The "spillover effect" of long-term care insurance in China on spouses' health and well-being

Yanan Luo [a,b], Kexin Yuan [c], Yuxiao Li [d], Yating Liu [e], Yao Pan [f,*]

[a] Department of Global Health, School of Public Health, Peking University, Beijing, China
[b] Institute for Global Health and Development, Peking University, Beijing, China
[c] School of Software and Microelectronics, Peking University, Beijing, China
[d] School of Applied Economics, Renmin University of China, Beijing, China
[e] School of Nursing, Peking University, China
[f] School of Economics, Zhongnan University of Economics and Law, Wuhan, China

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ABSTRACT

This study examined the spillover effect of long-term care insurance (LTCI) on the health outcomes and well-being of spouses for Chinese middle and old-aged adults with expected LTC demand or actual care burdens. Using panel data from the China Health and Retirement Longitudinal Study between 2011 and 2018, we investigated the impact of the introduction of LTCI pilots across several cities on old individuals by using the difference-in-differences (DID) approach. We found a spillover effect of LTCI on the health and well-being outcomes of spouses of middle and old-aged individuals with functional limitations. It might due to the fact that LTCI could relieve economic burden by reducing out-of-pocket medical expenditures, which further affects health and well-being of spouses. The spillover effect on health and well-being was found to be stronger for male spouses and low-educated spouses. Spouses of the individuals aged below 80 years old and those live without adult children were more likely to benefit from the introduction of LTCI. Moreover, providing combination benefits seems to make spouses better off than offering direct services. Therefore, the results implied that the expansion of LTCI not only helped the care recipients themselves but could also improve the health and well-being of the spouses of functionally impaired older adults.

1. Introduction

China's population is considerably distinguished by aging and longevity, as the average life expectancy of the population has grown rapidly over the past several decades. Consequently, the number of older adults with functional limitations continues to rise (Zhu and Österle, 2017, Choi et al., 2018; Feng et al., 2020). Facing the growing demand for long-term care services (LTC) induced by population aging in China, the introduction of long-term care (LTC) services can alleviate the burden on individuals and society by assisting people with chronic illness or disabilities to meet their health or personal needs.

Family members are one of the most preferable and important supportive resources for frail older adults to provide the majority of long-term care and informal care. In China, due to the fact of shrinking family size, traditional Chinese family values, the increasing working pressure on adult children and declining co-residence of parents with children, spouses often bear the heavy responsibility of providing LTC services for care recipients with functional limitations (Dong et al., 2019). Usually, people over 65 years old are the primary users of LTC services, and their spouse caregivers are also elderly or even potential care recipients. According to previous studies, spouse caregivers are found to have worse well-being, lower life satisfaction, higher unhealthy risks from senility, and poorer health than younger caregivers (Pinquart and Sörensen, 2003a,b, Robison et al., 2009; Chen et al., 2019). Although increasing attention has been given to the psychological distress and physical health of caregivers, specific policies and relevant studies for improving the health status and overall well-being of spouse caregivers have been largely overlooked.

In response to the concern of growing demand for LTC services to ensure access to affordable care services for older adults with functional limitations and to relieve burdens of informal care from family members, China initiated the pilot long-term care insurance (LTCI) program

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in 15 pilot cities in July 2016 and expanded to 14 other regions in 2020 (Lei et al., 2022). The LTCI covers the expenses of daily basic care and other costs of clinical and nursing services for people with functional limitations for a lengthy period, thereby increasing the utilization rate of LTC services and reducing the cost of LTC services, which may not only benefit LTC recipients but also liberate caregivers from some aspects of caregiving.

While numerous studies have examined the impact of the LTCI program on care recipients' health, its influence on the well-being and health of their family members, particularly elderly spouses, remains uncertain. Thus, examining the "spillover effect" on caregivers' health and well-being is of great importance for providing a more comprehensive understanding of the significance of LTCI plans. Caregiving burden is associated with the caregiver's physical, psychological, and social well-being (Kim et al., 2013). The LTCI program can be considered as a form of social support that increases the utilization of LTC services, reduces the cost of LTC services, and relieves the caregiving burden, thereby alleviating the physical, emotional, and financial burden of spouse caregivers and improving their health status and quality of life. The "stress buffer model" suggests that those with social support possess greater resources to manage negative emotions and challenges, thus mitigating the psychosocial stress related to caring for family members with functional limitations (Wibowo and Tisdell, 2010). In terms of the health production function, increased social support equates to a rise in nonmedical health inputs, leading to enhanced health outcomes (Kim et al., 2013). To evaluate this "spillover effect" could provide the new insight into the development of associated programs and services to support caregivers of older adults with functional limitations in China.

Using panel data from the China Health and Retirement Longitudinal Study (CHALRS) between 2011 and 2018, this study investigates the spillover effect of LTCI on the health outcomes of spouses for individuals aged 45 and above with functional limitations who are exposed to the expected LTC demand or actual care burdens. Our main contributions to the literature are as follows. Firstly, this study is the first to investigate the spillover effects of LTCI on the health status and well-being of spouses for Chinese middle and old-aged adults with expected LTC demand or actual care burdens. Our findings indicate that the expansion of long-term care services can not only assist the care recipients themselves but also benefit the health and well-being of the spouses of functionally impaired middle and old-aged individuals. Secondly, this study is based on a more stringent causal inference analysis to better deal with endogeneity issues. Based on the trial cities of LTCI policy and the design of longitudinal survey data, we apply difference-in-differences analysis (DID) to evaluate the spillover effect of LTCI on the well-being of spouses, which can detect the causal effect of LTCI and overcome the endogeneity problem. Thirdly, to fill the research gap, this study goes one step further to examine the heterogeneity of the effect between different groups of people and explore the potential mechanism behind it. Fourthly, this study adds to the literature by emphasizing the significance and sustainability of public financing for LTC by demonstrating that the implementation of LTCI could also improve the well-being and health outcomes of family members, not just care recipients.

Our main findings are that the introduction of LTCI significantly improves the self-reported health and life satisfaction and reduces the depressive scores of spouses for middle and old-aged adults with functional limitations. Specifically, according to heterogeneity analysis, this "spillover effect" of LTCI is more likely to benefit low-educated and male spouses. Spouses of the individuals aged 80 years and below and those live without adult children tend to experience a greater positive "spillover effect" of LTCI. Providing combination benefits can make spouses better off than offering direct services. Furthermore, reduction of out-of-pocket medical expenditures is one potential mechanism through which LTCI could affect health and well-being of spouses.

This study is organized as follows: Section 2 presents the literature review. Section 3 describes the data, sample selection procedures and variables. Section 4 shows the empirical results, and Section 5 discusses

the conclusion and limitations.

2. Literature review

2.1. Background of the LTCI pilot program in China

To enhance the capacities for coping with the growing demand for LTC, the government of China launched the LTCI program in 15 pilot cities and two provinces in 2016 (More details of the pilot cities could be found in Appendix Table 1), which were selected from diverse regions with variations in economic development, fiscal capacities, and population structure. Among these 15 pilot cities and two provinces, some of them started piloting LTCI before 2016, such as Qingdao and Changchun, (Zhu and Österle, 2019, Lei et al., 2022). The LTCI program thus provides a unique opportunity to examine the causality of LTCI on the health status and well-being of spouses of older adults with functional limitations.

The LTCI program launched in China covers older adults aged above 60 years who participated in Urban Employees Basic Medical Insurance (UEBMI) or Urban and Rural Residents Basic Medical Insurance (URRBMI) (Feng et al., 2020). The program design may differ among the pilot cities and provinces to satisfy the diverse needs of residents in different regions (i.e., targeting population, eligibility criteria benefits, and specific provisions). Despite some space remaining for flexible policy tailoring, the LTCI pilots implemented in pioneer cities were developed under an overall policy framework set by the central government. The pilot cities are mainly financed by existing public health insurance funds (approximately 80%), and some pilots also receive supplemental financing from the government and contributions from enrolled individuals and their employers (Chen and Ning, 2022, Lei et al., 2022).

For the eligibility of accessing LTCI, in most cities, older adults who had severe functional limitations for at least 6 months as determined by disability assessments (e.g., the Barthel ADL index) can be eligible for LTCI benefits. In some places, such as Qingdao, Suzhou, and Nantong, older adults with moderate or mild functional limitations can also be eligible for LTCI application.

When it comes to various types of benefits, LTCI in trial cities often offers three different modes: direct services, cash benefits, and a combination of both. Direct services refer to situations where insured individuals purchase and use formal care services, and the subsidies they receive are allocated to institutions. The first batch of pilot cities such as Qingdao, Chengde provides direct services to the insured individuals with functional limitations. The second type involves cash benefits, where nursing care fees are directly disbursed to the account of insured individuals. The third type is a combination of direct services and cash benefits. None of the 15 pilot cities or two provinces provide just cash benefits. For the benefits, eligible recipients receive both formal and informal care services that are financially supported by the government for the payments of the fees. Various services—both at home and at the institution—are provided to the recipients: feeding, bathing, safety care, nursing care, rehabilitation, counseling, etc. Recipients pay barely 30 percent of the fees in most cases. Hence, the majority of the costs of daily living care and related medical and nursing expenses for older adults, who are qualified beneficiaries and enrolled in the existing public health insurance programs, have been covered by LTCI(Lei et al., 2022).

2.2. The relationship between LTCI and health and well-being

Increasing evidence has focused on the association between LTCI and health outcomes and the well-being of older care recipients in developed countries, but the findings are inconclusive. For instance, evidence from South Korea finds a positive effect of LTCI policy and LTC utilization on declining mortality risks for care recipients (Choi and Joung, 2016, Sohn et al., 2020), while another study in South Korea shows no significant association between subsidies for LTC and mortality risks (Kim and Lim,

2015). In China, rigorous evaluations of the effect of LTCI programs on health are quite limited. Three recent studies found evidence that the launch of the LTCI pilot could improve self-reported health, mental health, and the activity of daily living (ADL), relieve physical pain, and decrease the mortality risk (Ma et al., 2019; Lei et al., 2022; Tang et al., 2022).

Regarding the possible mechanisms behind the impacts of LTCI on health, hypotheses from a social perspective and individual aspects have been proposed. From the social perspective, LTCI can help construct a more complete social security system (Tang et al., 2022), which further provides more security to individuals' health. From the individual perspective, the LTCI gives care recipients more ways to access daily care, nursing care, and rehabilitation services, which could improve their health and decrease healthcare expenditures and the burden of medical costs (Sato et al., 2006; Forder, 2009, Lee et al., 2014; Choi and Joung, 2016, Ju et al., 2017; Takahashi, 2019, Sohn et al., 2020).

2.3. The relationship between LTCI and the health and well-being of caregivers

Among the current literature on the effect of LTC on caregivers' health and well-being, very few examine the causal relationship between the LTCI program and the health and well-being of caregivers. Concerning the studies about LTC and caregivers' health, a small body of previous studies suggests that providing informal care could improve self-esteem and appreciation of life for caregivers (Ashworth and Baker, 2000; Kim et al., 2007; Haley et al., 2009). Nevertheless, most studies find a harmful health effect of informal care provision and suggest that caregivers tend to be at a higher risk of both mental disorders and chronic diseases (Dilworth-Anderson et al., 2002, Pinquart and Sörensen, 2003a,b; Pinquart and Sörensen, 2006). Evidence shows that high burdens and intensive caregiving responsibilities are the main triggers of mental and physical impairment for caregivers (Majerovitz, 1995; Sansoni et al., 2004; Hirst, 2005).

The possible mechanisms of LTCI's impact on health may be attributed to its ability to promote the utilization of LTC services after implementation. It, in turn, can reduce the economic burden caused by LTC, subsequently alleviating the stress on caregivers and promoting improvements in their health levels. Findings about the impact of LTCI and long-term care services on caregivers' health outcomes and well-being show that LTCI has a potentially positive spillover effect on improving caregivers' health by reducing the caregiving burden. For instance, one study from Taiwan province of China states that their Ten-Year Long-Term Care Project plays a crucial role in mitigating the burden of family caregivers (Dong et al., 2019). Schulz and Sherwood (2008) suggested that the duration of caring is highly associated with the health outcomes of caregivers; thus, the improvement in the health of care recipients is associated with a better health status of caregivers (Schulz and Sherwood, 2008). It further implies the potential spillover effect of LTCI to relieve the burden on the health outcomes of caregivers. In Lei et al.'s study, the introduction of LTCI was also found to reduce the risk of unmet care for ADL-impaired older adults, the intensity of informal care, the expenditures of ADL-related care, and out-of-pocket medical expenditure. They suggested that LTCI coverage may bring benefits to improve the well-being of both family members and care recipients (Lei et al., 2022). Moreover, caregivers could also benefit from the LTCI program by reducing their psychological stress. LTCI is found to promote the utilization of daily care, nursing care, and other services, such as rehabilitation, which further improve the care recipients' health (Lee et al., 2014; Choi and Joung, 2016, Takahashi et al., 2016; Ju et al., 2017; Sohn et al., 2020).

To date, rigorous evaluations of the impact of LTCI pilots on the health conditions and well-being of spouses are quite limited in mainland China. To the best of our knowledge, four recent studies in mainland China suggest that LTCI has a significant impact on reducing the total expenses of outpatient and inpatient and the out-of-pocket health expenditures, decreasing the length of inpatient stay, the quantity of outpatient and inpatient, the intensity of informal care and unmet activity of daily living (ADL)-related care demand, and is associated with improving self-reported health and the reduction for one-year mortality risks of care recipients (Feng et al., 2020; Chen and Ning, 2022, Lei et al., 2022; Tang et al., 2022). We find that very limited studies, such as Lei et al. (2022), consider the potential effect of LTCI on families of care recipients in China. This study investigated the impact of LTCI pilot programs on the well-being of older adults and their families. The findings revealed that the implementation of LTCI reduced the likelihood of older adults reporting unmet needs for ADL-related care, the intensity of informal caregiving, as well as the amount spent on ADL-related caregiving and out-of-pocket medical expenses. Although Lei et al. (2022)'s work examined the impact of LTCI on families from the perspective of medical and caregiving expenses, it implies indirect effect on the health and well-being of family members and need to be further detected. So far, no analysis was conducted regarding the direct spillover effect and its mechanism of LTCI on spouse's health outcomes and well-being in China.

3. Data and method

3.1. Data

Our main source of data is the China Health and Retirement Longitudinal Study (CHARLS), which collects information on health, household composition, demographics, and socioeconomic conditions. The CHARLS survey is nationally representative, including 28 provinces in China. It is based on a representative sample of the population of Chinese individuals aged 45 or over and their spouses. A pilot survey for CHARLS was conducted in two provinces in 2008 on 2685 individuals. Based on the pilot survey experience, the main national baseline survey was conducted in 2011, 2013, 2015, and 2018. Our measures of health and other socioeconomic factors are based on the main survey. Information about pilot cities is collected from official government websites and public documents. CHARLS covers 21 pilot cities and 104 nonpilot cities. Table 1 in the Appendix describes the complete list of pilot cities.

Given the focus of this study, we selected the spouses of individuals with functional limitation whose ages were above 45 years old during the period from 2011 to 2018 as our study subjects. Hence, those without spouses and aged below 45 years old were excluded.

We then selected those with IADL/ADL disability based on the following method. Since official government documents have no clear rules for defining an elderly with functional limitation eligible for attending LTCI during the CHALRS survey periods, we recognized a group of IADL/ADL disabled middle and old-aged individuals who (potentially) satisfied requirements and would be/was covered by LTCI in China. The CHARLS has a series of questions concerning instrumental activities of daily living (IADLs) and activities of daily living (ADLs). We followed one well-established reliable and valid measure of IADL/ADL disability, namely, the Groningen Activity Restriction Scale (GARS). We chose the same or the most proximate dimensions from CHARLS to construct the IADL/ADL disability measure. The measure comprises 20 (instrumental) IADL/ADL items. For example, "Do you have any difficulty with dressing?" "Do you have difficulty with stooping, kneeling, or crouching?" "Do you have difficulty climbing several flights of stairs without resting?". Each item has four response categories (1- No, I don't have any difficulty; 2- I have difficulty but can still do it; 3- Yes, I have difficulty and need help; 4- I cannot do it). The score ranges from 20 (no disability) to 80 (maximum disability). We then transformed the continuous IADL/ADL disability measure into a dichotomous measure. Nevertheless, there is no conventional cutoff. We thereby chose the cutoff of 21 on the continuous IADL/ADL disability score, as this cutoff score corresponded to the 85th percentile of the IADL/ADL disability score of a large random sample of Chinese middle and old-aged individuals, which has been proven to be a valid way of recognizing the

IADL/ADL disabled population (Ormel et al., 2002). The disabled group used in the analysis refers to those scores above and equal to 21, who are (potentially) the targeted population of LTCI in China. We also excluded the missing values of control variables. Finally, a total of 36,644 individuals were included in the analysis. The final sample for each analysis varies according to the dependent variables.

3.2. Variables

3.2.1. Dependent variables: spousal health outcomes and well-being

We examined both the objective and subjective health and well-being of spouses. The first measure is cognition, which is applied to represent the physical health of the spouses. We used word recall to measure episodic memory, which was part of fluid cognition. Fluid cognition is often found to decline rapidly with age and is one of the most important indicators of the frailty in the physical functioning of old individuals (Bäckman et al., 2005; Deary et al., 2009; Pan, 2020). In CHARLS, respondents will hear a complete list of words only once and then they are asked to immediately repeat 10 words (immediate word recall) in any order and to recall the same list of words in a few minutes (delayed word recall). Word recall was computed as the total number of immediate and delayed recall scores, ranging from 0 to 20 (Mazzonna, 2014). The second measure is depression, which represents an individual's mental health. We followed the Center for Epidemiologic Studies Depression (CES-D) scale to measure depressive symptoms, which has been proven to be valid in various studies (i.e. Radloff, 1977; Lei et al., 2014; Chen et al., 2019). The CHARLS includes ten items about depression, such as "I was bothered by things that don't usually bother me", "I felt depressed", and "I felt everything I did was an effort". For each item, responses have four answers, and we give a score to each answer (0-Rarely or none of the time; 1-Some or a little of the time; 2-Occasionally or a moderate amount of the time; 3-Most or all of the time). The total score ranges from 0 (no depression) to 30 (maximum depression). The third measure is self-reported health, which was measured by the question "Would you say your health is excellent, very good, good, fair, or poor?". The score ranges from 1 (poor) to 5 (excellent). The last measure is to rate an individual's life satisfaction, which varies from 1 (least satisfied) to 5 (most satisfied).

3.2.2. Key independent variable: long-term care insurance

After excluding the missing values, the whole sample was divided into a control group and a treated group. The treated group refers to the sample residing in the 21 pilot cities, while the control group consists of individuals from the rest of the nonpilot cities. We hence constructed a dummy variable to define whether the individual belonged to the pilot cities. According to the documents, pilot cities implemented long-term care policies in 2016 or 2017 (see Table 1 in the Appendix). We then created another dummy to indicate whether the city the individual resided in implemented LTCI that year or not. Specifically, it is equal to zero for waves in 2011, 2013, and 2015, while the dummy is equal to one for the wave in 2018.

3.2.3. Control variables

For the control variables, we included a rich set of spouse- and care-recipient-level variables available in the CHARLS that might be related to LTC settings and the spouse's health outcomes and well-being, as found in previous studies (Dong et al., 2019; He et al., 2021). For spouse-level variables, we controlled for age, gender (0-male; 1-female), education levels (0-equal to or below primary school; 1-above primary school, participation in the job market and ADL. For care-recipient-level variable, we included whether care recipient has any chronic disease to account for care recipients' health status. For the household-level variables, whether the household has clean water, whether the household has gas and the number of children were considered. Considering the data quality and missing values of income variables collected in CHARLS, we used proxies of living standards (access to clean water and

gas) as alternative measures for SES (i.e. Filmer and Pritchett, 2001; Booysen et al., 2008). In addition, we used year fixed effects to account for general time trends in spousal health outcomes, such as changes over time in the macroeconomy. We used city fixed effects to account for unobserved time-invariant city characteristics that may affect spousal health.

3.3. Empirical method

We began by estimating the effect of long-term care settings on spousal health and well-being using the difference-in-differences (DID) method and panel data. As most policy interventions can be regarded as natural experiments and exogenously given, the DID method can avoid endogenous problems (Gruber and Poterba, 1994; Feldstein, 1995). For the baseline model, our empirical specification is as follows:

$$outcome_{it} = \beta_0 + \alpha \cdot Treat_i \times Post_t + \beta_1 Treat_i + \beta_2 Post_t + \gamma X_{it} + \epsilon_{it} \quad (1)$$

where $outcome_{it}$ refers to the health outcomes and well-being of individual i at time t. $Post_t$ is a dummy to represent whether LTCI has been implemented ($Post_t = 0$ if t = 2011, 2013, 2015; $Post_t = 1$ if t = 2018). If individual i resides in the pilot cities, then this individual belongs to the treated group ($Treat_i = 1$); otherwise, the value is 0. X_{it} includes all the control variables. ϵ_{it} is the error term. α is of our main interest and evaluates the impact of the implementation of LTC on spousal health.

Based on equation (1), we then added year fixed effects and city fixed effects, which is a standard DID framework as presented in equation (2).

$$outcome_{it} = \beta_0 + \alpha \cdot Treat_i \times Post_t + \beta_1 Treat_i + \gamma X_{it} + \mu_c + \tau_t + \epsilon_{it} \quad (2)$$

where μ_c refers to city fixed effects, which absorb time-invariant differences in observable and unobservable characteristics. τ_t is a set of year fixed effects, which capture time-varying city changes. α is of our main interest to examine the impact of LTCI in China.

4. Results

4.1. Empirical results

Table 1 provides a summary of descriptive statistics of the sample between the control group (nonpilot cities) and the treated group (pilot cities) before and after the occurrence of LTCI. In an unadjusted comparison, there are significant differences between the treated and control groups in terms of spousal health. On average, spouses from the treated group are healthier and happier both before and after LTCI implementation. Moreover, after the implementation of LTCI in China, for the treated group, the spouse's cognitive score, self-reported health, and life satisfaction are significantly improved. Control group has similar trends. Nevertheless, this positive outcome for the treated group may be due to the introduction of LTCI or the fast development of technology, infrastructure, healthcare facilities and the economy in China. For a more specific analysis, we will apply the difference-in-differences (DID) method to disentangle the impact of LTCI on spousal health outcomes and well-being from other effects.

Table 2 and Table 3 report the main results to evaluate the influence of LTCI on spousal health and well-being in China. Table 2 is based on equation (1). We expected spouses of LTCI users to have a better health outcomes and well-being due to reduced pressure on informal caregiving responsibility, and they could spend more time on their own health and enjoy their life. In line with the hypothesis, the coefficients of interaction treat × post indicate the effect of the implementation of LTCI. Our results show that LTC will significantly increase self-reported health and life satisfaction and reduce depressive scores after controlling for other socioeconomic factors. No significant results are found for cognition.

Table 3 displays the results obtained after controlling for all city and year fixed effects. As consistent with the results from Table 2, it has a

Table 1
Descriptive statistics.

	All sample		Before LTCI		After LTCI	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Treated group						
spouse's cognition	6.996	3.875	6.746	3.701	7.709	4.253
spouse's depression	7.524	6.138	7.513	6.114	7.555	6.204
spouse's self-reported health	2.752	1.105	2.594	1.075	3.164	1.074
spouse's life satisfaction	3.278	0.759	3.252	0.748	3.341	0.782
spouse's gender	0.432	0.495	0.432	0.495	0.433	0.496
spouse's age	60.846	9.391	60.230	9.355	62.396	9.304
spouse's education level	0.333	0.471	0.333	0.471	0.334	0.472
spouse's job	0.681	0.466	0.697	0.460	0.642	0.479
spouse's ADL	0.841	0.366	0.841	0.365	0.838	0.368
number of children	2.434	1.504	2.393	1.523	2.535	1.450
number of care-recipient's chronic diseases	1.295	1.389	1.497	1.456	0.788	1.046
water	0.786	0.410	0.765	0.424	0.839	0.368
gas	0.185	0.388	0.164	0.371	0.236	0.425
Control group						
spouse's cognition	6.879	3.831	6.664	3.617	7.477	4.318
spouse's depression	8.573	6.288	8.464	6.199	8.865	6.511
spouse's self-reported health	2.584	1.034	2.451	1.019	2.936	0.990
spouse's life satisfaction	3.194	0.778	3.184	0.765	3.217	0.808
spouse's gender	0.450	0.497	0.451	0.498	0.447	0.497
spouse's age	60.738	9.458	60.126	9.376	62.278	9.490
spouse's education level	0.331	0.471	0.328	0.469	0.339	0.473
spouse's job	0.685	0.465	0.693	0.461	0.663	0.473
spouse's ADL	0.796	0.403	0.797	0.402	0.795	0.404
number of children	2.740	1.620	2.664	1.638	2.929	1.560
number of care-recipient's chronic diseases	1.395	1.426	1.612	1.475	0.849	1.122
water	0.693	0.461	0.657	0.475	0.785	0.411
gas	0.163	0.369	0.142	0.349	0.215	0.411

Table 2
DID estimates of LTCI on spouse's health with controls.

Variables	(1)	(2)	(3)	(4)
	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	0.092	−0.381**	0.092***	0.061**
	(0.116)	(0.186)	(0.029)	(0.024)
treat	0.008	−0.552***	0.096***	0.057***
	(0.075)	(0.137)	(0.021)	(0.016)
post	0.848***	0.858***	0.443***	0.005
	(0.052)	(0.084)	(0.012)	(0.011)
Spouse's gender	−0.045	1.817***	−0.097***	−0.056***
	(0.047)	(0.078)	(0.012)	(0.009)
Spouse's age	−0.092***	−0.043***	0.002***	0.008***
	(0.003)	(0.006)	(0.001)	(0.001)
Spouse's education level	2.16***	−1.40***	0.138***	0.004
	(0.054)	(0.092)	(0.014)	(0.011)
Spouse's job	−0.153***	−0.044	0.197***	0.034***
	(0.055)	(0.097)	(0.014)	(0.0112)
Spouse's ADL	0.506***	−4.45***	0.593***	0.226***
	(0.056)	(0.111)	(0.014)	(0.013)
Number of children	−0.139***	0.186***	−0.012***	0.023***
	(0.018)	(0.033)	(0.004)	(0.004)
Number of care recipient's chronic diseases	0.073***	0.196***	−0.030***	−0.010***
	(0.016)	(0.029)	(0.004)	(0.003)
water	0.233***	−0.630***	0.119***	0.036***
	(0.052)	(0.096)	(0.014)	(0.012)
gas	0.477***	−0.972***	0.108***	0.091***
	(0.067)	(0.108)	(0.017)	(0.013)
Constant	11.28***	14.10***	1.67***	2.44***
	(0.229)	(0.403)	(0.057)	(0.050)
city fixed effect	NO	NO	NO	NO
year fixed effect	NO	NO	NO	NO
Observations	32,065	31,321	35,504	33,097
R-squared	0.191	0.152	0.139	0.031

Notes: Standard errors clustered at the household level are reported in parentheses.***p < 0.01, **p < 0.05, *p < 0.1.

significantly positive effect on self-reported health and life satisfaction and a negative impact on depression. The self-reported health score of the treated group was improved by 3.5% when compared to the average score. Additionally, life satisfaction increased by 1.9% compared to the mean. For the depressive score, it can be reduced by 5.1% to the mean. However, no significant result is obtained with regard to cognition. The findings suggest that LTCI has a positive effect on spouses' health outcomes and well-being. Since LTCI lowers the pressure of informal caregiving, spouses are likely to benefit from it. In China, due to cultural values and laws, family caregiving is one of the most preferable and main sources of support for frail old adults in China (Chan and Chui, 2011; Lin and Yi, 2011). Spouses usually act as informal caregivers to take care of IADL/ADL-disabled elderly individuals, which results in higher levels of stress and burden leading to negative impacts on their health and well-being (Pinquart and Sörensen, 2003a,b). Our results imply that not only will LTCI users benefit from LTCI, but their spouses will also experience a positive "spillover effect" from LTCI.

4.2. Heterogeneity

To further explore the heterogeneity effect, we analyze the same models between different groups of people based on the attributes of spouses for grouping and from the perspective of care recipients.

Table 4 exhibits the impact of LTCI by spouse's gender. LTCI is found to affect male spouses more than female spouses. The implementing LTCI can improve the cognitive score, self-reported health, and life satisfaction for male spouses. However, no spillover effect is found for female spouses. The outcomes suggest a heterogeneity effect between

genders, revealing that if females play the role of informal caregivers, LTCI has no significant impact on their health and well-being. Conversely, if males provide informal caregiving for their spouses, the implementation of LTCI can improve their health and well-being. Prior research has demonstrated that elderly wives are more inclined to provide caregiving than elderly husbands (Dwyer and Coward, 1991). This phenomenon is explained by the participation of women in domestic labor, nurturance, and kinship relations, which may be congenital (Lee, 1992). As caregivers, men typically need to leave the workforce earlier to care for their wives. The implementation of LTCI can ease their stress and allow them to return to the job market, which could ultimately benefit their health and well-being (Behncke, 2012).

We then analyzed the model between the low-educated and high-educated groups of spouses. The results are shown in Table 5. Interestingly, we find that the impact of long-term care insurance (LTCI) is much greater in the low-educated group. In the low-educated group, LTCI significantly increases the cognition and well-being of their spouses. Conversely, for the highly educated group, LTCI only marginally enhances the life satisfaction of their spouses at 10% critical level. It is commonly known that low-educated spouses are more likely to have a lower level of income (Yoo et al., 2004), and taking care of the IADL/ADL disabled elderly may need them to leave job market earlier and put heavier pressure on them economically, physically and psychologically. The implementation of LTCI can relieve some pressure on low-educated spouses, and thereby has a greater impact on health and well-being for this group.

Table 6 describes the results between care-recipients aged above 80 years old and those aged below 80 years old. We find a larger impact on spousal health and well-being outcomes for those under 80 years of age.

Table 3

DID estimates of LTCI on spouse's health with controls and fixed effects.

Variables	(1)	(2)	(3)	(4)
	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	0.086	−0.385**	0.096***	0.063***
	(0.115)	(0.184)	(0.028)	(0.023)
treat	1.16***	−2.26***	0.544***	0.577***
	(0.435)	(0.753)	(0.111)	(0.103)
Spouse's gender	−0.068	1.85***	−0.100***	−0.050***
	(0.047)	(0.078)	(0.012)	(0.009)
Spouse's age	−0.091***	−0.032***	0.001	0.009***
	(0.003)	(0.006)	(0.001)	(0.001)
Spouse's education level	1.95***	−1.15***	0.106***	−0.017
	(0.055)	(0.093)	(0.015)	(0.011)
Spouse's job	0.114**	−0.389***	0.235***	0.050***
	(0.055)	(0.096)	(0.014)	(0.012)
Spouse's ADL	0.482***	−4.21***	0.566***	0.240***
	(0.055)	(0.109)	(0.014)	(0.013)
Number of children	−0.077***	0.109***	−0.006	0.009**
	(0.019)	(0.035)	(0.005)	(0.004)
Number of care recipient's chronic diseases	0.041***	0.170***	−0.024***	−0.017***
	(0.016)	(0.029)	(0.004)	(0.003)
water	0.195***	−0.286***	0.073***	0.036***
	(0.057)	(0.105)	(0.015)	(0.013)
gas	0.473***	−0.788***	0.104***	0.053***
	(0.072)	(0.118)	(0.018)	(0.015)
Constant	10.67***	14.58***	1.556***	1.97***
	(0.374)	(0.708)	(0.090)	(0.098)
city fixed effect	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES
Observations	32,065	31,321	35,504	33,097
R-squared	0.226	0.191	0.166	0.087

Notes: Standard errors clustered at the household level are reported in parentheses.***p < 0.01, **p < 0.05, *p < 0.1.

Table 4

DID estimates of LTCI on spouse's health between male and female spouses.

Group	Variables	(1)	(2)	(3)	(4)
		spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
female	treat*post	−0.137	−0.473	0.050	0.052
		(0.176)	(0.294)	(0.040)	(0.036)
male	treat*post	0.235*	−0.313	0.134***	0.074**
		(0.143)	(0.208)	(0.037)	(0.029)
	treat dummy	YES	YES	YES	YES
	controls	YES	YES	YES	YES
	city fixed effect	YES	YES	YES	YES
	year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. According to Wald chi-square test of coefficients of treat*post between two groups, results are found to be marginally significant for spouse's cognition and self-reported health at 10% critical level. ***p < 0.01, **p < 0.05, *p < 0.1.

For those aged above 80 years, we did not find a positive spillover effect from LTCI. For the oldest old people, their spouses are usually very old and have a limited ability to take care of their husbands/wives. For their families, before the implementation of LTCI, they might rely on other ways of informal caregiving, such as nursing homes or caregiving provided by other family members (Rubin and White-Means, 2009). Results

imply that LTCI benefits spouses of younger care recipients more than spouses of old care recipients.

Based on different types of services provided by LTCI, Table 7 compares results between direct services and combination benefits. Providing direct services only marginally enhances spouse's self-reported health at 10% critical level. The trial cities that offered combination benefits appear to provide better benefits to spouses, by reducing depressive score and increasing self-reported health and life satisfaction. In China, most families still prefer informal care, and a combination of benefits is more flexible for most families and better suits to the situation in China. Therefore, this type of benefit may ease the mental and physical pressure on spouses.

Additionally, due to the possibility that some spouses may not be the primary caregivers due to their own health conditions, and instead, caregiving responsibilities may be taken by adult children residing with the disabled elderly (although our data indicates that only 19.7% of disabled elderly co-reside with their adult children). In light of this argument, we performed a heterogeneous analysis on two subgroups based on whether adult children co-reside. Table 8 compares the results between those live with and without adult children. Notably, only for those live without children, results are consistent with our baseline model that LTCI could enhance spouse's self-reported health and life satisfaction. We did not find significant results for most of outcome variables of those living with children. Main results are again confirmed, which also implies that LTCI can be considered as an effective tool to assist those elderly who do not co-reside with adult children.

To conclude, we find a heterogeneity effect between different groups of people. LTCI benefits male spouses and low-educated spouses. The positive spillover effect is larger for spouses of old individuals aged below 80. Providing combination benefits seems to make spouses better off than just offering direct services. Moreover, LTCI could help those family live without adult children as well.

4.3. Robustness checks

The key assumption in the DID specification is that the selection of pilot cities is uncorrelated with other determinants of changes in health outcomes. A common trend test is typically conducted to address this issue. Following Moser et al. (2014), we estimated the DID coefficient separately for each year,

$$outcome_{it} = \beta_0 + \alpha \cdot Treat_i \times Year_t + \beta_1 Treat_i + \gamma X_{it} + \mu_c + \tau_t + \epsilon_{it} \quad (3)$$

where $Year_t$ is an indicator variable for each month before and after the implementation of LTCI. Fig. 1 (in the Appendix) shows the estimates of each year's coefficients. Before the implementation of LTCI, the co-efficients are close to zero. After the implementation of LTCI, the co-efficients significantly increase for self-reported health and life satisfaction while it decreases for depression. The results suggest that there are no confounding preexisting trends in the key dependent variables.

Furthermore, we conducted a placebo test to check the robustness of our results. Following previous literature (i.e., Li et al., 2016), we analyzed the same model for a counterfactual fact. We randomly generated a virtual year of implementation of LTCI and repeated the random selecting process 500 times. The premise of the test is that if other factors drove the results, then we should also have observed a significant effect for this analysis. As shown by the distributions of coefficients of treat*post in Fig. 2 (in the Appendix), we did not find any significant result, which provides evidence that the estimated effects are unlikely to be driven by other policies.

Additionally, we conducted several robustness checks by using a subsample. Firstly, Qingdao, Liaocheng, and Weifang had officially announced the launch of LTCI before 2016, but the program was fully launched afterwards. We excluded these three cities to ensure that the sample included only those that had officially implemented LTCI after

Table 5
DID estimates of LTCI on spouse's health between low-educated and high-educated spouses.

Group	Variables	(1)	(2)	(3)	(4)
		spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
low-educated	treat*post	0.212	−0.442*	0.114***	0.062**
		(0.151)	(0.237)	(0.034)	(0.030)
high-educated	treat*post	−0.137	−0.286	0.048	0.064*
		(0.172)	(0.278)	(0.051)	(0.039)
	treat dummy	YES	YES	YES	YES
	controls	YES	YES	YES	YES
	city fixed effect	YES	YES	YES	YES
	year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. According to Wald chi-square test of coefficients of treat*post between two groups, results are found to be statistically insignificant for all the outcome variables. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 6
DID estimates of LTCI on spouse's health between care recipients aged below 80 and above 80.

Group	Variables	(1)	(2)	(3)	(4)
		spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
above 80	treat*post	1.031	−0.761	0.040	0.019
		(0.710)	(1.102)	(0.141)	(0.126)
below 80	treat*post	0.0572	−0.372**	0.102***	0.066***
		(0.118)	(0.189)	(0.029)	(0.024)
	treat dummy	YES	YES	YES	YES
	controls	YES	YES	YES	YES
	city fixed effect	YES	YES	YES	YES
	year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. According to Wald chi-square test of coefficients of treat*post between two groups, results are found to be statistically insignificant for all the outcome variables. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 7
DID estimates of LTCI on spouse's health between direct services and combination benefits.

Group	Variables	(1)	(2)	(3)	(4)
		spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
direct services	treat*post	−0.030	0.264	0.081*	−0.009
		(0.177)	(0.285)	(0.042)	(0.035)
combination benefits	treat*post	0.095	−0.671***	0.076**	0.094***
		(0.149)	(0.234)	(0.038)	(0.031)
	treat dummy	YES	YES	YES	YES
	controls	YES	YES	YES	YES
	city fixed effect	YES	YES	YES	YES
	year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. According to Wald chi-square test of coefficients of treat*post between two groups, results are found to be marginally significant for depression and life satisfaction at 10% critical level. ***p < 0.01, **p < 0.05, *p < 0.1.

2016. The results are presented in Table 2 in the Appendix. All the findings are confirmed. Secondly, although all the pilot cities covered UEBMI, only five cities also covered urban and rural enrollees in URRBMI. Given that the sample size of these five cities was relatively small, we excluded them. As demonstrated in Table 3 in the Appendix, these findings are consistent with our main conclusion that the spillover effect of LTCI benefits the spouses in terms of lower depressive scores, better self-reported health, and increased life satisfaction. Thirdly, we only included those aged 60 and above as targeting population of LTCI was 60 years old and above. Main results remain the same as shown in Table 4 in the Appendix. Lastly, we changed the level of clustering standard error from household level to city level to account for possible correlation in outcomes between middle and old-aged adults in the same city. Results are again confirmed when standard errors are clustered at city level (see Table 5 in the Appendix).

4.4. Potential mechanisms

This section carries out a mechanism study by exploring the effect of LCTI on out-of-pocket medical expenditures. As shown in Table 6 in the Appendix, it shows a significant reduction in out-of-pocket medical expenditures after LTCI implementation. A great decline in medical expenditures may increase individuals' disposable income, which may ease economic pressure on family members. Numerous studies found that the increase in disposable income could improve health and quality of life, especially for those who are less healthy and in a poorer financial situation (Kawachi et al., 2010; Lee et al., 2021). Hence, one potential way of the impact of LTCI on spouses' health and well-being is through the reduction of out-of-pocket medical expenditures, which may further relieve economic pressure on spouses.

5. Conclusion

With longer life expectancies and lower fertility rates, population ageing is a phenomenon sweeping both developing and major developed countries. China is currently experiencing rapid population ageing, which has led to an increased need for long-term care and the introduction of LTCI. A series of studies on the impact of LTCI on care recipients' hospital utilization, medical expenses and health outcomes have been conducted in many developed countries (Choi and Joung, 2016, Choi et al., 2018; Costa-Font et al., 2018). However, studies about the rigorous evaluations of the impact of LTCI pilots in China are very few (Feng et al., 2020; Chen and Ning, 2022, Lei et al., 2022; Tang et al., 2022), and none of them have focused on the potential spillover effect and its mechanism of LTCI on spouses' health outcomes and well-being. Based on longitudinal survey data from CHARLS in 2011, 2013, 2015, and 2018, we investigate whether there is a spillover effect of LTCI on the health outcomes and well-being of spouses for middle and old-aged adults with functional limitations. We apply the DID approach to address our research questions. Our study contributes to the current

Table 8
DID estimates of LTCI on spouse's health between those live with children and those live without children.

Group	Variables	(1)	(2)	(3)	(4)
		spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
live with children	treat*post	0.054	−0.334	0.092***	0.056**
		(0.126)	(0.203)	(0.031)	(0.026)
live without children	treat*post	0.304	−0.674	0.102	0.094*
		(0.294)	(0.448)	(0.073)	(0.056)
	treat dummy	YES	YES	YES	YES
	controls	YES	YES	YES	YES
	city fixed effect	YES	YES	YES	YES
	year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. According to Wald chi-square test of coefficients of treat*post between two groups, results are found to be statistically insignificant for all the outcome variables. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

literature by examining the effect of LTCI on the health and well-being of the spouse of middle and old-aged adults with both an expected LTC demand and actual care burden, which has not been fully explored.

Our findings show that the implementation of LTCI has a positive spillover effect on spouses' health and well-being of middle and old-aged adults with expected long-term care demand or actual care burdens in China. In particular, the LTCI program improves the self-reported health and life satisfaction of spouses by 3.5% and 1.9% to the means, respectively. It will reduce the depressive score of spouses by 5.1% to the mean. The potential reason for this positive effect may be attributed to the reduction of out-of-pocket medical expenditures, which may relieve economic burden on spouses. Consequently, the health status of spouses, who take on the role of primary caregivers, experiences improvements. It is worth mentioning that the target population of our study is not limited to the spouses of care recipients (Lei et al., 2022). We also included those people with functional limitations who may not be covered by LTCI now and who were very likely to be qualified in the future. Although these impaired functional individuals are not actually involved in LTCI, they have potential demand for LTC. Our results give them some confidence that the coverage of LTCI will relieve their economic burden, lessen the psychological stress of people anticipating LTC requirements, and reduce future expenditures for LTC, and their spouses may receive a spillover effect from LTCI pilots. For care recipients, LTCI can increase their utilization of formal LTC. In addition, the LTCI reimbursement of their expenses on institutional care services, hospital care services, and the substitution of less expensively formal LTC can reduce their out-of-pocket payments and mitigate their financial burden (Stabile et al., 2006). These benefits for both care recipients and non-care recipients can help their spouses to relieve the burden of bearing caring and psychological strain.

Moreover, our analysis of heterogeneity reveals that the spillover effect is not homogenous among the whole population. We find a stronger spillover effect on health and well-being for male spouses than female spouses, and this effect is more significant for spouses of individuals aged below 80. Although the reasons underlying the heterogeneity benefits from LTCI do not come to light, possible explanations may be as follows. Compared with males, females have less authority and autonomy and higher participation in family responsibilities in China. Even though their duration of caring decreases or substitutes through the introduction of LTCI, females are less likely to return to the labor market or spend self-time like males. For the age-specific spillover effect of LTCI, older individuals aged 80 years and above are always at high risk of functional limitations and their spouses are potential care recipients. They may rely on other ways of caregiving. Thus, the spillover effect would be mitigated by their poor health conditions (Dong et al., 2019).

Furthermore, low-educated individuals are found to benefit more from the introduction of LTCI. The implementation of LTCI will improve the health and well-being of low-educated people. This finding partially supports the theory of resource substitution, which hypothesizes that

resources can substitute for one another to make the absence of another less harmful. Conversely, the effect of having a specific resource is greater for those who have fewer alternative resources (Ross and Mirowsky, 2006). LTCI can be regarded as a critical resource in this hypothesis to some extent, which can benefit the low-educated spouses of middle and old-aged adults with expected LTC demand or actual care burden. Because less educated individuals have fewer resources input into health (such as social capital and authority), the beneficial effect of LTCI is greater for less educated individuals than for highly educated counterparts. We also found that providing combination benefits tend to make spouses better off than just providing direct services.

Additionally, due to the possibility that some spouses may not be the primary caregivers due to their own health conditions, and instead, adult children residing with the disabled elderly may take the responsibilities. We found robust results for those live without adult children, which to a certain extent, highlights the significance of LTCI on the health and well-being of spouses.

It is worth mentioning that the target population of our study is not limited to persons with urban and rural resident basic medical insurance (URRBMI), urban employee basic medical insurance (UEBMI) or the urban resident basic medical insurance (URBMI). We also included individuals covered by the New Cooperative Medical Scheme (NCMS). Although currently only those covered by UEBMI, URRBMI, or URBMI may benefit from LTCI, we hypothesize that even individuals covered only by NCMS may experience the "spillover effects" of LTCI pilots. This is because the integration of NCMS and URBMI into URRBMI is rapidly progressing in China, and in the near future, more individuals will be covered by URRBMI and will enjoy the benefits of LTCI under its coverage. Although these impaired functional individuals are not directly involved in LTCI, they have potential demand for LTC. Our results provide some confidence that the coverage of LTCI will relieve their economic burden, lessen the psychological stress of people anticipating LTC requirements, reduce future expenditures for LTC, and that their spouses may receive a spillover effect from LTCI pilots. For care recipients, LTCI can increase their utilization of formal LTC, and the reimbursement of expenses on institutional care services and hospital care services, as well as the substitution of less expensive formal LTC, can reduce their out-of-pocket payments and mitigate their financial burden (Stabile et al., 2006). These benefits for both care recipients and non-care recipients can help their spouses alleviate the burden of caregiving and psychological strain. Our robustness test provides some support for this hypothesis.

In most countries, traditional LTC services and programs are designed to meet the immediate needs of care recipients, while the needs of family caregivers are usually neglected (Irpp, 2012). In China, the proportion of people aged 65 years old and above reached 13.50%, and more than 40 million older adults had varying degrees of disability (Zhu and Österle, 2017, Choi et al., 2018; Feng et al., 2020). Given the increased number of disabilities or high risks of functional limitation, the decreasing family size and cultures in China, spouses are the main

source of family caregivers. The findings of this study imply the necessity of addressing the caregiver burden, which not only affects caregiver health and well-being but also has an impact on care recipients. To date, there is no formal policy to support caregivers. However, we do find that the LTCI currently introduced in China can have a positive spillover effect on spouses' health and well-being. In the future, a nationwide policy supporting family caregivers should be called for.

Our study has several limitations. Firstly, given the limited information, we are not able to further explore the other mechanisms behind the effect and its long-term effect. If data are available, future work can go one step further. Secondly, we are also not able to include more objective measures of health given the limited data. Thirdly, the spillover effects of informal care, formal care, and non-care recipients on the spouses of middle and old-aged adults could not be separated. Therefore, the findings should be explained with caution. Fourthly, the interpretations of our results need to be cautious as well. Our selection of "sample" is broader than the actual selection of care recipients of LTCI, as our targeting population includes both care recipients and those potential "care recipients" who have functional limitations and demand LTC in the future. Fifthly, in this study, we are unable to distinguish between individuals who have eligibility for LTCI and those who actually utilize LTCI. In fact, many people are not aware of their eligibility for LTCI, so even if they are eligible, they may not utilize it. Consequently, our estimates of the effects of LTCI may be underestimated. Sixthly, the implementation of LTCI policies may vary across different pilot cities, and these differences could potentially influence our estimation results. However, due to data limitations, we were unable to quantify the impact of these variations. As a result, it should take caution

when interpreting our findings.

In conclusion, this study provides empirical evidence of the spillover effect of LTCI on the health outcomes and well-being of spouses for middle and old-aged adults with expected LTC demand or actual care burdens. The expansion of LTCI could not only help the care recipients themselves, but the health and well-being of the spouses of functionally impaired older adults will benefit from it.

CRediT authorship contribution statement

Yanan Luo: Conceptualization, Supervision, Writing - original draft, Writing - review & editing, Funding acquisition. **Kexin Yuan:** Data curation, Formal analysis, Methodology, Software. **Yuxiao Li:** Software, Validation, Formal analysis. **Yating Liu:** Writing - review & editing. **Yao Pan:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing - original draft, Writing - review & editing, Validation.

Data availability

Data will be made available on request.

Appendix

Table 1
Trial cities of LTC in China

Province	City	Year of Implementation
Hebei	Chengde	2017
Jilin	Jilin	2016
Heilongjiang	Qiqihaer	2017
Shanghai	Shanghai	2017
Jiangsu	Suzhou	2017
Zhejiang	Ningbo	2017
Anhui	Anqing	2017
Jiangxi	Shangrao	2017
Shandong	Binzhou, Qingdao, Jinan, Zaozhuang, Linyi, Liaocheng, Weihai, Weifang, Dezhou	Most cities started in 2016
Hubei	Jingmen	2016
Guangdong	Guangzhou	2017
Chongqing	Chongqing	2017
Sichuan	Chengdu	2017

Notes: We did not include pilot cities like Baishan, Nantong and some cities in Jilin and Shandong provinces as CHARLS did not conduct surveys in these cities. In total, treatment group covered 21 pilot cities.

Table 2
DID estimates of LTCI on spouse's health excluding Qingdao, Liaocheng and Weihai

Variables	(1)	(2)	(3)	(4)
	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	0.092	−0.340*	0.086***	0.065**
	(0.124)	(0.199)	(0.030)	(0.026)
treat dummy	YES	YES	YES	YES
controls	YES	YES	YES	YES
city fixed effect	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 3
DID estimates of LTCI on spouse's health for trial cities covered by UEBMI

Vriables	(1)	(2)	(3)	(4)
	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	0.083	−0.466**	0.089***	0.066***
	(0.123)	(0.197)	(0.030)	(0.025)
treat dummy	YES	YES	YES	YES
controls	YES	YES	YES	YES
city fixed effect	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 4
DID estimates of LTCI on spouse's health for those aged equal to and above 60

Variables	(1)	(2)	(3)	(4)
	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	0.086	−0.385**	0.096***	0.063***
	(0.115)	(0.184)	(0.028)	(0.023)
treat dummy	YES	YES	YES	YES
controls	YES	YES	YES	YES
city fixed effect	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 5
DID estimates of LTCI on spouse's health cluster at city level

Variables	(1)	(2)	(3)	(4)
	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	0.086	−0.385*	0.096***	0.063**
	(0.193)	(0.200)	(0.029)	(0.028)
treat dummy	YES	YES	YES	YES
controls	YES	YES	YES	YES
city fixed effect	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES

Notes: Standard errors clustered at the city level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6
Potential mechanism of out-of-pocket medical expenditures

Variables	Stage 1	Stage 2			
	Out-of-pocket medical expenditures	spouse's cognition	spouse's depression	spouse's self-reported health	spouse's life satisfaction
treat*post	−1784***				
	(688.9)				
Out-of-pocket medical expenditures		3.41e-07	1.48e-05***	−3.12e-06***	−9.64e-07***
		(1.05e-06)	(3.90e-06)	(7.76e-07)	(3.43e-07)
treat dummy		YES	YES	YES	YES
controls		YES	YES	YES	YES
city fixed effect		YES	YES	YES	YES
year fixed effect		YES	YES	YES	YES

Notes: Standard errors clustered at the household level are reported in parentheses. Control variables include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
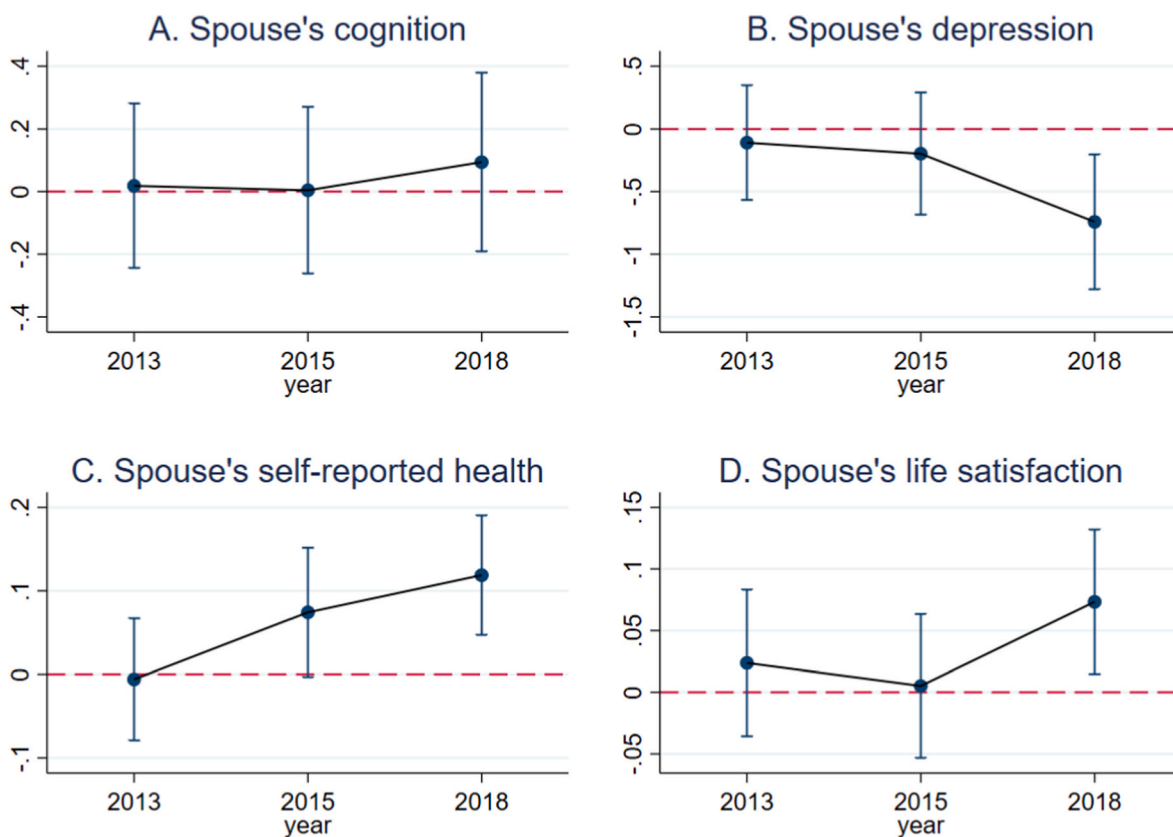
Fig. 1. Common trend test. *Notes*: The x-axis indicates the year. The LTCI implemented in 2016 and 2017. Hence 2013; 2015 are before the implementation of LTCI while 2018 is after the implementation of LTCI. Covariates include spouse's gender, spouse's age, spouse's education level, spouse's job, spouse's ADL, number of children, number of care-recipient's chronic diseases, water, gas. Graphs include 95 percent confidence intervals.
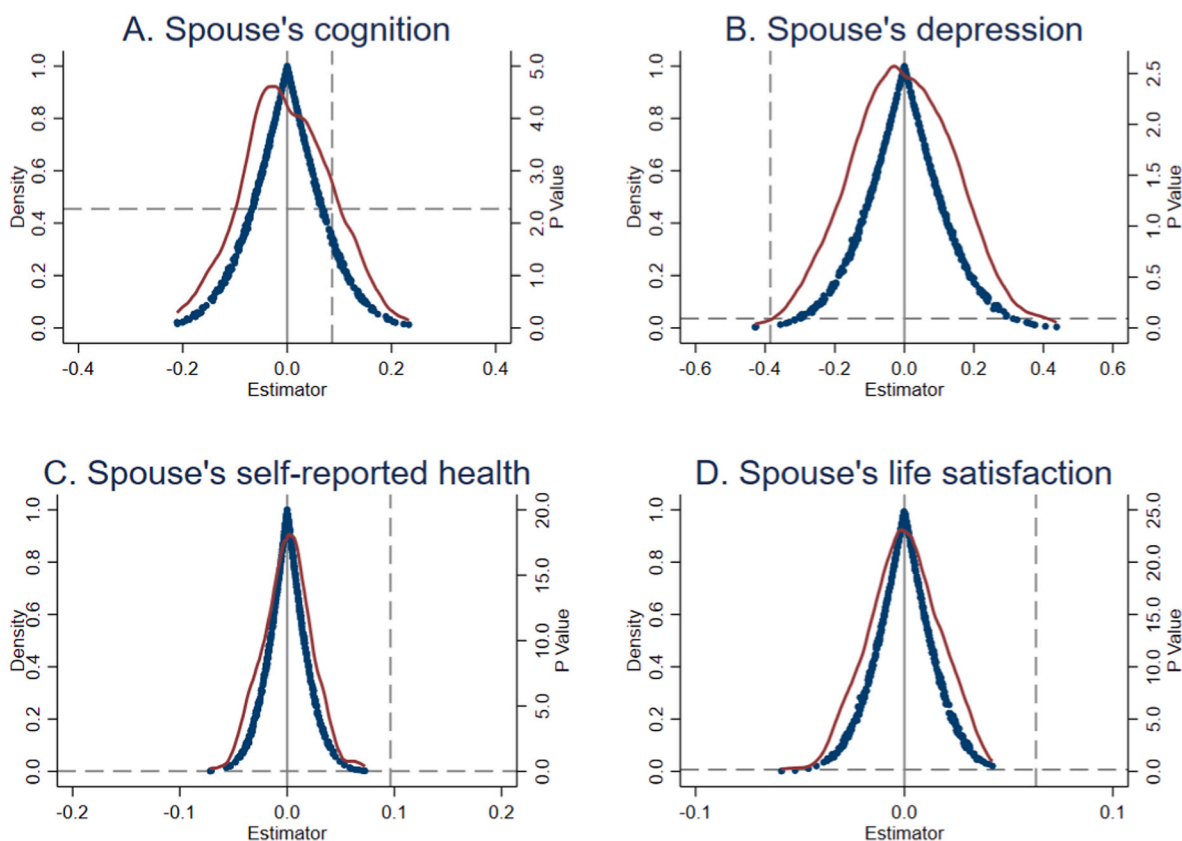
Fig. 2. Placebo test. ***Notes:*** We randomly generated a virtual year of implementation. We repeated the random selecting process 500 times. Blue dots are the distributions of coefficients of treat*post from randomly selecting process and gray dashed vertical line is the coefficient estimated by the DID method. For panel A, B, C and D, coefficients are concentrated on zero.

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