Chronic Pain And Depressive Symptoms In Chinese Middle-Aged And Older Adults:A Follow Up Study

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Abstract

Objective: This study aimed to analyze the effects of chronic pain on the occurrence of depressive symptoms in Chinese middle-aged and older adults, and to provide a scientific basis for reducing the incidence of depressive symptoms, improving the quality of life in middle-aged and older adults, and reducing the disease burden in the aging population.

Methods: a prospective study was conducted to select adults aged 45 years or older from the longitudinal study of China Health and elderly care follow-up survey (Charls) (2015 and 2018). Pain was assessed according to the patient's self exposure, and depression was assessed using the Chinese version of the center for epidemiological research Depression Scale (CES-D). Univariate analysis and binary logistic regression model were used for analysis.

Results: The 3-year cumulative incidence of depression in chronic pain patients was 52.4% and the annual incidence was 17.5% in the middle-aged and elderly Chinese population. Univariate analysis showed statistically significant differences in the incidence of depressive symptoms between the different genders, age, residence, education level, marriage, self perceived health status, nocturnal sleep time, number of social activities in the past month, smoking, alcohol consumption, impaired ADL and Medicare insurance coverage. This study, after controlling for demographic characteristics, health status and health behaviors, Different pain conditions remained statistically significant for depression in middle-aged and older adults. Compared with middle-aged and older adults without pain, both Unisomatic pain (OR = 1.388) and Multiple somatic pain (OR= 1.869) increased the risk of depression in the middle-aged and older populations.

Conclusion: chronic pain is associated with the risk of depressive symptoms in middle-aged and elderly people, and the incidence of depression in middle-aged and elderly people in China is not optimistic.

1. Introduction

Depression, as one of the most common mental health problems of the middle-aged and elderly, has become an increasingly serious public health problem because of stigma, lack of effective treatment and lack of mental health resources. According to WHO ,it is estimate that about 350 million people suffer from depression every year and more than 800000 people die of suicide ^[1]. In 2015, depression was estimated to be the third largest cause of disability in the world ^[2]. Depression has a high prevalence in China^[3,4] , and studies have shown that 30% of middle-aged and older Chinese men and 43% of women have depression ^[5]. Depression has a major impact on middle-aged and older adults in terms of quality of life, ability to live, and how they feel.

Pain, as one of the most common symptoms distressing people, is increasing in prevalence due to the aging population and increasing prevalence of chronic diseases ^[6,7]. In China, the prevalence of chronic pain in the elderly has reached 35.71% ^[8]. The results of the global burden of disease study 2016 show a

high prominence of pain and pain related disorders as leading causes of disability and disease burden worldwide^[9]. In 2011, the report of Institute Of Medicine 2011 (Institute Of Medicine 2011 Report) pointed out that the medical burden of pain exceeds the total cost associated with cardiovascular disease, diabetes and cancer^[10]. Pain has a high prevalence in China^[8,11, 12] and has become an important public health problem.

Acute pain has positive effects, alerting the organism of the potential danger that tissues and organs can be. In chronic pain, where central mechanisms are involved, however, the persistence of pain overrides its biological effectiveness and greatly discourses patient quality of life. Chronic pain can trigger various somatic and mental stresses that increase the risk of developing depression. The association between depression and pain can be explained by common neurobiological pathways as well as physiological contexts. The most frequently implicated neurobiological pathway is the HPA axis. Pain and depression involve many brain regions. In addition to possessing adjacent anatomical locations, these brain regions are co activated in their ontogenetic development. Pain signals pass through the spino thalamic tract to project to the thalamus and parietal cortex. It projects via the thalamus to the amygdala, insula, ventral striatum, hippocampus, as well as to the prefrontal cortex. These pathways are involved in the affective component of pain perception as well as in the pathophysiology of depression^[13]

Multiple studies have noted depression in approximately 35% of individuals diagnosed with chronic pain^[14-16]. Comorbid depression in patients with chronic pain causes greater difficulties in the treatment of pain and depression, severely affecting patients' quality of life and conferring a greater burden of disease. However, whether pain contributes to the development of depression among Chinese middle-aged and elderly is unknown. Therefore, this study uses data from the 2015 and 2018 China health and retirement longitudinal survey(Charls), which are based on community populations, to analyze the effects of chronic pain on the occurrence of depressive symptoms among middle-aged and elderly, and to reduce the incidence of depressive symptoms. Improving the quality of life of middle-aged and elderly and reducing the burden of disease in the aging population provide scientific evidence.

2. Methods

2.1 Study participants Using the Charls data, this survey project began in 2011 with a multistage stratified probability proportional sampling of individuals aged ≥ 45 years from about 170 000 households in 450 villages (communities) of 150 counties (municipalities) in 28 provinces (municipalities) of China, followed up biennially until 2018. Because the questions about pain in 2011 and 2013 and the home-based questionnaire settings were not consistent with the 2018 home-based questionnaire, the data of middle-aged and elderly aged ≥ 45 years who were visited in 2015 were selected as baseline data in this study, and the follow-up data of those visited in 2018 were terminal survey data.

Inclusion criteria: respondents had not yet developed depressive symptoms at the time of the 2015 survey and were aged ≥ 45 years and ≤ 105 years. The sample selected according to the inclusion criteria was

12832, excluding 88 who could not judge the outcome of depressive symptoms in the baseline and follow-up survey, 2085 lost follow-up samples, 285 missing pain variables, and 744 missing other key variables (baseline age, residential address, education level, conscious health status, night sleep time, smoking, drinking, medical insurance). Because cancer or major disability (including physical disability, intellectual disability, blindness, deafness and dumb) in the baseline will have a mixed impact on the research results, this study only selects the population without cancer and major disability at the baseline (excluding 966 people with cancer and major disability at the baseline), and finally includes 8664 people.

Entry criteria: ≥ 45 years of age, free of depressive symptoms (CES-D score < 10) in 2015, free of cancer and other significant disabilities and completing the 2018 survey, key variables (2011 gender, age, type of residence, address of residence, level of education, marriage, self perceived health status, night time sleeping, number of social activities in past month, smoking, alcohol consumption, impaired ADL, Medicare and pain conditions; 2015, 2018 depressive symptoms) People without deletions. This project was ethically reviewed by the Peking University Biomedical Ethics Committee, and all subjects interviewed gave written informed consent.

2.2 Study design The specific research design and methods are shown in the literature^[17]

2.3 Chronic Pain: subjects were self-reported to have had ongoing or intermittent pain lasting for more than 3 months involving two sites and above in the head, neck, shoulders, arms, wrists, fingers, chest, stomach, back, waist, hip, legs, knees, ankles, toes pain was defined as multisomatic pain, pain at either site was defined as unisomatic pain, Absence of pain sensation at any site was defined as no pain.

2.4 Depression: the depressive symptoms were measured by the Center for Epidemiological Studies Depression Scale "CES-D10"^[18] The scale consists of three depressed mood options, five somatic symptom items, and two positive affect items and is calculated according to the Chinese version of the scale with 0 representing $< 1D$, 1 representing $1-2D$, 2 representing $3-4d$, and 3 representing $5-7d$ added up to a total score of 30, with higher scores indicating more severe depressive symptoms, and a score of ≥ 10 rated as having depressive symptoms^[19]

2.5 Functional Health and Covariates

In addition, other studies were included on social and demographic characteristics (gender, age, level of education, marriage, type of address and residence) and health status and health-related behaviors (self-rated health, suffering from various chronic diseases, night sleep duration, number of social activities in the past month, smoking, alcohol consumption, ADL, and medical insurance). According to the World Health Organization classification method for the age of the middle-aged and elderly, they were divided into three groups—45-60 years, 60-75 years, and ≥ 75 years. The survey subjects were divided into married, unmarried, divorced / widowed / separated based on their marital status. Uneducated, not finished primary school, private home, and primary school graduation were defined as primary school and below; Junior high school graduate, senior high school graduate, and junior high school graduate are defined as secondary school, junior college graduate, undergraduate graduate, master's graduate, and

doctoral graduation are defined as junior college and above. The type of address included home dwelling, nursing home or other nursing home, hospital and other, divided into home dwelling and non home dwelling based on the response. The residential address includes the main city area, urban-rural Union area, town central area, town and Town Union area, special area, town central area and village, defining the main city area and town central area as town, the urban-rural Union area and town and town and village central area as urban-rural Union area, special area as special area, and the town central area and village as rural.

In the process of self-rated health questionnaire survey, the subjects' self-rated health status, including: very good, good, ordinary, bad and very bad. The questionnaire was self-administered with the question "have you ever been told by a physician that you have any of these chronic conditions?" and was categorized into " ≥ 2 , 1, 0" by answering. According to the recommendations of the American National Sleep Foundation^[20], the subjects were divided into three groups: short sleep duration (< 6 h / D), normal sleep duration ($6 \sim 9$ h / D) and long sleep duration (> 9 h / D). Study subjects were informed of the number of social activities in the past January by asking "have you performed the following social activities in the past month?" and were categorized as "0 times, 1 time, ≥ 2 times" by answering; According to the question "have you ever smoked", the respondents who answered "no" were judged as non-smoking, the respondents who answered "still smoking or quitting smoking" were judged as smoking. Whether or not they drank in the questionnaire based on the question "in the past 1 year, how often they drank", those who answered "less than 1 time per month or not drank" were judged as not drinking, and those who answered "more than 1 time per month" were judged as drinking. Definition of ADL: Katz^[21] ADL assessment scale is used as the assessment tool, which includes 6 items: toilet, eating, dressing, defecation control, getting out of bed and bathing. The evaluation results of each project are divided into three levels: no need for help, partial need for help and complete need for help. Any one of the six items (including partial need for help and complete need for help) is damaged by ADL, and the six items do not need help are intact. The types of medical insurance include: medical insurance for urban employees, medical insurance for urban residents, new rural cooperative medical insurance, medical insurance for urban and rural residents, public medical treatment and medical assistance; Any of the above medical insurance is defined as medical insurance, otherwise it is defined as no medical insurance.

2.6 Statistical analysis Statistical analysis of the data was performed in this study using spss26.0 software. Mean $\pm$ standard deviation ($\pm s$) was used to describe quantitative data that conformed to normal distribution, and rate or constituent ratio was used to describe qualitative data; use χ^2 Tests to compare differences in rates between two and more groups. The effect of different pain states on depressive symptoms was analyzed by multivariate logistic regression model, and $P < 0.05$ was considered statistically significant.

3. Result

3.1 Sample Characteristics

Of the 8664 older individuals included, 4313 (49.8%) were male and 2887 (50.2%) were female; There were 4432 individuals (51.2%) in the 45-59 years group, 4193 (48.4%) in the 60-74 years group, and 39 (0.5%) in the 75 years and older group, most of the study subjects had a household residence type, 8488 (98.0%) had a predominantly rural residence, 6004 (69.3%) had a predominantly married marital status, and 8064 (93.1%) were married.

3.2 Incidence of depression

There were 2887 individuals who developed depression, the 3-year cumulative incidence rate was 33.3%, the average annual incidence rate was: 11.1%, and the age of onset of depression was 58.33 ± 7.603 .

There were statistically significant differences in the incidence of depressive symptoms between the different genders, ages, residential addresses, educational levels, marriage, self perceived health status, nocturnal sleep time, number of social activities in the past month, smoking, alcohol consumption, impaired ADL and Medicare. The details of these analyses are shown in table 1.

Table 1 Analysis of depression incidence among survey subjects with different demographic characteristics

Characteristic	Total n=8162 %	depression		chi- square value	<i>P</i>
		Number of casesn=3340	Rate of cases%		
Gender				167.799	χ^2 0.001
Male	4313 49.8%	1153	26.7		
Female	2887 50.2%	1734	60.1		
Age group				23.122	χ^2 0.001
45~59y	4432 51.2%	1582	35.7		
60~74y	4193 48.4%	1294	30.9		
≥75y	390.5%	11	28.2		
Address type				1.951	0.162
Family housing	8488 98.0%	2837	33.4		
Non family housing	1762.0%	50	28.4		
Residence				128.084	χ^2 0.001
The center of city/town	1880 21.7%	438	23.3		
Combination zone between urban and rural areas	7378.5%	229	31.1		
Village	6004 69.3%	2214	36.9		
Special area	430.5%	6	14.0		
Education				271.355	χ^2 0.001
Elementary school and below	5107 58.9%	2051	40.2		
Middle school and high school	3341 38.6%	807	24.2		
junior college and above	2162.5%	29	13.4		
Marital status				39.176	χ^2 0.001

Married	8064 93.1%	2618	32.5	
Never married	350.4%	18	51.4	
separation /divorced/widowed	5656.5%	251	44.4	
self-rated health			381.012	χ^2 0.001
Very good	7698.9%	134	17.4	
Good	1321 15.2%	294	22.3	
Ordinary	2953 34.1%	943	31.9	
Poor	2872 33.1%	1088	37.9	
Very poor	7498.6%	428	57.1	
Number of chronic conditions			3.509	0.173
0	8577 99.0%	2865	33.4	
1	480.6%	10	20.8	
≥ 2	390.5%	12	30.8	
night sleep duration			150.282	χ^2 0.001
≤ 6 h	2037 23.5%	899	44.1	
6-9h	5839 67.4%	1712	29.3	
≥ 9 h	7889.1%	276	35.0	
Number of social activities in the past month			62.826	χ^2 0.001
0	3496 40.4%	1293	37.0	
1	2462 28.4%	848	34.4	
≥ 2	2706 31.2%	746	27.6	
Smoking status			30.747	χ^2 0.001

No	6101 70.4%	2144	35.1	
Yes	2563 29.6%	743	29.0	
Drinking status			69.849	χ^2 0.001
No	6065 70.0%	2189	36.1	
Yes	2599 30.0%	698	26.9	
ADL difficulty			174.402	χ^2 0.001
No	7909 91.3%	2472	31.3	
Yes	755 8.7%	415	55.0	
medical insurance			7.673	0.006
No	595 6.9%	229	38.5	
Yes	8069 93.1%	2658	32.9	

3.3 Association between pain and depression

As the number of painful sites increased, the incidence of depression increased compared with no pain. The details of these analyses are shown in table 2.

Table 2 Comparison of rates of depression among older adults in different pain conditions

Chronic Pain	Total %	depression		Chi square values	P	chi-square test trend	P
		the number of cases	Incidence rate%				
None	6960 80.3%	1994	28.6	369.179	χ^2 0.001	369.134	χ^2 0.001
Unisomatic pain	350 4.0%	147	42.0				
Multiple somatic pain	1354 15.6%	746	55.1				

With the occurrence or not of depression as the dependent variable (0=no, 1=yes), and the variables that were statistically significant in univariate analysis were used as the independent variables. By

constructing logistic regression analysis models with stepwise inclusion of control variables, the effects of different pain conditions on the occurrence of depression in middle-aged and older adults were explored separately. Only pain related variables were included in model 1, and the results showed that the middle-aged and older adults whose pain conditions were unipolar and multiple somatic pain had a higher risk of depression ($P < 0.05$). Model 2, after adjusting for demographic characteristics on the basis of model 1, still showed a statistically significant association between pain status and the occurrence of depressive symptoms ($P < 0.05$), but the or decreased compared with the unadjusted values before. Model 3 further adjusted the factors such as health status and health behavior on the basis of model two, and the results showed that the or values were further reduced compared with model 2, the risk of older people developing depression among those with monomodular pain was 1.388 times higher than that among those without pain, and the risk of older people developing depression among those with multiple somatic pain was 1.869 times higher than that among those without pain. Pain status remained statistically significant ($P < 0.05$) for the occurrence of depression in middle-aged and older adults. The details of these analyses are shown in table 3.

Table 3 Logistic regression analysis model of chronic pain and depression in middle-aged and elderly people

variable	b	SE	Wald	<i>P</i>	OR	OR 95%CI
Modle 1						
Chronic Pain						
None						
Unisomatic pain	0.590	0.111	27.972	0.001	1.803	(1.449, 2.244)
Multiple somatic pain	1.117	0.061	338.316	0.001	3.056	(2.713, 3.442)
Modle 2						
Chronic Pain						
None						
Unisomatic pain	0.518	0.114	20.587	<0.001	1.678	(1.342, 2.099)
Multiple somatic pain	0.955	0.062	233.814	<0.001	2.599	(2.300, 2.938)
Gender						
Male						
Female	0.409	0.049	69.575	0.001	1.505	(1.367, 1.657)
Residence						
The center of city/town						
Combination zone between urban and rural areas	0.304	0.100	9.188	0.002	1.355	(1.113, 1.649)
Village	0.424	0.066	41.824	0.001	1.528	(1.344, 1.738)
Special area	-0.604	0.450	1.802	0.180	0.547	(0.227, 1.320)
Education						
Elementary school and below						
Middle school and high school	-0.509	0.053	91.683	0.001	0.601	(0.542, 0.667)
junior college and above	-0.976	0.208	22.034	0.001	0.377	(0.251, 0.566)
Marital status						

Married						
Never married	0.913	0.347	6.924	0.009	2.492	(1.262, 4.920)
separation /divorced/widowed	0.388	0.092	17.742	0.001	1.475	(1.231, 1.767)
Modle 3						
Chronic Pain						
None						
Unisomatic pain	0.328	0.117	7.898	0.005	1.388	(1.104, 1.745)
Multiple somatic pain	0.625	0.067	86.174	0.001	1.869	(1.638, 2.133)
Gender						
Male						
Female	0.389	0.050	60.704	0.001	1.475	(1.338, 1.627)
Residence						
The center of city/town						
Combination zone between urban and rural areas	0.299	0.102	8.658	0.003	1.348	(1.105, 1.646)
Village	0.397	0.067	35.409	0.001	1.488	(1.305, 1.696)
Special area	-0.576	0.456	1.594	0.207	0.562	(0.230, 1.374)
Education						
Elementary school and below						
Middle school and high school	-0.457	0.054	71.367	0.001	0.633	(0.569, 0.704)
junior college and above	-0.856	0.209	16.749	0.001	0.425	(0.282, 0.640)
Marital status						
Married						
Never married	0.683	0.354	3.720	0.054	1.980	(0.989, 3.966)
separation /divorced/widowed	0.302	0.094	10.290	0.001	1.353	(1.125,

						1.627)
self-rated health						
Very good						
Good	0.280	0.118	5.608	0.018	1.323	(1.049, 1.669)
Ordinary	0.680	0.105	41.600	0.001	1.974	(1.606, 2.428)
Poor	0.813	0.106	59.118	0.001	2.255	(1.833, 2.774)
Very poor	1.266	0.128	98.266	0.001	3.546	(2.761, 4.554)
night sleep duratio						
6h						
6-9h	-0.387	0.057	46.581	0.001	0.679	(0.607, 0.759)
≥9h	-0.256	0.092	7.746	0.005	0.774	(0.646, 0.927)
ADL difficulty						
No						
Yes	0.384	0.084	20.846	0.001	1.468	(1.245, 1.730)
medical insurance						
No						
Yes	-0.248	0.093	7.065	0.008	0.781	(0.650, 0.937)

4. Discussion

The incidence rate of incidence rate incidence of depression in 3 years is 33.3% and the annual incidence rate is 11.1%. The cumulative incidence rate of depression in 3 years is 52.4%, and the annual incidence rate is 17.5%. Both significantly higher than the US depression incidence (1.51/100 person years) investigated by BF grant et al^[22] in 2008 and the Dutch depression incidence (8.86%) investigated by Ron de Graaf et al^[23] in 2012. The incidence rate of depression is high in middle-aged and old people in China, and the mental health status is not optimistic.

Epidemiological studies have shown that chronic pain increases the risk of depression by 2.5 to 4.1 times^[24, 25]. After controlling demographic characteristics, health status and health behavior, this study

found that different pain status still had statistical significance for middle-aged and elderly depression. Compared with the middle-aged and elderly people without pain, single body pain and multi body pain will increase the risk of depression in the middle-aged and elderly people. Nicassio et al.^[26] showed that the two-year follow-up of 242 patients with rheumatoid arthritis showed that pain may exacerbate sleep problems, and both pain and sleep disorders alone increase the risk of depression. Dohrenwend and others^[27] studied more than 100 chronic facial pain patients and a similar group of painless subjects. The results showed that chronic muscle facial pain was one of the causes of the incidence rate of depression in these patients. In addition, the link between pain and depression is not limited to the middle-aged and elderly. Rethelyi et al.^[28] found that the incidence of depression was significantly higher in pain subjects after a cross-sectional health survey of 3615 young Hungarian women aged 15-24 years. The incidence of major depression increased linearly with the increase of pain severity. The study of Currie et al.^[29] showed that after adjusting demographic variables, logistic regression analysis showed that back pain was the strongest predictor of severe depression.

Relevant studies have shown that pain and depression have a common neurobiological pathway^[13]. The occurrence and development of pain and depression involve the same brain structure, the same neural circuit and the activation of the same neurochemicals. Klaenberg et al.^[30] showed that the signs of increased central hyperexcitability were uniform in patients without pain. It is suggested that the common mechanism of depressive disorder and chronic pain is consistent with the hypothesis of non pain related mechanism of central hyperexcitability in depression, for example, by inhibiting the function of serotonin.

In this study, chronic pain was used as the measurement index. Chronic pain is not only a physical symptom, but also has harmful emotional factors^[31]. According to the International Association for pain research, it is defined as unpleasant sensory and emotional experiences associated with actual or potential tissue damage^[32]. There is a strong correlation between chronic pain and depression. Various physical pain symptoms will increase the possibility of depression. When the severity of depression increases, the severity of pain also increases. And the occurrence of depression becomes very complex due to psychological, social and physical health reasons. The middle-aged and elderly people who have been in a state of pain for a long time are accompanied by negative and unpleasant emotional reactions. There is a close relationship between physical health and mental health. Physical discomfort will not only bring serious pain and suffering and heavy economic burden to the middle-aged and elderly people, but also reduce the social participation of the middle-aged and elderly people and have a great impact on their mental health. Similarly, patients with severe depressive disorder have an increased probability of pain^[33]. The two affect each other, creating a vicious circle. The comorbidity of pain and depression reduces the overall efficacy of susceptible people, making them have to receive longer treatment, endure more serious symptoms, and reduce the possibility of complete remission.

In conclusion, pain is related to the risk of depressive symptoms in middle-aged and elderly people, and the incidence of depression in middle-aged and elderly people in China is not optimistic. As the most populous country in the world, the challenge of population aging is severe and urgent. Therefore, health-

related interventions related to effective and sustainable primary and secondary interventions deserve more research attention. We should take the middle-aged and elderly people with pain, especially the middle-aged and elderly people with multiple body pain, as the key prevention and treatment object of depressive symptoms, actively improve the physical condition of pain patients, pay close attention to the mental health condition of pain middle-aged and elderly people, and strengthen the mental health guidance for middle-aged and elderly people. At the same time, this suggests that when pain occurs, we can't think it is a simple physical problem. We also need to pay attention to the impact of physical health on people's mental health, which may be of great significance to improve the quality of life of middle-aged and elderly people and reduce the risk of depression.

This study still has some limitations. The pain information in this study comes from the self-report of the middle-aged and elderly. Although a large sample size can reduce the degree of recall bias, it is inevitable; Depression is investigated by CES-D scale, not the gold standard method for diagnosing depression, which has a certain deviation from the real level. And many studies have shown that there is a two-way correlation between pain and depression. In this study, we did not investigate the effect of depression on pain because it was beyond the scope of our study. The relationship and interaction between depression and pain still need to be further studied.

5. Declarations

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5.3 Availability of data and materials

The datasets used during the current study are available from the website of China Health and Retirement Longitudinal Study (<http://charls.pku.edu.cn/pages/data/111/zh-cn.html>) and can be accessed by registering to access the study data. The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

5.4 Author's contributions

Jialin LIU contributed to the study Methodology, Data Curation, Formal analysis and Writing- Original draft preparation. Zixuan CHEN contributed to the Data curation and Writing - Review & Editing. Yuke YU contributed to the Visualization and Writing - Review & Editing. Xiuxiu LIU and Qin WANG contributed to

the Writing - Review & Editing. Ping YUAN contributed to the Methodology and Writing- Reviewing and Editing. All authors reviewed the manuscript.

5.5 Competing interests

The authors declare that there is no conflict of interest.

5.6 Consent for publication

Not applicable.

5.7 Ethical approval and consent to participate

CHARLS was approved by the Ethical Review Committee (IRB) at Peking University, Beijing, China. Written informed consent has been obtained from all participant. All methods were performed in accordance with the relevant guidelines and regulations

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