SSM - Population Health 25 (2024) 101632

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

The impact of long-term care insurance pilot on the mental health of older adults: Quasi-experimental evidence from China

Lianjie Wang

Department of Sociology, Jiangnan University, Wuxi, China

ARTICLE INFO

Keywords:
Long-term care insurance
Mental health
Older adults
DID model
Healthy China

ABSTRACT

The Chinese government launched pilot programs for a long-term care insurance system in response to the ongoing increase in the aging population. This study uses the difference-in-differences (DID) model to analyze the impact of long-term care insurance on older adults' mental health based on China Health and Retirement Longitudinal Study (CHARLS) four-period panel data from 2011 to 2018. This study found that long-term care insurance reduced Center for Epidemiological Studies Depression Scale (CES-D) scores among older adults by 1.059 points. Moreover, there was an improvement of 0.181 and 0.870 points in mental status and scenario memory scores, respectively. The impact of the long-term care insurance pilot program on improving the mental health of older adults was more pronounced, especially for those with chronic diseases or disabilities as well as those living in rural and western regions. This study also revealed that long-term care insurance enhances mental health by reducing medical expenses and increasing daily companionship and social interaction. Therefore, a pilot study of long-term care insurance showed a significant improvement in the mental health of older adults. To provide a comprehensive care service system for older adults, the government should expand the scope of the pilot program and increase the accessibility of mental health services for older adults.

1. Introduction

With deepening economic transformation and social transition, China's population structure has undergone significant changes. One of the most critical features of this transformation is the aging of the population and the resulting risks to longevity and disability. According to statistical data, the number of older adults aged 60 years and above in China will increase from 194 million in 2012 to 280 million in 2022, with an annual growth of approximately 7.8 million. By the mid-century, the older adult population in China is projected to surpass 400 million, accounting for 34% of the total population (Su et al., 2022). Furthermore, in 2022, the number of older adults aged 80 years and above will reach 80 million, accounting for 28.57% of the older population, indicating that approximately one out of every 3.5 older individuals will belong to the oldest age group. However, it should be noted that longevity does not necessarily equate to good health, as physical functioning often declines with increasing age. According to the Seventh National Population Census data, the average life expectancy in China is 8.3 years longer than the healthy life expectancy, suggesting that older adults in China are more likely to experience prolonged periods of illness, disability, or semi-disability in their later years. Furthermore, the "2018–2019 China Long-term Care Research Report" indicates that the disability rate among the older population in China has reached 11%, with moderate and severe disabilities accounting for 7% and 5%, respectively. Scholars predict that by 2030, the proportion of older adults with semi-disabilities and disabilities in China will reach 17% and is projected to surpass 20% by 2050 (Xin & Ren, 2022). The progressively increasing disability rate among the older adults in China has given rise to prominent long-term care issues, posing a formidable challenge to the country's future economic and social development.

As the process of population aging continues to advance globally, the concept of "healthy aging" was first proposed by the United Nations First World Assembly on Aging. It encompasses multiple dimensions including physical health, mental health, and active social participation. Among these dimensions, a decline in physical health is the most significant factor affecting the quality of life of individuals in their later years. The increase in age and decrease in physiological function are irreversible, and the only way to slow the decline in physical functioning is through good daily care and maintenance. However, compared with physical health, there is a need to increase attention to the mental health of older adults. According to a 2022 survey report by the World Health Organization, approximately one billion people worldwide are currently

E-mail address: wanglianjie@jiangnan.edu.cn.

https://doi.org/10.1016/j.ssmph.2024.101632
Received 16 December 2023; Received in revised form 8 February 2024; Accepted 15 February 2024
Available online 16 February 2024

affected by mental disorders. Every 40 s, one person dies due to suicide, with low- and middle-income countries accounting for 77% of the global suicide deaths. One year after the onset of the COVID-19 pandemic, there has been a significant increase in anxiety disorders, with 90 million more affected patients worldwide. Additionally, there has been a 50 million increase in cases of depression and over 100 million insomnia disorders (WTO, 2022). According to a mental health survey in China, approximately 95 million people have depression, and a significant proportion of them are older adults. The physical functions of older adults gradually decline with age, coupled with changes in lifestyle rhythms and social roles after retirement, making them more prone to experiencing negative emotions such as anxiety, depression, and loneliness. More than 90% of older adults in China rely on family care, which significantly increases their burden. This is especially true for older adults with chronic illnesses or disabilities who often experience negative emotions such as self-blame and guilt due to the perceived increase in family burden. If not identified and addressed promptly, these negative emotions can lead to severe consequences such as self-harm or suicide. According to statistical data, China currently sees over 100,000 older individuals dying by suicide each year, accounting for 36% of the total suicide deaths (jia et al., 2023). Mental health issues among older adults are becoming increasingly prominent, requiring extensive attention from both countries and society.

Fundamentally, the primary reason for mental health issues faced by older adults is the government's insufficient investment in formal care systems, funding, and facilities. Consequently, older adults must often rely primarily on family caregivers in their later years. From a global perspective, countries such as Germany, Japan, and the United States have established long-term care insurance systems to address caregiving challenges brought about by aging populations. These systems ensure the quality of life and dignity of older adults, and provide institutional safeguards to improve their mental health. Faced with increasing long-term care needs among older adults, the Chinese government has actively implemented pilot programs for long-term care insurance to address elderly care issues in various areas including medical care and daily living assistance. These policies aim to prioritize the mental health of older adults, enabling them to enjoy the fruits of development and continuously enhance their happiness and well-being. Therefore, evaluating the impact of pilot programs for long-term care insurance on the mental health of older adults is crucial for providing insights into meeting the long-term care needs of older adults and improving long-term care insurance policies.

This study makes three contributions. First, China's long-term care insurance is still in the pilot phase. While existing literature has evaluated the policy's effects on medical service utilization and family caregiving for older adults, this study uniquely focuses on the impact of long-term care insurance on the mental health of older adults, thereby expanding the scope of research. Second, although the existing literature on mental health predominantly focuses on vulnerable groups, such as women and children, with some studies analyzing the impact of social participation and intergenerational support on the mental health of older adults, these studies generally employ cross-sectional data or basic regression methods and have yet to fully address endogeneity issues. This study overcomes these limitations by leveraging the quasi-experimental nature of the long-term care insurance pilot program and utilizing the DID method to evaluate policy effects, thereby enabling a more accurate examination of the causal relationship between long-term care insurance and mental health. Finally, while existing studies have explored the effects of long-term care insurance policies, there is a need for more detailed research. This study fills this gap by examining the heterogeneity of the policy's impact on the mental health of older adults and testing the potential mechanisms. In summary, this study serves as essential supplementary research to the existing literature and provides valuable insights for improving the long-term care insurance system.

2. Policy background and literature review

2.1. Policy background

The development of the long-term care insurance policy in China can be broadly categorized into three stages: the initial stage (2006–2012), the initial growth stage (2012–2015), and the comprehensive development stage (since 2016).During the initial stage, central and local governments introduced policies related to long-term care, end-of-life care, and subsidies for older adults. However, long-term care insurance has not yet been recognized as an independent insurance category. For instance, in 2006, the National Aging Office issued the "Opinions on Strengthening Grassroots Aging Work, emphasizing the need to establish an older adults service system to provide convenient medical and daily care for older adults. In 2011, the State Council released the "Twelfth Five-Year Plan for the Development of China's Aging Industry," which proposed the establishment of a socialized long-term care service system that prioritized home-based care, supported by community care, and supplemented by institutional care. During the initial growth stage, local governments began independently piloting long-term care insurance programmes, laying the groundwork for the central government to introduce relevant policies. In 2012, Qingdao became the first city in China to initiate a pilot program for long-term care insurance with the release of the "Opinions on Establishing a Long-Term Care Insurance System (Trial Implementation)" In 2015, Changchun and Nantong successfully launched their pilot long-term care insurance programs. Shanghai also piloted the Elderly Medical Care and Nursing Program from 2013 to 2015, and each pilot city developed unique development concepts and characteristics. In the comprehensive development stage, the Ministry of Human Resources and Social Security released the "Guiding Opinions on the Pilot Implementation of the Long-Term Care Insurance System" in 2016 with the aim of finding the most suitable long-term care insurance scheme for the Chinese context. Shanghai, Chongqing, and 15 other cities were selected as the first pilot cities for long-term care insurance. Simultaneously, Jilin and Shandong were identified as vital provinces for national pilot programs. In 2020, the National Healthcare Security Administration and Ministry of Finance issued the "Guiding Opinions on Expanding the Pilot Implementation of the Long-Term Care Insurance System," determining the second batch of national pilot areas. The number of pilot cities and regions for long-term care insurance increased to 49, marking the commencement of comprehensive development during the pilot phase of long-term care insurance.

From a coverage perspective, long-term care insurance in Qingdao and Changchun initially covered urban employees. However, as the pilot program expanded, coverage was gradually extended to include both urban and rural residents. Pilot cities such as Jiaxing covered employees as well as urban and rural residents, whereas cities such as Wenzhou and Anqing covered only urban employees. In terms of payment methods, all pilot areas adopted a designated mode for elderly care or medical institutions providing care services. Additionally, some pilot areas supported established institutions offering home-care services. Furthermore, cities like Chengdu and Shangrao provided subsidies to family members who provided care at home, known as "family affectionate care," to support their caregiving efforts.Regarding benefit levels, most pilot areas have reimbursement rates ranging from 70% to 90%, with maximum limits based on different types of care services. This effectively reduces the financial burden for individuals. The primary providers of long-term care insurance in terms of service delivery and content include elderly care institutions, medical institutions, and home-based care facilities. Elderly care and medical institutions offer a wide range of services, primarily focusing on life and medical care. For example, in Ningbo City, basic life care services include 40 aspects such as cleanliness and hygiene, nutrition intake, excretion care, mobility comfort and safety care, and medication guidance. Medical care services include 28 aspects such as sputum suction care, electrocardiogram

monitoring, and subcutaneous injections. Home-based care mainly focuses on life care services such as cleaning, sleep care, and dietary care.

As of the end of March 2022, the total number of participants in national pilot cities for long-term care insurance reached 145 million, with a cumulative total of 1.72 million individuals receiving benefits. The average level of benefit payment is approximately 16,000 yuan per person per year (Dai, 2022). This article examined the impact of long-term care insurance on older adults' mental health using the China Health and Retirement Longitudinal Study (CHARLS) data from 2011 to 2018, as shown in Fig. 1. The treatment group in this study includes the first batch of national pilot cities and the cities where local governments independently conducted the program during this period. The control group comprises the second batch of pilot and non-pilot cities.

2.2. Literature review

With continuous aging of the Chinese population and increasing levels of disability, the issue of long-term care for older adults has gradually gained widespread attention in the academic community. This study primarily analyzed three aspects of the literature: the impact of long-term care insurance pilot programs on older adults, factors affecting the mental health of older adults, and the mechanisms through which long-term care insurance affects mental health.

Existing literature has explored the impact of long-term care insurance on the physical health, medical expenses, and mortality risk of older adults. Tang et al. (2022) found that the implementation of long-term care insurance had a significant positive effect on older adults' physical and mental health. Using Qingdao as an example, Chao et al. (2019) found that long-term care insurance significantly reduced depression among older adults and improved their overall health status. This impact is more pronounced in rural areas (Yu, 2019). However, some scholars argue that long-term care insurance may not positively affect mental health because of the lack of psychological comfort services (Lee et al., 2019). Nevertheless, long-term care insurance is crucial for reducing the length of hospital stay in older adults (Jae et al., 2018).

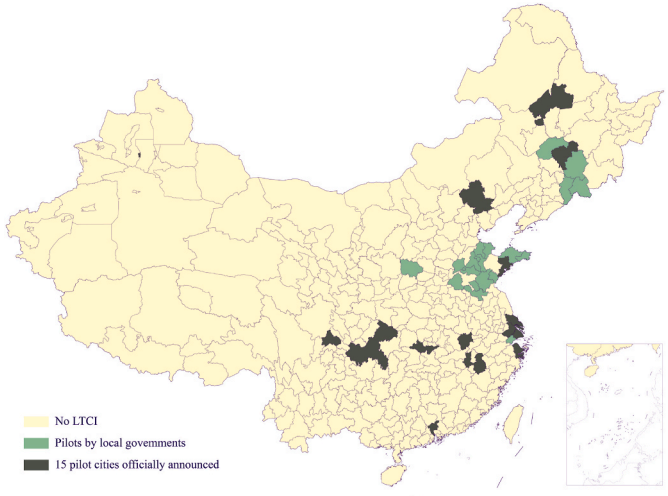

Fig. 1. Pilot Cities for Long-term Care Insurance in China (2011–2018)
Notes: Pilot projects implemented by local governments: Dongying, Rizhao, Jinan, Songyuan, Jilin, Xuzhou, Linyi, Liaocheng, Taian, Linfeng, Meihekou, Tonghua, Baishan, Jiaxing, Bingzhou, Zibo, Hezhe, Zaozhuang, Yantai, and Weihai. The 15 officially announced pilot cities were Qingdao, Shanghai, Changchun, Shangrao, Chengde, Nantong, Jingmen, Anqing, Chengdu, Guangzhou, Qiqihaer, Chongqing, Ningbo, Shihezi, and Suzhou. The implementation times and coverages of the pilot areas were sorted according to the policies published on the government websites of each city. Considering the policy effect, the pilot time refers to the policy implementation time rather than policy promulgation time. Since the coverage of each city varied, the empirical process was adjusted according to the actual scope.

Due to the economic compensation provided by long-term care insurance, participants experience a significant reduction in their medical expense burden (Hyun and Yun, 2018). Scholars suggest that a possible mechanism is that long-term care insurance improves the physical health of older adults, leading to a notable decrease in hospital utilization and medical expenditures (Feng et al., 2020). Choi and Joung (2016) pointed out that long-term care insurance can considerably reduce mortality risk in older adults. However, the mortality risk of older individuals receiving institutional care was much higher than that of those receiving home care. The implementation of long-term care insurance alleviates the burden of family caregiving, decreases disability levels among older adults, and enhances their quality of life (Chen & Xu, 2020).

Existing literature has extensively studied the impact of various factors on the mental health of older adults from individual, family, and societal perspectives. Regarding personal characteristics, factors such as the level of disability (Svensson & Hansson, 2017), marital status (Tian et al., 2015), educational level (Guo et al., 2016), and age (Zhou et al., 2023), and other factors have been found to affect the mental health of older adults. Generally, a higher level of disability, the absence of a spouse, lower educational level, and older age were associated with poorer mental health status. Additionally, income level is related to the mental health status of older adults, with lower income levels linked to higher levels of depression in this population (Du & Mu, 2022). Furthermore, Vaccaro et al. (2021) found that providing grandchild care could increase social interactions among grandparents and significantly impact their mental health. In terms of social factors, medical and pension insurance have been found to significantly reduce depressive symptoms among older adults and greatly improve their mental health status (Zhang et al., 2019). Social isolation can lead to feelings of loneliness in older adults, negatively affecting their mental health. Enhancing social engagement through increased social participation and integration into social groups can positively affect mental health (Guo & Ling, 2022).

Based on a specific pilot policy of long-term care insurance and a literature review, this study posits that this pilot policy has a positive impact on older adults' mental health. To further explore this impact, this study proposes a theoretical model to examine the mechanism through which long-term care insurance affects the mental health of older adults, as illustrated in Fig. 2. First, access to medical and daily care can improve older adults' health status (Zimmerman et al., 2022). However, in China, owing to a lack of stable income sources and relatively low pension benefits, older adults often face financial challenges when dealing with the risk of illness. High medical expenses can place a burden on family members, leading to fear and depression among older adults. Long-term care insurance offers financial subsidies and free services to older adults who face challenges arising from illnesses, accidents, and other factors. These individuals require various medical services, including but not limited to electrocardiogram monitoring, nebulization inhalation, subcutaneous injections, intramuscular injections, and intradermal injections.This assistance can help reduce medical expenses and improve the mental health of older adults in pilot cities. Second, increased daily companionship has been found to

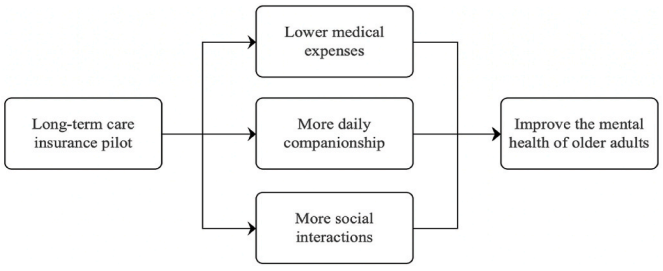

Fig. 2. Mechanisms of long-term care insurance on older adults' mental health.

significantly improves the mental health of older adults (Fang et al., 2021). Long-term care insurance facilitates access to companionship and social support, which can alleviate feelings of loneliness and isolation among older adults. Nearly all pilot cities have implemented home-based care services in which family members providing daily care services to older adults receive financial subsidies from long-term care insurance. Therefore, long-term care insurance can offer essential companionship to older adults, particularly to those with disabilities, thereby enhancing their mental health. Finally, social interactions significantly affect older adults' mental health (Domènech-Abella et al., 2017). The implementation of a long-term care insurance pilot program significantly accelerated the advancement of community-based elderly care services. These services encompass a wide range of offerings such as day care centers, nursing homes, canteens, recreational areas, rehabilitation facilities, and various opportunities for social interaction. In addition, during the pilot process. Internet platforms are widely utilized to provide targeted and customized services, offering platform support for the social participation of older adults.

3. Data, variables and methods

3.1. Data source

The data used in this study were sourced from the China Health and Retirement Longitudinal Study (CHARLS), a comprehensive interdisciplinary survey conducted by Peking University's National Development Research Institute in collaboration with the China Social Survey Research Center and the Peking University Youth League Committee. This survey project interviewed approximately 20,000 respondents across 28 provinces (autonomous regions, municipalities) in China, with the aim of collecting a high-quality set of microdata representing Chinese middle-aged and older households and individuals. The use of CHARLS data in this article is based on two main points. First, the survey questionnaire design draws on international experiences from countries such as the United States and Europe, utilizing various sampling methods such as Population Proportionate Sampling(PPS). The survey covers essential information on individuals and household structure, social security, and different types of income and expenditure, and provides high-quality data support for studying rural older adults. Second, the fourth wave of the survey covered the implementation period of long-term care insurance policies, and the data included information on mental health and long-term care insurance in various provinces and cities, which better caters to the research needs of this study. Based on this, this study uses complete four-wave data from CHARLS spanning 2011 to 2018 and processes them to obtain a balanced panel dataset. After processing, 41, 589 samples were acquired, with 1928 samples from the treatment group and 39,661 in the control group, respectively.

3.2. Variables

3.2.1. The explanatory variable

The explanatory variable in this study was the implementation of the long-term care insurance pilot program. Using the distribution of provinces in the CHARLS data, if an individual's city has implemented the long-term care insurance pilot program, it indicates that the individual is covered by the system. Owing to variations in the implementation time and coverage of the pilot program across different cities, we adjusted the scope of the treatment and control groups based on changes in the pilot implementation time and coverage range, as shown in Fig. 1. For example, in the case of urban samples from Qingdao, the control group is represented by data from 2011, whereas the treatment group consists of data from 2013. Similarly, for the rural samples, the control group includes data from the years before 2015, while the treatment group includes data from 2015 onwards. Analogous approaches were applied to other regions based on the implementation time and coverage range of the pilot program. As the CHARLS data were only collected through nationwide surveys in 2011, 2013, 2015, and 2018, this study focuses on examining the policy effects of the long-term care insurance pilot program during this specific period.

3.2.2. The explained variable

The explained variable studied in this article was the mental health of older adults. Based on the definitions provided by Li and Liu (2020), we measured mental health from three perspectives. First, the Center for Epidemiologic Studies Depression Scale (CES-D) scores were used. CES-D is a questionnaire tool used to measure individuals' potential levels of depression and anxiety. It was initially designed and introduced by James L. Radloff in 1977 and has since been widely utilized in various clinical psychological practices and scientific research domains. In the CHARLS data, the ten items of the CES-D scale were scored as follows: "rarely or none of the time (<1 day)" was assigned a value of 0, "some or a little of the time (1–2 days)" was assigned a value of 1, "occasionally or a moderate amount of the time (3–4 days)" was assigned a value of 2, and "most or all of the time (5–7 days)" was assigned a value of 3. For the two positively worded items, "I felt hopeful about the future" and "I felt happy," reverse scoring was applied. Second, mental status scores were considered. Mental status is an essential indicator of mental health in older adults. Respondents were sequentially asked a series of questions about drawing, arithmetic, current date, and day of the week. For each incorrect answer, the respondent received a score of 0, and for each correct answer, the respondent received a score of 1. Third, episodic memory scores were included. Episodic memory assesses an individual's memory capacity and is a core indicator of mental health. In the CHARLS questionnaire, the number of correct responses for short- and long-term memories of ten words read by the interviewer at different times was used to measure episodic memory.

3.2.3. The control variables

To control for the effects of other variables, this study selected individual- and household-level variables as control variables, including age, sex, urban/rural status, educational level, marital status, health status, per capita annual income, pension insurance, and medical insurance. The annual income per capita was calculated by summing up five components: wages, agricultural income, private income, social security income, and government transfer income, and then dividing it by the number of household members. Definitions of the other variables are listed in Table 1.

3.2.4. The mediating variables

This study examined three mechanisms based on a theoretical framework. The first is medical expenses. Long-term care insurance provides economic compensation to older adults for receiving medical and caregiving services at formal hospitals when they become disabled. Therefore, this study uses the total cost of outpatient and inpatient medical services as the primary outcome variable. Daily companionship. Long-term care insurance enhances intergenerational communication between older adults and their children. Therefore, this study uses the frequency of contact between older adults and their children as the primary measurement indicator. Third, there were social interactions. This study used 11 social activities, including socializing with friends, as primary measurement indicators.

3.3. Methods

3.3.1. PSM-DID model

The implementation of the long-term care insurance pilot program in various cities across China provided a quasi-natural experimental setting for this study. Owing to the varying policy pilots and implementation timings in each individual's city, this study employs a difference-in-differences (DID) model to assess the impact of long-term care insurance on the mental health of older adults. Unlike traditional regression models, the DID model exhibits strong applicability and effectively

Table 1
Descriptive statistics.

Variables	Variable definition	All samples		Treatment group		Control group	
		Mean	SD	Mean	SD	Mean	SD
CES-D scores	Value ranges: 0-30	8.392	6.347	7.556	6.079	8.434	6.357
Mental state scores	Value ranges: 0-12	9.450	2.498	9.675	2.277	9.433	2.513
Episodic memory scores	Value ranges: 0-20	5.596	4.062	7.510	3.797	5.522	4.054
Age	Interview year minus birth year	68.610	7.069	68.778	7.172	68.601	7.063
Sex	Male = 1, female = 0	0.504	0.500	0.553	0.497	0.502	0.500
Health status	Complete all ADLS indicators = 1, complete none or more = 0	0.875	0.331	0.894	0.307	0.874	0.332
Marital status	Spouse = 1, no spouse = 0	0.748	0.434	0.756	0.430	0.747	0.435
Urban/rural	urban = 1, rural = 0	0.284	0.451	0.315	0.465	0.283	0.450
Educational level	Years of education	5.059	3.390	5.039	4.047	5.060	3.354
Endowment insurance	Yes = 1, no = 0	0.713	0.452	0.839	0.367	0.707	0.455
Medical insurance	Yes = 1, no = 0	0.916	0.278	0.962	0.191	0.913	0.281
Yearly household income per person	Household income divided by family size(Unit: Yuan)	49560.29	36051.19	44714.87	41647.25	49796.82	35739.39
Medical expenses	Sum of outpatient and inpatient expenses(Unit: Yuan)	29766.29	18388.14	25971.68	16559.7	29950.6	18452.73
Daily companionship	Contact frequency of children and older adults	0.531	0.499	0.519	0.500	0.461	0.499
Social interactions	Participation in one or more of the 11 activities = 1, participation in none = 0	0.488	0.500	0.490	0.500	0.438	0.496
N		41589		1928		39661	

Note: The decimal values have been rounded to three decimal places.

circumvents endogeneity issues arising from omitted variables and reverse selection bias. Following the requirements of the DID model, we construct two sets of dummy variables. The first set is the policy dummy variable (Treat), representing the "treatment group" affected by the policy and the "control group" unaffected by the policy. If the city where the older adults reside implements long-term care insurance, it is coded 1 (coverage); otherwise, it is coded 0. The second set is the time dummy variable (Time), which represents two periods: before and after policy implementation. The value was 0 before policy implementation and 1 after policy implementation. The impact of long-term care insurance on the mental health of older adults was systematically evaluated by comparing the differences in the relevant indicators between the treatment and control groups before and after policy implementation. Therefore, the DID model for this study was constructed as follows:

$$MH_{ict} = \beta_0 + \beta_1 Treat_{ic} \times Time_t + \beta_2 \sum Z_{ict} + \mu_i + \tau_t + \varepsilon_{ict} \quad (1)$$

In Equation (1), MH_{ict} represents the mental health status of individual i residing in city c in year t, and includes three variables: CES-D, mental state, and episodic memory scores. $Treat_{ic} \times Time_t$ is the core explanatory variable. β_1 represents the policy effect of long-term care insurance. $\sum Z_{it}$ represents a series of individual and household-level control variables, and β_2 represents the corresponding regression coefficients. β_0 is the intercept term, μ_{ij} represents individual fixed effects, and τ_t represents time fixed effects. ε_{ict} represents a random disturbance term.

The choice of cities for the long-term care insurance pilot program was not random. In this study, we used the PSM-DID method to conduct robustness tests. After controlling for covariates, the treatment group was matched with the control group based on similar or identical scores, thereby eliminating selection bias and providing a more accurate assessment of the policy effects of long-term care insurance on older adults' mental health. Based on this, we construct the PSM-DID model, as shown in Equation (2):

$$MH_{ict}^{PSM} = \beta_0 + \beta_1 Treat_{ic} \times Time_t + \beta_2 \sum Z_{ict} + \mu_i + \tau_t + \varepsilon_{ict} \quad (2)$$

3.3.2. Mediating effect model

This study employed the mediation effect method to examine how long-term care insurance affects older adults' mental health. Based on this, we constructed the mediation effect model, as shown in Equations (3)–(5):

$$MH_{ict} = \alpha_0 + \alpha_1 \mathrm{Treat}_{ic} \times Time_t + \alpha_2 \sum Z_{ict} + \mu_i + \tau_t + \varepsilon_{ict} \quad (3)$$

$$M_{ict} = \gamma_0 + \gamma_1 \mathrm{Treat}_{ic} \times Time_t + \gamma_2 \sum Z_{ict} + \mu_i + \tau_t + \varepsilon_{ict} \quad (4)$$

$$MH_{ict} = \delta_0 + \delta_1 \mathrm{Treat}_{ic} \times Time_t + \delta_2 \sum Z_{ict} + \delta_5 M_{ict} + + \mu_i + \tau_t + \varepsilon_{ict} \quad (5)$$

where M_{ict} represents the mediating variable. According to equations (3)–(5), the testing procedure is as follows. Step 1: Examine the effect of long-term care insurance on mental health based on the baseline model. If the regression coefficient is significant, proceed to the next step.Step 2: Include the mediating variable as the dependent variable in the model and test its significance. If the regression coefficient is significant, it indicates the presence of a mediating effect. Step 3: Include the mediating variable and $\mathrm{Treat}_{ic} \times Time_t$ in the model and test their significance. The analysis determined whether the mediating effect was established by examining the changes in the regression coefficients.

4. Results

4.1. Descriptive statistical analysis

Descriptive statistics for the relevant variables are presented in Table 1. Regarding mental health, the mean scores for CES-D, mental state, and episodic memory in the total sample were 8.392, 9.450, and 5.596, respectively. Notably, the treatment group exhibited higher CES-D scores than the control group while scoring higher for mental states and episodic memory. This suggests that older adults residing in long-term care insurance pilot areas may have a better mental health status. However, these findings remain to be further examined and verified. In terms of the control variables, the average age of older adults is 68.610 years, with a fairly balanced gender distribution of 50.4% male and 49.6% female. The proportion of healthy older adults was 87.5% and the majority (74.8%) were married. The mean number of years of education received was 5.059, and the pension and medical insurance participation rates were 71.3% and 91.6%, respectively. The average annual household income was approximately 49,560.29 yuan. Group comparisons revealed that the treatment group had higher mean values than the control group in terms of age, health status, marital status, household registration, pension insurance, and medical insurance. However, the control group had higher mean values for education and average household income, with the mean total medical expenses being 29,766.29 yuan. A total of 53.1% of older adults received daily family companionship, while 48.8% engaged in social interactions. The treatment group incurred lower total medical expenses than the control group. Moreover, a higher proportion of older adults in the treatment

group received daily family companionship and participated in social interactions than those in the control group.

4.2. Main regression results

Table 2 reports the impact of long-term care insurance on the mental health of older adults. Models (1), (3), and (5) present the baseline results, while models (2), (4), and (6) highlight the regression results with additional control variables. The findings indicate that the policy pilot significantly reduced the CES-D scores of older adults. Specifically, the policy pilot led to a decrease of 1.059 points in the CES-D scores of the treatment group compared to the control group. Moreover, the policy pilot resulted in an increase of 0.181 points in the mental state scores and 0.870 points in the episodic memory scores. These results suggest that the long-term care insurance pilot effectively alleviated depressive symptoms among older adults, improved their mental state, and enhanced their overall psychological well-being. These findings align with the conclusions drawn by Yu et al. (2019) and Tang et al. (2022). Given that the Chinese government has historically implemented few policies related to formal elderly care, the long-term care insurance pilot provides much-needed policy support for the long-term care of older adults with chronic illnesses and disabilities, demonstrating recognition of their social value. Consequently, the long-term care insurance pilot meets the psychological expectations of older adults, thereby improving their mental health.

Regarding the control variables, although the mental state and scenario memory scores of older adults gradually decreased as age increased, depressive symptoms also decreased. Older males generally have a better mental health status than females, indicating the presence of significant gender differences in mental health. This highlights the need to strengthen attention to the mental health of older women and improve the quality of life in their later years. Compared with physically unhealthy older adults, physically healthy older adults have higher levels of mental health. In particular, physically unhealthy older adults had a CES-D score 3.041 points higher than healthy older adults. This suggests that there may be mutual impacts and transformations between physical and mental health, and that handling the relationship between them is essential. Furthermore, the higher the level of education and the average annual household income, the higher the mental health status of older adults. This is consistent with the findings of Gong et al. (2023).

4.3. Equilibrium trend test and dynamic effect analysis

An essential assumption for conducting policy effect evaluations using the DID model is that mental health status development trends among the treatment and control groups of older adults should remain consistent before implementing the long-term care insurance pilot programs. There should be no systematic differences between the two groups, and any observed differences should emerge solely after policy implementation. To validate this assumption, this study employs an Event Study Approach to estimate the dynamic effects and test for parallel trends. The regression model incorporates the interaction terms between policy implementation and year dummy variables, with 2015 serving as the reference group. The results presented in Fig. 3 reveal that among the three mental health indicators, there were no significant differences in the average mental health status between policy and non-policy cities before 2015. However, following policy implementation, older adults residing in policy cities experienced a notable reduction in depressive symptoms along with significant improvements in their mental state and episodic memory. These findings provide strong evidence that the DID model used in this study satisfied the parallel trend assumption, thus validating the baseline regression results presented in Table 2.

4.4. Robustness tests

This study conducted a series of robustness tests on the baseline regression results.

First, a PSM-DID test was performed. The baseline DID regression assumes a random assignment. However, compared with an ideal experiment, the impact of long-term care insurance pilot programs on the mental health of older adults is influenced by various factors, making it challenging to ensure the consistency of relevant characteristics. We employed the PSM-DID method to address the endogeneity issue caused by changes in individual characteristics within the treatment and control groups. By controlling for covariates and matching individuals in the treatment group with those in the control group who had similar or close scores, we minimized selection bias and provided a more precise evaluation of the long-term care insurance policy effects. Table 3 reports the standardized differences in the variables before and after matching. Notably, variables such as health, education level, and per capita annual income exhibited significant differences before matching, which may have led to selection bias in the results. After matching, all variable biases are reduced to within 10%, thereby satisfying this requirement. The results in Table 4 confirm that long-term care insurance has a significantly positive effect on the mental health of older adults, further demonstrating the robustness of the regression results.

Second, we used the replacement variable method. Life satisfaction is an overall psychological evaluation of an individual's quality of life and an essential indicator of mental health. Research has shown that higher life satisfaction is associated with 21 positive health conditions and serves as an essential reference indicator of mental health (Tokay & Mersin, 2021). Therefore, we used the life satisfaction of older adults as a replacement variable for mental health and incorporated it into the

Table 2
Main regression results.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	CES-D scores		Mental state scores		Episodic memory scores	
$Treat_{ic} \times Time_t$	−0.818*** (0.164)	−1.059*** (0.196)	0.065*** (0.063)	0.181*** (0.067)	0.864*** (0.106)	0.870*** (0.113)
Age		−0.059*** (0.007)		−0.051*** (0.003)		−0.139*** (0.003)
Sex		−1.281*** (0.085)		0.871*** (0.040)		−0.029 (0.046)
Health status		−3.041*** (0.116)		0.466*** (0.056)		0.887*** (0.041)
Marital status		−1.074*** (0.104)		0.284*** (0.049)		0.668*** (0.052)
Urban/rural		−1.871*** (0.098)		1.074*** (0.042)		1.463*** (0.055)
Educational level		−0.208*** (0.014)		0.188*** (0.006)		0.238*** (0.008)
Endowment insurance		−0.617*** (0.108)		−0.039 (0.054)		−0.490*** (0.060)
Medical insurance		0.497*** (0.161)		0.064 (0.074)		0.197*** (0.085)
Yearly household income per person		−0.394*** (0.155)		0.162*** (0.055)		0.143* (0.085)
_cons	8.660*** (0.208)	19.38*** (1.829)	8.670*** (0.094)	7.423*** (0.671)	1.460*** (0.125)	7.566*** (0.981)
Time-fixed effect	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES
N	34095	34095	23212	23212	38966	38966

Note:*p < 0.1, **p < 0.05, ***p < 0.01. In the regression process, per capita annual household income and medical expenses were logarithmically transformed.

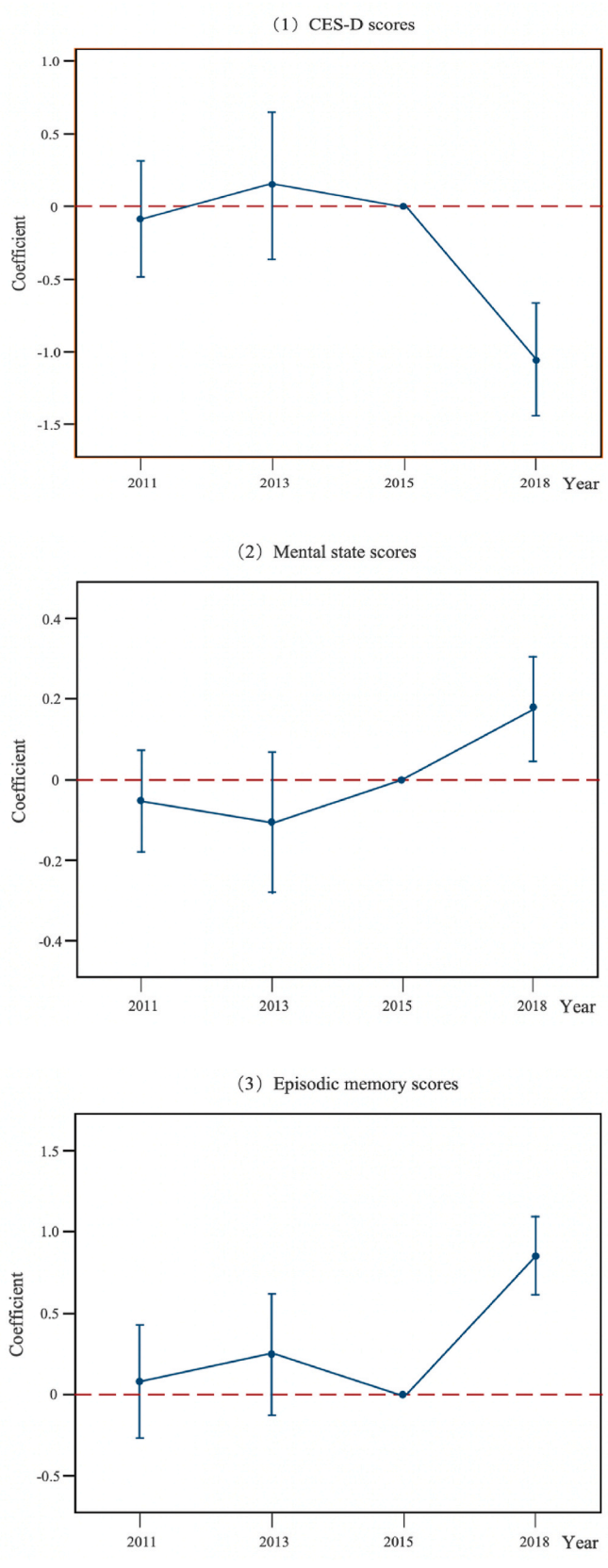

Fig. 3. Parallel trend test and dynamic effects (95%CI).

regression model. The results indicated that long-term care insurance significantly improves life satisfaction among older adults.

Third, we have changed the variable definition approach. Chen, Zhou, Yao, and Wang (2022) divided depressive mood into five categories: no depression (0–5 points), mild depression (6–10 points), moderate depression (11–15 points), severe depression (16–25 points), and severe depression (26–30 points). Based on this, we defined a binary dummy variable for mental health, where a CES-D score equal to or above six was categorized as mentally unhealthy (assigned a value of 0), and a CES-D score below six was categorized as mentally healthy (assigned a value of 1). The results in Table 4 demonstrate that long-term care insurance improved older adults' mental health by 7.1%, further confirming the robustness of the baseline results.

Fourth, the fixed effects were adjusted. In the baseline regression, we controlled only for city- and year-fixed effects. Therefore, in addition to the baseline regression, we further controlled for provincial and year fixed effects to eliminate the differential effects caused by different provincial elderly care policies. Furthermore, we adjust the city fixed effects to community and individual fixed effects. The results indicate that long-term care insurance significantly reduced older adults' CES-D scores, confirming the robustness of the baseline results.

4.5. *Placebo test*

The placebo test refers to the use of virtual policy implementation time or control group samples to test whether policy effects exist, and is a commonly used method for evaluating policy effects. In China, pilot cities for long-term care insurance are generally cities with highly aging populations, such as Shanghai and Qingdao. Simultaneously, these cities have higher levels of economic development and well-developed market-oriented older care service systems. Older adults in these cities may have better mental health because of their access to comprehensive care. Therefore, the conclusions drawn from the previous analysis using the DID and PSM-DID methods, which indicated that long-term care insurance improves mental health, cannot eliminate the impact of unobservable factors at the individual, city, or year levels.

Accordingly, we conducted placebo tests using two standard methods: a virtual control group and policy timing. First, we used a virtual control group. In this study, we utilized data from the four waves of the China Health and Retirement Longitudinal Study (CHARLS) from 2011 to 2018 to examine the impact of long-term care insurance pilot programs on the mental health of older adults during this period without being affected by long-term care insurance policy pilots after 2018. In 2020, the National Healthcare Security Administration and Ministry of Finance identified 13 regions, including Beijing, Tianjin, Fuzhou, Kaifeng, and Kunming, as the second batch of pilot cities. This study considered the second batch of pilot cities as the treatment group, while the other cities served as the control group. Theoretically, this treatment should not significantly impact mental health. The second is the virtual policy timing. As most long-term care insurance pilot programs commenced in 2016 or later, we excluded cities that implemented long-term care insurance pilot programs before 2016. We designated cities that initiated pilot programs from 2016 onwards as the treatment group, with others serving as the control group. Additionally, we assumed that the policy implementation time for the pilot cities was 2014. Assuming 2014 as the policy implementation time, we conducted a difference-in-differences (DID) analysis using data from 2011 to 2013 as the pre-implementation period and 2015–2018 as the post-implementation period. As presented in Table 5, the results indicate that the regression coefficients obtained using both methods are not statistically significant at the 10% level. This finding suggests that the estimation results are not affected by individual or time variations, confirming the robustness of the baseline regression results.

Table 3
Balance test results of PSM-DID model.

Variables	Before matching				After matching			
	Control group	Treatment group	Diff	%bias	Control group	Treatment group	Diff	%bias
Age	68.379	68.239	−0.14	−2.1	68.337	68.239	−0.098	−1.5
Sex	0.521	0.482	−0.039*	−7.8	0.469	0.482	0.013	−7.8
Urban/rural	0.274	0.308	0.034**	7.5	0.346	0.308	−0.038*	−8.4
Health status	0.902	0.934	0.032***	11.9	0.947	0.934	−0.013	−4.5
Educational level	4.842	5.117	0.275***	7.8	5.299	5.117	−0.182	−5.1
Marital status	0.758	0.753	−0.005	−1.2	0.754	0.753	−0.001	−0.2
Endowment insurance	0.707	0.851	0.144	35.2	0.859	0.851	−0.008	−2.0
Medical insurance	0.928	0.971	0.043	19.5	0.979	0.971	−0.008	−3.7
Yearly household income per person	10.759	10.610	−0.149	−44.9	10.637	10.610	−0.027	−8.1

Note: *p < 0.1, **p < 0.05, ***p < 0.01.

Table 4
Results of the robustness tests.

Test method/Variable	Coeff	Std. Err.	N
(1) PSM-DID test			
CES-D scores	−0.139***	0.229	22719
Mental state scores	0.070***	0.093	14757
Episodic memory scores	0.053***	0.115	25501
(2) Replacement variable method			
Life satisfaction	0.052**	0.023	21952
(3) Change the definition of variable			
Mental health (CES-D scores <6 = 1)	0.071***	0.014	27402
(4) Adjusting fixed effects			
Added province × year fixed effect	−0.533***	0.029	30495
Increased province × year, community fixed effect	−0.339***	0.195	28937
Increase province × year, individual fixed effect	−0.403***	0.099	32203

Notes: *p < 0.1, **p < 0.05, ***p < 0.01.PSM-DID used the logit model to estimate the propensity score and default kernel matching to estimate. Owing to space constraints, the fourth method presents only the estimated results of the CES-D scores.

4.6. Heterogeneity analysis

This section examines the heterogeneous effects of long-term care insurance on older adults' mental health through three types of grouping analyses. First, grouping was performed based on health status. Long-term care insurance primarily provides care and financial compensation to insured individuals who experience loss of daily living abilities, age-related illnesses, or death. Therefore, regarding policy effects, older adults with higher levels of disability and those with chronic illnesses may be more affected, potentially resulting in different effects on their mental health. Following the study by Wang et al. (2021), this study examines the six activities of daily living (ADL) indicators for older adults. It categorizes them into four groups: "healthy" (able to complete all six indicators), "mild disability" (difficulty completing 1–2 indicators), "moderate disability" (difficulty completing 3–4 indicators), and "severe disability" (difficulty completing 5–6 indicators). This study examined six noncommunicable chronic diseases in older adults: hypertension, hyperlipidemia, diabetes, chronic lung disease, liver disease, and heart disease. One or more of these conditions was defined as having a chronic disease, whereas none were defined as not having a chronic disease. Furthermore, living arrangement and marital status have different effects on the mental health of older adults. Therefore, we categorized living arrangements into four groups: living alone, living with a spouse or children, living with relatives, and living in a nursing home. Marital status was categorized into two groups: those with and without a spouse. This study examines the heterogeneous effects of long-term care insurance on mental health in relation to these factors. Finally, according to regional grouping, in the process of a long-term care insurance pilot, pilot cities generally first cover urban employees and residents and then expand the pilot scope to rural residents. In addition, there are significant differences in regional economic development, population aging, and government governance levels. Therefore, this study examined the heterogeneity of long-term care insurance impacts on mental health based on different regions, such as urban and rural areas, as well as the eastern, central, and western regions.

Figss. 4–6 present the heterogeneous results for three mental health indicators among older adults. Firstly, regarding depressive mood scores, long-term care insurance has a higher impact on older adults with chronic illness ($p < 0.001$), moderate ($p = 0.002$) and severe disability ($p < 0.001$), no spouse ($p < 0.001$), rural residence ($p < 0.001$), and in the central and western regions ($p < 0.001$). This indicates that long-term care insurance is beneficial in reducing negative psychological symptoms and preventing depressive mood among older adults with these characteristics. Secondly, in terms of mental status scores, the impact of long-term care insurance on older adults with chronic illness ($p < 0.001$), severe disability ($p < 0.001$), no spouse ($p < 0.001$), residing in nursing homes ($p = 0.062$), rural residence ($p < 0.001$), and in the central region ($p < 0.001$) is more significant. This indicates that long-term care insurance is beneficial for improving the mental well-being and psychological health of these older populations. Lastly, concerning episodic memory scores, long-term care insurance has a more significant positive effect on older adults with severe disability ($p < 0.001$), no spouse ($p < 0.001$), living alone ($p < 0.001$), rural residence ($p < 0.001$), and in the western region ($p = 0.006$). This

Table 5
Placebo test.

Variables	(1)			(2)		
	Virtual treatment group			Virtual pilot for 2014		
	CES-D scores	Mental state scores	Episodic memory scores	CES-D scores	Mental state scores	Episodic memory scores
$Treat_{ic} \times Time_t$	1.184(0.616)	0.208(0.136)	0.028(0.607)	−0.635(0.261)	−0.668(0.542)	0.302(0.116)
_cons	23.481***(1.835)	7.813***(0.788)	7.672***(0.987)	24.749***(1.787)	9.364***(0.916)	6.532***(0.775)
Control variables	YES	YES	YES	YES	YES	YES
Time-fixed effect	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES
N	28959	32458	33405	28622	34336	34852

Notes: *p < 0.1, **p < 0.05, ***p < 0.01. Some cities in the second batch were not included in the CHARLS database and were not processed.

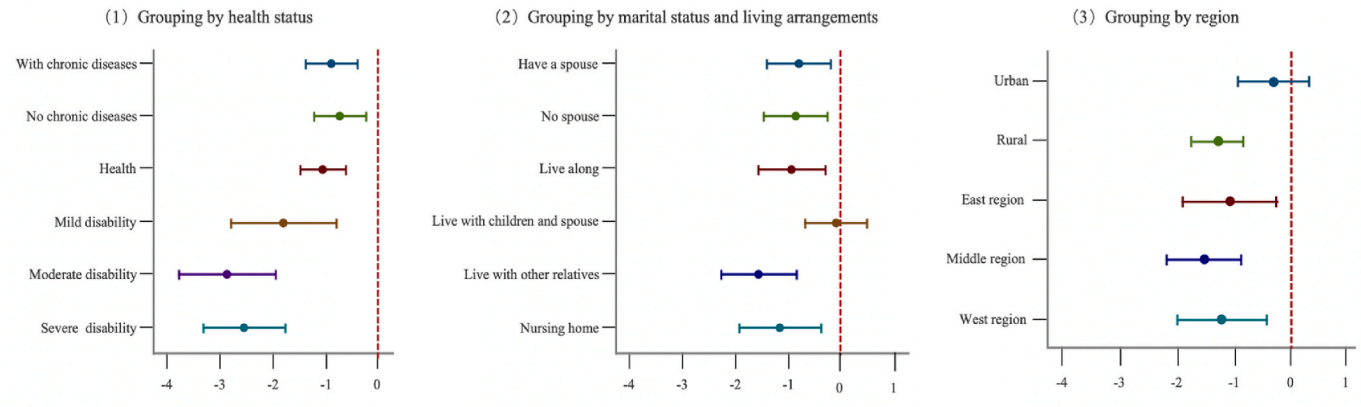

Fig. 4. Heterogeneity results of CES-D scores.

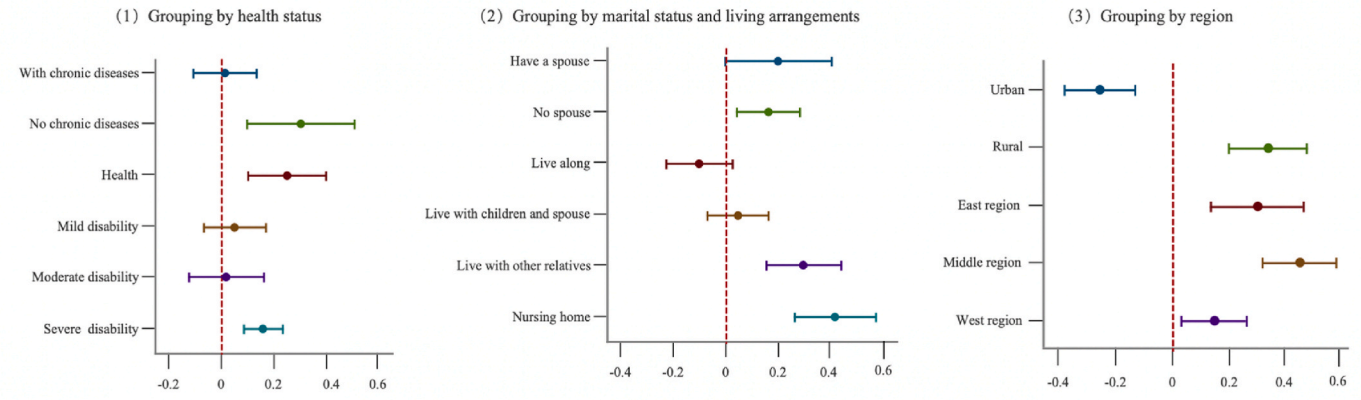

Fig. 5. Heterogeneity results of mental state scores.

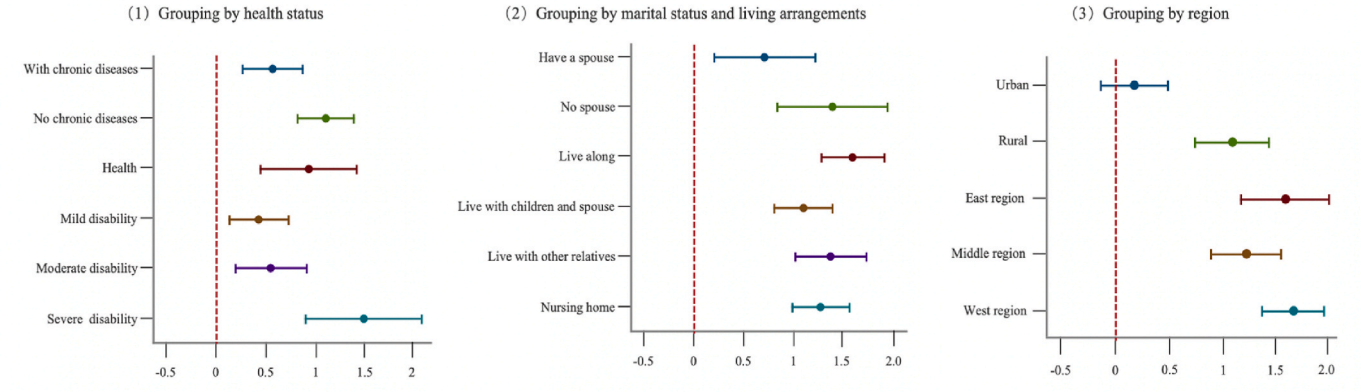

Fig. 6. Heterogeneity results of episodic memory scores.

suggests that long-term care insurance is beneficial for improving the memory and cognitive abilities of older adult populations. Overall, the pilot of long-term care insurance can reduce depressive mood among older adults with illness or disability, resulting in positive psychological improvements. Older adults without a spouse, living alone, or residing in nursing homes often have poorer mental health status, and long-term care insurance is beneficial in providing institutional support for this group and improving their mental health. It is widely recognized that older adults in rural and central-western regions have unmet long-term care needs. The policy pilot program has partially addressed this pressing demand for long-term care among older adults and has shown positive policy effects.

4.7. Mechanism analysis

Based on this research framework, this study primarily examined how long-term care insurance affects the psychological health of older adults through three key aspects: medical expenses, daily

companionship, and social interactions. The mediation analysis model comprised three steps. The results presented in Table 2 indicate that long-term care insurance significantly enhanced the psychological well-being of older adults, establishing the findings of the first step of the mediation analysis. The second step delved into the effects of long-term care insurance on the mediating variables. The results presented in Table 6 reveal that the pilot of long-term care insurance reduced the overall medical expenses of older adults, thereby alleviating the financial burden related to healthcare. This reduction in expenses is beneficial for mitigating the psychological anxiety and fear experienced by older adults due to increased family medical costs. Furthermore, long-term care insurance significantly increased the likelihood of family members providing daily companionship and engaging in social activities. Thus, the validity of the results of the second step was confirmed. Subsequently, we proceeded to the third step of the analysis, incorporating long-term care insurance and the mediating variables directly into the model to investigate the mediating variables' impact on older adults' psychological health.

Combining the results in Tables 6 and 7, we summarize the findings on the impact mechanisms in Table 8. The CES-D scores showed a total effect of −1.175, with a direct effect of −1.059 and an indirect effect of −0.116. The indirect effects accounted for 9.87% of the total effects. For mental state scores, the total effect was 0.232, with a direct effect of 0.181 and an indirect effect of 0.051. The indirect effects accounted for 21.98% of the total effect. For Episodic memory scores, the total effect was 0.992, with direct and indirect effects of 0.870 and 0.122, respectively. The indirect effects accounted for 12.30% of the total effect. Overall, all three mediating variables played partial mediating roles.

5. Discussion

This study is based on a quasi-natural experiment involving a long-term care insurance pilot conducted by the Chinese government. We analyzed the effects of long-term care insurance on the mental health of older adults using panel data from the China Health and Retirement Longitudinal Study (CHARLS) from 2011 to 2018. First, this study demonstrates that the long-term care insurance pilot program leads to a decrease of 1.059 points in the CES-D scores of older adults, while increasing their mental status scores by 0.181 points and episodic memory scores by 0.87 points. These findings were consistent with those of Wang et al. (2022) and Tian, Fan, Zhou, and Du (2024). In recent years, the aging population and level of disability in China have been increasing, with over 90% of older adults relying on family care, placing a more significant burden on families for caregiving. Older adults often experience self-blame and depression because of fear of increasing the burden on their families. Long-term care insurance policies provide financial and caregiving support for older adults, especially for those needing care. This improves their quality of life and allows them to feel respected by the nation and society, thereby improving their mental health (Chen & Xu, 2020).

Table 6
Effects of long-term care insurance on mediating variables.

Variables	(1)	(2)	(3)
	Medical expenses	Daily companionship	Social interactions
$Treat_{ic} \times Time_t$	−0.141*** (0.128)	0.002*** (0.014)	0.029** (0.015)
_cons	8.688*** (0.110)	0.654*** (0.130)	0.210*** (0.129)
Control variables	YES	YES	YES
Time-fixed effect	YES	YES	YES
Individual fixed effect	YES	YES	YES
N	27402	27402	27402

Note: *p < 0.1, **p < 0.05, ***p < 0.01.

The results of this study demonstrate that the impact of long-term care insurance on mental health differs based on factors such as chronic disease status, level of disability, and the region of the older adults. Compared to older adults without chronic illnesses, improvements in psychological well-being were more pronounced among older adults with chronic diseases who had long-term care insurance. This may be attributed to the specific characteristics of beneficiaries of long-term care insurance. Lei et al. (2022) found that a long-term care insurance pilot program enhanced the satisfaction of the caregiving needs of older adults, particularly those with limited daily activity abilities and underlying health conditions. The impact of long-term care insurance on the mental health of older adults with disabilities was more significant than that on healthy older adults. For healthy older adults, long-term care insurance primarily affects life expectancy and satisfaction by providing insurance coverage. However, for older adults with disabilities, long-term care insurance primarily offers financial support and caregiving services, thereby reducing the cost of care and improving psychological well-being (Kim & Meng, 2018). Additionally, the impact of long-term care insurance on older adults' mental health is more pronounced in the rural, central, and western regions. This may be due to the greater need for basic daily caregiving among older adults in these areas. Addressing the need for more formal caregiving support for older adults in these regions is a crucial issue requiring attention from governments and society.

The existing literature has not examined the impact of long-term care insurance on mental health. This study primarily examined these mechanisms through three dimensions–medical expenses, daily companionship, and social interactions–which serve as vital supplementary research in this area. These findings indicate that long-term care insurance improves mental health by alleviating medical expenses for older adults. This finding suggests that the substantial burden of healthcare increases the likelihood of depression among older adults. Some older adults who are reluctant to burden their children financially may resort to extreme measures such as suicide when faced with significant illnesses or disabilities. Long-term care insurance provides formal social support to older adults, aiding them in balancing their relationships with their family members. Moreover, long-term care insurance enhances the provision of informal caregiving by children to older adults, which is consistent with Yamada and Shimizutani's (2015) findings. This objectively reflected the mutually reinforcing relationship between formal and informal caregiving. Finally, long-term care insurance increases the likelihood of older adults engaging in social interaction and promoting healthy aging. Participation in social activities improves older adults' mental well-being, enables them to contribute to society, and elevates the social and economic value of the aging population.

Despite the insights gained from this study, there were some limitations. Firstly, we assessed the impacts of long-term care insurance on mental health using data from the China Health and Retirement Longitudinal Study (CHARLS) spanning from 2011 to 2018. With the upcoming CHARLS updates and access to more recent data, future research can provide additional insights into the evaluation of policy impacts. Secondly, some pilot cities were not included in the CHARLS data and were excluded from our study. Fortunately, the sample size of the excluded data was relatively small. As the pilot scope expands, future assessments of the policy effects on older adults will offer more comprehensive conclusions.

6. Conclusion and recommendations

This study investigates the impact of China's long-term care insurance pilot program on the mental health of older adults using China Health and Retirement Longitudinal Study (CHARLS) panel data spanning from 2011 to 2018. This study employs both DID and PSM-DID models to analyze the impact of long-term care insurance. These findings indicate that the long-term care insurance pilot program

Table 7
Results of mediation effect analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CES-D scores			Mental state scores			Episodic memory scores		
$Treat_{ic} \times Time_t$	−1.115***	−1.043***	−1.078***	0.172**	0.169***	0.187***	0.682***	0.848***	0.878***
	(0.198)	(0.197)	(0.197)	(0.067)	(0.067)	(0.067)	(0.114)	(0.114)	(0.113)
Medical expenses	0.590**			−0.006*			−0.956***		
	(0.122)			(0.046)			(0.065)		
Daily companionship		−0.681***			0.193***			0.326***	
		(0.084)			(0.039)			(0.045)	
Social interactions			−1.100***			0.332***			0.878***
			(0.064)			(0.039)			(0.113)
_cons	22.623***	17.314***	17.179***	7.984***	7.850***	8.017***	16.911***	8.707***	8.801***
	(2.106)	(1.817)	(1.820)	(0.797)	(0.665)	(0.665)	(1.134)	(0.980)	(0.968)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time-fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	22719	22719	22719	14757	14757	14757	25501	25501	25501

Note: *p < 0.1, **p < 0.05, ***p < 0.01.

Table 8
Summary of mediation analysis results.

Variables	Total effect	Direct effect	Indirect effect	Proportion of Indirect Effect	Test conclusion
CES-D scores	−1.175***	−1.059***	−0.116***	9.87%	Partial mediation
Mental state scores	0.232***	0.181***	0.051***	21.98%	Partial mediation
Episodic memory scores	0.992***	0.870***	0.122***	12.30%	Partial mediation

Note: *p < 0.1, **p < 0.05, ***p < 0.01.

significantly alleviated depression among older adults and improved their overall mental health and episodic memory. These results suggest that long-term care insurance has a notably positive impact on the mental well-being of older adults. Furthermore, the study revealed that this positive impact varies considerably based on health status, disability levels, and regional differences among older adults. Additional analysis delved into the mechanisms behind these effects, demonstrating that long-term care insurance enhances the mental health of older adults by reducing medical expenses, increasing daily companionship with children, and promoting social interactions. This study serves as valuable supplementary research to the existing literature and offers insightful recommendations for the government to refine long-term care insurance policies and develop targeted welfare initiatives for older adults.

Based on the research findings, this study proposes the following policy recommendations: First, the government should broaden the scope of the pilot LTC insurance program to cater to the growing needs of older adults. The findings of this study demonstrate that long-term care insurance improves the mental health of older adults and yields positive policy effects. Therefore, it is advisable to continue expanding the pilot program and gradually extending its coverage nationwide. During the pilot process, adhering to the principle of integrated urban-rural development is crucial to ensure equity in policy formulation and benefit provision. Second, long-term care insurance pilots should enlist the expertise of mental health specialists to strengthen their psychological services. Currently, long-term care insurance primarily focuses on providing daily care and medical services, with inadequate attention paid to mental health services. In the service delivery process, specialized psychological counseling services should be offered to older adults to promptly identify changes in their mental health, enhance their overall well-being, and prevent the emergence of negative psychological issues such as depression. Third, the research findings indicate that psychological issues among older adults are linked to insufficient social security benefits, which fail to meet their daily lives and healthcare service needs. Therefore, it is imperative to moderately increase pension benefits, augment older adults' income, and enhance healthcare insurance benefits. These measures are vital for promoting the mental health of older adults, and it is crucial to appropriately address the relationship between formal/institutional care and informal caregiving. This study indicates that long-term care insurance is beneficial in enhancing daily family companionship and improving informal family caregiving. By integrating family caregiving with long-term care insurance, we can ensure that they complement one another and jointly provide comprehensive long-term care services to older adults.

Competing interests

The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

Project of National Social Science Foundation of China, "Research on the Realization Path of Urban and rural Mutual Benefit Pension under the background of rural Revitalization" (21BSH163).

Ethics statement

Ethical statement and approval were waived for this study, due to the data used in this article coming from the public database - (China Health and Retirement Longitudinal Study (CHARLS). http://charls.pku.edu.cn./. With which all subjects involved are anonymous.

CRediT authorship contribution statement

Lianjie Wang: Writing – original draft, Formal analysis, Conceptualization.

Data availability

Data will be made available on request.

References

Chen, L., & Xu, X. (2020). Effect evaluation of the long-term care insurance (LTCI) system on the health care of the elderly: A review. *Journal of Multidisciplinary Healthcare, 13*, 863–875. https://doi.org/10.2147/JMDH.S270454

Chen, T., Zhou, R., Yao, N. A., & Wang, S. (2022). Mental health of homebound older adults in China. *Geriatric Nursing, 43*, 124–129. https://doi.org/10.1016/j.gerinurse.2021.11.012

Choi, J. K., & Joung, E. (2016). The association between the utilization of long-term care services and mortality in elderly Koreans. *Archives of Gerontology and Geriatrics, 65*, 122–127. https://doi.org/10.1016/j.archger.2016.03.013

Dai, W., Wang, Q., Zhu, R., et al. (2022). Characteristics, problems and path optimization of long-term care insurance pilot policies: A comparative analysis of pilot city policies in two batches of 29 countries. *China Soft Science, 382*(10), 41–50.

Domènech-Abella, J., Lara, E., Rubio-Valera, M., Olaya, B., Moneta, M. V., Rico-Uribe, L. A., Ayuso-Mateos, J. L., Mundó, J., & Haro, J. M. (2017). Loneliness and depression in the elderly: The role of social network. *Social Psychiatry and Psychiatric Epidemiology, 52*(4), 381–390. https://doi.org/10.1007/s00127-017-1339-3

Du, B., & Mu, Y. (2022). The relationship between health changes and community health screening participation among older people. *Frontiers in Public Health, 10*, Article 870157. https://doi.org/10.3389/fpubh.2022.870157

Feng, J., Wang, Z., & Yu, Y. (2020). Does long-term care insurance reduce hospital utilization and medical expenditures? Evidence from China. *Social Science & Medicine, 258*(1982), Article 113081. https://doi.org/10.1016/j.socscimed.2020.113081

Gong, R., Xia, D., Hu, Z., et al. (2023). The impact of neighborhood mental health on the mental health of older adults. *BMC Public Health, 23*, 1352. https://doi.org/10.1186/s12889-023-16263-w

Guo, J., & Ling, W. (2022). The relationship between the mental health status and social support of the lonely elderly with government participation in the Internet context. *Frontiers in Public Health, 10*, Article 1013069. https://doi.org/10.3389/fpubh.2022.1013069

Guo, Y. Q., Zhang, C. C., Huang, H., Zheng, X., Pan, X. J., & Zheng, J. Z. (2016). Mental health and related influencing factors among the empty-nest elderly and the non-empty-nest elderly in taiyuan, China: A cross-sectional study. *Public Health, 141*, 210–217. https://doi.org/10.1016/j.puhe.2016.09.005

Jia, K., Xia, Y., & Zhao, G. (2023). Home and community endowment service and mental health in the elderly. *The World Economy, 2023*(8), 163–185. https://doi.org/10.19985/j.carol.carroll.nki.cassjwe, 2023.08.007.

Kim, K., & Meng, X. (2018). A comparative study of korea and qingdao's long-term care insurance policy and its enlightenment. *Korea Gerontological Society, 3*. https://doi.org/10.31888/jkgs.2018.38.3.453

Lei, X., Bai, C., Hong, J., & Liu, H. (2022). Long-term care insurance and the well-being of older adults and their families: Evidence from China. *Social Science & Medicine, 1982*(296), Article 114745. https://doi.org/10.1016/j.socscimed.2022.114745

Liu, H., & Li, Q. (2020). The effect of child care on mental health of disabled elderly people in rural areas: Micro-evidence from Chinese families. In *Journal of yunnan university for nationalities (philosophy and social sciences edition)* (pp. 104–116). https://doi.org/10.13727/j.carol.carroll.nki.53-1191/c.2020.02.002, 02.

Radloff, L. S. (1977). The CES-D scale A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385–401. https://api.semanticscholar.org/CorpusID:252667563.

Su, D., Zhang, X., He, K., Chen, Y., & Wu, N. (2022). Individualized prediction of chronic kidney disease for the elderly in longevity areas in China: Machine learning approaches. *Frontiers in Public Health, 21*(10), Article 998549. https://doi.org/10.3389/fpubh.2022.998549

Svensson, B., & Hansson, L. (2017). Mental health first aid for the elderly: A pilot study of a training program adapted for helping elderly people. *Aging & Mental Health, 21*(6), 595–601. https://doi.org/10.1080/13607863.2015.1135873

Tang, Y., Chen, T., Zhao, Y., & Taghizadeh-Hesary, F. (2022). The impact of the long-term care insurance on the medical expenses and health status in China. *Frontiers in Public Health, 10*, Article 847822. https://doi.org/10.3389/fpubh.2022.847822

Tian, T., Chen, Y., Zhu, J., & Liu, P. (2015). Effect of air pollution and rural-urban difference on mental health of the elderly in China. *Iranian Journal of Public Health, 44*(8), 1084–1094.

Tian, Y., Fan, L., Zhou, M., & Du, W. (2024). Impact of long-term care insurance on health inequality in older adults in China based on the concentration index approach. *International health, 16*(1), 83–90. https://doi.org/10.1093/inthealth/ihad025

Tokay, A. M., & Mersin, S. (2021). Life satisfaction, life quality, and leisure satisfaction in health professionals. *Perspectives in Psychiatric Care, 57*(2), 660–666. https://doi.org/10.1111/ppc.12592, 2021.

Vaccaro, J. A., Gaillard, T. R., & Marsilli, R. L. (2021). Review and implications of intergenerational communication and social support in chronic disease care and participation in health research of low-income, minority older adults in the United States. *Frontiers in Public Health, 9*, Article 769731. https://doi.org/10.3389/fpubh.2021.769731

Wang, J., Guan, J., & Wang, G. (2022). Impact of long-term care insurance on the health status of middle-aged and older adults. *Health Economics*, (3), 558–573. https://doi.org/10.1002/HEC.4634

Xin, Y., & Ren, X. (2022). Predicting depression among rural and urban disabled elderly in China using a random forest classifier. *BMC Psychiatry, 22*, 118. https://doi.org/10.1186/s12888-022-03742-4

Yamada, H., & Shimizutani, S. (2015). Labor market outcomes of informal care provision in Japan[J].The *Journal of the Economics of ageing. 6*, 79–88. https://doi.org/10.1016/j.jeoa.2015.02.003

Yu, X., Liu, H., & Yang, W. (2019). The impact of long-term care insurance on medical expenses: A study of synthetic control based on Qingdao model. *Insurance research*, (2), 114–127. https://doi.org/10.13497/j.carol.carroll.nki.is.2019.02.010. The.

Zhang, Q., Wu, Y., Han, T., & Liu, E. (2019). Changes in cognitive function and risk factors for cognitive impairment of the elderly in China: 2005-2014. *International Journal of Environmental Research and Public Health, 16*(16), 2847. https://doi.org/10.3390/ijerph16162847

Zhou, D., Zhan, Q., & Li, L. (2023). The impact of self-employment on mental health of the younger elderly in China. *BMC Geriatrics, 23*(1), 280. https://doi.org/10.1186/s12877-023-03948-5

Zimmerman, S., Wretman, C. J., Ward, K., Aggarwal, N., Horsford, C., Efird-Green, L., & Sloane, P. D. (2022). Medical and mental health care challenges in nursing homes, assisted living, and programs of all-inclusive care for the elderly (PACE) during COVID-19. *Journal of the American Medical Directors Association, 23*(5), 754–755. https://doi.org/10.1016/j.jamda.2022.01.072