

Research Article

Physical Health, Economic Status, Social Relations, and Depression among Chinese Older Adults: A Structural Equation Modelling Analysis

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This study aims to test an integrated model of physical health, economic status, social relations, and geriatric depression, and in particular to examine the stress-buffering role of social relations on the negative psychological effects of declining physical health and worsening economic status. Data from 5,316 older adults (≥ 60 years) from a nationally representative cross-sectional database in China were used. Social relations were measured by both the intergenerational relationship and the social network beyond family ties. Descriptive analysis, multivariable regression, and structural equation modelling were used in a stepwise fashion. The results showed that poor physical health (identified as more chronic diseases, worse daily living function, and worse sleep quality) and lower economic status (identified as lower income and more debt) were significantly associated with weaker social relations and higher depression scores. Both intergenerational relationship and social network appeared to mediate the effects of physical health and economic status on geriatric depression, but in slightly different ways. Social relations play an important role in buffering the negative psychological effects of declining physical health and worsening economic status on the older group in China. The findings suggest the importance of strengthening health care, compensating for economic disadvantage and improving social relations in protecting the mental health of older adults.

1. Introduction

Worldwide epidemiological and demographic changes, combined with improvements in health care, have led to a steady increase in the proportion of older adults. For many of them, increased life expectancy is accompanied by a decline in both physical and social functioning, which affects psychological wellbeing. Geriatric depression has become one of the most common mental disorders in the older population [1], and it has been estimated that the average expected prevalence of geriatric depression is already 31.74% [2]. People with geriatric depression may experience potential negative consequences in terms of disability [3], lower quality of life [4, 5], and increased risk of suicide and mortality [6]. Geriatric depression has become a major public health concern.

1.1. Two Major Stressors for Depression in the Older Adults.

In general, depression is explained as a negative outcome of individuals experiencing threats to wellbeing that deplete available resources [7]. For older adults, declining physical health and worsening economic status associated with aging are major stressors that can lead to geriatric depression [8]. On the one hand, the decline in physiological function may play a role in both the initiation and maintenance of geriatric depression. Physical health indicators such as chronic disease [9] and functional impairment [10] have all been shown to be associated with geriatric depression. Indeed, many older people may experience comorbidities of related chronic physical and mental health problems [11]. On the other hand, along with aging, older people may also face strong pressures from income decline. A robust and consistent association

between poor economic status and geriatric depression has been well-established on the basis of social causation theory, as poor older adults consistently show higher levels of depressive symptoms [12]. Moreover, these two stressors can be compounded in complex ways, with a disproportionate impact on less well-off groups. For example, for those older people experiencing economic disadvantage, poor health is a significant risk factor for depression [13].

1.2. The Stress-Buffering Role of Social Relations. In recent years, the process from stressors to depressive symptoms has been studied, with social relations becoming the focus of much research attention [14]. According to the stress-buffer theory [15], social relations represent the possibility of receiving emotional, instrumental, and financial support from network members, which is crucial for buffering against the negative effects of multiple stressors. Many empirical studies have found the negative relationship between social relations and geriatric depression [7, 16], as well as the benefits of connecting with social groups in reducing depression [17]. Studies strongly suggest that high quality family relationships with spouse and children are inversely associated with depressive symptoms in older adults [18, 19]. Intergenerational relationships are particularly important for older adults in Confucian cultures, which emphasize filial piety [20]. Adult children are expected to provide instrumental, financial, and emotional support for older people. Failure to meet these expectations may lead to depressive symptoms in older parents [21]. Social networks beyond the family are also important, as a large body of literature based on activity theory suggests the importance of social engagement in reducing geriatric depression [22, 23]. Particularly, for older adults with poor economic status, receiving more social support is an even more important way to mitigate depressive symptoms in old age [24]. The life-span theory has also pointed to the importance of kinship and friendship in meeting one's emotional and instrumental needs, which contribute to positive psychological wellbeing [25].

Social relations are likely to change negatively with the aging process, which may create new stressors for older adults. The decline in physical health may lead to deficits in social engagement due to mobility limitations and difficulties in fulfilling one's social roles [7]. Meanwhile, the decline in income associated with aging may also reduce one's potential sources of social support. The exchange theory proposed by social psychologists suggests that low income may lead to isolation from relatives and friends [26, 27]. In this sense, poor physical health and low economic status act not only as direct stressors for older people but also as support disrupting stressors that may consequently affect their mental health.

1.3. Research Gap and Aims of the Current Study. Although the stress-buffering role of social relations on geriatric depression has been extensively studied [21, 25], research has not yet paid sufficient attention to the process by which declining physical health and worsening economic

status may exacerbate geriatric depression by affecting social relations. Based on the stress-buffer theory and previous relevant work, this study proposed an integrated model of physical health, economic status and geriatric depression, with social relations acting as mediators (Figure 1). Using a cross-sectional survey dataset, this study aimed to test this integrated model in the context of China. The main hypotheses to be tested in this study were as follows: (1) geriatric depression is directly related to older adults' physical health, economic status and social relations and (2) physical health and economic status may affect older adults' psychological wellbeing through the influence of social relations.

To date, much of the existing literature has focused unilaterally on the effects of physical health, economic status, or social relations on geriatric depression. For example, poor economic status [28] and physical health [29] are risk factors for geriatric depression, whereas social support is protective [30, 31]. Some studies have gone further to examine the complex relationship between these factors. For example, lower economic status has been found to be associated with both depression and poorer physical health [32], and social networks moderate the negative effects of economic disadvantage on depressive symptoms [24]. To our knowledge, the associations between physical health, economic status, social relations, and geriatric depression have not been comprehensively discussed in the Chinese context or in other social contexts.

The problem of geriatric depression in China deserves special attention because China, the world's most populous country, is facing rapid aging. According to the National Bureau of Statistics, the proportion of older adults increased from 13.3% to 19.8% of the total population between 2010 and 2022. The 2011 China Health and Retirement Longitudinal Study reported that about 40% of older adults in China had depressive symptoms [21]. As the older population increases, there may be a corresponding increase in the number of older people with depression. In addition, the context of China is also unique due to the high number of older adults with poor economic status and limited formal support from the government [33]. Developing knowledge about how social relations can help buffer the negative effects of declining physical health and worsening economic status can provide an important policy basis for tackling the negative mental health consequences of aging, particularly for economically disadvantaged older adults.

2. Methods

2.1. Participants and Procedure. The data in this study were obtained from the Survey on the Aged Population of Low-income Families in Urban/Rural China (2018), which is part of a whole survey project called "Sample Survey on Vulnerable Populations from Poor Families in Urban/Rural China (2018)," conducted from July 1 to September 31, 2018. The overall survey project consists of three sub-surveys for people with disabilities, children and adolescents (6–16 years), and older adults (over 60 years). It is officially initiated and sponsored by the Ministry of Civil Affairs of the

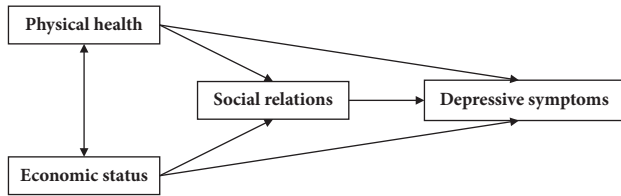


FIGURE 1: An integrated model of physical health, economic status, social relations, and geriatric depression.

People's Republic of China and conducted by the Institute of Social Science Survey in Peking University.

The Survey on the Aged Population of Low-income Families in Urban/Rural China (2018) aimed to investigate the family conditions, physical and psychological health status, social relations and social security conditions of older adults in China. A multi-stage, stratified and random cluster probability sampling method was used to select 6,042 participants from 1,800 cities (communities or villages) in 155 counties or districts in 29 provinces, autonomous regions and municipalities of mainland China. Of these, 4,531 participants belong to the low-income population and 1,511 to the general population. Low-income households in this survey are identified by the local civil affairs department, including households receiving the minimum living allowance from the local civil affairs department and households with an annual per capita household income below 1.5 times the local minimum living standard. For every three or four low-income households, one geographically nearby general household was randomly selected as a control group, and the gender, age group, and marital status of the respondent from the general household were matched with those of the low-income families.

Details of the inclusion and exclusion criteria have been described elsewhere [34, 35]. A written informed consent to participate in the interview was presented by the investigators at the beginning of the face-to-face interview. The interview continued if the participant agreed with the consent form. The analysis of these data was approved by the university research ethics committee. The aim of this study was to test an integrated model of physical health, economic status, social relations, and geriatric depression. The parent-child relationship was an important dimension of social relations. To reflect its impact on the overall model, data analysis was restricted to 5,316 participants who had at least one living child. Figure 2 shows the sampling and data processing for the study.

2.2. Measurements

2.2.1. Physical Health. Three indicators were used to measure participants' physical health status, including number of chronic diseases [21], daily living function [36], and sleep quality [37]. Older adults' daily living function was measured using the Activity of Daily Living (ADL) [38], a 6-item instrument that measures older adults' ability to perform six daily activities (i.e., bathing, dressing, toileting and cleaning, basic indoor activities, controlling urine and feces, and

eating independently), which had been validated among older adults in China [39, 40]. Responses for each item were scored from 1 to 4 (1 = have no problems, 2 = have some problems, 3 = face serious difficulties, 4 = totally unable). Total scores could range from 6 to 24, with the higher scores indicating poorer functioning in activities of daily living.

Sleep quality was measured using the Insomnia Severity Index (ISI) [41], a 7-item Likert scale, which had been validated among older adults in China [42]. Each response was scored from 0 to 4 to measure the severity of each item (0 = none, 1 = mild, 2 = moderate, 3 = severe, 4 = extremely severe) and the total scores could range from 0 to 28. The internal consistency of the ADL and ISI scales for the present sample was 0.86 and 0.88, respectively.

2.2.2. Economic Status. Economic status can reflect older people's quality of life in material terms, as well as their ability to access necessary social resources. It was measured by the annual income of older couples (or the income of the older adult if there was no spouse) and the amount of household debt [43, 44]. Data were collected on the basis of self-report in the face-to-face interviews. These two factors were selected based on research on family and intergenerational relationships in China [45, 46]. It was common for older couples to live independently of their adult children. The younger generation was less likely to fully share their income with their parents. Therefore, the income of older couples was a better measure of the real economic situation of older adults than household income. On the other hand, the older generation may be under strong pressure to provide financial support to their adult children once debt has arisen. In this case, debt was better measured at household level. Neither the income nor the debt data had a normal distribution. Therefore, the data were log-transformed in the regressions to avoid the influence of extreme values. In addition, in the original data, higher income values mean richer, while higher debt values mean poorer. It was not appropriate to construct a consistent concept of economic status. Therefore, income data have been converted into negative numbers. Both higher income and debt values mean lower economic status.

2.2.3. Social Relations. Based on the available data, two categories of social relations were measured in this study, including the parent-child intergenerational relationship and the social network beyond the family. The intergenerational relationship was operationalized by participants' self-assessment (ranging from 1 to 5, with higher scores indicating a better relationship). To measure social network, a 9-item Lubben Social Network Scale (LSNS) [47] was used in the original survey. In this study, 6 out of the 9 items were selected, which had been validated as the LSNS-6 among older adults in China [48]. The LSNS-6 was constructed from three questions to assess kinship ties and a comparable three questions to assess friendship ties. Total scores could range from 0 to 30, with higher scores indicating a better social network. The internal consistency of this scale in the present sample was 0.89.

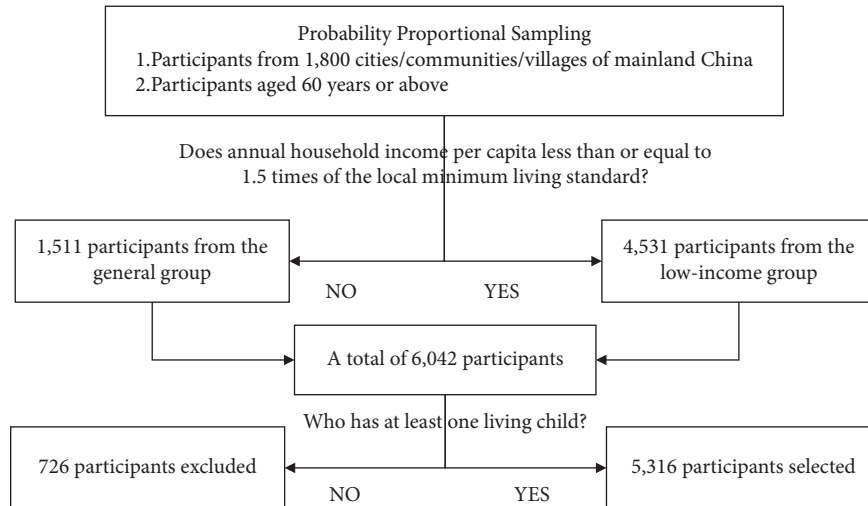


FIGURE 2: Flowchart illustrating the data selection for this study.

2.2.4. Geriatric Depression. The 10-item Center for Epidemiologic Studies Depression Scale (CES-D) [49] was used to measure the severity of geriatric depression. This scale has been widely used and its reliability has been tested in older adults in China [21]. The total score of the CES-D scale ranged from 0 to 30. The CES-D score was taken as a continuous variable, with higher scores indicating more severe depressive symptoms.

2.2.5. Sociodemographic Variables. Basic sociodemographic variables included gender (0 = female, 1 = male), age (in years), marital status (0 = without spouse, 1 = with spouse) [35], and education level (illiterate, primary school, middle school, high school and above) [1, 21]. Current work status (0 = no, 1 = yes), number of living children [27], and previous job stratification (low, middle, high) were also selected as covariates. Job stratification was based on the “ten social strata” theory in China [50, 51]. According to this, jobs can be categorized into ten types and further divided into three levels based on the amount of social resources that can be obtained from each [50].

2.3. Analytic Strategy. SPSS 23.0 and AMOS 21.0 were used for data analysis. First, descriptive analyses of the mean and distribution of the study variables were reported for the study population ($n = 5,316$). Multivariable regression was then used to examine the factors associated with social relations and geriatric depression. Unstandardized coefficients (B), 95% confidence intervals (95% CIs), and the significance levels were reported. Finally, structural equation modelling (SEM) of the integrated model was performed using AMOS. Reported model fit indices included the Chi-square test (χ^2), degrees of freedom (df), normed fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) according to normative standards [52].

3. Results

3.1. Descriptive Characteristics of the Sample. The characteristics of the total sample are summarized in Table 1. Of these, 55.0% were men, 68.7% had a spouse, 59.4% had less

than a middle school education, 15.1% worked in high-level jobs before retirement, and 28.0% were still working in the year of the survey. The mean age of the sample was 69.1 years ($SD = 6.43$) and on average they had more than two adult children (mean = 2.43, $SD = 1.24$). In terms of the physical health, they had on average more than two types of chronic disease (mean = 2.40, $SD = 1.71$). The mean scores for their daily living function and sleep quality were 7.72 ($SD = 2.86$) and 8.24 ($SD = 6.10$), respectively. In terms of economic status, their mean annual income and household debt were 22,382.90 ($SD = 24,599.44$), and 24,408.48 ($SD = 41,956.44$) CNY, respectively. Regarding social relations, the mean scores for intergenerational relationship and social network were 4.17 ($SD = 0.95$) and 13.78 ($SD = 7.04$), respectively. The mean score for the geriatric depression measure was 9.17 ($SD = 6.86$) for the present sample.

3.2. Multivariable Regression Analysis. The proposed model in Figure 1 includes multiple pathways from physical health and economic status to geriatric depression via social relations. Before testing the synthesized model, stepwise regression models were first run to analyze the factors associated with the main outcome variables. Table 2 shows the estimates of associative factors for older adults’ social relations in two facets, namely intergenerational relationship and the social network. The analysis of both facets was carried out using two models. The first one included only sociodemographic variables and other covariates, while the second one added indicators of physical health and economic status. The net effects of the newly included variables can be observed by comparing the explained variances between these two models.

As shown in Table 2, a better intergenerational relationship was positively associated with older people having a spouse ($\beta = 0.142$, $CI = 0.077$ to 0.207 , $p < 0.001$), having a middle school or higher level of education ($\beta = 0.222$, $CI = 0.120$ to 0.324 , $p < 0.001$), worked in medium or high level jobs before retirement ($\beta = 0.209$, $CI = 0.109$ to 0.309 , $p < 0.001$), and had more children ($\beta = 0.043$, $CI = 0.019$ to

TABLE 1: Descriptive statistics of the total sample in this study ($N=5,316$).

Variables	N (%)	$M \pm SD$ (range)
Gender, male	2,924 (55.0)	
Age		69.10 ± 6.43 (60–99)
With spouse, yes	3,650 (68.7)	
Education level		
Illiterate	1,144 (21.5)	
Primary school	2,014 (37.9)	
Middle school	1,386 (26.1)	
High school and above	772 (14.5)	
Job stratification		
Low level	858 (16.1)	
Middle level	3,655 (68.8)	
High level	803 (15.1)	
Work status, yes	1,489 (28.0)	
Number of adult children		2.43 ± 1.24 (1–11)
Physical health		
Number of chronic diseases		2.40 ± 1.71 (0–11)
ADL score		7.72 ± 2.86 (6–24)
ISI score		8.24 ± 6.10 (0–28)
Economic status		
Annual income (CNY)		$22,382.90 \pm 24,599.44$ (3,600–200,000)
Total household debt (CNY)		$24,408.48 \pm 41,956.44$ (0–1,000,000)
Social relations		
Intergenerational relationship		4.17 ± 0.95 (1–5)
Social network score		13.78 ± 7.04 (0–30)
Geriatric depression score		9.17 ± 6.86 (0–30)

Note. ADL, the Activity of Daily Living (to measure social functionings); ISI, the Insomnia Severity Index (to measure sleep quality).

0.067, $p < 0.001$), whereas it was negatively associated with older adults being male ($\beta = -0.147$, $CI = -0.206$ to -0.088 , $p < 0.001$), having more chronic diseases ($\beta = -0.020$, $CI = -0.036$, -0.004 , $p < 0.05$), had worse daily living function ($\beta = -0.026$, $CI = -0.038$ to -0.014 , $p < 0.001$), poorer sleep quality ($\beta = -0.028$, $CI = -0.036$ to -0.020 , $p < 0.001$), and higher household debt ($\beta = -0.022$, $CI = -0.034$ to -0.010 , $p < 0.01$).

Also, in Table 2, a better social network, another facet of favorable social relations, was positively associated with older adults who had a spouse ($\beta = 1.746$, $CI = 1.146$ to 2.346 , $p < 0.001$), had a middle school or higher level of education ($\beta = 2.265$, $CI = 1.309$ to 3.221 , $p < 0.001$), worked in a middle or high level job before retirement ($\beta = 2.213$, $CI = 1.286$ to 3.140 , $p < 0.001$), were still working ($\beta = 0.852$, $CI = 0.286$ to 1.418 , $p < 0.01$), and had more children ($\beta = 0.919$, $CI = 0.699$ to 1.139 , $p < 0.001$), whereas they were negatively associated with older adults being older ($\beta = -0.065$, $CI = -0.110$, -0.020 , $p < 0.01$), being male ($\beta = -2.593$, $CI = -3.146$ to -2.040 , $p < 0.001$), worse daily function ($\beta = -0.317$, $CI = -0.435$ to -0.199 , $p < 0.001$) and sleep ($\beta = -0.196$, $CI = -0.272$ to -0.120 , $p < 0.001$), and lower income ($\beta = -2.460$, $CI = -3.122$ to -1.798 , $p < 0.001$).

Table 3 shows the results of four-step linear regressions on geriatric depression. Variables on sociodemographic characteristics, physical health, economic status, and social relations were added stepwise to determine their specific contribution to geriatric depression. The first model included only sociodemographic variables. It explained 11.2%

of the total variance in geriatric depression. Depressive symptoms were significantly more severe in older adults who were older ($\beta = -0.139$, $CI = -0.172$ to -0.106 , $p < 0.001$), single ($\beta = -1.496$, $CI = -1.923$ to -1.069 , $p < 0.001$), illiterate ($\beta = -4.036$, $CI = -4.722$ to -3.350 , $p < 0.001$), working in low level jobs ($\beta = -1.926$, $CI = -2.614$ to -1.238 , $p < 0.001$) and unemployed ($\beta = -0.936$, $CI = -1.355$ to -0.517 , $p < 0.001$). When the physical health of older adults was taken into account, working status became insignificant, while other factors remained important. All three physical health measures were positively associated with more severe depressive symptoms ($\beta = 0.407$, $CI = 0.317$ to 0.497 , $p < 0.001$; $\beta = 0.613$, $CI = 0.544$ to 0.682 , $p < 0.001$; $\beta = 0.835$, $CI = 0.790$ to 0.880 , $p < 0.001$, for number of chronic diseases, ADL score, and ISI score, respectively).

In model 3, both measures of economic status were significantly associated with geriatric depression, as older adults with lower income and higher household debt may experience more severe depression ($\beta = 1.748$, $CI = 1.368$ to 2.128 , $p < 0.001$; $\beta = 0.381$, $CI = 0.312$ to 0.450 , $p < 0.001$ respectively). This model accounted for 37.8% of the total variance in geriatric depression. Older adults' gender ($\beta = -0.616$, $CI = -0.934$ to -0.298 , $p < 0.001$) and number of adult children ($\beta = -0.271$, $CI = -0.396$ to -0.146 , $p < 0.001$) had a salient relationship with geriatric depression in this model, as women and those with fewer adult children may experience more severe depression. In the final model, social relations were included and this set of variables explained an additional 13.3% of the total variance. A better intergenerational relationship ($\beta = -0.880$, $CI = -1.029$ to

TABLE 2: Results of regressions on intergenerational relationship and social network (N = 5,316).

	Intergenerational relationship		Social network	
	Model 1 B (95% CIs)	Model 2 B (95% CIs)	Model 1 B (95% CIs)	Model 2 B (95% CIs)
Constant	3.798 (3.459, 4.137)***	4.185 (3.734, 4.636)***	16.794 (15.583, 18.005)***	12.325 (8.109, 16.541)***
Gender (female = 0)	-0.122 (-0.181, -0.063)***	-0.147 (-0.206, -0.088)***	-2.674 (-3.219, -2.129)***	-2.593 (-3.146, -2.040)***
Age	0.000 (-0.004, 0.004)	-0.004 (-0.008, 0.000)	-0.044 (-0.089, 0.001)	-0.065 (-0.110, -0.020)**
With spouse (no = 0)	0.169 (0.095, 0.243)***	0.142 (0.077, 0.207)***	2.447 (1.865, 3.029)***	1.746 (1.146, 2.346)***
Education level (illiterate = 0)				
Primary school	0.079 (0.005, 0.153)	0.044 (-0.029, 0.117)	1.669 (0.977, 2.361)	1.205 (0.521, 1.889)
Middle school	0.241 (0.159, 0.323)***	0.149 (0.065, 0.233)***	2.814 (2.048, 3.580)***	1.550 (0.770, 2.330)***
High school and above	0.335 (0.235, 0.435)***	0.222 (0.120, 0.324)***	3.930 (2.997, 4.863)***	2.265 (1.309, 3.221)***
Job stratification (low level = 0)				
High level	0.259 (0.159, 0.359)***	0.209 (0.109, 0.309)***	2.963 (2.028, 3.898)***	2.213 (1.286, 3.140)***
Middle level	0.118 (0.040, 0.196)*	0.095 (0.019, 0.171)*	0.883 (0.150, 1.616)*	0.785 (0.064, 1.506)*
Work status (no = 0)	0.038 (-0.023, 0.099)	0.011 (-0.050, 0.072)	0.930 (0.360, 1.500)**	0.852 (0.286, 1.418)**
Number of adult children	0.031 (0.007, 0.055)*	0.043 (0.019, 0.067)***	0.693 (0.475, 0.911)***	0.919 (0.699, 1.139)***
Number of chronic diseases		-0.020 (-0.036, -0.004)*		-0.097 (-0.252, 0.058)
ADL score		-0.026 (-0.038, -0.014)***		-0.317 (-0.435, -0.199)***
ISI score		-0.028 (-0.036, -0.020)***		-0.196 (-0.272, -0.120)***
Converted income		-0.070 (-0.141, 0.001)		-2.460 (-3.122, -1.798)***
Converted debt		-0.022 (-0.034, -0.010)**		-0.023 (-0.143, 0.097)
Summary statistics				
Adjusted R ²	0.184	0.356	0.254	0.414

Note. 1: ADL, the Activity of Daily Living (to measure social functioning); ISI, the Insomnia Severity Index (to measure sleep quality). Income and debt data were converted in this analysis. Detailed rules are given in the method part (measurement of economic status). Note. 2: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

TABLE 3: Results of stepwise regression for geriatric depression in China (N = 5,316).

	Model 1 B (95% CIs)	Model 2 B (95% CIs)	Model 3 B (95% CIs)	Model 4 B (95% CIs)
Constant	23.550 (21.218, 25.882)***	10.380 (8.485, 12.275)***	15.128 (12.705, 17.551)***	19.879 (17.454, 22.304)***
Gender (female = 0)	-1.299 (-1.701, -0.897)	-0.210 (-0.528, 0.108)	-0.616 (-0.934, -0.298)***	-0.980 (-1.290, -0.670)***
Age	-0.139 (-0.172, -0.106)***	-0.102 (-0.127, -0.077)***	-0.065 (-0.090, -0.040)***	-0.074 (-0.099, -0.049)***
Having a spouse (no = 0)	-1.496 (-1.923, -1.069)***	-1.429 (-1.764, -1.094)***	-0.862 (-1.207, -0.517)***	-0.583 (-0.918, -0.248)***
Education level (illiterate = 0)				
Primary school	-1.421 (-1.929, -0.913)***	-0.846 (-1.246, -0.446)***	-0.620 (-1.012, -0.228)***	-0.471 (-0.851, -0.091)*
Middle school	-3.469 (-4.032, -2.906)***	-1.959 (-2.406, -1.512)***	-1.335 (-1.784, -0.886)***	-1.061 (-1.496, -0.626)***
High school and above	-4.036 (-4.722, -3.350)***	-2.155 (-2.698, -1.612)***	-1.370 (-1.919, -0.821)***	-0.970 (-1.503, -0.437)***
Job stratification (low level = 0)				
High level	-1.926 (-2.614, -1.238)***	-1.050 (-1.591, -0.509)***	-0.702 (-1.235, -0.169)*	-0.318 (-0.835, 0.199)
Middle level	-0.661 (-1.200, -0.122)*	-0.095 (-0.518, 0.328)	-0.122 (-0.538, 0.294)	0.034 (-0.368, 0.436)
Work status (no = 0)	-0.936 (-1.355, -0.517)***	-0.043 (-0.374, 0.288)	-0.341 (-0.666, -0.016)	-0.251 (-0.567, 0.065)
Number of adult children	0.012 (-0.147, 0.171)	-0.086 (-0.211, 0.039)	-0.271 (-0.396, -0.146)***	-0.151 (-0.274, -0.028)*
Number of chronic diseases		0.407 (0.317, 0.497)***	0.393 (0.305, 0.481)***	0.366 (0.280, 0.452)***
ADL score		0.613 (0.544, 0.682)***	0.533 (0.464, 0.602)***	0.483 (0.416, 0.550)***
ISI score		0.835 (0.790, 0.880)***	0.794 (0.749, 0.839)***	0.751 (0.708, 0.794)***
Converted income			1.748 (1.368, 2.128)***	1.466 (1.096, 1.836)***
Converted debt			0.381 (0.312, 0.450)***	0.360 (0.293, 0.427)***
Intergenerational relationship				-0.880 (-1.029, -0.731)***
Social network score				-0.089 (-0.105, -0.073)***
Summary statistics				
Adjusted R ²	0.112	0.352	0.378	0.511

Note. Same notes as shown in Table 2.

-0.731 , $p < 0.001$) and higher social network scores ($\beta = -0.089$, $CI = -0.105$ to -0.073 , $p < 0.001$) were associated with fewer depressive symptoms.

3.3. Fully Estimated Structural Equation Model. Before performing the SEM analysis, a correlation matrix of all variables included in the model was presented in Table 4. Geriatric depression was significantly associated with number of chronic diseases ($r = 0.312$, $p < 0.001$), ADL score of daily living function ($r = 0.445$, $p < 0.001$), ISI score of sleep quality ($r = 0.637$, $p < 0.001$), converted income ($r = 0.276$, $p < 0.001$), converted debt ($r = 0.276$, $p < 0.001$), intergenerational relationship ($r = -0.251$, $p < 0.001$), and social network ($r = -0.255$, $p < 0.001$).

Figure 3 shows the fully estimated SEM. The results addressed the question of the mediating role that social relations might have on the relationship between physical health, economic status, and geriatric depression. This integrated model had a good fit to the observed dataset (Chi-square = 284.443, $df = 15$, NFI = 0.959, CFI = 0.961, RMSEA = 0.058). As hypothesized, the results showed that physical health had a salient relationship with geriatric depression, indicating that participants who had more types of chronic diseases, poorer daily living function and worse sleep quality tended to have more depressive symptoms (direct effect = 0.6, $p < 0.001$). The poor economic status of older adults, represented by lower income and higher debt, may also have direct effects on geriatric depression (direct effect = 0.22, $p < 0.001$). Social relations seemed to mediate the effects of poor physical health and economic status on it. Those with poorer physical health and living in economic deprivation were more likely to have poorer intergenerational relationships and social network, and therefore more depressive symptoms.

4. Discussion

In response to the increasing attention paid to the psychological wellbeing of older adults [4, 9, 10] and the lack of information on older adults in China [7, 21], this study investigated the mechanisms linking physical health and economic status with geriatric depression in the Chinese older population. This study was guided by the stress-buffer theory [53]. It was hypothesized that geriatric depression would be shaped not only by the decline in physiological function and worsening economic conditions of older adults, but also by their negative impact on social relations. Analyses of data from 5,316 participants (≥ 60 years) in China provided evidence supporting our proposed integrated model of physical health, economic status, social relations and geriatric depression.

Consistent with the well-established literature on geriatric depression [8, 11], this study showed that the decline in physiological function and economic deprivation, as major stressors alongside the aging process, were strongly associated with geriatric depression. The findings regarding the associations of daily living function and sleep quality with geriatric depression were consistent with previous research

[7, 54]. Previously, the associations between depression and chronic diseases were examined by the type of disease [55]. This kind of estimation has been criticized due to the overlap of chronic disease symptoms with those of depression [56]. In this study, we counted the number of chronic diseases suffered by older adults. The results suggest a significant positive association between the number of chronic diseases and geriatric depression. While the association between income and depression has been documented several times [8, 11], this study further showed that debt also plays a role in influencing the psychological well-being of older adults [34, 57].

Social relations, in terms of both the intergenerational relationship and social network, were strongly associated with geriatric depression, as has been widely recognized [58]. By testing the integrated model, this study further highlighted the process by which physical health and economic status may influence older adults' mental health through their negative impact on social relations. Older adults' daily living function and sleep quality had a salient relationship with both measures of social relations. However, only the number of chronic diseases had a salient relationship with the intergenerational relationship. Adult children may be called upon to manage chronic diseases and care for these older adults, thus increasing intergenerational tension [59]. In terms of economic status, higher household debt was significantly associated with poorer intergenerational relationship, while income played a role in shaping older adults' social networks. Debt was more likely to be a stressor for family members, leading to anxiety and tension within the family [60].

It is well known that there are gender differences in geriatric depression [61]. This study also found that women had more depressive symptoms than men. Meanwhile, older women also had better intergenerational relationship and social network than their counterparts. There may also be gender differences in the way social relations buffer geriatric depression. Having a spouse was associated with better social relations [62]. The psychological wellbeing of older people without a spouse may deserve special attention, as they suffered not only from loneliness within the family but also from the decline of other social relations. Age was not associated with intergenerational relationship but was important in shaping older adults' social network and depressive symptoms. This may be partly explained by the homogeneity of older people's social networks. As they grow older, more friends and relatives may have died, leading to a shrinking of the social network and thus affecting their psychological well-being [63]. This study found that older people with more children enjoyed better social relations and suffered less from geriatric depression, which is consistent with the traditional Chinese concept of "more children, more blessings" [27].

Chinese society is getting older before it gets rich [64]. Negative changes in the physiological and social functions of older adults make them extremely disadvantaged. Meanwhile, the formal policy system to support them is still underdeveloped. In this case, social relations are of paramount importance for older adults to maintain a good life

TABLE 4: Correlations between variables included in the structural equation model (N=5,316).

Variables	1	2	3	4	5	6	7	8
Number of chronic diseases	1							
ADL score	0.299***	1						
ISI score	0.327***	0.415***	1					
Converted income	0.027	0.211***	0.161***	1				
Converted debt	0.120***	0.168***	0.208***	0.161***	1			
Intergenerational relationship	-0.086***	-0.299***	-0.175***	-0.140***	-0.061***	1		
Social network score	-0.061***	-0.183***	-0.132***	-0.182***	-0.034**	0.275***	1	
Depressive symptoms	0.312***	0.445	0.637***	0.276***	0.276***	-0.251***	-0.255***	1

Note. Same notes as shown in Table 2.

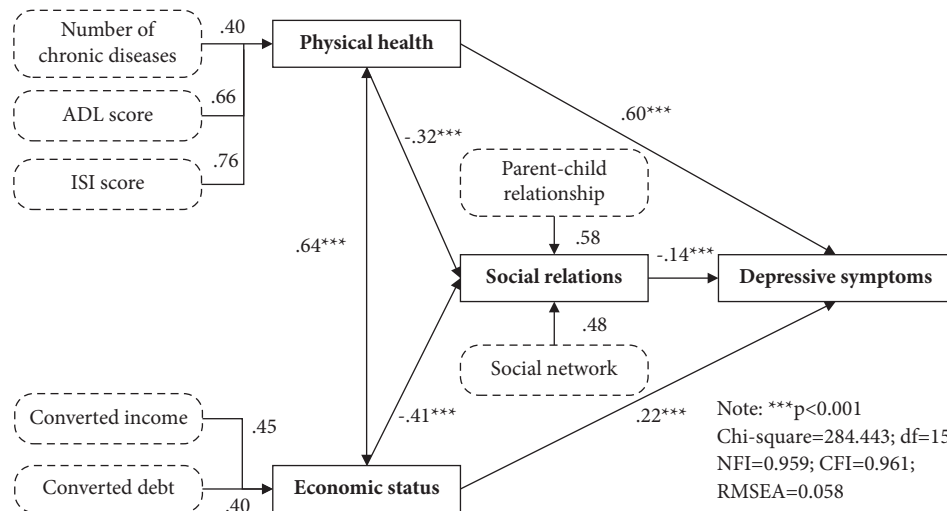


FIGURE 3: The fully estimated model connecting physical health and economic status to depression. Note. Same notes as shown in Table 2.

[27]. By testing an integrated model, this study revealed the relative effects of physical health, economic status and social relations in shaping the psychological wellbeing of older adults. Physical health was the most important in explaining the variation in geriatric depression, followed by economic status and social relations. It should be noted that poor physical health and low economic status can be mutually reinforcing for older adults, as the poor health can increase the economic burden, and conversely, financial stress in old age can exacerbate its negative effects on both physical and mental health [13, 28]. This integrated model may be more applicable to older adults who are economically disadvantaged, as they may face more stressors than those who are well-off.

The policy implications are threefold. First, given the strong and significant association between physical health and geriatric depression, further policy discourse on “healthy aging” should combine both physical and mental health [65]. Measures should be taken to improve the accessibility and convenience of treatment for older adults, especially those with multiple chronic conditions. Second, the pension system should be further strengthened to alleviate their financial burden. Special financial support is still needed for older adults with low economic status and has been shown to be effective in addressing mental health problems [66]. Third, the negative

impact of physical health decline and low economic status on social relations should be addressed. Further policies on family interventions should be developed to eliminate intergenerational tensions and meet the emotional needs of older people [27]. Meanwhile, improving their social network should also be taken as a serious task for the community building in China [67].

There are several limitations in this study. First, this study used a cross-sectional design and the pathways tested were based on theoretical assumptions [53]. Further studies may benefit from adopting a longitudinal design to verify the effects of declining physical health, increasing financial stress and shrinking social relations on geriatric depression, as well as examining the dynamics of mental health associated with these changes [68]. The use of secondary data also limited detailed analysis of the intergenerational relationship facet. It should be further explored across different household compositions and living arrangements [18, 21]. Second, only older people living in communities were surveyed, and this study further limited the sample to older adults with at least one living child. Further research attention should be paid to older people without children and those living in institutions. The role of social relations may be different for them. Third, the relationship between spouses, an important dimension of social relations, was not included in the survey. This study was also limited to

showing how physical health and economic status may influence geriatric depression by affecting the spousal relationship. In line with a previous study [62], the current study showed that having a spouse was protective for geriatric depression. Future studies could consider measuring the closeness of the spousal relationship and examining its impact on the psychological well-being of older adults. Meanwhile, this study simplified marital status as a binary variable (no spouse/with spouse) due to limited observations on the categories “never married” and “divorced.” Widowed older adults are likely to have a different status from those who never married or divorced. Further studies should investigate different marital status. Fourth, the way in which social relations can buffer the negative effects of declining physical health and worsening economic status on geriatric depression may differ for rural and urban older adults, as one study found that the effect of social connectedness with family was more strongly associated with reduced depressive symptoms for rural older adults, whereas the social network with friends was greater for urban older adults [20]. Further research is needed to identify rural-urban differences for this integrated model. Fifth, the measures of economic status in this study were based on self-reports of income and indebtedness. Further refined study should add assets, home-grown food supply and other assessments to increase the precision of economic status measurement. Finally, this study is rooted in the Chinese context, where social relations play an important role in supporting older adults. The results of this study may not be fully applicable to other social contexts. Meanwhile, this study is based on a survey with a large proportion of older adults from low-income families, which fits well with the proposed model, but may be limited in representing the general older population in China.

5. Conclusion

Previous studies have highlighted the important role of poor physical health and economic status as two major stressors in shaping the psychological wellbeing of older adults. Meanwhile, the role of social relations in buffering geriatric depression has also been investigated. However, these studies are fragmented and limited in their ability to elucidate the process by which declining physical health and increased financial stress may induce geriatric depression. Based on the stress-buffer theory, the process was investigated using SEM. Social relations, measured by intergenerational relationship and social network, were used as buffers. Despite the limitations mentioned above, this is one of the first studies to do so. The findings based on the Chinese context suggest that declining physical health and poor economic status may have a negative impact on social relations, which further worsens the mental health of older adults. To address this, some special attention should be paid to protecting the health and economic rights of older adults. Interventions that help to improve either the intergenerational relationship or the social network would also be helpful. Although rooted in the Chinese context, the potential universality of our integrated model should also be noted. It may be partially applicable in several other Asian and African countries, and even in some Western countries,

where intergenerational dependency and social support are common.

Data Availability

The survey was officially initiated and sponsored by the Ministry of Civil Affairs of the People’s Republic of China and conducted by the Institute of Social Science Survey, Peking University. The data were not publicly available. Restrictions apply to the availability of these data, which were used under license for the current study. Researchers interested in these data can contact the corresponding author (hhwruc888@126.com) to process the data request.

Ethical Approval

This official survey was initiated, approved, and sponsored by the Ministry of Civil Affairs of the People’s Republic of China.

Consent

All research participants received informed consent of this survey, including a detailed explanation for it.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Authors’ Contributions

Conceptualization and formal analysis were done by Yuehui Yu. Yuehui Yu also wrote the original draft. Xinyi Hu reviewed and edited the article. Conceptualization and review and editing were done by Hongwei Hu.

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