Does the information improvement change the health investment behavior? Evidence from Japan

Masato Oikawa*

November 8, 2016

Abstract

This paper examines the effect of health information on health investment behaviors and consequent outcomes. I use the exogenous variations resulted from the introduction of the Japanese health checkup systems related to obesity and apply difference in difference in differences method. In the pre-period, the participation rate of the checkups is different among the types of health insurance and I regard people insured by employee's health insurance at the pre-period who have higher rate as the treatment group and people insured by national health insurance as the control group. In addition, I use a variation from the criteria to have the guidance which is a component of the checkup systems. The estimated results suggest that the information improvement through the checkup systems lead individuals to change the health investments such as dietary habits and improve some health outcomes. Additionally, there are heterogeneous effects among different education levels. Higher educated people effectively change the investment and improve the obesity condition. On the other hand, lower educated people do not improve the obesity condition, although they change the health investment.

*Graduate School of Economics, the University of Tokyo, Japan. Email: masato.oikawa1991@gmail.com

JEL Classification Numbers: I12, I18

Keywords: information, checkups, health investment behavior, difference in difference in differences

1 Introduction

Information has important roles in economic behaviors. Many researchers have studied about the roles of information in various fields of economics. In the field of health economics, there are numerous studies which analyze the relationship between information and behaviors theoretically (Arrow (1963), Dardanoni and Wagstaff (1990), and Picone et al. (1998)) and empirically (Kenkel (1991), Hsieh and Lin (1997), Zhao et al. (2013), and Schmid (2015)). Moreover, according to the model of Grossman (1972), the level of health is determined by the investment in health. Therefore, the uncertainty in health may cause the distortion for the decision of health investment and consequent health conditions. And a reduction of uncertainty by an information improvement seems to lead individuals to more healthy conditions.

The importance of the health information and its handling have discussed in the world. In *Ottawa Charter for Health Promotion(1986)*, World Health Organization (WHO) advocated a public health strategy, *health promotion*. Nutbeam (1998) explained a definition of the health promotion as *"the process of enabling people to increase control over, and to improve their health."* The health promotion emphasizes the importance that individuals control for their health conditions oneself. One of the core concept of the health promotion is the *health literacy*. In the concept of health literacy, the health information and how to handle the information have important roles. Nutbeam (1998) explained a definition of the health literacy as *"the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health."* [1] The health literacy is the skills and knowledges to be helpful concerning such as medical care and daily habits, and helps individuals to control over and improve their health

[1] There are some other definition of the health literacy. Kickbusch et al. (2013) defined the health literacy as "Health literacy is linked to literacy and entails peoples knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgements and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life during the life course."

conditions thorough the everyday life. These concepts emphasize the importance of accessing and selecting the health information to achieve the individuals' healthy life.

In the field of health economics, many researchers have discussed about the role of information for economic behaviors. Uncertainties of health behavior is divided into two parts, one is the uncertainty in the effectiveness of treatment and the other is the uncertainty in the incidence of illness (Arrow (1963)). A number of studies have investigated the relationship between health behavior and these uncertainties. Several studies have empirically investigated the relationship between health behavior and information using the survey question based information measure. Kenkel (1991) examined the effect of health knowledge on health behavior using question based health information measure, for example, the number of correct responses for whether smoking or drinking causes several illness. He found that health knowledge are found to decrease smoking and drinking and to increase the time of physical activity. Hsieh and Lin (1997) investigated the relationship between health information and demand for preventive care using questionnaire based information measure. They found that, among the elderly in Taiwan, better health information increased the probability of preventive care. Schmid (2015) use the survey based consumer health information to estimate the effect of information on demand for physician visits. He found that the the number of physician visits decreased with the higher information level of health. These studies used the cross-sectional variation and there seem to be endogenous bias because of individual unobserved health preference.

Chern et al. (1995) use the number of medical journal articles as the information measure. They constructed a Bayesian-based measurement of health information using the Health and Diet Survey data and the number of articles in medical journals about linkage between health risk and food consumption and estimated a demand model of fats and oils consumption. Then they demonstrated that increase in information led to a significant increases in consumption of corn, cottonseed, and soybean oils and decreases in that of butter and lard. However, the

number of journal articles may depend on a public interest about health and therefore there may be an endogeneity. [2] These studies tried to investigate the relationship between health behaviors and health knowledge which includes the information about the effectiveness of health behaviors.

Similarly some studies have investigated the relationship between health behaviors and own health conditions. Slade (2012) examined the effect of diagnosed diabetes on the health investment behavior using the dynamic variation of Health Retirement Study (HRS). He found that newly diagnosed with medication led to decreases in drinking, smoking, and probability of overweight or obese and increase in physical activities. However, he did not take into account of endogenous decision of diabetes diagnosis and therefore there seems to be the endogeneity problem in terms of diabetes diagnosis. In addition, his results depends on the estimation model and the some estimated effects are mixed effects of diabetes diagnosis and medication.

Zhao et al. (2013) used the quasi-experimental situation to cope with the endogenous decision of diagnosis. They investigated the relationship between negative health information and health investment behavior using the Chinese data. [3] They estimated the effect of hypertension diagnosis on nutrition intakes using regression discontinuity design. Whether the systolic blood pressure is above 140 is the one determinant of the hypertension diagnosis and they use this value as cutoff point of discontinuity. They found that the hypertension diagnosis decreases the individual fat intake and impact is larger for the richer individuals. Although they found the significant impact of hypertension diagnosis on fat intake, in some specification, the level of significant seem to be weak and there are no significant effects on other nutrition intakes such as energy which is also important factor of improvement of hypertension condition. Additionally, they did not focus on the consequent health outcomes.

[2] Brown and Schrader (1990) and Kim and Chern (1999) also use the journal article based information measure.

[3] In the field of medical, Neutel and Campbell (2008) studied the relationship between newly diagnosis of hypertension and lifestyle habits in Canada.

In this paper, I use the Japanese policy introduction as a quasi-experiment and estimate the effect of information improvement on broad health investment behaviors and consequent health outcomes. The introduction of the checkup systems related to obesity gives us the exogenous variation of information improvement. [4] Since the checkup systems include not only the checkups but also the health guidance, the impact of the checkup systems includes the improvement effects of the own health condition and the effectiveness of behaviors. I apply the difference in difference in differences approach to estimate the effects on broad health investment behaviors such as dietary habits, nutrition intakes, and physical activities and outcomes such as body mass index (BMI). The JSTAR gives the information about not only various health investment and outcome variables but also economic variables and dynamic variation for individuals. I find that people with employee's health insurance and high probability of the guidance change their dietary habits, for example, decreasing the intakes of chicken, pork and beaf, cooking salt, and cooking oil. However, there are no significant effect on energy intake and negative effect on walking probability. As a results, there are no significant effects on BMI variables although the measures of physical and mental health are improved. In addition, the patterns of changes in health investment are heterogeneous across education level. Higher educated people more effectively change their investment behaviors and consequently, they improve the probability of obesity or overweight, although lower educated people exacerbate their obesity condition.

The remainder of this paper is organized as follows: section 2 describes the data; section 3 explains the institutional setting of the specific health checkups and specific health guidance; section 4 discusses the empirical framework; section 5 discusses our estimation results; and section 6 concludes this research and discusses the future scope for research.

[4] Several studies investigated the mechanism of obesity in the field of economics. (Trogdon et al. (2008), Ikeda et al. (2010), Ruhm (2012), and Godard (2016))

2 Data

This paper uses the Japanese Study of Aging and Retirement (JSTAR). The JSTAR is a biennial panel survey of elderly Japanese aged over 50 and conducted since 2007. Since the checkups was introduced in 2008, the JSTAR allows to use the data before and after introduction of the checkups. The JSTAR includes the information about the demographics, the labor force status, the economic variables, the health investment behaviors, and the health outcomes. These information allows us to analyze the policy impact of the checkups system on health investment behaviors and outcomes. In this paper, I use the health investment behavior variables such as the dietary habits, the nutrition intakes, and physical activities.

Table 1 shows the summary statistics of the JSTAR. The JSTAR include the elderly aged between 50 and 84 and the ratio of female is 52 %. 16 % of the people have degree and about 79 % of those are married. The mean value of the number of children is about 2. The distributions of these demographic variables are roughly consistent with census data. [5]

The mean value of BMI is 23.1. About a quarter of the elderly people is overweight or obesity (BMI$\geq$25) and they have the potential risk of metabolic syndrome and consequent non-communicable diseases. In the case of other health variables, only 3% of the people assess their health condition as poor although about 20% of the elderly have depressed according to the CES-Depression measure. The measure of physical health, the number of difficulties of activities of daily living (ADL), is 0.11 and this indicate that elderly does not have serious physical problems.

Elderly have higher ratio of staple food (mean:41%) and plant food (mean:32%) intakes and the ratio of meat, fish, and soy are the same level (mean: meat(6%), fish(9%), and soy(7%)). The energy intake is 1885 Kcal. Almost all of the people walk for daily activities (92%) and three quarter of the people walk at least 30 minutes. On weekdays, people spend

[5] In 2010 census data, the ratio of female is about 52.8%, of having degree is about 18.8%, and of married people is 72.3%.

Table 1: Summary Statistics (JSTAR 2007 - 2013)

	mean	sd	min	max	N
Demographics					
Age	65.73	7.49	50.00	84.00	21708
Female	0.52	0.50	0.00	1.00	31650
University graduate	0.16	0.37	0.00	1.00	31478
Mariage	0.79	0.41	0.00	1.00	18747
Number of children	2.04	1.08	0.00	9.00	18789
Economic variable					
HH income (ten thousand yen)	432.63	359.48	0.00	2400.00	17768
Working variables					
Hours worked	18.03	21.60	0.00	72.00	17776
Physical Stress	0.23	0.42	0.00	1.00	18657
Job Stress	0.19	0.39	0.00	1.00	18628
Health checkup					
Health checkup	0.65	0.48	0.00	1.00	18647
Health outcomes					
BMI	23.09	2.91	16.67	32.39	18108
Overweight or Obesity(BMI≥25)	0.24	0.42	0.00	1.00	18108
Obesity(BMI≥30)	0.02	0.13	0.00	1.00	18108
Poor health	0.03	0.17	0.00	1.00	18851
ADL summary score	0.11	0.61	0.00	6.00	14776
Depression	0.18	0.38	0.00	1.00	17654
Dietary habits					
Ratio of staple food	0.41	0.14	0.00	1.00	17718
Ratio of meat	0.06	0.04	0.00	0.59	17718
Ratio of fish	0.09	0.05	0.00	0.78	17718
Ratio of soy	0.07	0.04	0.00	0.41	17718
Ratio of vegetables	0.32	0.11	0.00	0.81	17718
Energy intake					
Energy (kcal)	1885.37	637.99	0.00	7784.83	17733
Physical activities					
Walking	0.92	0.26	0.00	1.00	17648
Walking ≥ 30m	0.76	0.43	0.00	1.00	17648
Exercising(Min.:WD)	47.89	46.45	0.00	180.00	6789
Exercising(Min.:HD)	65.25	66.07	0.00	300.00	8447
Housework and child care (Min.:WD)	145.04	137.95	0.00	900.00	9698
Housework and child care (Min.:HD)	184.33	145.06	0.00	900.00	12695

about 47 minutes for exercising and about 145 minutes for housework and child care, and on weekends, they use about 65minutes and about 184.33 minutes for exercising and houseworks.

3 Specific Health Checkups and Specific Health Guidance

For a prevention of non-communicable diseases, a health checkup system which is focusing on the metabolic syndrome was introduced in April, 2008. This system focuses on people insured by public health insurance and their dependent aged between 40 and 74.

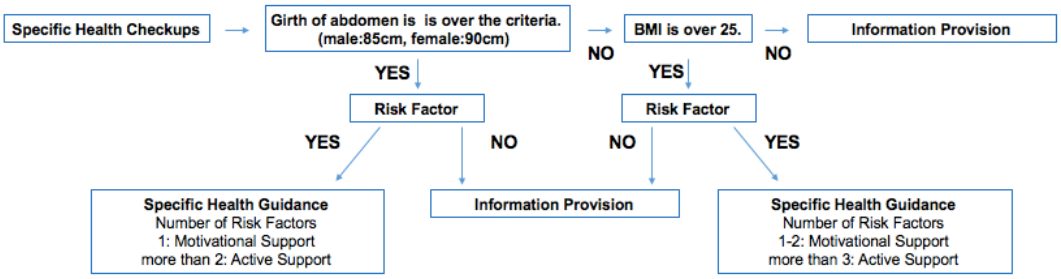
The system is divided into two parts: the first part is the specific health checkups; and the second is the specific health guidance. In the specific health checkups, people have a health checkup focusing on the metabolic syndrome which includes such as body measurements, blood tests, questionnaires about smoking history. Based on these checkups, the risk of the metabolic syndrome is evaluated and the examinees are informed of the results. By doing a screening with the results, the specific health guidance is conducted for people with the higher risk. Additionally, they are assigned to either one of two types of guidance, motivational support or active support, by their risk level. The screening procedure is as follows:

- First, examinees are divided by their girth of abdomen, examinees whose abdomen is over the criteria (male:85cm, female:90cm) are assigned to the group A.
- Second, even though their girth of abdomen is under the criteria (not in group A), when their value of body mass index (BMI) is above 25, they are assigned to the group B .
- Additionally, examinees who are in the group A or B are evaluated their risk level by additional four risk factors, the high blood sugar, the lipid abnormality, the high blood

pressure, and smoking history[6].

- In the group A, examinees with more than two risk factors receive the active support guidance, and examinees with one receive the motivational support guidance, and examinees without risk factor are provided the information about their health and do not receive any guidance.
- Similarly, in the group B, examinees with more than three risk factors receive the active support guidance, and examinees with one or two receive the motivational support guidance, and examinees without risk factor are provided the information.
- And examinees who are not in the group A and B are provided the information about their health and do not receive any guidance.

Figure 1: The screening procedure of Specific Health Checkups and Specific Health Guidance

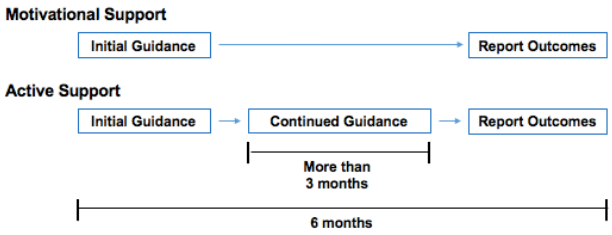


In the specific health guidance, participants receive the guidance about their lifestyle habits such as dietary habits and physical activities for improving their health condition. As mentioned above, there are two types of guidance and examinees with lower risks are only provided the information about their health conditions. In the motivational support guidance, participants receive the support by an interview with experts. In the interview support, participants have guidance such as about knowledge of the metabolic syndrome and lifestyle-related diseases, the relationship between their lifestyle habits and the result of

[6]Smoking history is counted only when examinees have either other risk factors.

checkups, and how to improve their lifestyle habits and health conditions. Six months later of the guidance, participants report the outcomes such as change in lifestyle habits and health conditions. In the active support, participants have the similar guidance of the motivational support at first. After that, they receive the continued guidance more than three months unlike the motivational support. Finally, six months later of the initial guidance, participants report the outcomes as in the case with the motivational support.

Figure 2: The Flowchart of the Specific Health Guidance



People covered by public health insurances can receive the specific health checkups and the specific health guidance. However, the participation rate of the checkups are different among the type of health insurance. According to Ministry of Health and Welfare (2014), in 2012, the participation rate of the Municipality controlled National Health Insurance is 33.7% while that of the society-managed, employment-based Health Insurance is 70.1% and of the mutual aid association is 72.7%. Obviously, the participation rate of the people covered by employee's health insurance is larger than that of national health insurance. Employer are obligated to implement the health checkups for their employees by Industrial Safety and Health Act. And by same law, employees are obligated to undergo the checkups. Therefore the participation rate of employee and civil officer, i.e., people covered by employee's health insurance are relatively high.

Finally, I show the relationship between checkups and health variables using the JSTAR data. I construct the dummy variables which takes value one when increasing a variable,

Table 2: Differences in Health outcomes and Health Investment Behaviors by Checkup Status

	(1) Checkup:No	(2) Checkup:Yes	(3) (2)-(1)
Health outcomes			
BMI	0.45	0.39	-0.06***
Overweight and obese	0.06	0.04	-0.02**
Self-report of health	0.27	0.31	0.04**
ADL summary score	0.05	0.01	-0.04***
Depression	0.10	0.08	-0.02*
Dietary habits			
Ratio of staple food	0.52	0.53	0.01
Ratio of meat	0.54	0.51	-0.03
Ratio of fish	0.49	0.48	-0.01
Ratio of soy	0.45	0.47	0.02
Ratio of vegetables	0.48	0.48	-0.01
Energy intake			
Energy (kcal)	0.44	0.45	0.01
Physical activities			
Walking	0.05	0.03	-0.02***
Walking $\geq$ 30m	0.12	0.11	-0.01
Exercising(Min.:WD)	0.33	0.40	0.07*
Exercising(Min.:HD)	0.41	0.42	0.01
Housework and child care (WD)	0.42	0.47	0.05
Housework and child care (HD)	0.52	0.54	0.03

* $p < .1$, ** $p < .05$, *** $p < .01$

i.e., $1\{x_{post} > x_{pre}\}$ [7], and divid the sample into two part, having checkups between pre- and post-periods and not having checkups. Table 2 shows the changes between pre- and post-periods by checkup status. Columns (1) and (2) of Table 2 indicate the proportion of the people whose value is increased. Column (3) shows the difference between columns (1) and (2), and the star indicates the significant level of t-test. The proportion of people with increasing BMI is 45% in the people who do not have the checkups and 39% in the people who have the checkups. Although in the both groups, the proportion with increasing BMI is about 40%, the proportion is 6% smaller for the people with checkups at the 1% significant level and that of overweight or obese is about2% smaller at the 5% significant level. In addition, the changes in other health outcomes are better for the people who have checkups (self-report of health: 4%, ADL: -4%, and depression -2%). There seems to be positive relationship between the information improvement through the checkups and health outcomes. In the case of physical activities, the proportion of people with increasing walking is 2% larger for the people without checkups and that of exercising on weekdays is 7% larger for the people with checkups. However, in most behaviors, the proportions are not different between these two groups.

These results shows the relationship between information through the checkups and health variables. However, there may be endogeneity problems and I have to control for these issues. In the next section, I discuss about the way to identify the information improvement effect on health investment and outcome variables.

[7] I use the 1st wave JSTAR as pre-period and the 2nd wave JSTAR as post-period and calculate values.

4 Empirical Framework

4.1 Identification Strategy

I use the specific health checkups and specific health guidance to examine the effect of information improvement on health investment behaviors and outcomes. The checkup systems have two treatment to the participants. One is the information provision about participant's health conditions, the other is the guidance about their lifestyle habits which is interpreted as health investment behaviors. As discussed, participants who have higher risk only receive the guidance.

I would like to estimate the effects on health related variables, however, there are some problems. One is an endogeneity problem of having the checkups. Since the decision of having the checkups and of health investment behavior may be correlated, there may be the endogenous bias in the estimates. The other is data limitation. Since the JSTAR does not include the information about the guidance, I cannot identify the participant of the guidance. To address these issues, I use the difference in differences (DID) method to identify the treatment effects.

Table 3: Participation Rate of the Checkups by Insurance Type at Pre-period (2007)

			Age category				
		All	50-54	55-59	60-64	65-69	70-74
EHI	PCR Health Insurance	80.3%	88.8%	82.7%	82.2%	62.3%	57.5%
	SMEB Health Insurance	89.9%	94.4%	93.0%	83.3%	82.9%	75.0%
	Mutual aid association	90.9%	98.1%	91.8%	88.5%	75.0%	40.0%
	National Health Insurance	55.3%	57.5%	54.4%	59.3%	56.4%	51.6%

Although the checkup systems introduced for all of the people who insured by public health insurance and their dependent aged between 40 and 74, the participation rate of the checkups are different among the health insurance types. Since the groups with higher participation rate have more treated population than those with lower rate, the average treatment effect should be larger in higher participation rate groups. As discussed, people who

covered by employee's health insurance have higher participation rate of the checkups than those covered by national health insurance. Table 3 shows the participation rate of checkups by insurance type at pre-period (2007) which is calculated using the JSTAR. Three types of employee's health insurance, the public-corporation-run (PCR) health insurance, the society-managed, employment-based (SMEB) health insurance, and the mutual aid association, have higher participation rate of checkups than the national health insurance, and, in particular, the people aged 50 to 64.

Table 4: Ratio of the people who are insured by employee's health insurance at Pre-period (2007)

	Age Category					
	50-54	55-59	60-64	65-69	70-74	75-79
Male	67%	64%	51%	20%	10%	6%
Female	34%	26%	11%	6%	3%	2%

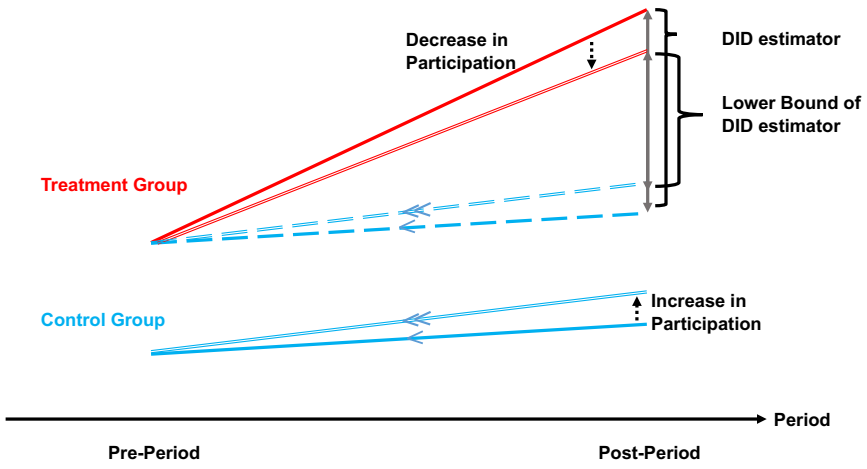
I use this variation to control for the endogeneity of the checkups. Therefore, I regard people who covered by the PCR health insurance, the SMEB health insurance, and the mutual aid association at pre-period as treatment group and those by national health insurance at pre-period as control group. Additionally, I focus on the male samples aged 50 to 64 because these samples have higher rate of the insured of employee's health insurance. (Table 4)

Table 5: Participation Rate of the Checkups by Insurance Type and Survey Year (Male aged 50 -64 at pre-period)

Year		**Insurance Type** NHI	EHI
Before	2007	54.7%	88.1%
After	2009	60.7%	83.3%
	2011	62.5%	82.7%
	2013	64.0%	82.6%

In this approach, since I use the variation of participation rate among insurance types, consistency of the checkup participation rate between pre- and post-period is important. Table 5 shows the participation rate of the checkups by insurance type and survey year.

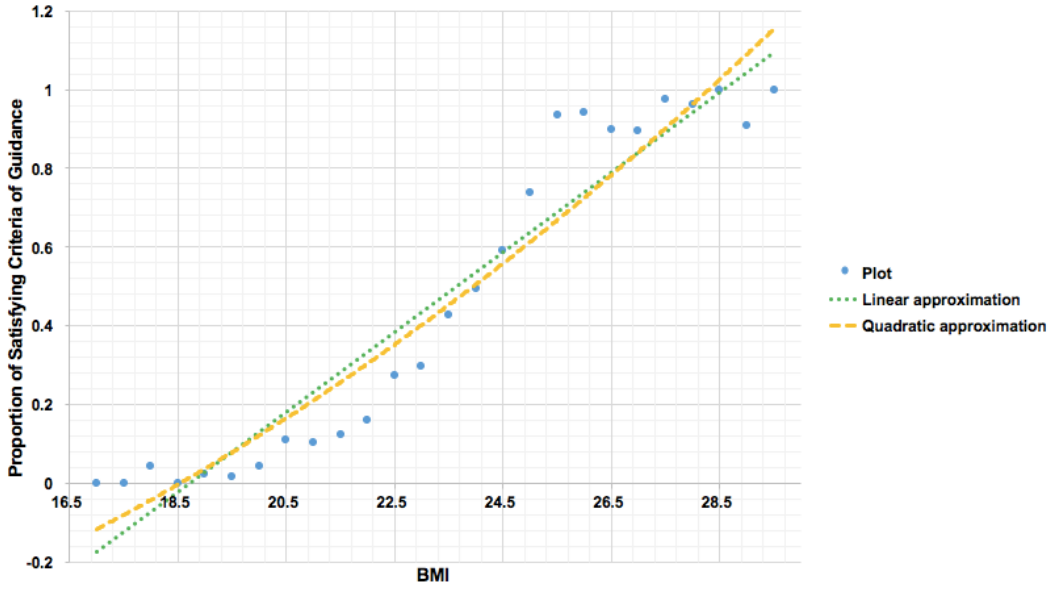
Figure 3: The Illustration of Identification



These are calculated using male samples aged 50 to 64 at pre-period (2007) and the insurance type is that of pre-period. In the pre-period, 2007, the participation rate of employee health insurance (EHI) is 88.1% and about 30 percentage point (pp) higher than that of national health insurance (NHI). However, in the post-period, 2009, the participation rate of EHI is about 5 pp lower than that in 2007 and the participation rate of NHI about 6 pp higher than that in 2007. In this case, since the treated population in the EHI are decreased in post-period, the average treatment effect becomes smaller than that in the consistent case. At the same time, in the case of NHI, the treated population are increased and the average treatment effect becomes larger. Therefore, our DID estimator should be lower bound of the true estimator. (Figure 3)

The JSTAR does not include the information about the participation status of the guidance. For this issue, I use BMI value at pre-period as the proxy of the probability to receive the guidance. As discussed, people whose BMI value is greater than 25 with at least one risk

Figure 4: The Probability of Receiving The Guidance and BMI



factor have the guidance regardless of the girth of abdomen and BMI value 25 is more strict criteria of receiving the guidance. However, BMI value may be correlated with the girth of abdomen and even though BMI value is less than 25, people have the guidance because of the criteria of the girth of abdomen. Therefore, I use BMI value as the proxy of the probability to receive the guidance. Only in the 2009 JSTAR, I can use the information about blood pressure readings and girth of the abdomen. Using these data, I calculate the proportion of people who satisfying the criteria of guidance for each BMI value. [8] Figure 4 show the relationship between proportion of satisfying the criteria and BMI value. [9] As increasing BMI value, the proportion of satisfying criteria of the guidance is increasing. Linear approximation and quadratic approximation of plots are almost the same. This shows that the value of BMI seems to be good proxy of the probability to receive the guidance. Additionally, since

[8] The 2009 JSTAR only includes the information about BMI, blood pressure readings, and girth of the abdomen and I cannot use the information about blood glucose level and level of neutral lipid which is the determinant of risk factors.

[9] In the sample whose BMI value over 30, the sample size is very small and I omit these samples from this figure.

the BMI value can be changed by the introduction of checkup systems, I use the BMI value at pre-period and interpret the value as predetermined probability to receive the guidance.

I use these two exogenous variation resulted from the introduction of the Japanese checkup systems and apply the difference in difference in differences (DDD) approach to identify the effect of information on health behaviors and outcomes. In the next subsection, I explain the estimation model and interpretation of estimated results.

4.2 Estimation Model

I estimate the equation as follows:

$$\begin{aligned} y_{it} &= \beta_0 + \beta_1 EHI_i + \beta_2 BMI_i + \beta_3 After_t \\ &\quad + \beta_4 EHI_i \cdot After_t + \beta_5 BMI_i \cdot After_t + \beta_6 EHI_i \cdot BMI_i \\ &\quad + \beta_7 EHI_i \cdot BMI_i \cdot After_t + x_{it}'\delta + \theta_i + \epsilon_{it}, \end{aligned} \tag{1}$$

where i and t is an index of individual and time respectively. The dependent variable y_{it} represents health investment behaviors such as eating habits and physical activities, and health outcomes. EHI_i takes one if respondent insured by employee's health insurance at 2007 and BMI_i is the value of BMI at 2007. $After_t$ takes one after 2008, i.e., respondents in 2009, 2011 and 2013, and the baseline year is 2007. x_{it} is a set of control variables that include age, age squared, marital status, number of children, household income, hours of work, physical stress, job stress, employment status dummy, and occupation dummy. θ_i is the unobserved individual fixed effects. ϵ_{it} is an unobserved error term.

In equation (1), β_7 is our target parameter. β_7 is the coefficient of the triple interaction term of pre-period insurance type and BMI value, and after dummy. Since people insured by employee's health insurance have higher participation rate of checkups by duty and the BMI value is proxy of the probability to receive the guidance, I interpret β_7 as the treatment

effect of health checkup systems. As discussed, I use DDD approach and common trend assumption is needed for identification. To guarantee this assumption, I control for the observed and unobserved individual characteristics. I add some exogenous control variables in equation (1) to control for the observables. In addition, I estimate equation (1) using fixed effects (FE) method to control for the unobserved individual fixed effects.

5 Result

In this section, I explain estimation results of the impact of information improvement on health investment behaviors, and health outcome. As discussed, I estimate only male aged from 50 to 64 at the 2007 survey and use the 2007, 2009, 2011 and 2013 JSTAR. All specifications are estimated with fixed effects model and same control variables.

5.1 Main results

Table 6 shows the impact of information improvement on health investment behaviors and outcomes. In the analysis of the dietary habit, the nutrition intake, and the time use variables, independent variables are logged and I can interpret coefficients as percentage change. Additionally, I focus on the coefficients of two interaction terms ($EHI_i \cdot After_t$ and $EHI_i \cdot BMI_i \cdot After_t$).

Panel A in Table 6 show the impact on the some food intakes of the main and side dishes. In chicken, pork and beef, and squid, octopus, shrimp and shell fish (SOSS), the coefficients of triple interaction, $EHI_i \cdot BMI_i \cdot After_t$, are negatively and significantly estimated. Since people insured by the employee's health insurance are obligated to undergo the checkups, the impact of the new checkup systems is relatively higher for people with employee's health insurance. Additionally, the BMI value at pre-period is interpreted as the proxy of pre-determined probability to receive the health guidance, people with higher

Table 6: Fixed Effects Model Estimation of Impact on Health Investment Behaviors and Outcomes

Dependent variable	Coefficient (S.E.)				Calculated effect at $BMI = 25$ (%)	Obs.
	$EHI(pre) \times BMI(pre) \times After$		$EHI(pre) \times After$			
Panel A: Dietary habits (Logged):						
Main and Side dishes						
Chicken	-0.109***	(0.034)	2.552***	(0.791)	-16.8	2485
Pork and Beef	-0.047*	(0.027)	1.167*	(0.636)	-1.1	2485
SOSS*1	-0.055*	(0.031)	1.331*	(0.738)	-4.8	2485
Canned Tuna	0.060*	(0.033)	-1.345*	(0.767)	16.2	2485
(Aggregate variables)						
Vegetables	-0.035**	(0.018)	0.839*	(0.431)	-3.9	2485
Total Eat	-0.025*	(0.014)	0.602*	(0.325)	-1.4	2485
Panel B: Dietary habits (Logged):						
Staple food and others						
Soba	0.091**	(0.041)	-1.918**	(0.973)	35.2	2485
Pasta	0.097**	(0.043)	-2.094**	(1.010)	32.6	2485
Milk	-0.180***	(0.065)	4.345***	(1.556)	-14.3	2485
Coffee	-0.093**	(0.044)	2.177**	(1.034)	-15.3	2485
Cooking Salt	-0.014*	(0.008)	0.336*	(0.191)	-0.9	2485
Cooking Oil	-0.024**	(0.012)	0.598**	(0.288)	0.4	2485
Panel C: Nutrition intakes (Logged)						
β Carotene Eq.	-0.018*	(0.011)	0.431*	(0.254)	-1.3	2485
Potassium	-0.044**	(0.022)	1.119**	(0.537)	0.7	2485
Vitamin K	-0.029*	(0.015)	0.710*	(0.367)	-1.1	2485
Panel D: Energy intake and Physical activities						
(Energy intakes)						
Energy(Logged)	-0.001	(0.010)	0.024	(0.230)	0.8	2485
(Physical activities)						
Walking	-0.022**	(0.009)	0.492**	(0.213)	-4.9	2481
Walking $\geq$ 30min.	0.012	(0.015)	-0.320	(0.357)	-2.5	2481
Exercise(WD:Logged)	0.020	(0.021)	-0.436	(0.484)	6.1	1149
Exercise(HD:Logged)	-0.007	(0.024)	0.021	(0.583)	-14.7	1303
Housework(WD:Logged)	0.049	(0.081)	-1.147	(1.935)	8.3	1391
Housework(HD:Logged)	-0.016	(0.055)	0.362	(1.306)	-4.5	1895
Panel E: Health outcomes						
BMI	0.035	(0.044)	-0.689	(1.014)	18.1	2603
BMI $\geq$ 25	0.008	(0.008)	-0.165	(0.170)	3.0	2603
Poor Health	-0.002	(0.005)	0.073	(0.111)	1.7	2615
ADL	-0.037**	(0.015)	0.901**	(0.383)	-2.7	1982
Depression	-0.019*	(0.011)	0.455*	(0.254)	-2.7	2513

*1: Squid, octopus, shrimp, and shell fish.

Standard errors in parentheses. All specifications include age, age squared, marital status, number of children, household income, hours of work, physical stress, job stress, employment status dummy, and occupation dummy.

* $p < .1$, ** $p < .05$, *** $p < .01$

BMI value have higher probability of receiving the guidance. Therefore, these results are interpreted as the changes in health investment behaviors due to the introduction of checkup systems. Here, the higher probability of receiving the guidance coincide with the higher risk of the metabolic syndrome and people with higher risk are likely to change their behaviors due to the improvement of own health conditions. For these reasons, it is difficult to separately identify the two effects, the information improvement of own health condition and effectiveness of health investment behaviors. Therefore, I interpret the changes as due to checkup systems, which is mixed effect of own health condition and effectiveness of health investment behaviors. Additionally, the estimated coefficients of the double interaction, the insurance type variable and the after dummy, are positive and significant. I calculate the effect for people with some BMI values as $\beta_4 + \beta_7 \cdot BMI_i$. The calculated effect on chicken, pork and beef, and SOSS for people whose BMI value is 25 at pre-period are -16.8%, -1.1%, and -4.8%, respectively. Conversely, in the case of canned tuna, the estimated coefficient of triple interaction is positive and significant and the calculated effect for people with BMI 25 is 16.2%. Additionally, this paper analyze the some aggregated food intake variables other than the raw food intakes. "Vegetables" is the summation of raw vegetables[10] and "total eat" is the total amount of main[11] and side[12] dishes. In vegetables and the total amount, the coefficients of triple interaction are negatively and significantly estimated, and the calculated effects are -3.9% and -1.4% for people with BMI 25. The results of main and side dishes suggest that people change their dietary habits due to the information improvement and, overall, they reduce these foods.

Panel B in Table 6 show the impact on the other dietary habits. In some staple foods,

[10]Vegetables consist of pickles (green leafy vegetables), pickles (Other), raw vegetable(lettuce, cabbage), green leafy vegetables, cabbage, carrot and pumpkin, Japanese radish and radish, root vegetable, tomato, mushroom, and seaweed

[11]Main dishes consist of meat (chicken, pork and beef, ham, and liver), fish (squid, octopus, shrimp, and shellfish, fish with bones, canned tuna, dried fish, fatty fish, and lean fish), egg, and soy (tofu and fried tofu, and natto).

[12]Side dishes consist of potato and vegetables.

the estimated coefficients of triple interaction are positive and significant, and the calculated effects for people with BMI 25 are positive (soba:35.2%, pasta:32.6%). As discussed, people reduce their intakes of main and side dishes. However, they increase the intakes of some staple foods and there may exist a substitution between staple foods and not staple foods. In milk, coffee, cooking salt, and cooking oil, the coefficients are negatively and significantly estimated, and the calculated effects are -14.3%, -15.3%, -0.9%, and 0.4% for people with BMI 25 at pre-period. Results in Panel B suggest that people also change other dietary habits after introduction of the checkup systems as well as the main and side dishes.

Although people change their dietary habits, few significant impacts on nutrition intakes are estimated. Panel C in Table 6 show the results of nutrition intakes. In β-carotene equivalents, potassium, and vitamin K, the coefficients of triple interaction are negatively and significantly estimated, and the calculated effects are -1.3%, 0.7%, and -1.1%.

Panel D in Table 6 show the results of the energy intakes and physical activities. This paper uses five physical activities, such as the exercising time in weekday (Exercise(WD)) and holiday (Exercise(HD)), the dummy variable whether walking or not(Walking), the dummy variable whether walking more than 30 minutes per day or not (Walking $\geq$ 30m), and the housework time in weekday (Housework(WD)) and holiday (Housework(HD)). The estimated coefficient in the energy intake is insignificant, although people changes their dietary habits. On the other hand, the coefficient in the walking is negatively and significantly estimated and the calculated effects for people with BMI 25 is -4.9%. In addition, there are no significant effects for other physical activities. These results suggest that the energy consumption is reduced in spite of the energy intake does not change and this may lead BMI greater. However, there are no significant effects on BMI variables. Panel E in Table 6 show the effect of information improvement on health outcomes and the estimated coefficients of triple interaction is insignificant for BMI variables. Nevertheless, in the cases of ADL and depression, the coefficient of triple interaction are negatively and significantly estimated and these results

suggest that ADL and depression are improved due to the changes in investment pattern.[13]

5.2 Heterogeneity of Education

Many researchers studied the relationship between education and health.[14] Cutler and Lleras-Muney (2010) examine the relationship between education and health behaviors in the U.S. and the U.K. and find that education is associated with positive health behaviors. According to these, there seems to be the heterogeneous effects of information improvement on health investment behaviors and consequent outcomes. Therefore, I analyze the effects with taking the heterogeneity of education into consideration, and thus I estimate the effects using samples divided by education level.

I divide our samples into two, less than university graduate (LTU) and university graduate (Univ.). Before estimating the equation, I check the health outcomes and investments of these two groups. Table 7 shows the differences in health outcomes and health investment behaviors by education level. Health outcomes are better for university graduate samples, for example, the probability of overweight or obese in higher educated sample is 4% lower than those in lower educated sample at the 1% significant level. In addition, investment pattern is different between education level. The ratio of staple food is lower and of vegetables is higher for the higher educated sample. Higher educated people walk and spend time for exercising in holiday more.

Table 8 shows the estimation results of dietary habits in two samples. In LTU samples, people change the food intakes of main and side dishes. (Panel A) The coefficients of triple interaction term is significantly estimated. (positive: canned tuna(8.4%), negative:chicken(-28.2%), pork and beef(-3.9%), SOSS(-6.5%), Tomato(-6.0%)) [15] However, in the

[13] In medical field, Akbaraly et al. (2009) examine the relationship between dietary habits and depression.

[14] Grossman (2006), Grossman (2011), and Eide and Showalter (2011) review the studies of the relationship between health and education.

[15] The calculated effects with BMI value 25 are in parenthesis. (BMI value is 26 for only tomato.)

Table 7: Differences in Health outcomes and Health Investment Behaviors by Education

	(1) LTU	(2) Univ	(3) (2)-(1)
Health outcomes			
BMI	23.46	23.28	-0.18*
Overweight or obese	0.28	0.24	-0.04***
Poor health	0.02	0.02	-0.01*
Self-report of health	2.47	2.23	-0.23***
ADL summary score	0.10	0.07	-0.03
Depression	0.16	0.13	-0.02*
Dietary habits			
Ratio of staple food	0.47	0.43	-0.03***
Ratio of meat	0.05	0.06	0.01***
Ratio of fish	0.09	0.09	0.00
Ratio of soy	0.07	0.07	-0.00***
Ratio of vegetables	0.28	0.31	0.03***
Energy intake			
Energy (kcal)	2124.78	2130.35	5.57
Physical activities			
Walking	0.91	0.94	0.02**
Walking more than 30m	0.75	0.76	0.01
Exercising(Min.:WD)	42.08	40.94	-1.14
Exercising(Min.:HD)	65.77	76.71	10.94***
Housework and child care (Min.:WD)	65.05	60.70	-4.35
Housework and child care (Min.:HD)	134.87	125.04	-9.82**

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 8: Heterogeneity of Education: Analysis of Dietary Habits

Dependent variable	Coefficient (S.E.)				Calculated effect at $BMI = 25$ (%)	Obs.
	$EHI(pre) \times BMI(pre) \times After$		$EHI(pre) \times After$			
Sample: Less Than University Graduate						
Panel A: Dietary habits (Logged):						
Main and Side dishes						
Chicken	-0.145***	(0.039)	3.344***	(0.901)	-28.2	1832
Pork an Beef	-0.071**	(0.030)	1.745**	(0.715)	-3.9	1832
SOSS*1	-0.097***	(0.035)	2.354***	(0.846)	-6.5	1832
Canned Tuna	0.067*	(0.039)	-1.595*	(0.920)	8.4	1832
Tomato	0.081*	(0.047)	-2.082*	(1.126)	-6.0	1832
(Aggregate variable)						
Total Eat	-0.015	(0.016)	0.351	(0.385)	-2.6	1832
Panel B: Dietary habits (Logged):						
Staple food and others						
Soba	0.115**	(0.050)	-2.481**	(1.197)	39.1	1832
Pasta	0.093*	(0.051)	-2.081*	(1.194)	25.1	1832
Milk	-0.155*	(0.079)	3.706**	(1.882)	-16.4	1832
Sample: University Graduate						
Panel C: Dietary habits (Logged):						
Main and Side dishes						
Tofu and Fried Tofu	-0.105**	(0.047)	2.520**	(1.128)	-11.4	652
Natto	-0.122*	(0.070)	2.910*	(1.666)	-13.2	652
Radish	-0.142**	(0.065)	3.197**	(1.507)	-35.2	652
Root Vegetable	-0.097*	(0.054)	2.381*	(1.281)	-5.5	652
Seaweed	-0.097**	(0.047)	2.223**	(1.124)	-19.5	652
(Aggregate variable)						
Total Eat	-0.055**	(0.026)	1.358**	(0.625)	-1.5	652
Panel D: Dietary habits (Logged):						
Others						
Milk	-0.202*	(0.114)	5.133*	(2.718)	7.7	652
Coffee	-0.220***	(0.072)	5.205***	(1.692)	-30.3	652

*1: Squid, octopus, shrimp, and shell fish.

Standard errors in parentheses. All specifications include age, age squared, marital status, number of children, household income, hours of work, physical stress, job stress, employment status dummy, and occupation dummy.

* $p < .1$, ** $p < .05$, *** $p < .01$

total amount of main and side dishes, "total eat", the coefficients are insignificant. These results suggest that people with lower education change the component of main and side dishes due to the information improvement. Additionally, people with lower education increase the intakes of some staple foods. (Panel B: soba(39.1%), pasta(25.1%))[15]

On the other hand, in Univ. samples, although people change the food intakes of main and side dishes, tendency to change is not the same as the case in LTU. (Panel C) People with higher education decrease some plant related foods which seem to be healthy foods. (tofu and fried tofu(-11.4%), natto(-13.2%), radish(-35.2%), root vegetables(-5.5%), seaweed(-19.5%))[15] These results suggest that high educated people adjust their over-investment due to uncertainty to the optimal level. Dardanoni and Wagstaff (1990) theoretically examine the relationship between the uncertainty related to health and the demand for a health investment behavior, medical care, using a simplified Grossman model. Their comparative static results indicated that, in an empirically plausible cases, better information about the effectiveness of investment behaviors lead to a reduction in the investment. In the checkup systems, the guidance gives people better information about health investment behaviors such as dietary habits and physical activities. This leads the expected effectiveness of health investment behaviors to increase and then they reduce the investments. Actually, higher educated people have higher ratio of the plant related foods intakes than lower educated people in our data. (LTU: 0.34, Univ.: 0.36) [16] Consequently, "total eat" decreases in the higher educated samples. (-1.5%)[15] Additionally, people with higher education does not change the staple food intakes unlike the case in the those with lower education. (Panel D)

In higher educated people, as a consequence of the reduction of plant related foods, some intakes of nutrition decrease. Panel A in Table 9 shows the results of nutrition intakes in two samples. In higher educated people, the coefficients of triple interaction are negatively and

[16] The ratio of the plant related foods is calculated by dividing amount of plant related foods by amount of main dishes, side dishes and staple foods, where plant related foods consist of soy, vegetables, and potato. I calculate the mean value using male aged 50 to 64 at pre-period.

Table 9: Heterogeneity of Education: Analysis of Nutrition Intakes

Dependent variable	Coefficient (S.E.)				Calculated effect at $BMI = 25$ (%)	Obs.
	$EHI(pre) \times BMI(pre) \times After$		$EHI(pre) \times After$			
Sample: University Graduate						
Panel A: Nutrition intakes (Logged)						
(Vitamin)						
Vitamin K	-0.071**	(0.031)	1.696**	(0.729)	-7.5	652
Vitamin B2	-0.018*	(0.010)	0.472*	(0.244)	1.2	652
Vitamin C	-0.046*	(0.026)	1.100*	(0.598)	-6.0	652
Folic Acid	-0.043**	(0.021)	1.055**	(0.488)	-3.0	652
(Dietary Fiber)						
Soluble Dietary Fiber	-0.035*	(0.019)	0.855*	(0.446)	-1.3	652
Insoluble Dietary Fiber	-0.034*	(0.020)	0.849*	(0.478)	1.0	652
Total Dietary Fiber	-0.037*	(0.021)	0.940*	(0.504)	0.4	652
(Minerals)						
Ash Content	-0.027*	(0.016)	0.695*	(0.377)	1.6	652
Potassium	-0.042**	(0.020)	1.047**	(0.475)	-1.1	652
Calcium	-0.051**	(0.024)	1.278**	(0.571)	0.8	652
Magnesium	-0.039**	(0.019)	0.967**	(0.434)	0.2	652
Iron	-0.032*	(0.017)	0.788**	(0.389)	-1.6	652
(Isoflavone)						
Daidzein	-0.079**	(0.033)	1.817**	(0.792)	-15.0	652
Genistein	-0.080**	(0.035)	1.860**	(0.829)	-15.0	652
(Others)						
Plant Fat	-0.038*	(0.021)	0.929*	(0.476)	-2.8	652
β Caroten Eq.	-0.068*	(0.035)	1.730**	(0.826)	4.1	652
Sucrose	-0.105**	(0.041)	2.540***	(0.951)	-7.7	652
N-6 Fatty Acids	-0.031*	(0.018)	0.771*	(0.427)	0.3	652

Standard errors in parentheses. All specifications include age, age squared, marital status, number of children, household income, hours of work, physical stress, job stress, employment status dummy, and occupation dummy.

* $p < .1$, ** $p < .05$, *** $p < .01$

significantly estimated for 18 nutritions, although there are no significant impact for lower educated people.

Table 10: Heterogeneity of Education: Analysis of Exercising, and Health Outcomes

Dependent variable	Coefficient (S.E.)				Calculated effect at $BMI = 25$ (%)	Obs.
	$EHI(pre) \times BMI(pre) \times After$		$EHI(pre) \times After$			
Sample: Less Than University Graduate						
Panel A: Energy intake and Physical activities						
(Energy intakes)						
Energy(Logged)	0.004	(0.011)	-0.102	(0.271)	-0.8	1832
(Physical activities)						
Walking	-0.028***	(0.010)	0.625**	(0.245)	-8.6	1823
Panel B: Health outcomes						
BMI $\geq$ 25	0.020**	(0.009)	-0.420**	(0.202)	6.9	1921
ADL	-0.047**	(0.020)	1.138**	(0.508)	-2.9	1442
Sample: University Graduate						
Panel C: Energy intake and Physical activities						
(Energy intakes)						
Energy(Logged)	-0.016	(0.018)	0.446	(0.410)	4.7	652
(Physical activities)						
Walking $\geq$ 30min.	0.068**	(0.029)	-1.601**	(0.664)	9.5	657
Housework(HD:Logged)	0.128*	(0.074)	-3.010*	(1.737)	19.5	553
Panel D: Health outcomes						
BMI $\geq$ 25	-0.027*	(0.015)	0.566*	(0.333)	-9.8	680
ADL	-0.024*	(0.013)	0.542*	(0.317)	-6.0	539

Standard errors in parentheses. All specifications include age, age squared, marital status, number of children, household income, hours of work, physical stress, job stress, employment status dummy, and occupation dummy.

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 10 shows the results of exercising and consequent health outcomes. Even though both higher and lower educated people change their dietary habits, there are no significant impact on the energy intake. (Penals A and C) In contrast, higher educated people increase the physical activities due to the checkups. The coefficients of triple interactions for the dummy variable whether walking more than 30 minutes per day (Walking $\geq$ 30min.) and housework time in holiday (Housework(HD)) are positively and significantly estimated. (Panel C: Walking $\geq$ 30min.(9.5%), Housework(HD)(19.5%))[15] These results imply that higher educated people increase their energy consumption due to the information improvement. Con-

sequently, among higher educated people, in the analysis of "BMI $\geq$ 25", the coefficient of triple interaction is negatively and significantly estimated ADL is improved. (Panel D: BMI $\geq$ 25(-9.8%), ADL(-6.0%))[15] These results suggest that people with higher education change their health investments due to the information improvement and improve their health condition. On the other hand, lower educated people reduce their walking. The coefficients of triple interactions for the dummy variable whether walking or not (Panel A: Walking) is negatively and significantly estimated (-8.6%)[15], this may lead the energy consumption to decrease. As a result, in the analysis of "BMI $\geq$ 25", the estimated coefficient of triple interaction is positive and significant. (Panel B: 6.9%)[15] Even though receiving the guidance, calculation of daily energy intake and consumption is difficult and needs specific knowledge. Lower educated people seem to misevaluate their energy intake and consumption and, consequently, they cannot improve their BMI condition. However, the coefficient for ADL is negatively and significantly estimated (Panel B: -2.9%)[15] and these result suggest that the changes in health investment pattern improve their physical condition.

6 Conclusion

This paper examines the effect of health information on health investment behaviors and con- sequent outcomes. I use the exogenous variation resulted from the introduction of the Japanese health checkup systems related to obesity and apply DDD method. The JSTAR gives the rich information about health investment and health outcomes.

The estimated results suggest that the information improvement through checkup systems lead individual to change the health investments such as dietary habits, for example, the intakes of chicken, pork and beef, cooking salt, and cooking oil are decreased. Consequently, some health outcomes are improved, although the BMI conditions are not improved. Moreover, there are heterogeneous effects between different education levels. Higher educated

people effectively change the investment and decrease the probability of overweight or obese (BMI$\geq$25). However, the obesity condition got worse for lower educated people, although they change the health investment. This is probably because of the difficulty of calculating daily energy intake and consumption.

The lack of information about participation status of health guidance is a limitation of this study. The accurate information gives us the more clear results. The JSTAR correct the receipt data of medical claim and these data are beneficial for the study. However, it is difficult to access these data and this is the future work.

References

Akbaraly, T. N., Brunner, E. J., Ferrie, J. E., Marmot, M. G., Kivimaki, M., and Singh-Manoux, A. (2009). Dietary pattern and depressive symptoms in middle age. *British Journal of Psychiatry*, 195(5):408–413.

Arrow, K. J. (1963). Uncertainty and the Welfare Economics of Medical Care. *The American Economic Review*, 53(5):941–973.

Brown, D. J. and Schrader, L. F. (1990). Cholesterol Information and Shell Egg Consumption. *American Journal of Agricultural Economics*, 72(3):548–555.

Chern, W., Loehman, E., and Yen, S. (1995). Information, Health Risk Beliefs, and the Demand for Fats and Oils. *The Review of Economics and Statistics*, 77(3):555–564.

Crutchfield, S., Kuchler, F., and Variyam, J. N. (2001). The Economic Benefits of Nutrition Labeling : A Case Study for Fresh Meat and Poultry Products. *Journal of Consumer Policy*, 24(2):185–207.

Cutler, D. M. and Lleras-Muney, A. (2010). Understanding differences in health behaviors by education. *Journal of Health Economics*, 29(1):1–28.

Dardanoni, V. and Wagstaff, A. (1990). Uncertainty and the demand for medical care. *Journal of Health Economics*, 9(1):23–38.

Eide, E. R. and Showalter, M. H. (2011). Estimating the relation between health and education: What do we know and what do we need to know? *Economics of Education Review*, 30(5):778–791.

Godard, M. (2016). Gaining weight through retirement? Results from the SHARE survey. *Journal of Health Economics*, 45:27–46.

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

Grossman, M. (2006). Chapter 10 Education and Nonmarket Outcomes. *Handbook of the*

Economics of Education, 1(06):577–633.

Grossman, M. (2011). The Relationship Between Health and Schooling. *Eastern Economic Journal*, 34:281–292.

Hsieh, C.-R. and Lin, S.-J. (1997). Health Information and the Demand for Preventive Care among the Elderly in Taiwan. *The Journal of human resources*, 32(2):pp. 308–333.

Ikeda, S., Kang, M. I., and Ohtake, F. (2010). Hyperbolic discounting, the sign effect, and the body mass index. *Journal of Health Economics*, 29(2):268–284.

Kahn, M. E. (1998). Education's role in explaining diabetic health investment differentials. *Economics of Education Review*, 17(3):257–266.

Kahn, M. E. (1999). Diabetic Risk Taking: The Role of Information, Education and Medication. *Journal of Risk and Uncertainty*, 18(2):147–164.

Kanj, M. and Mitic, W. (2009). 7th Global Conference on Health Promotion.

Keenan, P. S. (2009). Smoking and Weight Change After New Health Diagnoses in Older Adults. *Archives of Internal Medicine*, 169(3):237.

Kenkel, D. S. (1991). Health Behavior, Health Knowledge, and Schooling. *Journal of Political Economy*, 99(2):287–305.

Kickbusch, I., Pelikan, J., Apfel, F., and Tsouros, A. (2013). Health literacy: the solid facts.

Kim, S.-R. and Chern, W. S. (1999). Alternative Measures of Health Information and Demand for Fats and Oils in Japan. *Journal of consumer affairs*, 33(1):92–109.

Ministry of Health, L. and Welfare (2014). Press Release: The Implementation Status of the Special Health Checkups and Specific Health Gudance in 2012(Original Title: Heisei 24 Nenndo Tokutei Kenkou ShinsaTokutei Hoken Sidou No Jisshi Joukyo).

Neutel, C. I. and Campbell, N. R. C. (2008). Changes in lifestyle after hypertension diagnosis in Canada. *The Canadian Journal of Cardiology*, 24(3):199–204.

Nutbeam, D. (1998). Health promotion glossary. *Health Promotion International*,

13(4):349–364.

Picone, G., Uribe, M., and Mark Wilson, R. (1998). The effect of uncertainty on the demand for medical care, health capital and wealth. *Journal of Health Economics*, 17(2):171–185.

Roosen, J., Marette, S., Blanchemanche, S., and Verger, P. (2009). Does health information matter for modifying consumption? A field experiment measuring the impact of risk information on fish consumption. *Review of Agricultural Economics*, 31(1):2–20.

Ruhm, C. J. (2012). Understanding overeating and obesity. *Journal of Health Economics*, 31(6):781–796.

Schmid, C. (2015). CONSUMER HEALTH INFORMATION AND THE DEMAND FOR PHYSICIAN VISITS CHRISTIAN. *Health economics*, 24:1619–1631.

Slade, A. N. (2012). Health investment decisions in response to diabetes information in older Americans. *Journal of Health Economics*, 31(3):502–520.

Trogdon, J. G., Nonnemaker, J., and Pais, J. (2008). Peer effects in adolescent overweight. *Journal of Health Economics*, 27(5):1388–1399.

Zhao, M., Konishi, Y., and Glewwe, P. (2013). Does information on health status lead to a healthier lifestyle? Evidence from China on the effect of hypertension diagnosis on food consumption. *Journal of Health Economics*, 32(2):367–385.