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# Factors Affecting Participation in Health Checkups: Evidence from Japanese Survey Data

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# Factors affecting participation in health checkups: Evidence from Japanese survey data

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## Abstract

Multiple factors influence individuals to get health checkups. This study uses Japanese survey data to investigate key determinants of the health checkup decision. Relevant personal attributes and lifestyles are identified. The results indicate that the influence of these factors varies according to the type of health checkup. We also examine the impact of an individual's time preference on his/her health checkup behavior. The results suggest that hyperbolic discounters are more likely than non-hyperbolic discounters to seek health checkups, which indicates that the effect of time preference on health checkup behavior differs among the different types of time discount structures.

*Keywords*: health checkup; health behavior; time preference; hyperbolic discounting; Japan

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## 1. Introduction

Japan is a rapidly aging society. In 2015, 26.7% of the Japanese population was 65 years of age or older. Relative to most other countries in the world, this is an extremely high figure. (For comparison, the rate is 21.2% in Germany, 19.1% in France, 17.8% in the United Kingdom, 14.8% in the United States, 13.4% in Russia, and 9.6% in China.) Under such circumstances, a variety of social problems such as increasing medical expenses and elder-to-elder nursing care (i.e., elderly persons caring for the elderly) have emerged.

As part of the approach to dealing with these problems, efforts to prevent disease and promote health among the insured and their dependents have received increasing emphasis. According to Japan's Ministry of Health, Labor and Welfare in Japan, the implementation of data-driven health plans to reduce medical expenses is progressing. These plans are regarded as an effort by health insurers to become more efficient and effective businesses by using a large amount of electronically managed information that tracks such events as medical checkups.

At the same time, a mechanism that allows individuals to make efforts to improve their own health is also needed. For instance, appropriate support for individuals who are in "frail" health (somewhere between full health and being in need of care) should be provided. This is especially true for those who are in a stage of declining physical function due to aging. Appropriate support in such cases can be expected to delay the need for nursing care and prevent serious illness.

Getting routine health checkups to prevent illness and maintain good health is considered one of the most effective measures to alleviate many of the problems associated with aging. The most familiar health checkup program in Japan is composed of the Specific Health Checkup (SHC) and Specific Health Guidance (SHG). These two elements are part of an insurance system that was instituted in 2008 for all public health insurance members from age 40 to 70 years. SHC is a health examination intended to prevent lifestyle diseases, which have been increasing rapidly in recent years in Japan. SHG is the support provided to those who are judged likely to develop lifestyle diseases based on the results of their health checkups. Figure 1 provides the implementation rate of SHC, the percentage of SHG operations, and the percentage of persons completing SHG from 2008 to 2014. As shown in the figure, although the implementation rate for SHC has been increasing year by year, it is still low. On the other hand, while the percentage of individuals following SHG is decreasing, the proportion of those who complete the guidance is increasing.

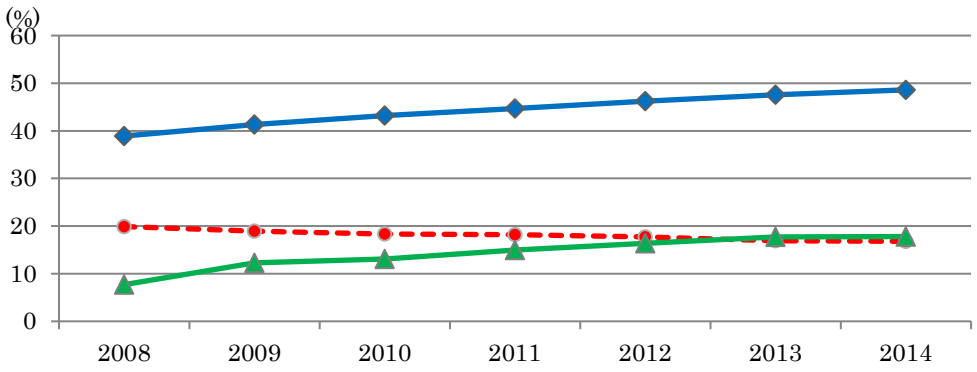


Figure 1. The implementation rate of Specific Health Checkup (blue), the percentage of Specific Health Guidance operation (red), and the percentage of persons completing Specific Health Guidance (green)

Through a health checkup and the medical report that follows, an individual is able to assess his/her health condition and take remedial steps if necessary. For those whose results are not good, changes in lifestyle activities (e.g., eating habits, exercise, etc.) are likely needed. Even for those whose examinations indicate no health problems, simply knowing their status can be useful. The very act of deciding whether to get a health checkup would appear to be related to one's awareness of maintaining health and preventing disease.

In the current study, we aim to identify those factors that affect an individual's participation in health checkups. While a number of studies have been conducted on this issue in Japan (e.g., Iwasaki et al., 2003; Funahashi et al., 2013; Takahashi et al., 2008; Mitsuhashi et al., 2006), most have focused on socio-demographic factors.[1] At the same time, several studies on time preference have reported that an individual's time preference can be associated with his/her health-related behaviors (e.g., Kang and Ikeda, 2016; Ikeda et al., 2010). Thus, it is considered that time preference may be an important factor affecting one's decision to get a health checkup. In this paper, we consider the interaction between hyperbolic discounting and health behaviors (e.g., smoking, drinking, engaging in physical exercise, etc.) as well as the individual's social demographic factors. Moreover, given that the cancer mortality rate in Japan is high and many individuals can benefit from aggressive cancer screening, we also analyze those factors affecting participation in cancer screenings.

The structure of this paper is as follows: In Section 2, we provide a detailed review of the

[1] More details are provided in Section 2.

literature dealing with factors related to health checkups and time preference. Section 3 explains our analytical methods and describes the data. Estimation results are presented and discussed in Section 4. Finally, we report our conclusions in Section 5.

## 2. Literature review

### 2.1 Factors affecting participation in health checkups

A number of studies have examined factors affecting the decision to seek a health checkup. Looking at differences between those who elected to have a health examination and those who did not, Iwasaki et al. (2003) reported that socio-demographic factors, lifestyle factors, and an individual's medical history were important factors influencing the checkup decision. Funahashi et al. (2013) found that men who did not have a medical examination had lower household incomes than those who had an exam. They also found that among the men who had not had a medical examination, few were self-employed or were regular employees. In addition, it has been found that the availability of support from the people close to an individual affects the individual's health checkup rate.[2] Mitsuhashi et al. (2006) analyzed the relationship between participation of the elderly in medical examinations and their social support. They found that those elderly who had medical checkups had a greater connection to society through, for example, their membership in a neighborhood association or having close friends and relatives.

Educational level also appears to affect health checkup behavior. Yoshida et al. (2008) showed that a low educational level was related to the non-consultation of health examinations in the case of men. Differences in the behavior of men and women with respect to their participation in health examinations has also been reported. Men who did not receive medical examinations had a weak relationship with those familiar to them, a feature not seen in women (Funahashi et al., 2013). Concerning the effect of age, Mitsuhashi et al. (2003) reported that one's subjective health condition affected the health examination decisions of the elderly.

### 2.2 Time preference and health-related behavior

In the studies mentioned in the preceding section, factors such as personal attributes and lifestyle were examined; in general, the time preference of the individual was not a consideration. However, several studies (e.g., Kang and Ikeda, 2016; Ikeda et al., 2010) suggest that time preference, especially hyperbolic discounting, affects health-related behaviors. We pursue this idea here.

The time discount factor of the hyperbolic type is shown below:

[2] Takahashi et al. (2008) reported that there is a connection between mental support and good health behavior.

$$f(t) = (1 + kt)^{-\gamma/k} \quad (1)$$

where $t \geq 0, \gamma \geq 0, k > 0$. Here, $\gamma$ and $k$ are constants, and $t$ represents delay in gain.[3] The time discount rate $\rho(t)$ can then be defined as $-f'(t)/f(t)$. That is,

$$\rho(t) = -\frac{f'(t)}{f(t)} = \frac{\gamma}{1+kt}. \quad (2)$$

Unlike exponential discounting, hyperbolic discounting is a time-inconsistent model of discounting. It indicates that people have higher discount rates for very short horizons but have lower discount rates for longer horizons (Thaler, 1981). Frederick et al. (2002) showed that the hyperbolic type discount function is a better approximation of the time discount function than the exponential type.

With respect to the effect of hyperbolic discounting on health-related behavior, Kang and Ikeda (2016) reported that respondents who were less patient (i.e., respondents with hyperbolic discounting) tended to have worse health-related attributes. In addition, Ikeda et al. (2010) found that time discounting was associated with body weight via hyperbolic discounting. That is, individuals with hyperbolic discounting are more likely to have high body weight. Further, Yamane et al. (2003) stated that socio-emotional status affected impulsivity in intertemporal choice.

Regarding the connection between time preference and checkup-seeking behavior, Fang and Wang (2015) used United States data to show a close relationship between the two. However, in their study they did not individually control for the possibility that the act of getting health checkups may be influenced by health-related behavior such as smoking and exercising. Accordingly, in the current study we investigate the determinants of getting health checkups by considering the interaction between hyperbolic discounting and health-related behavior.

## 3. Methods

### 3.1 Methodology

To examine the determinants of health check-up behavior, the following specification is considered:

$$\begin{aligned} CHECKUPi_j = {} & \alpha_j + \beta_M M_j + \beta_{BMI} BMI_j + \beta_A A_j + \beta_I I_j + \beta_S S_j + \beta_P P_j + \beta_{self} self_j \\ & + \beta_{fu} full_j + \beta_{pa} part_j + \beta_w w_j + \beta_u u_j + \beta_C C_j + \beta_{ho} hospital + \beta_{he} health \\ & + \beta_{SMOKING} SMOKING_j + \beta_{SPORT} SPORT_j + \beta_{DRINKING} DRINKING_j \\ & + \beta_{HD} \text{hyperbolic dummy}_j + \beta_{SM_{HD}} SMOKING \cdot \text{hyperbolic dummy}_j \\ & + \beta_{SP_{HD}} SPORT \cdot \text{hyperbolic dummy}_j + \beta_{DR_{HD}} DRINKING \cdot \text{hyperbolic dummy}_j + \mu_j \end{aligned} \quad (3)$$

[3] We refer to Kang and Ikeda (2016) and Morimoto (2009).

where *CHECKUPi* ($i$ = 1, 2, 3) is the dependent variable; specifically, *CHECKUP1* is the probability of getting health checkups, *CHECKUP2* is the number of health checkups undertaken, and *CHECKUP3* is the probability of having a cancer screening. *M* is male, *BMI* is body mass index, *A* is age, *I* is income, *S* is household size, *P* is population size of the area in which the respondent lives, *self* is self-employed, *full* is full-time employed, *part* is part-time employed, *w* is housewife, *u* is unemployed, *C* is a college graduate dummy, *hospital* indicates whether the respondent has been hospitalized within the past year, and *health* is a subjective health anxiety dummy. *SMOKING* is a binary variable for the frequency of smoking, *SPORT* is a binary variable for the frequency of participating in sports, *DRINKING* is a binary variable indicating the frequency of drinking alcohol, hyperbolic dummy is a binary variable indicating whether or not the respondent is a hyperbolic discounter. In addition, $\alpha$ is the constant term and $\mu$ is the error term. $\beta s$ are coefficients of each variable and *j* is the respondent index.

To analyze the impact of being a hyperbolic discounter or non-hyperbolic discounter on the health checkup behavior of a respondent, we create terms for the interaction of HD and the respondent's health-related behavior (i.e., *SMOKING・hyperbolic dummy*, *SPORT・hyperbolic dummy*, and *DRINKING・hyperbolic dummy*).[4] With the addition of these interaction terms to the regression models, the coefficients of *SMOKING*, *SPORT*, *DRINKING* represent the influence of these factors on the health checkup behavior of non-hyperbolic discounters, while the coefficients of interaction terms will indicate the impact on the dependent variable of *SMOKING*, *SPORT*, and *DRINKING* for hyperbolic discounters.

### 3.2 Data

The data used in this study were obtained from a questionnaire survey entitled "Preference Parameters Study" that was conducted in four countries by the Global Centers of Excellence (Global COE) program at Osaka University: in Japan from 2004; in the U.S. from 2005; in India from 2009; and in rural and urban areas in China from 2006 and 2007. The key question, "Did you participate in the following health checkups *in the last year?*" was asked in the 2011 questionnaire in Japan; therefore, we use the answers to this question for the dependent variables in our regressions and use the other answers from the 2010 questionnaire for the independent variables.[5]

[4] Morimoto (2009) used interaction terms to clarify the relationship between hyperbolic discounters and their consumption behavior.

[5] We used the data for one explanatory variable (i.e., hospitalization history) from the 2011 questionnaire because this question asked for the respondent's hospitalization history during the past year.

### 3.2.1 Questions regarding health checkups

We treat *CHECKUP1*, *CHECKUP2*, and *CHECKUP3* as the dependent variables. Based on responses to Q1 and Q2 as presented in Table 1, *CHECKUP1* equals 1 if the respondent had any health checkups or cancer screenings within the past year (i.e., if the respondent selected any of the choices except 6 in Q1 and 7 in Q2), and 0 otherwise. *CHECKUP2* indicates the number of health checkups taken; its value is assigned by combining a simple count of the number of checkups indicated by the respondent in Q1 and the number of cancer screenings indicated in Q2.[6] *CHECKUP3* indicates the behavior of respondents who received any cancer screenings *in addition to* other health checkups. For those who had at least one health checkup (i.e., *CHECKUP1* = 1), *CHECKUP3* is coded 1 if the respondent checked any cancer screenings in Q2, and 0 otherwise. We run Probit models for *CHECKUP1* and *CHECKUP3* and Ordinary Least Squares (OLS) regression for *CHECKUP2*. The same independent variables are used in each of these three regressions.

Table 1. Questions about health checkups (Q1, Q2)

| Q1) Have you had any health checkups (excluding cancer examination, prenatal check, dental checkup, and medical treatment) within the last year? (Indicate ALL That Apply) | |
|---|---|
| 1 | Health check organized by local municipality |
| 2 | Health check organized by your employer or labor union of your employer |
| 3 | Health check organized by your school |
| 4 | Medical checkups (other above 1-3) |
| 5 | Other checkups |
| 6 | I haven't taken any health check in the last year. |

| Q2) Have you had any cancer examinations in the last year? (ALL That Apply) Note: This can include the health check you checked in Q1. | |
|---|---|
| 1 | Stomach cancer examination |
| 2 | Lung cancer examination |
| 3 | Uterine cancer examination |
| 4 | Breast cancer examination |
| 5 | Colon cancer examination |
| 6 | Other cancer examinations |
| 7 | I haven't taken any cancer examination within the last one year. |

### 3.2.2 Questions regarding time preference

Time preference is assessed from responses to Q3 and Q4 as presented in Table 2. Q3 and Q4 are questions about intertemporal choices. We use it to measure time preference and to

[6] We run OLS regression on *CHECKUP2* to check the robustness of our Probit regression on *CHECKUP1*.

classify a respondent as a hyperbolic discounter or a non-hyperbolic discounter. In Q3, we elicit time preference based on the respondent's choices in the following situation: "Let's assume you have two options to receive some money. You may choose Option A, to receive ¥10,000 today, or Option B, to receive a different amount in seven days. Compare the amounts and timing in Option A with Option B and indicate which you would prefer for each of the 9 alternatives." In Q4, the respondent is asked to make choices in the following scenario: "Let's assume you have two options to receive some money. You may choose Option A, to receive ¥10,000 in ninety days, or Option B, to receive a different amount in ninety-seven days. Compare the amounts and timing in Option A with B and indicate which you would prefer to receive for each of the 9 alternatives." As can be seen, respondents were asked to make choices regarding the receipt of money at a point in time close to the present (Q3) and the receipt of money at a relatively distant point in time (Q4). Respondents seeking higher interest rates for transactions close to the present time (Q3) were considered to be more current-oriented.

Table 2. Questions about time preference (Q3, Q4)

Q3) Let's assume you have **two options** to receive some money. You may choose Option A, to receive ¥10,000 **today**; or Option B, to receive a different amount **in 7 days**. Compare the **amounts** and **timing** in Option A with B and indicate which you would prefer to receive for each of the 9 choices.

| Option A (receive today) | Option B (receive in 7 days) | annual interest rate(%) |
|---|---|---|
| 10000 | 9980 | -10 |
| 10000 | 10000 | 0 |
| 10000 | 10019 | 10 |
| 10000 | 10076 | 40 |
| 10000 | 10191 | 100 |
| 10000 | 10383 | 200 |
| 10000 | 10575 | 300 |
| 10000 | 11917 | 1000 |
| 10000 | 19589 | 5000 |

Q4) Let's assume you have two options: to receive ¥10,000 **in 90 days** or receive a different amount **in 97 days**. Compare the **amounts** and **timing** in Option A with B and indicate which you would prefer to receive for each of the 9 choices.

| Option A (receive in 90 days) | Option B (receive in 97 days) | annual interest rate(%) |
|---|---|---|
| 10000 | 9980 | -10 |
| 10000 | 10000 | 0 |
| 10000 | 10019 | 10 |
| 10000 | 10076 | 40 |
| 10000 | 10191 | 100 |
| 10000 | 10383 | 200 |
| 10000 | 10575 | 300 |
| 10000 | 11917 | 1000 |
| 10000 | 19589 | 5000 |

Following Ikeda and Kang (2015) and Morimoto (2009), the time discount rate (DR) is measured as the mean of the interest rate at the point at which there is a shift in the preferred option from A to B.[7,8] By comparing a respondent's time discount rate from Q3 (i.e., DR1) and his/her time discount rate from Q4 (i.e., DR2), we classify the respondent as either a hyperbolic discounter (if DR1 > DR2) or a non-hyperbolic discounter (if DR1≦DR2). Accordingly, we create a hyperbolic dummy as a binary variable coded 1 if the respondent is a hyperbolic discounter and 0 otherwise.

### 3.2.3 Questions regarding other variables

The following health-related variables are also created. *SPORT* is a dummy variable that takes the value 1 if the respondent exercises at least once a week and 0 otherwise. *SPORT* indicates whether the respondent has frequent exercise opportunities. *SMOKING* is a dummy variable with a value of 1 if the respondent smokes at least sometimes and 0 otherwise. This variable signifies whether the respondent has a habit of smoking cigarettes. *DRINKING* is also a dummy variable; it takes the value 1 if the respondent sometimes drinks alcohol and 0 otherwise. This variable indicates whether the respondent has a habit of drinking alcoholic beverages.[9]

The following variables, some of which have been used in previous studies, are also included in the regressions: gender, BMI, age, annual income, household size, population, occupational status, college graduate, hospital, and health anxiety. For gender, a male dummy is created and added to the model. BMI is defined as weight in kilograms divided by the square of height in meters and expressed in units of $kg/m^2$. Annual income was set by the respondent's answer to the question, "What was your approximate salary in 2009 (including business income if you are self-employed)?" Age is determined by the respondent's birth year information. Household size is defined as the number of family members, which is used as an indicator of the respondent's support from the people around him/her. In previous research (e.g., Takahashi et al., 2008), the presence of supportive family members and/or familiar friends or having connections to the local community was deeply involved in the decision to have a medical examination.

[7] For example, if a respondent chooses Option A for an interest rate from -10% to 10% and then shifts to Option B for a rate from 40% to 5000%, his/her time discount rate is calculated as 25%—the mean of 10% and 40%

[8] We exclude from the analysis respondents whose answers went back and forth between Option A and Option B and whose time discount rate was a negative value.

[9] We checked the relationship between discount rate (i.e., *DR1* and *DR2*) and health behavior (i.e., *SMOKING*, *SPORT*, and *DRINKING*) and found that both *DR1* and *DR2* significantly increase the probability of smoking and drinking and decrease the probability of doing physical exercise, confirming that respondents with a high time discount rate have one or more bad habits in their health-related behavior.

Population indicates the size of area in which the respondent lives. It takes the value of 4 if the respondent lives in a government designated city with a population of more than 700,000, 3 if he/she lives in a city with a population of 100,000 to 700,000, 2 if he/she lives in a city with a population less than 100,000, and 1 if he/she lives in a town or village with a population less than 50,000. Regarding occupational status, we create dummies for self-employed, full-time, part-time, housewife, and unemployed. A college graduation dummy is added to represent educational level, based on responses to the following: "Please indicate the highest level of education (or equivalent) completed by you. If you are still in school, check the level you are in now." Finally, to indicate the health condition of the respondent, we include in the model the hospitalization history of the respondent during the past year as well as a subjective assessment of the respondent's health anxiety. The questions for creating the above variables are provided in the Appendix. Table 3 summarizes the descriptive statistics for all of the variables.

Table 3. Descriptive statistics for all variables used in the regressions

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| taking health checkups | 0.7781 | 0.4155 | 0 | 1 |
| number of health checkups taken | 1.3306 | 0.8914 | 0 | 4 |
| taking cancer screening | 0.5229 | 0.4995 | 0 | 1 |
| male | 0.4683 | 0.4990 | 0 | 1 |
| age | 51.2317 | 13.1483 | 21 | 77 |
| income | 22.9779 | 18.0922 | 0 | 99 |
| household | 3.4815 | 1.4415 | 1 | 12 |
| sel- employed | 0.1250 | 0.3307 | 0 | 1 |
| full-time | 0.3817 | 0.4859 | 0 | 1 |
| part-time | 0.1805 | 0.3846 | 0 | 1 |
| housewife | 0.1407 | 0.3478 | 0 | 1 |
| unemployed | 0.0754 | 0.2640 | 0 | 1 |
| college graduate | 0.2248 | 0.4175 | 0 | 1 |
| population size | 2.8303 | 0.8945 | 1 | 4 |
| BMI | 22.6239 | 3.1940 | 14.4731 | 58.5938 |
| hospital | 0.0748 | 0.2630 | 0 | 1 |
| health anxiety | 3.1880 | 1.0454 | 1 | 5 |
| hyperbolicity dummy | 0.1484 | 0.3556 | 0 | 1 |
| smoking | 0.2338 | 0.4233 | 0 | 1 |
| sport | 0.3727 | 0.4836 | 0 | 1 |
| drinking | 0.5293 | 0.4992 | 0 | 1 |

## 4. Results

### 4.1 Results for getting health checkups

The marginal effects obtained from our Probit and OLS regressions are reported in Table 4. With respect to having health checkups, being *male* has a significant and negative coefficient, indicating that males are less likely than females to participate in health checkups. The coefficients of both *age* and *income* are significant and positive, implying that these two attributes raise the probability of getting health checkups. It is clear that the greater the age, the higher the risk of getting sick, which leads to a greater acceptance of health checkups among older people. The results also indicate that respondents with larger families are more likely to get health checkups. Taken together, our results reveal the same tendencies shown in previous studies: that men often do not undergo medical checkups and high-income earners are more likely to seek health consultations (Funahashi et al., 2013), and that the larger the family size, the more positive the impact on the individual's decision to get health checkups (Mitsuhashi et al., 2006; Takahashi et al., 2008). Regarding occupational status, a respondent who is self-employed, employed part-time, unemployed, or a housewife is less likely to have health checkups. In contrast, full-time employed respondents are more likely to get health checkups. The sign of the college graduate dummy is significant and positive, indicating that the higher the level of education, the more likely it is that the respondent will get a medical examination. This result is consistent with the results of earlier studies (Yoshida et al., 2008). The effect of having been hospitalized in the past year is significant, as well, with respondents in this situation having a higher probability of getting health checkups.[10]

Representing the key factor in this study, the *hyperbolic* dummy coefficient is significant and positive, which suggests that individuals with a hyperbolic discounting function are more likely than non-hyperbolic discounters to get health checkups. As for the interaction terms, the coefficient of the *DRINKING_ hyperbolic* dummy is significant and negative, indicating that in the group of hyperbolic discounters, the influence of drinking alcohol on getting health checkups is smaller than that in the group of non-hyperbolic discounters. On the other hand, *SPORT*, *DRINKING*, and *SMOKING* represent the influence of these health-related variables on the probability of getting checkups in the group of non-hyperbolic discounters. Probit regression results thus suggest that in the group of non-hyperbolic discounters, respondents who have the habit of engaging in sports and drinking alcohol are more likely to get health checkups but smokers are less likely.

[10] Hospitalization does not include overnight medical checkups.

Table 4. Marginal effects from Probit and OLS regressions

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| | getting health checkups | | number of health checkups | | getting cancer screening | |
| male | -0.0486 | ** | -0.2414 | *** | -0.2038 | *** |
| | (0.0205) | | (0.0429) | | (0.0251) | |
| age | 0.0039 | *** | 0.0194 | *** | 0.0113 | *** |
| | (0.0007) | | (0.0014) | | (0.0008) | |
| income | 0.0012 | * | 0.0037 | *** | 0.0024 | *** |
| | (0.0007) | | (0.0012) | | (0.0007) | |
| household | 0.0113 | ** | 0.0421 | *** | 0.0293 | *** |
| | (0.0053) | | (0.0114) | | (0.0070) | |
| self-employed | -0.2102 | *** | -0.4648 | *** | 0.0406 | |
| | (0.0227) | | (0.0569) | | (0.0369) | |
| full-time | 0.0985 | *** | 0.2265 | *** | 0.0533 | * |
| | (0.0234) | | (0.0520) | | (0.0317) | |
| part-time | -0.0549 | ** | -0.1063 | * | 0.0086 | |
| | (0.0268) | | (0.0624) | | (0.0364) | |
| housewife | -0.1755 | *** | -0.3414 | *** | 0.1297 | ** |
| | (0.0322) | | (0.0833) | | (0.0569) | |
| unemployed | -0.1272 | *** | -0.2983 | *** | 0.0530 | |
| | (0.0345) | | (0.0827) | | (0.0526) | |
| college graduate | 0.0505 | *** | 0.0703 | * | 0.0191 | |
| | (0.0183) | | (0.0364) | | (0.0217) | |
| population size | -0.0043 | | -0.0395 | ** | -0.0298 | *** |
| | (0.0080) | | (0.0175) | | (0.0106) | |
| BMI | 0.0033 | | 0.0025 | | -0.0030 | |
| | (0.0025) | | (0.0052) | | (0.0031) | |
| hospital | 0.0847 | *** | 0.1985 | *** | 0.0576 | |
| | (0.0316) | | (0.0647) | | (0.0400) | |
| health anxiety | -0.0017 | | 0.0088 | | 0.0142 | |
| | (0.0073) | | (0.0158) | | (0.0095) | |
| hyperbolicity dummy | 0.1233 | *** | 0.2566 | *** | 0.0623 | |
| | (0.0390) | | (0.0770) | | (0.0475) | |
| smoking | -0.0886 | *** | -0.2253 | *** | -0.0482 | ** |
| | (0.0182) | | (0.0400) | | (0.0244) | |
| smoking × hyperbolicity dummy | 0.0011 | | 0.0337 | | 0.0724 | |
| | (0.0477) | | (0.1045) | | (0.0644) | |
| sport | 0.0403 | ** | 0.1263 | *** | 0.0682 | *** |
| | (0.0171) | | (0.0368) | | (0.0220) | |
| sport × hyperbolicity dummy | -0.0239 | | -0.0680 | | -0.0531 | |
| | (0.0442) | | (0.0883) | | (0.0537) | |
| drinking | 0.0664 | *** | 0.1411 | *** | 0.0319 | |
| | (0.0166) | | (0.0369) | | (0.0224) | |
| drinking × hyperbolicity dummy | -0.1316 | *** | -0.2875 | *** | -0.0535 | |
| | (0.0430) | | (0.0871) | | (0.0531) | |
| Observations | 2,696 | | 2,696 | | 2,135 | |
| R-squared | | | 0.158 | | | |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

### 4.2 Results for the number of health checkups

To check the robustness of our Probit results, we conducted an OLS regression on the number of health checkups taken. As shown in Table 4, such demographic variables as gender, age, income, household size, occupational status, level of education, and hospitalization within the past year are significantly estimated with the same signs as in the Probit regression. Population size is significant and negative in the OLS regression, indicating that residents in smaller cities, towns or villages have more health checkups. In addition, the OLS estimates of the *hyperbolic* dummy, health-related variables, and their interaction terms have the same signs and significance results as the Probit estimates.

### 4.3 Results for cancer screening

The rightmost column of Table 4 shows study results related to cancer screenings. The first result worthy of note here is that, for housewives, the likelihood of getting a cancer screening is significantly less than the likelihood of having a normal (routine) health checkup. We also find that in the case of cancer screening, the *hyperbolic* dummy and its interactions with the health-related variables are not significant—a result that differs from what was found for normal checkups. This result implies that time preference does not affect one's behavior with regard to getting a cancer screening. In addition, the magnitudes of the significant influences of gender, age, income, and household size are larger in the regression on cancer screening than in the regression on health checkups. Taken together, these differences support the proposition that getting a cancer screening involves a somewhat different set of influences than is the case for other types of health checkups. Policy decision makers would do well to take these differences into account when designing policies intended to stimulate participation in cancer screening.

## 5. Conclusion

In this study, Japanese survey data was used to empirically investigate the determinants of an individual's participation in health checkups. In contrast to many previous studies, we included in our regression models variables representing an individual's time preference. Consistent with results reported in previous studies, we find that certain personal attributes do indeed influence health checkup behaviors. Females, individuals earning higher incomes, and those having higher levels of education are more likely to get health checkups. Moreover, since the higher the age, the higher the risk of illness, older individuals have a greater probability of getting health checkups. Additionally, individuals having more family members and who are more connected to their community are more likely to have a health checkup, suggesting the

importance of positive involvement with family and neighbors.

Importantly, the hyperbolicity of the time discounting function, which is introduced into the regression models as another personal attribute, is significant and positive in its effect on an individual's participation in health checkups. Our result suggests that hyperbolic discounters are more likely than non-hyperbolic discounters to have health checkups. There are several possible explanations for this. Since hyperbolic discounters show a tendency to engage in unhealthy behavior, they tend to be unhealthy and therefore may be more inclined to actively seek health checkups. Another possible explanation is that hyperbolic discounters may get health checkups to assess their health status, which serves as the basis for controlling their behavior.

Based on the results associated with our health-related variables and their interactions with the hyperbolic discounting dummy, we find that hyperbolic discounters and non-hyperbolic discounters differ significantly with regard to the influence of the various health-related variables on the probability of getting health checkups. This suggests the need to consider time preference when formulating policy to encourage health checkups.

Knowing what factors influence participation in health checkups is critical to the creation of a system and an environment that makes it more likely that individuals will get health checkups. Establishing an efficient system that makes people aware of their own health condition through regular checkups is likely to lead to cost-effective measures such as health maintenance and disease prevention that will help alleviate many of the problems related to aging in Japan.

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**Appendix**

The following the questionnaire items were used to create the variables used in the study.

Male dummy: Your gender: 1. Male 2. Female

Age: When were you born? (Write In Number for Month and Year) _____

Income: Approximately how much was your salary for 2009 (including business income if you are self-employed)? Salary per month ¥_____

Household size: How many people are currently living in your household? _____

Occupations dummy:

a: What are your occupations (Including part-time work)?

1. Office work (administrative support, sales)
2. Sales and related occupations

3. Managerial occupations (section chief or superior positions at government or private company)

4. Specialist/Technical Experts (Teacher, Medical Doctor, Engineer, Writer)

5. Service occupations (Hairdresser, Hall staff, Receptionist, Taxi driver, Security staff)

6. Industrial occupations (carpenter, service engineer, production worker)

7. Farming, fishing, and forestry

8. Housewife/Househusband

9. Student

10. Retired (except Housewife/Househusband)

11. Unemployed (except Housewife/Househusband)

12. Others_

b: What is your type of employment?

1. Employee of private company or nonprofit

2. Government employee

3. Manager or private company or nonprofit

4. Self-employed

5. Employee of family business

c: What is your employment status?

1. Full-time employee

2. Part-time employee

3. Student part-time employee

4. Temporary work (sent to a company from a temporary job agency, internship, specific project for a company, etc.)

5. Contract worker

6. Other

College graduate: Please indicate the highest level of education (or equivalent) completed by you. If you are still in school, check the category you are in now.

1. Graduated from Elementary/ Junior High School

2. Some High School – no degree

3. Graduated from High School

4. Some College (including Technical College) – no degree

5. Graduated from College (including Technical College) - Associate's Degree (2 year)

6. Some University (including old-education-system high school) – no degree

7. Graduated from University (including old-education-system high school) – Bachelor's

Degree (4 year)

8. Some post graduate studies – no degree
9. Master's Degree –MS, MA, MBA, etc.
10. Some doctoral studies – no degree
11. Doctoral Degree – DVM, Ph.D., DDS, etc.

Health anxiety: Do the following statements hold true for you? If "it is particularly true for you", choose "1", and if "it doesn't hold true at all for you", choose "5". Of course, you may choose any number in between.

"I have anxieties about my health"

1(It is particularly true for you) ~5(It doesn't hold true at all for you)

Hospital: During the last 12 months, have you been in a hospital or clinic as an in-patient overnight or longer? This includes child birth. 1. Yes 2. No

Smoking: Do you smoke?

1. Don't smoke at all
2. Hardly smoke
3. Smoke sometimes
4. About 10 cigarettes a day
5. About a pack a day
6. More than 2 packs a day
7. Used to smoke but had quit

Sport: Do you exercise?

1. Almost everyday
2. A few times in a week
3. About once a week
4. About once a month
5. Don't exercise at all

Drinking: Do you drink alcoholic beverages?

1. Don't drink at all
2. Hardly drink
3. Drink sometimes

4. One can of beer (12 oz.) or its equivalent a day, everyday
5. Three cans of beer (12 oz. × 3) or its equivalent a day, everyday
6. Five cans of beer (12 oz. × 5) or its equivalent a day, everyday