Does retirement change the age effect on health?: evidence from Japan

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Abstract

This study investigates the retirement effect on health of elderly men in Japan in terms of short- and long-term effect. To deal with the endogeneity problem of retirement and health, Instrumental Variables method is used by exploiting the pension reform as instruments. The results indicate that retirement has an immediate improving effect on self-rated health and depression, but no effect on difficulty in ADL and any diseases. Retirement also increases the rate of health deterioration with age. These findings suggest that the effect of retirement on health can be estimated positive, negative, or no effect depending on the length of observed period and the size of short- and long-term effect of retirement. This may be one of the reasons of the mixed results in the literature.

Keywords: Retirement, Health, age effect, Japan.

1. Introduction

Many developed countries facing the population aging have raised the retirement age and plan to raise it by increasing the pensionable age (OECD, 2017). This pension reform aims to sustain the pay-as-you-go public pension system with increased contributions and decreased pensions. The policy strengthens the sustainability of public pension system, it may in turn, however, increases the long-term care expenditures if the retirement has a positive health effect (Dave et al., 2008). Therefore, examining the retirement effect on health is crucial for policy making.

Several studies have examined the causal relationship between retirement and health of elderly people in developed countries, however, the results are mixed. First, while many

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studies find a positive retirement effect on self-rated health (Neuman, 2008; Johnston and Lee, 2009; Coe and Zamarro, 2011; Eibich, 2015; Hessel, 2016; Zhu, 2016; Oshio and Kan, 2017; Messe and Wolff, 2019), some studies find a negative effect (Coe and Lindeboom, 2008; Dave et al., 2008; Behncke, 2012) and find no effect (Atalay and Barrett, 2014). Second, as for the physical health including various diseases, retirement has a positive effect (Coe and Zamarro, 2011; Atalay and Barrett, 2014; Zhu, 2016), a negative effect (Dave et al., 2008; Behncke, 2012; Hessel, 2016), and no effect (Coe and Lindeboom, 2008; Neuman, 2008; Johnston and Lee, 2009; Horner and Cullen, 2016; Messe and Wolff, 2019). Finally, with respect to mental health, retirement has a positive effect (Charles, 2004; Johnston and Lee, 2009; Atalay and Barrett, 2014; Eibich, 2015; Zhu, 2016; Oshio and Kan, 2017), a negative effect (Dave et al., 2008; Bertoni and Brunello, 2017), and no effect (Coe and Lindeboom, 2008; Neuman, 2008; Coe and Zamarro, 2011;Behncke 2012; Horner and Cullen, 2016)[2].

Most studies theoretically consider a causal mechanism between retirement and health. For example, retirement decreases activity level or loses support networks and friends, resulting in poor health. On the other hand, retirement also means withdrawal from stressful work life or increase in leisure time, resulting in improvement of health. In economic theory, the model of Grossman (1972) suggests that retirement has both effects: a deteriorating effect through a reduction in investment to keep high productivity and an improving effect through an increase in healthy time to raise their utility. Consequently, retirement effect on health is an empirical question. Moreover, based on the Grossman model, Muurinen (1982) and Case and Deaton (2005) indicate the importance of considering the rate of health deterioration, which is a function including age as a main factor.

In terms of empirical method, many papers simply focus on whether retired or not and do not focus on a change in age effect before and after retirement. Some papers suggest the importance of duration after retirement using retired age (Coe and Zamarro, 2011), years after retirement (Bonsang et al., 2012; Zhu, 2016; Bertoni and Brunello, 2017), and short-

[2] For a systematic review of the retirement effect on different socioeconomic groups, see Schaap et al. (2018). Heide et al. (2014) surveys longitudinal studies investigating the effect of retirement on health.

and long-term retirement (Coe and Lindeboom, 2008; Insler, 2014; Oshio and Kan, 2017). The last group's method is close to this study. However, Coe and Zamarro (2008) and Insler (2014) use short- and long-term retirement dummy, thus there is no findings about the change in age effect on health. On the other hand, Oshio and Kan (2017) finds the change in age effect after retirement. These findings may be a key to understanding the inconsistent results in the literature. Let us here consider the case of negative age effect on health. If retirement has an immediate improving impact on health and strengthens the negative age effect, the improving retirement effect would be canceled in some years, resulting in deteriorating or insignificant effect on health as a total retirement effect in the estimation. Or, if the observed period is short or the immediate retirement effect is relatively large, the effect of retirement would be positive on health.

In addition, as mentioned in Insler (2014), little is known about the mechanism between retirement and health status. To tackle this problem, Insler (2014) finds an improving retirement effect on vigorous activity and smoking as well as on health status, concluding that these health behaviors may affect health. Eibich (2015) and Oshio and Kan (2017) also find a favorable retirement effect on health behaviors like smoking, drinking, and exercise as well as health status, supporting the findings by Insler (2014)[3]. However, Atalay and Barrett (2015) find no effect on health behaviors even finding positive impact of retirement on health. Therefore, understanding the mechanism between retirement and health is still controversial.

Consequently, this study provides three contributions. First, this study examines the change in the age effect after retirement. While Oshio and Kan (2017) already investigates the change in the age effect after retirement using the same data with this study, they use only retirees and observe the years before and after retirement. Including non-retirees as well as retirees in a sample, this study is able to examine the difference in the age effect between retirees and non-retirees even they are the same age. This leads to a better understanding of increase in pensionable age in the future.

[3] Dave et al. (2008) also suggests that participation in physical activity after retirement mitigates the negative health outcome.

Second, the area affected by retirement is expanded to usual activities beyond health behavior. Shiba et al. (2017) suggests that social participation mitigates the adverse effect of retirement on health. Therefore, to understand more about the mechanism between retirement and health, examining what changes after retirement in many related activities is important. This may lead to an understanding of the causes of longevity in Japan.

Third, most study do not take into account an employment status before retirement. As Dave et al. (2008) suggests, working condition before retirement is an important factor when examining the effect of retirement on health. This study estimates the retirement effect on health for each subsample divided by employment status before retirement, specifically, full-time, part-time, and self-employed as well as a whole sample.

2. Data and Variables

2.1 Data

This study uses 11 waves (2005-2015) from the Longitudinal Survey of Middle-aged and Elderly Persons (LSMEP). The LSMEP is a nationally representative longitudinal survey in Japan, which has been conducted each year since 2005 by the Ministry of Health, Labour and Welfare (MHLW). The survey collects the information of work status, health status, health behavior, social activity and so on from male and female in the age of between 50 and 59 in the first wave. The survey is conducted based on Statistics Act of Japan. This study obtains the survey through MHLW's official permission, thus ethical approval is not required.

The number of respondents is 34,240 in the first wave and 22,595 in the 11th wave. The main sample is restricted in some way. First, the sample contains only male respondents because, as described later, pensionable age for female is a little complicated and cannot be identified completely unlike male. Second, respondents who worked in the first wave (assuming that they had been working until the first wave) are used. Third, this study uses respondents who continue to work until the 11th wave or who retired during second and 11th wave. Some respondents re-enter the labor market after retirement are excluded. With respect to this restriction, those who have missing information about work status are excluded from the sample. Fourth, those who are 70 years are excluded from the sample because the number of them is quite small, around 20 observations, and their mean value of some dependent variables are unstable. Fifth, those who are born after April 2nd, 1955 are also excluded from the sample because this cohort does not reach the pensionable age, as mentioned later, even in the 11th wave. The final sample includes 7,300 individuals, however, the number of individuals and observations in each estimation varies depending on the missing value.

2.2 Variables

2.2.1 Dependent variables

This study investigates the effect of retirement on health, disease, health behavior, and usual activity.

Health

Health status includes poor self-rated health, difficulty in activities of daily life (ADL), depression at the survey time. The poor self-rated health ranges from one (very good) to six (very bad), used as an overall health status at the survey time. The difficulty in ADL is a dichotomous variable which takes 1 if respondents have difficulty in ADL and 0 otherwise. As activities of daily life, ten activities are shown in the questionnaire and the respondents take 1 if they have difficulty in at least one of ten activities. The depression variable is the Japanese version of Kessler Psychological Distress Scale (K6) in the past month, ranging from 0 (good) to 24 (bad). The K6 consists of six questions, for example, "During the last 30 days, how often did you feel anxious?" or "During the last 30 days, how often did you feel hopeless?" [4]. This study uses the total score summing up the responses ranging from 0 (never) to 4 (all of the time)[5].

Disease

This study also uses the information about whether the respondents have some diseases at the survey time. More precisely, respondents are asked if they have an outpatient visit or

[4] For more detail, see Furukawa et al. (2008).
[5] While the original score ranges from 1 (all of the time) to 5 (never), the scores are reversed for the ease of interpretation.

take a medicine for diabetes, heart disease, stroke, hypertension, hyperlipidemia, and cancer. These variables take 1 if the respondents have the disease and 0 otherwise.

Health behavior

As a health behavior, drinking, smoking, light exercise, medium exercise, and hard exercise in usual, and health check in the past year are used. The frequency of drinking ranges from 1 (never) to 7 (everyday). The frequncy of exercise also ranges from 1 (never) to 6 (everyday). Other variables are dichotomous variables which take 1 if they do the behavior and 0 otherwise. As for the exercise variables, the light exercise means an exercise does not produce shortness of breath, the medium exercise is an exercise produces a little shortness of breath, and the hard exercise causes shortness of breath.

Usual activity

This study expands the area of analysis to the usual activity. These activities include interaction with neighbors, interaction with friends, housework, and care for grandchildren in usual life. All these variables take 1 if they do or participate in the activity and 0 otherwise.

2.2.2 Retirement

As mentioned in Eibich (2015), definition of retirement varies in the literature. Retirement in this study is defined as complete withdrawal from the labor force. The LSMEP asks the respondents about their work status and intention to work at each survey time. Thus, this study defines the respondents as retirees (1) if they do not work and (2) if they have no intention to work. While some respondents re-enter the labor force after retirement, those respondents are excluded from the sample. In other words, the retirees used in this study means those who retire and continue to be out of the labor market after first retirement.

2.2.3 Covariate

This study uses two covariates other than age: having spouse or not and living with relatives other than spouse or not. Both variables take 1 if the respondents answer “yes” to the question and 0 otherwise. While these variables might be considered endogenous, there is little difference between two estimation results with and without two covariates.

2.2.4 Summary statistics

Table 1 shows summary statistics of the variables and the results of t-test of mean value between non-retirees and retirees. Poor self-rated health and difficulty in ADL show deterioration after retirement, however, depression shows improvement. All disease worsen after retirement. Health behavior and usual activity increase after retirement except health check.

3. Estimation strategy

3.1 Endogeneity problem

Retirement decision is endogenous to health in the sense that both retirement decision and health status may be affected by unobservable individual effects. The endogeneity causes a bias in the retirement effect on health. To avoid the endogeneity problem, this study uses the Instrumental Variable (IV) method, exploiting the assumption that the pensionable age, explained as follows, strongly affects the retirement decision and does not affect health.

Japanese public pension system consists of two part: basic pension which is paid in fixed amount and employee's pension/mutual aid pension (EPMAP) which is paid in proportional amount to income they earned before retirement[6]. While male workers face a same change in pensionable age either for employee's pension or mutual aid pension, female workers face different change in pensionable age between employee's pension and mutual aid pension. Since the LSMEP does not have an enough information about which pension female respondents receive, this study uses only male sample as mentioned before.

To sustain the public pension system, the Japanese government has gradually raised the pensionable age from 60 to 65 and its reform will complete in 2025 for male. The rise to the

[6] Employee's pension is for the employees in private company and mutual aid pension is for employees in public sector and private school.

age of 65 years for the basic pension started in 2001 and finished in 2013. On the other hand, the rise to the age of 65 years for the EPMAP started in 2013 and will have finished in 2025 for male. Table 2 shows male birth cohorts in the LSMEP and its pensionable age. The age they receive full pension benefits varies among cohorts: age of 63 for cohort A, 64 for cohort B, and 65 for cohort C, D, and E. The pensionable age for EPMAP is also different among cohort: age of 60 for cohort A, B, and C, 61 for cohort D, and 62 for cohort E. Moreover, most of respondents face the same mandatory retirement age of 60.

The pensionable age is considered to affect the retirement decision. This study uses this information as instruments in the IV estimation. This study excludes the cohort E, as mentioned before, from the sample because the cohort does not reach the pensionable age even in the 11th wave.

3.2 Estimation equation

Fig. 1 shows a Cumulative Density Function (CDF) and a Probability Density Function (PDF) of retirement by age. The figure of PDF of retirement shows a large increase of retirement after the age of 60. While it is difficult to confirm the effect of pensionable age on retirement because the four cohorts are mixed in the figures, it seems that not a few workers retire at each pensionable age.

From Fig. 2 to 5 show the trajectory of health status, disease, health behavior, and usual activity. Some trajectories show kinks around the age of 60 or 65, indicating the age effect increases or decreases after retirement. To confirm the change in age effect, an interaction term between age and retirement is used in the equation.

The outcome equation is as follows:

$$Health_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Ret_{it} + \beta_3 Age_{it} \times Ret_{it} + \delta \mathrm{X}_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1).$$

Here, $Health$ is one of dependent variables, X is a vector of covariates, μ is an individual fixed effect, λ is a time fixed effect, and ε is an idiosyncratic error term. While the dependent variables in this study include binary, ordinary as well as quantitative variables, Equation (1) is estimated by a linear Fixed Effect (FE) model rather than probit or logit model to be easily understandable[7].

To deal with the endogeneity problem of retirement, the IV estimation is used. First, the Ret and $Age \times Ret$ are estimated using pensionable age dummies, their interaction terms with age as instruments, age, and the same covariates in Equation (1) by the FE model. In the second stage, the Ret and $Age \times Ret$ in Equation (1) are replaced with their predicted values obtained in the first stage estimation.

4. Results

4.1 Effect of retirement in whole sample

The main estimation results by the Instrumental Variable Fixed Effects (IV-FE) model are shown from Table 3 to 6. First of all, two statistical tests prove that the instruments are valid in all equations[8]. First, for the weak instruments test, Kleibergen-Paap rk F statistic are well above the Stock-Yogo critical value of 19.83 for 5% maximal IV relative bias, indicating the instruments strongly affect retirement decision[9]. Second, as for the overidentification test, Hansen J statistic is not rejected, meaning the instruments are valid.

Table 3 shows the results of three health status. Age significantly deteriorates all health status. Retirement has a significant improving impact on poor self-rated health and depression. The coefficients of interaction term between age and retirement for poor self-rated health and depression are positive and statistically significant. This indicates that while retirement has an immediate improving effect on health, accelerates the health deterioration by age at the same time. As for poor self-rated health, the marginal age effects for retirees is increased to 0.030 + 0.049 = 0.079, however, it takes about 42 years to cancel the retirement improving effect –3.287. For depression, the marginal age effect of retirees, 0.182 + 0.422 = 0.604, cancels the improving effect of retirement, –28.193, in about 47 years. In sum, while

[7] Ai and Norton (2003) suggests that the interaction effect in non-linear model cannot be evaluated simply by looking at the sign and significance of the coefficient unlike the linear model.
[8] First stage estimation results for poor self-rated health is shown in Appendix 1.
[9] Stock and Yogo (2005).

retirement accelerate health deterioration, basically improves at least self-rated health and depression.

Table 4 shows the retirement effect on disease. Age s increases the probability of having four diseases: diabetes, heart disease, hypertension, and hyperlipidemia. However, retirement and the interaction term have no significant effect on any diseases. It seems that retirement has no impact on major disease.

Table 5 shows the effect on health behavior. Age decreases drinking, smoking, and health check, on the other hand, increases light and medium exercise. Retirement increases the frequency of medium exercise immediately, however, decreases the opportunity for health check. The signs of the interaction terms show positive for health check and negative for medium exercise. Opportunity for health check decreases right after retirement, however, the decreasing age effect is mitigated by retirement. To the contrary, the frequency of medium exercise increases upon retirement, however, the increasing age effect is weakened by retirement. Comparison between the retirement impact and the age effect by the same calculation in Table 3 suggests that retirement decreases the opportunity for health check and increases the frequency of medium exercise on average.

Finally, Table 6 shows the effect of retirement on usual activity. Age decreases participation in all activities. Retirement increases participation in care for grandchildren immediately. The sign of the interaction terms shows significant negative on care for grandchildren. Participation in caring for children increases upon retirement, however, the increasing age effect is weakened by retirement. Calculating the total retirement effect, it has positive effect on caring for grandchildren.

As mentioned earlier, two covariates, having spouse and living with relatives, might be endogenous in the causal mechanism between retirement and health. To check the robustness of the results, estimation excluding two covariates is performed. The results obtained shows almost the same with from Table 3 from 6. Accordingly, the results only for health status are shown in Table A2 in Appendix 2.

4.2 Effect of retirement by employment status

While the sample used in this study includes part-time employees and self-employed workers, retirement effect for those workers is considered to be smaller. Since the gap between working life and private life may not be large. As a result, retirement effect on health and related indicators may become smaller or nothing. Accordingly, an estimation by three employment status subsamples, full-time employee, part-time employee, and self-employed worker are performed.

In Table7, the top panel shows the results for full-time employee, the middle panel is for part-time employee, and the results for self-employed worker is shown in the bottom panel. The panel of full-time employee shows almost the same results with that in Table 3. The interaction effect on difficulty in ADL becomes slightly significant and positive, indicating retirement may accelerate physical health deterioration too. As for part-time employee and self-employed worker, Kleibergen-Paap rk F statistic is far below the Stock-Yogo critical value of 19.83 for 5% maximal IV relative bias. This means that the estimation results suffer from weak instruments problem, therefore, the interpretation of the results is doubtful. This also suggests that pensionable age is not a valid instrument for their retirement decision because part-time employees and self-employed workers usually have only basic pension and do not have EPMAP. As a result, pensionable age has a weak power to explain the retirement decision of them. The results for the other dependent variables are not shown here because those results show the almost same with Table 7.

5. Discussion

This study finds the improving effect of retirement on poor self-rated health and depression, being consistent with Oshio and Kan (2017) using the same date, but different sample and estimation method. However, this study also finds that the negative age effect becomes larger after retirement on these two health statuses. This means that retirement has certainly improving effect on health in short term, however, accelerate the health deterioration. That is to say, retirement does not necessarily improve elderly people in long term, by canceling the short-term improving effect in their later life. From the academic point of view, the effect of retirement on health can be estimated positive, negative, or no effect depending on the length of observed period and the size of immediate and subsequent effect unless considering the change in age effect after retirement. This may be one of the reasons of the conflicting results in the literature.

How does retirement accelerate the deterioration of self-rated health and depression for Japanese men? One possible reason is that they find pleasure or value in their work rather than in their leisure time. According to Cabinet Office (2015), almost half of sixties male respond that the purpose of work is not for money, rather to find a reason for living (23.2%), to play a role as a member of society (17.7%), and to utilize talent and ability (7.1%). If they lose those purposes after retirement, their health deterioration is likely to be accelerated[10]. The other possible reason is the large difference between work-oriented life and home-oriented life. Japanese male workers usually too much concentrate on their job before retirement and do not care about home life. As a result, spending a lot of time in home-oriented life may be very stressful, resulting in the acceleration of health deterioration.

With regard to the mechanism between retirement and health, three factors are affected by retirement. As improving factors, the increase in the frequency of medium exercise and the participation in caring grandchildren are suggested. These factors may improve self-rated health and depression. However, as a deteriorating effect, this study shows that retirement decreases the opportunity for health check. This is because Japanese employees take health check as one of fringe benefits in their workplace. The health check is considered to be more associated with physical health. In consequence, two sides of effects are canceled for the effect on the difficulty in ADL and all diseases. Or, physical health is not likely to be affected by life change (Coe and Lindeboom, 2008).

Finally, while this is based on a weak evidence, the improving retirement effect on depression is the largest for part-time employees, and there is no effect for self-employed in the estimation by the employment status. This suggests, although contrary to the expectation, that the working stress is the largest for part-time employee, following full-time employee, and self-employed. This result also suggests that the analysis without dividing the sample by

[10] Kajitani (2011) shows that Japanese elderly males prefer to work and their subjective health does not deteriorate even they continue to work in their later life.

the employment status before retirement provides unclear effect of retirement on health and related indicators at least in Japan.

6. Conclusion

This study finds that retirement does increase the deteriorating age effect on health. Retirement basically improves the health of elderly people right after their withdrawal from the labor force. However, the improving effect may be cancelled or mitigated in their later life. To keep the health of older people in long-term, policy that prevent the deterioration in age effect is needed, or the aged workers have to prepare for the life after retirement. In the prolonged longevity society like Japan and the developed nations, this finding has a crucial meaning.policy that encourages older people to continue to work in later life may keep their health.

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Appendix 1

Table A1 shows the results of the first stage estimation for poor self-rated health. Age6062 is an age dummy for partial pension benefits and Age6369 is an age dummy for full pension benefits for cohort A in Table 2. Other age dummies are likewise. The interaction term between age dummy and age, e.g., Age6062×Age, is used to capture a linear piece wise function of retirement as shown in Fig. 1. The other first stage estimation results are omitted here because they are almost the same with that of poor self-rated health.

Appendix 2

Table A2 shows the retirement effect on health status without two covariates: having spouse and living with relatives.

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Table 1. Summary statistics

	N	Mean	S.D.	Min.	Max.	Mean non-retirees	Mean retirees	t-test
Age	80,273	59.938	4.084	50	69	59.624	64.262	***
Poor self-rated health	79,710	2.742	0.891	1	6	2.733	2.857	***
Difficulty in ADL	77,876	0.064	0.245	0	1	0.061	0.105	***
Depression	77,848	2.674	3.625	0	24	2.682	2.558	**
Diabetes	73,990	0.135	0.341	0	1	0.131	0.177	***
Heart disease	73,850	0.061	0.239	0	1	0.059	0.090	***
Stroke	73,639	0.021	0.142	0	1	0.019	0.047	***
Hypertension	74,044	0.333	0.471	0	1	0.326	0.419	***
Hyperlipidemia	73,810	0.160	0.367	0	1	0.159	0.182	***
Cancer	73,647	0.022	0.147	0	1	0.020	0.049	***
Drinking	79,471	4.796	2.321	1	7	4.819	4.482	***
Smoking	80,065	0.349	0.477	0	1	0.354	0.269	***
Health check	79,778	0.758	0.428	0	1	0.769	0.598	***
Light exercise	79,076	2.386	1.910	1	6	2.350	2.872	***
Med exercise	79,100	2.143	1.688	1	6	2.071	3.133	***
Hard exercise	79,145	1.177	0.673	1	6	1.167	1.317	***
Interaction with neighbors	78,454	0.754	0.431	0	1	0.748	0.847	***
Interaction with friends	78,571	0.869	0.338	0	1	0.867	0.893	***
Housework	78,008	0.698	0.459	0	1	0.685	0.872	***
Care for grandchildren	76,619	0.431	0.495	0	1	0.424	0.533	***
Having spouse	79,695	0.890	0.313	0	1	0.893	0.842	***
Living with relatives	80,208	0.641	0.480	0	1	0.651	0.494	***

Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 2 Pensionable age and birth cohort

Birth cohort (mm/dd/yyyy)	Pensionable age	
	Basic pension	Employee's pension/mutual aid pension
(A) 04/02/1945-04/01/1947	63	60
(B) 04/02/1947-04/01/1949	64	60
(C) 04/02/1949-04/01/1953	65	60
(D) 04/02/1953-04/01/1955	65	61
(E) 04/02/1955-04/01/1956	65	62

Source: Annual Health, labour and Welfare Report 2011, Ministry of Health, Labour and Welfare

Table 3. Retirement effect on health status

	Poor self-rated health		Difficulty in ADL		Depression	
Age	0.030	***	0.008	***	0.182	***
	(0.010)		(0.003)		(0.042)	
Retirement	–3.287	**	–0.412		–28.193	***
	(1.296)		(0.440)		(5.108)	
Age×Retirement	0.049	**	0.008		0.422	***
	(0.019)		(0.006)		(0.074)	
F	20.79	***	17.03	***	8.02	***
Kleibergen-Paap rk Wald F	32.542		32.321		32.433	
Hansen J	13.282		8.465		15.633	
p-value	(0.349)		(0.748)		(0.209)	
# of observations	79088		77290		77269	
# of individuals	7300		7300		7295	

Controlled for having spouse, living with relatives other than spouse, and waves.
Standard errors are in parethesis and are clustered on the individual level.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Retirement effect on disease

	Diabetes		Heart disease		Stroke		Hypertension		Hyperlipidemia		Cancer	
Age	0.012	***	0.009	***	0.001		0.047	***	0.039	***	–0.001	
	(0.002)		(0.002)		(0.001)		(0.004)		(0.004)		(0.001)	
Retirement	–0.291		–0.148		–0.212		–0.347		0.214		–0.177	
	(0.422)		(0.383)		(0.251)		(0.639)		(0.525)		(0.321)	
Age×Retirement	0.004		0.003		0.004		0.005		–0.005		0.004	
	(0.006)		(0.006)		(0.004)		(0.009)		(0.008)		(0.005)	
F	35.01	***	24,16	***	8.72	***	135.43	***	30.98	***	16.00	***
Kleibergen-Paap rk Wald F	31.478		31.270		31.118		31.397		31.442		31.362	
Hansen J	16.288		9.286		12.039		11.874		14.432		8.228	
p-value	(0.178)		(0.678)		(0.443)		(0.456)		(0.274)		(0.767)	
# of observations	73454		73316		73104		73510		73276		73115	
# of individuals	7295		7295		7295		7295		7295		7295	

Controlled for having spouse, living with relatives other than spouse, and waves.
Standard errors are in parethesis and are clustered on the individual level.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Retirement effect on health behavior

	Drinking	Smoking	Health check	Light exercise	Med exercise	Hard exercise
Age	–0.039 ***	–0.023 ***	–0.020 ***	0.084 ***	0.073 ***	–0.011
	(0.011)	(0.003)	(0.004)	(0.023)	(0.017)	(0.007)
Retirement	2.786	–0.009	–2.410 ***	–0.873	8.450 ***	0.305
	(2.188)	(0.569)	(0.753)	(3.036)	(2.721)	(1.109)
Age×Retirement	–0.052	–0.002	0.029 ***	0.023	–0.106 ***	–0.001
	(0.032)	(0.008)	(0.011)	(0.044)	(0.040)	(0.016)
F	19.06 ***	96.49 ***	51.37 ***	65.56 ***	64.13 ***	4.38 ***
Kleibergen-Paap rk Wald F	32.284	32.403	32.444	32.441	32.467	32.457
Hansen J	16.40	15.862	7.438	13.564	16.01	14.722
p-value	(0.174)	(0.198)	(0.827)	(0.329)	(0.191)	(0.257)
# of observations	78852	79431	79150	78473	78498	78541
# of individuals	7300	7300	7300	7300	7300	7300

Controlled for having spouse, living with relatives other than spouse, and waves.

Standard errors are in parethesis and are clustered on the individual level.

Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Retirement effect on usual activity

	Interaction with neighbors	Interaction with friends	Housework	Care for grandchildren
Age	0.024 ***	0.019 ***	0.098 ***	0.052 ***
	(0.006)	(0.005)	(0.006)	(0.006)
Retirement	0.230	–0.153	0.448	2.986 ***
	(0.637)	(0.517)	(0.692)	(0.820)
Age×Retirement	–0.005	–0.000	–0.005	–0.041 ***
	(0.009)	(0.007)	(0.010)	(0.012)
F	345.35 ***	173.18 ***	604.06 ***	461.32 ***
Kleibergen-Paap rk Wald F	32.224	32.323	32.281	31.423
Hansen J	12.601	9.730	17.287	14.551
p-value	(0.399)	(0.640)	(0.139)	(0.267)
# of observations	77869	77988	77438	76050
# of individuals	7297	7297	7297	7297

Controlled for having spouse, living with relatives other than spouse, and waves.

Standard errors are in parethesis and are clustered on the individual level.

Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 7. Estimation by employment status

Full-time employee	Poor self-rated health	Difficulty in ADL	Depression
Age	0.033 ***	0.006 *	0.167 ***
	(0.011)	(0.003)	(0.047)
Retirement	–3.186 ***	–0.642	–25.035 ***
	(1.210)	(0.404)	(4.607)
Age×Retirement	0.047 ***	0.011 *	0.377 ***
	(0.018)	(0.006)	(0.067)
F	10.77 ***	11.99 ***	9.60 ***
Kleibergen-Paap rk Wald F	32.024	31.801	32.027
Hansen J	16.801	16.042	15.491
p-value	(0.157)	(0.189)	(0.216)
# of observations	56034	54992	55024
# of individuals	5164	5164	5162
Part-time employee	**Poor self-rated health**	**Difficulty in ADL**	**Depression**
Age	0.007	0.008	0.199
	(0.044)	(0.014)	(0.218)
Retirement	–5.163	0.994	–59.768 **
	(5.716)	(2.325)	(28.498)
Age×Retirement	0.077	–0.013	0.890 **
	(0.084)	(0.034)	(0.417)
F	2.28 ***	1.59 *	1.11
Kleibergen-Paap rk Wald F	2.862	2.775	2.755
Hansen J	11.526	12.999	6.717
p-value	(0.484)	(0.369)	(0.876)
# of observations	4998	4843	4842
# of individuals	463	463	461
Self-employed	**Poor self-rated health**	**Difficulty in ADL**	**Depression**
Age	0.021	0.012 *	0.224 **
	(0.022)	(0.007)	(0.094)
Retirement	7.292	3.839	–23.389
	(12.812)	(4.716)	(49.023)
Age×Retirement	–0.098	–0.049	0.324
	(0.183)	(0.068)	(0.694)
F	10.14 ***	4.33 ***	2.40 ***
Kleibergen-Paap rk Wald F	1.291	1.310	1.249
Hansen J	8.260	4.497	17.837
p-value	(0.765)	(0.923)	(0.121)
# of observations	18056	17455	17403
# of individuals	1673	1673	1672

Controlled for having spouse, living with relatives other than spouse, and waves.

Standard errors are in parethesis and are clustered on the individual level.

Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table A1 First stage estimation for poor self-rated health

Dependent	Ret			Age×Ret		
	Coef.	S.E.	p-value	Coef.	S.E.	p-value
Age	0.001	0.001	0.400	0.035	0.055	0.518
Age6062	–1.155	0.214	0.000	–73.62	13.25	0.000
Age6369	–1.865	0.183	0.000	–136.59	12.22	0.000
Age6063	–1.162	0.124	0.000	–75.93	7.79	0.000
Age6469	–1.840	0.238	0.000	–133.40	15.78	0.000
Age6064	–1.258	0.133	0.000	–82.78	8.42	0.000
Age6569	–2.037	0.854	0.017	–145.23	56.59	0.010
Age6164	–0.674	0.669	0.314	–43.30	41.64	0.298
Age6062×Age	0.020	0.004	0.000	1.251	0.220	0.000
Age6369×Age	0.031	0.003	0.000	2.264	0.190	0.000
Age6063×Age	0.020	0.002	0.000	1.289	0.130	0.000
Age6469×Age	0.031	0.004	0.000	2.214	0.244	0.000
Age6064×Age	0.021	0.002	0.000	1.408	0.140	0.000
Age6569×Age	0.034	0.013	0.010	2.404	0.871	0.006
Age6164×Age	0.012	0.011	0.283	0.755	0.684	0.270
Having spouse	0.018	0.010	0.070	1.146	0.639	0.073
Living with relatives	–0.005	0.004	0.176	–0.325	0.244	0.183
Wave3	0.001	0.001	0.618	0.046	0.081	0.573
Wave4	0.003	0.002	0.191	0.200	0.145	0.167
Wave5	0.002	0.003	0.489	0.163	0.200	0.414
Wave6	0.007	0.004	0.127	0.426	0.261	0.103
Wave7	0.008	0.005	0.121	0.517	0.319	0.105
Wave8	0.009	0.006	0.169	0.547	0.375	0.145
Wave9	0.013	0.007	0.072	0.850	0.447	0.057
Wave10	0.016	0.009	0.073	1.057	0.550	0.055
Wave11	0.030	0.011	0.007	2.049	0.697	0.003
# of observations			79088			
# of individuals			7300			

Table A2 Retirement effect on health status without covariates

	Poor self-rated health	Difficulty in ADL	Depression
Age	0.030 ***	0.008 ***	0.186 ***
	(0.010)	(0.003)	(0.041)
Retirement	–3.347 **	–0.463	–29.022 ***
	(1.295)	(0.438)	(5.121)
Age×Retirement	0.050 ***	0.009	0.435 ***
	(0.019)	(0.006)	(0.074)
F	24.11 ***	19.79 ***	8.96 ***
Kleibergen-Paap rk Wald F	32.768	32.606	32.735
Hansen J	13.739	8.495	14.628
p-value	(0.318)	(0.745)	(0.262)
# of observations	79710	77876	77844
# of individuals	7300	7300	7295

Controlled for only waves.

Standard errors are in parethesis and are clustered on the individual level.

Significance: *** p<0.01, ** p<0.05, * p<0.1.

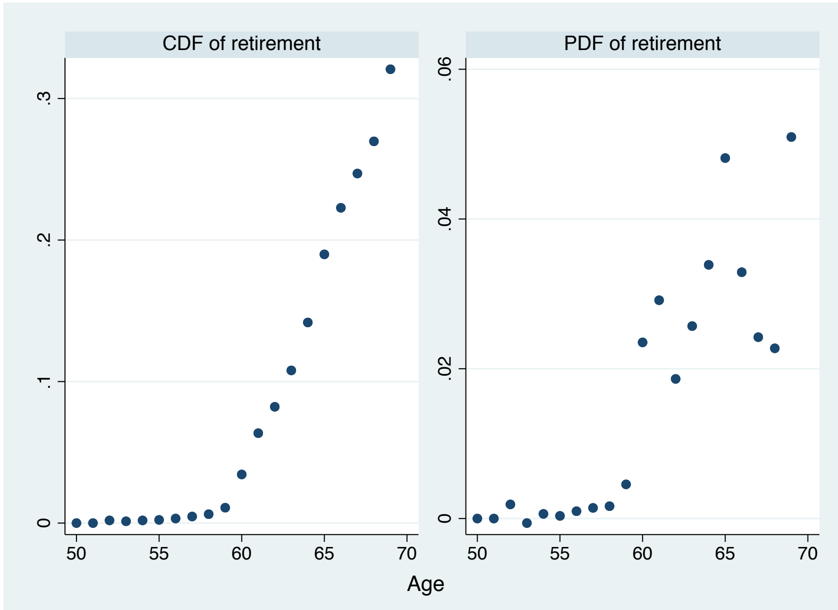

Fig.1. CDF and PDF of retirement by age

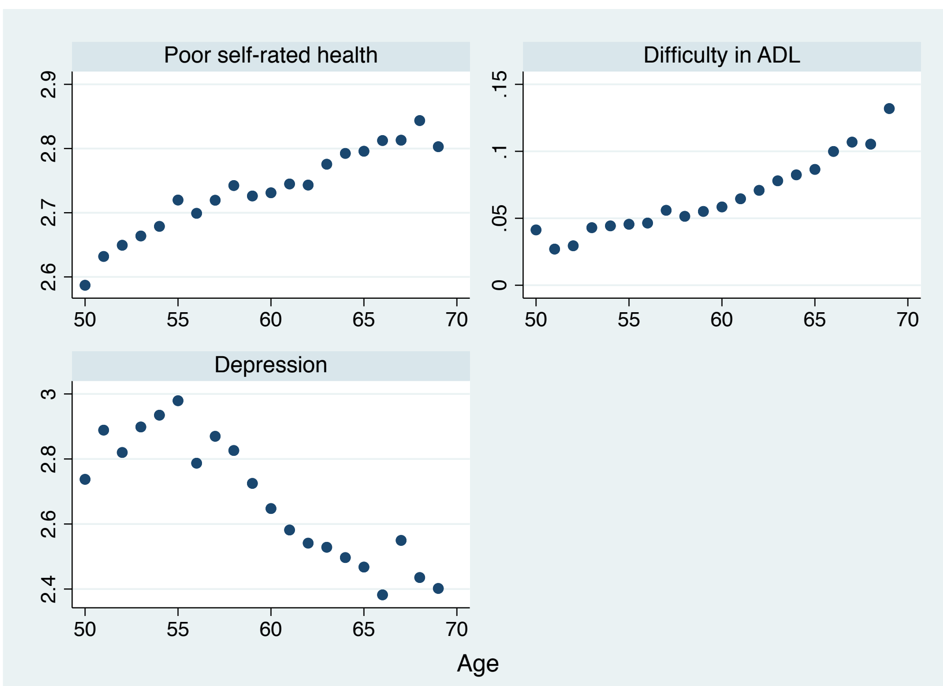

Fig. 2. Trajectory of health status

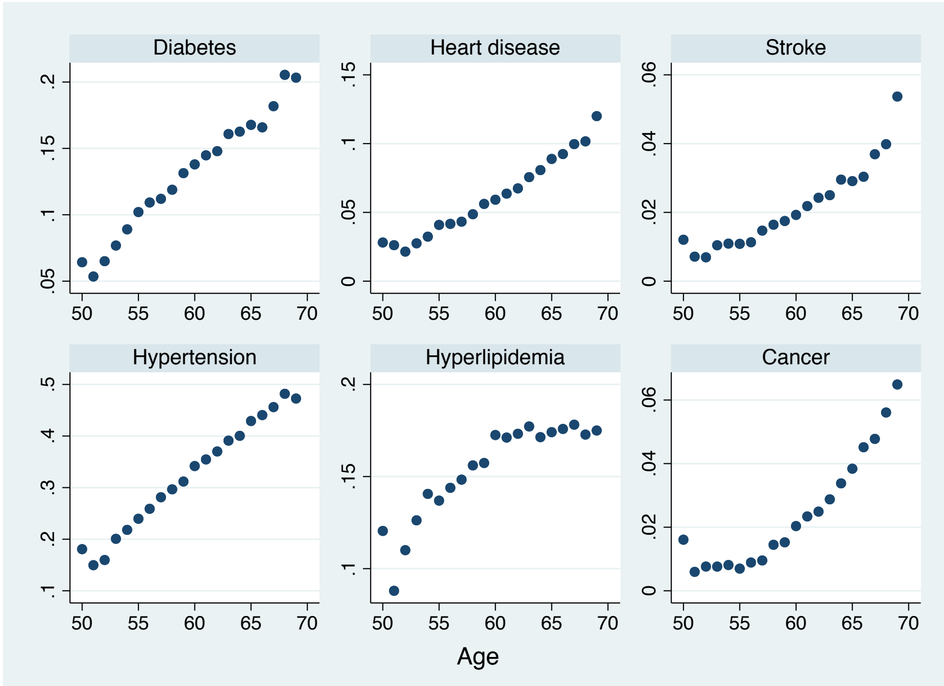

Fig. 3. Trajectory of disease

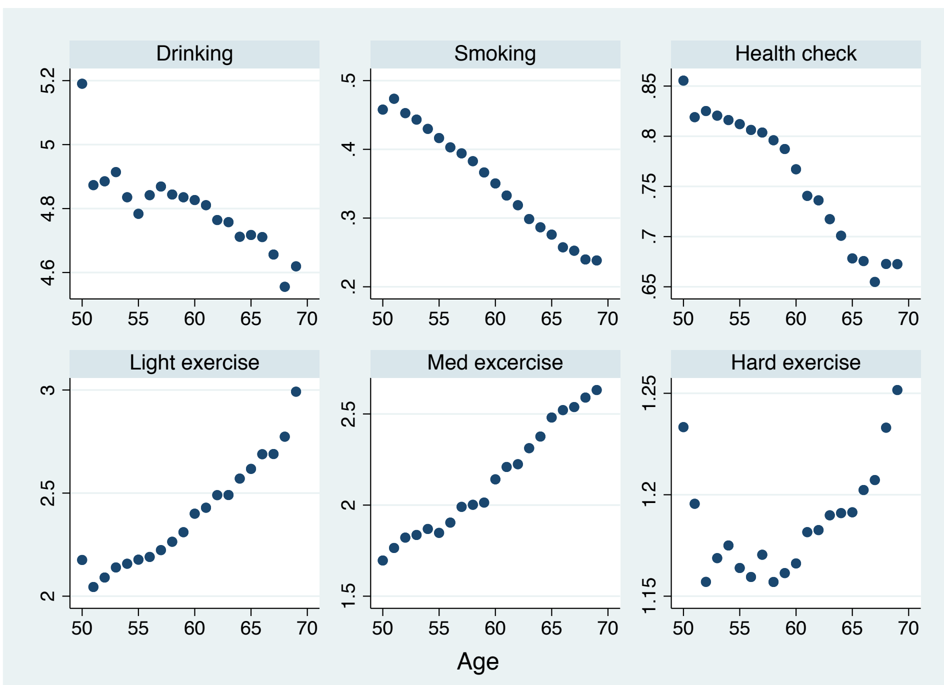

Fig. 4. Trajectory of health behavior

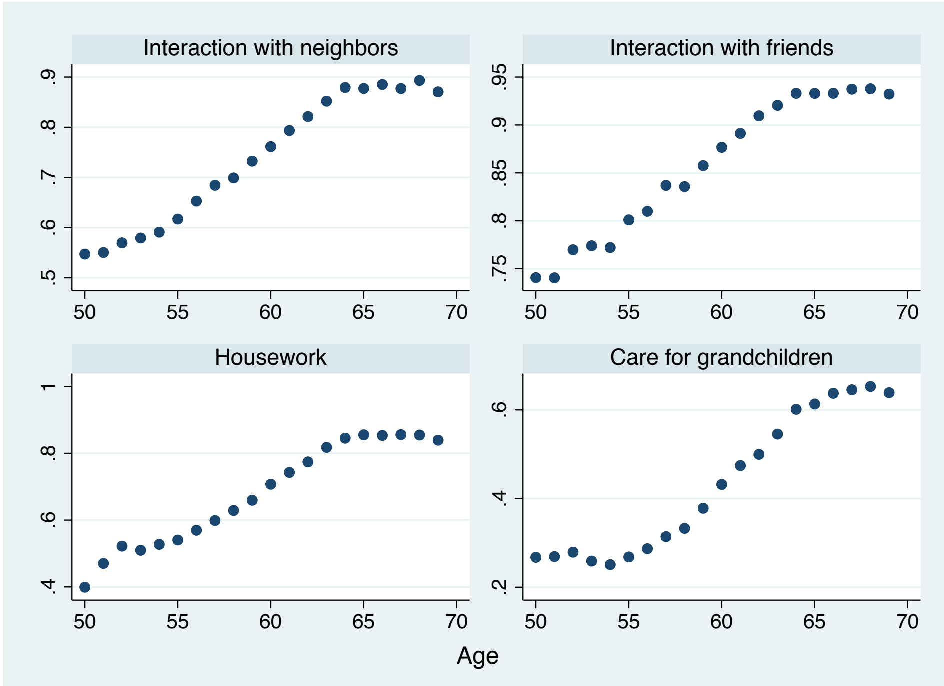

Fig. 5. Trajectory of usual activity