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The Impact of Long-Term Care Insurance on Healthy Lifestyle Behaviors: Evidence from China and the Role of Health Information

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Abstract

Background: A healthy lifestyle is an important means of preventing chronic diseases and reducing the risk of disability. However, insurance coverage may also create ex ante moral hazard by reducing individuals' incentives to invest in preventive behaviors. While this issue has been examined in the context of health insurance, empirical evidence on ex ante moral hazard associated with long-term care insurance (LTCI) remains limited.

Methods: This study uses the staggered implementation of China's LTCI pilot program as a quasi-natural experiment and draws on data from the China Health and Retirement Longitudinal Study (CHARLS). A two-way fixed-effects difference-in-differences model is employed to examine whether LTCI affects healthy lifestyle behaviors among middle-aged and older adults. The analysis focuses on three behavioral outcomes: drinking, smoking, and physical exercise. Medical service utilization is further controlled for to examine whether access to health-related information may offset the potential substitution effect of LTCI.

Results: The results indicate that the introduction of LTCI significantly reduces the probability of engaging in physical exercise, providing evidence consistent with ex ante moral hazard. By contrast, no statistically significant effects are observed for drinking or smoking. The negative effect on exercise remains after controlling for medical service utilization. Heterogeneity analyses suggest that the effect of LTCI varies with individuals' access to health-related information. The negative association between LTCI and exercise is concentrated among urban and rural residents, individuals with lower educational attainment, and those without recent healthcare utilization, whereas the effect is not statistically significant among groups with relatively greater access to health information.

Conclusions: The findings suggest that the effects of LTCI on health behaviors reflect a tension between the substitution effect of insurance coverage and the potential health-information effect associated with healthcare contact and policy exposure. LTCI policy should therefore consider not only the protection provided against disability-related care costs but also its potential implications for preventive health behaviors. Strengthening health education and improving access to health information may help mitigate the potential ex ante moral hazard associated with LTCI.

Keywords: long-term care insurance; ex ante moral hazard; healthy lifestyle; health information；Substitution effect；Information effect

1. Introduction

Cardiovascular disease, cancer, and cerebrovascular disease are among the leading causes of death in China and account for a substantial share of overall mortality. Many of the risk factors associated with these diseases are closely related to lifestyle behaviors. Regular physical activity, smoking cessation, moderate alcohol consumption,

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and other preventive behaviors can therefore play an important role in maintaining health and reducing the risk of chronic disease and disability [1]. Although medical care can mitigate the consequences of illness, prevention through healthier lifestyles remains an important component of population health.However, Insurance may alter individuals' incentives to invest in prevention. The classic insurance literature distinguishes between ex ante and ex post moral hazard [2]. Ex post moral hazard refers to changes in healthcare utilization after a health event has occurred, whereas ex ante moral hazard arises when insurance coverage reduces incentives to undertake preventive efforts before the insured event occurs. Once individuals are protected against part of the financial consequences of illness or disability, the perceived returns to preventive investment may decline. In this sense, insurance coverage can generate a substitution effect between formal financial protection and individual preventive behavior.

This issue is particularly relevant to long-term care insurance (LTCI). China has experienced rapid population aging, and disability among older adults has become an increasingly important social and economic concern. According to the China's Aging Industry Development Report (2021–2022), approximately 44 million older adults in China were living with disabilities by the end of 2022, with chronic diseases representing an important pathway into disability [3]. In response to the growing demand for long-term care, China launched a national LTCI pilot program in 2016. The program was designed primarily to provide financial protection and formal care services for individuals with severe functional limitations.

The introduction of LTCI may affect lifestyle behaviors through two potentially competing mechanisms. On the one hand, greater awareness of disability risks and increased exposure to formal care services may improve individuals' knowledge of disease prevention and healthy living. Families that obtain formal care services through LTCI may also have more opportunities to interact with professional caregivers and healthcare providers, potentially increasing exposure to health-related information. This information effect may strengthen individuals' preferences for maintaining a healthy lifestyle. On the other hand, LTCI reduces the expected financial burden associated with future disability and long-term care needs. This reduction in perceived future costs may weaken incentives to invest in preventive behaviors, generating ex ante moral hazard.

The net effect of these two mechanisms is therefore theoretically ambiguous. The substitution effect may discourage preventive behaviors, whereas the information effect may encourage them. Importantly, the consequences of unhealthy lifestyles for disability may not become apparent immediately. Behaviors such as physical inactivity, smoking, and excessive alcohol consumption can accumulate health risks over a long period, while the financial protection provided by LTCI may make the future costs of disability appear less salient to individuals. Consequently, LTCI could potentially weaken incentives to prevent disability even if it does not directly affect current health conditions.

Against this background, this study asks two related questions. First, does participation in an LTCI pilot program lead to ex ante moral hazard in healthy lifestyle behaviors? Second, can access to health-related information attenuate this potential effect? To address these questions, we exploit the staggered implementation of China's LTCI pilot program and use data from the China Health and Retirement Longitudinal Study (CHARLS). We employ a two-way fixed-effects difference-in-differences model to examine changes in three lifestyle behaviors—drinking, smoking, and physical exercise—among middle-aged and older adults in pilot and non-pilot cities. We further account for medical service utilization to examine whether the estimated effect is partly associated with differences in access to health-related information.

The empirical results provide evidence of ex ante moral hazard in physical exercise. The introduction of LTCI significantly reduces the probability that individuals engage in physical exercise, while the estimated effects on drinking and smoking are not statistically significant. Importantly, the negative effect on exercise remains after controlling for medical service utilization. These findings suggest that the potential substitution effect associated with LTCI may outweigh the health-information effect for some individuals.We further examine whether the effect varies across groups with different levels of access to health-related information. The results show that the negative association between LTCI and exercise is more pronounced among individuals who are relatively disadvantaged in terms of health information, including urban and rural residents, individuals with lower

educational attainment, and those without recent healthcare utilization. By contrast, the estimated effect is not statistically significant among groups with relatively greater exposure to health-related information. Although these findings do not directly establish a causal mediation mechanism, they are consistent with the possibility that access to health information and health preferences may shape how individuals respond to LTCI coverage.

This study contributes to the literature in three respects. First, it adds empirical evidence on ex ante moral hazard in LTCI, an issue that has received considerably less attention than ex post moral hazard. Existing studies have mainly focused on healthcare utilization, formal care use, or other outcomes associated with LTCI, while the potential behavioral response before disability occurs remains less well understood. By focusing on lifestyle behaviors, this study considers a potentially important but less visible dimension of LTCI-related behavioral responses.Second, this study highlights the role of health information in understanding the behavioral consequences of insurance coverage. Rather than treating the effect of LTCI as a purely substitution-based response, we consider the possibility that insurance-related information exposure and healthcare contact may modify individuals' preventive behaviors. This perspective may help explain why previous studies have reached different conclusions regarding the relationship between LTCI and healthy behaviors.Third, the findings have implications for the design of LTCI and for broader healthy-aging policies in China. If LTCI provides financial protection while unintentionally weakening incentives for preventive behaviors, policy design needs to account for both dimensions. Strengthening health education and improving access to reliable health information may help reduce the potential behavioral trade-off between insurance protection and preventive health investment.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the data, variables, and empirical strategy. Section 4 presents the main empirical results and robustness checks. Section 5 reports the heterogeneity analysis. Section 6 concludes and discusses the policy implications.

2. Literature Review

Moral hazard has long been a central concept in the economics of insurance. The literature commonly distinguishes between ex ante moral hazard, which concerns preventive behavior before an insured event occurs, and ex post moral hazard, which concerns behavior after the event. Because changes in healthcare utilization are relatively observable, ex post moral hazard has received substantial attention. Evidence from the RAND Health Insurance Experiment and the Oregon Health Insurance Experiment, for example, has documented changes in healthcare utilization associated with insurance coverage [4,5]. In the long-term care insurance market, however, the empirical evidence is more limited. Existing studies have examined nursing-home utilization and home-care markets and have reported mixed evidence regarding moral hazard [6–8].China's LTCI pilot program, launched in 2016, has generated growing interest in moral hazard. Theoretical studies have discussed intergenerational moral hazard and moral hazard in long-term care service provision [9,10]. Empirical studies using CHARLS data have examined outcomes such as expected retirement age [11], while administrative data have been used to investigate potential over-reporting of disability under cash-subsidy arrangements [12]. These studies provide useful evidence, but the available administrative data are often geographically limited, and relatively little is known about behavioral responses that occur before disability.

The relationship between insurance and preventive health behavior is also theoretically and empirically ambiguous. Ex ante moral hazard may arise when insurance lowers the expected cost of future illness and thereby reduces preventive investment [2]. Yet several studies have found limited evidence of such behavior in health insurance [4,13,14]. One possible explanation is that insurance coverage may simultaneously increase contact with healthcare providers, exposing individuals to information about disease prevention and healthy lifestyles. The resulting information effect may partially offset the substitution effect of insurance [15,16].Evidence from China is similarly mixed. Studies of the New Rural Cooperative Medical Scheme have reported increases in smoking and drinking after enrollment, although concerns remain regarding the exogeneity of insurance participation and the relatively limited benefits of the program [17,18]. Research specifically examining LTCI has also produced divergent findings. One study based on CHARLS reported reductions in preventive behaviors such as physical

examinations and exercise after accounting for health-risk perceptions [19]. Another study, however, found that LTCI could reduce smoking and increase physical activity and health examinations [20].These mixed findings suggest that the behavioral consequences of LTCI may depend on how individuals acquire and process health-related information. The direct substitution effect of insurance coverage may reduce preventive investment, while information obtained through policy exposure, healthcare utilization, or other channels may strengthen health preferences and encourage healthier behaviors. If the latter effect is not adequately considered, the magnitude of ex ante moral hazard may be underestimated.

Against this background, this study focuses on healthy lifestyle behaviors as an important but relatively understudied dimension of LTCI-related moral hazard. Examining whether LTCI changes preventive behaviors is particularly relevant as China continues to expand its LTCI system and pursue healthy aging. The analysis therefore contributes additional empirical evidence on ex ante moral hazard while considering the potential role of health information in shaping individual responses.

3. Research Design

3.1 Data source

This study uses data from the China Health and Retirement Longitudinal Study (CHARLS). CHARLS is a nationally representative longitudinal survey jointly conducted by Peking University and Wuhan University. The survey began in 2011 and is conducted approximately every two years, focusing primarily on adults aged 45 years and above. The present analysis uses five waves of survey data covering the period from 2011 to 2020.Because China's LTCI pilot program was introduced in 2016 and no dedicated nationally representative LTCI database was available during the study period, the publicly available city information in CHARLS is used to identify pilot and non-pilot cities. The treatment group consists of individuals living in cities that participated in the LTCI pilot, while the control group consists of individuals in non-pilot cities. In the early stage of the pilot, LTCI was primarily linked to existing basic medical insurance arrangements. Individuals without medical insurance are excluded from the analytical sample, leaving 4,314 observations. CHARLS provides detailed information on respondents' demographic characteristics, lifestyle behaviors, healthcare utilization, family characteristics, and health status, making it suitable for the present analysis.

3.2 Empirical strategy

The empirical objective is to estimate the effect of the LTCI pilot on lifestyle behaviors. We use a two-way fixed-effects difference-in-differences (DID) specification, comparing changes in outcomes between pilot and non-pilot cities before and after the implementation of LTCI.The baseline specification can be written as:

$$Y_{ict} = \beta_0 + \beta_{1treat_c} \times post_t + \beta_2 X_{ict} + \lambda_i + \theta_t + \varepsilon_{ict}$$

Among them, β_0 represents the intercept term; Y_{ict} includes multiple explanatory variables, including individual i drinking, exercise, and smoking behaviors in c city at t year ; $treat_c$ is a dummy variable for pilot cities of long-term care insurance, with a value of 1 for pilot cities and 0 otherwise. $post_t$ is a time dummy variable, with a value of 1 if the year is 2016 or later, and 0 otherwise. $treat_c * post_t$ represents the explanatory variable, with a value of 1 if the city starts the pilot of long-term care insurance after 2016, and 0 otherwise. The coefficient β_1 indicates the impact of long-term care insurance pilot programs on individual lifestyles compared to non-pilot cities. X_{ict} represents a series of control variables that may affect the time trend of the dependent variable. The purpose of controlling individual and family characteristics is to eliminate the heterogeneity of time trends caused by them. At the same time, the model also includes individual fixed effects and annual fixed effects, represented by λ_i and θ_t respectively. Individual fixed effects control the factors that do not change over time at the individual level, and different individuals have significant differences. Through individual fixed effects, the impact of unobserved factors can be eliminated. Year fixed effects control the changes in the environment of different years

and city policies, etc. Since the Ministry of Human Resources and Social Security launched the pilot program for long-term care insurance in 2016, there have been significant policy adjustments at the national level in the fields of elderly services and medical and health care. Adding time fixed effects can effectively control the impact of these factors. In the process of using the model to estimate, all regressions adopt the city-level clustering standard error.

Economic theory indicates that individuals with insurance may reduce preventive expenditures, such as reducing exercise time and health care needs, as insurance lowers the price of future care services. The impact of long-term care insurance on lifestyle may also be influenced by changes in the personal information set, as the increased utilization of medical services leads to significant changes in the information set about lifestyle [16]. At the same time, there is a large amount of evidence showing that doctors can influence patients' lifestyles. Therefore, the information effect of doctors on individual lifestyles may offset the substitution effect of long-term care insurance on lifestyles. In order to clearly identify the impact of long-term care insurance on lifestyle and test for the presence of ex ante moral hazard, this article modifies formula by incorporating the individual's utilization of medical services into the model, with the specific model design as follows:

$$Y_{ict} = \beta_0 + \beta_{1treat_c} \times post_t + \beta_2 X_{ict} + Medical_{it} + \lambda_i + \theta_t + \varepsilon_{ict}$$

Except for $Medical_{it}$ being different, the definitions and formulas (1) of the other variables are the same. $Medical_{it}$ represents the health service utilization of individual i in t year , by allowing doctors to influence individual lifestyle through health information, including the number of outpatient visits in the past month and the number of hospitalizations in the past year. At the same time, individual health service utilization behavior is related to whether the individual has medical insurance and health status, and it is necessary to control the impact of medical insurance and health status. This article excludes individuals without medical insurance in the sample, and controls health status in the individual characteristic variables, resulting β_1 in an unbiased estimate of the impact of long-term care insurance on lifestyle.

3.3 Variable selection and measurement

The dependent variables capture three lifestyle behaviors: alcohol consumption, smoking, and physical exercise. Drinking is measured by whether the respondent reports drinking alcohol. Smoking is measured by whether the respondent reports smoking in the relevant recent period. Exercise is defined as engaging in moderate-intensity physical activity for at least 30 minutes per day. The treatment variable is based on the LTCI pilot policy: individuals in cities included in the pilot are classified as the treatment group, while those in non-pilot cities form the comparison group.Control variables include individual characteristics, household characteristics, and healthcare utilization. Individual characteristics include gender, age, marital status, household registration, education, and self-rated health. Household characteristics include household size, number of children, and total household income. Healthcare utilization is measured using outpatient visits and hospitalizations.

Table 1 presents the descriptive statistics. The treatment and control groups are broadly comparable in several lifestyle and healthcare-utilization measures. The treatment group has a slightly higher mean age and household income, whereas the control group has a somewhat larger household size and number of children.

Table 1. Summary statistics

Variable	Treatment Mean	Treatment SD	Control Mean	Control SD
Drinking alcohol	0.230	0.420	0.240	0.420
Smoking	0.720	0.450	0.680	0.470
Exercise	0.130	0.340	0.130	0.340
Gender	0.550	0.500	0.540	0.500
Age	63.21	9.150	62.33	9.110
Marital status	0.850	0.360	0.830	0.380
Household registration	0.720	0.450	0.780	0.410
Education	3.500	2.000	3.360	1.890

Self-rated health	2.960	0.930	3.080	0.920
Household size	2.860	1.420	3.120	1.690
Number of children	2.500	1.340	2.840	1.380
Total household income	35061	43733	28009	36544
Outpatient visits	0.460	1.120	0.450	1.080
Number of hospitalizations	0.200	0.530	0.230	0.590

4. Empirical Results

4.1 Benchmark regression

Table 2 presents the baseline estimates. All specifications include individual characteristics, household characteristics, individual fixed effects, and year fixed effects. Columns (1) and (2) report the estimated effects of LTCI on drinking and smoking, respectively. Although the point estimates are positive, neither coefficient is statistically significant. Columns (3) and (4) report the estimates for physical exercise, without and with controls for healthcare utilization, respectively. The coefficient on LTCI is negative and statistically significant in both specifications, with an estimated coefficient of −0.052.The results therefore provide evidence consistent with ex ante moral hazard in physical exercise. At the same time, the absence of statistically significant effects on drinking and smoking indicates that the behavioral response is not uniform across lifestyle outcomes. One possible explanation is that smoking and drinking are relatively persistent behaviors, whereas physical exercise is a more discretionary preventive activity and may respond more readily to changes in perceived future health risks and financial protection.

Table 2. Baseline regression results

Variable	Drinking (1)	Smoking (2)	Exercise (3)	Exercise (4)
LTCI	0.003 (0.027)	0.310 (0.234)	−0.052** (0.024)	−0.052** (0.024)
Control variables	Yes	Yes	Yes	Yes
Medical service utilization	Yes	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	4314	476	4314	4314
R^2	0.8009	0.8339	0.4864	0.4869

Note: ** $p < 0.05$. Standard errors in parentheses are clustered at the city level.

4.2 Parallel-trends test

The DID design relies on the parallel-trends assumption: in the absence of the LTCI pilot, the treatment and comparison groups would have followed similar trends in the outcome. We therefore conduct an event-study analysis to examine the dynamics of the estimated treatment effect. The first pre-treatment period is used as the reference period, and the estimates are presented with 90% confidence intervals.Figure 1 shows that the estimated coefficients are close to zero across all pre-treatment periods, suggesting no evidence of differential pre-trends between groups.The post-treatment coefficients become statistically significant. Following Zhang and Huang [21], we additionally consider joint significance tests for the pre- and post-treatment coefficients. The pre-treatment coefficients are jointly insignificant, whereas the post-treatment coefficients are jointly significant. Taken together, these results support the plausibility of the parallel-trends assumption.

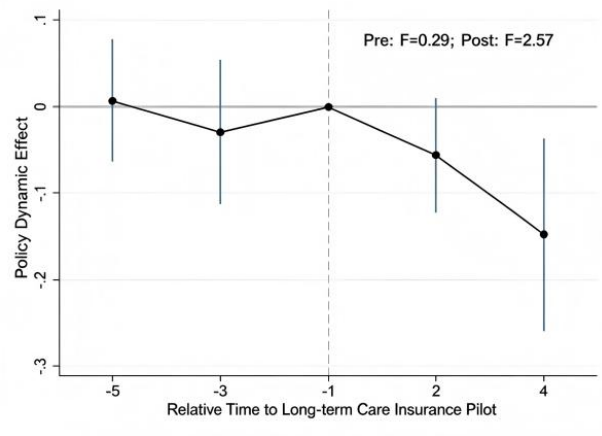

Figure 1. Parallel-trends test

4.3 Placebo test

A potential concern is that the selection of LTCI pilot cities may be correlated with unobserved factors that also affect lifestyle behaviors. To assess whether the baseline estimate could be driven by systematic differences unrelated to the policy, we conduct a placebo test by randomly assigning pseudo-treatment status and repeating the estimation 500 times, following the approach in Zhou et al. [22].Figure 2 illustrates that the distribution of placebo estimates is centered away from the true treatment coefficient; only approximately 5% of the simulated placebo coefficients fall below the observed coefficient. This result suggests that obtaining an effect of the observed magnitude under randomly assigned treatment status is relatively unlikely. The placebo exercise therefore provides additional support for the robustness of the baseline association.

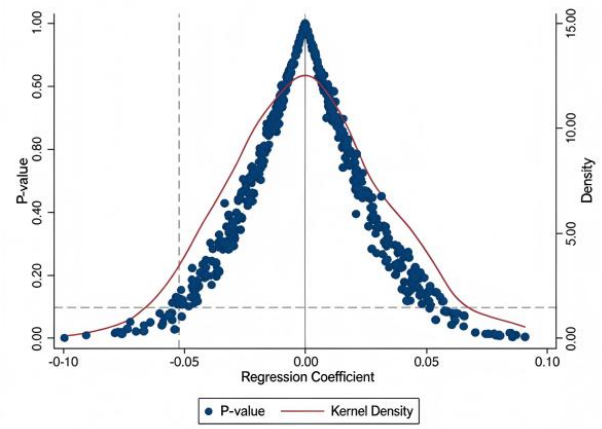

Figure 2. Placebo test.

4.4 Robustness tests

1. Restricting the sample to respondents aged 45 years and older.

Sample selection may cause bias in the results of this paper. Posner found in his research on the aging process that young and old people are influenced by different selves, with young people caring more about present utility and the elderly caring more about future utility. This is also why the lifestyle of the elderly is relatively healthier than that of the young [23]. Therefore, the results of this paper may come from a relatively younger sample. To avoid the issue of sample selection, this paper deletes samples under the age of 45 and only retains samples of 45 years and older. Table 3 (1) reports the estimated results, indicating that long-term care insurance also has a negative impact on the older population, with a strong substitution effect of long-term care insurance.

2. Using the 2020 expanded pilot cities as the comparison group.

To overcome the self-selection problem of pilot cities, this article uses the pilot cities announced by the Ministry of Human Resources and Social Security in 2016 as the treatment group, and the expanded pilot cities in 2020 as the control group. The selection of pilot cities is based on the same conditions and preferences, and the national pilot cities announced in 2020 may be based on certain common characteristics in terms of selection compared to those announced in 2016. Therefore, using the expanded pilot cities in 2020 as the control group for the pilot cities in 2016 has a certain degree of comparability. There are a total of 7 expanded pilot cities in 2020 in the CHARLS data, with the pilot period concentrated in 2021, which also meets the conditions of the control group. The estimated results of the pilot city selection issue are shown in column (2) of Table 3. The impact of long-term care insurance on individual exercise behavior is also significant, with the direction consistent with that of the baseline regression results.

3. Replacing individual fixed effects with community fixed effects.

The impact of long-term care insurance on lifestyle may lead to biased conclusions due to the selection of fixed effects, as community environment, community preferences, and community health development may all affect every resident in the community. To verify the robustness of the baseline regression conclusion in this paper, the individual fixed effects in the baseline regression are replaced with community fixed effects. Column (3) of Table 3 reports the results after replacing the fixed effects, showing that long-term care insurance has a significant negative impact on residents' exercise behavior, consistent with the direction of the baseline regression results.

4. Adding city-level hierarchy fixed effects.

The unobserved factors between cities are still a source of bias. In order to overcome the impact of unobserved city characteristics, this paper, based on the "2016 China City Commercial Attraction Ranking" released by the "New First-tier City Research Institute" in 2016, divides 338 prefecture-level cities into 6 city levels, and cities of the same level have certain comparability. Therefore, through the fixed effects of city levels, the unobserved factors between different cities can be overcome. The results in column (4) of Table 3 show that after adding the fixed effects of city levels, the estimated results are all significant, and the benchmark regression results are credible.

5. Controlling for the home- and community-based elderly care service reform.

The pilot reform of home and community-based elderly care services belongs to the concurrent policy of long-term care insurance, both of which affect the elderly care industry and have an information effect, which may cause bias in the research results. This article includes the pilot reform of home and community-based elderly care services from 2016 to 2020 as a control variable in the baseline regression model. Table 3, column (5) reports the estimated results. The results show that the pilot reform of home and community-based elderly care services indeed belongs to the confounding factors of the long-term care insurance pilot, and after controlling it, the regression coefficient is slightly higher than the baseline coefficient, but it does not affect the research conclusions of this article.

6. Controlling for the Healthy City pilot.

While the Ministry of Human Resources and Social Security issued the pilot program for long-term care insurance, the National Health and Family Planning Commission's Disease Prevention and Control Bureau (National Health and Hygiene Office) issued the "Notice on Carrying Out the Healthy City Pilot Program" (hereinafter referred to as the "Notice"). The Healthy City pilot includes the specific content of "Five Healths" such as healthy environment, healthy society, healthy services, healthy culture, and healthy population. The transmission of health information may have a synchronous impact on the lifestyle of the middle-aged and elderly as well as a positive impact on their lifestyle. To avoid the impact of this pilot, this article includes 38 Healthy City pilots in the baseline regression model as control variables for estimation. The estimation results are shown in column (6) of Table 3. Although the Healthy City pilot has a strong health information transmission effect, it still

has no significant impact on the estimation results of this article, and the baseline regression results of this article are robust and credible.

Table 3. Robustness tests

Specification	LTCI coefficient	SE	N	R^2
(1) Age ≥45	−0.052**	0.024	4232	0.4874
(2) Expanded pilot cities as control	−0.085**	0.030	884	0.4709
(3) Community fixed effects	−0.058**	0.023	4314	0.1107
(4) City-hierarchy fixed effects	−0.050**	0.024	4261	0.4875
(5) Elderly care service reform	−0.052**	0.023	4314	0.4869
(6) Healthy City pilot	−0.050***	0.026	4314	0.4869

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the city level.

5. Heterogeneity Analysis

The baseline results indicate that LTCI is associated with a reduction in physical exercise. To explore whether this relationship varies with access to health-related information, we conduct heterogeneity analyses along three dimensions: type of medical insurance coverage, educational attainment, and recent healthcare utilization.

5.1 Heterogeneity by insurance coverage

The long-term care insurance insured population can be divided into two major categories: employees' medical insurance insured population and urban and rural residents' insured population. During the pilot phase, long-term care insurance mainly adopts two methods for employees: fixed amount financing and fixed ratio financing. Employees need to pay a certain insurance premium, and the long-term care insurance payment information is noted on the payroll. For urban and rural residents, long-term care insurance mainly adopts the method of collecting with the basic medical insurance fund of urban and rural residents, including both medical insurance financing transfer, such as Qingdao, Shanghai, and Changchun, and personal payment + financial assistance. Insurance prices will determine the degree of attention people pay to product information. Urban and rural residents have lower out-of-pocket payments, even 0, so their attention to long-term care insurance will be less than that of employees. Currently, the focus of the long-term care insurance pilot implementation is on employees, with the focus of publicity, benefit guarantee, and supporting facilities mainly targeting the employee group. Therefore, urban employees have more information advantages in long-term care insurance and are more likely to obtain information about disability, care, and healthy lifestyles, which may lead to significant differences in health preferences between employees and residents.This article uses the differences in insurance information to divide it into employee insurance groups and resident insurance groups as reported in Table 4, the coefficient for the resident-insurance group is negative and statistically significant (−0.061**), whereas the coefficient for the employee-insurance group is positive but statistically insignificant (0.070). The contrast is consistent with the possibility that greater exposure to policy and benefit information may weaken the substitution effect of LTCI on preventive behavior.

5.2 Heterogeneity by educational attainment

Grossman emphasizes the heterogeneous impact of education on health in the theory of health capital, with higher levels of education leading to higher health production efficiency [24]. Since this paper uses the CHARLS data, which is a national survey targeting people aged 45 and above, dividing by education can fully reflect the differences in educational level. therefore divide respondents into those with junior high school education or

below and those with high school education or above. Table 4 presents the estimation results.LTCI has a negative and statistically significant association with exercise among respondents with junior high school education or below (−0.064**). Among respondents with high school education or above, the coefficient is positive but statistically insignificant (0.064). The pattern is consistent with the interpretation that educational attainment may be associated with differences in health information and health-related preferences.The empirical results show that the impact of long-term care insurance on the exercise behavior of different individuals exists in terms of education level, with higher levels of education leading to higher health preferences and less influence from the substitution effect of long-term care insurance.

5.3 Heterogeneity by healthcare utilization

Healthcare utilization provides an opportunity for individuals to interact with physicians and receive health-related advice. As mentioned in the previous text, during the process of healthcare utilization, one will receive health lifestyle advice from doctors. If the respondent has used healthcare services in the past month, the transmission of this health information may quickly improve the respondent's lifestyle. Therefore, whether or not the respondent has used healthcare services will determine the size of the respondent's health information set. This article uses the experience of the respondent in seeking medical treatment in the past month from the CHARLS data as the criterion for evaluating the size of the respondent's health information set. We therefore distinguish respondents according to whether they had a medical visit during the previous month. Table 4 presents the estimation results.Among respondents without a recent medical visit, LTCI is associated with a significant reduction in exercise (−0.072**). Among those with a recent medical visit, the coefficient is positive but statistically insignificant (0.159). This pattern is consistent with the possibility that recent healthcare contact may provide health information that offsets part of the substitution effect associated with LTCI.The results indicate that the impact of long-term care insurance on lifestyle will present heterogeneous results due to the differences in obtaining health information. For respondents with a health information advantage, long-term care insurance will not bring moral hazard.

Table 4. Heterogeneity analysis

Subgroup	LTCI coefficient	SE	N	R^2
Employee insurance	0.070	0.091	465	0.4720
Resident insurance	−0.061**	0.029	3672	0.4860
Junior high school or below	−0.064**	0.025	3803	0.4870
High school or above	0.064	0.085	439	0.5645
No recent medical visit	−0.072**	0.028	2852	0.5195
Recent medical visit	0.159	0.115	387	0.5117

Note: ** $p < 0.05$. Standard errors are clustered at the city level.

6. Conclusion and Policy Implications

This study examines whether China's LTCI pilot program affects healthy lifestyle behaviors among middle-aged and older adults. Using the staggered implementation of the pilot as a quasi-natural experiment and a two-way fixed-effects DID framework, we find that LTCI is associated with a significant reduction in the probability of engaging in physical exercise. The estimated effects on drinking and smoking are not statistically significant. The negative association with exercise remains after controlling for healthcare utilization and is robust to a series of alternative specifications and placebo tests.

The heterogeneity analysis shows that the estimated effect is concentrated among groups with relatively less access to health-related information, including residents covered by resident medical insurance, individuals with lower educational attainment, and respondents without recent healthcare utilization. Among groups with greater exposure to health-related information, the negative association is not statistically significant. These patterns are

consistent with the view that the behavioral consequences of LTCI reflect an interaction between the substitution effect of insurance protection and an information-related effect.

First, LTCI policy design should consider potential ex ante moral hazard alongside the protection benefits of insurance. A reduction in preventive behavior does not necessarily imply that LTCI reduces overall welfare, because insurance may generate substantial benefits for individuals who experience disability and face high care costs[25]. A complete welfare assessment therefore requires information on both the gains from risk protection and the behavioral costs associated with moral hazard. More detailed LTCI administrative and longitudinal data would allow future studies to conduct such welfare analyses.

Second, policymakers should improve access to health-related information while expanding LTCI coverage. The heterogeneous effects suggest that policy communication and health education may be particularly important for groups with relatively limited information exposure. Existing medical insurance and healthcare delivery channels could be used to explain LTCI eligibility, benefits, disability risks, and the value of preventive behaviors. Such measures may help LTCI operate as a complement to, rather than a substitute for, preventive health investment.

Third, the findings point to the importance of considering individual health responsibility in the longer-term design of social insurance. Germany's healthcare reforms have been discussed as an example of combining insurance protection with incentives for individual responsibility [26]. However, any similar policy approach should be adapted to China's institutional context and should be carefully evaluated for its effects on equity and access to care. Rather than relying primarily on penalties, a combination of health education, reliable information, preventive incentives, and appropriate cost-sharing may be more compatible with the objectives of LTCI.

Finally, changes in lifestyle behaviors are unlikely to result from short-term policy interventions alone. Multiple channels of health communication—including healthcare providers, community services, medical insurance platforms, and public health education—can help improve health literacy and counter misleading health information. Such efforts may be especially valuable for younger populations, for whom preventive habits can accumulate over the life course.

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Data availability

CHARLS data are publicly available at http://charls.pku.edu.cn/en/.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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