How does retirement affect health?

– Evidence from China Health and Retirement Longitudinal Study

A thesis submitted by

Ge Zhao

in partial fulfillment of the requirements for the degree of

Master of Science

In

Economics

Tufts University

May 2022

Adviser: Marcelo Bianconi

Abstract

The retirement age for Chinese urban employees is mandatory. In this thesis, I use data from China Health and Retirement Longitudinal Study (CHARLS) 4 waves and apply a nonparametric fuzzy Regression Discontinuity design to examine retirement's influence on urban Chinese male and female respectively. The results suggest that retirement causes a decline of males' self-rated health, however, such influence is insignificant for females' self-rated health. I also find the heterogeneity among different subgroups: the negative influence is statistically significant for males without a college degree. Further study shows that an increase of probability of taking care of grandchildren might partly account for such influence.

Key words: Retirement, Health, China, Urban, Heterogeneity

INDEX

Introduction

Due to better living conditions and the implementation of One-Child policy, China has undergone a decreasing fertility rate and prolonged individual longevity in the last three decades, making it one of the fastest aging countries in the world. Currently, about 10 percent of the total population in China was age 65 or older, the proportion is expected to climb to 15.7% in 2030 and 22.6% in 2050 (United Nations, 2013). Such an aging population and a forthcoming labor shortage because of the relative dropping proportion of the labor force have caused a heavy burden on the social security system in China. Since in China the retirement age is below the global average, with 60 for male and 50 for female workers, 55 for female clerks, progressive deferred retirement age could be proposed. While there are many economic and political deliberations in setting an appropriate retirement age. One key consideration which should be taken seriously before any further action is the influence of retirement on an individual's health and well-being.

The claim that retirement affects people's physical and psychological health is based on the idea that retirement plays an important part in transition during the lifetime, which changes individual social-psychological ecology thoroughly (Heide et al., 2013). There are several conflicting pathways through which retirement may influence one's health. For instance, retirement could increase one's leisure time, which could be devoted to physical exercises and spiritual refreshment. It could also release individuals from work-related stress. In these ways could retirement be beneficial for people's health. However, health decline could also happen after retirement. For instance, people lose the incentive to keep fit in order to maintain their job as they get retired. In this way, their health investment would be declined after retirement (Eibich, 2014). Besides, an individual could partly lose work-related social interactions as a result of a transition from the workplace to home. Moreover, those who are satisfied with their job might experience a sense of loss as a result of being "forced" to quit working, which would increase their stress level (Reitzes and Mutran, 2004). Meanwhile, some get extra stress from an income decline as they get retired. Individual health gets deteriorated in the above ways. Theoretically, the overall influence of retirement on one's health depends on the co-force of the above means.

Until now, researchers have not got conclusive results regarding retirement's influence on individual health. The inconclusive and contradictory results of studies could be from two sources: the effect of heterogeneity and endogeneity. For people from different cultures, with different socio-demographic backgrounds, different features and personalities, different previous working experiences and work conditions, it is rational for them to have different reactions to retirement, and thus experience a different change of life after they get retired. For instance, studies indicate that in China, gender difference exists in the effects of retirement on mental stress. To be specific, retirement reduces stress in men but raises stress in women (Chen et al., 2020). The other question is endogeneity. For example, evidence has shown that workers experiencing a health decline are more likely to choose to retire (Eibich, 2014). In such cases, reverse-causality exists. Confounding from omitted important variables might exist, causing an upward or downward bias. Endogeneity needs serious consideration since even strong associations are not likely to depict a causal relationship if endogeneity exists. To investigate the causal effect of retirement on health, researchers need to use efficient identification strategies.

This paper investigates retirement's causal effect on urban Chinese employees' health by utilizing national, individual-level, longitudinal, and comprehensive data from China Health and Retirement Longitudinal Study (CHARLS) 2011-2018. CHARLS links demographic as well as socioeconomic characteristics with a multiple of detailed health-related indicators together, which makes it possible to study Chinese's health-related problems. Previous study has found heterogeneity in the effects of retirement and health across different countries (Nishimura et al.,2018). Compared to other countries, there are relatively few studies focusing on retirement's health outcome of Chinese employees. This paper contributes to the literature on how retirement influence individual health, based on the scope of developing country. Additionally, this paper could contribute to broad literature on global aging population health issues.

Specially, to address the endogeneity of retirement existing broadly in previous literature, I use a rigorous quasi-experimental approach, the regression discontinuity design (RDD), to acquire an estimate the causal effect of retirement on individuals' health outcomes. I take advantage of the unique mandatory retirement policy for Chinese urban employees and exploits the fact that the probability of retirement increases discontinuously at the age of 60 for male (50 for female) to construct a fuzzy RD. Regression discontinuity was first established by Champbell in 1958, and was applied widely by researchers to study psychology, statistics, and economics issues. For the field of health, regression discontinuity has been used in epidemiology (Bor et al., 2017; Chen et al., 2019; Oldenburg et al., 2016; Patenaude, Chimbindi, Pillay, & Bärnighausen, 2018) and other health outcomes broadly.

Literature Review

There is a couple of literature on retirement's influence on people's well-being, regarding health behaviors, health outcomes, and healthcare utilization. Study samples include individuals from different countries and cultures with various retirement arrangements. For health status, studies focus on subjective (self-rated health status, depression tests, and so on) and objective (Activities of Daily Living (ADL), BMI, diagnoses of certain diseases) measures. The measurement of physical health, cognitive function, depression level, and mortality rate are of interest (Rose, 2020; Eibich, 2014). Additionally, health utilization, measured by hospitalization, drug prescription, and doctor visits, is studied widely. Since it is of special political importance because changes to retirement eligibility ages could significantly impact the budgets of government healthcare programs.

Prior findings are mixed regarding how retirement affects individuals' health. Until now, researchers have not got a consensus. As one meta-analysis suggests, among 275 observations from 85 articles, 28% (13%) find positive (negative) effects of retirement on health outcomes. However, most of the observations (almost 60%) do not provide statistically significant findings (Filomena et al., 2021).

Previous literature shows that the choice of analysis method is one of the key factors in explaining why the estimated results of the effect of retirement on health differ (Nishimura et al., 2017). Early work on the relationship between retirement and health stemmed from psychology and medicine literature and emphasized the association between individual retirement status and self-reported well-being (Rose, 2016). A few studies show that retirement may erode one's health (Minker, Meredith, 1981; Dhaval et al., 2006; Rohwedder et al., 2010). However, some others argue that one may benefit from retirement (Bound et al., 2007; Cue and Zamarro, 2011; Nishimura et al., 2017; Tran and Zikos, 2019; Eibich, 2015). These studies depict the association. However, association relationship between health and retirement status does not indicate a causality inference necessarily. Since the above studies fail to consider the endogeneity problem, serious bias could exist. It is known that individual choices to retire are not random, as a matter of fact, a self-selection problem might exist. As some researchers point out (Atchley, 1975; Bound et al., 1998), health problems are often the cause of retirement, rather than a consequence. Additionally, a bunch of unobservable variables exists because of limitations of investigation, such as the reason for retirement, as well as individual health endowment.

In the literature, researchers apply different methods to address endogeneity. One of these methods is IV design (and for the framework of fuzzy RD design) to infer a causal relationship since scholars believe retirement eligibility is a valid instrument and the only way how retirement eligibility influences health is through retirement itself (Bingley and Martinello, 2013; Kolodziej and García-Gómez, 2019). IV design assumes that the instrument (retirement eligibility, often measured by one's age) only influences the outcome variable (health outcome) through the instrumented variable (retirement or not). As they argue, there is no reason why reaching the threshold per se should affect health apart from via retirement, once smooth effects of age are held constant. While at the same time, a significant increase in one's probability to retire happens as one's age reaches the threshold of retirement age. Thus, in this case, applying IV design (Che and Li, 2018) or fuzzy Regression Discontinuity (Chen et al., 2020) is plausible to study the short-run effects immediately after retirement can be estimated. Another way to infer a causal relationship is through Difference in Differences design. In this case, researchers apply retirement age reform in one country as a natural experiment, which takes the group of people affected by the reform as the treated group while the group not affected by the reform as the control group (Sham, 2018; Zhu, 2016). In this case, the difference between trends of the groups over time indicates the causal effect of the reform. The key assumption of Difference in Differences, in this case, is that the differences between both groups would have remained the same without the reform (Bauer and Eichenberger, 2021).

Institutional Setting and Data

3.1 Retirement Policy in China

China has a different social security pension system from many western countries, which includes the Public Pension System for Urban Employees and the Public Pension System for Urban and Rural Residents. Within the whole system, Public Pension System for Urban Employees has been established with a combination of social pooling and individual account. The basic rule is that each employee enrolls in the basic endowment insurance. In the system, employers and employees jointly make insurance contributions before retirement. According to the current policy, the social pooling part is a pay-as-you-go system financed by 20% of contribution wages from employers or 12% of contribution bases from self-employees, and by 8% of contribution wages from employees (Zhao and Mi, 2019). A member shall receive a pension monthly if the member's cumulative length of contribution payment is no less than 15 years upon reaching the legal retirement age.

One special feature that makes the Chinese retirement policy unique from its counterparts is the mandatory retirement rule for urban employees in formal sectors, which include the government, the public sector, state-owned enterprises (SOEs), and collectively owned enterprises (COEs). In most cases, individuals are made to retire after they reach the legal retirement age, which for males is 60 years old, for female workers is 50 years old, and for female clerks is 55 years old, all below the global average of retirement age.

In some special cases, the Chinese have a chance to retire earlier or later than their retirement age. One special case is called internal retirement ("Neitui" in Chinese). It is induced by historical events in the 1990s when many SOEs underwent bankruptcy during national SOE reform. The policy claimed that employees who worked in a bankrupt or a to-be-bankrupt SOE, who were eligible to retire within five years, could retire and begin to receive their pension immediately. The policy is originally aimed to "dump" unproductive employees and save costs for SOEs. Overall, internal retirement provides individuals with chances to retire at an earlier age. The Chinese can get an informal job after their retirement. However, the job market participation rate after retirement in China is low.

3.2 Data and Measurement

The data in the thesis is from the 4 waves of the China Health and Retirement Longitudinal Survey (CHARLS) to examine retirement's influence on individual health. CHARLS has sufficient longitudinal, panel microdata regarding individual demography background, income and working status, family information, and health issues. It is the first nationally representative survey of people older than 45 years old in China, and is conducted every 2 years, with a baseline wave in 2011. CHARLS enables researchers to study the health of the aged population in China patterned after HRS, SHARE, ELSA, JSTAR, etc. CHARLS 2018 wave includes more than 11000 family samples, 19000 individual samples from both urban and rural areas in China. More information about CHARLS can be found on the official website http://charls.pku.edu.cn/en.

I clean and organize the sample of households and individuals since the existence of them may possibly give rise to bias in the study. I exclude following samples:1) individuals with rural household registration status (Hukou). It is because currently the mandatory retirement age is only applied to urban employees due to history reasons, 2) individuals who are neither pension-guaranteed retirement from government, public institutions, and enterprises, nor eligible by individuals from the informal sector who have contributed to the elemental social pension insurance, 3) individuals who are neither working nor retired, 4) samples which lack key variables of the study, such as age, marriage status, education level, working status, health condition, etc, 5) individuals who is younger than 45 years old, or older than 80 years old and 6) duplicated. The final sample consists of individuals, of whom 6349 were males and 5878 are females. A list of variables and summary statistics are shown in Table 1.

3.2.1 Independent variables

The main independent variable in this study is the individual's retirement status. It is measured by individual's answer in the survey to the question "Have you completed retirement procedures (including early retirement, internal retirement and receding position) at the time of the survey?" If the answer is "yes", the person is treated as "retired", otherwise he/she is treated as "not retired".

3.2.2 Outcome variables

The outcome variable list includes two sets of health measurements in order to acquire a more comprehensive understanding of retirement's influence: physical health and mental health.

This thesis uses self-rated health (SRH) and depressive symptoms to measure mental health. Self-rated health is measured by a point scale from 1 (excellent) to 5 (poor). It is based on the answer to the question "How do you think of your health status?" Self-rated good health is a binary variable, which equals 1 if one's answer of health status is 1(excellent) or 2(good), otherwise equals 0. Self-rated bad health is a binary variable, which equals 1 if one's answer of health status is 3(fair), 4(poor), or 5(very poor). Self-rated life satisfaction is based on the answer of "how satisfied are you with your life as a whole", measured by a point scale from 1 (completely satisfied) to 5 (not at all satisfied). Depressive symptoms are measured by a 10 items center for epidemiologic study depression (CES-D) scale, which is constructed by summing up the scores for 10 questions regarding depression symptom in the survey.

For physical health, I use diagnosis of chronic diseases including hypertension and diabetes and several organ diseases as outcome variables. Hypertension is a binary variable indicating whether a respondent has hypertension, defined as a systolic blood pressure ≥140 mm Hg, a diastolic blood pressure ≥90 mm Hg, or a hypertension diagnosis. Respondent's blood pressure was measured three times at 5-min intervals during the survey. Respondents are defined to have hypertension only when all three measurements have a systolic blood pressure ≥140 mm Hg or a diastolic blood pressure ≥90 mm Hg. When the blood pressure biomarkers are not available, a respondent is considered as having hypertension if one has been diagnosed with hypertension.

Diabetes is a binary variable indicating whether a respondent has diabetes, based on the answer of whether the respondent is diagnosed with diabetes or high blood sugar by the doctor. Especially, “memories” is a binary variable that indicates whether one has memory defection, and “emotion” is a binary variable that indicates whether an individual is bothered by emotion disorders.

3.2.3 Control variables

The study includes the following control variables: individual education level, age, the square of age, cube of age, marital status. Education level is based on the answer to the question “What’s your highest education attainment”. It is a binary variable that equals 1 if the respondent has a degree above high school, otherwise equals 0. Marital status is based on the answer to the question “What is your marital status”. It is a binary variable that equals 1 if the respondent lives with his/her spouse, 0 otherwise.

3.2.4 Variable of individual behavior

Scientists argue that the mechanism of retirement affecting individual health is based on empirical studies. Basic idea is that retirement could lead to inactivity, negatively impacting general/physical/mental health, while Retirement positively impact health if continued working becomes a burden to people. From previous literature, retirement could affect individual health by changing one’s lifestyle, as well as social circle (Insler, 2014; Muller and

Tobias, 2018; Celidoni and Rebba, 2016; Zhao et al., 2020). Following previous study methods (Emma, 2020), I study how retirement affect individual health by using following behavior variables. The behavior variable set includes :1) individual addiction consumption behavior, which includes drinking and smoking behavior. 2) individual exercise behavior, which includes whether one takes part in high, middle and low intense activities. 3) whether one takes part in social activities, including interacting with friends, playing board games. 4) whether one takes care of grandchildren. Drinking frequency is based on the answer to "How often do you drink in the last year". It is a binary variable that equals 1 if one drinks more than once a month last year, 0 otherwise. Smoking behavior is based on the answer to "How many cigarettes do you smoke one day". It equals the number of cigarettes one consumes in a day on average. Whether one takes part in social activities is a binary variable. It equals 1 if one of the answers to "Have you done any of these activities (including attending volunteer work, taking care of not-relatives, interacting with friends, attending training courses and other interactive activities) in the last month?" is "Yes". If one person does not do any of the activities, the variable equals 0. Whether one cares for grandchildren is a binary variable. If one spends time caring for grandchild, the variable equals 1, otherwise it equals 0. Whether one do exercise is a binary variable, it equals 1 if the answer to "During a usual week, do you do high/middle/low intense activities" is "Yes", and it equals to 0 otherwise. Table 1 shows the summary statistics of sample characteristics. In the full sample, 52% are males and 48% are females. 57.4% of males are 60 years old or older, and 86.5% of females are 50 years old or older. 40.9% of male samples are retired, and 41.8% of female samples are retired. 29.3% of males rate their health status as "in good health", among female samples the ratio becomes

25.4%.

Table 1: Summary Statistics

Variable	males			females		
	Mean	SD	N	Mean	SD	N
Self-rated health						
health	2.803	0.927	6349	2.872	0.909	5878
health good	0.293	0.455	6349	0.254	0.435	5878
health bad	0.707	0.455	6349	0.746	0.435	5878
satisf_health	3.029	0.809	2928	3.079	0.843	2727
depression	16.57	7.211	6537	18.24	7.245	6034
dep have	0.918	0.275	6540	0.94	0.238	6040
Physical health						
hypertension	0.254	0.436	3153	0.243	0.429	2970
dyslipidemia	0.171	0.376	3296	0.174	0.379	3102
diabetes	0.087	0.281	3490	0.087	0.283	3269
stomach	0.135	0.342	3409	0.149	0.356	3131
arthritis	0.152	0.359	3352	0.23	0.421	2960
emotion	0.01	0.101	3701	0.016	0.127	3457
memories	0.025	0.156	3680	0.021	0.142	3450
Behaviors						
smoke ever	0.509	0.5	3250	0.03	0.171	5758
smoke quit	0.43	0.623	2888	0.48	0.766	304
smoke still	0.514	0.599	5515	0.052	0.274	5938
smoke_vol	8.017	11.27	5429	0.471	2.821	5912
drink ever	0.571	0.495	6526	0.16	0.366	6022
drink more	0.456	0.498	6526	0.074	0.262	6022
act high	0.219	0.413	3606	0.117	0.322	3469
act med	0.468	0.499	3604	0.539	0.499	3469
act low	0.875	0.331	3604	0.868	0.339	3467
social	0.286	0.452	4373	0.284	0.451	4178
grandcare	0.342	0.475	2994	0.321	0.467	3058
grandmoney	3122	30000	2998	2444	23000	3060
Main variables						
retire	0.409	0.492	6540	0.418	0.493	6040
age	61.73	8.948	6540	60.29	9.051	6040
educ	5.23	1.866	6540	4.561	2.009	6040
college	0.119	0.324	6540	0.064	0.245	6040
married	0.784	0.309	6540	0.893	0.411	6040

age60	0.574	0.495	6540	-	-	-
age50	-	-	-	0.865	0.342	6040

Data source: The China Health and Retirement Longitudinal Survey (CHARLS), 2011, 2013, 2015 and 2018 waves.

Empirical strategy

It is hard to estimate retirement's effect on individual health in traditional linear regression framework because of endogeneity such method may cause. The endogeneity arises mainly because of two resources: reverse causality between retirement and health status, as well as the omit of unobserved but significant variables, such as individual preference, individual health endowment. Confounding influence both retirement behavior and health status.

RD design is essentially a natural experiment strategy, in which treatment status is determined largely by an assignment or forcing variable called running variable (Imbens and Lemieux, 2008). In the RD design, it assumes that samples just above and below the cutoff point are likely exchangeable with each other, except for the probability of being selected in treated/control groups. In China, pension-guaranteed urban employees are required to retire when they achieve certain age, which is 60 years-old for male and 50 years-old for female in most cases. We observe a sharp increase of retirement rate respectively after each legal age. Such discontinuity caused by regulation makes it possible for us to apply RD design. By comparing the health status between retired individuals just above the retirement age and unretired individuals just below the retirement age can we estimate the causal effect of retirement on individual health.

In this study, the legal retirement age is the rule, individual's retirement is the treatment variable, and age is the running variable. I use the legal retirement age as an instrument variable to identity the effect of one's retirement on his/her health status. Regarding to the setting of RD design, since whether one is retired or not is largely but not completely determined by his/ her age (i.e. "imperfect compliance"), fuzzy RD is applied in this case (Lee and Lemieux, 2010).

Fuzzy RD is a modification of instrument variable regression. It is based on the estimation of a Local Average Treatment Effect (LATE), which is the average treatment effect for the subpopulation affected by the instrument (in this case, is individuals retiring at legal retirement age). Since LATE only includes subpopulation whose age are very close to legal retirement age threshold in the regression, regression bias caused by age can be alleviated greatly. Let $Retire_{it}$ be a dummy variable indicating the retirement status for individual i at wave t, $Outcome_{it}$be variables indicating one's outcome variable value. The running variable is normalized age in years, $Above_{it}$, which is a binary variable. For men, it equals 1 if $(Age_{it} - 60) \geq 0$, otherwise it equals 0. For women it equals 1 if $(Age_{it} - 50) \geq 0$, otherwise it equals 0. Z_{it} is a vector of covariates that are associated with one's health status, which is not affected by the change of retirement.

Equation (1):

$$Retire_{it} = \alpha_0 + \alpha_1 Z_{it} + \alpha_2 f(Age_{it}) + \alpha_3 Above_{it} f(Age_{it}) + u_{it}$$

Equation (2):

$$Outcome_{it} = \beta_0 + \beta_1 Z_{it} + \beta_2 \widehat{Retire}_{it} + \beta_3 f(Age_{it}) + \beta_4 Above_{it} f(Age_{it}) + v_{it}$$

Therefore, the local average treatment effect τ can be estimated as the ratio of the change in individual's health and the increase in the probability that one retires at age threshold (60 for male and 50 for female):

$$\tau = \frac{E[Health_{it}=0+\varepsilon]-E[Health_{it}=0-\varepsilon]}{E[Retire_{it}=0+\varepsilon]-[Retire_{it}=0-\varepsilon]}, \text{ where } \varepsilon > 0.$$

I estimate the equation in a non-parametric way to allow more flexible functional forms of individual age ($f(Age_{it})$). In the thesis, local linear regression with a rectangular kernel is used. First-stage equation (Equation (1)) is used to regress individual's health status on his/her own age quadratic polynomials and covariates. Second-stage equation (Equation (2)) is then applied. A nonparametric RD method using residuals in the first step as the outcome variables. In line with the more recent findings by Gelman and Imbens (2014), we do not include higher order (third, fourth, or higher) polynomials of the forcing variable since in general, RD estimates have been proven to be sensitive and conventional inference performs poorly in these settings.

Regarding to the choice of bandwidth of the kernel function, a fully data-driven bandwidth algorithm derived by Imbens and Kalyanaraman (2011) is applied in the study, since the choice of bandwidth is about a trade-off between estimate bias and variance (Lee and Lemieux, 2010). An asymptotically optimal bandwidth under squared error loss is chosen in this way. The Stata package “rdrobust” is used to conduct analysis. In this thesis, two kinds of estimates are reported in the outcome of RD design. The “conventional” estimates are conventional RD estimates with a conventional variance estimator. The “robust” estimates are bias-correlated RD estimates with a robust covariance estimator. In the primary analysis, no covariates are included in the linear regression within optimal bandwidth. In the secondary analysis, covariates of individual education level, age, the square of age, cube of age, individual marital status are included in the regression to check for robustness. Including covariates is not expected to change the estimate result, but to increase the efficiency of RD estimation (Lee and Lemieux, 2010). In Appendix part, I also provide several robustness checks using different bandwidths, as well as different measures of outcome variables.

Following tests are applied to prove the validity of the RD design in this study. One main assumption that needs to be proven is that there must be a discontinuity in the probability of individual retirement at either side of the cutoff age (60 for men and 50 for women). I identify this assumption by plotting the retirement rate of every age by gender. The results are shown in Figure 1. The thesis shows discontinuity visually around the cutoff age. It’s clear that there is a jump in the percentage of retiring at 60 for males, 50 for females. Another assumption is that other baseline covariate that affects individual health be balanced across age threshold, which is to avoid an endogeneity in treatment/control group assignments. I justify the second assumption by a series of robustness checks in the Appendix part of the thesis.

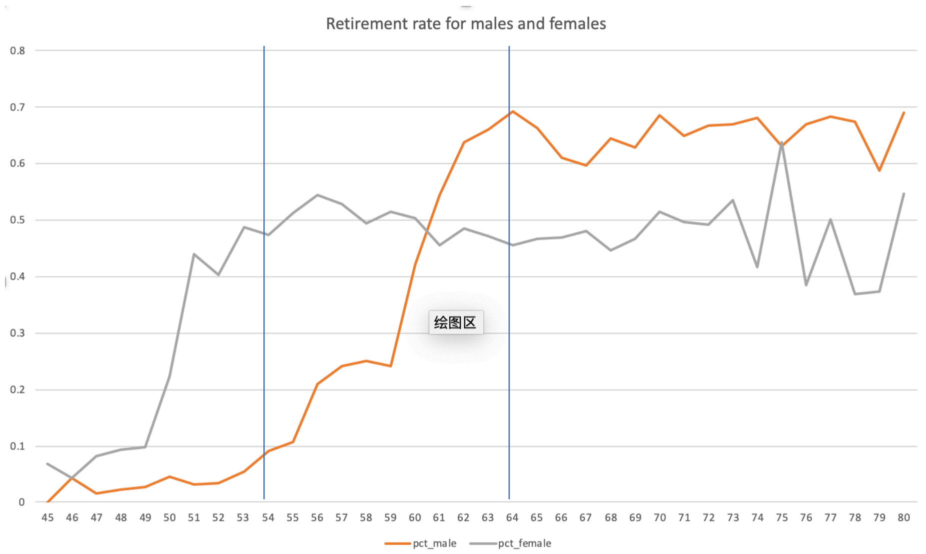


Figure 1: Retirement rate for males (orange) and females (gray)

Note: The vertical lines at age 50 and age 60 are legal retirement age for females and males respectively.

Results

5.1 Health Outcomes

The regression results of male and female samples are shown in Table 2 and Table 3 respectively. By controlling individual fixed-effect, I use individual (ID) fixed-effect regression to investigate the association between retirement and outcome variables respectively. In Column (1), The ID fixed-effect estimates indicate that there is no overall significant association between self-rated health status and retirement for both male and female individuals. To be specific, although the coefficients of regression are negative, they are not significant. Additionally, for most of the physical health indicators, the sample does not prove a significant association between such health indicators and one's retirement status, except for significant negative association concerning diabetes and retirement among female samples and a significant negative association between dyslipidemia and retirement for male samples.

As compared to ID fixed-effect estimates which suggest no association between individual health and retirement, RD results emphasize the short-term influence of retirement on individual health around the cut-off point. The nonparametric RD estimates suggest that a male's self-rated health is undermined when he gets retired since a health decline could be observed in RD with and without covariates. Compared to RD without covariates, the estimates are larger in terms of magnitude in the RD with covariates. The RD robust estimates are relatively smaller as compared to RD conventional estimates, but largely two sets of estimates reveal the same pattern. However, for females, no significant change in self-rated health is observed as one gets retired, neither in RD with variates (Column (3)(4)) nor RD without covariates (Column (1)(2)), shown in conventional estimates or robust RD estimates. This suggests that retirement does not have a significant influence on women's self-rated health. For indicators of health conditions, RD estimates do not prove significant change after retirement among male samples. However, a significant increase in arthritis and stomach disease diagnoses, as well as a significant decrease of memory-related illnesses are discovered among female samples. It is possible that retirement increases the risks of developing chronic diseases, or it reflects the phenomenon that female individuals increase healthcare utilization after retirement and therefore are diagnosed more (Zhang et al., 2018). For the magnitude of RD estimates, males' self-rated health scores have increased by 1.914 points on a 1-5-point scale, which indicates a decrease in health status (since in the survey point 1 indicates "excellent health", and point 5 means "very poor"). The 1.914 is based on a male self-rated health average score of 2.803, which is noteworthy. Additionally, males' self-rated good health decreases by 0.71, which indicates that 71% of samples start to report a not-healthy status after they get retired, which is also considerable. However, for women, no such significant decrease in health is observed.

Table 2: Effects on individual retirement on health status (male)

	ID FE (1)	Nonparametric RD				N
		without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Self-rated Health						
Self-rated health	0.008	1.540*	1.536	1.914**	1.126	6349
	(0.027)	(0.856)	(1.033)	(0.817)	(1.110)	
self-rated good health	0.009)	-0.715*	-0.668	-0.977**	-0.422	6349
	(0.015)	(1.657)	(1.293)	(0.407)	(0.548)	
self-rated poor health	-0.009	0.627	0.590	0.977**	0.422	6349
	(0.015)	(0.393)	(0.479)	(0.407)	(0.548)	
Depressed or not	-0.010	-0.153	-0.195	-0.126	-0.074	6540
	(0.009)	(0.184)	(0.212)	(0.220)	(0.263)	
Health Indicators						
Hypertension	-0.012	0.083	0.079	0.580	-0.137	3153
	(0.029)	(0.259)	(0.303)	(0.360)	(0.432)	
dyslipidemia	-0.081***	-0.173	-0.195	-0.028	-0.236	3296
	(0.030)	(0.273)	(0.327)	(0.328)	(0.400)	
diabetes	-0.014	-0.269	-0.291	-0.363	-0.279	3490
	(0.019)	(0.185)	(0.208)	(0.192)	(0.229)	
stomach disease	-0.039	0.147	0.133	0.124	0.142	3409
	(0.024)	(0.173)	(0.212)	(0.167)	(0.214)	
arthritis	0.029	0.137	0.165	0.084	0.146	3352
	(0.025)	(0.218)	(0.265)	(0.222)	(0.266)	
emotion	0.010	0.024	0.037	-0.004	0.085	3701
	(0.006)	(0.049)	(0.055)	(0.051)	(0.068)	
memories	-0.005	0.036	0.048	0.091	0.021	3680
	(0.012)	(0.058)	(0.069)	(0.066)	(0.080)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

Table 3: Effects on individual retirement on health status (female)

	ID FE (1)	Nonparametric RD	N

		without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Health Status						
Self-rated health	-0.015	0.786	3.431	-0.247	24.156	5878
	(0.030)	(1.142)	(2.397)	(7.317)	(15.210)	
self-rated good health	0.005	-0.600	-1.062	1.006	-12.435	5878
	(0.015)	(0.593)	(1.274)	(4.213)	(8.680)	
self-rated poor health	-0.005	0.597	1.058	-1.001	12.393	5878
	(0.015)	(0.589)	(1.269)	(4.204)	(8.657)	
Depressed or not	-0.009	0.313	-0.292	-1.202	4.096	6040
	(0.009)	(0.336)	(0.699)	(2.649)	(5.477)	
Health Indicators						
Hypertension	-0.008	0.169	-0.283	0.336	1.365	2970
	(0.027)	(0.557)	(1.130)	(1.141)	(2.247)	
dyslipidemia	-0.019	-0.107	-0.088	7.387	287.070	3102
	(0.032)	(0.378)	(0.378)	(90.889)	(175.690)	
diabetes	-0.036*	-0.039	0.025	0.446	2.167	3269
	(0.018)	(0.285)	(0.569)	(1.079)	(2.031)	
stomach disease	-0.008	-0.779	0.467	3.472	32.852*	3131
	(0.028)	(0.604)	(1.180)	(9.773)	(19.595)	
arthritis	-0.035	-0.826	-0.866	1.140	4.617*	2960
	(0.032)	(0.684)	(1.412)	(1.304)	(2.390)	
emotion	-0.004	0.095	0.057	0.012	-0.086	3457
	(0.011)	(0.089)	(0.117)	(0.144)	(0.163)	
memories	-0.008	0.230	0.270	-0.253	-1.332***	3450
	(0.011)	(0.227)	(0.310)	(0.242)	(0.476)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

5.2 Individual Behavior

After health outcomes, retirement's influence on individual behavior is examined. I use the same regression form as the regression on self-reported health outcomes above. The regression results of male and female behaviors are shown in Table 4 and Table 5 respectively. From the ID fixed-effect regression, retirement negatively affects male individual smoking behavior on whether one keeps smoking, as well as the volume of smoking, which is consistent from some of previous literature (Kesavayuth et al., 2018). However, such influence on the female individual is not significant according to female ID fixed-effect regression results for female samples. Gender heterogeneity in smoking behavior might account for the difference. From Table 2, 51.4% of male samples report they still smoke during the survey time, however, for female samples the proportion is 5.2%. Since few women has a smoking habit or even have ever tried smoking, retirement might have limited influence on the female group. As compared to ID fixed-effect regression, RD estimates do not produce significant results as regard to the influence of males' retirement on their smoking behavior. For women, the RD estimates on smoking behavior are still insignificant. For the behavior of drinking alcohol, retirement does not produce a significant influence on either male or female individuals. For social activities, according to individual fixed-effect regression, retirement is positively associated with the probability of taking social activities for both men and women. The RD estimates have shown similar patterns.

Another change worth attention is male samples taking care of grandchildren. Both individual fixed-effect regression results and RD estimates indicate a significant positive influence of retirement on the probability of taking care of grandchildren, as well as an increase of money devoted to one's grandchildren. As shown in summary statistics, 30.25% of male samples spend time taking care of their grandchildren before retirement, for female samples who have not retired, the proportion is 30.24%. However, the proportion taking care of grandchildren after retirement for male samples is 37.76, for female samples the proportion is 33.92%. Such difference is by RD estimates.

Table 4: Effects of retirement on individual behavior (male)

	ID FE (1)	Nonparametric RD				N
		without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Behavior						
still smoke or not	-0.139***	0.403	0.425	0.458	0.217	5415
	(0.021)	(0.359)	(0.431)	(0.297)	(0.360)	
smoke volume	-1.658***	0.089	0.078	0.003	0.054	2939
	(0.283)	(0.105)	(0.134)	(0.063)	(0.083)	
drinking frequently	-0.007	0.342	0.378	0.261	0.497	6526
	(0.013)	(0.370)	(0.452)	(0.332)	(0.403)	
social or not	0.125***	0.526	0.370	0.454	0.225**	4373
	(0.019)	(0.379)	(0.447)	(0.194)	(0.303)	
doing activities (high intense)	-0.024	0.168	0.186	0.387	0.131	3606
	(0.023)	(0.331)	(0.391)	(0.375)	(0.446)	
doing activities (med intense)	-0.062*	-0.449	-0.517	-0.608	-0.475	3604
	(0.032)	(0.431)	(0.500)	(0.418)	(0.502)	
doing activities (low intense)	0.017	-0.005	-0.069	0.179	-0.062	3604
	(0.021)	(0.268)	(0.314)	(0.279)	(0.331)	
taking care of grand children	0.042	0.590*	0.603	0.648*	0.534	2973
	(0.041)	(0.357)	(0.426)	(0.353)	(0.435)	
money spend on grandchilden	1342.7	15450.0**	10362.0	-13315.0	11742.0	2973
	(1639.9)	(7435.2)	(8073.0)	(7668.2)	(8606.7)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

Table 5: Effects of retirement on individual behavior (female)

	ID FE	Nonparametric RD				N
	(1)	without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Behavior						
still smoke or not	-0.016	-0.098	-0.188	-0.757	1.279	5913
	(0.008)	(0.177)	(0.395)	(1.130)	(2.356)	
smoke volume	-0.033	0.026	0.019	0.023	0.019	5693
	(0.059)	(0.020)	(0.027)	(0.025)	(0.032)	
drinking frequently or not	-0.005	-0.107	-0.860	-0.210	-3.261	6022
	(0.009)	(0.346)	(0.675)	(1.718)	(3.355)	
social or not	0.145***	0.194	-0.572	-4.897	74.730***	4178
	(0.020)	(0.459)	(0.923)	(20.362)	(39.754)	
doing activities (high intense)	0.024	-0.131	-0.821	-0.434	-0.873	3469
	(0.018)	(0.406)	(0.777)	(0.773)	(1.535)	
doing activities (med intense)	-0.010	0.206	0.229	-0.251	1.120	3469
	(0.032)	(0.537)	(1.100)	(0.977)	(2.055)	
doing activities (low intense)	0.017	0.088	0.080	1.017	-1.937	3469
	(0.021)	(0.370)	(0.370)	(1.358)	(2.298)	
taking care of grand children	-0.017	0.636	0.106	1.905	-2.627	3058
	(0.034)	(0.398)	(0.778)	(1.716)	(3.369)	
money spending on grandchilden	-2310.93	24671.0	7230.8	-20301.0	-856.760	3058
	(1481.8)	(27054.0)	(29669)	(20291.0)	(22158.0)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

5.3 Heterogeneity of treatment effects across subgroups

The thesis examines whether heterogeneity exists among gender and education level subgroups. By conducting RD in samples grouped by gender and whether one completed higher education (defined by whether one has a college degree or above). I do RD without covariates and RD with covariates respectively, with a triangle kernel function that gives more weight to samples closer to the retirement threshold, and a data-driven algorithm to find the best bandwidth. Results are listed in Table 6.

The results indicate that heterogeneity of retirement's influence exists between males and females, as well as between males with different education levels. It shows that retirement causes a significant health decline in males without a college degree. The magnitude of such decline is 0.79 on a 0-1scale, which indicates that 79% of male samples without college degrees start to report a not-healthy status after they get retired. Such effect on males without college degrees is larger than retirement's average influence on male self-reported health, which is 0.71 as sown in Table 2. However, neither significant health improvement nor health decline is observed in males with a college education. This indicates that a college degree may act as a buffer that could alleviate some of the retirement shocks on male individual health. Although we do not know how much influence acts due to the limitation of the data. Additionally, no significant causal effects of retirement on self-rated health are found in subgroups of women, no matter they have a college degree or not. A variety of robustness tests by gender and education level subgroups are provided in Appendix, with different choices of bandwidths. The robustness tests show largely consistence with main results above.

Table 6: Heterogeneity of effects on health status (male)

	ID FE	Nonparametric RD				N
	(1)	without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Male Full sample						
Self-rated health	0.008	1.540*	1.536	1.914**	1.126	6349
	(0.027)	(0.856)	(1.033)	(0.817)	(1.110)	
self-rated good health	0.009	-0.715*	-0.668	-0.977**	-0.422	6349
	(0.015)	(1.657)	(1.293)	(0.407)	(0.548)	
With college degree						
Self-rated health	-0.077	-1.214	-1.565	-0.142	-3.307	755
	(0.088)	(2.188)	(2.667)	(5.594)	(6.719)	
self-rated good health	0.093	1.352	1.479	1.152	1.749	755
	(0.052)	(1.232)	(1.445)	(1.468)	(1.693)	
Without college degree						
Self-rated health	0.008	1.686*	1.624	2.323**	1.382	5594
	(0.029)	(0.925)	(1.113)	(0.978)	(1.274)	
self-rated good health	0.006	-0.715*	-0.668	-0.219**	-0.540	5594
	(0.016)	(1.657)	(1.293)	(0.485)	(0.634)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

Table 7: Heterogeneity of effects on health status (female)

	ID FE	Nonparametric RD				N
	(1)	without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Male Full sample						
Self-rated health	-0.015	0.786	3.431	-0.247	24.156	5878
	(0.030)	(1.142)	(2.397)	(7.317)	(15.210)	
self-rated good health	0.005	-0.600	-1.062	1.006	-12.435	5878
	(0.015)	(0.593)	(1.274)	(4.213)	(8.680)	
With college degree						
Self-rated health	0.022	-1.389	5.199	0.552	0.871	373
	(0.124)	(10.295)	(21.979)	(2.083)	(4.356)	
self-rated good health	-0.005	3.745	-4.327	-1.249	-3.694	373
	(0.077)	(10.528)	(22.784)	(1.485)	(3.019)	
Without college degree						
Self-rated health	-0.016	0.946	3.393	0.470	11.565	5505
	(0.031)	(1.126)	(2.359)	(4.032)	(8.386)	
self-rated good health	0.006	-0.789	-1.314	-0.232	-4.096	5505
	(0.016)	(0.591)	(1.269)	(1.863)	(3.996)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

Discussion

This study provides investigation of the effect of retirement on individual health in urban China. I take advantage of China's compulsory retirement age for urban formal sector employees to construct a fuzzy RD design. In the fuzzy RD design, age is considered as the running variable, and one retired or not is treated as treatment variable. The threshold age for male individual is 60 years old, for female individual is 50 years old, which are from related legislation respectively. Additionally, a variety of health status as well as one's behavior estimates are treated as outcome variable. The fuzzy RD estimates are applied to show whether a significant difference exists between those who have just retired and those who are about to retire in a short time. The results show that retirement acts differently between male and female individuals. For male individuals, retirement have significantly undermined one's self-reported health status, while neither a positive nor a negative influence on female individuals is significant. By further investigation, I find evidence on heterogeneity among male samples. To be specific, retirement's negative influence on self-reported health is significant among male individuals without a college degree or above. However, for those males with a college degree or above, retirement does not provide significant influence on one's self-reported health. Most of retirement's influence on individual health is shown by self-rated health estimates, not by physical health indicators. This is possibly because of the short-term effect RD estimates examines, during which time one's physical health could not easily get changed.

I further examine how retirement affects individual lifestyle and daily behavior. From the results of RD estimates and individual fixed-effect regression, retirement reduces the probability of smoking in male individuals. Additionally, retirement has positive effect on one taking part in social activities, such as interacting with friends and providing help to family, friends and neighbors, for both male and female individuals. The influence above on one's behavior is not sufficient to explain the significant decline of self-rated health among male individuals. The RD estimates show that retirement have significantly increased males' probability of taking care of their grandchildren, as well as the money devoted to grandchildren. Since taking care of next generation is energy and time consuming, although not considered as formal work, such devotion might partly explain males' health decline after retirement.

The findings in this study is consistent with some existing evidence from China (Lei et al., 2010). At the same time, it violates some of the former literature from China and other countries (Chen and Li, 2018; Rose, 2020; Horner and Cullen, 2016).

This study has limitations which need further research. First, this study is based on the urban employees in China, therefore it might lack generalization to rural individuals in China. China is a young country that has significant different social structure and civilization between its urban and rural part. Social security system works differently between those two parts. Retirement has different implication to them. For rural China, most residents work for themselves. In this case, the compulsory retirement age is not applied to them. Additionally, most of rural individuals lack sufficient pension support from employers and firms, in which case they need to work until very old age to save money for themselves. It is reasonable that retirement's influence on rural individuals is different from their urban counterparts. However, due to our limitation of study design and sample, the results cannot be generalized to all Chinese. Therefore, further studies are needed to emphasize specially on China rural individuals.

Second, my research is not able to provide precise explanation for the mechanism through which retirement affects Chinese urban employees. The study finds a significant self-reported health decline after retirement among male samples. However, why such significant decline happens is still unclear. The significant increase of doing social activities cannot explain such health decline, which is quite anti-intuition. Meanwhile, although I detect a significant increase of probability for males to care for their grandchildren, which might contribute to male's health decline, further studies are still needed to prove the probabilities. Additionally, there is a large number of missing values in terms of childhood health status, personal income, occupation type and sub-terms regarding self-rated life satisfaction in the survey data. To dump samples with missing values may cause serious selection bias, so I have to get rid of those variables in the study. Therefore, although those issues might theoretically determine retirement's influence on individual health, I do not have chances to further investigate them.

Third, RD estimates is used to study the short-term effect of retirement, which lies in the principle of RD design. However, long-term effect of retirement on individual health is as important as short-term effect, if is not more important. It is especially important under the circumstance that the government is intended to promote a flexible deferred retirement age choice for individuals recently. Therefore, further study is needed to address the long-run health influence of retirement.

Appendix

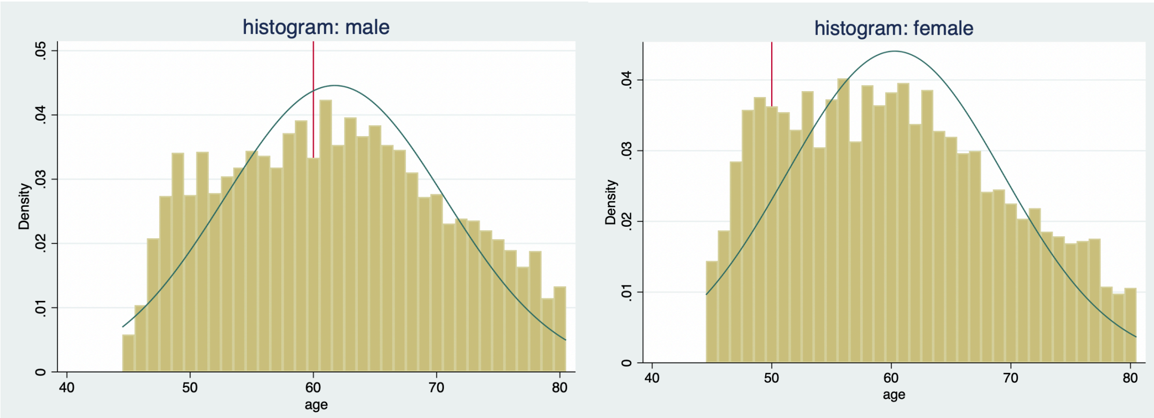


Figure 1: histogram graph for male (left) and female (right)
(no-manipulation-with-precision assumption)

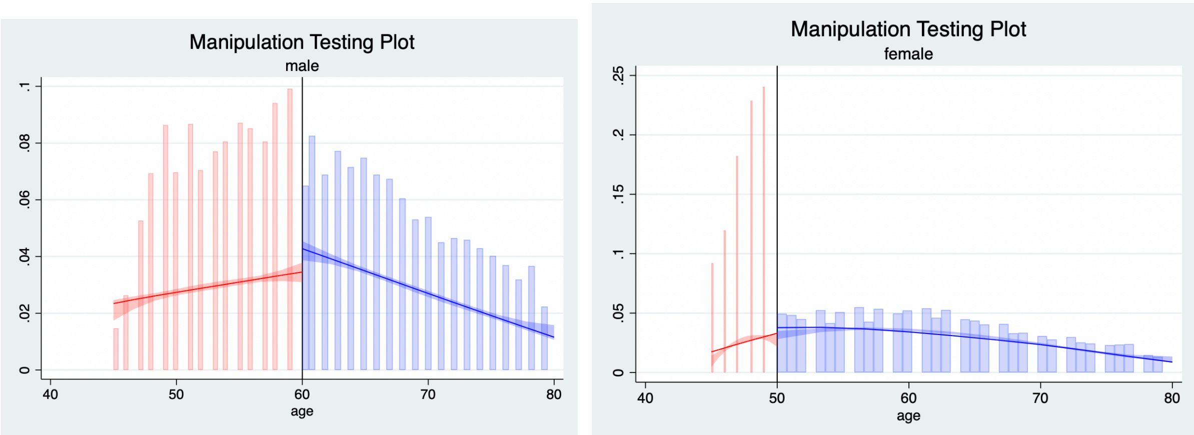


Figure 2: rddensity graph for male (left) and female (right)
(no-manipulation-with-precision assumption)

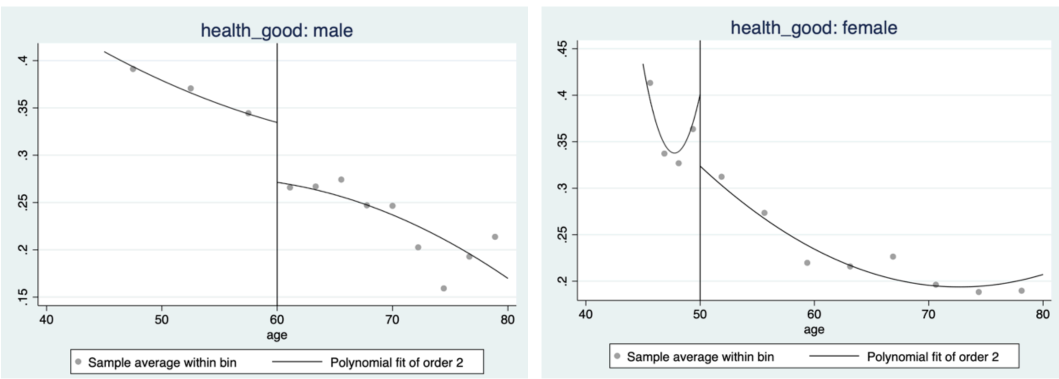


Figure 3.1: rdplot graph (Good health condition) for male (left) and female (right)

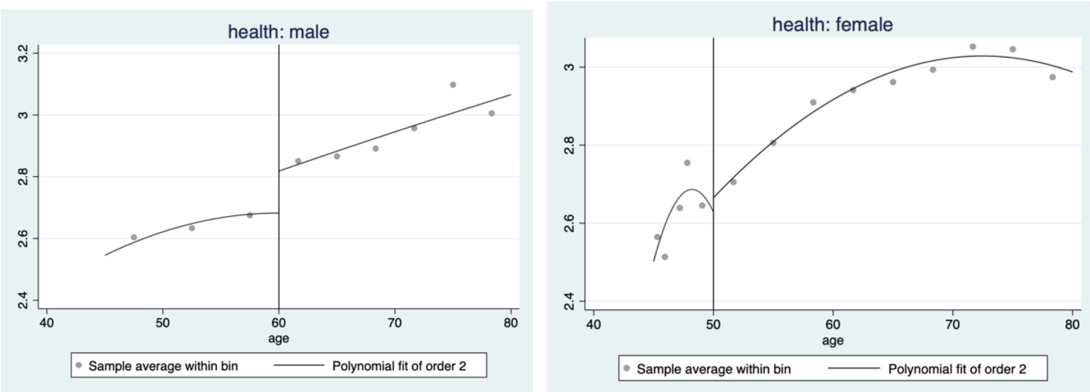


Figure 3.2: rdplot graph (Health condition) for male (left) and female (right)

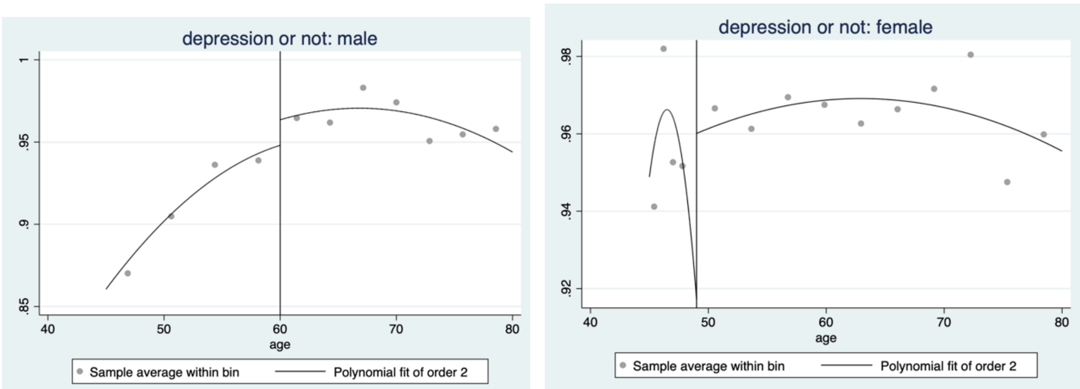


Figure 3.3: rdplot graph (Have depression or not) for male (left) and female (right)

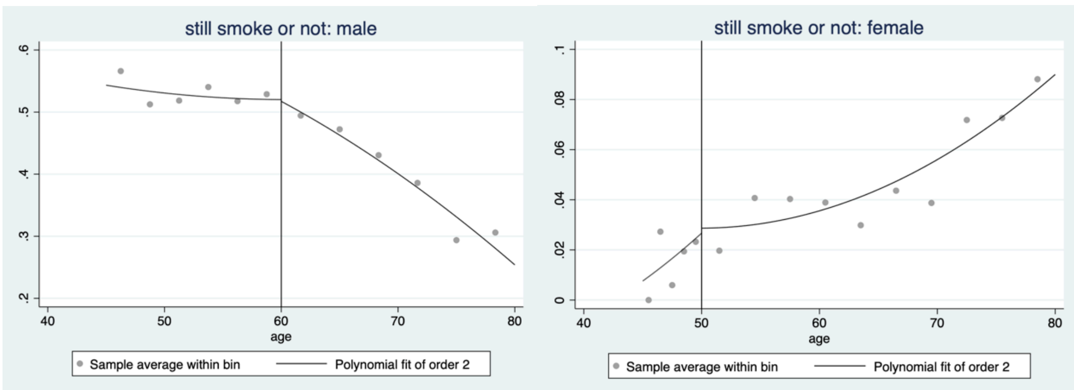


Figure 4.1: rdplot graph (Smoking or not) for male (left) and female (right)

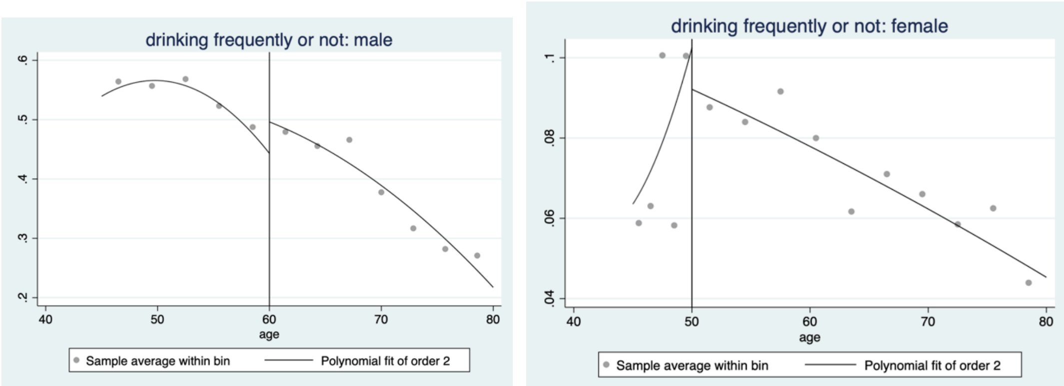


Figure 4.2: rdplot graph (Smoking or not) for male (left) and female (right)

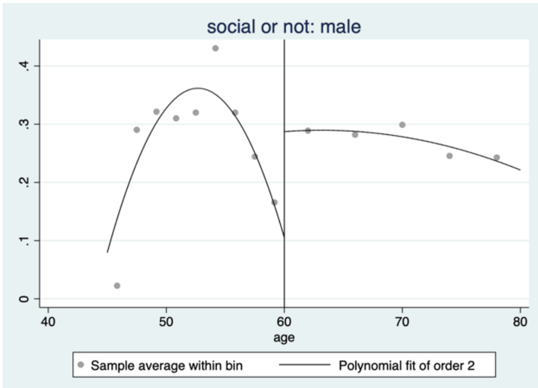
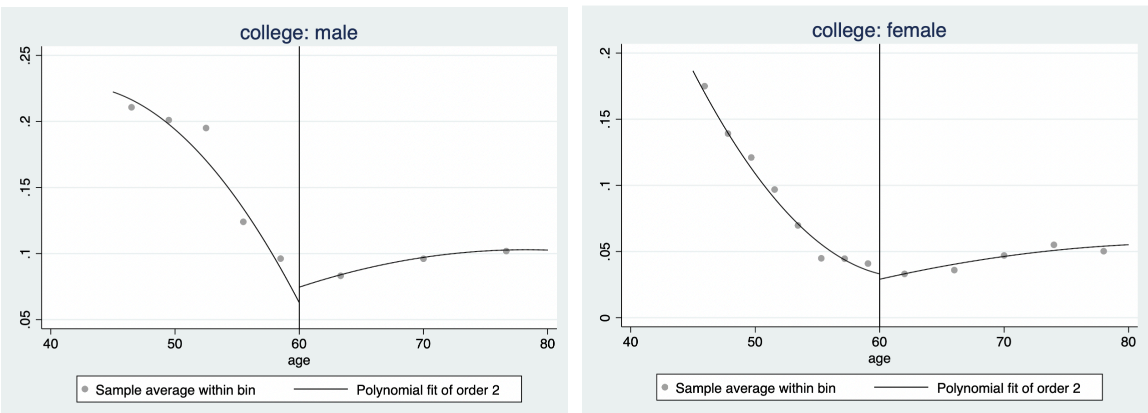
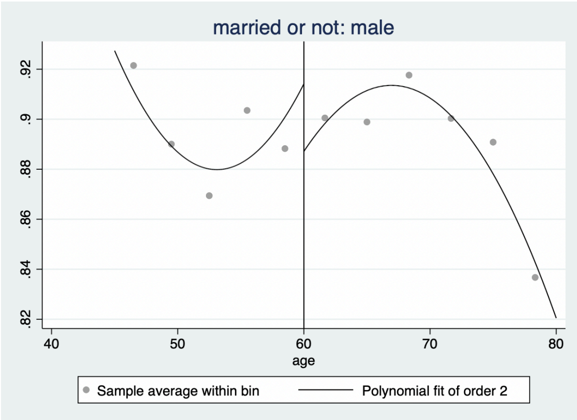
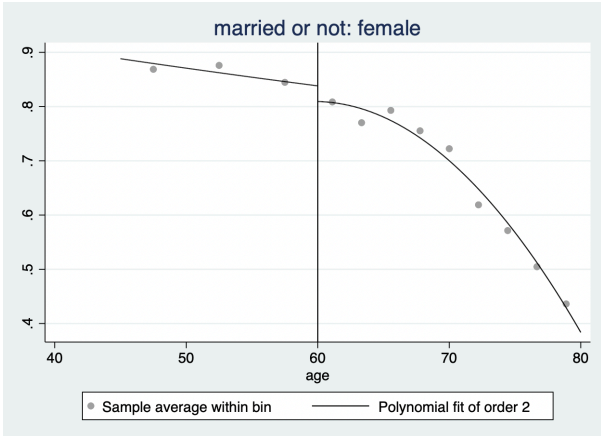


Figure 4.3: rdplot graph (Social interaction or not) for male (left) and female (right)

Placebo test results (shown in figure)







Education heterogeneity of male individuals (divided by whether one has high school degree or not)

Table 6: Heterogeneity of effects on health status (male)

	ID FE	Nonparametric RD				N
	(1)	without covariates		with covariates		
		Conventional (2)	Robust (3)	Conventional (4)	Robust (5)	
Male Full sample						
Self-rated health	0.008	1.540*	1.536	1.914**	1.126	6349
	(0.027)	(0.856)	(1.033)	(0.817)	(1.110)	
self-rated good health	0.009	-0.715*	-0.668	-0.977**	-0.422	6349
	(0.015)	(1.657)	(1.293)	(0.407)	(0.548)	
With high school degree						
Self-rated health	0.002	0.820	0.769	0.873	0.326	1502
	(0.053)	(1.364)	(1.559)	(1.014)	(1.438)	
self-rated good health	0.040	0.086	0.110	-0.334	0.229	1502
	(0.031)	(0.635)	(0.757)	(0.548)	(0.731)	
Without high school degree						
Self-rated health	0.001	1.599	1.520	2.472**	1.214	4847
	(0.032)	(0.985)	(1.171)	(1.215)	(1.488)	
self-rated good health	0.006	0.748	-0.665	-1.258**	-0.527	4847
	(0.016)	(0.467)	(0.553)	(0.590)	(0.731)	

Note: ***, **, * denotes significance at the 1%, 5%, and 10% level, respectively.

References

Bauer, Ann Barbara, and Reiner Eichenberger. 2021. “Worsening Workers’ Health by Lowering Retirement Age: The Malign Consequences of a Benign Reform.” The Journal of the Economics of Ageing 18 (February): 100296. https://doi.org/10.1016/j.jeoa.2020.100296.

Bingley, Paul, and Alessandro Martinello. 2013. “Mental Retirement and Schooling.” European Economic Review 63 (October): 292–98. https://doi.org/10.1016/j.euroecorev.2013.01.004.

Bor, Jacob, Ellen Moscoe, Portia Mutevedzi, Marie-Louise Newell, and Till Bärnighausen. 2014. “Regression Discontinuity Designs in Epidemiology: Causal Inference Without Randomized Trials.” Epidemiology 25 (5): 729–37. https://doi.org/10.1097/EDE.0000000000000138.

Celidoni, Martina, and Vincenzo Rebba. 2017. “Healthier Lifestyles after Retirement in Europe? Evidence from SHARE.” The European Journal of Health Economics 18 (7): 805–30. https://doi.org/10.1007/s10198-016-0828-8.

Che, Yi, and Xin Li. 2018. “Retirement and Health: Evidence from China.” China Economic Review 49 (June): 84–95. https://doi.org/10.1016/j.chieco.2018.01.005.

Chen, Simiao, Pascal Geldsetzer, and Till Bärnighausen. 2020. “The Causal Effect of Retirement on Stress in Older Adults in China: A Regression Discontinuity Study.” SSM - Population Health 10 (April): 100462. https://doi.org/10.1016/j.ssmph.2019.100462.

Chen, Simiao, Nikkil Sudharsanan, Feng Huang, Yuanli Liu, Pascal Geldsetzer, and Till Bärnighausen. 2019. “Impact of Community Based Screening for Hypertension on Blood Pressure after Two Years: Regression Discontinuity Analysis in a National Cohort of Older Adults in China.” BMJ, July, l4064. https://doi.org/10.1136/bmj.l4064.

Eibich, Peter. 2015. “Understanding the Effect of Retirement on Health: Mechanisms and Heterogeneity.” Journal of Health Economics 43 (September): 1–12. https://doi.org/10.1016/j.jhealeco.2015.05.001.
“Filomena, Mattia & Picchio, Matteo, 2021. ‘<B><A HREF=’Https://Ideas.Repec.Org/p/Zbw/Glodps/897.Html">Retirement and Health Outcomes in a Meta-Analytical Framework</A></B>," <A HREF="https://Ideas.Repec.Org/s/Zbw/Glodps.Html">GLO Discussion Paper Series</A> 897, Global Labor Organization (GLO).” n.d.

Gelman, Andrew, and Guido Imbens. 2014. “Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs.” w20405. Cambridge, MA: National Bureau of

Economic Research. https://doi.org/10.3386/w20405.

Heide, Iris van der, Rogier M. van Rijn, Suzan JW Robroek, Alex Burdorf, and Karin I. Proper. 2013. “Is Retirement Good for Your Health? A Systematic Review of Longitudinal Studies.” BMC Public Health 13 (1): 1180. https://doi.org/10.1186/1471-2458-13-1180.

Horner, Elizabeth Mokyr, and Mark R. Cullen. 2016a. “The Impact of Retirement on Health: Quasi-Experimental Methods Using Administrative Data.” BMC Health Services Research 16 (1): 68. https://doi.org/10.1186/s12913-016-1318-5.

“The Impact of Retirement on Health: Quasi-Experimental Methods Using Administrative Data.” BMC Health Services Research 16 (1): 68. https://doi.org/10.1186/s12913-016-1318-5.

Imbens, G., and K. Kalyanaraman. 2012. “Optimal Bandwidth Choice for the Regression Discontinuity Estimator.” The Review of Economic Studies 79 (3): 933–59. https://doi.org/10.1093/restud/rdr043.

Imbens, Guido W., and Thomas Lemieux. 2008. “Regression Discontinuity Designs: A Guide to Practice.” Journal of Econometrics 142 (2): 615–35. https://doi.org/10.1016/j.jeconom.2007.05.001.

Insler, Michael. 2014. “The Health Consequences of Retirement.” Journal of Human Resources 49 (1): 195–233. https://doi.org/10.3368/jhr.49.1.195.

Kesavayuth, Dusanee, Robert E. Rosenman, and Vasileios Zikos. 2018. “Retirement and Health Behaviour.” Applied Economics 50 (54): 5859–76. https://doi.org/10.1080/00036846.2018.1488070.

Kolodziej, Ingo W.K., and Pilar García-Gómez. 2019. “Saved by Retirement: Beyond the Mean Effect on Mental Health.” Social Science & Medicine 225 (March): 85–97. https://doi.org/10.1016/j.socscimed.2019.02.003.

Lee, David S, and Thomas Lemieux. 2010. “Regression Discontinuity Designs in Economics.” Journal of Economic Literature 48 (2): 281–355. https://doi.org/10.1257/jel.48.2.281.

Müller, Tobias, and Mujaheed Shaikh. 2018. “Your Retirement and My Health Behavior: Evidence on Retirement Externalities from a Fuzzy Regression Discontinuity Design.” Journal of Health Economics 57 (January): 45–59. https://doi.org/10.1016/j.jhealeco.2017.10.005.

Nishimura, Yoshinori, Masato Oikawa, and Hiroyuki Motegi. 2018. “WHAT EXPLAINS THE DIFFERENCE IN THE EFFECT OF RETIREMENT ON HEALTH? EVIDENCE FROM GLOBAL AGING DATA: EVIDENCE FROM GLOBAL AGING DATA.” Journal of Economic Surveys 32 (3): 792–847. https://doi.org/10.1111/joes.12215.

Oldenburg, Catherine E., Ellen Moscoe, and Till Bärnighausen. 2016. “Regression Discontinuity for Causal Effect Estimation in Epidemiology.” Current Epidemiology Reports 3 (3): 233–41. https://doi.org/10.1007/s40471-016-0080-x.

Patenaude, Bryan N., Natsayi Chimbindi, Deenan Pillay, and Till Bärnighausen. 2018. “The Impact of ART Initiation on Household Food Security over Time.” Social Science & Medicine 198 (February): 175–84. https://doi.org/10.1016/j.socscimed.2017.11.036.

Reitzes, Donald C., and Elizabeth J. Mutran. 2004. “The Transition to Retirement: Stages and Factors That Influence Retirement Adjustment.” The International Journal of Aging and Human Development 59 (1): 63–84. https://doi.org/10.2190/NYPP-RFFP-5RFK-8EB8.

Rose, Liam. 2020. “Retirement and Health: Evidence from England.” Journal of Health Economics 73 (September): 102352. https://doi.org/10.1016/j.jhealeco.2020.102352.

Shai, Ori. 2018. “Is Retirement Good for Men’s Health? Evidence Using a Change in the Retirement Age in Israel.” Journal of Health Economics 57 (January): 15–30. https://doi.org/10.1016/j.jhealeco.2017.10.008.

X. Lei, L. Li, Y. Zhao. Does retirement affect health? China Economic Quarterly, 9 (4) (2010), pp. 1539-1558

Zang, Emma. 2020. “Spillover Effects of a Husband’s Retirement on a Woman’s Health: Evidence from Urban China.” Social Science & Medicine 245 (January): 112684. https://doi.org/10.1016/j.socscimed.2019.112684.

Zhao, Meng, Yoshifumi Konishi, and Haruko Noguchi. 2017. “Retiring for Better Health? Evidence from Health Investment Behaviors in Japan.” Japan and the World Economy 42 (June): 56–63. https://doi.org/10.1016/j.japwor.2017.06.003.

Zhu, Rong. 2016. “Retirement and Its Consequences for Women’s Health in Australia.” Social Science & Medicine 163 (August): 117–25. https://doi.org/10.1016/j.socscimed.2016.04.003.