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Retirement Effect on Health Status and Health Behaviors in Urban China

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Abstract

This paper analyzes the causal impact of retirement in China on Body Mass Index (BMI) and weight, which are a good gauge of the risk for some diseases. Many middle income developing countries are aging very rapidly and may have to adjust the retirement age to have financially feasible government budgets. It is important to know and understand any plausible health consequences of raising the retirement age in developing countries, and which sub-populations within these countries may be most affected. By using 2011, 2013 and 2015 waves of the China Health and Retirement Longitudinal Study (CHARLS), our identification strategy uses variation in China's mandatory retirement age with a fuzzy discontinuity design to examine an exogenous shock to retirement behavior. Our study finds that retirement will increase weight and BMI among men. This effect is much larger for men with low education. The channel may be that men with low education drink more and take less vigorous exercises after they get retired. Retirement does not affect weight and BMI for women. These effects are robust with different definitions of retirement, narrow retirement bandwidth for samples as well as dropping samples with rural Hukou.

Keywords

Retirement; Overweight; Mandatory Retirement Age; Channel

JEL Codes

J10; J12; J13

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1. Introduction

Impact of retirement on health has been an interesting research question for decades. The literature on this topic is growing rapidly as it raises important policy questions on the debate on the optimal the retirement age. During an era of population aging, several countries are implementing or discussing the reform of raising the retirement age. An older retirement age could lead to more labor supply and more permanent contributions to the social security system. Hence it can be an effective policy to improve the financial situation of public pension systems in many countries. Possible positive health effects by raising the retirement age may reduce health care expenditure as well as making individuals better off. Alternatively, if retirement improves overall health, increasing retirement age may be problematic from the perspectives of health care and individual welfare.

There are several channels through which retirement might affect health. Retirement can lead to social isolation, a diminished sense of purpose, and a lack of physical and intellectual exercise, which may worsen both mental and physical health (Rohwedder and Wills, 2010). On the other hand, retirement may increase leisure, reduce physical and mental stress and lead to a healthier lifestyle, thereby improving health (Shai, 2018; Eibich, 2015).

The existing literature on causal effects of retirement on health employs a variety of indicators to measure health, including self-reported health (Coe & Zamarro, 2011; Eibich, 2015), a morbidity index and poor health index (Shai, 2018); limitation in activities of daily living or diagnoses of specific diseases (Coe & Zamarro, 2011)[1], cognition (Rohwedder and Wills; 2010; Bonsang et al, 2012; Coe and Zamarro, 2011 Lei and Liu, 2018)[2], and mental health (Zhan, 2009; Eibich, 2015; Heller-Sahlgren, 2017)[3].

In this paper, we focus on Body Mass Index (BMI) and weight when investigating the retirement effect on health in urban China. BMI is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. BMI is a good gauge of the risk for diseases, such as heart disease, high blood pressure, type 2 diabetes, gallstones, breathing problems, and certain cancers. The worldwide prevalence of obesity more than doubled between 1980 and 2014. 39 percent of adults aged 18 years and over were overweight in 2014, and 13 percent were obese (WHO, 2016). Not only high-income countries go through the problem of being overweight or obese- low and middle-income countries are also facing the same situation. For example, obesity in China is a major health concern according to the WHO, with overall rates of obesity below 5 percent in the country, but greater than 20 percent in some cities. Using China Health and Nutrition Survey (CHNS) data, study shows that the age-adjusted prevalence of obesity was increasing rapidly during 1991 to 2011. In 2011 the prevalence of obesity was 11.3 percent overall, 11.8 percent among men, and 11.0

[1]Several of these studies report a significant increase in health after retirement (e.g. Coe and Zamarro, 2011;, Latif, 2013; Eibich, 2015). While other studies report a negative effect on health (e.g. Behncke, 2012).

[2]Cognition is measured by memory in immediate and delayed reword recall. Rohwedder and Wills (2010), Bonsang et al (2012), find that retirement leads to a decrease in cognitive functions. Coe & Zamarro (2011) find significant negative effect with OLS, but not significant with IV. Heterogeneous retiring from cognitively demanding jobs may lead to faster decline than retiring from not cognitively demanding job. Blue collar work less cognitively demanding than white-collar work, implying retiring is worse for white-collar workers.

[3]Mental health is measured by depression, loneliness or SF12. Most studies on mental health find positive effect of retirement (Zhan, 2009; Eibich, 2015). However, a few studies report negative effect (Heller-Sahlgren, 2017).

percent among women. Among those aged 40–59, it was 11.9 percent and 14.0 percent for men and women respectively (Mi, et al., 2015). There are many reasons for the increasing overweight rate in China. The effect of transition to retirement, which might change physical activities and health behaviors, could be one of the reasons waiting for statistical tests.

This paper proceeds as follows. Section 2 introduces the institutional background in China, and section 3 describes relevant parts of our data (2011, 2013, and 2015 waves of CHARLS). Section 4 explains our empirical strategy and section 5 presents our estimates of effects of retirement on health and health behaviors. The final section highlights our major conclusions.

2. Literature Review and Institutional Background

2.1 Literature Review

According to WHO, high BMI may increase health risks. The non-fatal but debilitating health problems associated with obesity include respiratory difficulties, chronic musculoskeletal problems, and skin problems (WHO, 2004). Raising BMI may severely increase the burden of disease to both individuals and society. To illustrate, Finkelstein et al. (2003) used US nationally representative data to compute aggregate overweight attributable medical spending for select payers and found that such expenditures accounted for 9.1 percent of total annual U.S. medical expenditures in 1998. Medicare and Medicaid finance approximately accounts for half of these costs.

Yang and Hall (2008) investigated the financial burdens attributed to overweight on the U.S. health care system among elderly Americans. They found that elderly men who were overweight or obese at age 65 had 6–13 percent more lifetime health care expenditures than the same age cohort within normal weight range at age 65. Elderly women who were overweight at age 65 spent 11–17 percent more than those in a normal weight range. For Chinese people, Jiang, et al. (2017) examined the impact of overweight on health-care expenditure among university retirees in Beijing, China. Compared to their normal-weight counterparts, obesity was associated with an increase in annual out-of-pocket expenditure on outpatient care by 27 percent, inpatient care by 19 percent and medication by 15 percent, and an increase in annual total out-of-pocket health-care expenditure by 33 percent.

There are several studies specifically investigating retirement effects on weight or BMI. Chung et al. (2009) used HRS data and found that retirement leads to modest weight gain, 0.24 BMI on average. Weight gain with retirement was found among people who were already overweight and those with lower wealth retiring from physically demanding occupations. Godard (2016) estimated causal impact of retirement on Body Mass Index (BMI) of adults aged 50–69 years old, on the probability of being obese based on the Survey of Health, Ageing and Retirement in Europe (SHARE). Her finding is that retirement causes a 12-percentage point increase in the probability of being obese among men within a two- to four-year period. This pattern was driven by men retiring from strenuous jobs and by those who were already at risk of obesity. In contrast, no significant results are found among women. Kämpfen and Maurer (2016) studied causal effects of retirement on recommended levels of physical activity. They used data from the U.S. Health and Retirement Study and find significant positive effects of retirement on meeting the Guidelines.

Our study contributes in several ways. First, almost all existing studies are on European countries and the US. This is a rare paper investigating evidence of BMI change after retirement from China. China, as a developing country, is different from developed countries in human capital and employment sectors, which are closely related to BMI. For example, according to United Nations "Human Development Reports", the average year of schooling of adults in China was 7.5 in 2013, and the figure was 12.9 in the US. China's manufacturing employment is much larger than employment of many other countries. There was 17 percent employment in manufacturing sectors according to the most recent census in 2010. Second, we identify effect of retirement on BMI, utilizing mandatory retirement-age policy for employees in urban sectors in China, controlling individual fixed effects using longitudinal data. Parametric regression discontinuity with fixed effect model is used to eliminate time-invariant or variant unobserved heterogeneity more effectively. Third, we investigate possible channels of raised BMI after retirement.

2.2 Background

In the past decade, China witnessed a remarkable expansion of its social insurance system. For employees in non-agricultural sectors, the social insurance system provides comprehensive social security to defend against risks of old age poverty, illness, unemployment, workplace injury, and maternity leave. Up to the end of 2016, the two largest programs, the Basic Old Age Insurance (BOAI) and the Basic Medical Insurance (BMI) covered more than 65 percent and 70 percent of labor force in urban labor market respectively. Total expenditures for social insurance increased to 6.7 percent of GDP in 2016 (China Statistic Yearbook 2017).[4]

At the early stage, a pension program was established in 1951 for urban employees in enterprises as an unfunded employer-sponsored program that covered employees of state-owned enterprises (SOEs) and collectively owned enterprises. With marketization of the economy and reform of SOEs, enterprise pension pooled at the municipal or county level was introduced but the system remained a pay-as-you-go (PAYG) system financed by enterprises since the mid-1980s. China adopted a 2-pillar public pension system for urban employees in 1997 to deal with population aging and the pension burden of the SOEs. The new system was called Basic Old Age Insurance system (BOAI). The first pillar is a PAYG system financed by employers. The second pillar is a mandatory funded system, financed by both employers and employees. After that, BOAI's coverage has expanded to non-SOE employees.

Participation in BOAI is compulsory for formal employees in urban sectors, but voluntary for workers in informal sectors. For rural migrant workers, the Social Insurance Law was enacted in 2010, and it specifies that rural migrant workers are entitled to the same treatment given to urban workers. There were about 20 percent of rural migrant workers covered by BOAI in 2014.[5] The benefit from BOAI system depends on an individual's wage before

[4]All data in this section are from China Statistics Yearbook 2010–2017.

retirement, local average wage and years of contribution. For a person who was employed for thirty-five years and earned the average wage in his or her city or county, the benefit would be 59.2 percent of his or her average wage before retirement. Another program, the Public Employee Pension (PEP), was established in 1953 for civil servants and employees in public sectors. It provides an average pension replacement ratio of 80–90 percent of wages before retirement. There are far fewer participants in PEP, with about thirty million people covered. The two programs, BOAI and PEP were merged into one in 2015.

BOAI and PEP programs both have a mandatory retirement-age policy. For men, the retirement age is 60. For women, it is age 55 for white-collar employees, and age 50 for blue-collar employees. The retirement policy was established in 1951. Earlier retirement age for women was a consideration of freeing women from hard physical work at that time, since the burden for household work was heavier for women.

In urban China, reaching retirement age means one must go through the retirement process, retire from one's current job, and start receiving the public pension benefit. After that, the individual can stay in the labor market informally without losing the pension benefit, but the opportunity to find a job declines dramatically. A clear majority of employees comply with the retirement-age policy and retire institutionally at the mandatory retirement age. Data from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative sample of Chinese residents ages 45 and older, show a jump in transition to retirement for men at age 60 and for women at age 50 in urban areas, but there is no such pattern for rural population (Giles et al. 2015).

3. Data

The data used are from the China Health and Retirement Survey (CHARLS) 2011, 2013 and 2015 waves. CHARLS is a representative panel data aimed at people aged 45 and years old. The survey followed a multi-stage stratified random PPS (probability proportional to size) sampling strategy. A total of 450 villages or resident committees were included, covering 150 counties or city districts. There were 17,706 respondents in 2011, 18,613 in 2013 and 21,113 in 2015 respectively. All respondents are asked detailed questions including labor market participation, demographic background, marital status as well as health and health behaviors. For further details, see Zhao et al. (2009).

We draw on data on individuals close to the mandatory retirement age. Firstly, we keep respondents aged between 45 and 70. There are about 17,177 person-year observations dropped. Secondly, we exclude respondents who are not covered[6] by China's basic old age insurance (BOAI or PEP) with an additional 30,787 person-year observations dropped. Thirdly, we further exclude those retired before 45 years old, dropping 90 person-year

[5]To achieve universal coverage of public pension, the New Rural Pension Scheme (NRPS) was established in 2009 to cover rural residents, and the Urban Residents Pension Scheme (URPS) was established in 2011 to cover urban non-employed residents.

[6]Those respondents who are covered according to the following criteria: (1) individuals who reported they have gone through the official retirement process; (2) individuals who reported they are currently participating or receiving public pension benefit from BOAI or PEP; (3) employee in urban sectors with formal labor contract; (4) individuals who reported they will officially retire from current employers.

observations. Fourthly, we drop those who only engage in farm work (712 person-year observations) and those who were never in the labor market (42 person-year observations).

Since we focus on the effect of retirement on body mass index (BMI), we are using information of individual's weight and height[7]. There are 2,907 observations' where BMI is missing[8]. After dropping these missing values, there are about 5,717 observations. The sample with BMI information has similar personal characteristics distribution to the full sample (Appendix table A1). We then drop 336 observations who just reach or will reach retirement age in the survey year to avoid the noise created by unclear eligibility status. Since we further narrow our sample to a +/−5 year band from retirement, we finally have 3,090 observations for analysis. In the samples we are using for estimation, 29% of individuals are present in one wave, 43% are present in two waves and 28% are present in all three waves.

3.1 Health

In this paper, BMI is calculated as weight in kilograms divided by the square of the height in meter (kg/m^2). BMI in CHARLS is measured by CHARLS interviewers. We use the individual's BMI level as well as weight as dependent variables to identify the effect of retirement on weight gain. Table 1 presents mean values of health variables stratified by gender and retirement status. Men's BMI is significantly higher among the retired and men's weight is higher among the retired but the difference is not significant. The difference of women's weight and BMI are not significant between retired and non-retired. When using BMI of 25 as cutoff for overweight, about 37% men are overweight or obese before retirement, but this number goes up to 42%, which increases by 13.5% after retirement. As for women, the ratio changes from 46% to 43%, reducing about 6.5%.

3.2 Health Behaviors

Retirement effect on one's health could be the result of changes in health behaviors. Behavioral adjustments may occur if people are conscious of their retirement status. In this section, we describe individual's health behaviors from three perspectives: (1) whether a respondent took vigorous activities for at least ten minutes during a usual week and the number of activity days during a usual week; (2) whether a respondent drank any alcohol beverages in the past year and frequency of drinking; (3) whether respondents smoke now and frequency of smoking.

We are going to test whether the shortage of vigorous exercise contributes to the ascending probability of higher BMI and weight. Physical activity is captured by CHARLS by the following question; during a usual week, did you do any physical exercise for at least ten minutes continuously. The purpose of doing these vigorous activities include for entertainment, job demand or exercise. If the respondent answers yes, then the variable is coded with 1. As shown in table 1, we see a lower probability of vigorous exercise after

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[7]In CHARLS data, not every respondent is measured with height and weight index. Some respondents answer themselves and their spouse information, but when measuring their body information, their spouse was not in home, the information of measure index is missing.

[8]In CHARLS survey, biomarker data are only available for those who are present during the interview.

retirement for men and women. The probability of taking vigorous activities for men declines from 41% to 25% after retirement and for women from 26% to 11%.

Drinking and smoking are two factors contributing to change of BMI. In the CHARLS questionnaire, an individual was asked “Did you drink any alcoholic beverages, such as beer, wine, or liquor in the past year? The answer is “1. Drink more than once a month; 2. Drink but less than once a month; 3. None of these. If someone answers “1” or “2”, then the variable “drinking” equals to 1. As shown in table 1, about 59% of retired men drink in the past year after retirement. The figure is much higher than that of women, which is only 23%. However, drinking behavior seems same before and after retirement for both men and women. Smoking is asked and measured in the same way as drinking. Men smoke less after retirement (Table 1).

Food consumption may be directly related to change of BMI. CHARLS does not have information about individual’s food consumption, but there is data of food consumption of the whole household, including food purchased, food eaten from own production and spend on eating out[9]. Table 1 lists household food consumption per capita for men and women. Both men and women increase their food consumption after retirement. When we divide the total food consumption by family size, the average food consumption is higher for women than for men. A possible reason may be that the probability of losing a partner for women is much higher in elder age. Correspondingly, the family size for women is less than that of men.

3.3 Independent Variables

Retirement status is the key variable used to measure retirement. There are a few definitions used in the previous literature (see, e.g., Coe and Zamarro, 2011). For example, Gustman and Steinmeier (2000) defined individuals as retired if they report complete retirement or if they report partial retirement but work less than 20 hours per week on average. We follow the definition of Godard (2016) and consider the individual is retired if he or she declares a retired status, regardless of whether he or she has been in a paid job during the month proceeding the interview. More concretely, when someone has completed retirement procedures or reported no market working hours but they did ever worked they can be identified as retired. According to this definition, in our sample, about 43.97% of men retired and 32.47% of women retired. We also consider alternative definitions of retirements as a robustness check.

We include other covariates when investigating health effect of retirement, e.g., age, gender, Hukou status (legal place of residence in China to receive government benefits), marital status, and household size. Mean age of non-retired men is about 58 years old, and 62 years old for retired men. The figures are 49 and 53 respectively for women. Other individual characteristics, such as education level and marital status are similar for non-retirees and retirees in both male and female groups (Table 1). We also include individuals who are in a

[9]We get household food consumption per capita through this route: Firstly, we add the value of household consumption of food (including both food purchased and food eaten from own production) and spend on eating out. Secondly, we get per capita food consumption by using aggregated household food consumption divided by number of people (including guests).

rural Hukou. Individuals with rural Hukou may have entered formal work in urban sectors and are therefore covered by pension insurance provided by government, institutions, NGO and Firm[10]. The coverage of social insurance to employees with rural hukou expanded over time, so the share of rural hukou among non-retirees is larger than the share among retirees.

We divided two sub-samples in both male and female groups according to educational attainment when testing the heterogeneous effects of retirement, since education is closely related to job characteristics. For those who have college and above education, the likelihood in occupation requiring physical effort is significantly lower than workers only have high school or below education.

4. Empirical strategy

4.1 Endogeneity

We consider possible endogeneity when exploring effect of retirement on health. The literature highlights three different sources of endogeneity-omitted variable biases, reverse causality and measurement errors. Omitted variable biases may come from unobservable individual characteristics that not only affect one's health status but also the retirement decision, for example, genetic factors and subjective life expectancy. We use individual fixed effects panel data models to eliminate unobserved time-invariant heterogeneity.

Reverse causality exists where health affects the retirement decision. Health shocks can also affect individual's retirement decision. Though we may exclude individuals retiring due to health problems with the data available, the result might be biased due to misreporting of the exclusion criterion. We use a Fuzzy Regression Discontinuity method to deal with this issue. IV is the eligibility of retirement age, which has been widely used in literature (e.g. Eibich, 2015; Bonsang et al, 2012). Another bias may be induced by measurement error. One source of measurement error may arise from justification bias, which more often occurs with subjective health variables. People may be more likely to exaggerate their bad health conditions to justify their retirement decision (McGarry, 2004). The key dependent variables in our paper are BMI and weight, which are measured by investigators, so this is less likely to encounter justification bias. Another source of measurement error is attenuation bias due to measurement error in the height and weight variables. Height measures more often encounter measurement error by different investigators between different waves. To reduce measurement error, we do the following procedure: (1) First we find out the abnormal value[11] through comparing the height and weight of 2011, 2013, 2015. (2) If the gap of height between any two waves exceeds 5 centimeters, we then substitute the abnormal value with the mean of the other two wave values. For example, if height of 2013 exceed height of 2011 or height of 2015 above 5 centimeters but the difference between height of 2011 and 2015 is below 3 centimeters, then we substitute the height of 2013 with the mean height of 2011 and 2015.[12]

[10]Rural Hukou has been entitled with benefit that urban Hukou cannot give, e.g., land contractual right. We also run the regressions excluded observations with Rural Hukou in robustness checks.

[11]There are about 514 people whose height difference between 2011–2013 or 2013–2015 is above 5 centimetres.

4.2 Regression Discontinuity Design

We use a Regression Discontinuity Design (RD) with fixed effect model to reduce estimation biases. The main idea behind RD is that individuals who are marginally younger than the retirement benefit eligibility age can be compared to individuals who are just above the age (Lee and Lemieux, 2010). The only difference between the two groups is their eligibility for retirement benefits. The probability of retirement for those older than the eligibility age is higher due to the policy rule, but difference in retirement decisions across the eligibility threshold is unrelated to the outcome variables, which in this case are health variables.

The literature acknowledges the discontinuity in the probability of retirement near the eligibility threshold and has widely utilized retirement benefit eligibility as an instrument to identify the effect of retirement consumption and health (see, Battistin et al., 2009; Bonsang, Adam, and Perelman, 2012; and Eibich, 2015). Due to retirement policy in China, the discontinuity of retirement probability around retirement age should be clear. Yet, an individual may not necessarily retire at the retirement age. Empirically, the probability of retirement below retirement age is more than 0, while the probability of retirement above retirement age is less than 1.

A fuzzy RD can be used to address noncompliance with the retirement age. The fuzzy Regression Discontinuity method has some advantages compared with other estimation methods. Fixed effect models only reduce the estimation biases through eliminating time-invariant omitted variables and do not avoid estimated biases induced by reverse causality. The estimated effect by fuzzy RD is a local average treatment effect (LATE), i.e., the effect on compliers affected by retirement age restriction.

4.2.1 Estimation Model—The fuzzy RDD is estimated as a Two-Stage Least Squares model with individual fixed effects. Equation 1 is also the first-stage relationship between eligibility and retirement.

$$R_{it} = \pi_{it} + \pi_1 E_{it} + \beta_1 age + \beta_2 age^2 + X_{it}\rho + Z_{it}\eta + \alpha_i + \delta_t + u_{it} \quad (1)$$

In Equation (1), R_{it} indicates whether individual i has retired in year t and E_{it} indicates whether individual's age is above the eligibility retirement age. If one's age is above eligibility retirement age, then equal to 1, else equal to 0. For women, the retirement age is 50 or 55 depending on occupation in ways highly correlated with education attainment (Connelly, Maurer-Fazio and Zhang, 2014). For those with a high school education and below, retirement age is 50 years. For those with a college education or above, the retirement age is 55 years. As supplementary information, we use 50 as the retirement age in all of the female samples to create the instrument variable and obtain similar results (Appendix table A3).

For *age*, we use number of years between current age and eligibility retirement age. In our main specification, we use a quadratic age trend.[13] X_{it} is a vector of individual characteristics either time-variant or time invariant, including marital status and Hukou status. For people aged 45 years old and above, the chance to improve their education is small, so we did not include the education variables. Z_{it} is a vector of household characteristics, including household size. α_i is an individual fixed effect. δ_t indicates time dummies. u_{it} is the error term. The first stage results are available in Table 2.

We present our main results in an instrumented regression (Equation 2):

$$Y_{it} = \pi_{it} + \lambda \widehat{R}_{it} + \beta_1 age + \beta_2 age^2 + X_{it}\rho + Z_{it}\eta + \alpha_i + \delta_t + \varepsilon_{it} \quad (2)$$

Where R_{it} denotes the predicted values from the first stage. λ signifies the estimated effect of retirement on health. α_i is also individual-fixed effects, while δ_t signify year fixed effect. ε_{it} are the idiosyncratic errors. Outcome variable Y_i represents a set of outcome variables that measure health conditions and possible channels which affect one's health, including one's BMI and weight, and health behavioral variables. We also do some robustness checks: (1) using different definition of retirement as the independent variable; (2) dropping sample with rural Hukou; (3) estimating the model specified above using only a bandwidth of 4 years.

5.1 Results-Effect of Retirement on Health

We first check for a discontinuity in retirement status by the number of years to and from retirement age eligibility. Figure 1 shows the proportion of retired individuals. The x-axis depicts the number of years to and from the age of retirement eligibility. The y-axis is the mean retirement rate at each age. We fit a quadratic trend to the retirement rates on either side of the retirement age. For both women and men, figure 1 suggests that after reaching retirement age, the retirement rate increases markedly and discontinuously. For women, the retirement rates one year before and one year after retirement age are 16 percent and 50 percent, respectively. For men, the two figures are 22 percent and 73 percent, respectively.

As illustrated in figure 1, actual retirement behavior is well correlated with the retirement eligibility age. Table 2 shows the first-stage results of the relationship between individual eligible for retirement and individual's retirement status. The results are estimated using fixed effects probability models. As expected, eligibility for retirement significantly increases the probability of retirement by 37.4 percentage points for men and 29.8 percentage points for women, respectively (both effects are significant at the 1% level).

We also check for a discontinuity in BMI and weight by the number of years to and from retirement age eligibility in online Appendix Figure A1 and Figure A2. Table 3 presents fixed effect estimation of effects of retirement on individual's BMI and weight by gender. All specifications include age, age squared/100, rural Hukou, marital status and household size, as well as individual and year fixed effects. As shown in the top panel, being retired significantly increases weight and high BMI. increasing weight by 2.1 kilogram and BMI index by 0.92 units for men. Both effects are statistically significant.

[13] We used other age trends to do robustness checks and the results are still there.

The right panel of Table 3 reports a parallel set of estimation results for females. The estimation results indicate no statistically significant effects of retirement on either BMI or weight for women, in sharp contrast with the results for men. In sum, after retirement, men tend to gain weight and have high BMI compared to women. These results are in line with, for example, the findings of Godard (2016) for European countries. Godard (2016) used retirement age as an instrument for retirement and found a significant impact of retirement on men's probability of being obese but no significant impact on women.

5.2 Results -Heterogeneous Effects of Retirement

We further checked whether impacts of retirement on being BMI and weight within gender differ between different sub-groups. People who retired from strenuous work tend to gain weight if they do not take exercise or reduce their food intake in their leisure time. We re-estimated the health effect by education levels. High education is defined if people attain high school and above, low education is divided by Junior school and below. The results of first stage by different education levels which are presented in table 2 demonstrate instrument for retirement is appropriate. As shown in table 4, the retirement effect on BMI and weight are mainly driven by male retirees with lower education attainment. More concretely, we find that the effect of retirement on weight and BMI are much higher if we estimate regressions among low-educated men. In contrast, men with higher education tend to lose weight when they switch from work to retirement, though the coefficient are not significant.

Low-educated men engage in arduous work with higher probability. Once they retire and do not engage in physical exercise which can compensate for the reduced exercise related to their foregoing work, they are likely to increase their weight. The effect of retirement on the probability of higher BMI or weight is not significant for women, both for low education or high education elderly. Overall, our results show that retirement effect is heterogeneous, especially for men with low education, retiring from strenuous job can trigger weight gains.

5.3 Underlying Mechanisms

We further investigated some possible channels which may induce retired-related weight and BMI. The previous literature suggested physical activity as a possible channel (Godard, 2016). Besides this probable channel, we also add the following possible channels-frequency of drink in the past year; frequency of smoking in the past year, food consumption per capita. Reduced form estimations are presented in table 5.[14]

Transition to retirement tends to reduce the probability of engaging in vigorous activities as well as the frequency of doing vigorous exercises for males, though the results are not statistically significant. We find two possible channels which may trigger men's weight gain. The first is that men drink more than before after retirement, and the second is that men eat more than before they retired. As we can see from table 5, men significantly increase the frequency of drinking by 0.428 levels per month in the last year after their retirement. They

[14]We also have 2SLS estimation results. The significant of coefficient "Above eligibility retirement age" is the same, but size in some regressions are unreasonable large due to small sample size caused by missing information.

also increase the food consumption by 41.9 percentage points than before. When we examine women, we find the opposite trend that women do not tend to drink more than before and have less food consumption. We interpret the lower food consumption association with female retirement as the now retired women cooking the food less expensively at home. These adverse health behaviors can explain why the probability of gaining weight or obese increases for men but not for women.

Heterogeneous effects on health behaviors are consistent with effects on health. We find that results of men are driven mainly by men with low education. Men with low education significantly increase the frequency of drinking as well as food consumption, but men with high education tend to reduce their drinking frequency, though not significantly. Why people with different education display different drinking, the possible reason can be ascribed to three items:

(1) Low educated men have less healthy knowledge and are less self-disciplined compared with high educated men; (2) Low educated men always work in strenuous and nervous job requiring no-drinking, if they retired, they have more freedom and time to drink compared with high educated men. Gaining weight is associated with drink (Scott et al.,1998). (3) High educated men always work in regular sectors such as government or large state-owned enterprises. When they work, there are many social engagements, so they drink more. With the retirement and reduced social networks, the chance to drinking becomes less. So, the different drinking behaviors can help us understand why men with low education gain weight but men with high education do not. Furthermore, according to the rule of pension benefit, individual income including pension income is a little bit higher than wage income before retirement for lower education group in our sample, while the former is lower than the latter in higher education group. The increasing consumption of lower education men might partly due to income effect.

As to other activities related to physical effort, such as grandchild care, a tradition in Chinese culture, one study shows retirement has similar effect on grandchild care provision by men and women in urban China (Feng and Zhang, 2018).[15] The study also shows that grandparents who have less than a high school education supply slightly more grandchild care after transition to retirement than grandparents with a high school education or above, although the differences are not very big. So, our results are not likely driven by differences in childcare.

In view of the fact that lower education adults account for a significant share in China, for example, in our data the share is 68 percent, the effect of lower education group will keep dominant in the future.

5.4 Robustness

In this subsection, we carry out several robustness checks. First, we re-define retirement status. Though all individuals reported themselves retired, some still are engaged in work.

[15]They find a significant increase of 29 percentage points in the provision of grandchild care after the transition to retirement for women and a 21 percentage-point increase for men.

We exclude these individuals in the sample and keep the individuals who report themselves retired and report no work in the survey. The estimates are shown in table 6, panel A. The coefficient of man's BMI or weight gets slightly bigger compared to the coefficient in table 3, and is significant at the 5% and 10% level. The coefficient for female remains insignificant in the sample with this alternative way of defining retirement. Thus, gender differences of the effect of retirement on individual's health remain in the alternative sample.

Secondly, we re-estimate the equations using narrowed bandwidths. Compared with the sample of male aged 55 to 65 and females aged 50 to 60 used in the main analyses, the estimation uses sample including the males aged 56 to 64 and females aged 51 to 59.[16]The sample size has dropped from 1,858 to 1,524 for males. The results show that the retirement will increase the man's BMI by 0.874. This coefficient of retirement gets a litter smaller, compared to 0.918 in table 3.

Thirdly, we re-estimated the equations dropping samples with rural Hukou. People who work in formal work also can keep their rural Hukou identity status instead of changing their rural Hukou into urban Hukou. One might argue that we should not include individuals with rural Hukou because retirement behavior of these individuals may differ from urban population, since many of them still have land right and farm works even working in urban sectors and even after retirement. We show the differences in retirement rate before and after retirement eligible age for urban and rural individuals in Appendix Figure 3 and Figure 4.

The urban individuals comply with retirement age policy better than rural individuals. To eliminate doubts about the results, we also do regressions dropping individuals with rural Hukou. The results are presented in panel C. We find that the coefficient of retirement effect on being overweight or obese stay significant among men and the effects of retirement on women's being weight are still not significant.

6. Conclusion

The paper examines effects of retirement on BMI and weight using the 2011, 2013 and 2015 CHARLS data. Our results show that retirement induced by mandatory retirement rules causes an increase in men's weight and BMI, but has no significant effect on women's BMI and weight. We further checked whether the effect is heterogeneous between different groups. The results substantiate our judgement that men with low education are more likely to gain weight. Our results lend support to the findings of Godard (2016) and Chung et al. (2009). In contrast, retirement does not cause a significant increase in weight and BMI among women with low education who have less chance to work in physically demanding jobs.

We go a further step to interpret why retirement affects weight and BMI for males and females from different channels. We find two interesting mechanisms. First, men especially the ones with low education increase their frequency of drinking significantly but women have no change in frequency of drinking, though the frequency of drinking of women is

[16]We calculated the optimal bandwidth according to Imbens and Kalyanaraman (2012). The outcome is 3.97. So we use 4 as a bandwidth in robustness check.

much lower than that of men. Second, after retirement men tend to reduce physical activities, especially in low education group, though provision of childcare is increased similarly for men and women. This may explain why men gain weight but women do not gain weight after retirement. Increasing retirement age is a policy orientation in China with increasing life expectancy and challenge of financial sustainability of pension fund. Our findings provide implications on the reform of retirement age policy in public pension system. First, retirement has some effect on weight gain and higher BMI, which will increase the probability of getting overweight or obese, especially for low education male employees. Thus, the policy aiming to increase retirement age may reduce health risks and health expenditure. Second, retirement age of women in China is not only lower than many other countries, but lower than Chinese men. Increasing retirement age of women seems more feasible. However, our results imply that increasing retirement age of men is also worth considering from a perspective of health outcome.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Impact of retirement on health is an important research topic related to public finance as well as individual welfare.
- We focus on Body Mass Index and weight outcome effects due to mandatory retirement-age policy for employees in urban China.
- After reaching mandatory retirement age, retirement rates increase markedly and discontinuously for Chinese men and women.
- Retirement increases weight and BMI among men but not women. This male effect is much larger for men with low education.
- Drinking and eating more, fewer physical activities are channels which may induce related male weight and BMI increases.

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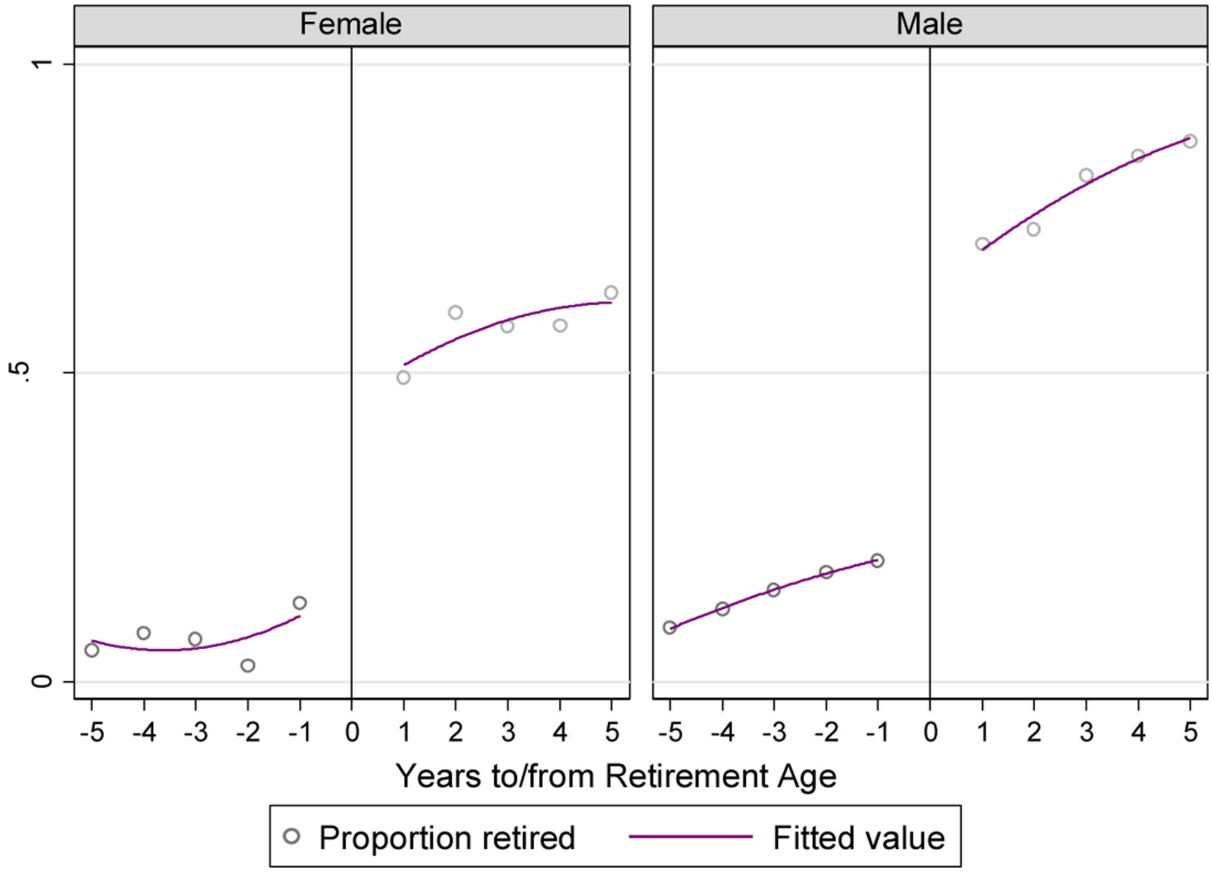

Figure 1.

Retirement rate and years to retirement eligibility

Table 1

Summary statistics for pooled sample

Variable	Non-retirees male	Retirees male	Difference	Non-retirees female	Retirees female	Difference
Weight (kg)	66.09 (10.62)	66.64 (10.47)	0.54	60.48 (9.09)	61.33 (9.49)	0.84
Weight/height^2 (BMI)	24.00 (3.27)	24.34 (3.27)	0.33 **	24.78 (3.11)	24.76 (3.39)	−0.01
Overweight	0.37 (0.48)	0.42 (0.49)	0.05 **	0.46 (0.50)	0.43 (0.50)	−0.02
Age	57.92 (2.53)	61.96 (2.54)	4.05 ***	49.27 (2.95)	52.89 (2.46)	3.63 ***
Rural Hukou	0.55 (0.49)	0.14 (0.35)	−0.41 ***	0.53 (0.49)	0.10 (0.30)	−0.43 ***
Married with spouse present	0.91 (0.29)	0.92 (0.27)	0.02	0.87 (0.34)	0.89 (0.30)	0.03
Widowed	0.03 (0.17)	0.02 (0.13)	−0.01*	0.04 (0.19)	0.04 (0.19)	0.00
High school and below	0.88 (0.33)	0.85 (0.36)	0.07 ***	0.92 (0.27)	0.83 (0.38)	−0.23 ***
Vocational school	0.07 (0.25)	0.08 (0.28)	0.02	0.04 (0.19)	0.09 (0.29)	0.05 ***
College and above	0.06 (0.23)	0.07 (0.26)	0.01	0.04 (0.20)	0.09 (0.28)	0.04 ***
Household size	2.91 (1.99)	2.64 (1.96)	−0.28 ***	2.56 (1.57)	2.39 (1.49)	−0.18*
Vigorous activities for at least 10 minutes	0.41 (0.49)	0.25 (0.44)	−0.16 ***	0.26 (0.44)	0.11 (0.32)	−0.15 ***
Days of vigorous activities (conditional)	5.22 (2.26)	5.20 (2.18)	−0.83 ***	5.23 (2.21)	4.62 (2.27)	−0.81 ***
Ever drink any alcohol last year	0.61 (0.49)	0.59 (0.49)	−0.02	0.19 (0.39)	0.23 (0.42)	0.03
Frequency of drinking last year (conditional)	4.12 (2.59)	4.06 (2.75)	−0.12	1.30 (1.89)	1.07 (1.73)	−0.01
Smoke now	0.55 (0.50)	0.47 (0.50)	−0.08 **	0.03 (0.16)	0.03 (0.18)	0.01
Number of cigarette smoked per day (conditional)	18.79 (10.87)	18.10 (10.17)	−1.70 **	12.83 (9.91)	11.64 (5.84)	0.13
Log (food consumption per capita)	7.89 (1.82)	8.19 (1.72)	0.30 ***	7.98 (1.84)	8.31 (1.77)	0.33 ***
N	1041	817		832	400	

Source: CHARLS 2011, 2013, 2015. Sample is narrowed to a +/− 5-year band from retirement age. Note: Standard deviations are in parentheses. Difference is the mean difference between retirees and non-retirees of each variable.

** Significant at 5% level;

*** Significant at 1% level.

Table 2.

First-stage estimation results by gender of being retired

	Male			Female		
	All	**Low education**	**High education**	**All**	**Low education**	**High education**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Age above the eligibility retirement threshold	0.374*** (0.040)	0.367*** (0.045)	0.481*** (0.090)	0.298*** (0.044)	0.246*** (0.053)	0.348*** (0.083)
Age	0.013 (0.010)	0.004 (0.012)	0.019 (0.020)	0.002 (0.019)	0.059 (0.034)	−0.025 (0.026)
Age Square/100	0.003*** (0.001)	0.005*** (0.001)	0.001 (0.003)	0.004*** (0.001)	0.003** (0.002)	0.005 (0.003)
Observations	1,858	1,331	527	1,232	774	458

Note: (1) Standard errors are in parentheses. (2)

* Significant at 10% level;

** Significant at 5% level;

*** Significant at 1% level. (3) First stage is estimated by fixed effect model with panel data. (4) We also control rural Hukou, marital status, household size, individual fixed effect and time effect.

Table 3

Effect of retirement on BMI and weight, by gender

	Males		Females	
	BMI	**Weight**	**BMI**	**Weight**
	(1)	**(2)**	**(3)**	**(4)**
Retired	0.918 ** (0.399)	2.099 * (1.095)	0.252 (0.605)	−0.058 (1.692)
Age	−0.041 (0.041)	−0.125 (0.113)	−0.095 (0.092)	−0.272 (0.221)
Age Square/100	−0.015 *** (0.005)	−0.039 *** (0.014)	−0.021 *** (0.007)	−0.056 *** (0.018)
Observations	1,858	1,858	1,232	1,232

Note: (1) Standard errors are in parentheses. (2)

* Significant at 10% level;

** Significant at 5% level;

*** Significant at 1% level. (3) the result is estimated by fixed effect model with panel data. (4) We also control rural Hukou, marital status, household size, individual fixed effect and time effect. The results of full model are presented in table A2 in online appendix.

Table 4

Effect of retirement on weight and BMI by education

	Low education		High education	
	BMI	**Weight**	**BMI**	**Weight**
	(1)	**(2)**	**(3)**	**(4)**
		Males		
Retired	1.092** (0.481)	2.793** (1.328)	0.277 (0.631)	−0.265 (1.763)
Age	−0.021 (0.049)	−0.108 (0.136)	−0.041 (0.075)	−0.072 (0.210)
Age Square	−0.017*** (0.006)	−0.042** (0.018)	−0.012 (0.010)	−0.031 (0.027)
Observations	1,331	1,331	527	527
		Females		
Retired	0.022 (0.996)	−1.580 (2.403)	0.724 (1.217)	1.966 (2.966)
Age	0.004 (0.176)	0.093 (0.424)	−0.120 (0.127)	−0.412 (0.309)
Age Square	−0.021** (0.009)	−0.044** (0.022)	−0.026* (0.015)	−0.089** (0.036)
Observations	774	774	458	458

Note: (1) Standard errors are in parentheses. (2)

*Significant at 10% level;

**Significant at 5% level;

***Significant at 1% level. (3) the result is estimated by fixed effect model with panel data. (4) We also control rural Hukou, marital status, household size, individual fixed effect and time effect.

Table 5

Effect of retirement on health behavior by gender

	Vigorous activities	Frequency of vigorous activities	Frequency of drinking	Frequency of smoking	Log (food consumption per capita)
	(1)	(2)	(3)	(4)	(5)
			Males		
Above eligibility retirement age	−0.161 (0.106)	−0.836 (0.670)	0.428** (0.195)	0.288 (1.037)	0.419* (0.217)
Observations	741	739	1,797	1,532	1,858
			Male with low education		
Age above the eligibility retirement threshold	−0.185 (0.125)	−0.972 (0.817)	0.589*** (0.216)	0.342 (1.295)	0.445* (0.231)
Observations	521	521	1,285	1,091	1,331
			Male with high education		
Age above the eligibility retirement threshold	−0.234 (0.221)	−1.338 (1.142)	−0.275 (0.482)	0.012 (1.360)	0.565 (0.564)
Observations	220	218	512	441	527
			Females		
Age above the eligibility retirement threshold	−0.206* (0.117)	−1.578** (0.707)	0.035 (0.116)	0.107 (0.134)	−0.750*** (0.268)
Observations	551	550	1,217	1,220	1,232
			Females with low education		
Age above the eligibility retirement threshold	−0.248 (0.195)	−1.441 (1.078)	0.060 (0.131)	−0.100 (0.108)	−0.597* (0.322)
Observations	316	315	765	767	774
			Females with high education		
Age above the eligibility retirement threshold	−0.244 (0.148)	−2.171** (1.008)	0.034 (0.248)	0.431 (0.357)	−0.983* (0.516)
Observations	235	235	452	453	458

Note: (1)Standard errors in parentheses. (2)

* Significant at 10%;

** at 5%;

*** at 1% level. (3) estimated by fixed effect model with panel data. (4) We control rural Hukou, marital status, household size, individual fixed effect and time effect.

Table 6

Robustness check

	Male		Female	
	BMI	**Weight**	**BMI**	**Weight**
	(1)	**(2)**	**(3)**	**(4)**
Panel A: Retired, excluding those report engaging in work				
Retired	0.926 ** (0.422)	2.183 * (1.161)	0.269 (0.767)	0.154 (1.852)
Age	−0.071 (0.045)	−0.172 (0.124)	−0.086 (0.097)	−0.253 (0.234)
Age Square/100	−0.019 *** (0.006)	−0.046 *** (0.016)	−0.022 *** (0.008)	−0.057 *** (0.019)
Observations	1674	1674	1207	1207
Panel B: Bandwidth [−4, 4]				
Retired	0.874 ** (0.393)	1.986 * (1.077)	−0.225 (0.830)	−0.629 (2.015)
Age	−0.047 (0.047)	−0.149 (0.129)	−0.077 (0.130)	−0.324 (0.315)
Age Square/100	−0.012 (0.008)	−0.041 * (0.022)	−0.034 ** (0.014)	−0.088 *** (0.033)
Observations	1,524	1,524	995	995
Panel C: Dropping retirement with rural Hukou				
Retired	0.785 * (0.404)	1.937 * (1.124)	0.508 (0.881)	0.692 (2.124)
Age	−0.039 (0.042)	−0.112 (0.116)	−0.091 (0.096)	−0.268 (0.232)
Age Square/100	−0.015 *** (0.005)	−0.037 ** (0.015)	−0.023 *** (0.008)	−0.060 *** (0.019)
Observations	1,742	1,742	1,191	1,191

Standard errors are in parentheses. (2)

* Significant at 10% level;

** Significant at 5% level;

*** Significant at 1% level. (3) the result is estimated by fixed effect model with panel data. (4) We control rural Hukou, marital status, education level, household size, log (household expenditure per capita), individual and time fixed effects