

# Relieving Depressive Symptoms Through Chinese Relational Culture Among Older Adults with Multimorbidity: Evidence from CHARLS

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**Background:** Depressive symptoms and multimorbidity are global public health concerns, the relationship between the two variables remains unclear. This study was an intervention attempt through the lens of regional relational culture to identify and reduce adverse consequences of this relationship. We aimed to explore the prevalence of multimorbidity and depressive symptoms among older Chinese adults, the association between the two variables, and the underlying moderating mechanism.

**Methods:** This study extracted data from the China Health Retirement Longitudinal Study (CHARLS) of 8356 older adults aged 60 years and older and analyzed the correlation between multimorbidity and depressive symptoms in this population using Stata 16.0. Moreover, the correlation between multimorbidity and depressive symptoms was verified using logistic regression analysis, and a hierarchical multiple regression analysis was used to test the existence of moderating effects between the two variables.

**Results:** The prevalence of multimorbidity and depressive symptoms among seniors aged 60 years and older was 66.16 and 36.85%, respectively. Multimorbidity was positively associated with depressive symptoms ( $p < 0.001$ ), and relationship satisfaction, social activity, and information isolation moderated this association ( $p < 0.05$ ).

**Conclusion:** Older adults with multimorbidity are more likely to develop depressive symptoms, and regional relational culture can play a moderating role between them. The government, as well as aging-related sectors, can reduce the risk of depressive symptoms by improving relationship satisfaction, increasing social activity, and decreasing information isolation among older adults.

**Keywords:** depressive symptoms, multimorbidity, older adults, relationship satisfaction, social activity, information isolation

## Introduction

### Depressive Symptoms

Depressive symptoms in older adults are an increasingly concerning global public health issue, significantly threatening the quality of life and overall health of this population. An estimated 3.8% of the global population, including 5.7% of adults older than 60 years, experiences depression. Approximately 280 million people experience depression globally.<sup>1</sup> Especially, China is undergoing a rapid process of population aging, with a large base of older adults, among whom the issue of depression is particularly severe, yet this phenomenon often fails to receive adequate recognition and attention. In recent years, the detection rate of depressive symptoms among older adults in China has reached 44.5% of the total population.<sup>2</sup> As one of the most common psychological disorders in modern society, depressive symptoms are characterized by persistently low mood, an unhappy existence, low self-esteem, pain, pessimism, misanthropy, negativity, avoidance, obvious external manifestations of restlessness, and suicidal tendencies and behaviors.<sup>3</sup> However, as a relatively vulnerable group, older adults have long been disturbed by depressive symptoms, which seriously reduce their sense of well-being and quality of life, inducing a series of

problems such as chronic diseases and suicides,<sup>4</sup> which places great pressure on all aspects of the family and society. Long-term suppression of negative emotions that cannot be relieved can lead to depressive symptoms and other mental health problems among older adults, causing damage to their health, and leading them to suicide.

## Multimorbidity

Physical health issues also require consideration, alongside mental health. With the increase in population aging, the health problems of older adults worldwide are exacerbating, with the proportion of older adults with multimorbidity increasing annually. World Bank data show that the prevalence of multimorbidity is 26.2% in Sub-Saharan Africa, 29.5% in Asia, 31.8% in East Asia, 33.1% in the Middle East and North Africa, 44% in Europe and Central Asia, and 50.4% in Latin America and the Caribbean.<sup>5</sup> A systematic review showed that the prevalence of multimorbidity among adults aged 60 years and older in China ranged from 6.4% to 76.5%.<sup>6</sup> According to the World Health Organization (WHO), chronic diseases such as heart disease, stroke, cancer, other malignant tumors, chronic respiratory lung diseases, and diabetes, which account for 74% of all deaths worldwide, are the main causes of death in the world today.<sup>7</sup> Multimorbidity is a major public health issue that has received global attention. Multimorbidity increases the risk of death in older adults through a combination of the following factors. Prevalence and severity are the most significant causes of multimorbidity in older adults.<sup>8,9</sup> In addition, the burden of disease and economic stress cannot be ignored; the presence of multimorbidity not only leads to deteriorating health conditions, but also imposes an unbearable financial burden.<sup>10</sup> Owing to the need to treat multiple diseases simultaneously, medical costs are often high, which is a huge financial burden for patients and their families. Finally, the diagnosis and management of multimorbidity, both face significant challenges; diagnosis and management of multimorbidity are more difficult, as there may be interactions and effects between different diseases that require comprehensive consideration.<sup>11</sup> Furthermore, the management of multimorbidity involves challenges that require interdisciplinary cooperation and integrated interventions.<sup>12</sup> Additionally, multimorbidity has a wide-ranging social impact. Because patients require long-term treatment and rehabilitation, their quality of life, ability to work, and social participation may be affected. Simultaneously, multimorbidity can also burden families and society; for example, family members need to spend more time and energy caring for patients, and society needs to invest more resources to deal with the challenges of chronic disease multimorbidity.<sup>13</sup> Therefore, it is important to explore multimorbidity to improve the quality of life of older adults.

## Depressive Symptoms Related to Multimorbidity

Previous studies have found that multimorbidity is an important factor that increases the risk of suicide due to depressive symptoms.<sup>14</sup> Multimorbidity causes the health of older adults to deteriorate, and long-term medication increases the economic burden. In addition, because of the damage to activities of daily living, the majority of older adults rely on the care of family members, which increases the financial burden on the family,<sup>15</sup> further adding to the psychological burden on older adults. Moreover, it is inconvenient for them to participate in social activities, which prevents them from talking about their inner emotions, and may exacerbate their depression. There is evidence that depressive symptoms are closely related to chronic diseases,<sup>16,17</sup> including diabetes,<sup>18–20</sup> hypertension,<sup>21</sup> arthritis,<sup>22</sup> chronic kidney disease,<sup>23</sup> chronic lung disease,<sup>24</sup> cancer,<sup>25</sup> asthma<sup>26</sup> and stroke.<sup>27</sup> In addition, the greater the number and variety of chronic diseases, the more obvious are the symptoms of depression.<sup>28,29</sup> Overall, to provide a reference for other developing countries to prevent depression among older adults as well as to provide advice for countries with severe aging, it is of great value and practical significance to study the physical and psychological health problems of Chinese older adults. Based on the above findings, this study initially identifies multimorbidity as the primary risk factor for the development of depressive symptoms in older adults, and presents four hypotheses establishing the research question.

Hypothesis 1: Whether the older adults suffer from multimorbidity has an impact on their experiencing depressive symptoms, and suffering from multimorbidity may contribute to the occurrence of depressive symptoms in older adults.

## The Moderating Role of Regional Relational Culture

It has been shown that poor family relationships may have the potential to increase the risk of depressive symptoms,<sup>30</sup> and a study from Michigan found that lower levels of social activity predicted higher levels of depressive symptoms for Black couples.<sup>31</sup> Moreover, the relationship between older adults and the Internet is found to have an impact on the emergence of depressive symptoms.<sup>32</sup> Therefore, regardless of the country, relational culture may have an impact on the emergence of depressive symptoms.

Chinese older adults—under the profound influence of traditional Chinese culture—live in a complex network of relationships and play an indispensable role in the family, community, and even broader social structure.<sup>33</sup> Consequently, Chinese relational culture is representative in studies of the moderating role of regional relational culture on depressive symptoms.

Based on the above research background, this study focuses on the influence of multimorbidity on depressive symptoms in older adults, and attempts to test hypotheses 1–4 and thus explore measures to improve depressive symptoms in older adults. In addition, this study takes the triadic interaction theory as a theoretical basis from the perspective of Chinese relational culture, and hypothesizes that the level of depressive symptoms in older adults may be linked to the relationships among family, society, and networks, which correspond to the individual, environmental, and behavioral levels of the triadic interaction theory, respectively.

## The Moderating Role of Satisfaction with Intergenerational Relationships

It has been shown that satisfaction with intergenerational relationships affects the mental health status of family members; the higher the satisfaction with intergenerational relationships, the lower the level of depressive symptoms.<sup>34,35</sup> The absence of family support is a significant risk factor for depressive symptoms. Family relationships were found to negatively moderate the relationship between organizational participation and life satisfaction.<sup>36</sup> Therefore, satisfaction with intergenerational relationships may moderate the relationship between multimorbidity and depressive symptoms.

Hypothesis 2: Satisfaction with intergenerational relationships moderates the effect of multimorbidity on depressive symptoms.

## The Moderating Role of Social Activity

Social activity is an indicator of the perceived quality of relationships and interactions with others.<sup>37</sup> It represents the psychological and material resources that older adults perceive as available to them. The level of social activity was found to be negatively associated with depression and loneliness.<sup>38</sup> At the same time, compared to other age groups, older adults' well-being and depressive symptoms were more likely to be influenced by social activity.<sup>39</sup> Therefore, we propose the following hypothesis:

Hypothesis 3: Social activity moderates the effect of multimorbidity on depressive symptoms.

## The Moderating Role of Isolation of Information

As the trend of overlapping digitalization and aging becomes increasingly obvious, online information is gradually becoming an important part of older adults' daily lives. According to the 52nd Statistical Report on the Development of the Internet in China published by the China Internet Information Center, as of June 2023, the proportion of netizens over the age of 50 in China was 29.9%. Increased by 19.4 percentage points compared to June 2018,<sup>40</sup> The Internet continues to infiltrate the middle and senior population, and the older adults' catchphrase "touch the net" gradually becomes the norm. However, many older adults broadly experience information isolation for reasons such as an inability to operate the Internet. Evidence indicates that the use and frequency of the Internet can affect a person's mental health<sup>41</sup> and the appearance of depressive symptoms in older adults,<sup>42,43</sup> providing sufficient basis for the following hypothesis.

Hypothesis 4: Isolation of Information moderates the effect of multimorbidity on depressive symptoms.

## Aims

Depressive symptoms was affected by multiple factors cover physiological, psychological, and sociocultural aspects. Given the large base of China's older adult population and its global representativeness, in-depth research on their depressive symptoms holds significant importance for mental health studies among older adults both in China and worldwide. The unique culture of Filial piety and Confucian culture in China have a profound impact on the mental health of older adults, deeply shaping their perception and response to depressive symptoms. Therefore, it is of significant value to constantly study the depressive symptoms of older adults from the perspective of Chinese culture, especially in older adults with multimorbidity.

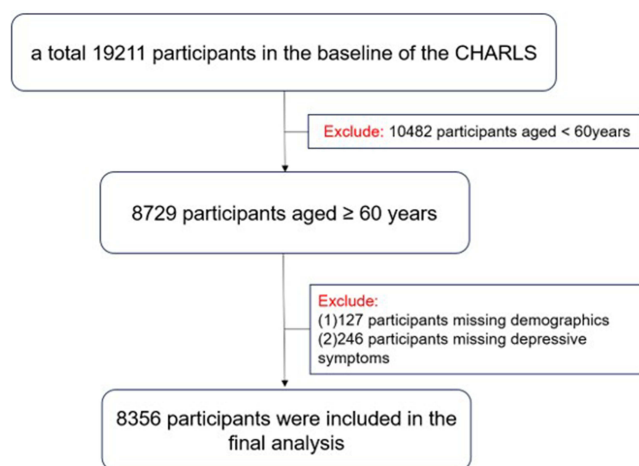
The main objective of this study was to explore whether multimorbidity among older adults has an impact on the presence of depressive symptoms. Moreover, we investigated whether satisfaction with intergenerational relationships, social activity, and isolation of information moderated the relationship between multimorbidity and depressive symptoms.

## Materials and Methods

### Data

Data used in this study were obtained from the China Health and Retirement Longitudinal Study (CHARLS). The CHARLS belongs to the survey data of the China Social Science Survey Centre of Peking University, which uses the probability proportional volume sampling method to collect information on the demographic characteristics, economic situation, and medical and healthcare needs of middle-aged and older adults aged over 45 years in China. The project's national baseline survey began in 2011 and was conducted nationwide in 2011, 2013, 2015, 2018 and 2020, targeting middle-aged and older adults aged 45 years or older in the country. By the time the nationwide follow-up visit was completed in 2020, the survey sample had covered a total of 28 provinces in China, and there were approximately 20,180 respondents in the 150 county-level units, 450 village-level units, and more than 10,000 households randomly selected for the survey. The survey included information on gender, age, education level, current marital status, current living environment, healthcare, lifestyle, etc. This study used the CHARLS data for the fifth time in 2020, which was released in November 2023 and is the latest and most nationally representative survey of middle-aged and older adults in China as of 2024.

The inclusion criteria for the age of the population in this study were 60 years and above, and based on the criteria for studying the impact of chronic disease multimorbidity on depressive symptoms, the data were initially collated using the Stata 16.0 software, and after excluding samples that did not meet the age criterion and cleaning up the missing and abnormal samples, 8,356 valid samples were eventually obtained. For details of the data selection process, please refer to Figure 1.



**Figure 1** CHARLS Data Selection Flowchart.

## Measurement of Depressive Symptoms: Centre for Epidemiological Studies Depression Scale

In this study, the depression status of the respondents was assessed using the Centre for Epidemiological Studies Depression Scale (CES-D) with good validity,<sup>44</sup> developed by the National Institute of Mental Health in the United States in 1977, which is widely used as a measure of mental health in older adults in China<sup>45</sup> and consists of ten questions. Each dimension is scored from 0 to 3, of which the 5th and 8th dimensions are reverse scored, and the interval of the total score is from 0–30; the higher the total score, the higher the degree of depressive symptoms. In this study, the presence of depressive symptoms was determined when the respondents' scores were 10 or above.<sup>46</sup>

## Measurement of Multimorbidity

Based on the CHARLS database classification of chronic diseases in older adults, the chronic diseases included in this analysis were hypertension, dyslipidemia, diabetes or elevated blood glucose, malignant neoplasms such as cancer, chronic lung disease, liver disease, heart disease, stroke, kidney disease, gastric or digestive disorders, emotional and psychiatric problems, memory-related disorders, Parkinson's disease, arthritis or rheumatism, asthma, and 15 physician-diagnosed chronic diseases. Multimorbidity was defined as the presence of two or more chronic diseases. Stata software (version 16.0) was used to calculate multimorbidity among older adults aged 60 years and above by assigning a score of 1 to each question of whether they were diagnosed by a doctor, and a score of 0 for each question of whether they were diagnosed by a doctor.

## Measurement of Satisfaction with Intergenerational Relationships

Satisfaction with intergenerational relationships was evaluated in the CHARLS questionnaire via the question "Are you satisfied with your relationship with your child?" Responses were categorized as "Not at all satisfied", "Not very satisfied", "Quite satisfied", "Very satisfied", and "Thoroughly satisfied". The higher the score, the more satisfied the respondent was with their relationship with their children.

## Measurement of Social Activity

Social activity was assessed using the following question: "Have the following social activities taken place in the past month?" The level of social activity of the respondents was described by assigning a value of 1 to respondents who participated in one or more activities and a value of 0 to respondents who did not participate in social activities.

## Measurement of Isolation of Information

Isolation of information in this paper refers to the isolation of older adults from online information, therefore, the question "In the past month, did you go online? Including chatting, reading news, watching videos, playing games, managing money, etc., on the cell phone network?" was used as an indicator of information segregation. A "yes" answer was assigned a value of 0, and a "no" answer was assigned a value of 1, and the information segregation was evaluated sequentially.

## Measurement of Demographic Characteristics

We analyzed four demographic characteristics: gender, marital status, residence, and Zone of residence. Gender was categorized into male and female, marital status into with and without spouse, residence into urban and rural areas, and zone of residence according to whether or not it was a Frigid zone. Frigid zone usually refers to a zone where the average temperature in January is  $-18^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ) or lower and is located at a high latitude of 45.

## Statistical Analyses

This study obtained relevant data from the CHARLS database, and used Stata16.0 software to gradually screen and extract relevant data, to classify, organize, and analyze descriptive statistics on multimorbidity and the occurrence of depressive symptoms among older adults in China, and to explore the impact of multimorbidity on the occurrence of

depressive symptoms in this demographic by constructing regression models for correlation analyses, with two-tailed probability values of  $<0.05$ , indicating statistical significance. The correlation between multimorbidity and depressive symptoms was verified using logistic regression analysis. Hierarchical multiple regression was used to evaluate the relationship between multimorbidity, satisfaction with intergenerational relationships, social activity, isolation of information, and depressive symptoms and to explore the moderating role of satisfaction with intergenerational relationships, social activity, and isolation of information in the relationship between multimorbidity and depressive symptoms.

## Results

### Demographic Characteristics

This study extracted data from the 2020 CHARLS database on 8356 older adults. The demographic variables of the sample and the differences between the groups of depressive symptoms are shown in Table 1. Gender ( $\chi^2=257.22$ ,  $P<0.001$ ), marital status ( $\chi^2=90.80$ ,  $P<0.001$ ), residence ( $\chi^2=150.41$ ,  $P<0.001$ ), zone of residence ( $\chi^2=6.81$ ,  $P<0.05$ ) were significantly associated with depressive symptoms. As shown in Table 1, The probability of depressive symptoms among older adults was 44.97% for women and 28.79% for men; the probability of depressive symptoms among older adults with spouse was 34.59%, and that among older adults without spouse was 45.59%; the probability of depressive symptoms among older adults living in rural areas was 41.45%, and that among older adults living in urban areas was 28.33%; the probability of depressive symptoms among older adults living in cold areas was 37.22%, and that among older adults living in non-cold areas was 33.67%.

### Trends of Multimorbidity and Depressive Symptoms

Among the 8,356 older adults aged 60 years and older, the prevalence of multimorbidity was 66.16% (5,528), with the highest frequency of both hypertension and arthritis or rheumatism (21.9%), totaling 1,836 survey respondents; 1,708 survey respondents experienced two chronic diseases simultaneously—hypertension and dyslipidemia, with a prevalence rate of 20.4%; hypertension + heart disease had the third highest pattern of multimorbidity, with 1,459 survey respondents (17.4%) experiencing both of these chronic diseases.

The detection rate of depressive symptoms among our study sample was 36.85% (3,079), and the mean depression scale score was 8.18, indicating that the occurrence of depressive symptoms was relatively low among the studied sample.

**Table 1** Demographic Characteristics of Participants (N = 8356) and Univariate Analysis of Factors Related to Depressive Symptoms

Variable	Number of Subjects n (%)	Depressive Symptoms (Mean $\pm$ SD)	P-value (by t-test)
Sex			
Female	1207(28.79%)	0.54 $\pm$ 0.66	<0.001
Male	1872(44.97%)	0.33 $\pm$ 0.55	
Marital status			
With spouse	2298(34.59%)	0.40 $\pm$ 0.59	<0.001
Without spouse	781(45.59%)	0.56 $\pm$ 0.67	
Residence			
Rural areas	2248(41.45%)	0.49 $\pm$ 0.64	<0.001
Urban areas	831(28.33%)	0.32 $\pm$ 0.55	
Zone of living			
Frigid zone	2782(37.22%)	0.44 $\pm$ 0.62	<0.05
Non-frigid zone	297(33.67%)	0.39 $\pm$ 0.58	



## Multimorbidity and Its Positive Association with Depressive Symptoms

As shown in Table 2, out of the sample of 8356 cases, Correlation analysis of multimorbidity and depressive symptoms revealed a significant correlation between the two ( $P < 0.001$ ). This finding also suggests that older adults with multimorbidity are more likely to experience depressive symptoms. Therefore, the results support Hypothesis 1.

## The Moderating Role of Satisfaction with Intergenerational Relationships, Social activity and Isolation of Information

As can be seen in models (1) and (2) in Table 3, satisfaction with intergenerational relationships passed the 5% level of significance in the path of multimorbidity to depressive symptoms. Again, the simple slope analysis in Figure 2 shows that the moderating effect of satisfaction with intergenerational relationships and multimorbidity on depressive symptoms was negative; that is, the higher the satisfaction with intergenerational relationships, the weaker the effect of multimorbidity on depressive symptoms. Furthermore, the results of the study support hypothesis 2.

As can be seen in models (3) and (4) in Table 3, the effect of multimorbidity on depressive symptoms remained significant after adding the variable of social activity and model (4) indicates that social activity also has a significant

**Table 2** Analysis of the Correlation Between Multimorbidity and Depressive Symptoms (N = 8356)

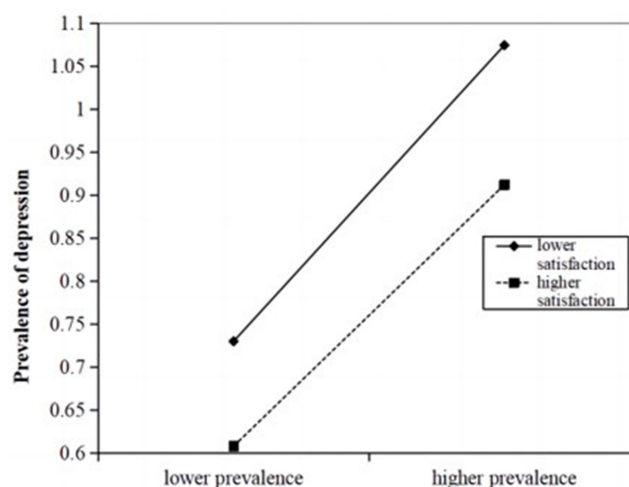
Variable	No Depressive Symptoms	Depressive Symptoms
Multimorbidity	0.663***	1.342***
Age	-0.009	0.038***
Marital status	-0.408***	-0.860***
Residence	-0.566***	-0.972***
Constant	-0.654***	-2.281***

Note: \*\*\* $p < 0.001$  (two-tailed).

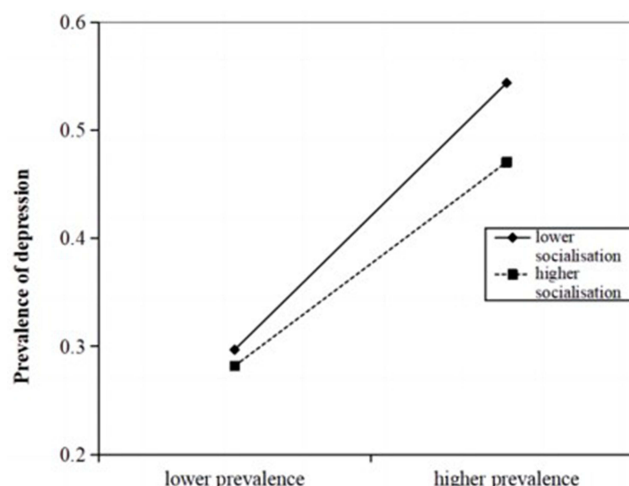
**Table 3** Moderating Effect Test Results of Satisfaction with Intergenerational Relationships, Social Support, Isolation of Information

Variable	Outcome: Depressive Symptoms					
	M 1 ( $\beta$ )	M 2 ( $\beta$ )	M 3 ( $\beta$ )	M 4 ( $\beta$ )	M 5 ( $\beta$ )	M 6 ( $\beta$ )
Step 1						
Multimorbidity	0.190***	0.151				
Satisfaction with intergenerational relationships	-0.194***	-0.203***				
Interaction M*Sa		0.013***				
Step 2						
Multimorbidity			0.221***	0.247***		
Social activity			-0.054***	-0.015		
Interaction M*So				-0.058**		
Step 3						
Multimorbidity					0.223***	0.081
Isolation of information					0.191***	0.134***
Interaction M*I						0.082**
N	583	583	8356	8356	8356	8356
adj. R <sup>2</sup>	0.083***	0.081***	0.030***	0.030***	0.046***	0.046***

Notes: \*\* $p < 0.01$ , \*\*\* $p < 0.001$  (two-tailed).



**Figure 2** Simple slope plot of the interaction between multimorbidity and satisfaction with intergenerational relationships on depressive symptoms.



**Figure 3** Simple slope plot of the interaction between multimorbidity and social activity on depressive symptoms.

moderating effect in the path of multimorbidity on depressive symptoms. From the coefficients of the variables in models (3) and (4), it is clear that the moderating effect of social activity and multimorbidity on depressive symptoms is negative; that is, the higher the level of social activity, the weaker the effect of multimorbidity on depressive symptoms. The simple slope analysis plots shown in Figure 3 demonstrate this result. Therefore, Hypothesis 3 was supported.

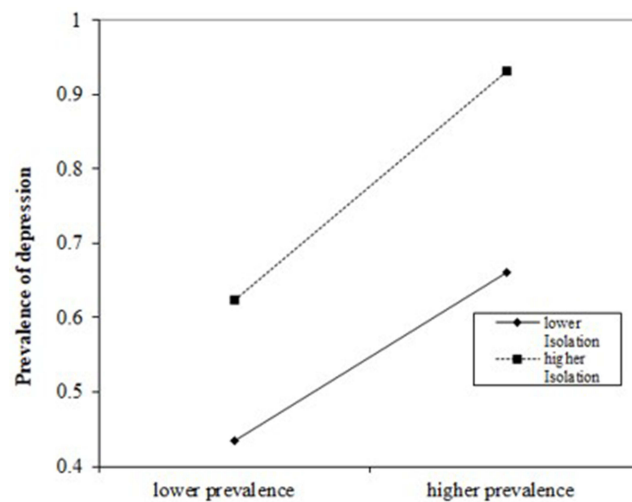
The regression results in Table 3 show that the effect of multimorbidity on depressive symptoms is moderated by information isolation. Figure 4 shows that the moderating effect of information segregation and multimorbidity on depressive symptoms was positive; that is, the higher the degree of information segregation, the stronger the effect of multimorbidity on depressive symptoms, whereas the lower the degree of information segregation, the weaker the effect of multimorbidity on depressive symptoms. In summary, Hypothesis 4 was supported.

## Discussion

### The Increasing Prevalence of Multimorbidity and Depressive Symptoms Among Chinese Older Adults is Deeply Concerning

The results showed that the prevalence of multimorbidity among older adults in China was substantially high. The prevalence of multimorbidity among Chinese older adults is 66.16%, which implies that in China, more than half of the older adults suffer





**Figure 4** Simple slope plot of the interaction between multimorbidity and isolation of information on depressive symptoms.

from multimorbidity. The results are in line with previous studies regarding the prevalence of multimorbidity among older adults in China.<sup>47</sup> As a unique social group, older adults exhibit unique physical and mental health characteristics and complexities. The detection rate of depressive symptoms among older adults was 36.85%. Although the result showed a low prevalence of depressive symptoms among Chinese older adults, this may be due to the fact that in traditional Chinese culture, depression may be viewed as a sign of weakness or abnormality, and the older adults may thus feel ashamed or reluctant to talk openly about their emotional problems.<sup>48</sup> In addition, most people's awareness and understanding of depression systems among older adults may not be sufficiently deep, resulting in a lack of adequate understanding and support for depression among older adults and those around them. In the United Kingdom, the prevalence of depressive symptoms ranges from 11.3% for mild symptoms to 3.3% for severe symptoms, and a study in Spain found that 13.1% of 22,723 older adults exhibited depressive symptoms. Compared to other countries,<sup>49,50</sup> the prevalence of depressive symptoms among China's older adult population is relatively high, a phenomenon that may be closely associated with China's relational culture. Mental health issues of older adults should not be ignored on this account.

## Demographic Differences Among Chinese Older Adults with Multimorbidity

The findings of this study show demographic differences in depressive symptoms among older adults with multimorbidity. The first difference in the presence of depressive symptoms manifested in the gender variable. Older women were more likely to experience depressive symptoms than older men.

The results of this study are the same as those of previous studies.<sup>51</sup> Chang et al also found that women were more likely to experience symptoms of depression. According to Mirowsky and Ross, married women are more stressed than men when assuming the role of wife or mother and are at a higher risk of developing depressive symptoms as family caregivers. Regarding the marital status of older adults, the study found that widowed and divorced older adults had higher levels of depressive symptoms than married older adults. A Japanese study also found that depressive symptoms were more common in the non-spouse group.<sup>52</sup> From the results of this study, it can be seen that Chinese older adults living in rural areas are more likely to experience depressive symptoms, which may be due to the relatively low level of education of rural older adults and the limited economic and medical resources in rural areas.<sup>53</sup>

## Multimorbidity More Likely to Cause Depressive Symptoms Among Chinese Older Adults

The findings of this study showed a significant link between multimorbidity and depressive symptoms in older Chinese adults. Older adults with multimorbidity were at higher risk of developing depressive symptoms. Long-term and recurrent chronic diseases can cause physical pain and discomfort in older adults, and this ongoing painful experience can trigger or aggravate depression.<sup>54,55</sup> Multimorbidity reduces older adults' self-care abilities, such as reduced mobility,

which may cause them to feel depressed and lost, thereby increasing their risk of depression. Multimorbidity increases the financial burden on older adults and causes economic problems, further increasing the likelihood of depressive symptoms.

To alleviate chronic diseases among older adults and further enhance their well-being, the government, society governors, and individuals should actively respond to the national policy of healthy aging, strengthening the prevention and treatment of chronic diseases, encouraging regular medical check-ups for middle-aged and older adults, and ensuring early detection and treatment of various chronic diseases. Thus, the government, society governors, and individuals can make joint efforts to build a more effective system for the prevention and control of chronic diseases and strengthen the daily management of chronically ill older adults. Governments, societal governors, and individuals should work together to build a more effective chronic disease prevention and control system, and strengthen the daily management of chronically ill older adults.

Universities and communities for older adults should pay more attention to the chronic diseases experienced by them, while paying more attention to the accompanying depressive symptoms. The mental healthcare services designed for them must be analyzed and suitable interventions made to incorporate physical, mental, and social activities into their daily health regimes, alongside mechanisms for and diagnosing depression at an early stage to realize the synchronous treatment of the physiology and psychology of older adults.

## **Negative Moderating Role of Satisfaction with Intergenerational Relationships in the Negative Associations Between Multimorbidity and Depressive Symptoms**

Satisfaction with intergenerational relationships played a moderating role in the pathway of multimorbidity on depressive symptoms; the higher the satisfaction with intergenerational relationships, the weaker the relationship between multimorbidity and depressive symptoms. In this study, satisfaction with intergenerational relationships was used as an indicator of family relationships among older Chinese adults. In Chinese society, the family is one of the core sources of emotional support.<sup>56</sup> Satisfaction with intergenerational relationships can fully reflect the degree of family harmony in the context of traditional Chinese culture of filial piety, which has a positive effect on mental health. Older adults who lived in harmony with family relationships had a lower risk of depressive symptoms because their children provided positive emotional support to alleviate their stress and life challenges. Conversely, older adults who are dissatisfied with their relationships with their children may feel lonely, helpless, and lack emotional support, leading to increased depressive symptoms.

## **Negative Moderating Role of Social Activity in the Negative Associations Between Multimorbidity and Depressive Symptoms**

The results showed that social activity for older adults significantly moderated the effect of multimorbidity on depressive symptoms among this demographic. Older Chinese adults with multimorbidity who receive high levels of social activity may have lower levels of depressive symptoms. In the current study, social activity was used as an indicator of social relationships among older Chinese adults. Social relationships are regarded as an important part of their individual lives in Chinese culture. Older adults form their own social activity networks by establishing and maintaining relationships with family, friends, neighbors, etc.

When older adults face difficulties or stress, these social relationships provide emotional support, material help, and information guidance to alleviate difficulties and negative emotions, further reducing depressive symptoms.<sup>57,58</sup> Similarly, if older adults have access to social activity systems such as community engagement and volunteering, they can rediscover their place and value in society, thereby reducing the risk of depressive symptoms.

## **Positive Moderating Role of Information Isolation in the Negative Associations Between Multimorbidity and Depressive Symptoms**

From the results of the study, it is clear that information isolation plays a significant positive moderating role between multimorbidity and depressive symptoms. Specifically, the higher the level of information isolation, the stronger the association between multimorbidity and depressive symptoms among older Chinese adults. In this study, information isolation was used as an indicator to represent the network relationships among older Chinese adults. Interpersonal

relationships are highly important in Chinese culture. Interpersonal relationships are not limited to everyday life but also exist on the Internet.<sup>59</sup> With the development of technology, the Internet and smart devices have become a part of people's daily lives. However, some older adults may not be proficient in using these devices due to technical impairments, chronic diseases, and other causes of visual or hearing loss. The inability to use smart devices prevents older adults from communicating effectively, further exacerbating information isolation. Information isolation can result in older adults not communicating easily with others, thus reducing their social interactions and making them feel lonely and lost.<sup>60</sup> Older adults find it more difficult to integrate into a digital society, which exacerbates their sense of disconnection from society. This increased digital divide can lead older adults to feel abandoned by society, thereby increasing their risk of depressive symptoms.

In summary, at the Chinese cultural relationship level, family, social, and network relationships moderate the effects of multimorbidity on depressive symptoms in older adults.

To effectively minimize the continuous emergence of depressive symptoms among older adults with multimorbidity, they should receive more care and support. On the one hand, it is recommended that the relevant departments for caring for older adults vigorously promote society as a whole, with the idea that the children of older adults should take care of their parents. Meanwhile, the children of older adults should provide more emotional and financial support so that they can find a greater sense of participation and pay attention to the physical and psychological health of older adults. On the other hand, to promote the social participation of older adults with multimorbidity, the community should organize more recreational activities, and interactions through these activities can enhance communication and increase the sense of social activity among older adults and reduce the possibility of depression symptoms. Finally, departments responsible for caring for older adults can reduce information isolation by establishing community-based mutual aid groups for older adults. Social workers should play a pivotal role in narrowing inequality among older adults regarding the use of digital technology.

This study delved into the uniqueness of Chinese culture, particularly the impact of three key dimensions of Chinese relational culture on the depressive symptoms of older adults with multimorbidity. Not only does this research enhance our understanding of mental health issues among Chinese older adults and further to providing targeted intervention measures, but it also offers a novel perspective and evidence-based experience for the international community to reduce depressive symptoms and care for their mental health. This perspective aids other countries in considering the function of cultural context when developing and implementing mental health strategies for older adults with multimorbidity. Globally, more diversified and effective cultural management methods also should be exploratory developed to relieve depressive symptoms in older adults with multimorbidity.

## Limitations

The main research tools used in this study were subjective questionnaires or scales, which may cause bias problems, and whether the participants suffered from a chronic disease was self-reported by the respondents, which may cause information bias. Moreover, the CES-D Depression Self-Rating Scale belongs only to the category of tools used to screen for depressive symptoms, which is somewhat different from the tools used to diagnose depression in clinical settings. In future research, a semi-structured approach to qualitative research based on structured questionnaires could be adopted to comprehensively analyze and measure the variables to be investigated to reduce survey bias.

## Conclusions

This study explored the mechanism of the influence of multimorbidity on the depressive symptoms of Chinese older adults aged 60 years and above through descriptive statistical analysis of multimorbidity and depressive symptoms in China. Three variables were summarized in three dimensions of the Chinese relational culture, which represent the relationship between older adults and their families, society, and the network, and explored the moderating role of Chinese relational culture in the relationship between multimorbidity and depressive symptoms. Older adults with multimorbidity were more likely to develop depressive symptoms, and their relationship satisfaction, social activity, and information isolation had a moderating effect. The government, as well as aging-related sectors can reduce the risk of depressive symptoms by improving the relationship satisfaction, increasing social activity, and decreasing information isolation for older adults.

## Abbreviations

CHARLS, China Health and Retirement Longitudinal Study; CES-D, Centre for Epidemiological Studies Depression Scale.

## Ethics Statement

The data for this study came from the China Health and Retirement Longitudinal Study (CHARLS). Each round of the CHARLS survey has been approved by the Biomedical Ethics Committee of Peking University. The fieldwork plan for this round of household questionnaire survey has been approved, with the approval number: IRB00001052-11015. All the participants provided signed informed consent at the time of participation.

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## Author Contributions

Xin-Yu Duan: Writing – original draft, Methodology, Formal analysis, Data curation. Tao Sun: Writing – review & editing. Feng Lu: Data curation, Formal analysis. Xiao-Jing Yang: Writing – review & editing. Hong-Yan Yin: Writing – review & editing. De-Pin Cao: Funding acquisition, Conceptualization. Shu-E Zhang: Writing – review & editing, Funding acquisition, Conceptualization. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

All the authors of this article have no conflict of interest at all.

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