The Impact of Social Insurance On Health Among Middle-Aged and Older Adults In Rural China: A Longitudinal Study Using A Three-Wave Nationwide Survey

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Research article

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Abstract

Background: Many studies have examined the impact of social insurance on health but the results have generally been mixed, presumably because they have not fully addressed potential biases related to cross-sectional study design. In this study, we conducted a longitudinal analysis to investigate how participation in two social insurance programs in China—the New Rural Social Pension Insurance (NRSPI) and the New Rural Cooperative Medical Scheme (NRCMS)—was associated with health outcomes among middle-aged and older adults in rural China.

Methods. Using three-wave longitudinal data from the China Health and Retirement Longitudinal Study conducted in 2011, 2013, and 2015, we estimated the dynamic fixed-effects regression models to examine the association between participation in the NRCMS/NRSPI and six types of health outcome.

Results. Participation in the NRSPI was positively associated with some health outcomes, but the associations were relatively modest and were observed only for some specific age and household income groups. Participation in the NRCMS was not associated with any health outcome.

Conclusions. The results provide limited evidence of the positive impact of social insurance on health among middle-aged and older adults in rural China. Social insurance programs should be reformed to enhance their positive impact on health.

Background

To maintain the living standard of the elderly and reduce their risk of uncertainty with age, establishing a universal social security system has become an important policy challenge in both developing and developed countries. This is particularly true of China, which is facing serious problems of an aging population; the proportion of people aged 65 and older to the total population is expected to rise rapidly to 26.3% in 2050 from 10.9% in 2017 [1].

Correspondingly, an increasing number of studies have examined the impact of social insurance on health in many countries, including China. However, the results have generally been mixed. Regarding the impact of medical insurance on health, studies have obtained inconsistent findings for both developed countries [2–4] and developing countries [5–7]. For China, some studies found medical insurance to have a positive impact on health [8–13], while others failed to find any significant impact [14–16], and one study even found a negative impact [17]. Meanwhile, many studies found a positive impact of public pension on health [18–20], one study found no significant impact in Korea [21], and only one study reported a positive impact of pensions on health among rural residents in China [18].

In general, social insurance may affect individuals’ health in several ways. First, it can reduce the out-of-pocket (OOP) costs of health care, which may increase the utilization of healthcare services and medical examinations and thus improve participants’ health [22]. Second, social insurance can have a positive impact on mental health by reducing uncertainty about future income and health expenditure. Third,
social insurance may lead to problems of moral hazard, which may worsen an individual’s health [23]; insured individuals may be more inclined to engage in unhealthy behaviors such as smoking and excess drinking. The overall effect of social insurance on health should be evaluated using a large-scale dataset.

In the current study, we attempted to examine the impact of social insurance programs in China—the New Rural Social Pension Insurance (NRSPI) and the New Rural Cooperative Medical Scheme (NRCMS)—on the health of middle-aged and older adults in rural China, using three-wave longitudinal data from the China Health and Retirement Longitudinal Study (CHARLS).

In contrast with other countries, China’s social insurance schemes have been fragmented by the population registration system known as Hukou (e.g., rural Hukou and urban Hukou) since the planned economy period [13, 24, 25]. Although a public pension program for urban workers was inaugurated in the 1950s, the public pension scheme targeting rural Hukou residents was not established until the early 2000s. The NRSPI was formally launched in 2009 as the first pension insurance program to cover rural Hukou residents.

Regarding medical insurance, its public scheme for urban workers was established in the 1950s, while in rural areas the Cooperative Medical Scheme (CMS), which was managed by country communities but unsupported by the central government, was introduced in the 1950s [16]. The proportion of the population enrolled in CMS was as high as 90% in the late 1970s. However, with the collapse of the collective economy in the early 1980s, the coverage rate fell sharply to 5% in 1985. The NRCMS was introduced in 2003 to replace the CMS, with more subsidies from the central and local governments.

This study is expected to make three contributions to the literature on the impact of social insurance on health. First, based on three-wave longitudinal survey data, it addresses statistical issues such as the initial value effect, individual heterogeneity, and reverse causality. These problems have remained largely unsolved in previous studies, most of which have been cross-sectional. Second, unlike previous studies, which concentrated on only a certain type of scheme, this study compared the two schemes’ impact on health. Third, this study compared the results between different age and household income groups, an issue that previous studies have largely ignored. Notably, we compared the impact of the NRSPI on the health of middle-aged adults who had not started to receive pension benefits, with its impact on those aged 60 or above, unlike previous studies that only considered the latter age group [18].

## Methods

### Study sample

We used longitudinal data from the CHARLS, which was conducted by Peking University in representative regions of China in 2011, 2013, and 2015. The survey respondents comprised individuals aged 45 or older in the baseline survey. The CHARLS contains rich individual- and household-level information, such as a set of indices of health, demographic characteristics, family structure, house ownership, health
behavior, and social participation, which were used in this study. The baseline wave included 17,708 individuals in 150 counties/districts and 450 villages/resident communities.

This study focused on rural *Hukou* residents aged 45 or older in the baseline survey and who remained in at least one of two follow-up surveys. After excluding respondents who were missing key variables used in the statistical analysis, the total number of individuals whose data were used in this study was 32,808 (10,245 for 2011, 10,630 for 2013, and 11,933 for 2015). The sample used in the regression differed slightly, depending on the models.

**Variables**

Key independent variables were binary variables for participation in the NRSPI and NRCMS. As for health variables, we used six indices of health: (i) self-rated health (SRH), (ii) cognitive function (CF), (iii) mental health in prospect (MH1), (iv) mental health at present (MH2), (v) no health problem for working (NHP), and (vi) no disease. (i)–(iii) are continuous variables, while (v) and (vi) are binary variables. Regarding SRH and CF, we categorized them into “excellent” = 5, “very good” = 4, “good” = 3, “fair” = 2, and “poor” = 1, respectively. We constructed the binary variables of SRH and CF as “1 = excellent, 0 = otherwise” As for MH1, we categorized the answers to the question “How often do you feel hopeful about the future” into “most or all of the time (5–7 days)” = 4, “occasionally or a moderate amount of the time (3–4 days)” = 3, “some or a little of the time (1–2 days)” = 2, and “rarely or none of the time (< one day)” = 1. As for MH2, we categorized the answers to the question ”How often have you felt depressed recently” in the revised order. We constructed a binary variable of MH1 or MH2 as “1 = when the value of MH1 or MH2 is equal to 4, 0 = otherwise.” Regarding NHP, we constructed a binary variable for it by allocating 1 to the answer “no health problems at work” and 0 otherwise. We also constructed a binary variable of no disease by allocating 1 to those who answered that they had no disease diagnosed by doctors and 0 otherwise.

We considered the following as covariates: (1) demographic factors: age, gender, and educational attainment (junior high school and lower, senior high school, and college or higher); (2) family factors (having a spouse or not, parents alive or not, number of family members, and living arrangement with children (residing together or apart); (3) house ownership; (4) health behavior (smoking and drinking); (5) social participation (participating in at least one of its seven types); (6) regions (East, Central, West, and Northeast), and (7) survey years (2011, 2013, and 2015). We used house ownership as a proxy for household income because using household income would substantially reduce the sample size due to missing variables.

**Analytic strategy**

As the benchmark, we considered the regression model to explain the health variable by participation in the NRSPI and NRCMS along with a set of covariates, X:

\[
H_t = \alpha + \beta \text{NRSPI}_t + \gamma \text{NRCMS}_t + \sum_n \delta_n X_{ni} + \epsilon_i, \quad (1)
\]
where \( i \) denotes the individual and \( \varepsilon \) is an error term. If \( \varepsilon \) includes an individual-specific, time-invariant factor, heterogeneity problems may occur when these factors are not controlled for. To address this problem, we should use the fixed-effects (FE) or random-effects (RE) model. We employed the \( F \) test, the Breusch and Pagan Lagrange multiplier test, and the Hausman specification test to compare the appropriateness of pooled ordinary least squares, FE, and RE models. Because the results of these tests indicated that the FE model was the most appropriate, we employed it in this study.

We further considered an initial value problem [26–28]: health in time \( t \) might be affected by health in time \( t-1 \). To address this problem, we considered a dynamic FE model, which includes health in time \( t-1 \) as an explanatory variable. We further replaced all other explanatory variables in time \( t \) with those in time \( t-1 \) to mitigate the reverse causality problem. In all, we estimated dynamic FE models with lagged explanatory variables in the current study:

\[
H_{it} = \alpha + \rho H_{it-1} + \beta NRSPI_{it-1} + \gamma NRCMS_{it-1} + \sum \delta_n X_{nit-1} + u_{it},
\]

where \( t \) denotes the survey year (2011, 2013, or 2015) and \( u \) is an error term. In the actual regression analysis, we estimated logistic regression models using a set of binary variables of health indices, rather than linear models. We estimated the regression models not only for the entire sample, but also separately by age group (aged 45–59, 60–64, and 65 or above) and household income group (low, middle, and high) to examine the heterogeneity.

**Results**

**Descriptive analysis**

Table 1 summarizes the key features of the study sample used in the statistical analysis. Figure 1 summarizes the participation rates of the NRSPI and NRCMS from 2011 to 2015. The participation rates of the NRSPI rose from 35.7% in 2011 to 69.4% in 2013 and 67.5% in 2015, indicating that the Chinese government succeeded in raising participation in public pensions for rural areas after introducing them in 2009. By comparison, the enrollment percentage in the NRCMS, which was introduced in 2003, remained high at approximately 90% during the study period.
Table 1

Key features of the study sample

| Demographic factors          | Proportion (%) |
|------------------------------|----------------|
| Age                          | M 59.3         |
| Gender                       |                |
| Male                         | 53.1           |
| Female                       | 46.9           |
| Educational attainment       |                |
| Junior high school or lower  | 94.0           |
| Senior high school           | 5.7            |
| College or higher            | 0.3            |
| Family factors               |                |
| Having a spouse              | 86.8           |
| Parents alive                | 16.9           |
| Number of family members     | M 3.47         |
| Living arrangement with children |          |
| Living together              | 57.0           |
| Living apart                 | 43.0           |
| House ownership              | 60.8           |

| Health behavior             |                |
| Smoking                     |                |
| No smoking                  | 31.6           |
| Smoking in the past         | 42.5           |
| Smoking currently           | 25.9           |
| Drinking                    |                |
| No drinking                 | 75.2           |
| Drinking per week           | 20.0           |
| Drinking per month          | 4.8            |
| Social participation        | 45.7           |

| Regions                      |                |
| East                         | 18.8           |
| Central                      | 20.7           |
| West                         | 57.9           |
| Northeast                    | 2.6            |

| Survey years |                |
|--------------|----------------|
| Living together | 2011 | 31.5 |
| Living apart   | 2013 | 32.5 |
| House ownership| 2015 | 36.0 |

Table 2 compared the health of participants and non-participants in the NRSPI and NRCMS using the entire sample. Participation in the NRSPI was negatively associated with CF, MH2, and no disease, and positively associated with MH1. Meanwhile, participation in the NRCMS was negatively associated with all health outcomes except MH2. It should be noted, however, that the comparisons in Table 2 were not controlled for covariates and/or adjusted for potential biases related to cross-sectional comparisons.
Table 2
Comparing health outcomes between participants and non-participants in social insurance programs

| Program                                      | Participants (a) | Non-participants (b) | Difference (a)–(b) | t-test | N     |
|----------------------------------------------|------------------|----------------------|-------------------|--------|-------|
| New Rural Social Pension Insurance (NRSPI)   |                  |                      |                   |        |       |
| Self-rated health (SRH: 1–5)                | 2.13             | 2.12                 | 0.01              | 0.440  | 36793 |
| Cognitive function (CF: 1–5)                | 1.83             | 1.86                 | -0.03             | p < 0.001 | 38719 |
| Mental health in prospect (MH1: 1–4)        | 3.12             | 3.07                 | 0.05              | p < 0.001 | 38143 |
| Mental health at present (MH2: 1–4)         | 2.52             | 2.61                 | -0.09             | p < 0.001 | 37287 |
| No health problem for working (NHP: 0–1)    | 0.66             | 0.67                 | -0.01             | 0.142  | 26267 |
| No disease (0–1)                             | 0.27             | 0.30                 | -0.03             | p < 0.001 | 42113 |
| New Rural Cooperative Medical Scheme (NRCMS)|                  |                      |                   |        |       |
| Self-rated health (SRH: 1–5)                | 2.12             | 2.22                 | -0.11             | p < 0.001 | 36820 |
| Cognitive function (CF: 1–5)                | 1.84             | 1.89                 | -0.06             | p < 0.001 | 38739 |
| Mental health in prospect (MH1: 1–4)        | 3.09             | 3.15                 | -0.06             | p < 0.001 | 38160 |
| Mental health at present (MH2: 1–4)         | 2.56             | 2.54                 | 0.02              | 0.432  | 37304 |
| No health problem for working (NHP: 0–1)    | 0.66             | 0.70                 | -0.04             | p < 0.001 | 26278 |
| No disease (0–1)                             | 0.28             | 0.32                 | -0.04             | p < 0.001 | 42175 |

Note. aThe higher the score, the better the health outcomes.

Regression analysis

The results of the regression models are summarized in Table 3, which reports the odds ratios (ORs) of reporting better health status, along with their 95% confidence intervals (CIs), in response to participation in the NRSPI and NRCMS. Unlike the results based on the cross-sectional data reported in Table 2, there was no negative association with any health outcome.
Table 3
Estimated associations between participation in social insurance and health outcomes

|                                          | OR  | 95% CI     | N      |
|-----------------------------------------|-----|------------|--------|
| New Rural Social Pension Insurance (NRSPI) |     |            |        |
| Self-rated health (SRH)                 | 1.06| (0.97, 1.18) | 18358 |
| Cognitive function (CF)                 | 1.30| **(1.10, 1.57) | 21714 |
| Mental health in prospect (MH1)         | 0.94| (0.92, 1.12) | 20002 |
| Mental health at present (MH2)          | 1.07| (0.99, 1.17) | 10190 |
| No health problem for working (NHP)     | 0.95| (0.85, 1.06) | 11878 |
| No disease                              | 1.01| * (1.00, 1.03) | 21776 |
| New Rural Cooperative Medical Scheme (NRCMS) |     |            |        |
| Self-rated health (SRH)                 | 1.01| (0.98, 1.00) | 18358 |
| Cognitive function (CF)                 | 0.96| (0.77, 1.20) | 21714 |
| Mental health in prospect (MH1)         | 1.02| (0.91, 1.12) | 20002 |
| Mental health at present (MH2)          | 1.07| (0.97, 1.08) | 10190 |
| No health problem for working (NHP)     | 0.79| (0.65, 0.93) | 11878 |
| No disease                              | 0.95| (0.78, 1.16) | 21776 |

Note. aObtained from the dynamic fixed-effects ordered logistic or logistic models with lagged explanatory variables, controlled for covariates.

* * p < 0.05, ** p < 0.05, † p < 0.1.

Specifically, the table shows that participation in the NRSPI had positive and significant (p < 0.05) associations with CF (OR: 1.30, 95% CI: 1.10–1.57) and no disease (OR: 1.01, 95% CI: 1.00–1.03), while it had less significant but positive associations (p < 0.1) with SRH (OR: 1.06, 95% CI: 0.97–1.18) and MH2 (OR: 1.07, 95% CI: 0.99–1.17). The positive association between participation in the NRCMS and health was more limited; it had a modest association only with MH2 (OR: 1.07, 95% CI: 0.97–1.08).

Tables 4 and 5 summarize the results obtained by separate estimations by age and household income, respectively. Table 4 indicates that participation in the NRSPI had modestly positive associations with SRH, CF, and MH2 (p < 0.1) among those aged 45–59 years, while the results were mixed among older age groups; participation in the NRSPI was negatively associated with NH1 and NHP (p < 0.05) among those aged 65 years or above. The results for the NRCMS were generally mixed, with no clear pattern.
Table 4
Estimated associations between participation in social insurance and health outcomes by age group\(^a\)

|                       | Aged 45–59 | Aged 60–64 | Aged 65 or above |
|-----------------------|------------|------------|------------------|
|                       | OR        | 95% CI     | OR               | 95% CI     | OR               | 95% CI     |
| New Rural Social      |           |            |                   |            |                   |            |
| Pension Insurance     | (NRSPI)   |            |                   |            |                   |            |
| Self-rated health     | 1.12      | (0.98, 1.28)| 1.19             | (0.95, 1.49)| 0.92             | (0.77, 1.10)|
| (SRH)                 |            |            |                   |            |                   |            |
| Cognitive function    | 1.24      | (0.99, 1.54)| 1.98 **          | (1.33, 2.94)| 1.12             | (0.79, 1.60)|
| (CF)                  |            |            |                   |            |                   |            |
| Mental health in      | 1.00      | (0.89, 1.11)| 0.95             | (0.79, 1.13)| 0.85 *           | (0.75, 0.98)|
| prospect (MH1)        |            |            |                   |            |                   |            |
| Mental health at      | 1.11      | (0.98, 1.24)| 1.07             | (0.88, 1.29)| 1.05             | (0.88, 1.26)|
| present (MH2)         |            |            |                   |            |                   |            |
| No health problem     | 0.99      | (0.86, 1.14)| 1.08             | (0.84, 1.38)| 0.77 *           | (0.59, 1.00)|
| for working (NHP)     |            |            |                   |            |                   |            |
| No disease            | 1.12      | (0.92, 1.36)| 0.75             | (0.54, 1.05)| 1.09             | (0.81, 1.48)|
| New Rural Cooperative  |           |            |                   |            |                   |            |
| Medical Scheme (NRCMS)| (NRCMS)   |            |                   |            |                   |            |
| Self-rated health     | 0.88      | (0.73, 1.28)| 0.90             | (0.66, 1.22)| 0.89             | (0.71, 1.10)|
| (SRH)                 |            |            |                   |            |                   |            |
| Cognitive function    | 0.90      | (0.66, 1.21)| 0.66 *           | (0.41, 1.08)| 1.37             | (0.87, 2.17)|
| (CF)                  |            |            |                   |            |                   |            |

Note. \(^a\)Obtained from the dynamic fixed-effects ordered logistic or logistic models with lagged explanatory variables, controlled for covariates.

*** \(p<0.001\), ** \(p<0.01\), * \(p<0.05\), \(\ddagger p<0.1\).
|                                | Aged 45–59 | Aged 60–64 | Aged 65 or above |
|--------------------------------|------------|------------|------------------|
| Mental health in prospect (MH1) | 1.00       | (0.86, 1.17) | 1.15 (0.90, 1.46) | 0.99 (0.82, 1.18) |
| Mental health at present (MH2)  | 0.97       | (0.82, 1.21) | 0.88 (0.68, 1.13) | 1.07 (0.86, 1.33) |
| No health problem for working (NHP) | 0.66 ***  | (0.54, 0.82) | 1.09 (0.76, 1.56) | 1.00 (0.70, 1.43) |
| No disease                      | 0.85       | (0.65, 1.12) | 1.58 * (1.00, 2.49) | 0.83 (0.56, 1.21) |

Note. Obtained from the dynamic fixed-effects ordered logistic or logistic models with lagged explanatory variables, controlled for covariates.

*** p < 0.001, ** p < 0.01, * p < 0.05, p < 0.1.
| Low | Middle | High |
|-----|--------|------|
| OR  | 95% CI  | OR  | 95% CI  | OR  | 95% CI  |
| New Rural Social Pension Insurance (NRSPI) |
| Self-rated health (SRH) | 1.28 * | (1.02, 1.59) | 0.99 | (0.79, 1.25) | 1.16 | (0.94, 1.45) |
| Cognitive function (CF) | 2.04 *** | (1.29, 3.00) | 0.98 | (0.64, 1.51) | 1.30 | (0.91, 1.88) |
| Mental health in prospect (MH1) | 1.00 | (0.84, 1.20) | 0.87 | (0.72, 1.04) | 0.86 | (0.72, 1.04) |
| Mental health at present (MH2) | 1.18  | (0.97, 1.43) | 0.90 | (0.75, 1.10) | 1.06 | (0.88, 1.28) |
| No health problem for working (NHP) | 1.07 | (0.76, 1.52) | 0.98 | (0.77, 1.24) | 0.94 | (0.74, 1.20) |
| Non-disease | 1.28 * | (1.02, 1.59) | 0.96 | (0.67, 1.39) | 1.36  | (0.96, 1.92) |
| New Rural Cooperative Medical Scheme (NRCMS) |
| Self-rated health (SRH) | 0.88 | (0.64, 1.20) | 0.86 | (0.63, 1.17) | 0.90 | (0.70, 1.17) |
| Cognitive function (CF) | 1.05 | (0.60, 1.83) | 0.87 | (0.50, 1.50) | 0.82 | (0.54, 1.24) |
| Mental health in prospect (MH1) | 1.27  | (0.96, 1.65) | 0.96 | (0.75, 1.21) | 0.87 | (0.70, 1.09) |

Note. a Obtained from the dynamic fixed-effects ordered logistic or logistic models with lagged explanatory variables, controlled for covariates.

*** $p<0.001$, * $p<0.05$, $\ddagger p<0.1$. 

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Table 5 compares the association between participation in the NRSPI/NRCMS and health by household income group. The most noticeable finding was that participation in the NRSPI was positively associated with SRH, CF, and no disease \( (p < 0.05) \) and to a lesser extent MH2 \( (p < 0.1) \) among the low income group. Excluding these combinations, neither the NRSPI nor NRCMS were associated with any health outcome.

### Discussion

We have examined how two social insurance programs, the NRSPI and NRCMS, were associated with health among middle-aged and older adults in rural China. Our longitudinal regression analysis, based on the dynamic FE models with lagged explanatory variables, indicated that participation in the NRSPI had positive associations with some health outcomes, but that the associations were relatively modest and were observed only for some specific age and household income groups. Meanwhile, participation in the NRCMS had no association with any health outcome. These results are generally in line with the mixed results in previous studies in China [8–17], which have not fully controlled for statistical biases.

Regarding the association between the NRSPI and health, our results contrast with those of Cheng et al. [18], who reported more positive results using the CHARLS data. There are three differences between their study and ours. First, we used three-wave longitudinal survey data from 2011 to 2015, while they only used two-wave (2008/2009 vs. 2010/2011) data. Second, we employed dynamic FE models with lagged explanatory variables, while they employed the usual FE and FE with instrumental variables models. Third, we included individuals aged 45–59 years in the sample, while they focused on those aged 60 or above. As for the association between medical insurance and health in China, most previous studies reported that the NRCMS increased the probability of healthcare utilization and improved health [12, 22, 25, 29]. These previous studies used data from earlier periods (such as 2000–2008) than ours (2011–
suggesting that the impact of the NRCMS on health should be analyzed from both short-term and long-term perspectives.

Our estimation results indicated the positive, albeit modest, impact of the NRSPI on health among rural Hukou residents, particularly among those aged 45–60 years and among low-income groups. These results suggest that the NRSPI may help have a positive, albeit modest, and indirect effect on people's health in rural areas by reducing uncertainty about income after retirement, especially among the low-income groups.

Meanwhile, no positive impact of NRSPI on health was consistently observed among the elderly aged 60 years or older. The adaptation hypothesis can explain why: as individuals continue to receive pension benefits, they will more likely take them for granted. The results were also likely attributable to low levels of NRSPI benefits, which were below the poverty line in rural areas. According to CHARLS, the average NRSPI pension benefit in 2011 and 2013 was CNY 965 per year, compared to CNY 2300 per year as the standard poverty line in rural areas since 2011 [30].

We also found that the NRCMS had no impact on most health outcomes, pointing to limitations in this program compared to the public medical insurance covering urban workers, that is, the Urban Employee Basic Medical Insurance (UEBMI). Although the percentage of OOP for healthcare expenditure is regulated to be 30% in both the NRCMS and UEBMI, most outpatients are excluded from the NRCMS, and fewer types of fatal diseases are covered by it. Moreover, participants in the NRCMS must first pay the total healthcare fee by themselves, and then seek reimbursement after submitting claims to their local governments, making low-income individuals inclined not to utilize the healthcare service. These factors seem to explain the limited impact of the NRCMS, which was expected to improve the health outcomes of rural Hukou residents.

Based on the results of our study, the Chinese government should increase NRSPI benefits to support income conditions for rural Hukou residents, particularly those with low income. The government should also reform the NRCMS to reduce the payment of healthcare fees by rural Hukou residents and cover outpatients and more types of diseases.

**Conclusions**

We conclude that the NRSPI is positively associated with some health outcomes, but that the associations are relatively modest and observed only for some specific age and household income groups. Participation in the NRCMS has no association with any health outcomes. These results provide limited evidence of the positive impact of social insurance on health among middle-aged and older adults in rural China.

This study has several limitations. First, although we used the dynamic FE models with lagged explanatory variables, we could not identify the causation from social insurance to health, which should be investigated in a more in-depth analysis. Second, because we focused on individuals aged 45 or older
due to data limitations, we should expand the analysis to include younger individuals. Third, it remained unanswered why the association with social insurance was observed for selected types of health outcomes.

Despite these limitations, we believe that the current study, which took full advantage of longitudinal data, provided new insights for understanding the association between social insurance and health. We also expect that the experiences of Chinese social insurance policy reforms targeting rural Hukou residents may provide valuable lessons for developing countries to establish or reform their social insurance schemes.

**Abbreviations**

CF: cognitive function; CHARLS: China Health and Retirement Longitudinal Study; CI: confidence interval; CMS: Cooperative Medical Scheme; FE: fixed-effects; MH1: Mental health in prospect; MH2: Mental health at present; NHP: No health problem for working; NRCMS: New Rural Cooperative Medical Scheme; NRSPI: New Rural Social Pension Insurance; OOP: out-of-pocket; OR: odds ratio; RE: random-effects; SRH: self-rated health; UEBMI; Urban Employee Basic Medical Insurance.

**Declarations**

**Ethics approval and consent to participate**

The dataset, the China Health and Retirement Longitudinal Study (CHARLS), which was used in this study, is publicly available (http://charls.pku.edu.cn/en), and its study protocol was approved by the Ethical Review Committee of Peking University, China. Hence, ethical approval was not required for this study. Survey data were obtained from the Peking University with its official permission. Therefore, the current study did not require ethical approval. The need for written consent was waived by the committee.

**Consent for publication**

Not applicable.

**Availability of data and materials**

The dataset, the China Health and Retirement Longitudinal Study (CHARLS), which was used in this study, is publicly available (http://charls.pku.edu.cn/en).

**Competing interests**

The authors declare no competing interests.

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Authors’ contributions

XM and TO organized this research project and conceptualized and designed the study. XM conducted data collection and performed a formal analysis. XM and TO prepared the initial manuscript, and reviewed and edited it. XM and TO acquired the funds. All authors have read and approved the final manuscript.

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Figures
Figure 1

Participation rates of social insurance programs