# Lifestyle and Time Use: The Impact of Retirement on Health

Su Chunhong, Li Song*

Shandong University, Jinan Branch of Postal Savings Bank of China

**Abstract:** Based on the data from the China Health and Retirement Longitudinal Study (CHARLS) in 2011 and 2013, this paper studied the impact of retirement on male and female workers' health and its impact mechanism under the mandatory retirement age system in China by using Fuzzy Regression Discontinuity Design (FRDD). The results indicated that retirement increased the probability of men assessing themselves as "healthy" by 25 percentage points and lowered the probability of suffering from chronic diseases for women by 26 percentage points. In terms of mechanism analysis, it was found that the remarkable increase in social interactions after retirement was the main reason for the improvement of health for male retirees, but not the reason for the lower probability of having chronic diseases for female retirees. The findings serve as important references for formulating policies regarding postponing retirement age and flexible retirement.

**Keywords:** retirement, health, mechanism, lifestyle and time use, Fuzzy Regression Discontinuity

## Introduction

To postpone the mandatory retirement age is a common measure adopted by various countries in the world in response to an aging population. According to the latest data released by the National Bureau of Statistics of China in 2018, as of the end of 2017, there were 241 million people aged 60 and above in China, accounting for 17.3% of the total population, and 150 million

* Su Chunhong, School of Economics, Shandong University; Li Song, Jinan Branch of Postal Savings Bank of China, Jinan.

This research was supporter by "Economic Effect of Postponing Retirement Age and Research on a Fair, Sustainable Pension Insurance System" (15BJY182) funded by the National Social Science Fund of China (NSSFC).

Correspondence concerning this article should be addressed to Su Chunhong, School of Economics, Shandong University, Shandong. E-mail: suchunhong@sdu.edu.cn

people aged 65 and above, accounting for 11.4% of the total. The UN estimates that by 2030, people aged 60 and above in China will surpass 300 million, or 21% of the total population, suggesting an aging population is an irreversible trend. The aging population poses a serious challenge for the sustainable development of China's pension insurance system; therefore, the policy of postponing the retirement age has been put on the government's agenda. As early as 2005, the then Ministry of Labor and Social Security of China conducted research on delaying the retirement age. Later in 2012, The Outline of the the 12th Five-Year Plan for Social Security again put forward the policy of flexibly delaying the age for receiving pension benefits, and in 2013, the "Decision of the Central Committee of the Communist Party of China on Some Major lssues Concerning Comprehensively Deepening the Reform" floated the idea of postponing the retirement age in progressive steps. As of today, however, an implementation program for postponing the retirement age has yet to be announced. Another factor that poses a challenge to the pension insurance system is the change in economic growth. In 2011, China's GDP growth rate entered a single-digit growth era and began to fall in 2012. The aging of the population and the slowdown in economic growth have brought many uncertainties and risks to the financial sustainability of China's pension insurance. It is imperative to delay the retirement age in order to ease the pressure on pension payments. China's current mandatory retirement ages — 60 and 50 for male and female workers, respectively; and 55 for female cadres — are much lower than those of major developed and developing countries in Organization for Economic Co-operation and Development (OECD) (Su & Li, 2014). Plus, it's incompatible with China's economic, social and demographic developments. As a result, delaying the retirement age is on the horizon. Also, delaying the retirement age will increase the labor supply and output and improve the efficient utilization of human capital; furthermore, it will shorten the time pensions need to be paid thus improving the ability to pay pensions to the ever increasing number of retired people. Because health capital is an important part of the value of human capital, the formulation of the retirement age policy should take the impact of retirement on health into account. If retirement has a negative impact on health, delaying retirement can improve the ability to pay for pensions, while reducing medical expenses and enhancing welfare of residents. Conversely, if retirement has a positive impact on health, the expected benefits of delayed retirement may be offset by the increase in medical spending (Sahlgren, 2017). When formulating the policy of delaying the retirement age, the government should weigh the costs and benefits, and adjust the health behavior and working hours of older workers by considering the impact of retirement on health. Therefore, studying the impact of retirement on health and the mechanism behind it will provide important decision-making references for the policy of delaying retirement age.

Previous studies on the impact of retirement on health failed to reach consistent conclusions. A majority of the past studies focused on both subjective and objective health indicators. Sahlgren's research found that retirement had a negative impact on subjective self-assessed health and objective health (Sahlgren, 2012). Lei Xiaoyan studied the impact of retirement on self-assessed health and found that retirement had a negative impact on men's health, but has no effect on women's (Lei, Tan and Zhao, 2010). Some researches revealed that retirement cut off the social contact between individuals and their friends, making individuals feel “neglected” and “old” mentally and emotionally, which would harm health (Bradford, 1979). But Coe and Zamarro’s (2011) research concluded that retirement should have a significant positive impact on health, as retirement was the beginning of a healthy lifestyle, and the reduction in stress and anxiety after retirement should have a positive impact on health (Ekerdt, Bosse & Locastro, 1983, pp. 231-236).

Some scholars who studied mental health also drew different research conclusions. Lindeboon, Portrait and Van used a fixed-effects model to analyze the impact of retirement on mental health and found that retirement had no statistical impact on health (Lindeboom, Portrait & Berg, 2002, pp. 505-520). Lee and Smith (2009) came to a similar conclusion that retirement had little to do with subsequent depression. Dave, Rashad and Spasojevic et al. (2008) found that unprepared retirement had a negative impact on health;  Belloni, Meschi and Pasini (2015), on the contrary, believed that retirement, as a relief, improved men’s mental health, especially for the blue-collar workers in the areas heavily hit by the economic crisis. The above-mentioned contrary conclusions are derived from different measurement methods and research samples, in addition to the varied driving mechanisms behind the health of different sample groups. The theoretical mechanisms of retirement’s impact on health is represented by Grossman, whose health capital demand model shows that the increase in leisure time after retirement reduces the opportunity cost of health investment. However, since the income of pension insurance does not depend on health level, people are seldom motivated to invest in health after retirement and the health effects of retirement rest with the comparison between the two (Grossman, 1972). More recent research has focused on the impact mechanisms from the changes in post-retirement lifestyle, as retirement has transformed people’s way of exercise, social interactions, sleep, smoking, drinking, etc. Research of Heide, Van Rijn and Robroek in Japan revealed that after retirement, older people, under the influence of peers, reduced their cigarette and alcohol consumption, and spent more time exercising and sleeping on weekdays (Heide et al., 2013, pp. 1-11). Retirees will do healthier activities because they have more leisure time (Insler, 2014). Studies in Australia showed that changes in risky lifestyles brought about by retirement promoted health transformations after retirement (Ding et al., 2016). Holdsworth et al. (2016) also studied the influencing mechanism of retirement to promote or deteriorate health, and concluded that the promotion was mainly due to lifestyle changes and the deterioration due to future health-related anxiety and fear. To analyze the impact of retirement on health and its impact mechanisms, most scholars focused their research on developed countries, and therefore the research in China was relatively limited. Following the people-oriented development concept, the reform of the retirement system should fully consider the health effects of retirement. Based on the data of the China Health and Retirement Longitudinal Study (CHARLS), this paper uses Fuzzy Regression Discontinuity Design (FRDD) to analyze the impact of China’s retirement system on the health of urban workers and its impact mechanism, enriching the research on the impact of retirement on health in China, and providing an empirical reference supporting a government policy postponing the retirement age.

Our study found that retirement increased the probability of male workers assessing themselves as "healthy" by 25% and reduced the probability of women suffering from chronic disease by 26%. In terms of impact mechanisms, retirement has significantly increased the social interaction (e.g. making friends and engaging in recreational activities in parks) probability of males by 38%, and this lifestyle change has raised the probability of men assessing themselves "healthy" by 6%, indicating that lifestyle change after retirement leads to a change in the male group's health status; although retirement has significantly improved female's social interaction probability, the impact of retirement on health has not changed greatly after the variable "social interaction" is controlled, so more social activities do not cause the change in women's health status. Compared with the existing literature, our paper makes contributions in the following three aspects: First, based on the more accurate CHARLS micro-database, and using FRDD, the research alleviates the endogenous problem between retirement and health, and at the same time, conducts robustness tests from various aspects to deliver more rigorous analysis results. Second, the research is more comprehensive as it covers both subjective and objective health indicators and mental health indicators, and the mechanism research encompasses the five indicators of exercise, social interaction, sleep, smoking and drinking, enriching the research on the impact of retirement on health. Third, we revealed that the impact mechanism of retirement on health varies by gender, which means that a gender-differentiated retirement policy should be developed considering the impact of retirement on health.

This paper is structured as follows: Part 2 introduces the background and research methods of the retirement system. Part 3 describes data sources and the definition of variables. Part 4 empirically examines the impact of retirement on health and the mechanisms of action. Part 5 describes the robustness test. Part 6 lays out the conclusions and policy implications.

## Background and Empirical Methods of the Retirement System

### Background

As a social system, the retirement system not only closely relates to personal welfare and corporate performance, but also is of important significance for the sound operation of a nation's macro economy and the harmony and stability of society. The system related to the retirement of enterprise employees is basically derived from the Labor Insurance Regulations of the People's Republic of China in 1953, the Interim Measures for the Retirement of Staff of State Organs in 1955, and the Interim Provisions of the State Council on the Retirement of Workers and Staff in 1958. The three documents stipulate the retirement system for corporate employees by gender and occupation. According to the stipulations, the retirement age is 60 for male employees, and 55 for those engaged in special types of work including high-risk work such as down-hole operations, operations at high temperature and high altitude or for those engaged in work harmful to health; the retirement age is 50 for female employees, 55 for female cadres (generally engaged in management and scientific research), and 45 for those engaged in high-risk work or work harmful to health, which is similar to that of male employees. The retirement system for employees of government, government agencies and public institutions in China, in addition to inheriting partial provisions of the Interim Measures in 1955, is also derived from the Interim Measures of the State Council on Providing for the Old, Weak, Sick and Handicapped Cadres and the Interim Measures of the State Council on the Retirement and Resignation of Workers promulgated by the State Council in 1978, and the Temporary Regulations for National Civil Servants promulgated in 1993. For civil servants, the retirement age is 60 for men and 55 for women, or 55 for men and 45 for women if eligible. For professional technical staff and management staff in public institutions, the retirement age is 60 for men and 55 for women, or 55 for men and 45 for women if they have lost their ability to work due to work-related disabilities. For logistics workers in government agencies and public institutions, the retirement age is set at 60 for men and 50 for women.

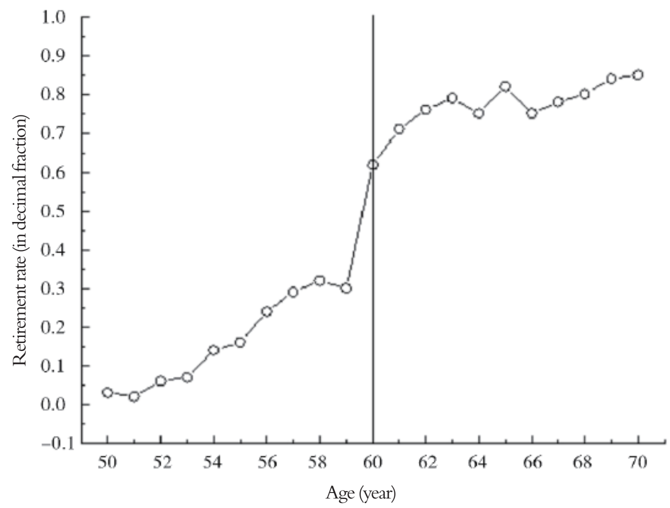
In general, for employees in Chinese enterprises, government, government agencies and public institutions, the normal retirement age is 60 for male workers and 55 for female civil servants and 50 for female workers.

## Empirical Methods

The difficulty in studying the impact of retirement on health is to solve the endogenous problem, as the deviations may be caused by omission of variables, some of which (personal preference, health endowment, etc.) are unobservable. At the same time, there is a two-way cause and effect relationship between retirement and health, and studies have shown that the health level and unobservable health impact seriously affect retirement behaviors (Mcgarry, 2004). Traditional ordinary least squares (OLS) and panel data methods have difficulty overcoming the above endogenous problems, leading to biased research results. By controlling the age effect, marital status, and educational background, we have mitigated the deviations caused by the omission of variables due to individual heterogeneity, and by using the Regression Discontinuity Design (RDD), we alleviated the endogenous problem caused by two-way causal relationships. In RDD, like a local random experiment, all variables are similarly distributed below or above the cutoff point. RDD allows a discontinuous change in the probability and expected value of the treatment status given a certain covariate (Lee & Lemieux, 2010). This was necessary under the premise that the impact of age on health varies below or above the cutoff point. Furthermore, considering the mandatory nature of the retirement system and the relative regularity of normal retirement age for both men and women in China, which was consistent with the assumptions of the RDD, we adopted RDD for our analysis.

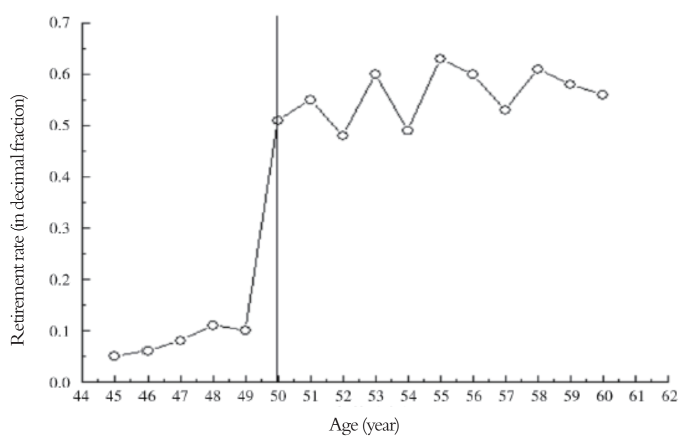
RDD was first used in 1960, but only heeded by economists until 1990 when Hahn and Klaauw provided the econometric theoretical basis for RDD (Hahn & Klaauw, 2001). RDD includes Sharp Regression Discontinuity (SRD) and Fuzzy Regression Discontinuity Design (FRDD). In the former, the probability that an individual is treated at a cutoff point completely jumps from 0 to 1. In the latter, the possibility that a treatment variable is treated only experiences a probabilistic jump. Although the current retirement system in China stipulates that the mandatory retirement age is 60 for men and 50 for women (55 for female cadres), some workers would retire early out of health issues or some highly educated or high-tech staff would not retire at the statutory retirement age. As a result, the retirement rate of retirees at the cutoff point for retirement age does not jump from 0 to 1 in the strict sense, as shown in Figure 1 and Figure 2, in which the vertical axis indicates the ratio of male (or female) retirees at the corresponding age point to the total number of people of the same age.

Figure 1. Retirement and Age of Men




Source: Calculated by the authors based on the CHARLS database, the same below.

Figure 2. Retirement and Age of Women




According to Figure 1, there is a big jump in the retirement rate of male employees (including those in enterprises, government agencies and public institutions) in China's urban areas, from 30% at the age of 59 to 60% at the age of 60, rather than a complete jump from 0 to 1. In Figure 2, the retirement rate of female employees also jumps①, to a certain extent, from 10% at the age of 49 to 50% at the age of 50, with the probability of jumping less than 1. It indicates that the impact of the retirement system in China on retirement behavior satisfies the assumptions of the RDD, and furthermore, that the particularity of the retirement behavior of urban employees in China meets the requirements of the FRDD.

One of the approaches to FRDD is the instrumental variable method. We defined the variables as follows: $T_i = 1\ (x_i \geq c_g)$ ($c_g$ stands for cutoff point value, xi stands for age). $T_i$ is obviously related to $D_i$ (individual retirement behavior), satisfying the correlation of instrumental variables. Meanwhile,

① In Figure 2, the female samples do not have a jump point at the age of 55, since the number of individuals who are cadres in the female samples is small. For this matter, this paper excludes the impact of retirement on health of women who should retire at the age of 55.

$T_i = 1$ ($x_i \geq c_g$) is equivalent to a local random experiment around the cutoff point, so it only affects the explained variable $Y_i$ (health) through $D_i$ and satisfies the exogeneity. Therefore, it can be used as an effective instrumental variable of $D_i$ and the Two-Stage Least Squares (2SLS) method can be adopted for regression analysis. For the purpose of this study, as the retirement system is exogenous for an individual, we attempted to use the retirement system as an instrumental variable to identify the impact of retirement on health and study its impact mechanism. Identifying whether an individual reaches the mandatory retirement age is a method of quantifying the retirement system, therefore, we used the fact "whether an individual reaches the mandatory retirement age" as a instrumental variable to replace the "retirement system". However, age itself has a certain impact on health. As age increases, health status deteriorates. In this sense, we needed to control the influence of age on health when conducting regression analysis, and also, drawing on the thinking of instrumental variables, to divide the people around the mandatory retirement age into a control group and a treatment group. In this way, we could borrow the idea of random experiment to test the impact of retirement on health. We set the model as follows:

$$Y_i = \alpha + \sigma D_i + \gamma^1 (x_i - c_g) + \gamma 2 T_i (x_i - c_g) + K_i + \mu_i \qquad (1)$$

$$D_i = \beta + \theta_1 T_i + \theta_2 (x_i - c_g) + \theta 3 T_i (x_i - c_g) + K_i + \varepsilon_i \qquad (2)$$

In the model, equation (1) is the second-stage formula, and equation (2) is the first-stage formula. $Y_i$ represents health and mechanism variable; $D_i$ refers to individual retirement behavior; $xi$ means the actual age of an individual; cg represents the mandatory retirement age under the system, i.e., 60 for men and 50 for women; $T_i$ is an instrumental variable (i.e. binary variable: $T_i = 1$ when $x_i \geq c_g$; $T_i = 0$ when $x_i < c_g$), i.e. the fact that "whether an individual reaches the mandatory retirement age;" Ki is a control variable, including marital status and educational background; $\mu i$ and $\varepsilon i$ are the disturbance terms; $\alpha$ and $\beta$ are both constant terms; $(x_i - c_g)$ means the normalization of $xi$ to make it 0 at the cutoff point①; $T_i (x_i - c_g)$ means the control of the age effect below and above the cutoff point to allow the separate regression of data on both sides of the cutoff point for calculation of the difference between the intercepts on both sides, which avoids regression bias caused by the same slope on both sides. In the model, σ in equation (1) is the core parameter of interest in this paper.

## Data and Variables

### Data Source

We used the cross-section data from the national baseline data of the China Health and Retirement Longitudinal Study (CHARLS) in 2011 and 2013 for empirical research. CHARLS is currently the only large-scale household survey database that collects nationally representative samples of middle-

① If no normalization is performed here, though the difference between the intercepts of the regression lines on both sides of the cutoff point is measured, it is not equal to the jump distance of the two regression lines at the cutoff point.

aged and elderly people in China. It contains micro-data for households and individuals aged 45 and over in 23 provinces and 5 autonomous regions in China. Adopting a multi-stage sampling method, the CHARLS questionnaire includes personal basic information, health status and function, occupation, retirement, pension and other modules. A nationwide baseline survey started in 2009, followed by a follow-up survey of baseline survey data every two years.

According to China's retirement system, only those who live in cities or have an urban *hukou* (an official document issued by the Chinese government, certifying that the holder is a legal resident of a particular area) can enjoy retirement benefits. Based on this, we chose people who lived in urban communities and had a non-agricultural *hukou* when they were surveyed as our sample data; and because the system differs in terms of males and females, we analyzed the male and female sample groups separately. In addition, in order to reduce the impact of age on health, male samples aged 50-70 and female samples aged 45-60 were chosen.①

## Definitions of Variables

For the purpose of this research, retirement is the independent variable, while health, exercise, social interactions, sleep, smoking, drinking and other mechanism variables are the dependent variables. The variables and descriptions are shown in Table 1.

Table 1. Variables and Descriptions

| Type of variable | Symbol of variable | Meaning of variable | Definition of variable |
|---|---|---|---|
| Explanatory variable | $D_i$ | Retirement | "Have you retired?" "Yes" = 1; "No" = 0. |
| Explained variable | *SAH* | Self-assessed health | "How do you feel about your health?" "Very Good", "Good" or "Fair" = 1; "Poor" = 0. |
| | *no chronic disease* | Objective health | "Having none of the 14 chronic diseases" = 1; otherwise = 0. |
| | *CES-D* | Mental health | The total score of less than 10 = 1; otherwise = 0. |
| Mechanism variable | *exercise* | Exercise | "Do you exercise?" "Yes"" = 1; "No" = 0. |
| | *social* | Social interaction | "Have you engaged in the 11 social activities in the questionnaire in a month?" One or more social activities = 1; no activities = 0. |
| | *sleep2* | Sleep | 7-8 h sleep time = 1; otherwise = 0. |
| | *smoke* | Smoking | "Are you a smoker?" "No" = 1; "Yes" = 0. |
| | *drink* | Drinking | "Have you drunk alcohol in the recent year?" "No"= 1; "Yes" = 0. |
| Control variable | *age* | Age | – |
| | *marriage* | Marital status | "Married (including cohabitation)" = 1; other status = 0. |
| | *education* | Educational background | "Junior high school diploma or above" = 1; other level = 0. |

① The validity of the regression results can be improved when the bandwidths are the same below and above the cutoff point. But since the CHARLS database sample group consists of people aged 45 and above, the female samples aged 45–60 were chosen here.

**Retirement.**

Retirement means that individuals voluntarily or involuntarily exit the labor market. In this paper, retirement is treated as a binary variable. According to the survey, if the respondent answers "Yes"[①], a value of "1" is assigned; otherwise, "0" assigned.

**Health.**

In terms of health, this paper examines three aspects, namely, self-assessed health, objective health and mental health. Self-assessed health (SAH) is favored in the relevant research literature because it represents a comprehensive level of individual health. At the same time, we chose the objective health indicator "chronic diseases" to measure an individual's health status. A total of 14 chronic diseases are considered, including hypertension, diabetes and heart disease. In addition, compared with the health indicators, mental health status is more sensitive to environmental changes (Coe & Zamarro, 2011). Therefore, we adopted the Center for Epidemiological Studies Depression Scale (CES-D) score to measure an individual's mental health. CES-D is mainly used for screening subjects with depressive symptoms. If the total score is ≥ 10, the individual is considered to be depressed. The validity and reliability of this standard to measure mental health indicators has been proven (Andresen, Malmgren, Carter & Patrick, 1994, pp. 77-84). In terms of mechanism, Grossman (1972) pointed out in his model of demand for health capital that health was a function of medical services, lifestyle, etc.; Insler (2014), through studying smoking and exercise, found that retirement may affect health through these channels; in addition, Ding et al. (2016) also concluded that retirement led to changes in lifestyles such as physical activity, diet, and sleep. Since the CHARLS database provides a wealth of lifestyle-related variables, this paper, from the perspective of health-related lifestyles, explored the impact mechanism of retirement on health by using exercise, social interactions, sleep, smoking, drinking and other lifestyles and time use as mechanism variables for analysis. In terms of control variables, we controlled marital status, educational background and age.

Table 2 gives a statistical description of the samples. From the t-test value, it can be seen that for men and women, in the health indicators such as self-assessed health, chronic diseases and mental health and mechanism indicators including exercise, social interaction and sleep, both the employee group and the retiree group show significant differences. The reason for the results may be the impact of "retirement", or the impact of age and other factors on the indicators.

Table 2. Descriptive statistics of samples

| Variable | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Employee sample | | Retiree sample | | t–test | Employee sample | | Retiree sample | | t–test |
| | Mean value | Sample size | Mean value | Sample size | | Mean value | Sample size | Mean value | Sample size | |
| 1.Health | | | | | | | | | | |

① Some people will be rehired after retirement. Usually high–tech or highly–educated staff will have the opportunity to return to the workplace, and the general staff will retire after the retirement procedures have been gone through. (Lei, 2010)

| Variable | Men | | | | | Women | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Employee sample | | Retiree sample | | t–test | Employee sample | | Retiree sample | | t–test |
| | Mean value | Sample size | Mean value | Sample size | | Mean value | Sample size | Mean value | Sample size | |
| *sah* | 0.57 (0.50) | 855 | 0.54 (0.50) | 823 | 0.38 | 0.58 (0.02) | 905 | 0.52 (0.02) | 556 | 2.15 |
| *no chronic disease* | 0.37 (0.48) | 778 | 0.26 (0.44) | 774 | 4.69 | 0.40 (0.02) | 846 | 0.31 (0.02) | 517 | 3.61 |
| *CES-D* | 0.78 (0.02) | 763 | 0.82 (0.01) | 702 | 2.09 | 0.72 (0.02) | 847 | 0.75 (0.02) | 503 | 1.08 |
| 1. Lifestyle and time use | | | | | | | | | | |
| *exercise* | 0.89 (0.31) | 297 | 0.90 (0.29) | 336 | 1.87 | 0.88 (0.02) | 379 | 0.90 (0.02) | 220 | 0.43 |
| *social* | 0.65 (0.48) | 758 | 0.69 (0.46) | 776 | 0.03 | 0.58 (0.02) | 858 | 0.72 (0.02) | 521 | – 5.26 |
| *sleep1* | 0.54 (0.50) | 854 | 0.54 (0.50) | 823 | 0.46 | 0.49 (0.02) | 897 | 0.57 (0.02) | 556 | – 2.84 |
| *sleep2* | 0.40(0.50) | 854 | 0.40 (0.49) | 823 | 0.74 | 0.44 (0.02) | 897 | 0.40 (0.02) | 556 | 1.54 |
| *sleep3* | 0.06(0.23) | 854 | 0.06 (0.23) | 823 | 1.80 | 0.06 (0.01) | 897 | 0.01 (0.17) | 556 | 2.94 |
| *smoke* | 0.24 (0.43) | 583 | 0.35 (0.48) | 553 | 3.76 | 0.35 (0.07) | 43 | 0.00 (0.09) | 25 | 0.93 |
| *drink* | 0.37 (0.48) | 854 | 0.47 (0.50) | 824 | 2.28 | 0.86 (0.01) | 904 | 0.87 (0.01) | 555 | 0.81 |
| 2. Control variable | | | | | | | | | | |
| *age* | 54.95 (2.86) | 855 | 64.45 (3.04) | 823 | 28.98 | 50.69 (0.16) | 906 | 54.88 (0.15) | 556 | –18.10 |
| *marriage* | 0.95 (0.23) | 855 | 0.93 (0.25) | 823 | – 2.74 | 0.91 (0.01) | 906 | 0.90 (0.01) | 556 | 1.05 |
| *education* | 0.78 (0.42) | 855 | 0.60 (0.50) | 823 | 0.02 | 0.61 (0.02) | 906 | 0.82 (0.02) | 556 | 8.50 |

Source: Compiled by the authors based on the CHARLS database.

Note: (1) The data in parentheses is the robust standard error. Unless otherwise stated, it has the same meaning hereinafter; (2) For men, “employee sample” and “retiree sample” refer to the sample aged 50-59 and the sample aged 60-70, respectively; for women, “employee sample” and “retiree sample” refer to the sample aged 45-49 and the sample aged 50-60, respectively; (3) sleep1, sleep2, and sleep3 represent normal sleep time of 0-7 (excl.) hours, 7-8 hours and over 8 (excl.) hours at night, respectively.

## Analysis of Regression Results

### The Impact of Retirement on Health

The regression results concerning the impact of retirement on health are illustrated in Table 3. The data shows that in the first stage of regression, F values are greater than 10, so we can assume the instrumental variable is not a weak one and, as an indicator of “discontinuity of retirement status”, it is very significant. The retirement rate of men aged over 60 increased by about 31% compared with those aged below 59; the retirement rate of women aged over 50 increased by about 43% compared with those aged below 50①.

The second-stage regression results show that for men, retirement had a significant positive effect on self-assessed health (SAH), and the probability of men assessing themselves as healthy after retirement grew by 25%. This result is consistent with the findings of Deng Tinghe’s research, which concluded that retirement,

① Due to limited space, the results of the first stage regression are omitted here.

at 10% significance level, raised the probability of the elderly men assessing themselves as healthy by 25.9 percentage points (Deng & He, 2016); however, retirement had no significant effect on men's chronic diseases and mental health. On the female side, retirement significantly reduced the likelihood of women getting chronic diseases, lowering the probability of chronic diseases by 26%, yet the impact coefficient of retirement on other health indicators of women was not significant. The above conclusions may be derived from the role effect which matters greatly. In the role assignment of Chinese family members, men have always been responsible for supporting a family. In order to obtain a higher income, men need to bear more pressure from the workplace and work longer hours than women, so the changes toward a healthy lifestyle after retiring, including doing housework and exercise, adjusting sleep time and improving sleep quality, and conducting social activities such as playing chess and cards, interacting with friends, and participating in volunteer and charities activities, will greatly improve men's self-assessment on health. On the other side, women generally bear heavy domestic work, as well as great work pressure, and they spend less time on social life and exercise. After retirement, women are freed from work stress with more free time, so their objective health indicators are improved to a certain extent, leading to a lower probability of suffering from chronic diseases. Changes in lifestyle and time use have a positive impact on health. The specific mechanism of retirement's impact on health will be further explored later.

Table 3. The regression results concerning the impact of retirement on health

| Variable | *sah* | *No chronic disease* | *CES–D* |
|---|---|---|---|
| Men: | | | |
| Retirement | 0.25* (0.15) | - 0.18 (0.16) | - 0.03 (0.13) |
| Age | - 0.02* (0.01) | - 0.002 (0.01) | 0.00 (0.01) |
| Educational background | 0.04 (0.04) | 0.05 (0.03) | 0.11*** (0.03) |
| Marital status | - 0.003 (0.06) | 0.05 (0.05) | 0.14** (0.05) |
| Constant term | 0.40*** (0.07) | 0.31*** (0.07) | 0.58*** (0.07) |
| F value | 369.32 | 348.70 | 367.26 |
| Sample size | 1678 | 1152 | 1465 |
| Women: | | | |
| Retirement | 0.18 (0.14) | 0.26* (0.14) | 0.15 (0.15) |
| Age | - 0.03* (0.02) | - 0.05*** (0.02) | - 0.01 (0.02) |
| Educational background | 0.00 (0.06) | - 0.03 (0.06) | 0.11** (0.05) |
| Marital status | Constant term | - 0.04 (0.05) | 0.14 *** (0.04) |
| Constant term | 0.48 *** (0.06) | 0.35 ***(0.06) | 0.48*** (0.06) |
| F value | 186.34 | 174.66 | 164.90 |
| Sample size | 1461 | 1363 | 1350 |

Source: Calculated by the authors based on the CHARLS database, the same below, unless otherwise noted.
Note: *, ** and *** represent significance at 10%, 5% and 1% level respectively, the same below.

For control variables, as we expected, a high degree of education and being married significantly increased the probability of mental health for both men and women; in addition to causing a remarkable reduction in the probability of men and women assessing themselves as healthy, age also led to a higher probability of women getting chronic diseases. Regarding the reasons for the corresponding results, people with a higher degree of education tend to have higher benefits or can better arrange life and time after retiring, so the indicator will have a greater role in promoting health; and being married means having a kind of companionship, exerting certain positive effect on mental health because when one spouse encounters distress in life, the other can give comfort and support.

## Analysis of the Impact Mechanism of Retirement on Health

The above analyses show that retirement has a positive impact on men's self-assessed health and women suffering from chronic diseases. So, what is the impact mechanism of retirement on health? Assuming "changes in health-related lifestyles and time use after retirement" is a reason for retirement to have an impact on health, we regressed exercise, social interactions, sleep, smoking and drinking as the dependent variables of "lifestyle and time use" to verify the assumptions. Table 4 illustrates the regression results. The results show that retirement increased the social interaction probability of men by 38% and that of women by 48%. This finding is consistent with that of Holdsworth et al. (2016), that is, retirement promotes health mainly in social aspects. However, whether social interactions are the mechanism that affects health will be further analyzed.

Table 4. Regression Results Concerning the Impact of Retirement on Lifestyle and Time Use.

| Variable | *exercise* | *social* | *sleep1* | *sleep2* | *sleep3* | *smoke* | *drink* |
|---|---|---|---|---|---|---|---|
| Men: | | | | | | | |
| Retirement | 0.03 (0.12) | 0.38** (0.17) | 0.17 (0.15) | 0.15 (0.15) | 0.02 (0.07) | 0.08 (0.19) | 0.07 (0.15) |
| Age | 0.001 (0.01) | – 0.03** (0.01) | – 0.01 (0.01) | 0.01 (0.01) | −0.002 (0.01) | 0.02 (0.01) | 0.02 (0.01) |
| Educational background | – 0.01 (0.03) | −0.02 (0.04) | 0.01 (0.04) | 0.01 (0.04) | −0.02 (0.02) | 0.02 (0.04) | −0.03 (0.04) |
| Marital status | 0.10 (0.07) | −0.12** (0.05) | −0.10* (0.05) | 0.08 (0.05) | 0.02 (0.02) | 0.09 (0.06) | – 0.03 (0.05) |
| Constant term | 0.80*** 0.07) | 0.56*** (0.08) | 0.55*** (0.07) | 0.4*** (0.07) | 0.05 (0.03) | 0.25** (0.09) | 0.53*** (0.07) |
| F value | 143.64 | 364.72 | 370.48 | 370.48 | 370.48 | 212.68 | 369.17 |
| Sample size | 633 | 1534 | 1677 | 1677 | 1677 | 1136 | 1678 |
| Women: | | | | | | | |
| Retirement | 0.05 (0.12) | 0.48*** (0.14) | – 0.18 (0.15) | 0.11 (0.14) | 0.07 (0.06) | 3. 96 5 33) | 0.03 (0.11) |
| Age | −0.03*** (0.01) | −0.03** (0.02) | 0.03* (0.02) | −0.02(0.02) | −0.01* (0.01) | 0.20 (0.33) | −0.01 (0.01) |
| Educational background | 0.01 (0.05) | 0.01 (0.06) | 0.06 (0.06) | −0.03 (0.06) | −0.04 (0.03) | 1. 79 (2.44) | −0.05 (0.04) |
| Marital status | 0.05 (0.05) | 0.06 (0.05) | 0.05 (0.04) | 0.03 (0.04) | 0.01 (0.02) | 0.68 (1.23) | 0.06 (0.03) |
| Constant term | 0.76*** (0.07) | 0.42*** (0.06) | 0.58*** (0.06) | 0.38*** (0.06) | 0.04* (0.03) | 0.71 (1.02) | 0.79*** (0.04) |
| F value | 68.72 | 175.29 | 185.70 | 185.7 | 185.7 | 10.69 | 186.13 |
| Sample size | 599 | 1379 | 1453 | 1453 | 1453 | 68 | 1459 |

Based on the above analysis, we found that retirement significantly increased the probability of social interactions for both men and women. Then, does retirement affect health through social interactions? According to Eibich's approach, if retirement affects health through social interactions, then the impact of retirement on health will be reduced after the variable of social interaction is controlled, that is, the regression coefficient of retirement to health will no longer be significant or the absolute value will decrease (Eibich, 2015). On this basis, this paper controlled the variable of social interactions to identify changes in the impact of retirement on health, to further verify that "change in social interaction probability after retirement" was indeed a way for retirement to affect health. Table 5 illustrates the regression results. The results showed that after adding the control variable "social interaction", the coefficient of influence of retirement on men's self-assessed health was no longer significant. At the same time, social interaction boosted the probability of men assessing themselves as healthy by 6% at 5% significance level. Therefore, we concluded that the impact of retirement on men's self-assessed health is indeed caused by the higher social interaction probability after retirement; for women, on the contrary, the significance of the impact of retirement on health did not change after the variable of social interaction was controlled, so the change in the probability of chronic diseases cannot be explained by the change in social life of women.

Table 5. Regression Result Concerning the Impact of Retirement on Health after Controlling the Variable of Social Interaction

| Variable | *SAH* (Men) | | *Chronic disease* (Women) | |
|---|---|---|---|---|
| | 1 | 2 | 1 | 2 |
| Retirement | 0.25* (0.15) | 0.23 (0.16) | 0.26* (0.14) | 0.29* (0.15) |
| Social interaction | - | 0.06** (0.03) | - | –0.09** (0.03) |
| F value | - | 310.01 | - | 143.21 |
| Sample size | - | 1533 | - | 1293 |

Note: The first column and the second column in the table indicate the regression results without and with the control variable of "social interaction," respectively.

## Robustness Test

The previous analysis shows the impact of retirement on the health of urban male and female groups and its impact mechanism. To verify the reliability of the results, we conducted a robustness test.

The validity of the RDD depends on two assumptions. First, control variables other than age should change continuously with age. If the control variable jumps at the cutoff value, then the treatment effect of the cutoff point on dependent variables may be caused by other reasons. Therefore, we first tested the continuity of the control variable at the cutoff point of retirement. During the test, educational background and marital status were regressed as the dependent variables in the same measurement method as before. The results showed that retirement, for both men and women, has no significant effect on the two control variables–educational background and marital status, and thus the changes of the control variables with age are continuous①.

① Due to limited space, the regression results of the robustness test are not listed. The interested readers can request them from the authors.

Second, the grouping variable, i.e. age, is continuous. Because CHARLS uses questionnaires to identify the impact of retirement on health, respondents may lie about their age in order to get pension benefits or continue to work when answering the questionnaires. If the age is optional, this will have an impact on the research. For this reason, the continuity of the grouping variable (age) density function was tested by gender, as shown in Figure 3 and Figure 4.

Figure 3. Age Density Function of the Male Sample (Aged 50–60)

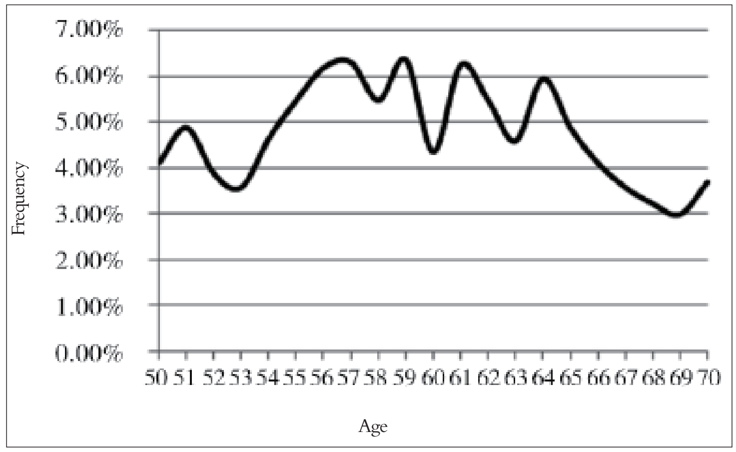
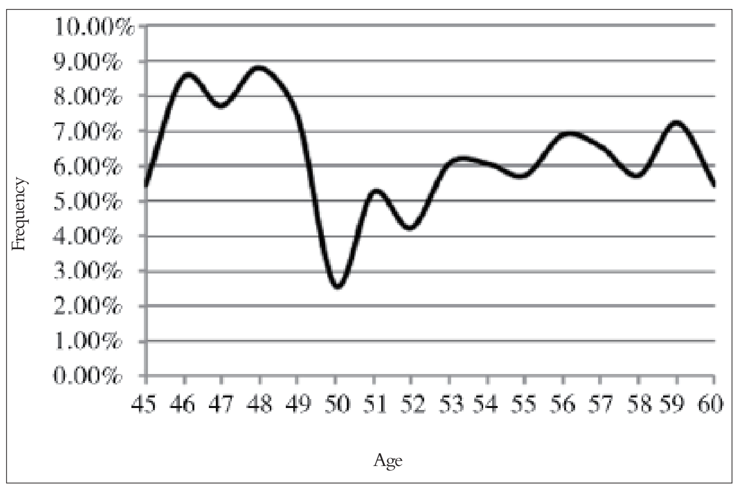



Figure 4. Age Density Function of the Female Sample (Aged 45–60)




In Figure 3 and Figure 4, the horizontal axis represents the age, and the vertical axis represents the ratio of the number of individuals to the total number of the sample (by gender) at the corresponding age. According to the graphs, the age density function of the male sample did not jump to a large extent at the retirement age of 60 under the current system, and the age density function was continuous and smooth; the age density function of the female sample was also relatively continuous and smooth at the retirement age of 50 under the current system. The above results also intuitively showed that the research methods we adopted are valid.

Next, we changed the bandwidth to test the validity of the previous regression results. The choice of bandwidth is critical in the use of RDD, and the size of bandwidth affects the stability and accuracy of the regression results. Therefore, this paper limited the age of the male samples to 55-65 years old and that of the female samples to 45-55 years old, to further test the regression results. After narrowing the bandwidth of the samples, the regression results were still significant, proving that the analysis results of the impact of retirement on health and its mechanism in the previous chapters were robust.

Finally, this paper used other values as cutoff points to identify whether a variable has a jump. If there is a jump at other cutoff values, then the assumption that "the jumps of health, life behavior, and time use at the cutoff value are caused by the retirement system" is no longer true, indicating that there are other factors that have contributed to the impact of retirement on health and health behavior. During the test, one year before and one year after the normal retirement age under the system was selected as the assumed cutoff points. Specifically, the ages of 59 and 61 were chosen as the assumed cutoff values for men, and the ages of 49 and 51 for women. The regression method adopted was the same as before.

The results showed that in terms of health, for the male group, at the ages of 59 and 61, the impact of retirement on self-assessed health was still positive, but no longer significant, and the impact of retirement on other health indicators was not significant either; for the female group, at the ages of 49 and 51, the measurement of the impact of retirement on chronic diseases falls from a significance level of 10% to a "no longer significant" level, and similar to men, other measurements of the impact of retirement on health are not significant either. The above results revealed that although points very similar to the retirement age under the system were chosen, they greatly changed the regression results, which proved that the regression results are reliable.

As for the impact mechanism, for the male group, at the ages of 59 and 61, the regression coefficient of retirement to social interaction is no longer significant. The regression coefficients of other lifestyle and time use variables are still not significant except for sleep time (sleep3), which, however, is excluded here because retirement behavior does not affect it; for the female group, at the ages of 49 and 51, the impact of retirement on social interaction is still significant, indicating retirement is not the only reason for the change in social interaction probability after retirement, which further confirms that social interaction has little to do with the impact of retirement on women's health. In summary, for the male group, the change in social interaction probability after retirement indeed leads to the change in men's health.

## Conclusions and Policy Implications

The impact of retirement on health is a factor that must be considered by the government when formulating retirement policies. This paper used CHARLS micro survey data to identify the impact of Chinese urban workers' retirement on their health and its impact mechanisms. Our research found that retirement significantly improved the self-assessed health of men and significantly reduced the probability of suffering from chronic diseases for women, but the impact on other health indicators for both men and women were not significant. A significant increase in social interaction probability after retirement is the reason for the improvement in men's health but has little to do with women's changes in their health after retirement. Based on these findings, we believe that in the process of formulating policies postponing the retirement age, the government should attempt to avoid the possible negative impact of postponed retirement on health, and explore the possibility of a flexible policy to mitigate the adverse effects of postponed retirement on health by shortening the working hours of older workers or providing part-time work to allow more time for them to engage in social activities.

The research in this paper still has certain limitations. First, retirement from different occupations will have different impacts on health. However, this database has not been carefully divided into related occupations, which makes the research relatively incomplete. Second, due to the sample size limitation caused by the response rate, we did not consider the impact of time and other heterogeneous factors on the regression results, and failed to conclude the impact mechanism of retirement on women's health. These limitations have yet to be overcome in future research.

## REFERENCES


Andreasen, E. M. et al. (1994). Screening for depression in well older adults: evaluation of a short form of the CES-D. *American Journal of Preventive Medicine, 10 (2),* 77-84.

Bradford, L. P. (1979). Can you survive your retirement? *Harvard Business Review, 57*(4), 103-109

Belloni, M., Meschi, E. & Pasini, G. (2015). The effect on mental health of retiring during the economic crisis.

*Working Paper, 10.*

Coe, N. B., & Zamarro, G. (2011). Retirement effects on health in Europe. J*ournal of Health Economics,), 30*(1), 77-86.

Dave, D., & Spasojevic, R. J. (2008). The effects of retirement on physical and mental health outcome. *Southern Economic Journal, 75* (2), 497-523.

Deng, T. H., & He, X. R. (2016). The effect of retirement on the health of male elderly people – an empirical study based on regression discontinuity. *Population & Economics,* 6, 81-91.

Ding, D. et al. (2016). Retirement–a transition to a healthier lifestyle: evidence from a large Australian study. *American Journal of Preventive Medicine, 51* (2), 170-178.

Eibich, P. (2015). Understanding the effect of retirement on health: mechanisms and heterogeneity. *Journal of Health Economics, 43* (1), 1-12.

Ekerdt, D. et al. (1983). Claims that retirement improves health. *Journal of Gerontology, 38*(2), 231-236.

Grossman, M. (1972). On the concept of health capital and the demand for health. Journal of Pubic Economy, 80 (2), pp. 223-55.

Hahn, T., & Klaauw, V. D. (2001). Identification and estimation of treatment effects with a regression discontinuity design, *Econometrica, 69*(1), 201-209.

Heide, V. D., Van Rijn, R. M., & Robroek, S. J. (2013). Is retirement good for your health? A systematic review of longitudinal studies. *BMC Pubic Health, 13* (1), 1-11.

Holdsworth, C. et al. (2016). Is regular drinking in later life an indicator of good health? Evidence from the English longitudinal study of ageing. *Journal of Epidemiology & Community Health, 70* (8), 764-770.

Insler, M. (2014). The health consequences of Rretirement. *Journal of Human Resources, 49*(1), 195-233.

Lee, J. P., & Smith, J. (2009). Work, retirement, and depression. *Population Ageing, 2*(1-2). 57-71.

Lee, D. S., & Lemieux, T. (2010). Regression discontinuity design in economics, *Journal of Economic Literature, 48* (2), 281-355.

Lei, Xiaoyan., Tan, Li., & Zhao, Yaohui. (2010). Will retirement affect health? China Economic Quarterly, 3, 1539-1558.

Lindeboom, M., Portrait, F, & Van, d. B. G. J. (2002). An econometric analysis of the mental-health effects of major events in the life of older individuals. *Health Economics, 11*(6), 505-520.

Mcgarry, K. (2004). Health and retirement: do changes in health affect retirement expectations? *The Journal of Human Resources, 39* (3). 624-648.

Sahlgren, G. H. (2017). Retirement blues. *Journal of Health Economics, 54,* 66-78.

Sahlgren, G. H. (2012). Work 'till you drop': short- and longer-term health effects of retirement in Europe, IFN Working Paper, 928.

Su, Chunhong., & Li, Qiyun. (2014). Effect analysis of delaying retirement age and study of the implementation strategy. *Theory Journal, 5,* 69-76.


*(Translator: Jessica Gui; Editor: Yan Yuting)*

This paper has been translated and reprinted from *Journal of Shandong University (Philosophy and Social Sciences),* No. 2, 2019, pp. 86–97.