Comparison of Depressive Symptoms and its Influencing Factors among the Elderly in Urban and Rural Areas: Based on a Longitudinal Study (CHARLS) in China

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Comparison of depressive symptoms and its influencing factors among the elderly in urban and rural areas: Based on a Longitudinal Study (CHARLS) in China

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Abstract

Background: The imbalance between urban and rural areas leads to heterogeneous loci of depression in urban and rural elderly and affects the depressive symptoms of elderly by changing the social environment. Depression amongst the elderly population is a worldwide public health problem, especially in China. Affected by the urban-rural dual structure, depressive symptoms of the elderly in urban and rural areas are different.

Methods: Based on the data of China Health and Retirement Longitudinal Study (CHARLS) in 2018y, 7690 elderly people aged ≥ 60 years were included in the final analysis. Center for Epidemiologic Studies Depression Scale (CES-D-10) were used to measure the depressive symptoms, and the generalized linear model (GLM) and binary logistic regression were employed to assess the association between urban and rural source and depression.

Results: Depressive symptoms of the elderly in urban and rural areas were significantly different ($P<0.001$). GLM showed that the risk of depression in the rural elderly is 1.52 times ($OR=1.52$,

95% *CI*: 1.32 to 1.76) that of the urban elderly. The result of logistic regression showed that the influencing factors of depression in urban and rural areas were different. Gender, education level, life satisfaction, chronic disease and social activities were influencing factors of depression among the urban elderly. But for the rural elderly, influencing factors of depression were gender, education level, minorities, self-reported health status, life satisfaction, sleep duration (≤ 5 h), chronic disease, social activities and income (except for pension).

Conclusions: The results of our study indicated that targeted and precise intervention strategies to prevent depression should be proposed for the urban and rural elderly respectively.

Keywords: Elderly, depressive symptoms, difference of urban and rural area, influencing factors, CHARLS (wave 4)

Background

According to the data of China's National Bureau of Statistics, by the end of 2019, there were 253.88 million elderly people aged 60 years and over in China, accounting for 18.1% of the total population. Predication indicated that by 2050, the elderly population in China will increase substantially, with up to 400.83 million people aged 60 years and over ^[1-2]. With the aging problems becoming increasingly serious, more attention must be paid to the health of the elderly. Depression amongst the elderly is a global public health problem ^[3]. The Global Health Estimates reported by the World Health Organization (WHO) estimated that the prevalence of depression had peaked amongst the elderly ^[4], and more than 10% of the elderly worldwide have experienced depressive symptoms. While in China, the prevalence rate of depression in the elderly is 23.6%, which is higher than that of other age groups ^[5].

Depression is a common psychological disorder, usually manifested as sadness, self-depression, loss of interest in things and other negative emotions ^[6-8]. Studies have shown that when people transition from middle adulthood to older age, depressive symptoms tend to increase, often together with worsening physical health ^[9-11], which may be a main cause of disabilities and a big contributor to the global disease burden. In China, depression is the fourth leading cause of disabilities and affects 54 million people as estimated by WHO ^[12-13]. Meanwhile, the development of depression had group heterogeneity, and locus forms of depressive symptoms vary

by people's characteristics ^[14-16]. Li et al's study found that there were five heterogeneous loci of depression in the elderly in China, namely "high level symptom", "symptom remission", "symptom relapse", "symptom deterioration" and "low level symptom" ^[17]. The identification of heterogeneous locus is helpful to further analyze the causes of depression in the elderly, and the heterogeneous locus model can provide ideas for related interventions for elderly depressive symptoms ^[17].

Depression is a prevalent psychiatric disorder associated with biological and social factors and functional impairment ^[18-20]. At present, many theories have been introduced to explain the mechanism of urbanization's influence on mental health, such as Grossman's theory of healthy production, Michael Marmot's social determinism, Max Weber's theory of social stratification, the social decision theory of health ^[20-21] and Blum's model of environmental health medicine. Blum's model of environmental health medicine proposed that environment factors, especially the social environment, played an important role in people's health, physical and spiritual development ^[22]. Urbanization is an important manifestation of the current social and economic environment, which affects residents' health by changing the social environment. With the acceleration of China's urbanization, the imbalance in social and economic development between urban and rural areas affects the difference in depressive symptoms among the elderly in urban and rural areas. According to the 1% sample survey data of China's population in 2005, 25.5% of the rural elderly suffered from moderate and severe depression, which was much higher than that of the elderly in urban areas (13.6%) ^[23]. Based on the data of 2013 China Health and Retirement Longitudinal Study (CHARLS, provided by the National Development Research Institute of Peking University), Yang et al's study in 2013 found that the prevalence rates of "elderly depression" in urban and rural areas were 16.3% and 30.0% respectively ^[24]. Using data of CHARLS (2015y), Shan et al found that the depression prevalence was nearly 30.08% among middle-aged and elderly people, and the higher the level of urbanization, the lower the prevalence of depression ^[22,25-27]. Gan et al's study (1075 elderly people aged 65 years and over) indicated that the prevalence rate of the urban elderly (23.5%) was lower than that of the rural elderly (31.9%) ^[28]. Shan and Zhao et al studied the association of Chinese drifting elderly intergeneration support satisfaction with expectation in Shanghai, China, and found that the urban and rural elderly have received different intergenerational support which had a very important impact on depression, especially for the

drifting elderly^[29-30].

In conclusion, urbanization is an important influencing factor of elderly depression. The imbalance between urban and rural areas leads to heterogeneous loci of depression in urban and rural elderly. However, the association of urbanization with depression is not clear enough, and the specific differences in depressive symptoms and its influencing factors between urban and rural elderly are also unclear. Therefore, based on Blum's model of environment health medicine, we analyzed the CHARLS data (wave 4, 2018y) to clarify the urban-rural differences in depressive symptoms and the impacts of demographic characteristics, self-reported health and social factors on depressive symptoms among the elderly in urban and rural areas, and proposed the following two hypotheses:

Hypothesis 1. *There was significant difference in the prevalence estimate of depression between urban and rural elderly, and the prevalence estimate of depression in rural elderly was higher than that in urban elderly.*

Hypothesis 2. *The influencing factors of depressive symptoms were different between urban and rural elderly, and the impacts of these factors were also different.*

Methods

Data and design

Data were from the forth wave of China Health and Retirement Longitudinal Study (CHARLS), which is a survey of middle-aged and elderly people in China, based on a sample of households with members aged 45 years or above. It aims to establish a high quality public microdatabasethat can provide a wide range of information from socioeconomic status to health conditions, to meet the needs of scientific research on the middle-aged and elderly people^[31]. To ensure sample representativeness, the survey followed strict randomization procedures and used a multi-stage sampling method. When sampling county and rural administrative units, a probability proportional to size (PPS) sampling mothed was adopted^[30-33]. In the first stage of sampling, 150 county-level units were randomly selected using the PPS method from a sampling frame containing all county-level units in China (excluding Tibet). In the second stage, three communities (rural administrative villages or urban resident committees) were randomly chose using the PPS method from a sampling frame containing all communities in the county-level units. In the third stage, to create a sampling frame, using the software developed by the CHARLS team which utilized Google Earth map images, all dwelling units in a community were listed following an extensive mapping and listing operation, and then a certain number of dwelling units were randomly chose^[32-33]. All data collected in CHARLS are maintained by the Institute of Social

Science Survey of Peking University and have been publicly released on the CHARLS website (<http://www.charls.pku.edu.cn/en>).

In this study, we used data from the wave 4 (2018y) of the CHARLS, which involved 19816 respondents in 150 counties/districts and 450 villages/urban communities. According to the study purpose, the elderly aged 60 years and over were selected as the research objects. After excluding those who with missing data, 7690 respondents were finally included (the sample screening and analysis framework is shown in **Fig.1**).

Fig. 1 The flowchart of this study

Measurement of depressive symptoms

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D-10) which has been validated among elderly respondents in China using CHARLS data [34]. The CES-D-10 response scale includes 10 questions regarding the participant's experience in the past week: feeling bothered, having trouble in concentrating, feeling depressed, feeling as though everything was effortful, feeling hopeful, feeling fearful, having restless sleep, feeling happy, feeling lonely and having difficulty getting going [35]. The total CES-D-10 score ranges from 0 to 30, with higher scores indicating more severe depressive symptoms. In this study, we used a cutoff score of ≥ 10 to distinguish participants with depression from those who were relatively free of depression [36-37]. The CES-D-10 used in CHARLS exhibited good internal consistency, with $\alpha = 0.793$ in the baseline investigation (2011y), $\alpha = 0.787$ in the follow-up investigation (2013y), $\alpha = 0.779$ in the second follow-up investigation (2015y) [36], and $\alpha = 0.818$ in our study (2018y).

Description of variables (Table 1.)

Table 1 Description of variables used in this study

Type of variables	Name and definition of variables	Variables assignment
Demographic variables	Gender	Male=1
		Female=2
	Age (The real age at the time of investigation)	60-64=1
		65~74=2
		$\geq 75=3$
	Marital status	Married and live with spouse=1
		Married but not live with spouse=2
		Divorced=3
		Widowed=4
		Never married=5
	Education level	Illiterate
		Elementary school and below
		Middle school
		High\vocational school and associate degree
	Urban and rural areas	Bachelor degree and above
		Urban=1
	Minorities	Rural=2
		Han=1
	Religious belief	Ethnic minorities=2
		Yes=1
	Having income (Did you receive any wage and	No=0
		Yes=1

Other depression related variables	bonus income [except pension] in the past year?)	No=0
		Very good=1
	Self-reported health (Would you say your health is very good, good, fair, poor or very poor?)	Good=2
		Fair=3
		Poor=4
		Very poor=5
	Duration of sleep (During the past month, how many hours of actual sleep did you get at night?)	≤ 5h=1
		6~9h=2
		≥10h=3
	Life satisfaction (How satisfied are you with your life overall? Are you completely satisfied, very satisfied, somewhat satisfied, not very satisfied, or not satisfied at all?)	Completely satisfied=1
		Very satisfied=2
		Somewhat satisfied=3
		Not very satisfied=4
		Not satisfied at all =5
Dependent variable	Chronic disease or not (Have you been diagnosed by a doctor as having one of the 14 chronic diseases listed below?)	Yes=1
		No=0
	Having social activities (interacted with friends\played, etc)	Yes=1
		No=0
Dependent variable	Depressive symptoms (Binary variable, recoded from continuous variable [1-30 scores])	≤10, 0, no depression
		>10, 1, having depression

Statistical analysis

First, demographic characteristics of the elderly in urban and rural areas were described as frequencies and percentages. Second, the prevalence rates of depression of the elderly in urban and rural areas were calculated and compared by Chi-square test. Then a generalized linear model (GLM) was employed to estimate the association between living in urban or rural areas and depression after controlling other confounding factors. GLM is an extension of the traditional linear model that allows the overall average to depend on a linear predictor through a nonlinear link function and allows the response probability distribution to be any member of the exponential distribution family, including logistic regression model. In our study, a binary logistic regression model was used to analyze the influence of living in urban or rural areas on depression in the elderly when controlling for other confounding factors. A GLM always includes three components:

$$\text{Linear component: } \eta_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_m x_{mi} \quad (1)$$

$$\text{Random component: } \varepsilon_i = Y_i - \eta_i \quad (2)$$

$$\text{Link function: } \eta_i = g(\mu_i) \quad (3)$$

In our study, we chose *Logit*: $g_1(\pi) = \ln\left(\frac{\pi}{1-\pi}\right)$ as the link function, therefore the form of the generalized linear model is:

$$\text{logit}(\pi) = \ln(\text{Odds}) = \ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p \quad (4)$$

In equation (4), π is the prevalence rate of depressive symptoms, β_0 is a constant and β_p is the regression coefficient which represents the effect of X_p on the predictive value of individual incidence π ($Y=1$).

Then Chi-square test and binary logistic regression model were used to analyze influencing factors of the occurrence of depression in the urban and rural elderly. All statistical analyses were performed using IBM SPSS StatisticsV22.0, and P -value < 0.05 was considered statistically significant.

Results

Characteristics of the participants

A total of 7690 elderly people were included in this study, including 2023 urban elderly and 5667 rural elderly (73.7%). The characteristics of the participants were all shown in **Table 2**.

Table 2 Characteristics of participants (N, %)

Variables	Options	Urban	Rural	Total
Gender	Male	987 (48.8%)	2962 (52.3%)	3949 (51.4%)
	Female	1036 (52.30%)	2705 (47.7%)	3741 (48.6%)
Age	60~64	712 (35.2%)	2091 (36.9%)	2803 (36.4%)
	65~74	958 (47.4%)	2803 (49.5%)	3761 (48.9%)
	≥75	353 (17.4%)	773 (13.6%)	1126 (14.6%)
Marital status	Married and live with spouse	1574 (77.8%)	4405 (77.7%)	5979 (77.8%)
	Married but not live with spouse	68 (3.4%)	201 (3.5%)	269 (3.5%)
	Divorced	35 (1.7%)	38 (0.7%)	73 (0.9%)
	Widowed	346 (17.1%)	1023 (18.1%)	1323 (17.2%)
	Never married	6 (0.3%)	40 (0.7%)	46 (0.6%)
Education level	Illiterate	225 (11.1%)	1761 (31.1%)	1986 (25.8%)
	Elementary school and below	760 (37.6%)	2858 (50.4%)	3618 (47.0%)
	Middle school	547 (27.0%)	758 (13.4%)	1305 (17.0%)
	High\vocational school and associate degree	434 (21.5%)	285 (5.0%)	719 (9.3%)
	Bachelor degree and above	57 (2.8%)	5 (0.1%)	62 (0.8%)
Minorities	Han	1885 (93.2%)	5288 (93.3%)	7173 (92.8%)
	Ethnic minorities	138 (6.8%)	397 (6.7%)	517 (7.2%)
Religious belief	Yes	208 (10.3%)	616 (10.9%)	824 (10.7%)
	No	1815 (89.7%)	5051 (89.1%)	6866 (89.3%)
Self-reported health	Very good	212 (10.5%)	592 (10.4%)	804 (10.5%)
	Good	278 (13.7%)	586 (10.3%)	864 (11.2%)
	Fair	1072 (53.0%)	2710 (47.8%)	3782 (49.2%)
	Poor	351 (17.4%)	1368 (24.1%)	1719 (22.4%)
	Very poor	110 (5.4%)	408 (7.2%)	518 (6.7%)
Duration of sleep	≤5h	676 (33.4%)	2059 (36.3%)	2735 (35.6%)
	6~9h	1254 (62.0%)	2955 (52.1%)	4209 (54.7%)
	≥10h	93 (4.6%)	653 (11.5%)	746 (9.7%)
Life satisfaction	Completely satisfied	107 (5.3%)	277 (4.9%)	384 (5.0%)
	Very satisfied	605 (29.9%)	1873 (33.1%)	2478 (32.2%)
	Somewhat satisfied	1174 (58.0%)	2915 (%)	4089 (53.2%)
	Not very satisfied	99 (4.9%)	446 (7.9%)	545 (7.1%)
	Not at all satisfied	38 (1.9%)	156 (2.8%)	194 (2.5%)
Chronic disease or not	Yes	1046 (51.7%)	2569 (45.3%)	3615 (47.01%)
	No	977 (48.3%)	3098 (54.7%)	4075 (53.0%)
Having social activities	Yes	1291 (63.8%)	2574 (45.4%)	3865 (50.3%)
	No	732 (36.2%)	3093 (54.6%)	3825 (49.7%)
Having income	Yes	440 (21.7%)	1174 (20.7%)	1614 (21.0%)
	No	1583 (78.3%)	4493 (79.3%)	6076 (79.0%)

Comparison of depression in the elderly between urban and rural areas

There was a significant difference in the prevalence estimate of depression between urban and rural elderly ($P < 0.001$) (**Fig. 2**), and the risk of depression in the rural elderly was 1.88 times ($OR=1.88$, 95% CI : 1.67 to 2.12) that of the urban elderly. Specifically, to control the influence of other variables, we used a GLM to identify the difference in depression between urban and rural

elderly. The GLM showed that living in urban or rural areas was an important influencing factor of depression in the elderly, and the risk of depression in rural elderly was 1.52 times ($OR=1.52$, 95% CI : 1.32 to 1.76) that of the urban elderly after adjusting for gender, age, education level, marital status, self-reported health status, life satisfaction, having chronic disease or not and other variables (**Table 3**). Gender, ethnic minorities, self-reported health status, life satisfaction, duration of sleep, chronic diseases, social activities and income (except pension) were also influencing factors of depressive symptoms in the elderly.

Comparison of influencing factors of depression between urban and rural areas

χ^2 -test and binary logistic regression analyses were performed to screen the influencing factors correlated to depression in urban and rural elderly. The results of χ^2 -test showed that in both urban and rural areas, the prevalence of depression varies significantly by gender, marital status, minorities, education level, self-reported health, life satisfaction, duration of sleep, chronic disease in the elderly ($P < 0.05$). In addition to the differences among these variables, for the elderly in urban areas, the prevalence of depression varies significantly by having social activities or not. But for the elderly in urban areas, “having income or not (except pension)” was an important influencing factor of depression (**Table 4**). The results of binary logistic regression showed that the influencing factors of elderly depression in urban area were slightly different from those in rural area. For urban areas, gender, education level (illiterate), life satisfaction, having chronic disease or not and having social activities (interacted with friends\played and so on) were the influencing factors of elderly depression. But for rural areas, the influencing factors of depression included gender, education level, minorities, self-reported health, life satisfaction, duration sleep ($\leq 5h$), chronic disease, social activities (interacted with friends\played, et al) and having income (except pension). The impacts of those factors on depression were also different in urban and rural areas (**Table 5**).

Fig. 2 Comparison of the prevalence of depression among the elderly in urban and rural areas

Table 3 Determinants of depression in the elderly by generalized linear model (n=7690)

Variables	Regression coefficient	Wald χ^2	P-value	OR	95%CI
Living in urban or rural areas					
Urban	0	-	-	1	-
Rural	0.42	32.03	<0.0001	1.52	1.32,1.76
Gender					
Male	0	-	-	1	-
Female	0.48	58.97	<0.0001	1.62	1.42,1.84
Age					
60~64	0	-	-	1	-
65~74	-0.05	0.32	0.57	0.95	0.79,1.14
≥75	-0.03	0.11	0.73	0.97	0.82,1.15
Marital status					
Married and live with spouse	0	-	-	1	-
Married but not live with spouse	0.28	0.62	0.43	1.33	0.66,2.68
Divorced	0.31	0.63	0.43	1.36	0.64,2.91
Widowed	0.07	0.02	0.88	1.08	0.43,2.67
Never	0.08	0.05	0.82	1.09	0.53,2.22
Education level					
Illiterate	0	-	-	1	-
Elementary school and below	-1.10	5.64	0.02	0.33	0.14,0.83
Middle school	-1.03	4.99	0.03	0.36	0.15,0.88
High\vocational school and associate degree	-0.71	2.37	0.12	0.49	0.20,1.22
Bachelor degree and above	-0.37	0.63	0.43	0.69	0.28,1.73
Minorities					
Han	0	-	-	1	-
Ethnic minorities	0.27	6.13	0.01	1.31	1.06,1.62
Religious belief					
Yes	0	-	-	1	-
No	0.12	1.62	0.20	1.23	0.94,1.35
Self-reported health					
Very good	0	-	-	1	-
Good	0.42	13.57	<0.0001	1.52	1.22,1.91
Fair	1.27	133.51	<0.0001	3.56	2.87,4.41
Poor	1.56	122.55	<0.0001	4.76	3.61,6.27
Very poor	1.86	141.74	<0.0001	6.43	4.73,8.73
Duration of sleep					
≤5h	0	-	-	1	-
6~9h	0.10	0.95	0.33	1.09	0.89,1.33
≥10h	-0.63	38.15	<0.0001	0.53	0.44,0.65
Life satisfaction					
Completely satisfied	0	-	-	1	-
Very satisfied	0.84	13.57	0.001	2.33	1.43,3.79
Somewhat satisfied	2.16	87.02	<0.0001	8.67	5.51,13.64
Not very satisfied	2.76	137.86	<0.0001	15.82	9.98,25.08
Not satisfied at all	2.84	111.90	<0.0001	17.14	10.13,29.0
Chronic disease or not					
Yes	0	-	-	1	-
No	0.20	12.05	0.001	1.22	1.09,1.37
Having social activities					
No	0	-	-	1	-
Yes	-0.14	6.08	0.01	0.87	0.78,0.97
Having income					
Yes	0	-	-	1	-
No	0.22	9.45	0.002	1.25	1.08,1.43

Table 4 Comparison of the influencing factors of depression between urban and rural areas

Variables		Urban (N=2023)			Rural (N=5667)		
		Depression	Normal	χ^2 -Value	Depression	Normal	χ^2 -Value
Gender							
	Male	171 (17.3%)	816 (83.7%)	19.93**	773 (26.1%)	2189 (73.9%)	173.60**
	Female	264 (25.5%)	772 (74.5%)		1155 (42.7%)	1550 (57.3%)	
Age							
	60~64	155 (21.8%)	557 (78.2%)	3.70	692 (33.1%)	1399 (66.9%)	1.89
	65~74	192 (20.0%)	766 (80.0%)		978 (34.9%)	1825 (65.1%)	
	≥75	88 (24.9%)	265 (75.1%)		258 (33.4%)	515 (66.6%)	
Marital status							
	Married and live with spouse	315 (20.0%)	1259 (80.0%)	13.67*	1408 (32.0%)	2997 (68.0%)	49.78**
	Married but not live with spouse	17 (25.0%)	51 (75.0%)		63 (31.3%)	138 (68.7%)	
	Divorced	5 (14.3%)	30 (85.7%)		20 (52.6%)	18 (47.4%)	
	Widowed	97 (28.5%)	243 (71.5%)		422 (42.9%)	561 (57.1%)	
	Never	1 (16.7%)	5 (83.3%)		15 (37.5%)	25 (62.5%)	
Education level							
	Illiterate	69 (30.7%)	156 (69.3%)	36.11**	720 (40.9%)	1041 (59.1%)	110.53**
	Elementary school and below	194 (25.5%)	566 (74.5%)		967 (34.1%)	1882 (65.9%)	
	Middle school	100 (18.3%)	447 (81.7%)		186 (24.5%)	572 (75.5%)	
	High \vocational school and associate degree	66 (15.2%)	368 (84.8%)		46 (16.1%)	239 (83.9%)	
	Bachelor degree and above	6 (10.5%)	51 (89.5%)		0 (0%)	5 (100.0%)	
Minorities							
	Han	403 (21.4%)	1482 (78.6%)	0.25	1769 (33.5%)	3519 (66.5%)	11.38**
	Ethnic minorities	32 (23.3%)	106 (76.8%)		159 (42.0%)	220 (58.0%)	

Religious belief		Yes	42 (20.2%)	166 (79.8%)	0.24	220 (35.7%)	396 (64.3%)	0.88
		No	393 (21.7%)	1422 (78.3%)		1708 (33.8%)	3343 (66.2%)	
Self-reported health		Very good	11 (5.2%)	201 (94.8%)	230.04**	96 (11.9%)	711 (88.1%)	585.92**
		Good	25 (9.0%)	253 (91.0%)		144 (16.7%)	720 (83.3%)	
		Fair	192 (17.9%)	880 (82.1%)		933 (24.7%)	2849 (75.3%)	
		Poor	144 (41.0%)	207 (59.0%)		863 (50.2%)	856 (49.8%)	
		Very poor	63 (57.3%)	47 (42.7%)		327 (63.1%)	191 (36.9%)	
Duration of sleep		≤5h	240 (35.5%)	436 (64.5%)	121.78**	991 (48.1%)	1068 (51.9%)	288.07***
		6~9h	174 (13.9%)	1080 (86.1%)		755 (25.5%)	2200 (74.5%)	
		≥10h	21 (22.6%)	72 (77.4%)		182 (27.9%)	471 (72.1%)	
Life satisfaction		Completely satisfied	17 (15.9%)	90 (84.1%)	246.16**	54 (19.5%)	223 (80.5%)	605.07**
		Very satisfied	62 (10.2%)	543 (89.8%)		418 (22.3%)	1455 (77.7%)	
		Somewhat satisfied	261 (22.2%)	913 (77.8%)		1004 (34.4%)	1911 (65.6%)	
		Not very satisfied	61 (61.6%)	38 (38.4%)		317 (71.1%)	129 (28.9%)	
		Not satisfied at all	34 (89.5%)	4 (10.5%)		135 (86.5%)	21 (13.5%)	
Having chronic disease or not		Yes	282 (27.0%)	763 (73.0%)	38.21**	1027 (40.0%)	1542 (60.0%)	74.24**
		No	153 (15.7%)	824 (84.3%)		901 (29.1%)	2197 (70.9%)	
Having social activities		Yes	224 (17.4%)	1067 (82.6%)	36.44**	835 (32.4%)	1739 (67.6%)	5.26*
		No	211 (28.8%)	521 (71.2%)		1093 (35.3%)	2000 (64.7%)	

Having income							
Yes	82 (18.6%)	359 (81.4%)	3.03	346 (29.5%)	828 (70.5%)	13.66**	
No	353 (22.3%)	1229 (77.7%)		1582 (35.2%)	2911 (64.8%)		

Note: (1) *: P < 0.05, **: P < 0.001.

(2) *OR*, odds ratio; 95% *CI*, 95% confidence interval.

Table 5 Determinants of depression of elderly in urban and rural areas by binary logistics regression (n=7690, *OR* (95% *CI*))

Variables		Urban		Rural	
		<i>OR</i>	95% <i>CI</i>	<i>OR</i>	95% <i>CI</i>
Gender					
	Female	1.48**	1.13,1.93	1.68**	1.46,1.93
	Male	1		1	
Age					
	60~64	0.95	0.65,1.38	1.11	0.90,1.37
	65~74	0.79	0.56,1.12		
	≥75	1		1	
Marital status					
	Married and live with spouse	2.03	0.16,26.66	0.68	0.33,1.40
	Married but not live with spouse	2.21	0.15,31.61	0.63	0.29,1.41
	Divorced	0.91	0.56,14.71	1.45	0.51,4.12
	Widowed	2.26	0.17,29.90	0.84	0.40,1.77
	Never married	1		1	
Education level					
	Illiterate	2.87*	1.07,7.71	2.39**	1.65,3.46
	Elementary school and below	2.47	0.96,6.34	2.27**	1.59,3.24
	Middle school	1.85	0.71,4.82	1.69**	1.15,2.50
	High\vocational school and associate degree	1.45	0.55,3.81		
	Bachelor degree and above	1		1	
Minorities					

	Han	1.14	0.70,1.85	1.37**	1.08,1.74
	Ethnic minorities	1		1	
Religious belief					
	Yes	0.84	0.55,1.28	0.91	0.74,1.11
	No	1		1	
Self-reported health					
	Very good	0.09	0.04,0.20	0.18**	0.13,0.25
	Good	0.14	0.07,0.25	0.24**	0.17,0.32
	Fair	0.55	0.34,0.91	0.30**	0.23,0.38
	Poor	1.49**	1.15,1.92	0.69**	0.54,0.88
	Very poor	1		1	
Duration of sleep					
	≤5h	1.51	0.84,2.71	1.92**	1.55,2.38
	6~9h	0.63	0.35,1.13	0.97	0.79,1.20
	≥10h	1		1	
Life satisfaction					
	Completely satisfied	0.03**	0.01,0.12	0.07**	0.04,0.12
	Very satisfied	0.02**	0.01,0.07	0.08**	0.05,0.13
	Somewhat satisfied	0.05**	0.02,0.16	0.14**	0.09,0.23
	Not very satisfied	0.23*	0.01,0.79	0.50**	0.30,0.85
	Not satisfied at all	1		1	
Having chronic disease or not					
	Yes	1.49**	1.15,1.92	1.17**	1.02,1.33
	No	1		1	
Having social activities					
	Yes	0.67**	0.52,0.86	0.93	0.82,1.06
	No	1		1	
Having income					
	Yes	0.82	0.60,1.12	0.79**	0.68,0.93
	No	1		1	

Note: (1) *: $P < 0.05$, **: $P < 0.001$.

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(2) OR, odds ratio, 95% CI: 95% confidence interval.

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(3) Education level: Education level of the elderly in rural areas was low, and there were few people with a bachelor degree or above.

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Therefore, in the logistic regression analyses, we merged groups “Bachelor degree and above” and “High\ vocational school and

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associate degree” of the elderly in rural areas, but not in urban areas.

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Discussion

Studies have shown that urbanization is an important influencing factor of the current socio-economic environment, leading to the imbalance of social and economic development between urban and rural areas and the difference in depressive symptoms in urban and rural elderly. In this study, CHARLS data were used to analyze the differences in elderly depression between urban and rural areas. The results verified the hypotheses that there was a significant difference in the prevalence rate of depression between urban and rural elderly. The depression risk in rural elderly was significantly higher than that of the urban elderly ($OR=1.88$). The GLM showed that the depression risk in rural elderly was 1.52 times ($OR=1.52$, 95% CI : 1.32 to 1.76) that of the urban elderly after adjusting for gender, age, education level, marital status, self-reported health status, life satisfaction, chronic disease or not and other variables, confirming the influence of urban-rural differences on depression in the elderly. Therefore, it is necessary to explore the specific differences in depressive symptoms and their influencing factors among the elderly in urban and rural areas.

In both urban and rural areas, the prevalence of depression varies significantly among the elderly by characteristics, such as gender, marital status, chronic disease, education level, duration of sleep, self-reported health and life satisfaction [38-39]. The prevalence of depression in female was higher than that in male, which was consistent with Yang et al's study using CHARLS data in 2013 [24]. Yang et al's study found that in urban areas, the prevalence of depression in men was 12.0% and that in women was 19.7%, both lower than in rural areas (men: 20.2%; women: 35.6%). From the perspective of longitudinal comparison, the prevalence of depression of the elderly in urban and rural areas in our study (CHARLS in 2018y) was higher than that of Yang et al's study using the CHARLS data in 2013, indicating that the depression prevalence of the elderly in urban and rural China was on the rise in the past five years. In rural areas, education levels had an impact on depression in the elderly. With the improvement of education level, the prevalence of depression in the elderly gradually decreases. But in urban areas, the prevalence of depression among illiterate was 2.87 times that of the elderly with a bachelor degree or above.

From the perspective of life satisfaction and self-reported health, with the improvement of life satisfaction and self-reported health, the prevalence rates of depression among the elderly decreased in both urban and rural areas. Self-reported health is the subjective feelings of the elderly about their own health status and largely depends on the psychological status of the elderly. The better their self-reported health, the more confident they are in their health and the more likely they are to take a positive attitude towards life [22-23]. Through binary logistic regression analysis, we found that after controlling other independent variables, in rural areas, the elderly who self-reported poor health were more likely to suffer from depression than those who self-reported good health (Table 5). But in urban areas, the elderly who self-reported as "poor" health were 1.49 times more likely to suffer from depression than those who self-reported as "very poor" health, and the effects of other self-reported health levels on depression were similar to the "very poor"

level in the elderly. The results suggested the urban and rural heterogeneity loci of depressive symptoms in the elderly [15-16].

Chronic disease is an important factor influencing depressive symptoms in the elderly. Zhang et al's study found that the prevalence of depression in the elderly with chronic diseases was 2.35 times that of the elderly without chronic diseases, and among 2370 elderly over 60 years old with depression, 56.3% had somatic pain [40]. We also found that having chronic diseases was a risk factor for depression in the elderly. In urban areas, the prevalence of elderly people with chronic diseases was 1.49 times that of elderly people without chronic diseases, while in rural areas, the elderly with chronic diseases were 1.17 times more likely to suffer from depression than those without chronic diseases. Sleep is also a factor influencing depression of the rural elderly, but it had no effect on the depression of the urban elderly. Zhang et al's study found that the prevalence depression among elderly adults with poor sleep quality (31.1%) was significantly higher than that of elderly adults with good sleep quality (12.3%) [40]. Depressive symptoms in the elderly may be affected by social activities. This study found that the urban elderly who engaged in social activities were less likely to suffer from depression. Ae et al's study found that depression was a risk factor in health-promoting behaviors, and that the engagement level in health-promoting behaviors increased as the depression level decreased in the low-income ordinary elderly hypertensive patients [41-42]. Elderly people with poor functional status are at higher risk of depression in urban areas. All these suggested that improving the social activities of the urban elderly is an important measure to reduce the prevalence rate of depression.

Conclusions

The effects of demographic, self-reported health, chronic diseases, life satisfaction, duration sleep, social activities and income on depression of the elderly in urban and rural areas and their differences were analyzed in this study. The results have shown that the prevalence of depression in rural areas was higher than in urban areas. The influencing factors of depression in urban and rural areas were different. Thus, it is necessary to propose targeted and precise intervention strategies to prevent depression in urban and rural elderly respectively.

Supplementary information: No.

Abbreviations: CHARLS: China Health and Retirement Longitudinal Study; CES-D-10: 10-item Center for Epidemiologic Studies-Depression Scale; GLM: Generalized linear model

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Figures

Figure 1

The flowchart of this study

Figure 2

Comparison of the prevalence of depression among the elderly in urban and rural areas