Does social pension expansion relieve depression and decrease medical costs? Evidence from the rural elderly in China

Authors and Affiliation:
Mi Zhou[1] Xiaotong Sun[1] Li Huang[1*]
[1] College of Economics and Management, Shenyang Agricultural University, Shenyang, 110866, Liaoning, China, Email: zhoumi2011@syau.edu.cn, sunxiaotong1211@stu.syau.edu.cn, lilyhuang@syau.edu.cn
[*] Correspondence: lilyhuang@syau.edu.cn (L.H.);Tel.:+86 13897954628

Abstract

Objectives: The goal of this paper is to determine whether the New Rural Pension Scheme positively or negatively impacts depressive symptoms and medical costs induced by depression among the elderly in rural China. In pursuing this research goal, we examine the overall effects of the New Rural Pension Scheme on depressive symptoms and medical spending, and explore the mechanism through which these impacts occur, specifically, confidence about the future among the rural elderly. Pension income may improve mental health by making pension recipients more confident about the future. Therefore, New Rural Pension Scheme can reduce psycho-social stress and adverse moods associated with financial hardship, as well as increase self-esteem and sense of control.

Methodology: This paper uses the Probit, OLS and 2SLS models to analyze the causal effect of the New Rural Pension Scheme on depressive symptoms and medical costs induced by depression among rural elderly in China.

Key Findings: Using nationally representative panel dataset from the CFPS, we demonstrate that the New Rural Pension Scheme significantly decreased both mental health problems and the medical expenditure induced by depressive symptoms and depression among rural elderly in China. Specifically, the depressive symptoms of pension recipients is, on average, 5.2% lower than that of non-recipients in the baseline regression, while it is 16.6% lowers in the IV estimations. The rate of depression is 14.4 percentage points lower among pension recipients. Medical costs induced by depressive symptoms of pension recipients are, on average, 4.5% lower than that of non-recipients in the baseline regression and 56.8% lower in the IV estimations. The quantity of medical expenditures due to depression are 6.5 percentage points lower among pensioners. The trend is the same for monthly pension income. This finding indicates that mental health and medical costs induced by depressive status are indeed an issue in China, and steps must be taken to perfect the pension system and improve mental health among rural elderly.

Although it appears that the rural elderly in China as a whole are affected by pension enrollment or income and, therefore, see improved mental health and reduced medical spending induced by depression, our results also show that the influence is particularly great for certain subgroups. One possible explanation of this phenomenon is that pensions play different roles in

the lives of different groups. For example, the New Rural Pension Scheme has a greater effect on mental health and medical costs for men than women. Men spend more on daily expenses than women because of drinking and smoking. As a result, the impact of pension income on mental health is more pronounced in male groups. Less-educated rural elderly may suffer from less depression when they participate in the pension scheme. The New Rural Pension Scheme is a system in which rural elderly participate voluntarily. This scheme can improve a sense of self-actualization, and the promotion of spiritual comfort may lead to less serious depression, especially for vulnerable groups. The impact of pension enrollment and pension income on mental health was even greater among rural elderly without chronic diseases. The pension is too small to treat chronic diseases. Rural elderly who received both pensions from the program and economic support from their children have fewer medical costs induced by depressive status. This may be due to the dual benefits of pension income and financial support from children. However, those without economic support from their children also see decreased depressive symptoms and depression when receiving pensions. One possible reason is that pension income plays a greater role in their mental health.

Conclusion and Recommendations

From a policy perspective, our results suggest that the Chinese government needs to perfect the New Rural Pension Scheme to eliminate income-caused barriers to mental health, especially for the rural elderly. Specifically, the government should raise the level of pension benefits gradually and reasonably. The level of pension benefits is the basis for measuring the effect of the New Rural Pension policy, and it is the economic support for the role of the pension scheme. Secondly, the rural elderly should be encouraged to participate in the New Rural Pension Scheme actively. At present, willingness to participate and the level of payment are both low. The government should explore the flexible use of various pension accounts to provide more choices for the rural elderly. Lastly, rural endowment resources should be integrated to establish a sound rural pension system.

Keywords: Rural elderly; Pension enrollment; Pension income; Depression; Medical expenditure

Introduction

By 2020, depression will become the second largest killer of mankind, trailing only cancer (Wu and Wang 2010). The number of depressive patients in China has reached 90 million (Sun et al. 2020). Research shows that the detection-rate for depression in Chinese elderly people has reached 33% of the population in recent years (Nie et al. 2013; Miao and Zhang 2017). Studies have also shown that the rural elderly, as a group, are less able to care for themselves, have worse economic and physical status, and exhibit more serious depression symptoms than the urban elderly (Zhou et al. 2018). Depression seriously impairs the physical and mental health of the rural elderly (Pennebaker et al. 1988; Mayne 1999). For example, depression increases the incidence of acute diseases (such as cancer and heart disease) and chronic diseases (such as arthritis, high blood sugar, high cholesterol, and high blood pressure) among the rural elderly (Mund and Mitte 2012). A study conducted in China found that the per annual capita medical expenditure of depression and depressive symptoms among adults was estimated at 268.8 CNY in 2012. For the elderly, the cost is as high as 525.6 CNY (Hsieh and Qin 2018).

Studies have shown that there is a relationship between income and health (Chen et al. 2019). The New Rural Pension Scheme is an important source of income for the rural elderly in China. The New Rural Pension Scheme is a program established in 2008 that combines social pooling and personal accounts. It is financed by a combination of personal contribution, collective subsidies, and government subsidies. Although the New Rural Pension Scheme grants some income, compared with those in urban areas, the income of the rural elderly is lower (Sun 2017). To our knowledge, while early studies found a strong relationship between pension income and mental health (Marmot 1994), few studies have demonstrated a causal relationship (Marmot 2002; Deaton 2002). Findings also conflict. For instance, Snyder and Evans (Snyder and Evans 2006) find that higher pension income leads to higher mortality, while others find that higher pension income leads to better health (Case 2001) and lower mortality (Jensen and Richter 2004).

Given this mixed evidence, the goal of this paper is to determine whether the New Rural Pension Scheme positively or negatively impacts depressive symptoms and medical costs induced by depression among the elderly in rural China. In pursuing this research goal, we examine the overall effects of the New Rural Pension Scheme on depressive symptoms and medical spending, and explore the mechanism through which these impacts occur, specifically, confidence about the future among the rural elderly. Pension income may improve mental health by making pension recipients more confident about the future. Therefore, New Rural Pension Scheme can reduce psycho-social stress and adverse moods associated with financial hardship, as well as increase self-esteem and sense of control (Fernald and Gunnar 2009; Baird et al. 2013). This paper uses the Logit, OLS and 2SLS models to analyze the causal effect of the

New Rural Pension Scheme on depressive symptoms and medical costs induced by depression among rural elderly in China.

New Rural Pension Scheme

"New Rural Pension Scheme" refers to a recently established new program that combines social pooling and personal account since 2008. It is financed by a combination of personal contribution, collective subsidy, and government subsidy.

The basic pension financed solely by the government is available to all enrollees at age 60 (Chen et al. 2017a). While the New Rural Pension Scheme was rolled out at the county level, the level of basic pension is set at the provincial level. Many provinces set 55 CNY (or around 9 USD) per month as the basic pension benefit, although a few wealthier provinces (e.g., Beijing, Tianjin) set the benefit at up to 360 CNY (or around 60 USD) per month. The government fully finances all basic pension benefits.

Regarding the individual (or contributory) account, according to the guidance released by the State Council of China, there are five categories of premiums for individual accounts: 100, 200, 300, 400, and 500 CNY per year per person. While some provinces offer additional higher levels of individual premiums, a majority of participants choose to contribute 100 CNY per year per person, the lowest level of pension premium (Lei et al. 2013). The financing of the pension benefits comes in part from a government subsidy of 30 CNY per person per year for the first 100 CNY of individual premiums contributed to the individual account; there is a lower than proportional subsidy for additional individual premiums contributed.

At the time of the roll-out, the provisions for the individual account differed by age. Adults below age 45 at New Rural Pension Scheme rollout must contribute to the individual account for at least 15 years to be eligible to receive benefits drawn from the individual account at age 60 (of course, they would be eligible for the basic pension conditional on making these contributions). Those age 45–59 at New Rural Pension Scheme implementation may contribute for any length of time to be eligible for the individual account benefit.

Conceptual frameworks

The determinants of mental health are complicated, involving socioeconomic and physical environments at different stages of life (WHO 2014). In our context, mental health has been found to be associated with socioeconomic status (e.g. marital status, education, income) and physical health (e.g. chronic disease) for the aging population in China (Lei et al. 2014; Li et al. 2014; Qin et al. 2016). Special attention should be paid to income as it not only affects mental health directly through investments in mental health but indirectly via other socioeconomic factors and physical health conditions.

Grossman's framework suggests that pension payments to the older cohort (those age 60 or greater) may affect mental health through at least three plausible channels: (i) changes to

lifestyle factors, such as independent living, service consumption, leisure time, and connectedness with friends and communities; (ii) health investments, such as nutritional intake and medical treatment; and (iii) economic security leading to reduced financial stress.

First, elders who prefer to live independently and are able to do so due to increased income likely have better mental health through channel (i). This is in part because these individuals have a greater sense of self-actualization. The atomization of extended families may reduce family conflicts (The Economist 2014). Recent studies on the New Rural Pension Scheme show that pension results in older Chinese living more independently (Cheng et al. 2015), spending less time caring for grandchildren (Chen et al. 2017b), and with children of older Chinese more likely to move out or even migrate away from the home county (Chen 2017).

Second, health care resources are often expensive in low- and middle-income countries where individuals often rely on out-of-pocket funds to finance medical care. Through channel (ii), pension income may improve mental health via reducing the relative cost of inputs for health. The combination of widespread stigma regarding mental illness (Fung et al. 2007; Young and Ng 2016), poor mental health literacy (Wong et al, 2012) and limited capacity to treat mental illness in China (The Economist 2017) results in a low fraction (8%) of Chinese with mental illness being treated (Xiang et al. 2012). Therefore, we expect the health investment channel is mainly indirect, i.e. through better nutrients intake and treatment for physical health conditions that, in turn, improve mental health.

Third, pension income may improve mental health through channel (iii), i.e., reduced psychosocial stress and adverse moods associated with financial hardship as well as increased self-esteem and sense of control (Fernald and Gunnar 2009; Baird et al. 2013).

Methods

Data Source and Sampling

The panel dataset used for this study comes from the China Family Panel Studies (CFPS) data for the years 2012 and 2016. The CFPS is a nationally representative, longitudinal social survey that was launched in 2010 and is conducted biennially by the Institute of Social Science Survey (ISSS) at Peking University, China. The survey design is based on the Panel Survey of Income Dynamics (PSID), the National Longitudinal Surveys of Youth (NLSY), and the Health and Retirement Study (HRS) in the United States. It focuses on a range of topics related to educational outcomes, economic activities, migration, health, and family dynamics. The survey collects data at three levels: the individual, family, and community levels.

The CFPS surveyed respondents in sampling units in 25 provinces (all provinces except Xinjiang, Tibet, Qinghai, Inner Mongolia, Ningxia, and Hainan), a sampling frame that represents 95% of the Chinese population. To generate a nationally and provincially representative sample, the CFPS adopted a “Probability-Proportional-to-Size” (PPS) sampling strategy with multi-stage stratification and carried out a three-stage sampling process. The first

stage was the Primary Sampling Unit, in which county level units were randomly selected. In the second stage, village level units (villages in rural areas and neighborhoods in urban areas) were selected. In the third stage, households from the village level units were selected according to the systematic sampling protocol of the study. All members present at the time of surveying in each household were interviewed.

Following an initial baseline survey wave in 2010, ISSS conducted four follow-up surveys in 2012, 2014, 2016 and 2018. For the purposes of the survey, we examine the spending of rural elderly who were 60 years old or older at the time of the 2012 survey and 64 years old or older at the time of the 2016 survey. In this study, we use CFPS data for the years 2012 and 2016, which include the same depression scale (Center for Epidemiologic Studies Depression Scale), to create a panel dataset. This dataset includes 2,938 rural elderly for both years, after excluding observations with missing information (Figure 1). This panel allows us to examine the depressive symptom outcomes of the rural elderly over these two periods.

Measurement

The key block of the survey questionnaire for this study was made up of questions from the Center for Epidemiologic Studies Depression Scale (CES-D). The CES-D scale has been widely used in the international literature to evaluate symptoms of depression (Radloff 1977; Link et al. 1997). The CES-D scale includes 20 items that are designed to evaluate four aspects of depression and is scored on a Likert scale with four possible answers corresponding to how often the respondents experienced a given emotion within the past week: “less than 1 day; score= 0”, “1-2 days; score= 1”, “3-4 days; score= 2”, and “5-7 days; score= 3”. The total CES-D score can thus be calculated as follows:

$$CES-D=\sum_{i} Score_{i,somatic}+\sum_{j} Score_{j,interpersonal}+\sum_{k} Score_{k,depressed}+\sum_{l}(3-Score_{l,positive}), \quad (1)$$

where $Score_{i,\ somatic}$, $Score_{j,\ interpersonal}$, $Score_{k,\ depressed}$, and $Score_{l,\ positive}$ represent the score for the ith question on the somatic-retarded activity, the jth question on interpersonal relations, the kth question on the depressed affect, and the lth question on the positive affect, respectively.

Scores range from 0 to 60. We set our threshold values based on the 80th and 95th percentile of the CES-D distribution in the national sample of CFPS dataset: a CES-D score between 20 and 28 indicates “depressive symptoms”, and scores of 28 or higher indicate “depression” (Hsieh and Qin 2018). The Chinese version of CES-D has been used in previous research and its reliability and its validity has been tested among Chinese populations (Rankin and Galbraith 1993; Greenberger et al. 2000).

Results

Descriptive Analysis

The characteristics of the main variables are displayed in Table 1 using the panel dataset. The mean CES-D score of the rural elderly was 14.799, among which 17.7% were depressive symptoms and 10.1% suffered from depression. Depression can create a serious medical burden (Sun et al. 2020). Medical expenses induced by depressive symptoms (depression) for the rural elderly were 481.062CNY (383.977 CNY) per month. In terms of the New Rural Pension Scheme, 60.1% of rural elderly participated in the pension, of which each person received an average of 118.994 CNY per month.

Regression results

Table 2 Group A lists the key regression results. The baseline regression model indicates that pension enrollment has a significant effect on both the probability of suffering from depressive symptoms and depression among the rural elderly. Specifically, the regression results report that rural elderly who participate in the New Rural Pension Scheme are 5.2% less likely to suffer from depressive symptoms and 14.4% less likely to be depressed than people without pension. These conclusions are consistent with existing findings that show that pension enrollment significantly relieves depression (Chen et al. 2019). Table 2 Group B shows the regression outcomes found by using monthly pension income as an explanatory variable. The outcomes are similar to those from Table 2 Group A. To be specific, Table 2 Group B shows that rural elderly who have more pension income per month are 1.6% less likely to suffer from depressive symptoms and 4.9% less likely to be depressed.

Table 3 Group A lists key regression results about the influence of pension enrollment on medical cost induced by depression or depressive symptoms. The results indicate that the rural elderly who participate in the New Rural Pension Scheme spend 4.5%/6.5% less on medical services due to depressive symptoms and depression per year, respectively.

Table 3 Group B shows the regression outcomes about the effect of pension income on medical spending due to depressive status. The outcomes are similar to those from the Table 3 Group A. To be specific, Table 3 Group B shows that pension income on average decreases medical costs caused by depressive symptoms and depression by 1.3% and 1.9%, respectively.

Main results based on IV regression

In the first stage estimation, we examine the correlation between community-level monthly pension income and individual pension enrollment (Table 4 Group A), including the quantity of pension benefits (Table 4 Group B). Results for the rural elderly indicate that community-level monthly pension income increases the probability of enrollment by 13.9 percentage points (Table 4 Group A column (1)) and pension income by 78.1 CNY (Table 4

Group B column (1)). These results indicate that monthly pension income at the county level is a strong instrument for both pension enrollment and pension benefits.

In the second stage, the effects of pension enrollment (Table 4 Group A) and pension income (Table 4 Group B) on mental health and medical costs indicate that pension significantly reduced the degree of depression and the medical expenses due to depressive symptoms and depression. The depressive symptoms of pension recipients is 16.7% points lower on average than that of non-recipients in the IV regression, while it is 27 percentage points lower in the depression. The medical cost due to depressive symptoms/depression is 57.1/60.8 percentage points lower among pension recipients, respectively. The salient difference between the IV estimates and the OLS estimates indicates the importance of using the IV strategy to resolve the endogeneity of pension enrollment. Table 4 Group B shows the regression outcomes about the effect of pension income on medical spending due to depressive status based on IV regression. The outcomes are similar to those from Table 4 Group A.

Main results based on mediating effect regression

The determinants of mental health and medical spending are complicated, involving socioeconomic factors and physical environments that vary across different stages of life (WHO 2014). Pension enrollment or pension income may improve mental health by increasing confidence about the future. Firstly, we verified the impact of pension enrollment and pension income on future confidence. As is shown in Table 5 (1)-(2), rural elderly who participate in the New Rural Pension Scheme will see an increase in confidence of 0.172 units. In terms of rural elderly pension income, an increase of 1 CNY per month, causes an increase of confidence in the future of 4.8%. Secondly, we verified the effect of the confidence about the future on mental health and medical costs induced by depressive status. Table 5 shows that each increase in confidence was associated with a 26% drop in depressive symptoms and an 18.3% drop in medical expenses induced by depressive symptoms. After considering the mediating effect, the influence of the New Rural Pension Scheme on depressive symptoms and medical costs is still significant, indicating that confidence plays an incomplete mediating effect.

Heterogeneity analysis and robustness test

Heterogeneity analysis

To discuss the effect of New Rural Pension Scheme on mental health or medical cost induced by depression in different characteristics of rural elderly, we divided the rural elderly into different groups by gender, education, chronic disease and economic support from children to discuss the heterogeneous effects. First, Table 6 shows heterogeneity analysis based on gender. Compared to men, fewer women smoke or drink, and fewer women attend social events (Tomiak et al. 1997). Therefore, pension income has a greater effect on mental

health for men. As a more specific example, pension enrollment and income have a significant impact on depressive status and medical spending induced by depression among elderly rural men. This result indicates that pension benefits may remove financial constraints for men.

Second, almost two thirds of the rural elderly in the CFPS national sample are illiterate or semi-illiterate, defined as having not completed primary education. To determine whether the effects we find differ by educational background, we divide the rural elderly sample into three groups, including individuals who are illiterate or semi-illiterate, those who completed only primary education, and those who completed junior high school. Table 7 shows that pension income is the most effective in reducing depressive symptoms or medical cost for the illiterate or semi-illiterate group, which is consistent with recent evidence in the U.S. (Ayyagari 2015).

Third, the influence of pension enrollment and income on mental health or medical cost may vary according to the physical health of the rural elderly. Chronic diseases are more common among the elderly (Wang and Li 2014). Therefore, we examined the heterogeneity of the effect of pensions on depression based on chronic disease. As is shown in Table 8, the negative effect of pension on mental health was significant among healthy rural elderly. The possible reason is that those with chronic diseases are not getting enough pension income to treat chronic disease.

Finally, it is likely that rural elderly with economic support from their children may benefit more than those without, due to doubled benefits. We divide the rural elderly sample into two sub-samples: those who have economic support from their children, and those who do not. Table 9 indicates that rural elderly with who participated in the New Rural Pension Scheme who had economic support from their children will decrease the medical expense induced by depressive symptoms and depression. This may be due to the dual benefits of pension income and financial support for children. However, Table 9 shows that those without economic support who receive pension income will show a decrease in depressive symptoms. One possible reason is that pension income plays a greater role in their mental health.

Robustness test

1. Quantile regression

In this part, a robustness check is described to provide reassurance that the main estimation results hold. We consider the quantile regression models by using CES-D score as the explained variable. Table 10 indicates that pension enrollment significantly reduced CES-D scores of the rural elderly, as did monthly pension income. The result is significant for any quantile. The research about the effect of pension enrollment or pension income on depression is robust.

2.Regression discontinuity

In the main regression above, to avoid reverse causation and omitted variable bias and obtain unbiased and consistent estimates, we measure community-level monthly pension income and use this variable as an instrument for actual pension enrollment status and pension income. In order to test the robustness of the results, this part adopts the method of discontinuity regression to verify the causal relationship between the New Rural Pension Scheme and depression or medical expenses induced by depression of the rural elderly.

New Rural Pension Scheme stipulates that rural residents who have reached the age of 60 can receive basic pension. We take the age 60 as the running variable, it is the discontinuity point of the New Rural Pension Scheme receiving state. The discontinuity plot between age and the participation rate of New Rural Pension Scheme is shown in figure 2, The graph indicates that there is a significant jump in the participation rate of New Rural Pension Scheme on each side around the cutoff point (60 years old). The rate of New Rural Pension Scheme on the right side is almost 0.6 higher than that on the left side.

The specific method of discontinuity regression is as follows: Firstly, we use CFPS data for the years 2012 and 2016 to re-screen sample age. We set the sample boundary to be in the range of [-15, 15] (Wang and Zhou 2017) with 60 years as the center (Li and Li 2017), and obtain 13332 observation values between 45 and 75 years old. Secondly. We make linear regression according to the optimal bandwidth calculated by discontinuity regression. The results are as follows:

Table 11 Group A reports RD parametric estimations under the linear model. The New Rural Pension Scheme significantly reduced the depressive symptoms (depression) and the medical expenditure caused by depressive symptoms (depression). To be specific, the New Rural Pension Scheme reduced the incidence of depressive symptoms by 18.8% with 1% significance level. For depression, the New Rural Pension Scheme reduced the incidence of depression by 4.8% with 10% significance level. About medical spending, the New Rural Pension Scheme reduced the medical expenditure induced by depressive symptoms by 33.6% with 10% significance level and reduced the medical spending induced by depression by 44.5% with 1% significance level.

Table 11 Group A mainly used linear regression to estimate the impact of New Rural Pension Scheme on depression and medical expenditure caused by depression of rural elderly. Table 11 Group B will further use the non-parametric method proposed by Austin (Austin 2007) (based on the estimation of triangular kernel function) to test the robustness.

Table 11 Group B reports RD non-parametric estimations. The New Rural Pension Scheme significantly reduced the depressive symptoms (depression) and the medical expenditure induced by depressive symptoms (depression). The findings are robust in terms of both parametric estimations and non-parametric estimations.

Table 12 reports the results of a placebo test that assumes the age cutoff point at 55 (Jiao 2016) or 65 (Xie 2015) years old. Clearly, the RD treatment effects are statistically non-significant. This result primarily indicates that the jump in age at 60 years old is reasonable.

Discussion

Using nationally representative panel dataset from the CFPS, we demonstrate that the New Rural Pension Scheme significantly decreased both mental health problems and the medical expenditure induced by depressive symptoms and depression among rural elderly in China. Specifically, the depressive symptoms of pension recipients is, on average, 5.2% lower than that of non-recipients in the baseline regression, while it is 16.7% lowers in the IV estimations. The rate of depression is 14.4 percentage points lower among pension recipients. Medical costs induced by depressive symptoms of pension recipients are, on average, 4.5% lower than that of non-recipients in the baseline regression and 57.1% lower in the IV estimations. The quantity of medical expenditures due to depression are 6.5 percentage points lower among pensioners. The trend is the same for monthly pension income. This finding indicates that mental health and medical costs induced by depressive status are indeed an issue in China, and steps must be taken to perfect the pension system and improve mental health among rural elderly.

Although it appears that the rural elderly in China as a whole are affected by pension enrollment or income and, therefore, see improved mental health and reduced medical spending induced by depression, our results also show that the influence is particularly great for certain subgroups. One possible explanation of this phenomenon is that pensions play different roles in the lives of different groups. For example, the New Rural Pension Scheme has a greater effect on mental health and medical costs for men than women. Men spend more on daily expenses than women because of drinking and smoking (Tomiak 1997). As a result, the impact of pension income on mental health is more pronounced in male groups. Less-educated rural elderly may suffer from less depression when they participate in the pension scheme. The New Rural Pension Scheme is a system in which rural elderly participate voluntarily. This scheme can improve a sense of self-actualization (Chen et al. 2019), and the promotion of spiritual comfort may lead to less serious depression, especially for vulnerable groups. The impact of pension enrollment and pension income on mental health was even greater among rural elderly without chronic diseases. The pension is too small to treat chronic diseases. Rural elderly who received both pensions from the program and economic support from their children have fewer medical costs induced by depressive status. This may be due to the dual benefits of pension income and financial support from children. However, those without economic support from their children also see decreased depressive symptoms and depression when receiving pensions. One possible reason is that pension income plays a greater role in their mental health.

Although no previous studies have comprehensively examined the effect of the New Rural Pension Scheme on medical expenditure induced by depressive status among subgroups of rural elderly in China, our findings about the influence of pensions on mental health are supported by the literature. For example, Chen et al. (2019) provides new evidence of a positive causal relationship between pension income and mental health in the elderly, especially for those with educational, financial or health constraints. A study conducted by Ding (Ding 2017) indicates that old-age security is a key component of personal life satisfaction for the rural elderly, and that the New Rural Pension Programme may significantly improve their subjective well-being. In addition, in spite of low pension levels, the New Rural Pension Scheme did relieve the depression of the elderly in rural China (Zheng et al. 2017).

This study has a number of strengths. First, our sampling frame represents 95% of the Chinese population, and can therefore be considered nationally representative. Second, the large sample size of our dataset (2,938) gives our research a high degree of statistical power and considerable external validity. Third, the Institute of Social Science Survey (ISSS) of Peking University collected all data using a common sampling strategy. Lastly, this paper focuses on the effect of pension on depression or medical spending induced by depressive status among various sub-groups. The comparison of different types of rural elderly can give us more evidence on the effect of New Rural Pension Scheme on depressive status or medical expenditure induced by depression.

From a policy perspective, our results suggest that the Chinese government needs to perfect the New Rural Pension Scheme to eliminate income-caused barriers to mental health, especially for the rural elderly. Specifically, the government should raise the level of pension benefits gradually and reasonably. The level of pension benefits is the basis for measuring the effect of the New Rural Pension policy, and it is the economic support for the role of the pension scheme. Secondly, the rural elderly should be encouraged to participate in the New Rural Pension Scheme actively. At present, willingness to participate and the level of payment are both low. The government should explore the flexible use of various pension accounts to provide more choices for the rural elderly. Lastly, rural endowment resources should be integrated to establish a sound rural pension system.

Author Contribution

Conceptualization, M.Z. and L.H.; Data curation, X.S.; Formal analysis, X.S.; Methodology, M.Z.; Writing - original draft, X.S.; Writing - review & editing, M.Z. and L.H.

Data Availability Statement

The data that support the findings of this study are available in [China Family Panel Studies] at [http://isss.pku.edu.cn/cfps/download/index#/fileTreeList]. These data were derived

from the following resources available in the public domain: [China Family Panel Studies http://isss.pku.edu.cn/cfps/download/index#/fileTreeList].

The dataset is publicly available online for all researchers; however, approval was sought from and given by the China Family Panel Studies (CFPS) program office to use this data set. According to the CFPS, written informed consent was obtained from all participants enrolled in the survey.

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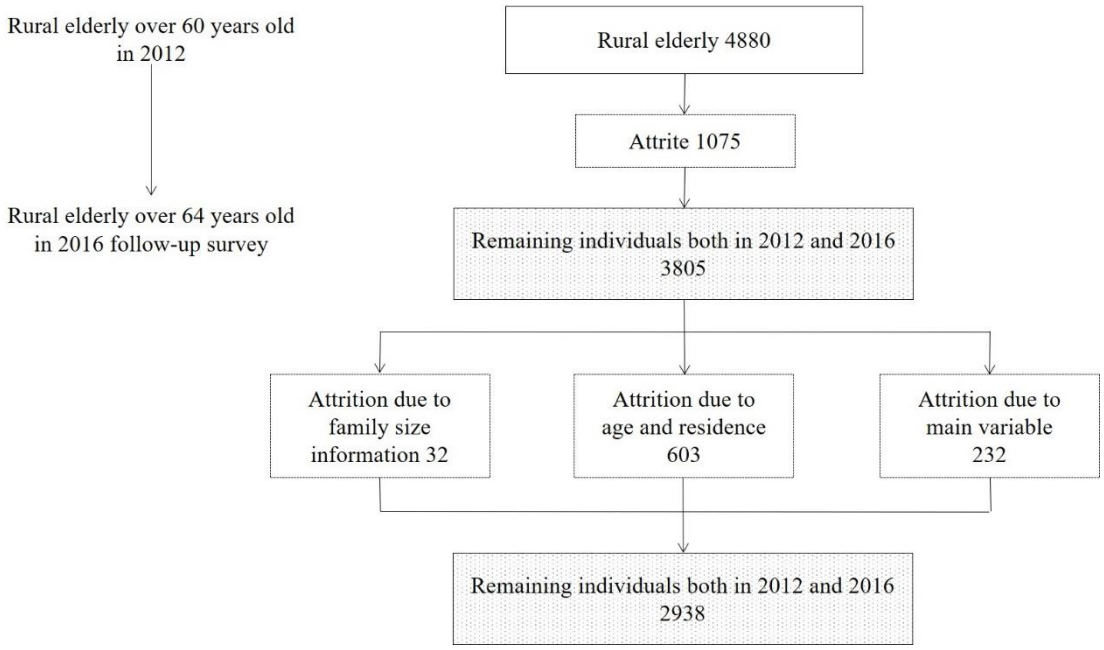

Figure 1. The construction of the panel dataset. Source: CFPS (2012, 2016). Note: The shaded boxes show the data used in our sample

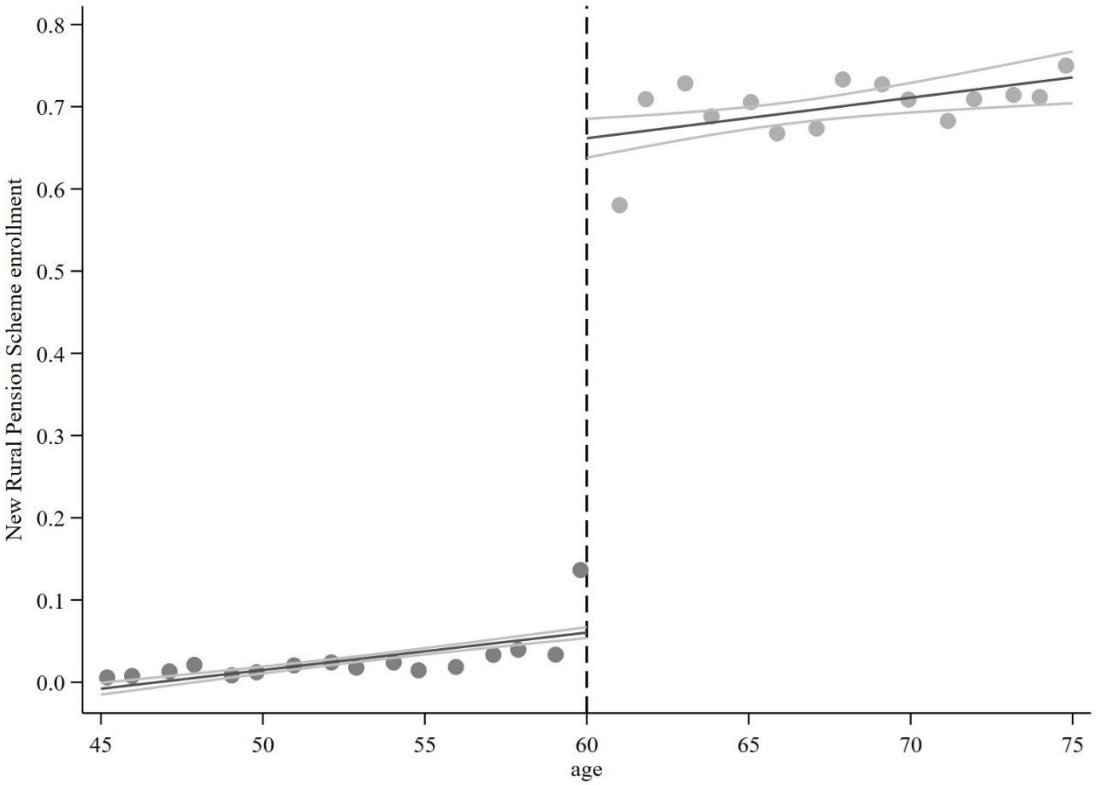

Figure 2. Regression discontinuity (RD) plot

Table 1. Sample summary statistics for key variables about panel dataset

Variables	Definition	Observations	Mean	S.D.	Min	Max
Explained variables						
CES-D	score	2,938	14.799	9.096	0	54
Depressive symptoms [a]	1=Yes; 0=No	2,938	0.177	0.382	0	1
Depression [a]	1=Yes; 0=No	2,938	0.101	0.302	0	1
Medical cost induced by depressive symptoms	CNY	2,938	481.062	988.324	0	3415
Medical cost induced by depression	CNY	2,938	383.977	748.873	0	3308
Explanatory variables						
Pension enrollment	1=Yes; 0=No	2,938	0.601	0.490	0	1
Monthly pension income	CNY	2,938	118.994	291.921	0	1800
Instrumental variable						
Community-level of monthly pension income [b]	CNY	2,913 [c]	126.629	204.747	0	1588
Mediating variable						
Confident about future	1 Not confident→5 Confident	2,938	3.513	1.193	1	5
Control variables						
Gender	1=Male; 0=Female	2,938	0.504	0.500	0	1
Age	Year	2,938	68.387	5.845	60	94
Marriage status						
Married	1=Yes; 0=No	2,938	0.820	0.385	0	1
Widowed	1=Yes; 0=No	2,938	0.162	0.369	0	1
Single	1=Yes; 0=No	2,938	0.014	0.119	0	1
Divorced	1=Yes; 0=No	2,938	0.004	0.061	0	1
Education						
Illiterate/Semi-literate	1=Yes; 0=No	2,938	0.650	0.477	0	1
Primary school	1=Yes; 0=No	2,938	0.247	0.431	0	1
Junior high school and above	1=Yes; 0=No	2,938	0.103	0.304	0	1
Income	CNY	2,938	888.646	3533.789	0	25800
New Rural Cooperative Medical Scheme	1=Yes; 0=No	2,938	0.911	0.285	0	1
Family size	Number of family members	2,938	4.059	2.204	1	14

Source: China Family Panel Studies (2012, 2016). Note: [a] The Depressive symptoms group and depression group are categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [b] The instrumental variables are the community-level of monthly pension income, where a community refers to the village in which the respondent lives; [c] Observations whose residential community contains only one sample individual are dropped, thus the sample size associated with the IV regressions is reduced to 2,913.

Table 2. Effect of New Rural Pension Scheme on mental health (Logit regression)

Variables	Definition	Group A		Group B	
		Depressive symptoms [b]	Depression [b]	Depressive symptoms [b]	Depression [b]
		1=Yes 0=No	1=Yes 0=No	1=Yes 0=No	1=Yes 0=No
		(1)	(2)	(3)	(4)
Pension enrollment	1=Yes; 0=No	-0.052**	-0.144***		
		(0.025)	(0.039)		
Pension income	CNY/Month			-0.016***	-0.049***
				(0.005)	(0.007)
Gender	1=Male; 0=Female	-0.405***	-0.591***	-0.403***	-0.588***
		(0.009)	(0.001)	(0.010)	(0.000)
Age	Year	-0.002**	0.015***	-0.001*	0.017***
		(0.001)	(0.002)	(0.001)	(0.002)
Married [c]	1=Yes; 0=No	0.168***	-0.818***	0.169***	-0.813***
		(0.009)	(0.017)	(0.008)	(0.016)
Widowed [c]	1=Yes; 0=No	0.457***	-0.266***	0.455***	-0.271***
		(0.011)	(0.023)	(0.011)	(0.021)
Single [c]	1=Yes; 0=No	0.846***	0.593***	0.839***	0.574***
		(0.006)	(0.012)	(0.007)	(0.013)
Education	1= Illiterate; 2= Primary school; 3= Junior high school and above	-0.243***	-0.380***	-0.241***	-0.375***
		(0.007)	(0.039)	(0.007)	(0.039)
Income	Log	-0.024***	-0.090***	-0.025***	-0.092***
		(0.001)	(0.004)	(0.001)	(0.004)
NRCMS [d]	1=Yes; 0=No	0.269***	-0.318***	0.266***	-0.321***
		(0.010)	(0.104)	(0.008)	(0.108)
Family size	Count	-0.015***	-0.099***	-0.016***	-0.100***
		(0.003)	(0.001)	(0.003)	(0.001)
Constant		-1.329***	-1.013***	-1.356***	-1.103***
		(0.053)	(0.120)	(0.051)	(0.119)
Fixed effect [e]		Yes	Yes	Yes	Yes
Observations		5,876	5,876	5,876	5,876
Number of pid		2,938	2,938	2,938	2,938

Note: [a] ***/** Statistically significant at the 1%/5% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] Marital status includes married, widowed, single, and divorced groups. As the divorced group makes up 0.00% of the sample, we did not add the divorced variable to the regression results; [d] New Rural Cooperative Medical Scheme; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 3. Effect of New Rural Pension Scheme on medical costs induced by mental health (OLS regression)

Variables	Definition	Group A		Group B	
		Medical cost induced by depressive symptoms [b]	Medical cost induced by depression [b]	Medical cost induced by depressive symptoms [b]	Medical cost induced by depression [b]
		Log	Log	Log	Log
		(1)	(2)	(3)	(4)
Pension enrollment	1=Yes; 0=No	-0.045*	-0.065*		
		(0.026)	(0.036)		
Pension income	CNY/Month			-0.013**	-0.019***
				(0.006)	(0.005)
Control variables [c]		Yes	Yes	Yes	Yes
Fixed effect [d]		Yes	Yes	Yes	Yes
Observations		5,876	5,876	5,876	5,876
Number of pid		2,938	2,938	2,938	2,938

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The medical cost induced by depressive symptoms / depression is calculated by the early results of project team (Sun et al. 2020); [c] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [d] The regression results control for the regional fixed effect; [e] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 4. Effect of New Rural Pension Scheme on mental health and medical costs induced by mental health (IV regression)

Group A Variables	Definition	Pension enrollment	Depressive symptoms [b]	Depression [b]	Medical cost induced by depressive symptoms [c]	Medical cost induced by depression [c]
		1=Yes 0=No	1=Yes 0=No	1=Yes 0=No	Log	Log
		(1)	(2)	(3)	(4)	(5)
Community-level of monthly pension income [d]	CNY	0.139***				
		(0.004)				
Pension enrollment	1=Yes; 0=No		-0.167*	-0.270**	-0.571***	-0.608***
			(0.098)	(0.116)	(0.148)	(0.143)
F-statistics		130.690				
P-value		0.000				
Group B		Pension income	Depressive symptoms [b]	Depression [b]	Medical cost induced by depressive symptoms [c]	Medical cost induced by depression [c]
		CNY /Month	1=Yes 0=No	1=Yes 0=No	Log	Log
Community-level of monthly pension income [d]	CNY	0.781***				
		(0.017)				
Pension income	CNY/Month		-0.030*	-0.048**	-0.102***	-0.108***
			(0.017)	(0.020)	(0.026)	(0.025)
F-statistics		178.630				
P-value		0.000				
Control variables [e]		Yes	Yes	Yes	Yes	Yes
Fixed effect [f]		Yes	Yes	Yes	Yes	Yes
Observations [g]		5,826	5,826	5,826	5,826	5,826

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical cost induced by depressive symptoms / depression is calculated using the early results of the project team (Sun et al. 2020);

[d] The instrumental variables are the community-level of monthly pension income, where a community refers to a rural village in which the respondent lives in; [e] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [f] The regression results control for the regional fixed effect; [g] Observations whose residential community contains only one sample individual are dropped, thus the sample size associated with the IV regressions is reduced to 5,826. [h] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 5. Effect of New Rural Pension Scheme on mental health and medical cost induced by mental health (Mediating Effect)

Variables	Definition	Confidence about future		Depressive symptoms [b]		Depression [b]		Medical cost induced by depressive symptoms [c]		Medical cost induced by depression [c]	
		1 Not confident→5 Confident		1=Yes; 0=No		1=Yes; 0=No		Log		Log	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Confident about future	1 Not confident → 5 Confident			-0.264***	-0.263***	-0.523***	-0.520***	-0.183***	-0.183***	-0.180***	-0.179***
				(0.069)	(0.069)	(0.018)	(0.015)	(0.011)	(0.010)	(0.006)	(0.005)
Pension enrollment	1=Yes; 0=No	0.172***		-0.012*		-0.055***		-0.016*		-0.035*	
		(0.033)		(0.007)		(0.015)		(0.008)		(0.021)	
Pension income	CNY/ Month		0.048***		-0.005***		-0.026***		-0.005***		-0.010**
			(0.007)		(0.000)		(0.010)		(0.001)		(0.005)
Control variables [d]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect [e]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		5,876	5,876	5,876	5,876	5,876	5,876	5,876	5,876	5,876	5,876
Number of pid		2,938	2,938	2,938	2,938	2,938	2,938	2,938	2,938	2,938	2,938

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical cost induced by depressive symptoms / depression is calculated using early results of the project team (Sun et al. 2020); [d] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 6. Heterogeneity analysis based on gender

Variables	Definition	Depressive symptoms [b]		Depression [b]		Medical cost induced by depressive symptoms [c]		Medical cost induced by depression [c]	
		1=Yes; 0=No		1=Yes; 0=No		Log		Log	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pension enrollment	1=Yes; 0=No	-0.077***	-0.039	-0.206**	-0.130	-0.080***	-0.012	-0.075*	-0.061
		(0.018)	(0.102)	(0.099)	(0.136)	(0.018)	(0.086)	(0.042)	(0.080)
Monthly pension income	CNY	-0.015***	-0.018	-0.074**	-0.036	-0.028***	0.000	-0.032*	-0.006
		(0.004)	(0.022)	(0.034)	(0.029)	(0.006)	(0.018)	(0.019)	(0.012)
Gender	1=Male; 0=Female	Male	Female	Male	Female	Male	Female	Male	Female
Control variables [d]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect [e]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		2,962	2,914	2,962	2,914	2,962	2,914	2,962	2,914
Number of pid		1,481	1,457	1,481	1,457	1,481	1,457	1,481	1,457

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical costs induced by depressive symptoms / depression are calculated using the early results of the project team (Sun et al. 2020); [d] Control variables include age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 7. Heterogeneity analysis based on education

Variables	Definition	Depressive symptoms [b]			Depression [b]			Medical cost induced by depressive symptoms [c]			Medical cost induced by depression [c]		
		1=Yes; 0=No			1=Yes; 0=No			Log			Log		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Pension enrollment	1=Yes; 0=No	-0.096***	0.035	0.224	-0.127***	-0.007	-0.653	-0.098*	0.057	0.087	-0.127***	0.073	0.027
		(0.033)	(0.181)	(0.337)	(0.025)	(0.278)	(0.506)	(0.051)	(0.082)	(0.128)	(0.006)	(0.113)	(0.180)
Monthly pension income	CNY	-0.025***	-0.017	0.086	-0.044***	-0.034	-0.145	-0.022*	-0.004	0.021	-0.027***	-0.000	-0.003
		(0.001)	(0.037)	(0.068)	(0.003)	(0.057)	(0.103)	(0.013)	(0.024)	(0.035)	(0.004)	(0.023)	(0.036)
Education	1= Illiterate; 2= Primary; 3= Junior	Illiterate	Primary	Junior	Illiterate	Primary	Junior	Illiterate	Primary	Junior	Illiterate	Primary	Junior
Control variables [d]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect [e]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		3,817	1,453	606	3,817	1,453	606	3,817	1,453	606	3,817	1,453	606
Number of pid		1,909	727	303	1,909	727	303	1,909	727	303	1,909	727	303

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical costs induced by depressive symptoms / depression are calculated using the early results of the project team (Sun et al. 2020); [d] Control variables include gender, age, marital status, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 8. Heterogeneity analysis based on chronic disease

Variables	Definition	Depressive symptoms [b]		Depression [b]		Medical cost induced by depressive symptoms [c]		Medical cost induced by depression [c]	
		1=Yes; 0=No		1=Yes; 0=No		Log		Log	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pension enrollment	1=Yes; 0=No	0.304	-0.178***	-0.216	-0.136***	0.147	-0.137***	-0.067	-0.102***
		(0.203)	(0.023)	(0.203)	(0.032)	(0.100)	(0.019)	(0.082)	(0.012)
Monthly pension income	CNY	0.059	-0.043***	-0.055	-0.055***	0.030	-0.035**	-0.014	-0.030**
		(0.043)	(0.005)	(0.043)	(0.006)	(0.021)	(0.015)	(0.017)	(0.014)
Chronic disease	1=Yes; 0=No	Yes	No	Yes	No	Yes	No	Yes	No
Control variables [d]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect [e]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1,411	4,465	1,411	4,465	1,411	4,465	1,411	4,465
Number of pid		1,179	2,706	1,179	2,706	1,179	2,706	1,179	2,706

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical costs induced by depressive symptoms / depression are calculated using the early results of the project team (Sun et al. 2020); [d] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 9. Heterogeneity analysis based on children's economic support

Variables	Definition	Depressive symptoms [b]		Depression [b]		Medical cost induced by depressive symptoms [c]		Medical cost induced by depression [c]	
		1=Yes; 0=No		1=Yes; 0=No		Log		Log	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pension enrollment	1=Yes; 0=No	0.076	-0.175***	-0.105	-0.155**	-0.089***	-0.018	-0.156*	0.002
		(0.116)	(0.022)	(0.159)	(0.073)	(0.016)	(0.019)	(0.083)	(0.081)
Monthly pension income	CNY	0.010	-0.042***	-0.041	-0.057***	-0.010***	-0.018	-0.020**	-0.019
		(0.024)	(0.005)	(0.033)	(0.013)	(0.002)	(0.017)	(0.010)	(0.017)
Economic support from children	1=Yes; 0=No	Yes	No	Yes	No	Yes	No	Yes	No
Control variables [d]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect [e]		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		2,864	3,012	2,864	3,012	2,864	3,012	2,864	3,012
Number of pid		2,025	2,099	2,025	2,099	2,025	2,099	2,025	2,099

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical costs induced by depressive symptoms / depression are calculated using the early results of the project team (Sun et al. 2020); [d] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 10. Robustness test based on CES-D (Quantile regression)

Variables	Definition	CES-D score				
		10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
		(1)	(2)	(3)	(4)	(5)
Pension enrollment	1=Yes; 0=No	-1.000***	-0.897***	-0.742**	-0.934**	-1.029*
		(0.228)	(0.232)	(0.307)	(0.402)	(0.593)
Monthly pension income	CNY	-0.143***	-0.221***	-0.209***	-0.306***	-0.309**
		(0.050)	(0.046)	(0.065)	(0.080)	(0.123)
Control variables [b]		Yes	Yes	Yes	Yes	Yes
Fixed effect [c]		Yes	Yes	Yes	Yes	Yes
Observations		5,876	5,876	5,876	5,876	5,876

Note: [a] ***/* Statistically significant at the 1%/10% level; [b] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size. [c] The regression results control for the regional fixed effect; [d] The reported statistics are the marginal effects of the explanatory variables with standard errors shown in parentheses.

Table 11 Effect of New Rural Pension Scheme on depressive symptoms/depression and medical cost induced by depressive symptoms/depression (RD regression)

Group A Parametric RD regression Variables	Depressive symptoms [b]	Depression [b]	Medical cost induced by depressive symptoms [c]	Medical cost induced by depression [c]
	1=Yes; 0=No	1=Yes; 0=No	Log	Log
	(1)	(2)	(3)	(4)
RD treatment effect	-0.188***	-0.048*	-0.336*	-0.445***
	(0.067)	(0.027)	(0.195)	(0.035)
Bandwidth of age	2.03	1.99	3.19	3.24
$N^-\|N^+$	1238|1694	656|1137	1718|2250	1718|2250
Group B	Non-parametric RD regression			
RD treatment effect	-0.074**	-0.054*	-0.452**	-0.783***
	(0.034)	(0.031)	(0.192)	(0.185)
Bandwidth of age	1.59	1.57	2.50	2.54
$N^-\|N^+$	656|1137	656|1137	1238|1694	1238|1694
Control variables [d]	Yes	Yes	Yes	Yes
Fixed effect [e]	Yes	Yes	Yes	Yes
Observations	13,332	13,332	13,332	13,332

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical costs induced by depressive symptoms / depression are calculated using the early results of the project team (Sun et al. 2020); [d] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the RD treatment effects of the explanatory variables with standard errors shown in parentheses.

Table 12 Placebo test of regression discontinuity

Variables	Depressive symptoms [b]	Depression [b]	Medical cost induced by depressive symptoms [c]	Medical cost induced by depression [c]	Depressive symptoms [b]	Depression [b]	Medical cost induced by depressive symptoms [c]	Medical cost induced by depression [c]
	1=Yes; 0=No	1=Yes; 0=No	Log	Log	1=Yes; 0=No	1=Yes; 0=No	Log	Log
	Bandwidth of age: 55				Bandwidth of age: 65			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD treatment effect	-4.189	-1.731	-25.331	-5.021	3.960	0.967	-23.939	-19.006
	(3.454)	(1.617)	(25.027)	(6.935)	(18.340)	(2.365)	(45.448)	(64.755)
Bandwidth of age	1.83	3.86	3.33	2.93	1.94	1.83	2.44	2.69
Control variables [d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect [e]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$N^-\|N^+$	585|969	1690|2031	1690|2031	1149|1449				
$N^-\|N^+$					494|732	494|732	1050|1075	1050|1075
Observations	13,332	13,332	13,332	13,332	13,332	13,332	13,332	13,332

Note: [a] ***/**/* Statistically significant at the 1%/5%/10% level; [b] The depressive symptoms / depression group is categorized using CES-D scores (depressive symptoms= CES-D between 20 and 27; depression= CES-D of 28 or higher); [c] The medical costs induced by depressive symptoms / depression are calculated using the early results of the project team (Sun et al. 2020); [d] Control variables include gender, age, marital status, education, income, New Rural Cooperative Medical Scheme, and family size; [e] The regression results control for the regional fixed effect; [f] The reported statistics are the RD treatment effects of the explanatory variables with standard errors shown in parentheses.