Role of socioeconomic status and housing conditions in geriatric depression in rural China: a cross-sectional study

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ABSTRACT

Objectives The primary aim of this study was to describe the socioeconomic status (SES), housing conditions and depression of the elderly in rural China, as well as to examine the associations between depression and SES and housing conditions using the China Health and Retirement Longitudinal Study (CHARLS).

Design This is a cross-sectional study.

Setting A nationally representative sample of elderly in rural China.

Participants A total of 4585 elderly adults in 2015 in rural China.

Outcome measures Prevalence and risk factors of depression among rural elderly.

Results Among the participants in this study, approximately 46.15% (2116/4585) reported depressive symptoms (10-item Center for Epidemiologic Studies Depression Scale [CESD-10] score >10) in rural China. The results revealed significant associations between higher scores on CESD-10 (indicating more symptoms of depression) and lowest personal annual income (OR=1.63, 95% CI 1.290 to 2.060), polluting cooking fuel (OR=1.16, 95% CI 1.018 to 1.321), toilet without seat (OR=1.273, 95% CI 1.056 to 1.535), as well as having no bath facility (OR=1.172, 95% CI 1.025 to 1.341) after adjustment for confounders.

Conclusion Elderly in rural China experienced severe depressive symptoms. Lowest personal annual income, polluting cooking fuel, toilet without seat and having no bath facility were significantly associated with more depressive symptoms. Caution needs to be taken in generalising the findings of this study to the rest of the population in China since its highly selected sample.

INTRODUCTION

Ageing is one of the most conspicuous phenomena in the contemporary world.1 Between 2015 and 2050, the proportion of the world’s older adults is estimated to almost double from about 12% to 22%. In absolute terms, this is an expected increase from 900 million to 2 billion people over the age of 60.2 While population ageing is a global phenomenon, the progress is fastest in low-income and middle-income countries, especially in China. In 2016, the Chinese population aged above 60 years old was over 230 million, which will further increase to 480 million by 2050.3

Older adults face special physical and mental health challenges that need to be recognised. According to a WHO report published in 2017, over 20% of the older adults suffered from the mental or neurological disorder (excluding headache disorders), and 6.6% of all disabilities among people over 60 years were attributed to mental and neurological disorders. Depression, one of the most common mental and neurological disorders, affects approximately 7% of the world’s older population and comprises a substantial proportion of the global burden of disease. Depression among the Chinese older population first captured the research attention in the 1980s and emerged as a growing concern since the 1990s.4

Depression in the elderly is often a function of many contributing factors, which include biological, psychosocial or environmental characteristics. Socioeconomic status (SES), an important indicator of social structures, has consistently been found to be associated...
with geriatric depression. Some previous studies have shown that poor SES is related to the decrease in the ability to manage stress and further reduces the ability to deal with negative emotions and cognitions. 5–8

Housing conditions are an important social determinant of health, and their association with the development of depressive symptoms is well documented in the literature. 9–11 Housing conditions may encompass tangible and observable attributes, such as physical structure, design and housing facility. The association between housing conditions and mental health has been investigated in several studies, particularly in urban areas. 12 Some previous studies have shown the relationship between mental health and different aspects of urban housing conditions. 13–15 However, research on housing conditions and depression among rural populations is remarkably underdeveloped. Few studies have discussed in more detail the impact of rural housing conditions on depressive symptoms among the elderly, especially in China. 16 17 In rural China, the poor physical housing conditions may lead to a greater possibility of depressive symptoms. With development and urbanisation, it is necessary to further focus on the relationship between rural housing conditions and mental health, which have a significant effect on the construction of age-friendly environments and further reduce the health inequality between urban and rural populations.

It is important to identify factors associated with depression in the rural population. Therefore, the primary aim of this study was to describe SES, housing conditions and depression in this population, as well as to examine the associations between depression and SES and housing conditions. We believe our study will improve understanding of the complex nature of the relationship between SES, housing conditions and the developing of depressive symptoms among the rural elderly population in low-income and middle-income countries.

**MATERIALS AND METHODS**

**Study design**

A cross-sectional design was used. The data were based on the third wave of the nationally representative China Health and Retirement Longitudinal Study (CHARLS) in 2015.

**Setting and participants**

CHARLS used a multi-stage stratified probability-proportional-to-size sampling technique to select participants. Face-to-face interviews were conducted to collect detailed information on participants. A total of 21,095 respondents of 150 counties/districts and 450 villages/resident committees participated during the third wave in 2015. A more detailed CHARLS survey design has been described elsewhere. 18–20

The sample included only adults aged 60 and above who lived in rural China. The inclusion criteria were (1) age ≥60, (2) living at the survey site for at least 6 months, (3) being at home during the investigation period and (4) ability to participate in the study. Subjects with mental retardation and severe cognitive impairment had been excluded from the original research by using a short screening form. Thus, the number of respondents eligible for our analysis dropped to 4,585 rural elderly.

**Assessment and measurements**

**Depressive symptoms**

Depressive symptoms were screened by the 10-item Center for Epidemiologic Studies Depression Scale (CESD-10) short form. The time frame for the CESD-10 questions refers to the week prior to the interview. Each item was rated on a four-point Likert scale, with answers varying from ‘rarely or none of the time (0–1 day)’ to ‘most or all of the time (5–7 days)’; the total score ranges from 0 to 30, with a lower score indicating a lower level of depressive symptoms. CESD-10 has shown good validity and reliability in the Chinese population. 21 A previous validation study found that a cut-off point of 10 had reasonable levels of sensitivity and specificity in Chinese older adults. Hence, a cut-off point of 10 was used in this study to generate the binary depressive symptom variable. Those participants with total scores of more than 10 were categorised as depressed. The CESD-10 has been described in detail elsewhere. 18

**Housing conditions**

Five variables were used to measure housing conditions: years of house building; housing structure; housing materials were dichotomized as ‘improved material’ (concrete and steel/bricks and wood) and ‘unimproved material’ (adobe, wood, cave dwelling, Mongolian yurt/wool felt and stone); number of bedrooms; cooking fuel (clean fuel/polluting fuel/others); and housing facility (availability of toilet, running water, shower or bath facility, heating system, telephone connection and Internet connection). These facilities were all categorised as ‘0=yes’ (available) and ‘1=no’ (unavailable), while toilet was categorised as ‘0=toilet with seat’ and ‘1=toilet without seat’.

**Number of non-communicable diseases**

Non-communicable diseases (NCDs) were assessed as the cumulative number of diagnosed chronic conditions (hypertension; dyslipidaemia; diabetes; cancer; chronic lung diseases; liver or gallbladder disease; heart disease; stroke; kidney disease; stomach or other digestive diseases; emotional, nervous, or psychiatric problems; memory-related disease; rheumatism/arthritis; and asthma) that includes information collected from the clinical records available with the participants. They were categorised as ‘0’, ‘1–2’ and ‘3 and above’. 0 was defined as participants who had no diagnosed chronic conditions. 18

**Disabilities status**

It was measured by asking ‘Do you have one of the following disabilities?’ Responders were categorised as ‘yes’ when they had any disability or physical disabilities, brain damage/mental retardation, vision problem, hearing problem and speech impediment.
Activities of daily living

Activities of daily living (ADL) limitations indicate any self-reported difficulty in any of the following six ADLs: eating, dressing, getting into or out of bed, using the toilet, bathing/showering, or controlling urination and defecation. The four response options were 1 = ‘I don’t have any difficulty’, 2 = ‘I have difficulty but can still do it’, 3 = ‘I have difficulty and need help’ and 4 = ‘I cannot do it’. It was dichotomously coded (dependent vs independent). ‘ADL dependent’ was defined as ‘have difficulty and need help’ or ‘cannot do it’ in any ADL item.

Socioeconomic status

Education level and personal annual income were used to determine SES. Education level was classified as ‘primary school and below’ and ‘high school and above’. Personal annual income (Chinese yuan [CNY]) was categorised as ‘≤10000’, ‘10000–20000’ and ‘≥20000’.18

Sociodemographic characteristics

The sociodemographic variables considered in the analysis were age (60–69, 70–79, 80–89 and ≥90 years), gender (male/female) and marital status (married or unmarried).

Patient and public involvement

The study did not involve patients. The results of the survey are disseminated to the public through websites of the public county councils.

Statistical analysis

All statistical analyses were conducted with SPSS (Statistical Package for the Social Science) V.22 for Windows. Data are presented with percentages and proportions for categorical values. The Pearson $\chi^2$ test was applied for categorical data to access statistical differences between groups. Binary logistic regression analysis was used to identify the potential risk factors of depressive symptoms. Ordered logistic regression was used to examine the relationship between SES, housing conditions and depression. Then the adjusted covariates, including age, gender, marital status, number of NCDs, disability and ADL, were added. Finally, four ordered logistic regression models were established.

Results

Demographic characteristics

Of the 4585 rural participants (2529 men and 2056 women), 3008 (65.61%) were married and 1577 (34.39%) were unmarried elderly. The participants ranged in age from 60 to 102 years (mean 69.46±7.34), with 59.15% between the ages 60 and 69. More than 4333 (90%) were primary school and below, nearly four-fifths (79.45%) had lowest personal annual income, nearly three-fifths (2615) had 2 kinds of chronic diseases. Among the participants in this study, approximately 46.15% (2,116/4,585) reported significant depressed (CESD-10 score >10) in rural China (table 1).

Demographic factors associated with depression: univariate findings

A univariable analysis revealed that eight demographic variables are associated with depression using $\chi^2$ tests at a significance level of 0.05 (table 1). Compared with those without depressive symptoms, participants with depressive symptoms had a lower education level and personal annual income, had a worse health status (57.61% older had one to two NCDs and 55.58% had disabilities) except for ADL limitation, in which only 19.90% were dependent. The percentage of married participants who experience depression was significantly higher than that of unmarried participants. $\chi^2$ tests revealed that age, gender, marital status, education level, number of NCDs, disability status and ADL limitations all had significant associations with depressive symptoms.

Housing conditions associated with depression: univariate findings

Table 2 lists the frequency distributions of the housing condition variables across the outcome variable (depressive symptoms). It is particularly striking that 59.40% and 88.99% of the responders, who were depressed, reported using polluting cooking fuel and toilet without seat, respectively. $\chi^2$ tests revealed that housing materials, cooking fuel, type of toilet, running water, shower or bath facility had significant differences in depressive symptoms. In addition, other housing condition variables, such as the age of the house, housing structure, indoor temperature, number of bedrooms and heating system, were also analysed while these variables all had no significant difference among different depressive symptoms.

Binary logistic regression analysis of depressive symptoms: OR (95% CI)

The results of the binary logistic regression analysis of the associations between SES, housing conditions and depressive symptoms are shown in table 3. Model 1 included only controlled variables, including sociodemographic and health status factors, as a baseline model. In model 2, SES variables (marital status, education and income) were added to model 1 to explore the association between SES and depressive symptoms separately. In model 3, housing condition variables were added to model 1 to explore the impact of housing conditions on depressive symptoms separately. Model 4 added housing conditions and SES variables to model 1 to explain the impact of SES and housing conditions on depressive symptoms after controlling other variables.

The final regression model (model 4) showed that personal annual income, cooking fuel, type of toilet and bath facility were significantly and independently associated with depression. However, depression had no significant association with education and other housing conditions variables. Elderly participants with the lowest personal annual income (≤10000) were 1.6 times more likely to have depression compared with participants with the highest personal annual income (≥20000) (OR=1.63, 95% CI 1.290 to 2.060). Older individuals who
used polluting cooking fuel were nearly 1.2 times more likely to have depression than those used clean cooking fuel (OR=1.16, 95% CI 1.018 to 1.321). Older individuals who used the toilet without seat and had no bath facility were almost 1.3 and 1.2 times separately, more likely to have depression than those who used the toilet with seat (OR=1.273, 95% CI 1.056 to 1.535) and had a bath facility (OR=1.172, 95% CI 1.025 to 1.341) (table 3).

**DISCUSSION**

**Key findings**

This study examined the association between SES, housing conditions and depressive symptoms in rural China. Among the participants in this article, approximately 46.15% (2116/4585) reported significant depression (CESD-10 score >10) in rural China, which was consistent with previous population-based surveys in China that found up to 44.2% of rural-dwelling older adults have depression and depressive symptoms.  

**SES and depression**

Using education level and personal annual income as measures of SES, we found that education level was not associated with depressive symptoms as other studies have found. Personal annual income was found to be a stronger factor in this study, and elderly participants with the lowest personal annual income (≤10 000) were 1.6 times more likely to have depression than participants with the highest personal annual income (≥20 000). Depressive symptoms among the elderly in rural China are positively related to better SES, in particular, personal annual income. This result is consistent with what other studies in China have found for depression, but is now replicated on a national sample and for the elderly population. Further, it has been suggested that poor SES may

| Table 1 | Bivariate association between depressive symptoms and socio-demographic characteristics, SES and health status |
|---------|---------------------------------------------------------------------------------------------------------------|
| Variable | Total N (%) | Depressive symptoms | Not depressed n (%) | Depressed n (%) | P value |
|---------|-------------|---------------------|---------------------|----------------|---------|
| Age (years) | | | | | |
| 60–69 | 2712 (59.15) | 1539 (62.33) | 1173 (55.43) | <0.001 |
| 70–79 | 1350 (29.44) | 711 (28.80) | 639 (30.20) | |
| 80–89 | 476 (10.38) | 205 (8.30) | 271 (12.81) | |
| ≥90 | 47 (1.03) | 14 (0.57) | 33 (1.56) | |
| Gender | | | | | |
| Male | 2529 (55.16) | 1530 (61.97) | 999 (47.21) | <0.001 |
| Female | 2056 (44.84) | 939 (38.03) | 1117 (52.79) | |
| Marital status | | | | | |
| Married | 3008 (65.61) | 1735 (70.27) | 1273 (60.16) | <0.001 |
| Unmarried | 1577 (34.39) | 734 (29.73) | 843 (39.84) | |
| Education | | | | | |
| Primary school and below | 4333 (94.50) | 2309 (93.52) | 2024 (95.65) | 0.002 |
| High school and above | 252 (5.50) | 160 (6.48) | 92 (4.35) | |
| Personal annual income | | | | | |
| ≤10000 | 3643 (79.45) | 1871 (75.78) | 1772 (83.74) | <0.001 |
| 10 000–20 000 | 556 (12.13) | 334 (13.53) | 222 (10.49) | |
| ≥20 000 | 386 (8.42) | 264 (10.69) | 122 (5.77) | |
| Number of NCDs | | | | | |
| 0 | 698 (15.22) | 458 (18.55) | 240 (11.34) | <0.001 |
| 1–2 | 2615 (57.03) | 1396 (56.54) | 1219 (57.61) | |
| ≥3 | 1272 (27.74) | 615 (24.91) | 657 (31.05) | |
| Disability | | | | | |
| Yes | 2175 (47.44) | 999 (40.46) | 1176 (55.58) | <0.001 |
| No | 2410 (52.56) | 1470 (59.54) | 940 (44.42) | |
| ADL | | | | | |
| Unimpaired | 3828 (83.49) | 2133 (86.39) | 1695 (80.10) | <0.001 |
| Impaired | 757 (16.51) | 336 (13.61) | 421 (19.90) | |

ADL, activity of daily living; NCD, non-communicable disease; SES, socioeconomic status.
lead to poor access to mental health services, and further affect the diagnosis and treatment of depression, as it is very difficult for low-income populations to keep regular healthcare needs and be screened for depressive symptoms.8 How to approach these problems is outside the scope of this article, but our findings highlight the importance of SES on the development of depressive symptoms in rural China.

### Housing conditions and depression

Poor housing conditions (using polluting cooking fuel, toilet without seat and having no bath facility) were found to be associated with depressive symptoms. Older individuals who used polluting cooking fuel was nearly 1.2 times more likely to have depression than those who used clean cooking fuel. Older individuals who used the toilet without seat and had no bath facility were almost 1.3 and 1.2 times more likely to have depression than those who used the toilet with seat and had a bath facility.

In this study, there are 2544 (55.50%) older people using polluting cooking fuel in rural China in 2015. Indoor air pollution (IAP), one of the major public health concerns in low-income and middle-income countries, is caused mainly by the use of polluting cooking fuels, such as coal, charcoal, crop residue and wood burning.22 23 Globally, nearly 3 billion (40%) of the world’s population, according to a WHO report in 2016, relies on solid fuels, including coal and biomass for domestic cooking.22 23 Research on health, especially on microbiological pollution, has demonstrated that the species of microbes on squat pans are roughly the same as those on the toilet, while the numbers alone are much more.34 35 As a result, the possibility of transmitting the virus through the air is greater. Some other previous investigations have suggested that using squat pans over time can cause anal fissure to a certain extent, raising the risk of dizziness due mainly to the lack of oxygen to the brain, which results from resuming blood circulation and flow to the lower limb artery after a long time using of squat pans, even leading to a fall or a cerebrovascular accident, such as cerebral haemorrhage and angina pectoris.

### Table 2 Percentage distribution and the prevalence of depressive symptoms and housing conditions

| Variable                  | Total N (%) | Depressive symptoms n (%) | P value |
|---------------------------|-------------|---------------------------|---------|
|                          | Not depressed | Depressed            |         |
| Housing materials        |             |                          |         |
| Improved                 | 3567 (77.80) | 1958 (79.30)            | 1609 (76.04) | 0.008 |
| Unimproved               | 1018 (22.20) | 511 (20.70)             | 507 (23.96)  |
| Cooking fuel             |             |                          |         |
| Clean fuel               | 1993 (43.47) | 1156 (46.82)            | 837 (39.56) | <0.001 |
| Polluting fuel           | 2544 (55.50) | 1287 (52.13)            | 1257 (59.40) |
| Others                   | 48 (1.05)    | 26 (1.05)               | 22 (1.04)   |
| Type of toilet           |             |                          |         |
| Toilet with seat         | 603 (13.15)  | 370 (14.99)             | 233 (11.01)  | <0.001 |
| Toilet without seat      | 3982 (86.85) | 2099 (85.01)            | 1883 (88.99) |
| Running water            |             |                          |         |
| Yes                      | 3128 (68.22) | 1729 (70.03)            | 1399 (66.12)  | 0.005 |
| No                       | 1457 (31.78) | 740 (29.97)             | 717 (33.88)   |
| Shower or bath facility  |             |                          |         |
| Yes                      | 1916 (41.79) | 1128 (45.69)            | 788 (37.24)  | <0.001 |
| No                       | 2669 (58.21) | 1341 (54.31)            | 1328 (62.76)  |
Table 3  Relative risk (and 95% CIs) for the associations between housing conditions and depressive symptoms

| Variable                                      | Model 1                  | Model 2                  | Model 3                  | Model 4                  |
|-----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                               | OR (95% CI)              | OR (95% CI)              | OR (95% CI)              | OR (95% CI)              |
| Age (60–69)                                   |                          |                          |                          |                          |
| 70–79                                         | 1.080 (0.940 to 1.240)   | 1.055 (0.918 to 1.212)   | 1.062 (0.924 to 1.220)   | 1.043 (0.907 to 1.199)   |
| 80–89                                         | 1.334** (1.079 to 1.650) | 1.322** (1.069 to 1.636) | 1.356** (1.095 to 1.679) | 1.343** (1.085 to 1.664) |
| ≥90                                           | 2.160* (1.127 to 4.141)  | 2.161* (1.125 to 4.149)  | 2.242* (1.165 to 4.314)  | 2.231* (1.159 to 4.295)  |
| Gender (man)                                  |                          |                          |                          |                          |
| Woman                                         | 1.668*** (1.470 to 1.893)| 1.638*** (1.442 to 1.860)| 1.678*** (1.477 to 1.905)| 1.650*** (1.452 to 1.876)|
| Marital status (married)                      |                          |                          |                          |                          |
| Unmarried                                     | 1.146 (0.997 to 1.317)   | 1.121 (0.975 to 1.289)   | 1.122 (0.976 to 1.291)   | 1.104 (0.960 to 1.271)   |
| Number of NCDs (0)                            | 1.428*** (1.193 to 1.710)| 1.412*** (1.178 to 1.692)| 1.422*** (1.187 to 1.704)| 1.408*** (1.175 to 1.689)|
| Disability (no)                               | 1.757*** (1.442 to 2.142)| 1.741*** (1.427 to 2.124)| 1.757*** (1.440 to 2.143)| 1.743*** (1.428 to 2.128)|
| ADL (unimpaired)                              | 1.431*** (1.216 to 1.683)| 1.432*** (1.217 to 1.686)| 1.420*** (1.206 to 1.673)| 1.422*** (1.207 to 1.676)|
| Education (high school and above)             |                          |                          |                          |                          |
| Primary school and below                      | 0.919 (0.698 to 1.209)   |                          | 0.933 (0.709 to 1.229)   |                          |
| Personal annual income (≤ 20000)              |                          |                          |                          |                          |
| 10000–20 000                                 | 1.354* (1.022 to 1.794)  |                          | 1.290 (0.972 to 1.713)   |                          |
| ≤10000                                       | 1.760*** (1.396 to 2.219)|                          | 1.630*** (1.290 to 2.060)|                          |
| Cooking fuel (clean fuel)                     |                          |                          |                          |                          |
| Polluting fuel                                 | 1.171* (1.029 to 1.334)  |                          | 1.160* (1.018 to 1.321)  |                          |
| Others                                        | 1.005 (0.552 to 1.827)   |                          | 1.041 (0.571 to 1.898)   |                          |
| Type of toilet (toilet with seat)             |                          |                          |                          |                          |
| Toilet without seat                           | 1.308** (1.086 to 1.575) |                          | 1.273* (1.056 to 1.535)  |                          |
| Shower or bath facility (yes)                 | 1.200** (1.050 to 1.372) |                          | 1.172* (1.025 to 1.341)  |                          |
| Running water (Yes)                           | 1.067 (0.933 to 1.219)   |                          | 1.065 (0.932 to 1.218)   |                          |
| Housing materials (improved)                  |                          |                          |                          |                          |
| Unimproved                                    | 1.018 (0.876 to 1.183)   |                          | 1.005 (0.864 to 1.168)   |                          |

*P<0.05; **P<0.01; ***P<0.001.  
ADL, activity of daily living; NCD, non-communicable disease.
especially among patients with constipation. 36, 57 Maybe we can deduce from these existing studies that the existence or deterioration of chronic diseases resulting from using the toilet without seat may lead to a greater possibility of depression among older adults, especially those with high blood pressure, heart disease, chronic bronchitis and other senile diseases.

Finally, in terms of the relationship between shower/bath facility and depressive symptoms, there are 2669 (58.21%) older adults who reported that the shower/bath facility is not available among respondents in 2015. We found few articles involving the relationship between the availability of bath facilities and health outcome. 39 Our findings underscore the importance of the availability of bath facilities on depressive symptoms among the elderly in rural China.

Limitations

The main limitations of this study were a cross-sectional study design and its use of self-report data. This study cannot use the Geriatric Depression Scale to assess or screen for depression in the elderly according to original data. Finally, we used screening instruments of depression only while no diagnostic instrument was used to further confirm depression.

Conclusions

Using a large nationally representative sample of elderly in rural China, we concluded that the elderly in rural China experienced severe depressive symptoms. The study identified lowest personal annual income, polluting cooking fuel, toilet without seat and having no bath facility as being significantly associated with more depressive symptoms. Older adults living in rural areas are the vulnerable group that faces multiple serious health inequities. Therefore, this study emphasises that SES and housing conditions are important for this vulnerable group and should at least be part of the current governmental intervention to improve depressive symptoms. In addition, further studies should investigate the rural–urban differences among elderly adults using a prospective design.

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