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Decomposition and comparative analysis of differences in depressive symptoms between urban and rural older adults: Evidence from a national survey

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ABSTRACT

Objectives: The aim of this study was to investigate the factors influencing urban–rural differences in depressive symptoms among old people in China and to measure the contribution of relevant influencing factors.

Design: A cross-sectional research. The 2018 data from The Chinese Longitudinal Health Longevity Survey (CLHLS).

Setting: Twenty-three provinces in China.

Participants: From the 8th CLHLS, 11,245 elderly participants were selected who met the requirements of the study.

Measurements: We established binary logistic regression models to explore the main influencing factors of their depressive symptoms and used Fairlie models to analyze the influencing factors of the differences in depressive symptoms between the urban and rural elderly and their contribution.

Results: The percentage of depressive symptoms among Chinese older adults was 11.72%, and the results showed that rural older adults (12.41%) had higher rates of depressive symptoms than urban (10.13%). The Fairlie decomposition analysis revealed that 73.96% of the difference in depressive symptoms could be explained, which was primarily associated with differences in annual income (31.51%), education level (28.05%), sleep time (−25.67%), self-reported health (24.18%), instrumental activities of daily living dysfunction (20.73%), exercise (17.72%), living status (−8.31%), age (−3.84%), activities of daily living dysfunction (−3.29%), and social activity (2.44%).

Conclusions: The prevalence of depressive symptoms was higher in rural than in urban older adults, which was primarily associated with differences in socioeconomic status, personal lifestyle, and health status factors between the urban and rural residents. If these factors were addressed, we could make targeted and precise intervention strategies to improve the mental health of high-risk elderly.

Key words: Depression, Elderly, Depressive symptom disparity, Chinese, Decomposition analysis

Introduction

With the deepening of the global aging, the number of elderly people worldwide was slightly higher than 1 billion in 2021, representing about 13.5% of the global population, and by 2030, one in six people will be 60 years of age and older (WHO, 2021). China is also facing the same serious problem of an aging population. In 2020, the national population aged 60 years and above was 200 million,

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accounting for 18.70% of the national population, an increase of 5.44% compared to 2010 (Office of the Leading Group of the State Council for the Seventh National Population Census, 2021). Over 20% of adults aged 60 and over suffer from mental or neurological disorder (excluding headache disorders), while 6.6% of all disabilities (Disability Adjusted Life Years - DALYs) in people aged 60 and over are attributable to mental and neurological disorders, most commonly dementia and depression (WHO, 2017). Depression in the elderly is associated with a major functional impact, impaired quality of life, and significant risk of suicide (Tayaa *et al.*, 2020). It mainly affects old people with chronic medical illnesses and cognitive impairment, causes suffering, family disruption and disability, worsens the outcome of many medical illnesses, and increases mortality (Alexopoulos, 2005).

Depressive symptoms in older adults are not only age-related but also vulnerable to other factors including gender (Tsai *et al.*, 2005a; Zhai *et al.*, 2015), self-perceived financial status (Gong *et al.*, 2012; Zhao *et al.*, 2018), marital status (Chen *et al.*, 2005; Wu *et al.*, 2010), self-reported health (SRH) status (Gong *et al.*, 2012; Li *et al.*, 2011), hypertension (Wu *et al.*, 2010; Yunming *et al.*, 2012), diabetes (Wu *et al.*, 2010; Yunming *et al.*, 2012), negative life events (Gong *et al.*, 2012; Wu *et al.*, 2017), social support (Tsai *et al.*, 2005b; Zhao *et al.*, 2018), the number of cardiovascular diseases a person has (Li *et al.*, 2011; Zhao *et al.*, 2018), smoking (Tsai and Tsai, 2013; Wu *et al.*, 2010), alcohol consumption (Tsai and Tsai, 2013; Wu *et al.*, 2017), and functional impairment (Wu *et al.*, 2017; Wu *et al.*, 2010). One study showed that poor self-perceived financial status, average and poor SRH, diabetes, negative life events, two or more cardiovascular diseases, functional disability, and poor social support were significant factors for depressive symptoms in older Chinese. However, average or good social support was found to be a protective factor, and age, living alone, hypertension, smoking and current alcohol consumption had no effect on depressive symptoms in older Chinese (Qiu *et al.*, 2020).

Are there differences in depressive symptoms between urban and rural areas in the elderly? Some studies have shown that the pattern of urban–rural differences was no significant difference (St John *et al.*, 2021; Sun *et al.*, 2022) or the higher prevalence in cities (Evans, 2009; Ziarko *et al.*, 2015). But older urban people in China had significantly lower levels of depressive symptoms than older rural people (Guo *et al.*, 2018; Wang *et al.*, 2021a). The widening gap between urban and rural development in China in terms of economy, social welfare, medical services, employment, and infrastructure may contribute to the different conditions of depressive symptoms among older people in urban and rural areas (Chow and Bai, 2011). In order to solve the problem, the recent 14th Five-Year Plan for healthy ageing calls for an increase in the coverage rate of health education services for the elderly in urban and rural areas and makes elderly people with dysfunction, advanced age, disabilities, and family planning special families a priority group for family doctor services (National Health Commission of the People's Republic of China, 2022).

In order to further analyze the influencing factors for the higher levels of depressive symptoms in rural Chinese older people than in urban older people and to provide a basis for precise prevention and control policies to control the levels of depressive symptoms in older people, we began to focus on the urban–rural differences in depressive symptoms in older people (aged 65 +) in China. To this end, using the Chinese Longitudinal Health Longevity Survey (CLHLS), we initially explored the extent to which sociodemographic characteristics, personal lifestyle, and health status explain urban–rural differences in depressive symptoms among older Chinese.

Methods

Data sources

We used data from the 8th CLHLS (PKU Center for Healthy Aging and Development, 2020). The project's data sources and data design reports are available here (https://opendata.pku.edu.cn/dataset.xhtml?persistentId=doi:10.18170/DVN/WBO7LK, Assessed 23 Feb 2022). The CLHLS was organized by the Centre for Healthy Ageing and Development Studies/National Development Research Institute of Peking University. The survey covered 23 provinces in China and was targeted at people aged 65 and above and adult children aged 35–64. The questionnaire was divided into two types: a questionnaire for surviving respondents and a questionnaire for family members of deceased elderly people. The eighth CLHLS used in this study was conducted in 2017–2018, interviewing a total of 15,874 older people aged 65 years and over and collecting information on 2,226 older people who died between 2014 and 2018. The study was approved by the Ethics Committee of Peking University (No. IRB00001052-13074). The 8th CLHLS included a total of 15,874 respondents. The exclusion criteria included age under 65 and/or nonresponse to depressive symptoms measurement indicators and/or nonresponse to demographic characteristics, sociological characteristics, personal lifestyle, or health status indicators. Finally, a total of 11,245 respondents were selected for this study. There were 3,338 older people

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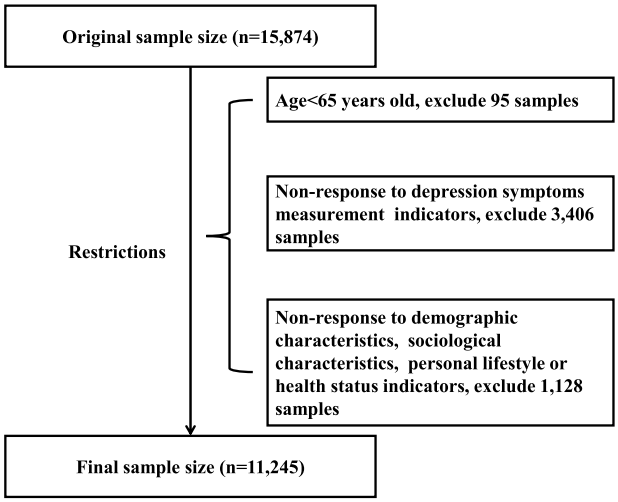

Figure 1. Flowchart of study participant.

from urban areas and 7,907 from rural areas. The exclusion process is shown in Figure 1.

Depressive symptoms

We used the Chinese version 10-item short form of Center for Epidemiological Studies-Depression Scale (CES-D 10) (Andresen *et al.*, 1994) to measure depressive symptoms in this study. Responses are rated on a 4-point scale from 0 (less than one day) to 4 (5–7 days). Scores range from 0 to 30. Higher scores indicate more severe depressive symptoms (James *et al.*, 2020). The scale has been used extensively in several studies and has been well validated in the measurement of depressive symptoms in older adults, with an internal consistency reliability Cronbach's α of 0.815 (Lei *et al.*, 2014), regardless of the age and dementia status of the participants, indicating that the internal consistency reliability of the questionnaire was at a reasonable level. In the same way that multiple previous studies defined a score of 10 as a threshold score, participants with a score greater than or equal to 10 were defined as experiencing depressive symptoms (Jiang *et al.*, 2020; Yao *et al.*, 2021).

Grouping variables

Respondents were classified as rural and urban based on the nature of domicile at the time of the survey.

Covariates

To obtain more reliable findings, we controlled for a range of potential confounding factors. Demographic characteristics, sociological characteristics, personal lifestyle, and health status were incorporated with reference to other studies on depressive symptoms. Demographic characteristics included age, gender, BMI, and education level. Sociological characteristics included marital status, living status, and annual income. Personal lifestyle included sleep time, annual physical examination, smoking, drinking, exercise, and social activity. Health status included SRH, number of chronic diseases, activities of daily living (ADL), and instrumental activities of daily living (IADL).

Demographic characteristics

Age was classified as <80 years and ≥ 80 years. BMI was calculated by dividing weight (kg) by the square of height (m) and was divided into four categories: <18.5, 18.5–23.9, 24.0–27.9, and >28.0. Education level was classified according to time in school as 0 years, 1–6 years, and ≥ 7 years.

Sociological characteristics

Marital status included married and living with spouse, widowed, and others (including married but not living with a spouse, divorced, and never married). Living status was classified as living with household members, living alone, and living in an institution. Annual income was divided into four categories: very poor (<10,000 RMB), poor (10,000–29,999 RMB), middle (30,000–49,999 RMB), and rich (≥ 50,000 RMB).

Personal lifestyle

Sleep time was classified as <4, 4–5.9, 6–7.9, 8–9.9, and ≥ 10 according to the answer to the question 'How many hours do you sleep normally?'. Based on participants' responses to the questions 'Do you have regular physical examination once every year?,' 'Do you smoke at the present time?', 'Do you drink alcohol at the present time?,' and 'Do you do exercises regularly at present?', annual physical examination, smoking, drinking, and exercise were categorized as yes and no. Social activity was assessed according to activity participation, including six items: Tai Chi, square dance, visiting and interacting with friends, other outdoor activity, playing cards and/or mahjong, and social activities (organized), and the responses to each question were five options: almost every day, not every day but at least once a week, not every week but at least once a month, not every month but sometimes and never, and all activities answered never were considered no social, and the results were classified as yes and no.

Health status

The SRH was based on the answer to the question 'How do you rate your health at present?' and the results were categorized as good (very good or good) and poor (so so, bad or very bad). We included seven

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categories of chronic diseases: hypertension, diabetes, heart disease, stroke and cerebrovascular disease, cancer, prostate tumor and Parkinson's disease, and classified the results into three categories: no chronic disease, having one chronic disease and two or more chronic diseases. One or more of the five basic activities (dressing, bathing, indoor transferring, eating, and toileting) requiring assistance or incontinence was defined as ADL dysfunction. IADL dysfunction was defined as needing help with one or more of the eight abilities assessed (going to a neighbor's house alone, shopping alone, cooking alone, washing clothes alone, walking 1 km continuously, lifting a weight of 5 kg, crouching, and standing up three times continuously, taking public transportation alone).

Statistical analysis

Descriptive statistics were used to analyze general information on demographic characteristics, sociological characteristics, personal lifestyle, and health status. The chi-square test was used to analyze the distribution characteristics of depressive symptoms among the urban and rural elderly. The binary logistic regression model was used to explore the main influences on depressive symptoms in rural and urban older people. The above statistical analysis was carried out using SPSS 21.0 software. Finally, the Fairlie model was used to analyze the factors influencing and contributing to the differences in depressive symptoms between urban and rural older people. The analysis was carried out using Stata MP16.0 software. The level of statistical significance was defined as 0.05.

Fairlie decomposition analysis

As the dependent variable is a dichotomous variable, we used the Fairlie nonlinear decomposition method to decompose the depressive symptoms differences into the contributions of various factors (Fairlie, 2005). According to Fairlie (Fairlie, 1999), the decomposition of the nonlinear equation $Y = F\left(X\hat{\beta}\right)$ can be written as

$$\hat{Y}^a - \hat{Y}^b = \left[\sum_{i=1}^{N^a} \frac{F\left(X_i^a \beta^a\right)}{N^a} - \sum_{i=1}^{N^b} \frac{F\left(X_i^b \beta^a\right)}{N^b}\right] + \left[\sum_{i=1}^{N^b} \frac{F\left(X_i^b \beta^a\right)}{N^b} - \sum_{i=1}^{N^b} \frac{F\left(X_i^b \beta^b\right)}{N^b}\right] \quad (1)$$

$\hat{Y}^a$ and $\hat{Y}^b$ were the mean probabilities of the binary outcomes of depressive symptoms in the two groups, F was the cumulative distribution function of the logistic distribution, $\hat{Y}^a - \hat{Y}^b$ represented the total difference due to group differences, and N^a and N^b were the sample sizes of the two population samples. The first term in parentheses in equation (1) represented the portion of the gap due to group differences in observed characteristics and the portion attributable to differences in estimated coefficients. The second term represented the portion due to differences in Y levels.

Results

General data of the respondents

The total sample size of this study was 11,245. Table 1 shows the results of descriptive statistical analyses for older people in rural and urban China. We found that 11.72% of older people experienced depressive symptoms, and 88.28% had no depressive symptoms. A higher proportion of older people in rural areas (12.41%) experienced depressive symptoms than in urban areas (10.13%) ($p<0.001$). The results of chi-square test showed that there were differences in the distribution of 14 covariates between rural and urban elderly in gender, BMI, education level, marital status, living status, annual income, sleep time, annual physical examination, smoking, drinking, exercise, number of chronic diseases, ADL dysfunction and IADL dysfunction, and there was no difference in the distribution of three factors: age, social activity, and SRH.

Comparison of variable distributions of different depressive symptoms

Table 2 shows the distribution of covariates between rural and urban elderly in different depressive symptoms. The results showed that some covariates for elderly with and without depressive symptoms had different distribution characteristics. They were gender, marital status, sleep time, annual physical examination, drinking, and IADL dysfunction.

Logistic model results

Figure 2 shows the results of the logistic model calculations for depressive symptoms in rural and urban older people. Among rural older adults, BMI (<18.5, OR = 1.307), living status (alone, OR = 1.374), sleep time (<4, OR = 3.677, 4.0-5.9, OR = 2.403), and IADL dysfunction (yes, OR = 1.519) were risk factors for depressive symptoms; age (≥ 80, OR = 0.729), gender (male, OR = 0.785), education level (≥ 7, OR = 0.799), sleep time (≥ 10, OR = 0.795), social activity (yes, OR = 0.815), and SRH (good, OR = 0.249) were protective factors. Among urban older adults, gender (male, OR = 1.407), sleep time (<4, OR = 5.552, 4.0–5.9, OR = 2.185), ADL dysfunction (yes, OR = 1.493), and IADL dysfunction (yes, OR = 1.722) were risk factors for depressive symptoms; age (≥ 80, OR = 0.586), annual income (rich, OR = 0.626), sleep

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Table 1. Distribution of the variables in rural and urban respondents

VARIABLE	RURAL[n(%)]	URBAN[n(%)]	χ^2	p
CES-D 10			11.794	0.001
<10	6926 (87.59)	3000 (89.87)		
≥ 10	981 (12.41)	338 (10.13)		
Age			1.855	0.173
<80	3224 (40.77)	1315 (39.39)		
≥ 80	4683 (59.23)	2023 (60.61)		
Gender			8.859	0.003
Female	4267 (53.96)	1699 (50.90)		
Male	3640 (46.04)	1639 (49.10)		
BMI			121.701	<0.001
<18.5	1438 (18.19)	435 (13.03)		
18.5–23.9	4035 (51.03)	1536 (46.02)		
24.0–27.9	1758 (22.23)	973 (29.15)		
≥ 28.0	676 (8.55)	394 (11.80)		
Education level			837.494	<0.001
0	3495 (44.20)	721 (21.60)		
1–6	2462 (31.14)	910 (27.26)		
≥ 7	1950 (24.66)	1707 (51.14)		
Married status			8.303	0.016
Married and living with spouse	3516 (44.47)	1579 (47.30)		
Widowed	4155 (52.55)	1655 (49.58)		
Other	236 (2.98)	104 (3.12)		
Living status			287.278	<0.001
Living with household members	6378 (80.66)	2650 (79.39)		
Living alone	1413 (17.87)	441 (13.21)		
Living in an institution	116 (1.47)	247 (7.40)		
Annual income			1753.824	<0.001
Very poor	2615 (33.07)	272 (8.15)		
Poor	1772 (22.41)	262 (7.85)		
Middle	1105 (13.97)	429 (12.85)		
Rich	2415 (30.54)	2375 (71.15)		
Sleep time			52.050	<0.001
<4.0	283 (3.58)	79 (2.37)		
4.0–5.9	1252 (15.83)	494 (14.80)		
6.0–7.9	2575 (32.57)	1284 (38.47)		
8.0–9.9	2289 (28.95)	961 (28.79)		
≥ 10	1508 (19.07)	520 (15.58)		
Annual physical examination			33.945	<0.001
No	2158 (27.29)	1093 (32.74)		
Yes	5749 (72.71)	2245 (67.26)		
Smoking			61.010	<0.001
No	6471 (81.84)	2931 (87.81)		
Yes	1436 (18.16)	407 (12.19)		
Drinking			11.454	0.001
No	6607 (83.56)	2874 (86.10)		
Yes	1300 (16.44)	464 (13.90)		
Exercise			464.640	<0.001
No	5655 (71.52)	1680 (50.33)		
Yes	2252 (28.48)	1658 (49.67)		
Social activity			0.461	0.497
No	2136 (27.01)	881 (26.39)		
Yes	5771 (72.99)	2457 (73.61)		
SRH			1.899	0.168
Bad	4118 (52.08)	1691 (50.66)		
Good	3789 (47.92)	1647 (49.34)		

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Table 1. Continued

VARIABLE	RURAL[n(%)]	URBAN[n(%)]	χ^2	p
Number of chronic diseases			674.765	<0.001
0	4317 (54.60)	1186 (35.53)		
1	2620 (33.14)	1087 (32.56)		
≥ 2	970 (12.27)	1065 (31.91)		
ADL dysfunction			94.696	<0.001
No	6420 (81.19)	2436 (72.98)		
Yes	1487 (18.81)	902 (27.02)		
IADL dysfunction			7.645	0.006
No	3358 (42.47)	1512 (45.30)		
Yes	4549 (57.53)	1826 (54.70)		

CES-D 10, the Chinese version 10-item short form of Center for Epidemiological Studies-Depression Scale; SRH, self-reported health; ADL, activities of daily living; IADL, instrumental activities of daily living.

Table 2. Distribution of the variables in depressive symptoms and non-depressive symptoms respondents

VARIABLE	NON-DEPRESSIVE SYMPTOMS				DEPRESSIVE SYMPTOMS			
	Rural [n (%)]	Urban [n (%)]	χ^2	p	Rural [n (%)]	Urban [n (%)]	χ^2	p
Age			1.896	0.169			0.214	0.643
<80	2859 (41.28)	1194 (39.80)			365 (37.21)	121 (35.80)		
≥ 80	4067 (58.72)	1806 (60.20)			616 (62.79)	217 (64.20)		
Gender			3.059	0.080			11.490	0.001
Female	3623 (52.31)	1512 (50.40)			644 (65.65)	187 (55.33)		
Male	3303 (47.69)	1488 (49.60)			337 (34.35)	151 (44.67)		
BMI			103.121	<0.001			16.375	0.001
<18.5	1190 (17.18)	370 (12.33)			248 (25.28)	65 (19.23)		
18.5–23.9	3560 (51.40)	1388 (46.27)			475 (48.42)	148 (43.79)		
24.0–27.9	1580 (22.81)	894 (29.80)			178 (18.14)	79 (23.37)		
≥ 28.0	596 (8.61)	348 (11.60)			80 (8.15)	46 (13.61)		
Education level			719.997	<0.001			111.922	<0.001
0	2959 (42.72)	634 (21.13)			536 (54.64)	87 (25.74)		
1–6	2199 (31.75)	809 (26.97)			263 (26.81)	101 (29.88)		
≥ 7	1768 (25.53)	1557 (51.90)			182 (18.55)	150 (44.38)		
Married status			6.437	0.040			2.701	0.259
Married and living with spouse	3175 (45.84)	1448 (48.27)			341 (34.76)	131 (38.76)		
Widowed	3551 (51.27)	1456 (48.53)			604 (61.57)	199 (58.88)		
Other	200 (2.89)	96 (3.20)			36 (3.67)	8 (2.37)		
Living status			230.902	<0.001			61.545	<0.001
Living with household members	5659 (81.71)	2399 (79.97)			719 (73.29)	251 (74.26)		
Living alone	1169 (16.88)	391 (13.03)			244 (24.87)	50 (14.79)		
Living in an institution	98 (1.41)	210 (7.00)			18 (1.83)	37 (10.95)		
Annual income			1586.81	<0.001			160.470	<0.001
Very poor	2217 (32.01)	225 (7.50)			398 (40.57)	47 (13.91)		
Poor	1563 (22.57)	228 (7.60)			209 (21.30)	34 (10.06)		
Middle	1002 (14.47)	388 (12.93)			103 (10.50)	41 (12.13)		
Rich	2144 (30.96)	2159 (71.97)			271 (27.62)	216 (63.91)		
Sleep time			46.477	<0.001			8.130	0.087
<4.0	185 (2.67)	48 (1.60)			98 (9.99)	31 (9.17)		
4.0–5.9	948 (13.69)	395 (13.17)			304 (30.99)	99 (29.29)		
6.0–7.9	2318 (33.47)	1170 (39.00)			257 (26.20)	114 (33.73)		
8.0–9.9	2102 (30.35)	911 (30.37)			187 (19.06)	50 (14.79)		
≥ 10	1373 (19.82)	476 (15.87)			135 (13.76)	44 (13.02)		

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Table 2. Continued

Variable	Non-depressive symptoms				Depressive symptoms			
	Rural [*n* (%)]	Urban [*n* (%)]	χ^2	*p*	Rural [*n* (%)]	Urban [*n* (%)]	χ^2	*p*
Annual physical examination			37.016	<0.001			0.310	0.578
No	1849 (26.70)	981 (32.70)			309 (31.50)	112 (33.14)		
Yes	5077 (73.30)	2019 (67.30)			672 (68.50)	226 (66.86)		
Smoking			58.014	<0.001			5.004	0.025
No	5626 (81.23)	2624 (87.47)			845 (86.14)	307 (90.83)		
Yes	1300 (18.77)	376 (12.53)			136 (13.86)	31 (9.17)		
Drinking			12.978	<0.001			0.111	0.739
No	5734 (82.79)	2571 (85.70)			873 (88.99)	303 (89.64)		
Yes	1192 (17.21)	429 (14.30)			108 (11.01)	35 (10.36)		
Exercise			465.514	<0.001			5.927	0.015
No	4894 (70.66)	1440 (48.00)			761 (77.57)	240 (71.01)		
Yes	2032 (29.34)	1560 (52.00)			220 (22.43)	98 (28.99)		
Social activity			0.265	0.607			0.028	0.867
No	1784 (25.76)	758 (25.27)			352 (35.88)	123 (36.39)		
Yes	5142 (74.24)	2242 (74.73)			629 (64.12)	215 (63.61)		
SRH			0.162	0.688			0.952	0.329
Bad	3311 (47.81)	1421 (47.37)			807 (82.26)	270 (79.88)		
Good	3615 (52.19)	1579 (52.63)			174 (17.74)	68 (20.12)		
Number of chronic diseases			585.804	<0.001			103.976	<0.001
0	3838 (55.41)	1085 (36.17)			479 (48.83)	101 (29.88)		
1	2272 (32.80)	993 (33.10)			348 (35.47)	94 (27.81)		
≥ 2	816 (11.78)	922 (30.73)			154 (15.70)	143 (42.31)		
ADL dysfunction			75.558	<0.001			28.300	<0.001
No	5692 (82.18)	2237 (74.57)			728 (74.21)	199 (58.88)		
Yes	1234 (17.82)	763 (25.43)			253 (25.79)	139 (41.12)		
IADL dysfunction			5.476	0.019			0.214	0.644
No	3095 (44.69)	1417 (47.23)			263 (26.81)	95 (28.11)		
Yes	3831 (55.31)	1583 (52.77)			718 (73.19)	243 (71.89)		

time (8.0-9.9, OR = 0.612), exercise (yes, OR = 0.542), and SRH (good, OR = 0.303) were protective factors.

Thus, the differences in depressive symptoms between rural and urban older people were reflected in the following four main areas. First, BMI (<18.5, OR = 1.307) and living status (alone, OR = 1.374) were risk factors only in rural areas. Second, gender (male, OR = 1.407) and ADL dysfunction (yes, OR = 1.493) were risk factors only in urban areas. Three, gender (male, OR = 0.785), education level (≥ 7, OR = 0.799), sleep time ≥ 10 (OR = 0.795), and social activity (yes, OR = 0.815) were protective factors only in rural areas. Fourth, annual income (rich, OR = 0.626), sleep time (8.0–9.9, OR = 0.612), and exercise (yes, OR = 0.542) were protective factors only in urban areas.

Decomposition analysis results

To ensure the stability of the results, the software was used to repeat the decomposition model 100 times. Table 3 presents the results of the decomposition model of the differences in depressive symptoms between rural and urban older people. The results showed that 73.96% of the difference in depressive symptoms was due to observed factors, and 26.04% was due to urban and rural factors and unobserved factors. Annual income (31.51%), education level (28.05%), sleep time (−25.67%), SRH (24.18%), IADL dysfunction (20.73%), exercise 17.72%), living status (−8.31%), age (−3.84%), ADL dysfunction (−3.29%), and social activity (2.44%) were significant in explaining differences in depressive symptoms (p<0.05).

Discussion

This study investigated the relationship between some factors (such as sociodemographic characteristics, personal lifestyle, and health status) and depressive symptoms among urban and rural older adults in mainland China and quantified the extent to which these factors could explain persistent differences in depressive symptoms between urban and rural older adults in China. Our study confirmed that there were indeed differences in depressive symptoms among older people in urban and rural China.

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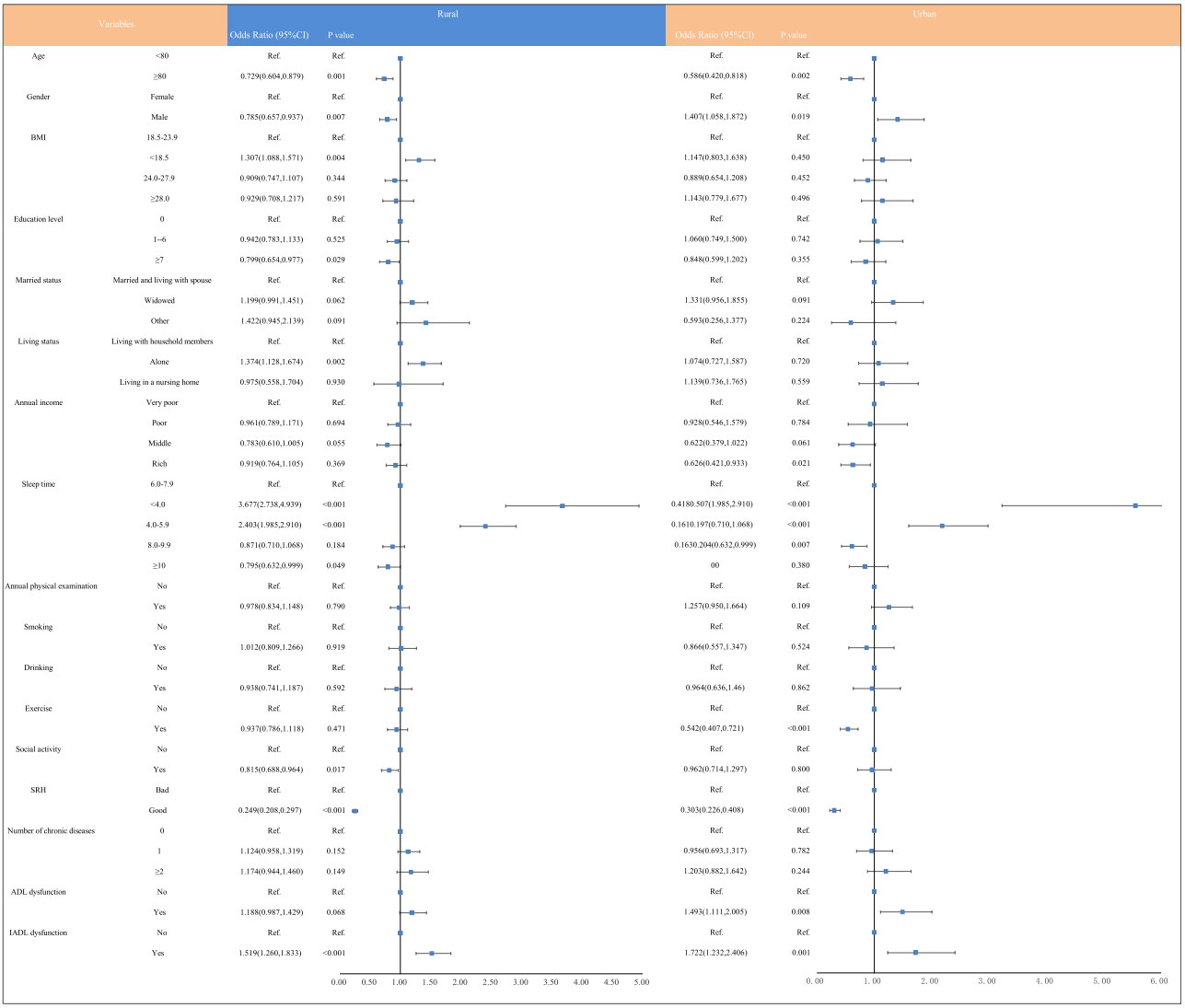

Figure 2. Results of Logistic model in rural and urban elderly.

This study showed that the prevalence of depressive symptoms among Chinese older adults (age ≥ 65) was 11.72%, which was much lower than the similarly reported prevalence of depressive symptoms among Chinese older adults (age ≥ 60) of around 36.00% (Hu *et al.*, 2018; Zhou *et al.*, 2021). The prevalence of depressive symptoms among older people in rural areas (12.41%) was higher than in urban areas (10.13%), which was similar to the findings of other scholars on depressive symptoms among older people in China (Shang, 2020; Wang *et al.*, 2021b), suggesting that there were significant urban–rural differences in depressive symptoms among older people in China. This urban–rural disparity in depressive symptoms in older people can be found in countries such as Myanmar (Sasaki *et al.*, 2021), Spain (Urbina Torija *et al.*, 2007), Vietnam (Nguyen *et al.*, 2019), and Ghana (Adjaye-Gbewonyo *et al.*, 2020). In addition, the 2.28 percentage point difference in the prevalence of depressive symptoms between urban and rural elderly suggested that medical personnel have a greater need to focus on the rural elderly clients' mental health. And it may be better to communicate with them in plain language to ease any anxiety or depression they may have.

Our logistic regression analysis further revealed differences between the covariates of depressive symptoms in urban and rural Chinese older adults. Age, gender, BMI, education level, living status, annual income, sleep time, exercise, social activity, SRH, ADL dysfunction, and IADL dysfunction were factors associated with the presence of depressive symptoms, similar to the findings of other researchers (Guo *et al.*, 2018; Liu *et al.*, 2021; Yang *et al.*, 2020). Unlike other findings (Hu *et al.*, 2018; Qiu *et al.*, 2020), older adults ≥ 80 years of age in this study were less likely to have depressive symptoms, and the specific reasons need to be further investigated. Men in rural areas were less likely to

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Table 3. Fairlie decomposition of depressive symptoms disparity between rural and urban elderly

TERMS OF DECOMPOSITION	DS
DIFFERENCE	0.0228090
EXPLAINED (%)	0.0168706(73.96)
NON-EXPLAINED (%)	0.0059384(26.04)

EXPLAINED

CONTRIBUTION TO DIFFERENCE	*p*	*β*	CONTRIBUTION (%)	(95%*CI*)
Age	0.019	−0.0008749	−3.84	(−0.0016072, −0.0001425)
Gender	0.163	0.0001663	0.73	(−0.0000672,0.0003998)
BMI	0.539	0.0003599	1.58	(−0.0007884,0.0015083)
Education level	0.001	0.0063978	28.05	(0.0025576,0.0102380)
Married status	0.786	−0.0000470	−0.21	(−0.0003869,0.0002929)
Living status	0.036	−0.0018964	−8.31	(−0.0036643, −0.0001285)
Annual income	0.002	0.0071874	31.51	(0.0025672,0.0118075)
Sleep times	<0.001	−0.0058561	−25.67	(−0.0069972, −0.0047150)
Annual physical examination	0.969	0.0000062	0.03	(−0.0003086,0.0003209)
Smoking	0.963	−0.0000221	−0.10	(−0.0009623,0.0009181)
Drinking	0.658	−0.0000729	−0.32	(−0.0003956,0.0002499)
Exercise	0.002	0.0040414	17.72	(0.0015089,0.0065739)
Social activity	0.028	0.0005562	2.44	(0.0000591,0.0010534)
SRH	<0.001	0.0055157	24.18	(0.0043373,0.0066941)
Number of chronic diseases	0.149	−0.0023481	−10.29	(−0.0055354,0.0008391)
ADL dysfunction	0.005	−0.0007505	−3.29	(−0.0012777, −0.0002234)
IADL dysfunction	<0.001	0.0047289	20.73	(0.0028875,0.0065702)

have depressive symptoms than women, while men in urban areas were more likely to have depressive symptoms than women, a result that differed from other studies of older Chinese (age ≥ 60)—both rural and urban men were less likely to have depressive symptoms than women (Hu *et al.*, 2018; Liu *et al.*, 2021). Female rural older adults with a BMI <18.5, lower levels of education, living alone and social isolation, and male urban older adults with lower annual incomes, lack of exercise, and ADL dysfunction were more likely to have depressive symptoms. This was probably due to the lower socioeconomic status and poorer living conditions of this group, which was a vulnerable group and less likely to have access to qualified living security and health care. The results of the logistic model showed that older people with <6 h of sleep were more likely to experience depressive symptoms and those in rural areas with ≥ 10 h of sleep and those in urban areas with 8–9.9 h of sleep were less likely to experience depressive symptoms. This result indicated that lack of sleep was associated with more depressive symptoms in older adults, while adequate sleep was associated with fewer depressive symptoms in older adults. Consistent with a meta-analysis study (Maier *et al.*, 2021), we found that older people with IADL dysfunction were at greater risk of having depressive symptoms. Poor SRH would increase the risk of having depressive symptoms in terms of SRH status. SRH was self-rated by older people based on their own subjective perceptions of their health and was a general perception of their health. Poor SRH meant that they were more dissatisfied with their health and found it difficult to engage in their lives with a positive mindset (Liu *et al.*, 2021).

There were significant urban–rural differences in depressive symptoms among older Chinese. The results of the Fairlie model showed that this part of the differences was related with annual income (31.51%), education level (28.05%), sleep time (−25.67%), SRH (24.18%), IADL dysfunctional (20.73%), exercise (17.72%), living status (−8.31%), age (−3.84%), ADL dysfunctional (−3.29%), and social activity (2.44%). All factors other than age were intervenable. If these intervening factors could be improved, the difference in depressive symptoms between urban and rural older people could be reduced by about 70%.

Our study can make meaningful policy recommendations. Firstly, we should pay attention to health education, promote the elderly to develop good living habits, ensure adequate sleep time, actively exercise, and participate in social activities. Secondly, increased funding in the area of elderly

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care could encourage the community to actively participate in health maintenance projects for the elderly to improve their health status with a focus on preventing and improving ADL dysfunction and IADL dysfunction. Thirdly, the government should pay more attention to people in need, especially the elderly in rural areas with BMI <18.5, lower levels of education, living alone and more socially isolated, and give them an appropriate tilt in health insurance policies and formulate targeted assistance and aid programmes.

Limitations

Our study has several limitations. Firstly, our definition of depressive symptoms was based on the CES-D 10 scale, which, while extensively validated with good reliability, was still self-reported and lacked accuracy in the assessment of depressive symptoms compared to medical diagnosis. Secondly, there are many factors that influenced depressive symptoms and we have included only some of these indicators. Finally, China's elderly population is so large that the CLHLS data we have used covered only a portion of it and cannot cover all elderly people.

Conclusion

In summary, the results of regression and decomposition analysis showed that the prevalence of depressive symptoms in rural elderly was higher than that in urban elderly, and age, education level, living status, annual income, sleep time, exercise, social status, SRH, ADL dysfunction, and IADL dysfunction were related to the differences in depressive symptoms between urban and rural areas. The results provided new evidence of urban–rural differences in depressive symptoms among older people in China and will help to facilitate the development or adjustment of mental health prevention and treatment policies for older people in China. Therefore, after accurately identifying the factors influencing urban–rural differences in depressive symptoms, we can make targeted and precise intervention strategies to improve the mental health of high-risk group. Finally, the problem of urban–rural differences in depressive symptoms will be effectively solved.

Conflict of interest

None.

Source of funding

None.

Description of author's roles

Lei Yuan and Jinhai Sun designed the study. Qin Xu and Zhe Zhao controlled the quality of the data and performed statistical analysis. Lei Yuan, Zhe Zhao, Jing Gui, and Fuwang Lin managed and checked all the data. Jinhai Sun, Zhe Zhao, Yuqing Liu, and Lei Yuan contributed to manuscript preparation, editing, and review. All authors read, checked, and approved the final manuscript.

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Data Availability Statement

The datasets analyzed in this study can be found in the Peking University Open Research Data website: https://opendata.pku.edu.cn/dataset.xhtml?persistentId = doi:10.18170/DVN/WBO7LK.

Ethics statement

The data for this study were taken from the CLHLS, which is organized by the Center for Healthy Ageing and Development Studies at Peking University, and has been approved by the Research Ethics Committees of Peking university and Duke University; the data analyzed here are available in the public domain. Therefore, separate ethical approval was not required for this study.

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