RIETI Discussion Paper Series 15-E-068

Does Retirement Change Lifestyle Habits?

MOTEGI Hiroyuki
University of Tokyo

NISHIMURA Yoshinori
University of Tokyo

TERADA Kazuyuki
University of Tokyo

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 15-E-068
May 2015

Does Retirement Change Lifestyle Habits?[1]

MOTEGI Hiroyuki, NISHIMURA Yoshinori, TERADA Kazuyuki
Graduate School of Economics, the University of Tokyo

Abstract

This paper studies the effect of retirement on lifestyle habits, including drinking, smoking, exercise, and sleeping, by using panel data from the Japanese Study of Aging and Retirement (JSTAR). Rich information in JSTAR enables us to use an interesting instrumental variable to account for endogeneity. We have three contributions in this paper. This is the first paper that focuses on and investigates the mechanism of the relation between retirement and health, namely, lifestyle habits. Second, new results show that people reduce drinking after retirement and increase sleeping time on weekdays although smoking, frequency of exercise, and sleeping time on holidays seem to be unchanged. Third, controlling important factors also allows us to inspect the detailed channels between retirement and lifestyle habits. Our estimation suggests that the peer effect in the workplace may be influential mainly on drinking habits.

Keywords: Lifestyle habits, Japanese elderly people, Mandatory retirement, Instrumental variable, Local average treatment effect (LATE), Fixed effect
JEL classification: I00, I100, I120, I190, J260

[1]This study is conducted as a part of the Project "Toward a Comprehensive Resolution of the Social Security Problem: A new economics of aging" undertaken at Research Institute of Economy, Trade and Industry (RIETI). The authors would like to thank Hideki Hashimoto, Hidehiko Ichimura, Masaaki Imaizumi, Nobuyoshi Kikuchi, Ryuichi Tanaka, Masanori Tsuruoka, Meng Zhao and the seminar participants at RIETI-JER Workshop, Policy Modeling Workshop at GRIPS and at Tokyo Institute of Technology for helpful comments. The Japanese Study of Aging and Retirement (JSTAR) was conducted by the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University, and the University of Tokyo. We are responsible for all errors and interpretations.

1 Introduction

Nowadays, there are many discussions about reforms of social security system in developed countries. Social security expenditure accounts for a large percentage of whole government expenditure, tightening national finance. Increasing life expectancy due to progress of medical technology allows people to work at higher ages. Many developed countries, facing the problem of a low birth rate and an aging population, have been trying to make use of labor force of elderly people who are still able to work. For such reasons, the governments in developed countries must take policies to cut social welfare spending and raise worker's retirement age. For example, they have raised the pensionable age and further postponement is under consideration.[1] These polices succeed in delaying the retirement of workers and cutting costs of social security.[2]

Policymakers' evaluation on such policies may be inaccurate because the relation between health and retirement has not yet examined enough. Whether the effect of retirement on health is beneficial or harmful should be taken into account of the evaluation on retirement policy. If the increase in the pensionable age encouraged elderly people to work more and retirement worsened health, we would underestimate the impact of raising the pensionable age on social welfare since the evaluations of the retirement policy have so far ignored the impact on health and medical cost.[3] Inspecting the impact of retirement on health is required so as to more accurately evaluate the retirement policy.

To examine the relation between retirement and health is an important question not only as a practical economic policy question but also as an econometric question estimating dynamic structural model about labor supply. All structural models assume that transition of health status is exogeneous even although it may be endogeneous. For example, French (2005) develops a dynamic life cycle model including asset accumulation and uncertainty about death shocks, subjective health shocks and wage shocks. He provides an empirical analysis of the effects of the social security system and liquidity constraints on life cycle labor supply. He finds that shifting the early retirement age has little effect on labor supply by counter factual simulation. There are many models including other factors based on French (2005) such as French and Johns (2011), which includes health insurance. Their model assumes that people decide to retire or not given exogenous subjective health shocks. As we mentioned before, there is possibility that retirement affect their health so that we must take the possibly endogenous relation between retirement and health into considerations when estimating a structural model.[4] Examining the existence of causality that retirement has an influence on health is a challenging question from the aspect of test of economic theory.

A number of studies have investigated the relation between retirement and health over the last decades. Charles (2004), Coe and Zamarro (2011), Insler (2014), Johnston and Lee (2009) and Rohwedder and Willis (2010) are representative papers studying the effect of retirement on health. Most of the studies apply unique identification strategies such as instrumental variables method, regression discontinuity or fixed effects method. There are, however, no unifying views about the impact of retirement on health. Some studies conclude that retirement has an positive impact on health defined as mental health or physical health, but other studies conclude that retirement has no or negative effect.

We also measure impact of retirement on health such as subjective health, mental health, BMI,

[1] In another view, the governments in developed countries have raised the pensionable age to cut social security expenditure and elderly people must work longer to earn an income until they become eligible to receive pension.

[2] See Staubli and Zweimüller (2013) and Mastrobuoni (2009).

[3] Of course, there are other effects such as shifting the loss to younger workers.

[4] They assume exogeneity of health shocks for modeling and computational simplicity.

grip strength, ADL and IADL through OLS and IV estimation by using the panel data of the Japanese Studies of Aging and Retirement (JSTAR).[5] Our results are also different from above the previous researches. Why are there differences in views of the relation between health and retirement across each paper? Some reasons can be considered. Health variables are very sensitive and may include measurement errors. Furthermore, especially JSTAR has only three periods panel data. It takes much time for a change of health conditions to come out after retirement due to the nature of it.

In addition, it is important to examine the mechanism how retirement influences on health to explain the different results so as to obtain a consistent view about relations between retirement and health. There are two researches to analyze this mechanism although there are many researches to investigate the effect of retirement on health. Insler (2014) confirmed the effect of retirement on health and investigated the the channels in subanalysis. Insler (2014) finds the effect of retirement on lifestyle habits as channels by using HRS in the United States. Insler (2014) concludes that retirement increases exercise and decreases smoking by using fixed effects logit models. Insler (2014) cannot control other factors such as health conditions and the result is not very robust, so that there is a room for improvement. Zhao et al (2014), which is independent of our papers, also analyzes the effect of retirement on health investment behavior by using Japanese data which is different from JSTAR.[6]

We consider retirement possibly affects health through two channels. First, retirement changes people's daily lifestyle and strength healthy behavior so that new habits have good influence on their health as Insler (2014) considers. People, for instance, exercise more for their health after retirement. Second, retirement itself recovers their health. This is because, for example, a relief from pressure due to workload would improve health after retirement. We would like to focus on the first channel because it can have a room for improvement from the policy perspectives. Medical literatures prove that drinking, smoking, exercise and sleeping have a remarkable impact on health. For example, C. Arden Pope III et al (2009) finds that a carcinogenic substance in cigarette is a cause of lung cancer and fine particulate matter exposure by smoking including smokeless tobacco derives cardiovascular diseases. There are other medical literatures studying the relationship between above lifestyle habits and health.[7] Drinking and smoking mainly cause circulatory system disease which account for a large percentage of whole government medical expenditure.[8] Analyzing the effect of relief from stress on daily life habits is also important so as to inspect the mechanism between them. This paper, therefore, investigates whether retirement changes people's behavior such as drinking, smoking, exercise and sleeping or not and furthermore inspects these channels.

There are three contributions in this paper. First, this paper is first paper to focus on and investigate the mechanism of the relation between retirement and health, that is lifestyle habits. Second, we find new and robust results by using a valid instrumental variable. Third, we inspect the channels in which retirement affects lifestyle habits. There is no research about the channels between retirement and lifestyle habits.

[5]The appendix discusses this issue.

[6]They do not, however, restrict the sample to the people who smoke or drink before retirement so that the results may represent people who do not smoke or drink from the beginning. In addition, some important factors like health status and individual heterogeneity are not controlled.

[7]See Hashibe et al (2007), Jemal et al (2008), Gottlieb et al (2006) and Broderick et al (2007).

[8]Circulatory system disease account for 20.5% of whole medical expenditures (5793.3 billion yen) and also account for 26.7% in the case of restricting more than 65 years old age people in 2012. Neoplasm like cancer also account for 13.5% of whole medical expenditures (3812 billion yen) and also account for 13.7% in the case of restricting more than 65 years old age people in 2012. (Ministry of Health, Labour and Welfare (2012))

We analyze the latest longitudinal data set from JSTAR, which includes valuable information about Japanese elderly people. We apply the instrumental variables method and fixed effects regression. JSTAR asks whether respondents have ever experienced mandatory retirement or not, and the variable is used as an instrumental variable. We justify that mandatory retirement satisfies IV conditions by using JSTAR. The results to be shown in the following section reveal that people decrease drinking and increase sleeping time on weekdays, but do not change the amount of smoking, time for exercise and sleeping time on holidays. Furthermore, the peer effect in the workplace is likely considered as the main factor about changes of the amount of drinking.

The rest of this paper is arranged as follows. Section 2 explains the inspection of hypothesis in detail. Section 3 describes the data. Section 4 explains our estimation methods and identification strategies. Section 5 shows instrumental validity and main results. Section 6 concludes this research and discusses future extensions.

2 Inspection of Hypothesis

We examine whether retirement from labor market changes people's lifestyle habits such as drinking, smoking, exercise and sleeping or not. Exercise and sleeping are different from drinking and smoking in the way that retirement affects on such practices. This is because on the one hand exercise and sleeping are regarded as health promoting behavior, but on the other hand drinking and smoking are regarded as health diminishing behavior. Tobacco and alcohol are also physical goods, but exercise and sleeping are not. In addition, people can get utility from consuming tobacco and alcohol, but cannot get it from exercise and sleeping themselves for ordinary people.

Why do people change lifestyle habits after retirement? Inspecting the channel one by one is indispensable. We exclude the situations as follows.[9] Some people change preference for daily practices after retirement, but preference is constant over time in economics as deep parameter. We follow this convention. In addition, changes in prices of alcohol and tobacco alters consumption of them. But both alcoholic price and cigarettes price show no change in the sample periods.[10] Furthermore, the sharp decrease of income after retirement may keep people from drinking and smoking, but this possibility can be rejected. This is because people can foresee the mandatory retirement and the pension eligibility age. Rational agents smooth consumption. Income and asset are controlled in our econometric analysis.

We raise two channels between retirement and drinking and smoking as hypotheses. First, people drink and smoke for mental stress such as working pressure and owing to job relations before retirement. After quitting jobs, people decrease or stop smoking for no need of it because of being released from job-related mental stress. In medical and psychological literatures, the fact that there are relations between mental conditions and taking alcohol, and mental conditions and smoking is confirmed.[11] Second, people drink and smoke for job communications including reception and drinking party, which is a kind of peer effect. They sometimes drink and smoke because fellow workers do them. In economic literatures, there have been numerous studies about the peer effect of smoking such as Powell et al (2005). The same discussion about the peer effect of smoking

[9] Other channels except those in this paper can be considered. For example, many local governments have instituted by-law of banning smoking in a road in the 2000s, but we assume that this by-law has no effect on people and people have continued to smoke in a smoking area.

[10] The tax of cigarettes has changed in 2010, but we do not use the 3rd period about smoking analysis due to a defect of data.

[11] Cooper et al (1995) and Hasin et al (2005) are representative studies.

behavior is applied to drinking behavior directly.[12] However, drinking with bosses and business clients are sometimes a part of tasks in the Japanese culture. There are two causes of over-drinking in the workplace; one is the peer effect and the other is drinking at work. This research focuses on these channels that are not identified perfectly by our data unfortunately. We construct the hypothesis that the amount of drinking and smoking decrease after retirement because of stress or peer effect.

About exercise and sleeping, we can expect the other channel, that is, a time allocation channel and retirement promotes exercise. We assume that people cannot exercise and sleep for time constraint while working. We can think that people just change time allocations between time for exercise, sleeping and labor hours. They use redundant time resulting from job retirement on investing health. This hypothesis is not applicable about drinking and smoking because people spend less time on them from the beginning.

In addition, only exercise and sleeping can be reinterpreted in the framework of Grossman (1972). Grossman (1972) thought of health as a capital stock variable. Health depreciates like capital stock and people invest in health, for example, by exercise and buying healthy good in each period.[13] An opportunity cost of exercise, that is the price of health investment, is high while working, but decreases after retirement in most cases. It depends on magnitude of substitution effect and income effect of changing of cost of exercise whether time for exercise and sleeping increases or not.

We cannot come up with the consistent model explaining the four lifestyle habits based on Grossman (1972) because the characteristics of those goods are totally different. Drinking and smoking can be considered as disinvestment behavior in health stock and consumption of physical goods. The cost of drinking and smoking is the price of tobacco and alcohol. In contrast, exercise and sleeping can be considered as health investment behavior and they are not physical goods. The cost of exercise and sleeping is only an opportunity cost. This paper does not propose a concrete economic model and focuses on reduced form estimation.

3 Data

This paper uses the Japanese Study of Aging and Retirement (JSTAR) to analyze the effect of retirement on lifestyle habits. JSTAR is a panel survey of elderly people aged 50 or older in other countries such as the China Health and Retirement Longitudinal Study (CHARLS), the English Longitudinal Survey on Aging (ELSA), the Health and Retirement Study (HRS) in the United States, the Korean Longitudinal Study of Aging (KLoSA), the Longitudinal Aging Study in India (LASI) and the Survey on Health, Aging, and Retirement in Europe (SHARE). The survey years are 2007, 2009 and 2011. The number of observations is about 4291 in the first period. JSTAR includes a rich variety of variables to capture living aspects in terms of economic status, health status, family background, as well as social and work status.

The reason why we use JSTAR is that the rich information in JSTAR enables us to use mandatory retirement system as IV and control health conditions. Especially health conditions are interviewed in detail in JSTAR and the information is very important in this analysis. In addition, the other detailed questionnaire is essential for accurate analysis. For example, we can define retirement accurately as explained in the estimation method section. We mainly use the Harmonized JSTAR

[12] Lundborg (2006).

[13] Becker (2007), which extended Grossman (1972), interprets health stock as a survival probability.

data set.[14] When variables which we want to use are not available in the Harmonized JSTAR, we use the original variables in JSTAR. Table 1 shows summary statistics. "Cigarettes smoked" represents how many cigarettes people smoke per day[15], and "Alcohol intake" represents how much gram people take alcohol per day. "Frequency of heavy exercise" is a variable which takes the value of one if people answer they do heavy exercise at least once or twice a month.

Table 1: Summary Statistics (JSTAR)

	2007			2009			2011		
Variable	Mean	(s.d.)	N	Mean	(s.d.)	N	Mean	(s.d.)	N
Smoking frequency	4.483	(9.598)	3940	3.766	(8.738)	4069	2.879	(7.389)	1951
Alcohol intake	13.437	(24.931)	3773	11.979	(23.428)	4134	12.073	(21.889)	5367
Avg. daily sleeping time (weekday)			0	4.635	(2.61)	2395	5.13	(2.651)	3082
Avg. daily sleeping time (holiday)			0	5.952	(3.1)	3052	6.467	(3.183)	4215
Heavy exercise Dummy			0	0.127	(0.333)	2796	0.126	(0.332)	3297
Not working for pay	0.434	(0.496)	4148	0.494	(0.5)	4558	0.49	(0.5)	5667
Male	0.5	(0.5)	4164	0.491	(0.5)	5731	0.48	(0.5)	7913
Age	62.869	(7.046)	4160	64.528	(7.181)	4617	65.578	(7.285)	5031
Age squared / 100	40.022	(8.846)	4160	42.155	(9.237)	4617	43.535	(9.532)	5031
Education (high school)	0.535	(0.499)	4142	0.553	(0.497)	5699	0.575	(0.494)	7870
Education (college)	0.123	(0.329)	4142	0.132	(0.339)	5699	0.161	(0.367)	7870
Married	0.814	(0.389)	4152	0.789	(0.408)	4554	0.786	(0.41)	5637
Number of children	2.054	(0.974)	4157	2.104	(1.129)	4575	1.976	(1.104)	5662
Logged income	14.894	(2.086)	3972	14.647	(2.394)	4347	14.743	(2.07)	5319
Own house	0.887	(0.394)	4036	0.848	(0.435)	4360	0.847	(0.437)	5496
Bad Health Dummy	0.188	(0.391)	4145	0.176	(0.381)	4571	0.154	(0.361)	5678
Depression Dummy	0.14	(0.347)	4120	0.146	(0.353)	4149	0.158	(0.365)	5313
Any IADL Difficulty	0.088	(0.283)	4036	0.085	(0.279)	4202	0.082	(0.274)	5363
Pressure due to workload	0.229	(0.42)	4128	0.175	(0.38)	4514	0.19	(0.393)	5609
Physical labor	0.251	(0.434)	4133	0.222	(0.416)	4521	0.222	(0.416)	5612

We can easily confirm the transition of lifestyle habits without econometric analysis. In Table 2, we summarize the transition pattern of smoking behavior. In Table 2, we can observe that the ratio of the transition pattern 'Smokes at t → Does not smoke at t+1' is a little larger in the group who have the transition "Work → Not Work" in "2007 → 2009" case (15% compared to 13%). "2009 → 2011" case also shows the same tendency (31% compared to 21%). In Table 3, the number of cigarettes smoked decreases more in the group who have the transition "Work → Not Work" (-1.2 compared to -0.7). Especially male respondents decrease smoking more than female respondents. It is possible that the change of work status "Work → Not Work" leads workers to stop or decrease smoking behavior. This evidence might support the two hypotheses that stress in the workplace tempts people to smoke and that colleagues in the workplace influence workers' behavior. However, it is possible that people stop or decrease smoking behavior because people take care of their health as they get older. In Table 4, we observe that people are not likely to smoke after they become older. We have to control the effect of age in econometric analysis.

In Table 5, people are not likely to drink after they stop working(-4.66 compared to 0.92 in "2007

[14]The program code to generate the Harmonized JSTAR dataset from the original JSTAR dataset is provided by the Center for Global Aging Research, USC Davis School of Gerontology and the Center for Economic and Social Research (CESR). Some variables like asset and income are imputed by this code

[15]How much cigarette tar do people smoke is an ideal measure for this analysis, but JSTAR do not have this measure.

Table 2: The Transition Pattern of Smoking Behavior

2007 → 2009 (Work → Work)	Smokes at $t+1$ (Obs)	Does not smoke at $t+1$ (Obs)
Smokes at t	87%(317)	13% (47)
Does not smoke at t	2%(21)	98% (935)
2007 → 2009 (Work → Not Work)	Smokes at $t+1$ (Obs)	Does not smoke at $t+1$ (Obs)
Smokes at t	85% (56)	15% (10)
Does not smoke at t	3% (5)	97% (161)
2009 → 2011 (Work → Work)	Smokes at $t+1$ (Obs)	Does not smoke at $t+1$ (Obs)
Smokes at t	79% (286)	21% (77)
Does not smoke at t	1% (14)	99% (991)
2009 → 2011 (Work → Not Work)	Smokes at $t+1$ (Obs)	Does not smoke at $t+1$ (Obs)
Smokes at t	69% (31)	31% (14)
Does not smoke at t	2% (3)	98% (180)

→ 2009" and -0.98 compared to -0.48 in "2009 → 2011" cases).[16] In addition, male respondents decrease alcohol more in "2007 → 2009" case than "2009 → 2011". There is the same tendency in smoking behavior. However, as in Table 6, average drinking amount decreases when people become older. We cannot identify the retirement effect and the age effect in these tables and we also have to control the age effect in econometric analysis as to drinking behavior.

In Table 7 and 8, we show the transition of sport habit. "Increase" in Table 7 and 8 means that a respondent increased the frequency of exercise from 2nd wave to 3rd wave. We can observe that there is not large difference between the transition "Work → Not Work" and the transition "Work → Work" in both heavy exercise and light exercise cases. We must consider this situation in detailed by econometric analysis.

Finally, Table 9 show that the ratio of the transition pattern "Increase" of sleeping time on weekdays is a little larger in the group who have the transition "Work → Not Work"(55% compared to 40%). This is very intuitive because we can easily imagine that people can sleep longer for no need to prepare work in tomorrow. In contrast, people do not increase sleeping time in holidays after retirement.

4 Estimation Method

4.1 Estimation Model

This section presents the estimation methods. First, we use ordinary least squares (OLS) as a baseline model. We estimate an equation of the form:

$$y_i = \beta_0 + \beta_1 NWi + X_{1i}\delta_1 + \epsilon_{1i} \tag{1}$$

In the following model, i is individual, X_{1i} is a set of exogenous control variables that include gender, age[17], education level[18], marital status, the number of children, income, owning house, bad

[16]For example, 500ml beer contains about 20g alcohol.

[17]Base of age is less than 54 years old.

[18]Base of education level is junior high school.

Table 3: The Change of Smoking Amount

Change in working status (Obs)	Change in the number of cigarettes smoked per day
Work → Work (1293)	-0.7
(male) (790)	-1.0
(female) (503)	-0.3
Work → Not Work (230)	-1.2
(male) (136)	-1.8
(female) (94)	-0.3

Table 4: The Smoking Rate in 2007

	Female		Male	
Age	Yes (Obs)	No (Obs)	Yes (Obs)	No (Obs)
60-64	12% (47)	88% (358)	39% (154)	61% (240)
65-71	6% (37)	94% (564)	28% (164)	72% (424)
72-78	4% (12)	96% (257)	21% (50)	79% (192)

Table 5: The Change of Average Amount (gram) of Alcohol per day

gram	2007 → 2009 (Obs)	2009 → 2011 (Obs)
Work → Work	0.92g (1292)	-0.48g (1383)
(male)	1.30g (796)	-0.51g (847)
(female)	0.31g (496)	-0.44g (536)
Work → Not Work	-4.66g (223)	-0.98g (238)
(male)	-7.18g (133)	-0.92g (133)
(female)	-0.93g (90)	-1.06g (105)

Table 6: The Average Amount (gram) of Alcohol Intake per day in 2007

	All Sample		Sample Except for Nondrinker	
Age Group	Female	Male	Female	Male
60-64	3.87g (383)	25.11g (372)	10.50g (141)	33.37g (280)
65-71	2.24g (584)	20.10g (559)	9.14g (143)	29.57g (380)
72-78	1.46g (225)	15.80g (226)	9.08g (41)	94.98g (13)

Table 7: The Change of Heavy Exercise from 2009 to 2011

Change in Working Status	Increase (Obs)	Not Increase (Obs)
Work → Work	4% (7)	96% (164)
Work → Not Work	5% (56)	95% (1048)

Table 8: The Change of Light Exercise from 2009 to 2011

Change in Working Status	Increase (Obs)	Not Increase (Obs)
Work → Work	17% (30)	83% (143)
Work → Not Work	15% (163)	85% (937)

Table 9: The Change of Sleeping Time from 2009 to 2011

Change in Working Status (weekday)	Increase (Obs)	Not Increase (Obs)
Work → Work	40% (400)	60% (595)
Work → Not Work	55% (32)	45% (26)
Change in Working Status (holiday)	Increase (Obs)	Not Increase (Obs)
Work → Work	47% (405)	53% (462)
Work → Not Work	39% (58)	61% (91)

health, depression, instrumental activities of daily living (IADL), feeling pressure to work, physically demanded work, and four city dummies. Feeling pressure to work and physical labor variables catch the information about the cause of drinking and smoking. Dependent variable y_i is about drinking, smoking, exercise and sleeping. Drinking and smoking are binary variables taking the value of one if people decrease them compared to the previous period period. Exercise is also a binary variable taking the value of one if people increase exercise compared to the previous period. Comparing the amount in the current period with that in the previous period is important to exclude preference because drinking and smoking are addictive. The binary and target variable NW_i takes the value of one if people do not work at all, which means that working hours are zero. The JSTAR data confirms that almost all nonworking elderly are not seeking a job, are not going to seek a job and are not a leave of absence. This means that they are retired. We restrict the sample to the people who smoke or drink before retirement, and identify the effect of retirement.

The error term ϵ_{1i} seems to be correlated with NW_i in most cases. OLS cannot consistently estimate β_1 in this case. We apply the instrumental variables (IV) method to account for endogeneity in retirement. Retirement is endogenous because people may determine lifestyle and working decision simultaneously by other reasons which are not captured by observed variables. We use the variable MR_i which represents whether people experienced mandatory retirement or not. JSTAR directly asks people whether they have ever experienced mandatory retirement or not. The variables X_{2i} include the information about health conditions. Health conditions affect the decision of retirement so that controlling them is very important. The validity of IV is discussed in the next section. In the end, we estimate the equations of the form:

$$y_i = \beta_0 + \beta_1 NW_i + X_{1i}\delta_1 + \epsilon_{1i} \tag{2}$$

$$NW_i = \alpha_0 + \alpha_1 MR_i + X_{2i}\delta_2 + \epsilon_{2i} \tag{3}$$

Finally, we use fixed effects models in order to control individual's fixed effects like preference. In this case, the unit of dependent variables is different from that of OLS and IV. Smoking in fixed effects regression means how many cigarettes people smoke per day. Drinking also means how much alcohol people drink per day. The estimated equation is as follows;

$$y_{it} = \beta_0 + \beta_1 NW_{it} + X_{1it}\delta_1 + \theta_i + \eta_t + \epsilon_{1it} \tag{4}$$

4.2 Validity and Interpretation of IV

We discuss the validity and interpretation of our IV in this subsection. Most of the Japanese people working for a firm experience mandatory retirement. The variable of mandatory retirement has enough variations across ages. The fact that the age when working people experience mandatory retirement varies from 55 to 70 is observed in Table 10.

JSTAR reports that the main reason of retirement among the Japanese elderly is mandatory retirement, so that it is a good instrumental variable. The main reasons why people retire are mandatory retirement (38.89%), taking pension (2.88%) and taking care of family (2.06%) in JSTAR. The results of the first stage estimation are significant as we are going to explain in Section 5. These confirmation from JSTAR means that mandatory retirement can avoid weak instruments problem. MR_i captures retirement decision enough, therefore, rank condition satisfies. In addition, we must confirm that mandatory retirement satisfies $E(MR_i\epsilon_{1i}) = 0$ because factors affecting mandatory retirement decision and job types may be included in ϵ_{1i}. In Table 11 and Table 12, there is little difference in the distribution of the mandatory retirement age across industry and occupation. We finally include industry type and occupation type as control variables in the first stage and the second stage estimation, but the results are almost unchanged. This implies that mandatory retirement satisfies the exogeneous condition.

We would like to discuss the interpretation of IV estimator. This paper interprets this parameter as local average treatment effect (LATE) in case of 2SLS. We discuss the assumptions that IV estimator can be regarded as LATE. First, we check the exclusion restriction condition, that is, $y_i(NW, MR_i = 0) = y_i(NW, MR_i = 1)$. This means that IV does not affect potential outcomes directly. It is difficult to imagine that retirement itself has an influence on lifestyle habits.[19] To confirm this assumption, we regress y_i on MR_i and X_{1i} by restricting people who work in the previous period and do not work in the current period. The results support our argument except smoking.[20] Second, we check the assumption for the first stage estimation; IV can affect treatment variable, not working. The results of the first stage estimation in Table 13, 14, 15, 16 and 17 prove that the assumption is satisfied. MR_i is not weak instruments as we explained before. Third, independence assumption, that is $(y_{1i}, y_{0i}, NW_i(MR_i = 1), NW_i(MR_i = 0))$ is independent of MR_i, where y_{1i} is a potential habitual variable with retirement, and y_{0i} is without retirement. This condition cannot be checked by data directly. It is difficult to assert this condition is satisfied. Employers usually set the age of mandatory retirement, but some people have bargaining power to control their retirement age. Retirement decision conditional on control variables is independent of employer's decision in some cases.[21] Finally, monotonicity assumption is discussed, which means $NW_i(MR_i = 1) \geq NW_i(MR_i = 0)$ almost surely. This condition cannot also be checked by data directly. We can assert this assumption is almost satisfied. This assumption is violated if there is a worker who experiences mandatory retirement, promotes and continues to work with high salary, but the same worker who does not experience mandatory retirement, not promote and stop working. There are not such people in Japan. This research considers there are very few people who violate these four assumptions. Then, IV estimator can be interpreted as LATE. In this research, LATE estimates average treatment effect for those who decide retirement by experience of mandatory retirement allowing for heterogeneous treatment effect. We, therefore, estimate $E(y_{1i} - y_{0i}|NW_i(MR_i = 1) \neq NW_i(MR_i = 0))$.

5 Results

This section reports the main results of estimation about four health behaviors: smoking, drinking, exercise and sleeping. The models are estimated via instrumental variables method and fixed effects

[19] Very few people may make up their mind to change lifestyle by regarding mandatory retirement as good opportunity.

[20] Smoking is 10% significant. But it is very small sample.

[21] Original definition of LATE does not include covariates, and we follow it.

Table 10: The relation between mandatory retirement (MR) experience and age in 2007

	Male		Female	
Age Group	$MR_i = 0$ (Obs)	$MR_i = 1$ (Obs)	$MR_i = 0$ (Obs)	$MR_i = 1$ (Obs)
55-58	95% (217)	5% (11)	98% (81)	2% (2)
59-61	75% (140)	25% (47)	85% (88)	15% (15)
61-64	53% (101)	47% (89)	70% (63)	30% (27)
65-67	47% (90)	53% (102)	72% (67)	28% (26)
68-70	48% (89)	52% (96)	74% (52)	26% (18)

Table 11: The distribution of mandatory retirement age (by industry)

Industry	Firm size: less than 300 workers				Firm size: more than 300 workers			
code	< 60	60	61-64	> 65	< 60	60	61-64	> 65
1	20% (6)	43% (13)	17% (5)	20% (6)	14% (6)	23% (10)	9% (4)	53% (23)
2	16% (22)	42% (58)	22% (31)	20% (27)	8% (19)	37% (85)	15% (35)	39% (90)
3	17% (12)	47% (34)	15% (11)	21% (15)	9% (11)	39% (46)	18% (21)	33% (39)
4	21% (16)	43% (32)	9% (7)	27% (20)	11% (20)	38% (68)	19% (34)	31% (56)

Note: Number of observation is in parenthesis.

1: agriculture, fishery, forestry and mining

2: construction, manufacturing, infrastructure, telecommunications and traffic

3: retail and finance

4: service and civil servant

Table 12: The distribution of mandatory retirement age (by occupation)

Occupation	Firm size: less than 300 workers				Firm size: more than 300 workers			
code	< 60	60	61-64	> 65	< 60	60	61-64	> 65
white-color	17% (42)	45% (113)	18% (45)	21% (53)	11% (39)	38% (132)	19% (66)	32% (110)
blue-color	23% (23)	40% (41)	16% (16)	22% (22)	8% (19)	35% (82)	13% (30)	44% (105)

Note: Number of observation is in parenthesis.

regression, respectively.

5.1 Instrumental Variables Method

Table 13, Table 14, and Table 15, show the results of three models, ordinary least squares (OLS), two stage least squares (2SLS). To begin with, our IV, mandatory retirement, has a positive significant coefficient at 5% in the first stage regression of each table, which implies that those who have ever experienced mandatory retirement are likely to be in the status of retirement. In addition, it is tested that the variable mandatory retirement has no significance direct effect on the health behaviors. This fact supports the assumption that mandatory retirement is a valid IV. As mentioned above, controlling the endogeneity would provide a better estimate in the presence of the endogeneity in working decision.

Regarding to the result about smoking behavior presented in Table 13, working status does not have a statistically significant coefficient in 2SLS. That is, a transition in working status from working to not working does not have any impact on smoking. The results show that working environment does not affect the change in the smoking behavior because the variables of stress at work and physical labor are not significant. This means that we can reject the hypothesis that stress from jobs leads people to smoke. In the first stage regressions of 2SLS, bad health dummy and depression dummy are positive significant; that is, less healthy workers tend to retire earlier. This means that health takes an important role in retirement decision.

As in Table 14, drinking behavior seems to have a significant effect from working status. Those who quit job are likely to reduce the amount of alcohol. The results also tell us that either stress at work or physical labor is not significant. The variable of gender is also statistically significant. The reason is that average male respondents drink alcohol much more than female respondents and there is more room to reduce the amount of alcohol. Age and age squared variables are also significant, which means that older people are likely to decrease drinking alcohol. College dummy has positive coefficients in the second stage regressions, suggesting that people with higher education are more likely to take care of their health. In addition, the bad health dummy encourages retirement according to the first stage regressions.

In contrast to smoking and drinking, the estimate about heavy exercise, displayed in Table 15, does not show any interesting relation with the explanatory variables. Only male dummy, logged income, and city dummy 1 show statistically significant estimates. In the context of health investment, one can expect the frequency of exercise would increase after retirement due to loosen time constraint, but, the estimates reject such a prediction. This results imply uncontrolled individual heterogeneity is important. For instance, people who habitually play sports with their colleges may stop the habit after retirement. Retirement, on the other hand, would not affect the exercise habit of people who regularly do exercise with someone out of their workplace. The coefficient of male dummy implies that male elderly are more likely to increase the frequency of exercise than female elderly. There is also a trend that wealthy people exercise more after retirement. The reason would be that doing sports or exercise requires some costs, such as cost of buying sporting goods and cost of using gym facilities. This result is consistent with the implication of the model of Grossman (1972) that the individuals with higher income invest more in their health.

In Table 16 and 17 we can observe that people decrease sleeping time on weekdays but not in holidays as discussed in Section 2. It might be thought that people can afford more sleeping time on weekdays because there is no work on weekdays after retirement. Sleeping time varies largely across city although the other habits do not exhibit this tendency. Sleeping style may depend on

regional customs.

Since drinking and smoking are highly addictive and the degree of addiction may change the effect of retirement on drinking and smoking, we also divide the samples into two groups depending on the amount of drinking and smoking. As in Table 18, people who drink below twenty gram per day reduce drinking after retirement because they stop drinking after work with their colleagues. In contrast to, people who drink more than thirty gram do not decrease the amount of drinking, which implies that the influence of addiction is stronger than that of the peer effect.

Table 19 shows that people who smoke more than twenty cigarettes per day reduce smoking.[22] The variables of stress at work and physical labor are not significant in Table 19. The results imply that there are some people who smoke many cigarettes due to the peer effect in the workplace. On the other hand, people who smoke less do not change their behaviors. In addition, highly educated people are more likely to reduce smoking than low educated people, which is consistent with the implication of the model of Grossman (1972).

[22]One package contains twenty cigarettes in Japan.

Table 13: JSTAR Smoking Behavior

Whether number of cigarettes smoked decreased	OLS	2SLS 2nd	2SLS 1st
Not working for pay	0.124	0.834	
	(0.079)	(0.532)	
Male	0.006	0.062	-0.085
	(0.077)	(0.097)	(0.053)
Age	-0.038	-0.028	-0.057
	(0.088)	(0.096)	(0.063)
Age squared / 100	0.035	0.020	0.051
	(0.070)	(0.076)	(0.050)
Education (high school)	0.024	0.006	0.021
	(0.064)	(0.071)	(0.048)
Education (college)	0.193	0.154	0.045
	(0.087)**	(0.096)	(0.057)
Married	-0.108	-0.169	0.081
	(0.083)	(0.099)*	(0.059)
Number of children	0.010	0.038	-0.036
	(0.028)	(0.038)	(0.019)*
Logged income	-0.001	0.034	-0.052
	(0.021)	(0.035)	(0.012)***
Own house	-0.059	0.012	-0.113
	(0.091)	(0.120)	(0.070)
Bad Health Dummy	0.109	0.006	0.136
	(0.097)	(0.133)	(0.076)*
Depression Dummy	-0.095	-0.189	0.127
	(0.086)	(0.116)	(0.066)*
Any IADL Difficulty	-0.024	-0.158	0.183
	(0.105)	(0.174)	(0.093)*
Pressure due to workload (t-1)	-0.016	0.001	-0.025
	(0.057)	(0.064)	(0.041)
Physical labor (t-1)	-0.069	-0.064	0.002
	(0.057)	(0.063)	(0.041)
City dummy 1	-0.031	0.002	-0.040
	(0.080)	(0.086)	(0.055)
City dummy 2	-0.014	-0.042	0.060
	(0.097)	(0.107)	(0.068)
City dummy 3	-0.044	-0.098	0.082
	(0.091)	(0.105)	(0.064)
City dummy 4	-0.010	0.034	-0.050
	(0.085)	(0.090)	(0.057)
Mandatory retirement			0.145
			(0.059)**
N	353	353	353

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

Table 14: JSTAR Drinking Behavior

Whether quantity of alcohol intake decreased	OLS	2SLS 2nd	2SLS 1st
Not working for pay	0.050	0.515	
	(0.037)	(0.274)*	
Male	0.116	0.117	-0.023
	(0.028)***	(0.029)***	(0.021)
Age	-0.088	-0.106	0.002
	(0.039)**	(0.042)**	(0.030)
Age squared / 100	0.066	0.077	0.004
	(0.030)**	(0.033)**	(0.024)
Education (high school)	0.019	0.021	-0.016
	(0.033)	(0.035)	(0.024)
Education (college)	0.089	0.087	-0.006
	(0.048)*	(0.049)*	(0.031)
Married	-0.025	-0.034	0.017
	(0.037)	(0.040)	(0.029)
Number of children	0.013	0.013	0.003
	(0.015)	(0.015)	(0.011)
Logged income	-0.002	0.018	-0.042
	(0.011)	(0.017)	(0.009)***
Own house	0.038	0.059	-0.051
	(0.043)	(0.046)	(0.034)
Bad Health Dummy	0.019	-0.050	0.147
	(0.044)	(0.063)	(0.039)***
Depression Dummy	0.011	-0.004	0.030
	(0.040)	(0.041)	(0.030)
Any IADL Difficulty	-0.004	-0.021	0.039
	(0.059)	(0.064)	(0.051)
Pressure due to workload (t-1)	-0.027	-0.020	-0.011
	(0.028)	(0.030)	(0.020)
Physical labor (t-1)	0.042	0.041	0.005
	(0.028)	(0.029)	(0.021)
City dummy 1	-0.009	-0.007	-0.002
	(0.041)	(0.042)	(0.028)
City dummy 2	0.003	-0.025	0.071
	(0.048)	(0.052)	(0.037)*
City dummy 3	-0.018	-0.027	0.026
	(0.045)	(0.047)	(0.031)
City dummy 4	0.062	0.084	-0.037
	(0.043)	(0.047)*	(0.029)
Mandatory retirement			0.135
			(0.029)***
N	1,371	1,371	1,371

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

Table 15: JSTAR Exercise

Whether frequency of heavy exercise increased	OLS	2SLS 2nd	2SLS 1st
Not working for pay	-0.016	-0.068	
	(0.029)	(0.047)	
Male	0.056	0.056	-0.045
	(0.022)**	(0.022)**	(0.018)**
Age	0.028	0.028	-0.055
	(0.032)	(0.032)	(0.025)**
Age squared / 100	-0.022	-0.021	0.046
	(0.024)	(0.024)	(0.020)**
Education (high school)	0.030	0.031	-0.009
	(0.025)	(0.026)	(0.023)
Education (college)	0.040	0.040	-0.009
	(0.039)	(0.039)	(0.030)
Married	-0.010	-0.011	-0.000
	(0.028)	(0.028)	(0.023)
Number of children	-0.006	-0.006	-0.001
	(0.011)	(0.011)	(0.009)
Logged income	0.011	0.009	-0.023
	(0.004)**	(0.004)*	(0.008)***
Own house	0.063	0.067	0.033
	(0.031)**	(0.031)**	(0.026)
Bad Health Dummy	-0.061	-0.057	0.060
	(0.025)**	(0.025)**	(0.036)
Depression Dummy	-0.001	0.001	0.032
	(0.030)	(0.030)	(0.028)
Any IADL Difficulty	-0.054	-0.054	-0.005
	(0.037)	(0.037)	(0.049)
Pressure due to workload (t-1)	-0.018	-0.020	-0.009
	(0.024)	(0.024)	(0.017)
Physical labor (t-1)	0.008	0.007	-0.014
	(0.022)	(0.022)	(0.019)
City dummy 1	-0.084	-0.083	-0.013
	(0.034)**	(0.034)**	(0.026)
City dummy 2	-0.052	-0.051	0.021
	(0.041)	(0.041)	(0.029)
City dummy 3	-0.060	-0.063	-0.050
	(0.037)	(0.037)*	(0.029)*
City dummy 4	-0.039	-0.041	-0.020
	(0.038)	(0.038)	(0.027)
Mandatory retirement			0.537
			(0.035)***
N	965	962	962

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

Table 16: JSTAR Sleeping (Weekday)

Sleeping time (weekday)	OLS	2SLS 2nd	2SLS 1st
Not working for pay	0.170	0.261	
	(0.066)**	(0.142)*	
Male	0.055	0.064	-0.058
	(0.034)	(0.037)*	(0.017)***
Age	0.055	0.060	-0.081
	(0.045)	(0.049)	(0.024)***
Age squared / 100	-0.044	-0.049	0.065
	(0.035)	(0.038)	(0.019)***
Education (high school)	-0.071	-0.082	-0.015
	(0.043)	(0.045)*	(0.022)
Education (college)	-0.080	-0.092	-0.011
	(0.054)	(0.057)	(0.027)
Married	-0.045	-0.052	0.016
	(0.042)	(0.045)	(0.021)
Number of children	0.021	0.021	0.009
	(0.014)	(0.016)	(0.007)
Logged income	-0.000	0.005	-0.022
	(0.013)	(0.013)	(0.011)**
Own house	-0.008	-0.014	0.004
	(0.046)	(0.049)	(0.021)
Bad Health Dummy	0.035	0.038	0.003
	(0.052)	(0.055)	(0.029)
Depression Dummy	0.026	0.037	0.014
	(0.046)	(0.050)	(0.023)
Any IADL Difficulty	-0.060	-0.072	0.028
	(0.076)	(0.079)	(0.046)
Pressure due to workload (t-1)	0.042	0.048	-0.019
	(0.033)	(0.035)	(0.015)
Physical labor (t-1)	-0.025	-0.038	0.015
	(0.032)	(0.035)	(0.016)
City dummy 1	0.062	0.068	-0.053
	(0.064)	(0.064)	(0.024)**
City dummy 2	-0.039	-0.039	0.003
	(0.070)	(0.070)	(0.032)
City dummy 3	0.130	0.131	-0.052
	(0.064)**	(0.064)**	(0.027)*
City dummy 4	0.148	0.153	-0.027
	(0.066)**	(0.066)**	(0.028)
City dummy 5	-0.393	-0.391	-0.039
	(0.054)***	(0.056)***	(0.028)
City dummy 6	-0.384	-0.384	-0.049
	(0.054)***	(0.056)***	(0.031)
Mandatory retirement			0.320
			(0.041)***
N	889	830	830

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

Table 17: JSTAR Sleeping (Holiday)

Sleeping time (holiday)	OLS	2SLS 2nd	2SLS 1st
Not working for pay	-0.001	-0.021	
	(0.047)	(0.071)	
Male	0.035	0.038	-0.042
	(0.038)	(0.039)	(0.019)**
Age	0.015	0.007	-0.093
	(0.052)	(0.054)	(0.023)***
Age squared / 100	-0.011	-0.004	0.075
	(0.040)	(0.041)	(0.018)***
Education (high school)	0.028	0.026	-0.032
	(0.047)	(0.047)	(0.026)
Education (college)	0.002	0.001	-0.030
	(0.059)	(0.060)	(0.034)
Married	-0.025	-0.038	0.004
	(0.050)	(0.051)	(0.023)
Number of children	0.004	0.013	-0.005
	(0.017)	(0.018)	(0.009)
Logged income	0.001	-0.002	-0.025
	(0.014)	(0.015)	(0.009)***
Own house	-0.026	-0.008	-0.001
	(0.052)	(0.053)	(0.024)
Bad Health Dummy	0.088	0.084	0.046
	(0.059)	(0.060)	(0.039)
Depression Dummy	-0.081	-0.094	0.012
	(0.050)	(0.050)*	(0.029)
Any IADL Difficulty	-0.093	-0.118	0.020
	(0.085)	(0.086)	(0.056)
Pressure due to workload (t-1)	0.026	0.038	0.003
	(0.036)	(0.036)	(0.018)
Physical labor (t-1)	0.057	0.059	0.004
	(0.036)	(0.037)	(0.019)
City dummy 1	0.218	0.217	-0.024
	(0.062)***	(0.061)***	(0.031)
City dummy 2	0.071	0.071	0.035
	(0.070)	(0.069)	(0.034)
City dummy 3	0.165	0.159	-0.053
	(0.066)**	(0.065)**	(0.034)
City dummy 4	0.159	0.159	-0.001
	(0.068)**	(0.067)**	(0.035)
City dummy 5	-0.194	-0.182	0.015
	(0.064)***	(0.066)***	(0.036)
City dummy 6	-0.229	-0.218	-0.029
	(0.061)***	(0.063)***	(0.037)
Mandatory retirement			0.592
			(0.036)***
N	844	810	810

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

Table 18: JSTAR Drinking Behavior 20+

Whether quantity of alcohol intake decreased	2SLS 2nd (20-)	2SLS 1st (20-)	2SLS 2nd (20+)	2SLS 1st (20+)
Not working for pay	0.588		0.305	
	(0.326)*		(0.515)	
Male	0.172	-0.010	0.002	-0.021
	(0.036)***	(0.025)	(0.079)	(0.057)
Age	-0.116	0.012	-0.063	-0.009
	(0.052)**	(0.035)	(0.071)	(0.053)
Age squared / 100	0.085	-0.004	0.041	0.011
	(0.040)**	(0.028)	(0.055)	(0.043)
Education (high school)	0.056	-0.017	-0.061	-0.002
	(0.043)	(0.029)	(0.061)	(0.045)
Education (college)	0.096	-0.005	0.065	-0.006
	(0.062)	(0.040)	(0.079)	(0.053)
Married	0.024	0.002	-0.237	0.064
	(0.045)	(0.034)	(0.090)***	(0.052)
Number of children	0.013	0.012	0.011	-0.020
	(0.020)	(0.014)	(0.027)	(0.019)
Logged income	0.013	-0.038	0.037	-0.058
	(0.018)	(0.011)***	(0.036)	(0.017)***
Own house	0.047	-0.045	0.066	-0.060
	(0.056)	(0.041)	(0.085)	(0.063)
Bad Health Dummy	-0.107	0.146	0.078	0.134
	(0.076)	(0.044)***	(0.105)	(0.085)
Depression Dummy	0.019	0.048	-0.037	0.006
	(0.054)	(0.039)	(0.063)	(0.046)
Any IADL Difficulty	-0.041	0.042	0.028	0.018
	(0.081)	(0.063)	(0.103)	(0.088)
Pressure due to workload (t-1)	-0.011	-0.003	-0.045	-0.035
	(0.036)	(0.025)	(0.054)	(0.032)
Physical labor (t-1)	0.037	0.000	0.029	0.012
	(0.036)	(0.026)	(0.049)	(0.035)
City dummy 1	-0.008	-0.008	-0.019	0.006
	(0.054)	(0.035)	(0.064)	(0.048)
City dummy 2	-0.072	0.106	0.044	-0.023
	(0.071)	(0.048)**	(0.088)	(0.056)
City dummy 3	-0.053	0.030	0.006	0.001
	(0.060)	(0.039)	(0.075)	(0.051)
City dummy 4	0.058	-0.058	0.106	0.012
	(0.060)	(0.034)*	(0.079)	(0.057)
Mandatory retirement		0.146		0.114
		(0.036)***		(0.049)**
N	966	966	405	405

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note. Robust standard errors are in parenthesis.

Table 19: JSTAR Smoking Behavior (21- and 21+)

Whether number of cigarettes smoked decreased	2SLS 2nd (21-)	2SLS 1st (21-)	2SLS 2nd (21+)	2SLS 1st (21+)
Not working for pay	0.690		1.123	
	(0.717)		(0.343)***	
Male	-0.005	-0.075	0.089	-0.206
	(0.102)	(0.057)	(0.205)	(0.107)*
Age	-0.010	-0.121	-0.131	0.070
	(0.112)	(0.062)*	(0.176)	(0.150)
Age squared / 100	0.010	0.102	0.089	-0.052
	(0.092)	(0.050)**	(0.136)	(0.122)
Education (high school)	0.016	0.027	0.090	-0.064
	(0.083)	(0.051)	(0.120)	(0.086)
Education (college)	0.047	0.076	0.605	-0.052
	(0.117)	(0.061)	(0.162)***	(0.109)
Married	-0.187	0.157	-0.073	-0.071
	(0.145)	(0.057)***	(0.157)	(0.116)
Number of children	0.019	-0.039	0.053	-0.011
	(0.045)	(0.020)**	(0.061)	(0.040)
Logged income	0.033	-0.058	-0.023	-0.027
	(0.045)	(0.012)***	(0.041)	(0.028)
Own house	0.227	-0.235	-0.611	0.198
	(0.200)	(0.094)**	(0.208)***	(0.108)*
Bad Health Dummy	0.082	0.093	-0.286	0.338
	(0.139)	(0.082)	(0.266)	(0.149)**
Depression Dummy	-0.239	0.175	0.001	0.003
	(0.160)	(0.078)**	(0.214)	(0.114)
Any IADL Difficulty	-0.041	0.078	-0.579	0.463
	(0.153)	(0.095)	(0.261)**	(0.147)***
Pressure due to workload (t-1)	-0.022	-0.059	0.015	0.014
	(0.078)	(0.046)	(0.113)	(0.074)
Physical labor (t-1)	-0.084	0.008	0.077	-0.015
	(0.068)	(0.047)	(0.119)	(0.080)
City dummy 1	-0.089	0.029	0.250	-0.243
	(0.093)	(0.061)	(0.162)	(0.127)*
City dummy 2	-0.226	0.167	0.502	-0.200
	(0.158)	(0.081)**	(0.204)**	(0.125)
City dummy 3	-0.218	0.102	0.155	0.011
	(0.133)	(0.066)	(0.167)	(0.150)
City dummy 4	-0.013	-0.051	-0.011	0.006
	(0.105)	(0.059)	(0.156)	(0.148)
Mandatory retirement		0.124		0.357
		(0.064)*		(0.123)***
N	249	249	104	104

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note. Robust standard errors are in parenthesis.

5.2 Fixed Effects Regression

The result of fixed effects regression is reported in Table 20. The dependent variables here are the number of cigarettes smoked, the amount of alcohol intake, the frequency of exercise (walking, light exercise, heavy exercise) and sleeping hours on weekdays and on holidays. The signs of working status's coefficient tell us that quitting job may encourage healthy habits although only the signs on drink and sleeping time on weekdays are statistically significant. Smoking has a large standard error since the number of people who have smoking habit is small relative to nonsmokers. Exercise is not significant here as well as in the IV result, which suggests that the reallocation of time after retirement does not affect the frequency of exercise. We cannot get significant results about exercise by all estimation methods including even OLS. It seems that it is important to analyze the mechanism which directs people toward exercise if appropriate exercise is good for health. Age variables are significant for drinking and sleeping. It is interesting that bad health dummy negatively affects smoking. A mutual interaction between bad health and smoking can exit; people who habitually smokes a large number of cigarettes would ruin their health, and people who have bad health may try to reduce smoking for better health. This kind of interaction needs to be investigated in future research. Moreover, depression dummy has a negative coefficient on walking. Exploring the relation between mental health and physical activity is a intriguing topic although it is not done in this paper.[23] Walking is affected by physical labor dummy. This would be because reported walking time includes walking in working time. Retirement has an impact on sleeping time on weekdays as well as above analysis, but no impact on sleeping time on holidays. One interesting point is that people with any IADL difficulty increase sleeping time on holidays.

5.3 Robustness

We run additional IV regressions with different sets of explanatory variables. For example, we run the regression without asset variables. We omit tables of results due to the limitation of the space. The signs and statical significance of them do not show a considerable difference from the previous ones. In addition, we also checked if types of job or industry may affect the relation between retirement and lifestyle habits. It is confirmed, as a result, that either including job variable and industry variable does not generate a remarkable change in our estimation. Finally we apply fixed effects IV estimation method. This means that firstly we exclude fixed effects by differentiating mean within individual and secondly we run IV estimation by using mandatory retirement as IV. The results are almost unchanged. It is considered that our result seems robust.

6 Conclusion

This research investigates the effect of retirement on lifestyle habits including drinking, smoking, exercise and sleeping. JSTAR has information about whether people have ever experienced mandatory retirement or not, and mandatory retirement is used as IV to deal with endogeneity. the variable about Japanese mandatory retirement satisfies the condition for valid IV. We construct the hypotheses that the release from mental stress or the lost of peer effect after retirement reduces drinking and smoking. In addition, the time reallocation due to retirement directs people to more exercise and sleeping. The wide variety of questions of the JSTAR survey allows us to control many possible factors so as to successfully investigate the channels. The main results reveal that the

[23] Paffenbarger et al (1994) discusses the relation between depression and physical activities like sports.

Table 20: JSTAR Fixed Effects

Variables	Smoke	Drink	Walk	Light Exercise	Heavy Exercise	Sleep (wd)	Sleep (hd)
Not working for pay	-0.353	-1.753	0.019	0.015	0.009	0.994	-0.372
	(0.337)	(0.780)**	(0.023)	(0.040)	(0.026)	(0.374)***	(0.371)
Age	-0.831	1.471	-0.020	0.035	0.006	-2.484	-1.871
	(0.445)*	(0.810)*	(0.024)	(0.051)	(0.033)	(0.431)***	(0.456)***
Age squared / 100	0.411	-1.214	0.006	-0.039	-0.002	1.870	1.468
	(0.347)	(0.621)*	(0.018)	(0.039)	(0.025)	(0.342)***	(0.350)***
Married	0.223	1.739	0.003	0.136	0.076	1.855	-0.013
	(1.107)	(2.268)	(0.067)	(0.128)	(0.084)	(1.192)	(1.099)
Number of children	-0.358	0.570	0.017	0.005	-0.061	-1.473	-0.304
	(2.580)	(1.976)	(0.055)	(0.142)	(0.092)	(0.508)***	(0.552)
Logged income	0.066	0.080	0.005	0.007	-0.002	-0.119	-0.076
	(0.039)*	(0.097)	(0.003)*	(0.005)	(0.003)	(0.057)**	(0.048)
Bad Health Dummy	-0.548	-0.954	-0.019	-0.031	0.000	0.335	0.314
	(0.259)**	(0.613)	(0.018)	(0.030)	(0.020)	(0.264)	(0.269)
Depression Dummy	0.150	-0.822	-0.052	-0.039	-0.004	0.145	0.003
	(0.282)	(0.666)	(0.019)***	(0.031)	(0.020)	(0.270)	(0.286)
Any IADL Difficulty	-0.820	0.908	-0.007	-0.006	-0.010	0.714	1.216
	(0.403)**	(0.960)	(0.028)	(0.046)	(0.030)	(0.455)	(0.435)***
Pressure due to workload	0.007	-0.789	0.028	-0.044	-0.029	0.101	0.109
	(0.258)	(0.646)	(0.019)	(0.033)	(0.021)	(0.223)	(0.297)
Physical labor	-0.059	0.118	0.060	0.004	0.029	-0.069	0.216
	(0.297)	(0.715)	(0.021)***	(0.035)	(0.022)	(0.240)	(0.315)
N	8,577	11,349	11,671	5,431	5,422	4,568	6,123

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

retirement decreases drinking, and increases sleeping time on weekdays, which is consistent with our hypotheses, but the retirement does not have a significant influence on the amount of smoking, the frequency of exercise and sleeping time on holidays. The peer effect in the workplace is mainly influential to drinking. It is interesting to examine the impact of retirement on other lifestyle habits, for example, nutrition and medical care, which is remained as future researches.

There are two limitations of this work. This paper does not propose unifying economic models that can explain the decision making process about the lifestyle habits: drinking, smoking, exercise and sleeping. Especially, we could not provide the model, which explain the discontinuous change of drinking and smoking after retirement based on Grossman (1972). There are other competing models for describing behaviors of drinking and smoking with Grossman (1972) such as the addiction model proposed by Becker et al (1994).[24] In addition, knowledge of behavioral economics may be taken advantage of. We are examining a variety of models closely while taking the characteristics of the goods into considerations.

The original purpose of this paper is to analyze the impact of retirement on health including mental health and physical health (BMI, grip strength, ADL and IADL). We regress health index on retirement variable and control variables by OLS, and furthermore use experience of mandatory retirement as IV to account for same endogeneity as our main research. The results are different from previous researches. Two speculations about these results are implied. First, measurement error can be an issue in analysis of health variables. Second, it possibly takes much time for health to show an observable change, although JSTAR has so far only three waves. Further waves of the

[24]The above results show that drinking is addictive behavior, but we do not propose any addiction models.

survey will answer the questions that this paper currently cannot.

Appendix

This section investigates the effect of retirement on health. The analysis of this paper is similar to that of previous literatures. This research also regress health outcomes on retirement variable. This paper uses subjective health, mental health, BMI, grip strength, ADL and IADL as health indices. We apply the same identification strategy as the main analysis of this paper. First, we estimate the equation (1) which replaces lifestyle habits with health outcomes by OLS. Second, we estimate the equations (2) and (3) replacing by IV estimate. Mandatory retirement is used as IV. Table 21 shows that we cannot find a significant effect on most of the health outcomes for the reasons we explained. There are effects of retirement on self reported health status.

Table 21: JSTAR Regression of Health Variables on NW

Whether health status improved	OLS	2SLS	Biprobit	N
Self reported health status	-0.036	-0.303	-0.351	1,350
	(0.035)	(0.245)	(0.161)**	
Depressed	-0.011	0.034	0.192	1,300
	(0.017)	(0.123)	(0.317)	
ADL difficulty	0.024	0.062	0.058	1,352
	(0.016)	(0.084)	(0.509)	
IADL difficulty	0.028	0.151	0.068	1,317
	(0.016)*	(0.100)	(0.394)	
BMI	-0.042	0.223	0.022	1,334
	(0.038)	(0.277)	(0.166)	
Grip strength	-0.011	0.432	0.116	1,101
	(0.040)	(0.276)	(0.180)	

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors are in parenthesis.

References

Becker, G. S. (2007). Health as human capital: synthesis and extensions. *Oxford Economic Papers*, 59(3):379–410.

Becker, G. S., Grossman, M., and Murphy, K. M. (1994). An Empirical Analysis of Cigarette Addiction. *American Economic Review*, 84(3):396–418.

Calhoun, D. a., Jones, D., Textor, S., Goff, D. C., Murphy, T. P., Toto, R. D., White, A., Cushman, W. C., White, W., Sica, D., Ferdinand, K., Giles, T. D., Falkner, B., and Carey, R. M. (2008). Resistant hypertension: diagnosis, evaluation, and treatment. A scientific statement from the American Heart Association Professional Education Committee of the Council for High Blood Pressure Research. *Hypertension*, 51(6):1403–19.

Charles, K. K. (2004). Is Retirement Depressing? Labor Force Inactivity and Psychological Well being in Later Life. *Research in Labor Economics*, 23:269–299.

Coe, N. B. and Zamarro, G. (2011). Retirement effects on health in Europe. *Journal of Health Economics*, 30(1):77–86.

Cooper, L. M., Frone, M. R., Russell, M., and Mudar, P. (1995). Drinking to Regulate Positive and Negative

Emotions: A Motivational Model of Alcohol Use. *Journal of Personality and Social Psychology*, 69(5):990–1005.

French, E. (2005). The Effects of Health , Wealth , and Wages on Labour Supply and Retirement Behaviour. *Review of Economic Studies*, 72:395–427.

French, E. and Jones, J. B. (2011). The Effects of Health Insurance and Self-Insurance on Retirement Behavior. *Econometrica*, 79(3):693–732.

Gottlieb, D. J., Redline, S., Nieto, F. J., Baldwin, C. M., Newman, A. B., Resnick, H. E., and Punjabi, N. M. (2006). Association of usual sleep duration with hypertension: the Sleep Heart Health Study. *Sleep*, 29(8):1009–1014.

Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy*, 80(2):223–255.

Hashibe, M., Brennan, P., Benhamou, S., Castellsague, X., Chen, C., Curado, M. P., Dal Maso, L., Daudt, A. W., Fabianova, E., Fernandez, L., Wünsch-Filho, V., Franceschi, S., Hayes, R. B., Herrero, R., Koifman, S., La Vecchia, C., Lazarus, P., Levi, F., Mates, D., Matos, E., Menezes, A., Muscat, J., Eluf-Neto, J., Olshan, A. F., Rudnai, P., Schwartz, S. M., Smith, E., Sturgis, E. M., Szeszenia-Dabrowska, N., Talamini, R., Wei, Q., Winn, D. M., Zaridze, D., Zatonski, W., Zhang, Z.-F., Berthiller, J., and Boffetta, P. (2007). Alcohol drinking in never users of tobacco, cigarette smoking in never drinkers, and the risk of head and neck cancer: pooled analysis in the International Head and Neck Cancer Epidemiology Consortium. *Journal of the National Cancer Institute*, 99(10):777–89.

Hasin, D. S., Goodwin, R. D., Stinson, F. S., and Grant, B. F. (2005). Epidemiology of major depressive disorder. *Archives General Psychiatry*, 62:1096–1106.

Insler, M. (2014). The Health Consequences of Retirement. *Journal of Human Resources*, 49(1):195–233.

Jemal, A., Thun, M. J., Ries, L. a. G., Howe, H. L., Weir, H. K., Center, M. M., Ward, E., Wu, X.-C., Eheman, C., Anderson, R., Ajani, U. A., Kohler, B., and Edwards, B. K. (2008). Annual report to the nation on the status of cancer, 1975-2005, featuring trends in lung cancer, tobacco use, and tobacco control. *Journal of the National Cancer Institute*, 100(23):1672–94.

Johnston, D. W. and Lee, W.-S. (2009). Retiring to the good life? The short-term effects of retirement on health. *Economics Letters*, 103(1):8–11.

Kruger, A. B. and Pischke, J.-s. (1992). The Effect of Social Security on Labor Supply: A Cohort Analysis of the Notch Generation. *Journal of Labor Economics*, 10(4):412–437.

Lundborg, P. (2006). Having the wrong friends? Peer effects in adolescent substance use. *Journal of Health Economics*, 25(2):214–233.

Mastrobuoni, G. (2009). Labor supply effects of the recent social security benefit cuts: Empirical estimates using cohort discontinuities. *Journal of Public Economics*, 93(11-12):1224–1233.

Moretti, E. (2004). Estimating the social return to higher education: Evidence from longitudinal and repeated cross-sectional data. *Journal of Econometrics*, 121(1-2):175–212.

Paffenbarger, R. S., Lee, I.-M., and Leung, R. (1994). Physical activity and personal characteristics associated with depression and suicide in American college men. *Acta Psychiatrica Scandinavica*, 89:16–22.

Penedo, F. J. and Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current opinion in psychiatry*, 18(2):189–193.

Pope, A. C., Burnett, R. T., Krewski, D., Jerrett, M., Shi, Y., Calle, E. E., and Thun, M. J. (2009). Cardiovascular mortality and exposure to airborne fine particulate matter and cigarette smoke shape of the exposure-response relationship. *Circulation*, 120(11):941–948.

Powell, L. M., Tauras, J. a., and Ross, H. (2005). The importance of peer effects, cigarette prices and tobacco control policies for youth smoking behavior. *Journal of Health Economics*, 24:950–968.

Rohwedder, S. and Willis, R. J. (2010). Mental Retirement. *Journal of Economic Perspectives*, 24(1):119–138.

Staubli, S. and Zweimüller, J. (2013). Does Raising the Early Retirement Age Increase Employment of Older Workers? *Journal of Public Economics*, 108:17–32.

Zhao, M., Konishi, Y., and Noguchi, H. (2014). Retiring for Better Health? : Evidence from Health Investment Behaviors in Japan. *Working Papers*.