Association between social integration and loneliness among the female migrant older adults with children: the mediating effect of social support

Jing Xu[1,2,3,4], Guangwen Liu[1,2,4], Hexian Li[1,2,4], Xiaoxu Jiang[1,2,4], Shengyu Zhou[1,2,4], Jieru Wang[1,2,4], Mingli Pang[1,2,4], Shixue Li[1,2,4] and Fanlei Kong[1,2,4]*

Abstract

Background The number of migrant older adults with children (MOAC) in China has been increasing in recent years, and most of them are women. This study aimed to explore the mediating effect of social support between social integration and loneliness among the female MOAC in Jinan, China.

Methods In this study, 418 female MOAC were selected using multi-stage cluster random sampling in Jinan, Shandong Province, China. Loneliness was measured by the eight-item version of the University of California Los Angeles Loneliness Scale (ULS-8), and social support was measured by The Social Support Rating Scale (SSRS). Descriptive analyses, t-tests, ANOVA, and structural equation modeling (SEM) were used to illustrate the relationship between social integration, social support, and loneliness.

Results The average scores of ULS-8 and SSRS were 12.9±4.0 and 39.4±5.9 among female MOAC in this study. Social integration and social support were found to be negatively related to loneliness, and the standardized direct effect was -0.20 [95% CI: -0.343 to -0.068] and -0.39 [95% CI: -0.230 to -0.033], respectively. Social support mediated the relationship between social integration and loneliness, and the indirect effect was -0.16 [95% CI: -0.252 to -0.100].

Conclusion The female MOAC's loneliness was at a relatively lower level in this study. It was found that social integration was negatively associated with loneliness, and social support mediated the relationship between them. Helping female MOAC integrate into the inflow city and improving their social support could be beneficial for alleviating their loneliness.

Keywords Migrant older adults with children, Female, Loneliness, Social integration, Social support, Structural equation model

*Correspondence:
Fanlei Kong
kongfanlei@sdu.edu.cn
Full list of author information is available at the end of the article

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 2 of 11

Background

As the world's most populous country, China has a very large group of elderly population. According to data from the Seventh National Census, in 2020, the total number of people aged 65 and above in China was about 191 million, accounting for about 13.5% of the total population [1]. Because of urbanization and industrialization, large-scale population migration movements have emerged in China since the last century [2]. In China, there were 376 million internal migrants whose homes were not the locations of household registration (hukou) in 2020, with 249 million of them moving from rural to urban areas and 127 million from urban to urban areas, respectively [3]. Driven by the rapid development of aging, the number of migrant elderly people in China increased year by year [4]. The 2018 report on China's migrant population development showed that the number of Chinese migrant elderly increased from 5.03 million in 2000 to 13.04 million in 2015 [5]. Most Chinese elderly migrants move to cities where their children live to provide care for their grandchildren [6]. In the current study, these elderly are referred to as the migrant older adults with children (MOAC) [7]. In general social and cultural norms, women are primarily responsible for childcare and other family responsibilities [8], while most grandchild care is also provided by grandmothers in current Chinese family [9, 10], which result in more women than men among the migrant elderly in China [11].

Loneliness has become a common problem among older people worldwide [12]. J de Jong-Gierveld's understanding of loneliness emphasized more on subjective feelings, and considered loneliness as an unpleasant emotional experience resulting from the perception of social isolation or lack of contact with others [13]. Peplau et al. consider loneliness as subjective social isolation, an unpleasant experience that arises when there is a discrepancy between an individual's desired social relationships and the reality [14]. A study in Anhui, China showed that 78.1% of older people had moderate to severe levels of loneliness [15]. In a study among Finland's elderly, about 39% of the older people felt lonely [16]. Factors associated with loneliness in older adults, such as sociodemographic characteristics [17, 18], social participation [19], social support [20], smoking [21], and physical exercise [22] were identified in some studies. Concerning the female elderly, about half of the Indonesian older women always felt lonely [23]. Widowhood, depression, mobility problems, and mobility reduction increased the risk of loneliness among older women in Sweden [24]. Several studies also showed that the female elderly reported higher levels of loneliness than males [25, 26]. Although there are more studies on loneliness among the older people, little attention has been paid to the loneliness of female migrant older adults in China.

Social integration is defined as participation in a wide range of social relationships [27], which is an essential element of health [28] and is considered to be related to loneliness for older people [29]. A study in Korea showed that the migrant elderly with better social integration had lower levels of loneliness [30]. A study on internal migrant workers in China found that the social integration of migrant workers was significantly and negatively related to loneliness [31]. Santini's study on older Americans showed that when older adults were more socially disconnected, they perceived higher levels of loneliness [32]. Jang et. al's study on Korean American older immigrants found that social integration was negatively related to loneliness [30]. Many studies have examined the social integration of migrant populations, but there is still a lack of attention to the social integration of female migrant older adults, with some studies in China mainly focusing on their health status [33–35].

Social support comes from people's social needs, and typically refers to services, care, or encouragement provided by members of social networks [36]. Previous studies have shown that social support was negatively related to loneliness [37–39]. Among Chinese older adults, social support from family or friends could help alleviate their loneliness [39]. Wong and Leung's study showed that social support had a positive impact on the mental health of Chinese female migrants [40], however, the study did not further explore the relationship between social support and other factors, such as social integration. A study of Muslim elderly in Turkey suggested that perceived social support was an important factor influencing loneliness in older adults [38].

Social integration and social support are both important and unique aspects of social relationships. Social integration referred to the principle of how individuals related to each other at the society level, and also reflected the connection between the individual and society, the community or other units [41]. Social support, on the other hand, emphasizes the real or perceived help and support that individuals receive from their social networks in difficult times [42]. Social integration mainly focused on interpersonal interactions within the background of social structures, and transferring individual characteristics and behaviors to the environment or group. For example, the community, which is an important environment for people's social integration. While social support was mostly still a concept at the individual level, focusing on interpersonal interactions only [43, 44]. There was little research on the relationship between social support and social integration, although social support and social integration could jointly influence an

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 3 of 11

individual's health [45, 46]. A study showed that when the old adults' social networks were limited, the level of social support generally decreased [47].

In summary, previous studies had explored the effect of social integration on loneliness, as well as the effect of social support on loneliness, yet none study clarified the relationship between social integration, social support, and loneliness simultaneously, not mention among the female MOAC. Thus, this study aimed to clarify the association between social integration and loneliness and the mediating role of social support between them among the female MOAC in Jinan, China.

Methods
Study design and participants
This study is a cross-sectional survey conducted in Jinan City, Shandong Province, China, in August 2020. Jinan is the capital city of Shandong Province, with 10 districts and 2 counties under its jurisdiction. In this study, multi-stage cluster random sampling was used to extract the survey sample, taking into account the geographical location and economic development of each district in Jinan. First, we selected three districts from the 10 districts in Jinan as primary sampling units (PSUs), then we selected one street from each of the three primary sampling units as a secondary sampling unit (SSUs); finally, we selected one community from each of the three secondary sampling units, so three communities in Jinan City were finally selected as the research sites. The survey was conducted among the elderly in these three communities who were 60 years old or older and had migrated to live in Jinan following their children, and those who were female in the survey became the target group of this study.

The investigators were thirty-two college students who were trained on the survey background, questionnaire content, and conversation skills before conducting the door-to-door interview. Finally, a total of 656 valid migrant elderly samples were obtained, of which 418 female migrant elderly were selected in this study.

Measurements
Dependent variable: loneliness
Loneliness was measured using the eight-item version of the University of California Los Angeles Loneliness Scale (ULS-8), this scale is a unidimensional scale with 8 items, which consists of 6 "lonely" positive ordinal items and 2 "non-lonely" inverse ordinal items, each of the items is scored on a 4-point Likert scale [48]. The total score on the scale ranged from 8 to 32, and the higher the total score, the higher the degree of loneliness. The scale has been widely used and has good reliability among Chinese

older adults [49]. The Cronbach's α for this scale in this study was 0.817.

Independent variables

Social support Social support of female MOAC was measured by the Social Support Rating Scale (SSRS), The scale was developed by Xiao [50] in 1986 and consisted of ten items with three dimensions: objective support, subjective support, and availability. The SSRS has been widely used among Chinese people and has good reliability and validity [51]. The Cronbach's α for SSRS in this study was 0.723.

Social integration Following previous studies [52–55], social integration was assessed by four domain questions: economic integration, psychological integration, cultural integration, and community integration. Each domain contained one question: the question "How much is your monthly income?" is for economic integration; "Do you think you have become a local?" for psychological integration; "Can you speak the local Chinese dialect?" for cultural integration, and "How often do you participate in community activities?" for community integration.

Covariates Sociodemographic characteristics mainly included age, education level, and marital status; other variables included chronic disease, and self-rated health.

Analysis approach
Descriptive statistics were used to describe the sociodemographic characteristics, health status, and social integration of the female MOAC. T-test and ANOVA were employed to compare the statistical differences in loneliness among the female MOAC with different characteristics. A *p*-value of < 0.05 denoted statistical significance, and all the analyses were performed using SSPS 24.0.

Structural equation modeling (SEM) was used to test whether social support mediates the relationship between social inclusion and loneliness. A 95% confidence interval (95% CI) of the estimated standardized effects was determined using the bootstrap method with 2,000 samples [56]. The indirect effect was regarded as statistically significant if the 95% CI excluded zero [56]. The fit of the structural equation model took into account several indicators. Good model fit was accepted when χ^2/df < 3.00, root mean square error of approximation (RMSEA) ≤ 0.08, incremental fit index (IFI) ≥ 0.900, goodness-of-fit index (GFI) ≥ 0.900, adjusted goodness-of-fit index (AGFI) ≥ 0.900, and comparative fit index (CFI) ≥ 0.900 [57–59]. All SEM analyses were performed using AMOS 24.0.

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 4 of 11

Results

Basic characteristics of the participants

Table 1 showed the general demographic characteristics of female MOAC. Nearly half (48.1%) of the 418 female MOAC were between the ages of 60 and 65, and more than 60% of them had an elementary school education level or less. 88% of the female MOAC were unmarried, and more than 40% had at least one chronic disease. 57.2% of the participants had a monthly income of less than 500 RMB, and only 23.2% had an income of 1000 RMB or more. Almost half of female MOAC (44.7%) could just understand but couldn't speak the local dialect, while 52.2% of them never participated in community activities.

Table 1 The basic characteristics of the female MOAC in this study

Characteristics	Categories	N	%
Total		418	100
Age	60–65	201	48.1
	66–70	207	51.9
Education	Illiterate	158	37.8
	Elementary school	103	24.6
	Middle School	102	24.4
	High School and above	55	13.2
Marital status	Married	368	88.0
	Unmarried*	50	12.0
Chronic diseases	No	243	58.1
	Yes	175	41.9
Self-rated health	Excellent	104	24.9
	Very good	144	34.4
	Good	81	19.4
	Fair and below	89	21.3
Monthly income	0–100 RMB	157	37.6
	101–500 RMB	82	19.6
	501–1000 RMB	82	19.6
	1001–2500 RMB	53	12.7
	2501–10000 RMB	44	10.5
Feel like a local	Don't agree	153	36.6
	Fair	172	41.1
	Agree	93	22.2
Local Chinese dialect	Can't understand or speak	24	5.7
	Can understand but can't speak	187	44.7
	Can speak a little	114	27.3
	Can fluently speak	93	22.2
Participate in community activities	Never	218	52.2
	Occasionally	87	20.8
	Sometimes	55	13.2
	Often	58	13.9

*:"Unmarried" includes: divorced, single, and widowed

Social support and loneliness of the female MOAC

Table 2 demonstrated the social support and loneliness of the female MOAC in this study. As for social support, the mean score of SSRS among total female MOAC was 39.4 ± 5.9. Among all age groups, those female MOAC aged 60–65 years old had the highest mean score of social support (40.0 ± 6.0). The mean score of social support was statistically significantly higher among those with a spouse (39.9 ± 5.7) than those without a spouse (35.2 ± 5.9, $p < 0.001$). The female MOAC had a high level of social support (41.1 ± 6.6) when they felt they had become local people. When they participated in community activities frequently, they had a higher social support score compared to those who never participated in community activities (41.9 ± 6.7 V.S. 38.2 ± 5.6). There was a significant difference in the social support scores of female MOAC with a different frequency of participation in community activities ($p < 0.001$).

For loneliness, the average score of ULS-8 among female MOAC was 12.9 ± 4.0. Concerning the age difference, the highest mean score of loneliness was found among those aged 60–65 years old (13.2 ± 3.9). As for the incomes, those who had a monthly income of 101–500 RMB felt the highest level of loneliness (14.4 ± 4.3), and there was a statistically significant difference in loneliness among the elderly with different income levels ($p < 0.001$). The mean score of loneliness for female MOAC who agreed that they had become local residents (10.9 ± 2.9) was 2.8 points lower than those who disagreed (13.7 ± 4.5).

The structural equation modeling analysis

Model fit indices

Before using SEM analysis to explore whether social integration had a mediating effect between loneliness and social support, the effects of social support and social integration on loneliness were explored using multiple linear regression. The results indicated that all four dimensions of social integration and social support were influencing factors of loneliness, controlling for covariates (Appendix, Table 5). Figure 1 displayed the findings of SEM analysis of the study's recommended two default models. The upper one in Fig. 1 showed a model of the total effect of social integration on loneliness (Model 1), while the lower one in Fig. 1 illustrated a mediated model that included social support (Model 2). It was found that social integration and social support were both related to loneliness, and social support mediates the relationship between social integration and loneliness.

Table 3 demonstrated the indicators related to the fit of Model 1 and Model 2, and it could be seen that the two models both fitted well. For the total effects model

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 5 of 11

Table 2 Social support and loneliness of the female MOAC in this study

Characteristics	Social Support		Loneliness	
	Mean (SD)	*p*	Mean (SD)	*p*
Total	39.4(5.9)		12.9(4.0)	
Age		0.001[a]		0.491[a]
60–65	40.0(6.0)		13.2(3.9)	
Over 65	38.9(5.6)		12.7(4.2)	
Education		0.096[a]		0.233[a]
Illiterate	39.2(6.0)		13.4(4.2)	
Elementary school	39.0(5.2)		12.8(3.9)	
Middle School	39.0(6.2)		12.5(4.0)	
High School and above	41.2(6.0)		12.4(3.5)	
Marital status		<.001[b]		0.404[b]
Married	39.9(5.7)		12.9(4.0)	
Unmarried	35.2(5.9)		13.4(4.0)	
Chronic diseases		0.020[b]		0.280[b]
No	39.9(5.7)		12.7(3.8)	
Yes	38.6(6.0)		13.2(4.2)	
Self-rated health		0.172[a]		0.595[a]
Excellent	40.5(5.1)		12.7(4.2)	
Very good	38.7(6.8)		13.3(3.9)	
Good	39.4(5.2)		12.7(4.1)	
Fair and below	39.0(5.6)		12.9(3.9)	
Monthly income		<0.001[a]		<0.001[a]
0–100 RMB	38.6(6.1)		13.2(4.2)	
101–500 RMB	38.2(6.2)		14.4(4.3)	
501–1000 RMB	39.4(4.8)		12.5(3.4)	
1001–2500 RMB	40.3(4.6)		11.3(3.1)	
2501–10000 RMB	43.2(6.1)		12.2(3.8)	
Feel like a local		<0.001[a]		<0.001[a]
Don't agree	37.9(5.7)		13.7(4.5)	
Fair	39.7(5.3)		12.3(3.7)	
Agree	41.1(6.6)		10.9(2.9)	
Local Chinese dialect		0.010[a]		0.073[a]
Can't understand or speak	36.9(7.3)		13.7(5.2)	
Can understand but can't speak	38.9(5.0)		13.4(4.2)	
Can speak a little	40.7(5.7)		12.4(3.8)	
Can fluently speak	39.4(7.0)		12.4(3.3)	
Participate in community activities		<0.001[a]		0.001[a]
Never	38.2(5.6)		13.0(4.0)	
Occasionally	40.1(5.5)		14.0(4.6)	
Sometimes	40.1(5.6)		12.6(3.4)	
Often	41.9(6.7)		11.3(2.7)	

[a] ANOVA

[b] t test

(Model 1), the $\chi^2/df = 1.436$, GFI = 0.973, CFI = 0.980, AGFI = 0.959, and RMSEA = 0.032, while for the mediated effects model (Model 2), $\chi^2/df = 2.040$, GFI = 0.919, AGFI = 0.898, CFI = 0.909 and RMSEA = 0.050.

The mediating effect of social support on the association between social integration and loneliness
Table 4 revealed the mediating role that social support played between social integration and loneliness, and
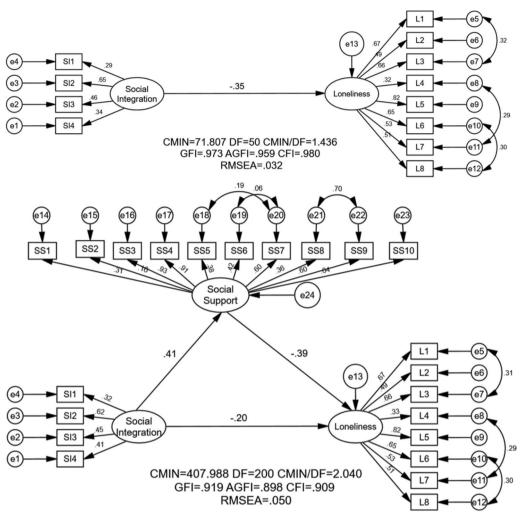
Fig. 1 SEM analysis of the association between social integration and loneliness with social support as a mediator among the female MOAC in Jinan, China. Note: CMIN, χ² value; AGFI, adjusted good-ness fit index; DF, degree of freedom; GFI, goodness fit index; AGFI, adjusted goodness fit index; CFI, comparative fit index; RMSEA, root mean square error of approximation. L1- L8, the items of ULS-8; SS1-SS10, the items of SSRS; SI1, economic integration; SI2, psychological integration; SI3, cultural integration; SI4, community integration

Table 3 The model fit indicators

Model	CMIN	DF	CMIN/DF	GFI	AGFI	CFI	RMSEA	Decision
Cut-off criteria	-	-	< 5	≥ 0.900	≥ 0.900	≥ 0.900	≤ 0.080	
Model 1	71.807	50	1.436	0.973	0.959	0.980	0.032	Good fitting
Model 2	407.988	200	2.040	0.919	0.898	0.909	0.050	Good fitting

the upper and lower bounds of the bootstrap indicated that the mediating effect (indirect effect in Table 4) was statistically significant. When social support was not included in the model, the standardized total effect coefficient of social integration on loneliness was -0.36 (bootstrap 95% CI = -0.494 to -0.234). When social support was included as a mediating variable, the direct effect of social integration on loneliness was -0.20 (bootstrap 95% CI = -0.343 to -0.068), and the standardized indirect effect coefficient was -0.16 (bootstrap 95% CI = -0.252 to -0.100), with a mediating effect of 44.4%. Therefore, social support was determined to have a partially mediating role in the association between social integration and loneliness.

Table 4 The mediating effect of social support on the association between social integration and loneliness

Effect Type	Coefficient	BOOT CI lower	BOOT CI upper	Percentage (%)
Direct effect				55.6
Social integration → loneliness	-0.20	-0.343	-0.068	
Social support → loneliness	-0.39	-0.510	-0.271	
Social integration → Social support	0.41	0.267	0.567	
Indirect effect				44.4
Social integration → Social support → Loneliness	-0.16	-0.252	-0.100	
Total effect	-0.36	-0.494	-0.234	100

Discussion

Female MOAC are a vulnerable group that had received little attention and loneliness is a common problem among them which is often influenced by social integration and social support. Our study was the first to use SEM to explore the relationship between social integration, social support, and loneliness among female MOAC, which could provide suggestions for future interventions for the female MOAC. This study found that social integration had a positive effect on social support and was negatively associated with loneliness; besides, social support mediated the relationship between social integration and loneliness among the female MOAC in Jinan, China.

Loneliness of the female MOAC

The mean score of the ULS-8 of female MOAC was 12.9 ± 4.0 in this study, which was less than a study that found that the mean ULS-8 score was 15.5 ± 4.4 for female Chinese empty nesters in Liaoning Province, China [60], indicating the loneliness of female MOAC in this study was lower than the female empty nesters in China. The possible reason may be because unlike the female empty-nest elderly, the female MOAC were generally living together with their children and got more accompanying which could lower their feeling of loneliness [61]. Besides, the mean score of the ULS-8 of female MOAC in this study (12.9 ± 4.0) was also found to be higher than a previous study that included both the Chinese male and female MOAC (loneliness score was 12.82 ± 4.1) [62]. The possible reason may come from the fact that women were generally more emotional and sensitive than men.

Association between social integration and loneliness

It was found that social integration was negatively correlated with the loneliness of female MOAC, which was consistent with David's research on social integration and loneliness in later life [63]. A qualitative study on migrant elders in Jiangsu Province, China found that

poorly integrated older people were more likely to feel lonely and desperate in a new city [64]. Domènech et al.'s study indicated that good social integration could alleviate the social isolation of the elderly and improve their mental health [65]. However, a qualitative research on the MOAC showed that they had a low level of social integration due to limited social interaction, increased intergenerational conflict, language barriers, and discrimination [66]. Thus, it is important to help the female MOAC better integrate into the new living environment to protect their mental health.

Relationship between social support and loneliness

The results of the present study showed that higher levels of social support were associated with lower loneliness in female MOAC [67], which was consistent with Hom et al.'s study [68]. Another study of elderly widowed women in the United States of America showed that those with better social support had lower levels of loneliness [69]. For Chinese older adults, social support was found could relieve their loneliness; the most important social support was support from family members, and those elderly with poor family functioning would experience higher levels of loneliness [39]. Moreover, the negative association between loneliness and social support was stronger among the rural Chinese populations than the urban ones [70]. Since most of the female MOAC were from rural areas [71], more attention was needed on the social support from the family members to relieve their loneliness.

Mediating effect of social support

The results of SEM analysis showed that social support could mediate the relationship between social integration and loneliness. When the female MOAC had better social integration, they had a higher level of social support and thus lower the level of loneliness. A study among the Chinese MOAC revealed that family support mediated the association between acculturation and loneliness [71]. Anna et al.'s study compared foreign-born

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 8 of 11

and native-born people in Sweden and found that lower social integration would generally indicate lower social support, and furthermore caused mental health inequalities between the native and immigrant Swedes [72]. Inter-action theory [18] suggested that social support could reinforce social networks and meet the need for social contact, and finally reduce the individual's loneliness [73]. Social integration could extend the social network of older adults, thus provide more access to social support [74]. This study measured the social integration of female MOAC in four dimensions, including monthly income in the economic dimension, sense of belonging in the psychological dimension, familiarity with the dialect in the cultural dimension, and social participation in the community dimension. An Israeli study revealed that economic status could affect the loneliness of older adults by influencing the perceived level of social support [75]. It was also found that a greater sense of belonging leads to higher perceived social support among individuals [76]. When the female MOAC master the local language and actively participated in community activities, they would have a higher level of social contact with neighbors and friends and receive more social support, which could finally relieve their loneliness [77].

Implications
Based on the results of this study, the following suggestions are given to improve the loneliness of female MOAC. Firstly, female MOAC could actively integrate into the local community and join more social activities of the community. Secondly, families have the important function of providing emotional support, hence, the children of female MOAC could give more care to their parents and create a good family atmosphere [71]. Thirdly, the community could create a good community environment and provide more social participation opportunities to help female MOAC to integrate into the inflow city better. As the community is the main living place of the elderly migrants and the main platform for their personal interactions, the creation of a friendly and accepting atmosphere is very conducive to the social integration of the elderly migrants [78]. For example, communities should build more public places to provide a convenient environment for MOAC to socialize, exercise, study and relax, and they can also regularly organize group activities and square dances for MOAC [79].

Limitations
This study had some limitations. Firstly, the data used in this study was from a cross-sectional survey, which could not determine the causal relationship between variables. Secondly, the indicator used to assess social integration were some questions based on previous studies and not measured using a scale, future studies are needed to make the measurement more objective and scientific. Thirdly, the variables used in this study may also be influenced by other confounding factors, thus more research is needed to verify their association.

Conclusions
As the first research to explore the relationship between social integration, social support, and loneliness in female MOAC, it was found that the female MOAC's loneliness was at a relatively lower level. Moreover, this study also revealed that social integration and social support were both negatively associated with loneliness, while social support mediated the relationship between social integration and loneliness. To conclude, better social integration and better social support would generally indicate lower loneliness in the female MOAC.

Appendix

Table 5 Multi-linear regression analysis between loneliness and other related variables

Characteristics	Model 1		Model 2	
	P	Beta	*P*	Beta
Age				
60–65	Ref		Ref	
Over 65	0.067	-0.09	0.038	-0.10
Education				
Illiterate	Ref		Ref	
Elementary school	0.145	-0.08	0.111	-0.08
Middle School	0.038	-0.11	0.082	-0.09
High School and above	0.216	-0.06	0.827	-0.01
Marital status				
Married	Ref		Ref	
Unmarried	0.486	-0.04	0.836	-0.01
Chronic diseases				
No	Ref		Ref	
Yes	0.443	0.04	0.365	0.04
Self-rated health				
Excellent	Ref		Ref	
Very good	0.647	0.03	0.684	0.02
Good	0.685	-0.02	0.711	-0.02
Fair and below	0.835	-0.01	0.948	0.00
Monthly income				
0–100 RMB			Ref	
101–500 RMB			0.030	0.11

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 9 of 11

Characteristics	Model 1		Model 2	
	P	Beta	*P*	Beta
501–1000 RMB			0.299	-0.05
1001–2500 RMB			0.005	-0.14
2501–10000 RMB			0.004	-0.15
Local Chinese dialect				
Can't understand or speak			Ref	
Can understand but can't speak			0.549	0.06
Can speak a little			0.692	-0.04
Can fluently speak			0.043	-0.10
Feel like a local				
Don't agree			Ref	
Fair			0.888	-0.01
Agree			0.001	-0.19
Participate in community activities				
Never			Ref	
Occasionally			0.012	-0.12
Sometimes			0.018	-0.12
Often			0.002	-0.18
Social support	< 0.001	-0.30	< 0.001	-0.24

Table 5 showed the results of multi-linear regression analysis between loneliness and other related variables. Model 1only included covariates and social support, and Model 2 added social integration. The results of Model 2 indicated that all four dimensions of social integration and social support were influencing factors of loneliness, controlling for covariates

Abbreviations
MOAC   The migrant older adults with children
PSUs   Primary sampling units
SSUs   Secondary sampling units
ULS-8   The eight-item version of the University of California Los Angeles Loneliness Scale
SSRS   The Social Support Rating Scale
95% CI   The 95% confidence interval
SEM   Structural equation model
RMSEA   Root mean square error of approximation
IFI   Incremental fit index
GFI   Goodness-of-fit index
AGFI   Adjusted goodness-of-fit index
CFI   Comparative fit index

Authors' contributions
Jing Xu analyzed the data and drafted the manuscript; Hexian Li and Xiaoxu Jiang joined the data collection, gave advices comments on the modification of manuscript; Guangwen Liu and Shengyu Zhou gave advices on the statistical analysis; Jieru Wang and Mingli Pang joined the data collection, gave many valuable comments on the draft; Shixue Li gave some valuable comments on statistical analysis and polished it; Fanlei Kong applied the fund to support this study, designed the study, completed the questionnaire design, supervised and combined the data collected, instructed the writing, statistical analysis, data processing and provided comments on the modification of the manuscript.

Availability of data and materials
The datasets used and analyzed in this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
The research has been performed in accordance with the Declaration of Helsinki. The survey and data use have obtained the informed consent of all participants. The research program of this was reviewed and approved by the ethical committee of Shandong University (No. 20180225).

Consent for publication
All authors consent to the publication as "not applicable".

Competing interests
The authors declare no competing interests.

Author details
[1]Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan 250012, China. [2]NHC Key Lab of Health Economics and Policy Research, Shandong University, Jinan 250012, China. [3]Department of Medical Administration, The First Affiliated Hospital of Anhui Medical University, Hefei 230000, China. [4]Institute of Health and Elderly Care, Shandong University, Jinan, China.

References
1. Liu L, Wu F, Tong H, Hao C, Xie T. The Digital Divide and Active Aging in China. Int J Environ Res Public Health. 2021;18(23):12675.
2. Zheng X, Zhang Y, Chen Y, Fang X. Internal migration experience and depressive symptoms among middle-aged and older adults: evidence from China. Int J Environ Res Public Health. 2021;19(1):303.
3. National Bureau of Statistics of China Press Conference on the Main Data Results of the Seventh National Census. 2021. http://www.chinanews.com/gn/2021/05-12/9475549.shtml. (In Chinese).
4. Tang D, Wang J. Basic Public health service utilization by internal older adult migrants in China. Int J Environ Res Public Health. 2021;18(1):270.
5. Chinese migrant population development report 2018: migrant population declined for the third consecutive year. https://www.sohu.com/a/285039190_753646. (In Chinese).
6. Zhi K, Chen Y, Huang J. China's challenge in promoting older migrants' health and wellbeing: a productive ageing perspective. BMJ. 2021;375:n2874.
7. Liu G, Li S, Kong F. Association between Sense of belonging and loneliness among the migrant elderly following children in Jinan, Shandong Province, China: the moderating effect of migration pattern. Int J Environ Res Public Health. 2022;19(7):4396.
8. Mussida C, Patimo R. Women's family care responsibilities, employment and health: a tale of two countries. J Fam Econ Issues. 2021;42(3):489–507.
9. Lai DW, Luk PK, Andruske CL. Gender differences in caregiving: a case in Chinese Canadian caregivers. J Women Aging. 2007;19(3–4):161–78.
10. Ko PC, Hank K. Grandparents caring for grandchildren in China and Korea: findings from CHARLS and KLoSA. J Gerontol B Psychol Soc Sci. 2014;69(4):646–51.
11. Xuan W. Study on the social inclusion problem of elderly female immigrants from the perspective of community. Mster: Anhui University; 2018.
12. Cacioppo JT, Cacioppo S. The growing problem of loneliness. Lancet. 2018;391(10119):426.
13. de Jong-Gierveld J. Developing and testing a model of loneliness. J Pers Soc Psychol. 1987;53(1):119–28.

Xu *et al. BMC Geriatrics*   (2024) 24:4

Page 10 of 11

14. Peplau LA, Perlman DJ. Loneliness: a sourcebook of current theory, research, and therapy. 1982.

15. Wang G, Zhang X, Wang K, Li Y, Shen Q, Ge X, Hang W. Loneliness among the rural older people in Anhui, China: prevalence and associated factors. Int J Geriatr Psychiatry. 2011;26(11):1162–8.

16. Savikko N, Routasalo P, Tilvis RS, Strandberg TE, Pitkala KH. Predictors and subjective causes of loneliness in an aged population. Arch Gerontol Geriatr. 2005;41(3):223–33.

17. Cohen-Mansfield J, Hazan H, Lerman Y, Shalom V. Correlates and predictors of loneliness in older-adults: a review of quantitative results informed by qualitative insights. Int Psychogeriatr. 2016;28(4):557–76.

18. Beal C. Loneliness in older women: a review of the literature. Issues Ment Health Nurs. 2006;27(7):795–813.

19. Aartsen M, Jylha M. Onset of loneliness in older adults: results of a 28 year prospective study. Eur J Ageing. 2011;8(1):31–8.

20. Kwag KH, Martin P, Russell D, Franke W, Kohut M. The impact of perceived stress, social support, and home-based physical activity on mental health among older adults. Int J Aging Hum Dev. 2011;72(2):137–54.

21. Richard A, Rohrmann S, Vandeleur CL, Schmid M, Barth J, Eichholzer M. Loneliness is adversely associated with physical and mental health and lifestyle factors: results from a Swiss national survey. PLoS ONE. 2017;12(7):e0181442.

22. Mays AM, Kim S, Rosales K, Au T, Rosen S. The Leveraging Exercise to Age in Place (LEAP) study: engaging older adults in community-based exercise classes to impact loneliness and social isolation. Am J Geriatr Psychiatry. 2021;29(8):777–88.

23. Widhowati SS, Chen CM, Chang LH, Lee CK, Fetzer S. Living alone, loneliness, and depressive symptoms among Indonesian older women. Health Care Women Int. 2020;41(9):984–96.

24. Dahlberg L, Andersson L, McKee KJ, Lennartsson C. Predictors of loneliness among older women and men in Sweden: a national longitudinal study. Aging Ment Health. 2015;19(5):409–17.

25. Pinquart M, Sorensen S. Influences on loneliness in older adults: a meta-analysis. Basic Appl Soc Psychol. 2010;23(4):245–66.

26. Pagan R. Gender and age differences in loneliness: evidence for people without and with disabilities. Int J Environ Res Public Health. 2020;17(24):9176.

27. Brissette I, Cohen S, Seeman TE. Measuring social integration and social networks. 2000.

28. Pinker S. The village effect: how face-to-face contact can make us healthier and happier. Toronto: Vintage Books Canada; 2015.

29. Kemperman A, van den Berg P, Weijs-Perrée M, Uijtdewillegen K. Loneliness of older adults: social network and the living environment. Int J Environ Res Public Health. 2019;16(3):406.

30. Jang Y, Choi EY, Park NS, Chiriboga DA, Duan L, Kim MT. Cognitive health risks posed by social isolation and loneliness in older Korean Americans. BMC Geriatr. 2021;21(1):123.

31. Zeng L, Yang Z, Zhang J, Wan R. The study on the mental adaption and social integration of migrant workers. J Guizhou Educ Univ. 2017;33(06):53–60.

32. Santini ZI, Jose PE, York Cornwell E, Koyanagi A, Nielsen L, Hinrichsen C, Meilstrup C, Madsen KR, Koushede V. Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): a longitudinal mediation analysis. Lancet Public Health. 2020;5(1):e62–70.

33. Xie J, Zhu Q, Wang X. A study on the health status of China's elderly migrant population and its influencing factors. Urban Dev Stud. 2020;27(11):30–5.

34. He T. Study on healthy life expectancy of elderly rural-to-urban migrants in China. Modern Prev Med. 2019;46(06):966–70.

35. Shi Z. Study on the influencing factors of self-assessed health and the responses of migrant elderly people. Lanzhou Acad J. 2020;04:199–208.

36. Ladin K, Daniels A, Osani M, Bannuru RR. Is social support associated with post-transplant medication adherence and outcomes? A systematic review and meta-analysis. Transplant Rev (Orlando). 2018;32(1):16–28.

37. O'Rourke HM, Collins L, Sidani S. Interventions to address social connectedness and loneliness for older adults: a scoping review. BMC Geriatr. 2018;18(1):214.

38. Dural G, Kavak Budak F, Ozdemir AA, Gultekin A. Effect of perceived social support on self-care agency and loneliness among elderly Muslim people. J Relig Health. 2022;61(2):1505–13.

39. Chen Y, Hicks A, While AE. Loneliness and social support of older people in China: a systematic literature review. Health Soc Care Community. 2014;22(2):113–23.

40. Wong DF, Leung G. The functions of social support in the mental health of male and female migrant workers in China. Health Soc Work. 2008;33(4):275–85.

41. Beresnevièiûtë VJES. Dimensions of social integration: appraisal of theoretical approaches. Ethn Stud. 2003:96–108.

42. Schwarzer R, Hahn A, Schröder H. Social integration and social support in a life crisis: effects of macrosocial change in East Germany. Am J Community Psychol. 1994;22(5):661–83.

43. Hartwell SW, Benson PR. Social integration: a conceptual overview and two case studies. In: Mental health, social mirror. Springer; 2007. p. 329–353.

44. Felton BJ, Shinn M. Social integration and social support: moving "social support" beyond the individual level. J Community Psychol. 1992;20(2):103–15.

45. Yang TC, Park K. Racial/ethnic disparities in depression: Investigating how sources of support and types of integration matter. Soc Sci Res. 2019;82:59–71.

46. Tay L, Tan K, Diener E, Gonzalez E. Social relations, health behaviors, and health outcomes: a survey and synthesis. Appl Psychol Health Well Being. 2013;5(1):28–78.

47. Harasemiw O, Newall N, Shooshtari S, Mackenzie C, Menec V. From social integration to social isolation: the relationship between social network types and perceived availability of social support in a national sample of older Canadians. Res Aging. 2018;40(8):715–39.

48. Hays RD, DiMatteo MR. A short-form measure of loneliness. J Pers Assess. 1987;51(1):69–81.

49. Zhou L, Li Z, Hu M, Xiao S. Reliability and validity of ULS-8 loneliness scale in elderly samples in a rural community. Zhong Nan Da Xue Xue Bao Yi Xue Ban. 2012;37(11):1124–8.

50. Xiao S-Y. The theoretical basis and research application of social support rating scale. J Clin Psychiatry. 1994;4(2):98–100.

51. Liu J, Li W. Reliability and validity of social support rating scale. J Xinjiang Med Univ. 2008;1:4–6.

52. Li Y, Xiong C, Zhu Z, Lin Q. Family migration and social integration of migrants: evidence from Wuhan Metropolitan Area, China. Int J Environ Res Public Health. 2021;18(24):12983.

53. Zhou H. Measurement and theoretical perspectives of immigrant assimilation in China. China Population Today. 2012;36:42.

54. Yue Z, Li S, Jin X, Feldman MW. The role of social networks in the integration of Chinese rural–urban migrants: a migrant–resident tie perspective. Urban Studies. 2013;50(9):1704–23.

55. Yang G, Zhou C, Jin W. Integration of migrant workers: differentiation among three rural migrant enclaves in Shenzhen. Cities. 2020;96:102453.

56. Fritz MS, Mackinnon DP. Required sample size to detect the mediated effect. Psychol Sci. 2007;18(3):233–9.

57. Tabachnick BG, Fidell L. Using multivariate statistics. 5th ed. New York: Pearson Education; 2007. p. 43.

58. Tabachnick BG, Fidell LS, Ullman JB. Using multivariate statistics, vol. 5. Boston: Pearson; 2007.

59. Hooper D, Coughlan J, Mullen MR. Structural equation modelling: Guidelines for determining model fit. Electron J Bus Res Methods. 2008;6(1):53–60.

60. Tao W, Li W, Shi M, Wang L. The correlation between loneliness and social participation level of empty nesters in urban communities. Chin J Gerontol. 2019;39(21):5363–6.

61. Zhang R, Zhang B, Zhang L. Mediation effect of parent-child social support on forgiveness and loneliness in elderly people. Chin J Public Health. 2017;33(01):129–31.

62. Liu G, Li S, Kong F. Association between social support, smartphone usage and loneliness among the migrant elderly following children in Jinan, China: a cross-sectional study. BMJ Open. 2022;12(5):e060510.

63. Russell D. Living arrangements, social integration, and loneliness in later life: the case of physical disability. J Health Soc Behav. 2009;50(4):460–75.

64. Hu Y, Liu Y, Wang C. Research on the status quo and countermeasures of social integration of migrant elders: a qualitative research on migrant elders in Jiangsu. Sci Res Aging. 2019;7(07):41–9.

65. Domènech-Abella J, Mundó J, Haro JM, Rubio-Valera M. Anxiety, depression, loneliness and social network in the elderly: longitudinal

associations from The Irish Longitudinal Study on Ageing (TILDA). J Affect Disord. 2019;246:82–8.

66. Jing Y. Urban integration of the elderly immigrants with the family. J Hubei Univ Arts Sci. 2019;40(06):32–6.

67. Liang D, Teng M, Xu D. Impact of perceived social support on depression in Chinese rural-to-urban migrants: the mediating effects of loneliness and resilience. J Community Psychol. 2019;47(7):1603–13.

68. Chalise HN, Kai I, Saito T. Social support and its correlation with loneliness: a cross-cultural study of Nepalese older adults. Int J Aging Hum Dev. 2010;71(2):115–38.

69. King BM, Carr DC, Taylor MG. Loneliness following widowhood: the role of the military and social support. J Gerontol B Psychol Sci Soc Sci. 2021;76(2):403–14.

70. Zhang X, Dong S. The relationships between social support and loneliness: a meta-analysis and review. Acta Physiol (Oxf). 2022;227:103616.

71. Zong D, Lu Z, Shi X, Shan Y, Li S, Kong F. Mediating effect of family support on the relationship between acculturation and loneliness among the migrant elderly following children in Jinan, China. Front Public Health. 2022;10:934237.

72. Brydsten A, Rostila M, Dunlavy A. Social integration and mental health - a decomposition approach to mental health inequalities between the foreign-born and native-born in Sweden. Int J Equity Health. 2019;18(1):48.

73. Kuhirunyaratn P, Pongpanich S, Somrongthong R, Love EJ, Chapman RS. Social support among elderly in Khon Kean Province, Thailand. Southeast Asian J Trop Med Public Health. 2007;38(5):936–46.

74. Heaney CA, Israel BA. Social networks and social support. Health Behav Health Educ. 2008;4:189–210.

75. Cohen-Mansfield J, Shmotkin D, Goldberg S. Loneliness in old age: longitudinal changes and their determinants in an Israeli sample. Int Psychogeriatr. 2009;21(6):1160–70.

76. Wong D, Amon KL, Keep M. Desire to belong affects instagram behavior and perceived social support. Cyberpsychol Behav Soc Netw. 2019;22(7):465–71.

77. Zhai S, Zhuang Q, Wang Z. Study on the relationship between social support and mental health of the elderly in China: a case study of Xi'an city, Shaanxi province. J Ment Health. 2019;28(2):119–24.

78. Bao Y, Tao J, Liu Q. "Embedding" and "pulling back": spatial transformations and urban assimilation of migrant elderlies following their children. Front Public Health. 2022;10:1009274.

79. Liu Y, Sangthong R, Ingviya T, Wan C. Nothing like living with a family: a qualitative study of subjective well-being and its determinants among migrant and local elderly in Dongguan, China. Int J Environ Res Public Health. 2019;16(23):4874.

Publisher's Note