9.71	27.02	0.001
Often	375 (42.61)	42.32±9.80		
Frequently	116 (13.18)	43.40±9.52		
Number of close friends				
0	198 (22.50)	47.09±9.00	41.37	0.001
1–2	380 (43.18)	47.28±8.53		
3–5	171 (19.43)	40.58±10.68		
≥6	131 (14.89)	38.93±10.45		
Home-based rehabilitation service				
Time (minutes)				

Continued

Table 1 Continued

Variables	Mean±SD/n (%)	Loneliness scores	t/F	P value
≤10	813 (92.39)	44.97±9.91	2.36	0.052
11–20	50 (5.68)	41.96±11.02		
21–30	11 (1.25)	38.27±11.24		
31–59	4 (0.45)	43.25±7.14		
≥60	2 (0.23)	40.00±1.41		
Frequency				
Once a month and below	683 (77.61)	45.44±9.68	9.57	0.001
Two or three times a month	41 (4.66)	46.95±7.13		
Once or twice a week	33 (3.75)	45.15±10.14		
Three to five times a week	6 (0.68)	40.50±9.09		
Once a day	117 (13.30)	39.64±11.26		
Covariates				
Gender				
Male	357 (40.57)	45.25±9.67	1.84	0.175
Female	523 (59.43)	44.32±10.22		

to 0.218). Compared with those without a spouse, those with a spouse ($\beta=-3.531$, 95% CI: -4.940 to -2.123) were significantly associated with decreased loneliness in older adults with ADL disability. Likely, those with more than two friends ($\beta=-5.266$, 95% CI: -6.826 to -3.705) and often ($\beta=-3.363$, 95% CI: -4.675 to -2.051) or frequently ($\beta=-2.095$, 95% CI: -4.047 to -0.142) communicating with their children significantly experienced lower loneliness than those with two friends or below and sometimes communicating with their children. When we added HBRS utilisation in model 3, we found that those who received the HBRS service once a day ($\beta=-3.692$, 95% CI: -5.642 to -1.743) had lower loneliness than those who received service once a month and below, which explained 1.4% of the variance in loneliness (Adj-R² changed from 0.218 to 0.232). In addition, when the SES variables and social network and HBRS utilisation were entered in model 3, female older adults with ADL disability were likely to feel less loneliness than male older adults ($\beta=-1.534$, 95% CI: -2.841 to -0.228).

Additional regression results based on gender group

Regression results indicated that the relationship between the variables and loneliness significantly differed between males and females (online supplemental table B1). Additional analysis showed that males in rural areas were lonelier than those in urban areas ($\beta=4.373$, 95% CI: 2.497 to 6.248). Among females, those who were married ($\beta=4.163$, $p<0.001$) and receiving HBRS once a day ($\beta=-5.044$, 95% CI: -7.632 to -2.456) were less lonely than others, supporting hypothesis 2.

CART model results

The CART model showed that loneliness was associated with the number of close friends, frequency of communicating with children, residence, work status before

retirement, marital status, and frequency of receiving HBRS (figure 1). Older adults with ADL disability who have fewer friends, a lower frequency of communicating with children and live in rural areas tend to experience higher loneliness.

The number of close friends is the most significant factor affecting the loneliness of older adults with ADL disability (node 0). Older adults with two or more friends experienced lower levels of loneliness than those with fewer friends, with moderate to severe loneliness rates of 65.9% (node 2) and 88.9% (node 1), respectively. Less frequent communication with their children and living in rural areas are essential to older people's loneliness. Among older adults without close friends and having little communication with their children, the incidence of moderate to severe loneliness was 93.7% (node 3). In contrast, those communicating frequently, even without friends, experienced lower loneliness, with moderate to severe loneliness rates of 83.8% (node 4). If older adults have more than two friends, the level of loneliness in rural areas was significantly higher than that of older adults in urban areas, with moderate to high loneliness rates of 84.4% (node 6) and 58.0% (node 5), respectively.

HBRSs are crucial for decreasing older adults' loneliness. In urban areas, disabled older adults who received HBRS 2–3 times or more per month had a lower incidence of loneliness compared with those who received fewer services, and the incidence of moderate to severe loneliness was 40.4% (node 12) and 64.5% (node 11), respectively.

DISCUSSION

To our knowledge, this is the first study in China focusing on the loneliness status of older adults with ADL disability

**Table 2** OLS regression examining the relationship of SES, social network and HBRS utilisation on loneliness

Variables	Model 1	Model 2	Model 3
	β (95% CI)	β (95% CI)	β (95% CI)
Socioeconomic status			
Residence (reference: urban)			
Rural	3.496 (2.171, 4.821)***	2.365 (1.117, 3.613)***	1.926 (0.658, 3.193)**
Education level (reference: senior or above)			
Junior school	-1.911 (-4.755, 0.933)	-1.834 (-4.453, 0.785)	-2.056 (-4.669, 0.557)
Primary or below	1.921 (-4.671, 0.830)	-2.369 (-4.901, 0.164)	-2.315 (-4.849, 0.220)
Preretirement Work (reference: government personnel)			
Private sector personnel	-0.548 (-3.509, 2.414)	0.512 (-2.235, 3.259)	0.624 (-2.115, 3.364)
Individual businesses and peasants	1.942 (-1.195, 5.079)	2.954 (0.028, 5.881)*	2.732 (-0.191, 5.655)
Temporary and unpaid workers	-1.829 (-5.056, 1.399)	-0.394 (-3.405, 2.617)	-0.701 (-3.699, 2.298)
Unemployed	3.965 (0.539, 7.390)*	5.199 (1.996, 8.402)**	4.691 (1.485, 7.898)***
Monthly income (¥) (reference: >10000)			
8001-10000	-1.587 (-7.207, 4.032)	-0.922 (-6.103, 4.260)	-2.280 (-7.513, 2.954)
6001-8000	3.299 (-1.949, 8.547)	1.674 (-3.191, 6.539)	0.078 (-4.831, 4.988)
4001-6000	2.446 (-2.486, 7.377)	1.837 (-2.724, 6.399)	0.403 (-4.193, 4.999)
2000-4000	0.844 (-3.888, 5.576)	-0.048 (-4.421, 4.325)	-1.754 (-6.196, 2.689)
<2000	2.081 (-2.628, 6.791)	0.429 (-3.930, 4.789)	-1.023 (-5.434, 3.389)
Social network			
Marital status (reference: others (single/divorced/widowed))			
Married		-3.531 (-4.940, 2.123)***	-3.554 (-4.959, 2.149)***
Number of children (reference: ≤ 2)			
≥ 3		0.605 (-0.810, 2.020)	0.577 (-0.830, 1.985)
Communication status with children (reference: sometimes)			
Often		-3.363 (-4.675, 2.051)***	-3.213 (-4.519, 1.908)***
Frequently		-2.095 (-4.047, 0.142)*	-1.555 (-3.518, 0.408)
Number of close friends (reference: 0-2)			
3-5		-5.266 (-6.826, 3.705)***	-5.373 (-6.939, 3.808)***
≥ 6		-6.702 (-8.500, 4.903)***	-6.421 (-8.234, 4.608)***
Home-based rehabilitation services utilisation			
Time (minutes) (reference: ≤ 10)			
11-20			0.041 (-2.671, 2.753)
21-30			-3.666 (-9.247, 1.916)
31-59			-1.700 (-10.619, 7.219)
≥ 60			3.078 (-9.468, 15.623)
Frequency (reference: once a month and below)			
Two or three times a month			2.033 (-0.848, 4.913)
Once or twice a week			-1.404 (-4.591, 1.783)
Three to five times a week			-3.345 (10.617, 3.928)
Once a day			-3.692 (-5.642, 1.743)***
Covariates			
Age	0.032 (-0.036, 0.100)	-0.049 (-0.123, 0.025)	-0.070 (-0.145, 0.005)
Gender (reference: male)			
Female	-1.059 (-2.455, 0.337)	-1.466 (-2.783, 0.149)*	-1.534 (-2.841, 0.228)*
Adj-R ²	0.074	0.218	0.232

All coefficients are unstandardised. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

HBRS, home-based rehabilitation service; OLS, ordinary least squares; SES, socioeconomic status.

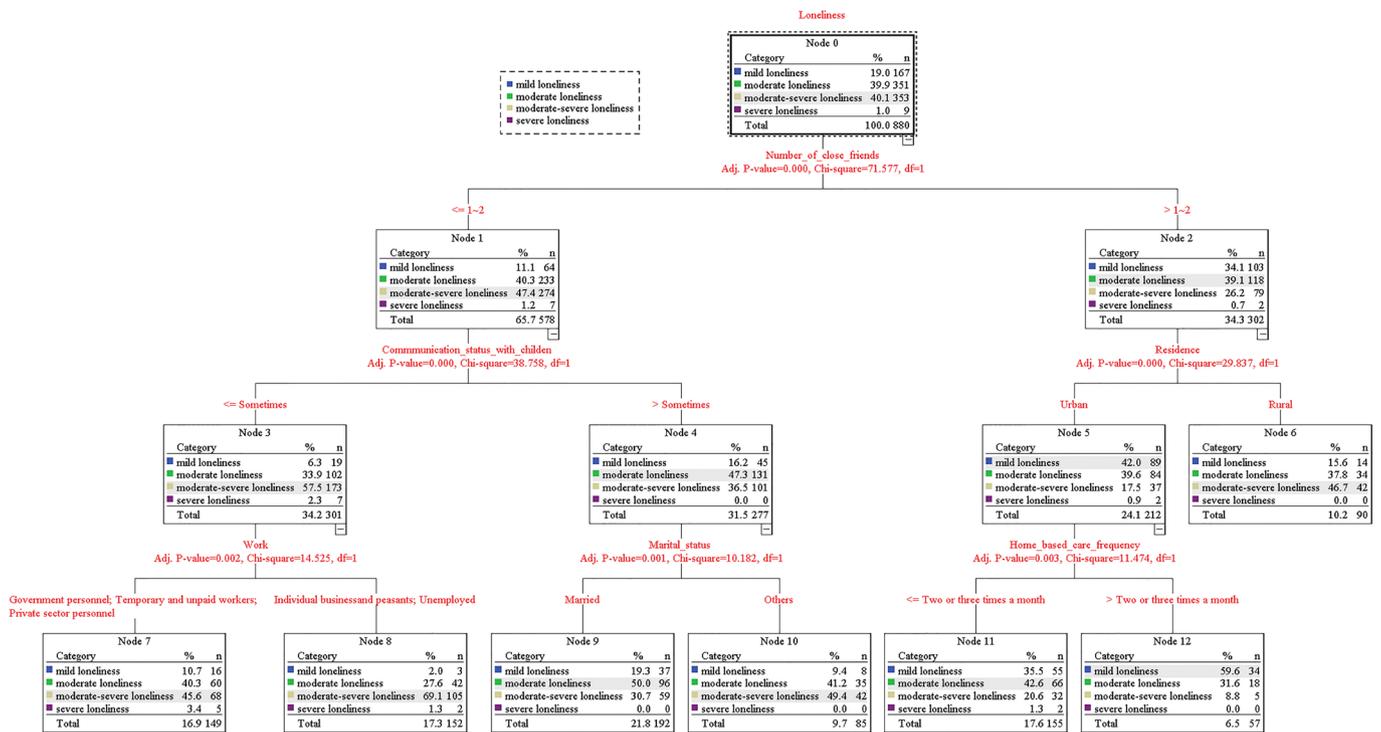


Figure 1 CART model analysis. CART, classification and regression tree.

who enjoy LTCI benefits and further explores the effect of SES factors, social networks and HBRs on loneliness. Older adults with ADL disabilities had a relatively high level of loneliness. Lower SES, such as living in a rural area and being unemployed before retirement, is more likely to increase loneliness in older adults with ADL disabilities. More social networks, such as having a spouse and more than two or more friends, frequent communication with children, and HBRs utilisation are essential for decreasing loneliness in older adults with ADL disability.

First, our study indicated that having more social networks, such as a greater number of friends and not being single, was associated with lower loneliness, similar to previous studies.²⁷ The Longitudinal Aging Study Amsterdam showed that older adults felt higher levels of loneliness after adverse life events, such as loss of social contacts or declining physical function.²⁸ Studies in Germany using data from the German Socio-Economic Panel indicated that having a higher frequency of contact with family and friends reduces loneliness.^{29 30} A cross-sectional survey in Spain also found that the type and size of smaller social networks are positively correlated with feelings of loneliness.³¹ Overall, these results confirm that social network is significantly related to loneliness and

will make older adults with ADL disabilities have a higher sense of subjective well-being and lower loneliness.

Second, our findings demonstrated that the higher the frequency of HBRs utilisation, the lower the loneliness among older adults. Home-based rehabilitation once a day could maintain engagement with others, consistent with the Canadian Community Health Survey and Midlife Development Survey in the USA.³²⁻³⁴ Home-based long-term care services have also proven to be effective in reducing hospitalisation and improving well-being for older adults.³⁵ Certain community-based healthcare services, such as rehabilitation care, can be complementary to complement informal care.³⁶ Older adults need formal or informal care, which helps improve their physical health while reducing loneliness and mental issues. However, there is a great divide in long-term care availability: care services are mainly offered in provincial capitals or large cities, whereas they are not prevalent in poor rural counties and villages.³⁷ By 2022, formal home and community-based care services had covered most urban areas but only extended to half of the rural areas.³⁸ Older adults residing in prosperous urban regions may experience greater advantages from formal home and community-based care, which is more accessible and of higher quality than in rural areas.³⁹ Therefore, providing LTCI services in rural areas should be given more attention.

Third, we also found that a lower SES was associated with more loneliness in older adults with ADL disabilities.



Previous studies showed that loneliness is related to socio-economic status.^{31 40–42} For example, a national longitudinal survey of 5043 Chinese participants aged 65 years or more showed that a better SES is associated with mild loneliness.⁴³ A case study also suggested that American adults with a higher SES and those who lived closer to the city centre were less likely to be lonely.⁴⁴ Adults with fewer resources and lower status cannot meet social adaptation and are thus perceived to be lonelier, leading to more health-risk behaviours.^{45 46} Additionally, the CART model was used as a predictive model to estimate the subsets of older people who are more likely to become lonely, which were observed with high loneliness in the CART model if older adults have poor social networks and take up jobs before retirement. Our study revealed that the role of SES on loneliness might partly depend on the social network variables, suggesting that loneliness among ADL-disabled older adults with poor social networks and high economic status should not be ignored.

In addition, female older adults with ADL disabilities had lower loneliness. However, previous studies revealed that females were more likely to have a higher level of loneliness.^{30 47 48} This may be because most of the women in the survey were single, as our research on gender differences in influencing factors of loneliness found that non-married women were more lonely. Therefore, the level of suffering associated with feelings of loneliness should be assessed to construct multifactorial interventions targeting the deficiencies in lonely older adults.

This study has some limitations. First, this was a cross-sectional study with limited ability to establish causal relationships among variables. Therefore, future studies should use longitudinal data or randomised controlled trials to provide more evidence for the efficacy of interventions. Second, the ADL scores or status might lead to a better understanding of the association between the level of loneliness and other variables, explaining the inconsistency in the results. Future studies should provide a targeted analysis of loneliness factors affecting older persons with ADL difficulties based on ADL scores. Third, the data were based on self-report and thus were susceptible to recall or reporting bias. Fourth, research participants were only collected in one city from a province of China, limiting the applicability of the findings to other areas or nations.

Implication

This study provides critical insights into improving loneliness among older adults with ADL disabilities. First, at the community level, volunteer social networks could be used to increase social interaction, especially for elderly individuals with ADL disability. Our study suggested that older adults with ADL disabilities deserve more concern in daily life, especially those having fewer friends, lower communication frequency with children, living in rural areas and not working before retirement. Second, the increasing availability of insurance coverage for HBRs should be strengthened for older adults with ADL disability,

especially in areas covered by LTCl. As we know, older adults with ADL disabilities lose autonomy, have less social participation, and feel lonely. Our findings revealed that the more HBRs received, the less lonely older adults felt. Increasing the availability of HBRs enables older adults to perceive more social connections with professionals or social workers. Third, at the family level, teaching older adults with ADL disabilities how to use technology, such as smartphones or tablets, for video calls can help them stay connected with family and friends, thereby reducing feelings of loneliness.

Conclusion

Older adults with ADL disabilities reported a high prevalence of loneliness. Older adults with lower SES often experience higher levels of loneliness. However, increased social networks and greater utilisation of HBRs have been shown to reduce feelings of loneliness in this population. Organising regular home visits by volunteers, community workers or professionals is essential to provide companionship, support and social interaction for these vulnerable groups, especially for rural adults and those without a spouse. In addition, encouraging family members to take an active role in the lives of older adults can also contribute significantly to their well-being.

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