

# **The Impact of Health Problems on Income of the Elderly in Japan<sup>1</sup>**

Junya HAMAAKI

Department of Economics, Hitotsubashi University

Haruko NOGUCHI

Faculty of Political Science and Economics, Waseda University

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## Abstract

The aim of this chapter is to empirically examine the impact of health problems of the elderly on their own and their household's income. Using micro panel data from the "Survey on Health and Retirement" focusing on the elderly, we estimate the effect on an individual's income and his household's income of the number of illnesses respondents suffered in the three years preceding the survey, of suffering from a lifestyle disease, and of suffering from one of the three major "killer diseases" in Japan (cancer or malignant growth, heart disease, stroke or cerebrovascular disease). In order to deal with endogeneity in the health indicators, we employ survey respondents' body mass index at age 30 and their parents' medical history as instruments in the estimation and, when focusing on suffering from at least one of the three killer diseases, use respondents' body height as an additional instrument. In the estimation, we focus on male survey participants.

The results suggest that an additional illness in the preceding years on average significantly reduced individuals' income. On the other hand, although the estimated coefficients on the effect of lifestyle diseases on individuals' income or household income were as expected negative, they were insignificant in both cases. Furthermore, when dividing observations into two subsamples – men under the age of 60 and age 60 and over – we find that in the case of the under 60s, a deterioration in health on average has no significant effect either on the individuals' own income or their household income. Likely reasons are that, if at all possible, such individuals will continue to work, or that any decline in income is offset by the spouse starting to work and/or the receipt of insurance payments. On the other hand, for men aged 60 and over, a deterioration in health has a significant impact on their own income, but that on household income is limited. That such individuals' own income declines is likely due to the fact that they are much more likely to stop working as a result of health problems, while the limited effect on household income may be due to the fact that the share of such individuals' income in total household income is relatively small.

## 1. Introduction

Health problems of a family member can potentially have devastating consequences for a household's economic welfare, if they lead to a decline in household income and simultaneously result in substantial medical expenses. This is especially the case when the main breadwinner of the household falls seriously ill and has to stop working, so that the household loses its main source of income while at the same time being settled with high medical bills, posing the risk that the household falls into poverty. In order to mitigate this risk, most societies, especially in the advanced countries, have devised mechanisms to deal with such instances, such as the sharing of health risks through social security systems. In addition, households engage in precautionary saving, and family members, relatives, and the local community can provide support. However, if these mechanisms do not sufficiently compensate for the decrease in income and increase in medical expenses, household economic welfare is likely to fall through a decrease in consumption.

For Japan, studies trying to estimate the income loss caused by health problems and the decrease in wages include those by Iwamoto (2000) and Oishi (2000). Both studies find that a deterioration in health has a significant negative impact on income and wages. However, the results of these studies need to be treated with care, since they fail to adequately deal with the potential endogeneity of the subjective health indicators that they employ for their analyses. The presence of such endogeneity problems with regard to health indicators, and especially subjective health indicators, has been highlighted in a large number of studies (see, e.g., Chirikos and Nestel, 1984; Anderson and Burkhauser, 1985; Bazzoli, 1985; Bound, 1991; Waidmann et al., 1995; Bound et al, 1999; Dwyer and Mitchell, 1999). Reasons for this endogeneity include that respondents tend to justify the fact that they are not working by exaggerating their health problems (justification hypothesis) and measurement errors in the proxy variables. Iwamoto (2000) and Oishi (2000) attempt to deal with this problem by employing a two-stage simultaneous equation approach using wages, health, and employment as endogenous variables; however, because the instruments for the health indicator they use are weak, the coefficient of determination of the health function they estimate is not very high and their results are unstable. To address these issues, in two earlier studies (Hamaaki and Noguchi, 2009; 2010) we proposed using the body mass index (BMI)<sup>2</sup> of respondents at age 30 and parents' medical history as alternative instruments. These variables are sufficiently correlated with health indicators and have the desirable property of being exogenous.

Our aim in this chapter is to deal with the endogeneity of health indicators by using survey respondents' BMI at age 30 and parents' medical history as instruments and empirically examine the

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<sup>2</sup> The body mass index is an indicator of obesity and obtained by dividing the person's body weight by their height.

impact of health problems of the elderly on their income. The data we use is the micro panel data of the 2008 to 2010 waves of the “Survey on Health and Retirement” (“Kenko to Intai ni kan suru Chosa,” in Japanese). They were funded by the Ministry of Health, Labour and Welfare (principal investigators: Yoshihiro Kaneko and Nobuyuki Izumida, National Institute of Population and Social Security Research (IPSS)). As proxy variables for individuals’ health status, we use objective indicators of illness, namely (a) the number of illnesses in the three years preceding the survey, (b) suffering from a lifestyle disease (high blood pressure, hyperlipidemia, sugar diabetes, and gout) in the three years preceding the survey, and (c) suffering from at least one of the “three killer diseases” (cancer or malignant growth, heart disease, stroke or cerebrovascular disease) in the three years preceding the survey. Therefore, the kind of endogeneity biases through justification or measurement errors associated with subjective health indicators should not be much of a problem here. However, even when using objective health indicators, endogeneity may still arise through reverse causality between income and health. For example, households with a high income or large wealth may be healthier because they can afford more or better (preventive) health care or a healthier diet. Conversely, it is also possible that those with a high income work longer hours or may tend toward obesity through excessive food intake, as a result of which they may suffer health problems. In order to deal with this potential endogeneity, we use the above-mentioned instrumental variables. Moreover, when focusing on the three killer diseases, in addition to individuals’ BMI at age 30 and their parents’ medical history, we also use individuals’ height as an instrumental variable. The reason is that a considerable number of studies have found that the taller an individual, the higher may be the risk of cancer – a finding that has recently received further support in the “Million Women Study” in the United Kingdom, which suggests that there is a statistically significant positive correlation between cancer incidence and height (Green et al., 2011). Therefore, body height appears to be a good instrument for cancer risk.

Our findings can be summarized as follows. First, our empirical investigation, which concentrates on male survey respondents, finds that an increase in the number of illnesses in the preceding three years is associated with a decline in individuals’ income. On the other hand, although the estimated coefficients on the effect of lifestyle diseases on individuals’ income or household income were as expected negative, they were insignificant in both cases. Finally, for the three killer diseases, the effect on income is significant in some of the estimations, but our results are not stable as a result of weak instruments.

Next, given that the effect of health problems on income may differ depending on the age at which someone falls ill, we examine the impact of the number of illnesses and of suffering from a lifestyle disease by dividing the sample for men into those under the age of 60 and those aged 60 and over. In

a previous study (Hamaaki and Noguchi, 2010), we found that men below the retirement age continue to work unless they suffer a serious illness, and in line with this result, we find here that the income of men under the age of 60 does not significantly decrease if they contract an illness, likely reflecting the fact that they continue to work if their illness allows them to do so. Further, we find that ill health in the subsample of the under 60s also has no significant effect on household income. Apart from the fact that those under 60 will try to continue to work if the illness is not too serious, this likely reflects that other household member start to work instead to make up (at least in part) for the lost income, and/or the receipt of public or private insurance payments.

On the other hand, when focusing on those aged 60 and over, we find a significant decrease in individuals' income as a result of health problems, while the impact on household income is limited. The likely reason why individuals' income decreases is that such workers soon retire when they have health problems because of the smaller opportunity costs of not being employed for men aged 60 and over. That the impact on household income is limited can be explained by the fact that the income of household members aged 60 and over makes up only a small share of households' total income.

The remainder of this chapter is organized as follows. The next section provides an outline of the data used in the analysis. Section 3 then looks at household characteristics and examines the correlation between the number of illnesses and income. Section 4 explains the estimation approach and choice of instrumental variables, while Section 5 presents the estimation results. Finally, Section 6 summarizes the findings.

## **2. Data**

### *2.1 Survey methodology and sample construction*

This study uses the micro data from the 2008 to 2010 waves of the “Survey on Health and Retirement” conducted annually (principal investigators: Yoshihiro Kaneko and Nobuyuki Izumida, IPSS) in February/March. The aim of the survey is to allow empirical investigations of the effect of the elderly's health status on their retirement behaviour and income. The survey is conducted by Central Research Services, Inc. (CRS) on behalf of IPSS and focuses on men and women that were aged 45 to 79 at the time of the first survey in 2008.

In the first survey (implemented in March 2008), 2,747 individuals were randomly chosen from the 39,311 “monitors” (individuals that had previously agreed to participate in future surveys) in the CRS database at the time, of which 1,074 responded (for a response rate of 39%).<sup>3</sup> In the second

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<sup>3</sup> The CRS conducts a Monthly Omnibus Survey of individuals randomly selected from the basic resident register.

survey (implemented in March 2009), in addition to a follow-up survey of the 1,074 respondents to the first survey, another 578 individuals were randomly chosen from among the CRS monitors. Responses were obtained from 862 respondents to the first survey (for a response rate of 80%) and from 257 newly chosen individuals (response rate: 44%). In the third survey (March 2010), the 1,119 respondents to the second survey were contacted again, of which 954 responded (response rate: 85%).

From the second survey onward, if survey respondents had a spouse, they were asked the same questions as the respondent. The number of spouses from which responses were obtained in the second and third surveys is 937 for 2009 and 798 for 2010. In this study, in addition to survey participants themselves, we also focus on spouses for whom their past income and health status can be established. However, when examining the effect of health problems on income, we focus on men only because, as we pointed out in Hamaaki and Noguchi (2010), the factors affecting the decision whether to participate in the labor market are likely to be more varied for women than for men, so that it would be necessary to assume a different model from that for men when estimating the effect of health on income. After excluding observations for which information necessary for constructing the dependent, independent, or instrumental variables is missing, and observations for which the number of previous illnesses and annual income are outliers,<sup>4</sup> the number of men that we finally focus on in our analysis is 514 for 2008, 693 for 2009, and 704 for 2010.<sup>5</sup>

## 2.2 Questions on health and income

In this subsection, we explain the variables used in the analysis of the relationship between health status and income of the elderly. With regard to health status, the survey asks respondents about specific previous illnesses and when these occurred. As a result, we know the specific time when an individual contracted one or more of different 29 illnesses (including “other”).<sup>6</sup> From this

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“Monitors” are individuals that have agreed to participate in more detailed surveys in the future. CRS then selects “monitors” for various surveys from municipalities around Japan that are representative of the sex and age structure (in five-year age brackets) of the population overall. The composition of monitors is adjusted regularly so that the sex and age structure is identical to that in the *Population Census*. Survey respondents receive a book voucher worth 500 yen as compensation for participating.

<sup>4</sup> Specifically, we excluded five individuals that reported 20 or more previous illnesses and one individual that reported an annual income of 69.45 million yen.

<sup>5</sup> The reason that the number of observations in our sample is largest for 2010 is that the question on parents’ medical history was added only in 2010, so that for the preceding years, we can only use observations for individuals that had already participated in the earlier surveys.

<sup>6</sup> The 29 illnesses are: (1) heart diseases (heart attack and heart failure, heart infarction, valvular heart disease, etc.); (2) high blood pressure; (3) hyperlipidemia; (4) stroke and cerebrovascular disease; (5) cancer and malignant growths (including leukemia and lymphoma; excluding benign skin cancer); (6) sugar diabetes; (7) gout; (8) chronic lung disease (chronic bronchitis, pulmonary emphysema, etc); (9) asthma; (10) digestive system disorders I (stomach diseases other than cancer such as ulcers); (11) digestive system disorders II (liver diseases other than liver cancer such as hepatitis B and C, cirrhosis of the liver); (12) digestive system disorders III (gall bladder-related diseases);

information, we can calculate the number of diseases contracted in the three years preceding the survey. Using income as the dependent variable and the number of illnesses in the preceding three years as the explanatory variable, we can interpret the coefficient on the number of illnesses as the average effect of an illness in the preceding three years on income. In addition, we construct a dummy variable for suffering from a lifestyle disease in the preceding three years and, similarly, a dummy variable for suffering, in the preceding three years, from at least one of the three killer diseases that are the main cause of death in Japan, and examine the effect on income. Because it is likely to be difficult to continue working when suffering from the three killer diseases, we expect that this will have a large negative impact on individuals' income. On the other hand, because suffering from a lifestyle disease is less likely to impair a person's ability to continue working, we expect the average impact on individuals' income to be smaller.

Next, as for income, the "Survey on Health and Retirement" asks participants about their own "income in the previous year including taxes and social insurance contributions" as well as that of the spouse and the household overall.<sup>7</sup> This income includes non-labor income such as pensions, rent income, interest and dividend income, but excludes lump-sum payments such as retirement or severance payments. Therefore, we can rule out any false positive correlation between health problems and income that might arise if individuals that fall ill and subsequently quit their job receive a lump-sum payment. On the other hand, a complicating factor is that in the first survey, the questionnaire asked respondents to report their income in terms of income brackets, while from the second survey onward, respondents were asked to simply state their income, so that the two are not directly comparable. However, the second survey also asked respondents how their income in the preceding year compared to that two years earlier, allowing us to calculate the rate of change in income. We use this rate and the income reported in the second survey to estimate respondents' income at the time of the first survey.

Finally, we explain the definition of the employment status dummies, which we include among the explanatory variables. The reason for including the employment status is that this is likely to have a large effect on the income level. The "Survey on Health and Retirement" asks survey participants to

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(13) digestive system disorders IV (other or unspecified digestive system disorders); (14) kidney-related diseases; (15) uterine fibroids and ovary-related diseases; (16) thyroid gland-related diseases (Graves' disease, prostatic hyperplasia, etc.); (17) urination problems (incontinence and leakage, urinary hesitancy, ureteral stones); (18) joint diseases (arthritis, rheumatism); (19) hernias, neuralgia; (20) lower back pain, stiff shoulders; (21) femoral neck fracture; (22) osteoporosis; (23) eye diseases (cataract, glaucoma, etc.); (24) ear diseases (deafness, etc.); (25) hay fever, allergies, etc.; (26) Parkinson's disease; (27) skin diseases (including benign skin cancer); (28) mental health problems such as depression; (29) other. It should be noted that the number of categories increased from 21 in the first survey to 27 in the second and finally 29 in the third as a result of refinements in the questionnaire by providing separate categories for diseases that made up a large share of the answers given under "other" in the earlier surveys.

<sup>7</sup> In the "Survey on Health and Retirement," a "household" is defined as a group of people who have a blood relationship, live together, and share their living expenses.

report their and their spouse's employment status by choosing from the following categories: (1) regular employee or civil servant; (2) contract or non-regular employee; (3) temporary employee (agency temp); (4) part-timer; (5) self-employed (own business); employed in agriculture, fishing, or forestry; (6) self-employed; (7) piecework at home; (8) professional job requiring qualifications; (9) other; (10) not working.<sup>8</sup> In this study, we group these categories into (1) regular employees; (2)-(4) non-regular employees; (5)-(9) self-employed and other, and (10) not working, and construct a dummy variable for each category that we use in our analysis.

### **3. Basic statistics**

#### *3.1 Trends in health status and annual income*

We start our analysis by looking at the basic statistics for survey respondents and household characteristics for each survey year. These are presented in Table 1, where standard deviations are shown only for continuous variables. As can be seen, the number of illnesses in the preceding three years increased from 0.24 in the first survey to 1.25 in the second survey and 1.75 in the third survey. Moreover, the share of respondents with lifestyle diseases or the three killer diseases similarly also gradually increased from the first to the third survey. Given that a large share of survey participants remained the same, this trend likely mainly reflects a worsening in health as respondents grew older.<sup>9</sup>

Turning to the income and employment status variables, we find that the annual income of male survey respondents increased from the first to the second survey and decreased slightly from the second to the third survey. The reason that the income in the first survey is lower than that in the second and third surveys probably is due to recall bias, that is, respondents did not accurately remember their income at the time of the first survey, because, as mentioned above, income at the time of the first survey is based on recollection at the time of the second survey. Meanwhile, the decline in average income from the second to the third survey may reflect several factors. One of these is the deterioration in economic conditions following the collapse of Lehman Brothers in September 2008. Another reason may be that the average age of survey participants increased. On the one hand, seniority based wages would push up average income; on the other, though, if many survey participants reached the mandatory retirement age set by employers, this would push down

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<sup>8</sup> The first survey did not include categories (6) and (8). However, taking respondents and spouses together, there were only 12 individuals in the second survey and 15 in the third survey that fell into these categories. Given these extremely small numbers, the difference in categories between the surveys is unlikely to have any major effect on our results.

<sup>9</sup> Another reason why the number of illnesses in the first survey is lower than in the other surveys apart from aging likely is that the number of categories for illnesses in the first survey was smaller than in the later surveys (see footnote 5).



average income irrespective of economic conditions. Further, household income increased only slightly from the second to the third survey, remaining more or less at the same level. Next, looking at changes in survey participants' employment status, we find that the share of regular employees decreased from the first to the third survey, while the share of non-regular employees increased. The decline in the share of regular employees and increase in the share of non-regular employees may be due to the fact that a non-negligible share of survey respondents reached the mandatory retirement age set by employers (typically age 60) and were re-employed as non-regular employees. On the other hand, the share of those that are "self-employed or other" remains largely unchanged between the first and the third survey probably because such workers are not forced to take on non-regular employment after the mandatory retirement age and before they reach the pensionable age. Further, the share of those not working shows a gradual increase. This trend appears to suggest that as people become older they are more likely to leave the labor market.

Insert Table 1

### *3.2 Health status and income*

Next, we visually examine the relationship between health and income – the main focus of the analysis. Figures 1(a) to (c) respectively show the link between the number of illnesses in the preceding three years, the incidence of lifestyle diseases, and the incidence of at least one of the three killer diseases on the one hand and the annual income of survey respondents by age on the other. In order to remove age factors from the health variables and income, we regress both variables on age and age squared, and plot the age average of the residual. We limited the age range to age groups for which more than 40 observations are available, namely individual from 47 to 76 years of age. The number next to each dot shows respondents' age. Each figure also shows a fitted quadratic curve.

Looking at Figures 1(a) to (c), we find that all of them show that respondents' annual income decreased as a result of a deterioration in health. The decrease in income is largest in the case of contracting the three killer diseases, followed by contracting a lifestyle disease. It is smallest in the case of the third health indicator, which shows the average effect of contracting one additional disease. Further, we find that most of the observations for those over the age of 70 (those most likely to be retired anyway) lie above the zero line for income; the reason is that at least part of their income derives from a public pension, which remains unaffected even if they contract a severe diseases.

Insert Figures 1(a) to (c)

Turning to the impact on household income, Figures 2(a) to (c) are the same as Figures 1(a) to (c), except that instead of individuals' income they examine the impact of health problems on household equivalent income, which is obtained by dividing household income by the square root of the number of household members. The figures indicate that household equivalent income decreases as a result of a deterioration in survey participants' health, but, generally speaking, the extent of the decline is relatively small when compared to the decrease in survey participants' own income. That being said, when a survey participant contracted at least one of the three killer diseases, this not only greatly decreased his own income, but also the income of the household as a whole.

Insert Figures 2(a) to (c)

#### 4. Empirical model and instrumental variables

When analyzing the effect of falling ill on income, it is necessary to deal with the endogeneity of the health variables. Therefore, we conduct a two-stage least squares (2SLS) estimation of the income function represented by the following model using instrumental variables:

$$\ln y_{it} = \alpha_1 + \alpha_2 X_{1,it} + \alpha_3 h_{it} + u_{it} \quad (1)$$

$$h_{it} = \beta_1 + \beta_2 X_{1,it} + \beta_3 X_{2,i} + v_{it}$$

where  $y_{it}$  is the annual income of individual  $i$  at time  $t$  ( $y_{ht}$  when the dependent variable is household income, with  $h$  replacing subscript  $i$ ). Moreover,  $h_{it}$  is the health variable showing health problems in the past three years (number of illnesses, whether the individual suffered from a lifestyle disease or at least one of the three killer diseases) of individual  $i$  at time  $t$ ;  $X_{1,it}$  is a vector of exogenous variables other than health explaining income (final educational attainment dummies, employment status dummies, the unemployment rate in the prefecture where the respondent lives, and year dummies), and  $X_{2,i}$  is a vector of the instruments for the health variable ( $h_{it}$ ). For the final educational attainment dummies, we distinguish three groups: junior high school graduates, those that graduated from a high school, a technical or vocational school, or a two-year college (for brevity summarily referred to as "high school graduates" hereafter) and university graduates, with high school graduates serving as the reference group. For the employment rate of the prefecture of residence of the survey respondent, we use the estimate of the prefectural unemployment rate provided in the "Labour Force Survey." For the employment status dummies, we distinguish four

groups: regular employees, non-regular employees, self-employed/other, and not working, with the latter serving as the reference group.

Because for 1.8% of the survey respondents in our sample the annual income is zero, the dependent variable has a corner solution. In order to deal with this, we also estimate equation (1) using instrumental variable Tobit regression. Moreover, because for respondents that have zero income we cannot take the logarithm, we conduct the estimation using a value of -1 for such individuals instead of the logarithm of income.<sup>10</sup>

When estimating model (1), the instruments we employ are individuals' BMI at age 30 and a dummy variable for their parents' medical history, which we already used in our earlier study (Hamaaki and Noguchi, 2010). Assuming that persons' present body height is more or less the same as their height at age 30, we calculate the BMI at age 30 by using their present height and the self-reported values of body weight at age 30. Parents' medical history refers to illnesses that respondents' parents and their spouses parents had suffered until the survey date. When employing the number of illnesses or suffering from a lifestyle disease for  $h_{it}$ , we use dummy variables indicating whether parents had a history of lifestyle diseases (high blood pressure, hyperlipidemia, sugar diabetes, gout) as instrumental variables. And when employing suffering from at least one of the three killer diseases in the preceding three years as the health indicator, we use dummies indicating whether parents had a medical history of at least one of the three killer diseases. Whichever health indicator we use, we construct separate dummy variables for the case that both parents have a medical history and that one of the parents only has a medical history, and use these as instrumental variables. Finally, when we employ suffering from the three killer diseases as the health indicator, we additionally use an individual's current body height as an instrument.

As previously mentioned, the estimation focuses on males, and we estimate the impact of a deterioration in the health status of an individual on his own income and on the household equivalent income. Moreover, we conduct the same estimations dividing our observations into two subsamples, namely, men aged 60 and over and under 60. The reason for splitting the sample at age 60 is that this is the most common mandatory retirement age in Japan and the response of individuals and household members to a deterioration in health status may differ before and after an individual has reached retirement age. Since incomes tend to be high before the retirement age is reached and the opportunity cost of stopping to work thus large, people are likely to try to continue to work even if

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<sup>10</sup> Iwamoto (2000) deals with this problem in a similar fashion. We also conducted our regressions excluding observations with zero income from the sample and the estimation results remained largely unchanged. However, because the estimator may no longer be consistent when zero observations are excluded, we assume that individuals reporting zero income in fact have an extremely small income.

their health deteriorates. As a result, the decrease in income due to health problems is likely to be small. Moreover, if the person is under 60, even if he stops working, the decline in income may be offset by the spouse starting to work instead. On the other hand, after reaching retirement age, many Japanese males tend to be re-employed and work as a non-regular employee until they reach the pensionable age.<sup>11</sup> This means that the opportunity cost of not working tends to be considerably smaller, so that such workers are more likely to quit their job if their health deteriorates, resulting in a decrease in income. At the same time, those that have reached the pensionable age will continue to receive their pension, meaning that although such persons will lose their work income, they will still receive pension income. Dividing observations into the two subsamples allows us to examine whether the decline in income differs depending on the age at which individuals experience health problems.

## 5. Estimation results

### 5.1 Results for full sample

In this section, we estimate model (1) for the full sample of all men. For comparison with the estimation results for model (1), we also estimate the relationship between income and health without using instrumental variables. Starting with the estimation without instrumental variables, Table 2(a) shows the results for the number of illnesses contracted in the preceding three years, for suffering from a lifestyle disease in the past three years, and for suffering from at least one of the three killer diseases in the past three years, using Tobit and OLS estimations. The marginal effect in the Tobit estimation measures the health effect with regard to the unconditional expectation ( $E(\ln y_{it} | X_{1,it}, h_{it})$ ), and is comparable to the coefficient in OLS estimations. We find that the signs for the health variables in Table 2(a) are all negative, but the estimates are not significant. If a deterioration in health does indeed have a negative impact on income, a possible reason for the insignificant result here is reverse causality from income to health, for example because those with a high income work long hours and/or tend toward obesity. If we can remove this bias through the use of instrumental variables, we potentially may obtain significant estimates of a negative impact of a deterioration in health on income. Moreover, because the marginal effect in the Tobit estimation and the coefficient in the OLS estimation for each of the health indicators are of almost the exact same magnitude and their significance is also very similar, from hereon we do not show the results of the

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<sup>11</sup> Japan's public pension program consists of the following three plans: (1) the National Pension Insurance (NPI, *Kokumin Nenkin* in Japanese) for the self-employed and those not employed; (2) the Employees' Pension Insurance (EPI, *Kosei Nenkin*) for private sector employees; and (3) the Mutual Aid Insurance (MAI, *Kyosai Nenkin*) for those employed in the public sector and in private schools. While the NPI offers only a flat-rate benefit, the EPI and the MAI offer wage-proportional benefits as well as a flat-rate benefit. The pensionable age for the NPI is 65 in principle. On the other hand, the pensionable age for the flat-rate benefit and wage-proportional benefits of the EPI and MAI used to be 60, but since 2001 (2006 for women) is gradually being raised to 65.

Tobit estimation and only report those of the OLS or 2SLS estimations.

Looking at the coefficient on variables other than the health indicator in Table 2(a), these generally have reasonable values. An increase in age has a significant positive impact on income. With regard to educational attainment, junior high school graduates have a significantly lower income and university graduates have a significantly higher income than the reference group, high school graduates. As for the employment status, relative to the reference group (those not working), regular employees have a much higher income, followed by those in the “self-employment/other” category (which, in addition the self-employed, includes professionals requiring a qualification), and then non-regular employees. While the coefficient on the unemployment rate of the prefecture in which an individual resides is not significant, the sign is negative, as one would expect.

Insert Table 2(a)

Next, Table 2(b) shows the OLS estimation results for the impact of health problems on household income. We find that, again, the effect of a deterioration in health on income is not significant, and furthermore the coefficients are positive. Because we would normally assume health problems to be associated with a fall in income, we would expect the sign on the coefficients to be negative. However, as mentioned above, the coefficients may be biased upward due to reverse causality from income to health. The fact that the coefficient is largest for lifestyle diseases is consistent with this hypothesis. If such reverse causality does indeed play a role, then using instrumental variables should remove this endogeneity bias and we would expect the signs on the health indicator coefficient to become negative.

Insert Table 2(b)

We now turn to the results of the 2SLS estimation, which are shown in Table 3. Column (A) shows that an increase by one in the number of illnesses in the preceding three years significantly lowers income by 21.4%. The coefficient in column (B) for contracting a lifestyle disease is negative, as expected, and large in absolute value, but marginally insignificant (p-value: 0.111). Finally, column (C) shows that the effect of contracting at least one of the three killer diseases is significant; however, due to the weak instruments problem, the coefficient estimate may not be very reliable.

Looking at the significance of the individual instruments in the first stage estimation, we find that a higher BMI at age 30 is associated with a significantly higher number of illnesses and a

significantly higher probability of suffering from a lifestyle disease and/or at least one of the three killer diseases. Turning to parents' medical history, the results indicate that individuals had a significantly larger number of illnesses and were significantly more likely to suffer from a lifestyle disease or from at least one of the three killer diseases if their parents had a history of lifestyle diseases. Individuals also had a significantly higher probability of suffering from at least one of the three killer diseases themselves if their parents had a history of such diseases. Furthermore, we also find a significant positive association between an individual's height, which, as mentioned, has been shown to be correlated with getting cancer, and the probability of suffering from the three killer diseases.

However, in the case of the estimation in column (C), the test for weak instruments shows that the F-statistic for the null hypothesis that the coefficients of the instruments are all zero is well below 10, the rule-of-thumb value for checking for weak instruments, indicating that the instruments may be weak. On the other hand, looking at the test for overidentifying restrictions, the null hypothesis that the instrumental variables are uncorrelated with the error term ( $u_{it}$ ) of the income function in all estimations is not rejected, suggesting that the instruments are exogenous.

Insert Table 3

Table 4 shows the results of the 2SLS estimation of the effect of health problems on household equivalent income. Columns (A), (C), and (E) show the results using the same instruments as in Table 3. The coefficients on the health indicators are insignificant in all cases. When the dependent variable is household equivalent income, the result of the test for overidentifying restrictions for the null hypothesis that all the instruments are uncorrelated with the error term is rejected, indicating that the error term may be correlated with the instruments. In particular, in the case when the health indicator is suffering from at least one of the three killer diseases (column (E)), the null hypothesis is rejected at the 1% level. Because parents' income is included in household income if parents are still alive and live in the household, it is possible that parents' medical history directly affects household income. Consequently, we conduct additional estimations dropping the dummies for parents' medical history from the instruments. The results are shown in columns (B), (D), and (F). The coefficients on the health indicators are still insignificant in all cases, but the negative values become bigger than in columns (A), (C), and (E). Therefore, it seems likely that the negative effect of health problems on household income in columns (A), (C), and (E) is underestimated. However, the coefficients on the health indicators in columns (B), (D), and (F) are still not significant, suggesting that health problems do not have a significant effect on household income. Likely reasons include that the spouse or other household members start to work instead and/or that the person that has fallen ill

receives public or private insurance payments, so that household income does not fall by much.

Insert Table 4

### *5.2 Estimation results for subsamples by age*

In this section, we divide observations into two subsamples by age and estimate the effect of health problems of male survey participants for each subsample on the individual's income and on household equivalent income. If health problems occur before retirement, i.e., when individuals' income is comparatively high, their own income and household income will fall considerably, if they are forced to stop working; at the same time, however, if the health problems are relatively minor, the individual may be able to continue to work, so that income may not fall by that much. On the other hand, if an individual falls ill after having reached retirement age, this may have a substantial negative impact on the income of the individual himself, but if the share of his (work) income in total household income is relatively small, household income will not fall by that much. By conducting separate estimates for the two subsamples, we can examine at what age – before or after 60 – health problems have a larger negative impact on income. Given that Tables 3 and 4 have shown that the instruments for estimating the effect of suffering from at least one of the three killer diseases in the preceding years are problematic, we focus only on the number of illnesses and suffering from a lifestyle disease.

Table 5 shows the results for the two subsamples using the same specification as in Table 3. We find that for those under 60, both an increase in the number of illnesses and suffering from a lifestyle disease on average do not result in a significant decrease in individuals' income. On the other hand, for those aged 60 and over, both health indicators have a significant negative effect on individuals' income. In our previous study (Hamaaki and Noguchi, 2010), we examined the effect of health on the decision of whether to continue to work by age group and found that for men aged 60 and over there was a significant positive association between falling ill and the probability of no longer being in work. Taken together, the two findings thus suggest that for older men health problems tend to be associated with a decrease in income by raising the likelihood that they withdraw from the labor market. In contrast, men under the age of 60 will try to continue working as long as the illness is not too serious, because of the large opportunity costs associated with stopping to work. It is likely for this reason that we find that for men under the age of 60, health problems, on average, do not significantly reduce income.

Insert Table 5

Next, Table 6 shows the estimation results when using household equivalent income as the dependent variable and the BMI at age 30 as the only instrument. In all cases, the coefficient on the health indicator is not significant, that is, we do not find that a deterioration in health results in a decrease in household income. In columns (B) and (D) for the subsample of those aged 60 and over, we find that although the effect of a deterioration in health is not significant, the coefficients are negative and the p-values are 0.126 (for an increase in the number of illnesses) and 0.113 (for contracting a lifestyle disease). In contrast, for the subsample of those aged under 60, the coefficient estimates are not only also insignificant, but are in fact positive. A possible interpretation for the latter result is that in households where the main breadwinner experiences health problems and faces a negative income risk, other household members offset any decrease in income by starting to work. On the other hand, while for those aged 60 and over a deterioration in health had a significant negative effect on their own income, the reason that this does not have a significant effect on household income likely is that the contribution of such individuals' work income to household income overall was relatively small.

Insert Figure 6

## **6. Conclusion**

This chapter examined the impact of health problems of elderly men in Japan on their own and their household's income, controlling for endogeneity in health indicators. Specifically, using micro panel data from the "Survey on Health and Retirement" for the years 2008 to 2010, we estimated income functions including individuals' health status as an explanatory variable. As health indicators, we used the number of illnesses in the preceding three years, whether an individual suffered from a lifestyle disease, and whether an individual suffered from at least one of the three killer diseases. In order to deal with the endogeneity of health indicators, we used individuals' body mass index (BMI) and parents' medical history as instrumental variables. In addition, for suffering from at least one of the three killer diseases, we also used individuals' body height as an instrument.

We found that a deterioration in health significantly reduced an individual's income, but found no significant effect on household equivalent income. Specifically, our results suggest that an additional illness in the preceding three years significantly reduced an individual's income. On the other hand, although the estimated coefficients on the effect of lifestyle diseases on individuals' income or household income were as expected negative, they were insignificant in both cases. For the effect on income of contracting the three killer diseases, we obtained significant results in some of our



estimations, but the results were not stable due to weak instruments. Further, we found that whichever health indicator we used, the impact on household income was not significant. We suggested that this may be due to other household members starting to work instead of the individual that fell ill, and/or that any decreases in household income were offset by the receipt of public or private insurance payments.

Next, taking into account that the impact on income may differ depending on the age at which an individual falls ill, we divided our sample into two groups, those under the age of 60 and those aged 60 and over. For the younger subsample, we did not find any significant effect of a deterioration in health either on the income of the individual concerned or on that of his household. On the other hand, for the older subsample, we found that a deterioration in health had a significant negative impact on the individual's income, but no significant effect on household income was observed. In Hamaaki and Noguchi (2010), we showed that the probability that an individual will continue to work when suffering from health problems greatly declines for those that have reached the mandatory retirement age. In line with those findings, the present study also suggests that differences in the income decline between age groups are greatly influenced by differences in the probability that individuals will continue to work when suffering from health problems. In addition, since in the case of men under the age of 60, it is likely that their spouse will be able to work, a decline in income due to the husband falling ill can to some extent be offset by the wife starting to work. Moreover, the fact that the impact on household income in the case of a deterioration in health of men aged 60 or over is limited can be explained by the fact that the share of such men's work income in total household income is relatively small.

The findings of this chapter suggest that a deterioration in health of the elderly does not result in a significant decline in household equivalent income. However, if medical expenses increase while household equivalent income remains unchanged, it is likely that consumption will have to decline by a similar amount. Whether a decrease in household economic welfare through such a decline in consumption does in fact occur depends on the extent to which the increase in medical expenses is covered by insurance. An important issue therefore is to examine how an adequate safety net should be constructed by measuring the effect that a deterioration in the health of the elderly has on their consumption expenditure.

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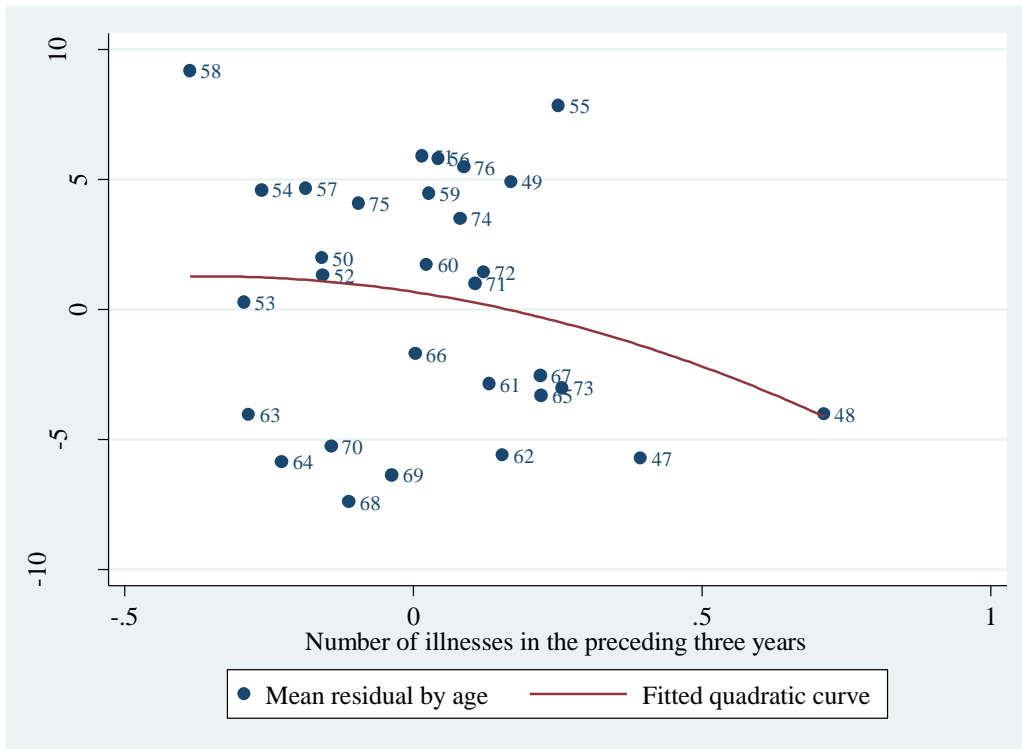
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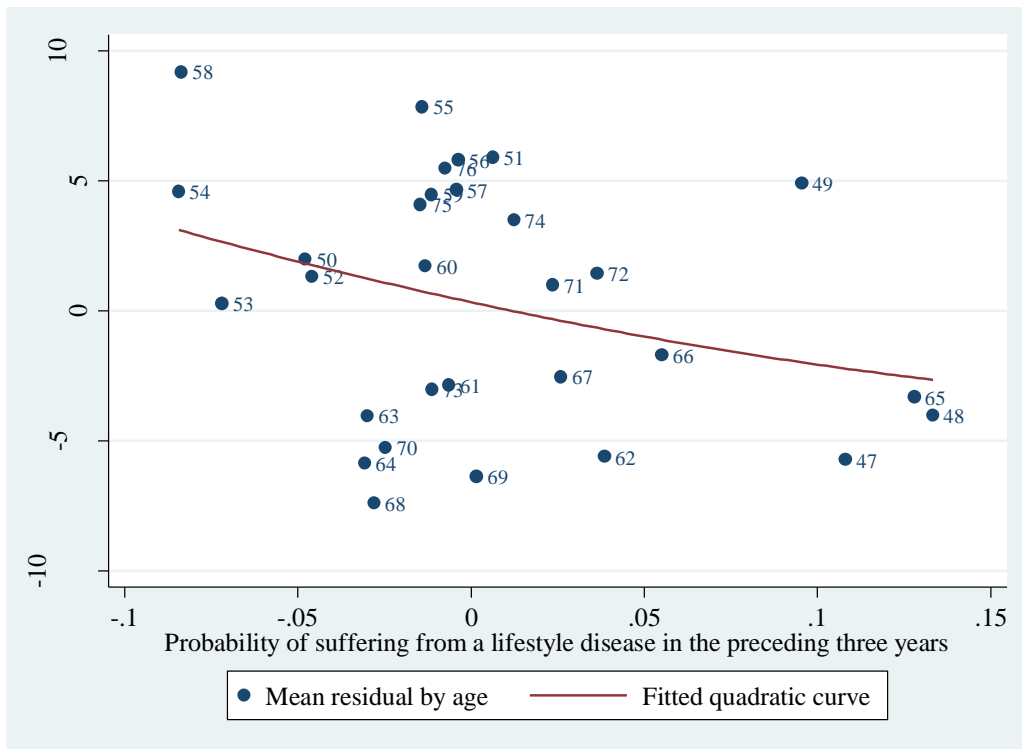
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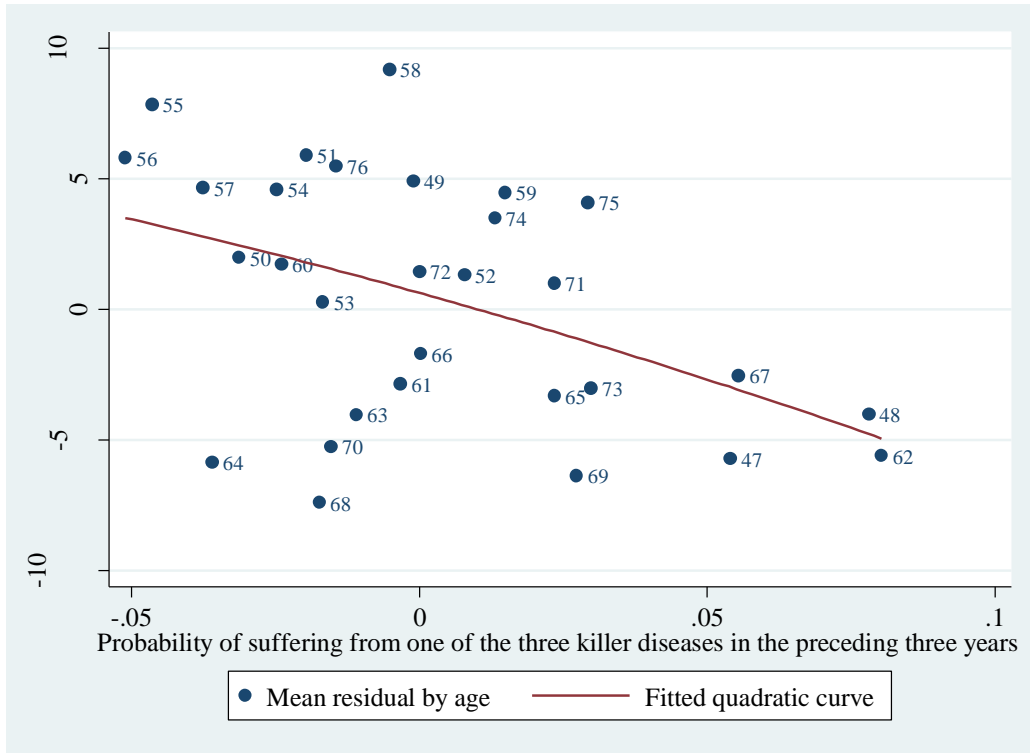
**Figure 1(a): Correlation between the number of illnesses in the preceding three years and individuals' income, by age**



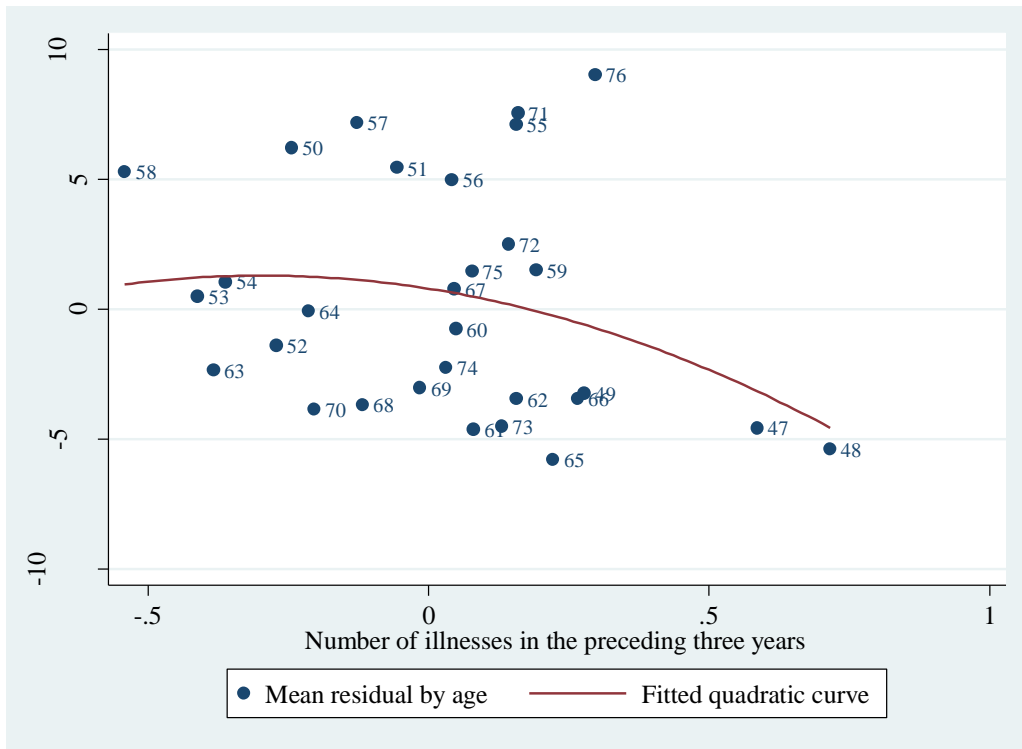
**Figure 1(b): Correlation between suffering from a lifestyle disease in the preceding three years and individuals' income, by age**



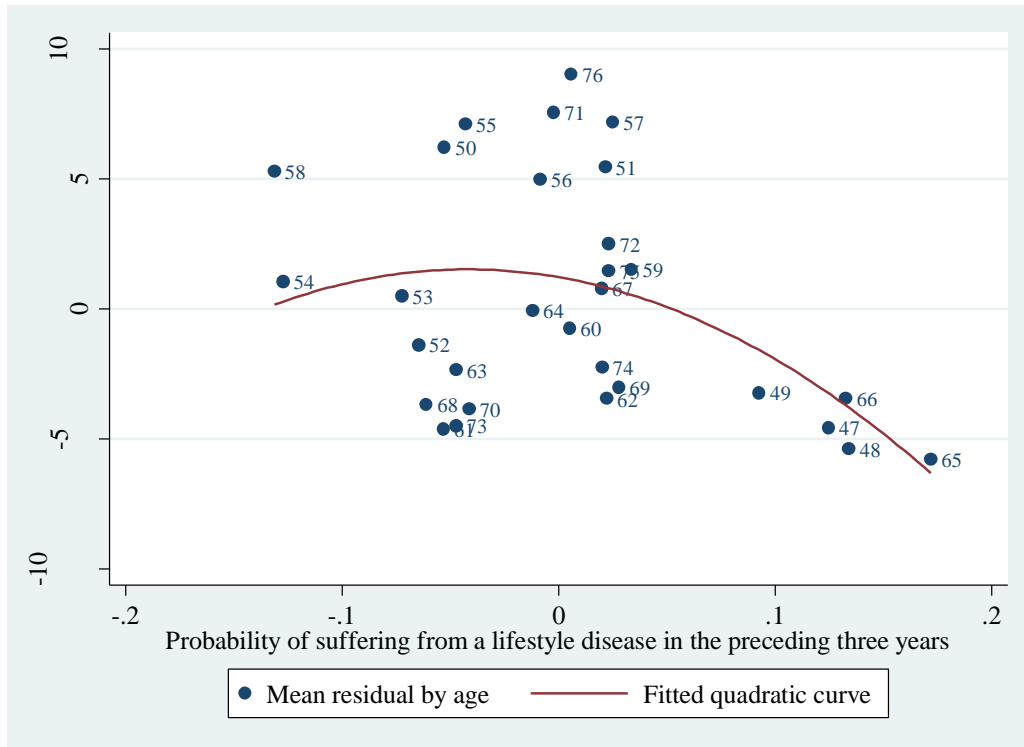
**Figure 1(c): Correlation between suffering from at least one of the three killer diseases in the preceding three years and individuals' income, by age**



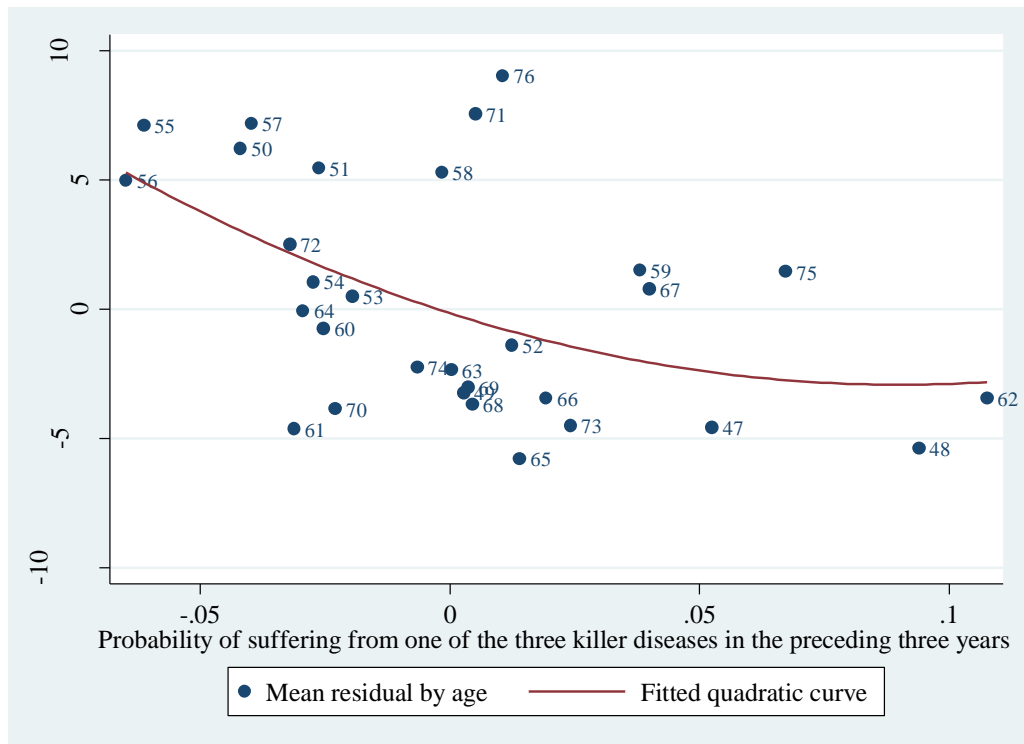
**Figure 2(a): Correlation between the number of illnesses in the preceding three years and household equivalent income, by age**



**Figure 2(b): Correlation between suffering from a lifestyle disease in the preceding three years and household equivalent income, by age**



**Figure 2(c): Correlation between suffering from at least one of the three killer diseases in the preceding three years and household equivalent income, by age**



**Table 1: Descriptive statistics for income, health status, and other characteristics at the time of "Survey on Health and Retirement"**

	First survey (March 2008)	Second survey (March 2009)	Third survey (March 2010)
	Average		
Male respondents' real income (100,000 yen, adjusted using the CPI (general, excluding imputed rent) as deflator)	36.6 (32.3)	42.8 (30.2)	41.9 (28.2)
Household real income (100,000 yen)	-	60.1 (37.3)	60.8 (39.7)
Health variable			
Number of illnesses in preceding three years	0.24 (0.53)	1.25 (1.77)	1.75 (2.07)
Suffered from lifestyle disease in preceding three years	8.4%	25.7%	32.7%
Suffered from at least one of the three killer diseases in preceding three years	2.9%	9.5%	14.3%
Age	61.2 (9.2)	62.2 (9.3)	63.2 (9.3)
Educational attainment			
Junior high school	12.8%	14.1%	13.9%
High school	53.5%	50.8%	52.7%
University	33.7%	35.1%	33.4%
Employment status			
Regular employment	37.9%	33.0%	29.5%
Part-time employment	10.5%	12.6%	13.6%
Self-employment/Other	19.5%	19.8%	19.3%
Not working	32.1%	34.6%	37.5%
Number of observations	514	693	704

Data source: National Institute of Population and Social Security Research, "Survey on Health and Retirement," (2008, 2009, 2010).

Note: Standard deviations are shown in parentheses.

**Table 2(a): The effect of a deterioration in health on an individual's income**

Health variable	Log of individuals' real income					
	Number of illnesses		Lifestyle diseases		Three killer diseases	
	Tobit	OLS	Tobit	OLS	Tobit	OLS
	(A)	(B)	(C)	(D)	(E)	(F)
	M.E.	Coef.	M.E.	Coef.	M.E.	Coef.
Health status	-0.005 (0.016)	-0.005 (0.016)	-0.004 (0.064)	-0.004 (0.063)	-0.070 (0.092)	-0.066 (0.091)
Age	0.010 ** (0.004)	0.010 ** (0.004)	0.010 ** (0.004)	0.010 ** (0.004)	0.010 ** (0.004)	0.010 ** (0.004)
Educational attainment						
Junior high school	-0.240 *** (0.081)	-0.241 *** (0.08)	-0.241 *** (0.082)	-0.241 *** (0.08)	-0.238 *** (0.082)	-0.238 *** (0.08)
University	0.223 *** (0.059)	0.221 *** (0.058)	0.223 *** (0.059)	0.221 *** (0.058)	0.223 *** (0.059)	0.221 *** (0.058)
Employment status						
Regular employment	1.034 *** (0.093)	1.029 *** (0.091)	1.036 *** (0.092)	1.031 *** (0.091)	1.031 *** (0.093)	1.026 *** (0.091)
Part-time employment	0.369 *** (0.093)	0.365 *** (0.091)	0.371 *** (0.092)	0.367 *** (0.091)	0.367 *** (0.093)	0.363 *** (0.091)
Self-employment/Other	0.505 *** (0.082)	0.500 *** (0.081)	0.507 *** (0.082)	0.502 *** (0.08)	0.503 *** (0.082)	0.498 *** (0.081)
Prefectural unemployment rate	-0.013 (0.03)	-0.014 (0.03)	-0.013 (0.03)	-0.014 (0.03)	-0.014 (0.03)	-0.014 (0.03)
Constant	-	4.138 *** (0.312)	-	4.135 *** (0.312)	-	4.136 *** (0.312)
(Pseudo/Adjusted) R-squared	0.0489	0.1488	0.049	0.1488	0.0489	0.149
Chi-squared/F-statistic (all coefficients=0)	308.88***	34.39***	309.36***	34.38***	308.79***	34.44***
Number of censored observations	35					
Number of uncensored observations	1876					

Note: Standard errors of coefficients are shown in parentheses. \*\*\*, \*\*, and \* denote significance at the 1, 5, and 10 percent level, respectively. The marginal effects of the Tobit model are the first derivative of the unconditional expectation. Year dummies are also included in the first- and second-stage equations.



**Table 2(b): The effect of a deterioration in health on household income**

Dependent variable	Log of real household equivalent income		
Health variable	Number of illnesses	Lifestyle diseases	Three killer diseases
Estimation method	OLS		
	(A)	(B)	(C)
	Coef.	Coef.	Coef.
Health status	0.004 (0.007)	0.037 (0.031)	0.008 (0.044)
Age	0.006 *** (0.002)	0.006 *** (0.002)	0.006 *** (0.002)
Educational attainment			
Junior high school	-0.141 *** (0.042)	-0.143 *** (0.042)	-0.141 *** (0.042)
University	0.174 *** (0.031)	0.173 *** (0.031)	0.175 *** (0.031)
Employment status			
Regular employment	0.700 *** (0.049)	0.699 *** (0.049)	0.699 *** (0.049)
Part-time employment	0.239 *** (0.048)	0.239 *** (0.047)	0.238 *** (0.048)
Self-employment/Other	0.279 *** (0.043)	0.280 *** (0.043)	0.279 *** (0.043)
Prefectural unemployment rate	-0.008 (0.016)	-0.007 (0.016)	-0.009 (0.016)
Constant	5.031 *** (0.167)	5.025 *** (0.167)	5.037 *** (0.167)
Adjusted R-squared	0.2554	0.2561	0.2553
F-statistic (all coefficients=0)	52.15***	52.32***	52.12***
Number of observations	1343		

Note: Standard errors of coefficients are shown in parentheses. \*\*\*, \*\*, and \* denote significance at the 1, 5, and 10 percent level, respectively. Year dummies are also included in the first- and second-stage equations.

**Table 3: The effect of a deterioration in health on an individual's income**

Dependent variable	Log of real income		
	Number of illnesses	Lifestyle diseases	Three killer diseases
Estimation method	2SLS		
	(A)	(B)	(C)
	Coef.	Coef.	Coef.
Health status	-0.214 *	-0.711	-1.732 *
	(0.127)	(0.446)	(0.942)
Age	0.011 **	0.010 **	0.013 ***
	(0.004)	(0.004)	(0.005)
Educational attainment			
Junior high school	-0.207 **	-0.169 *	-0.152
	(0.086)	(0.094)	(0.099)
University	0.238 ***	0.245 ***	0.233 ***
	(0.062)	(0.062)	(0.063)
Employment status			
Regular employment	0.936 ***	1.019 ***	0.907 ***
	(0.11)	(0.094)	(0.119)
Part-time employment	0.271 **	0.343 ***	0.259 **
	(0.111)	(0.095)	(0.115)
Self-employed/Other	0.422 ***	0.489 ***	0.399 ***
	(0.097)	(0.083)	(0.104)
Prefectural unemployment rate	-0.035	-0.035	-0.038
	(0.034)	(0.033)	(0.035)
Constant	4.268 ***	4.238 ***	4.173 ***
	(0.335)	(0.328)	(0.338)
First-stage regression			
BMI at age 30	0.063 ***	0.017 ***	0.007 ***
	(0.014)	(0.004)	(0.003)
Both parents have a history of lifestyle diseases	0.363 **	0.081 **	-
	(0.143)	(0.036)	-
One parent has a history of lifestyle diseases	0.248 ***	0.083 ***	-
	(0.084)	(0.021)	-
Both parents have a history of at least one of the three killer diseases	-	-	0.027
	-	-	(0.019)
One parent has a history of at least one of the three killer diseases	-	-	0.050 ***
	-	-	(0.015)
Respondent's body height	-	-	0.002 *
	-	-	(0.001)
Test statistic for weak instruments			
F-statistic for excluded instruments	10.69 ***	13.71 ***	5.21 ***
Test statistic for overidentifying restrictions			
p-value of Sargan statistic	0.162	0.129	0.133
Number of observations	1911		

Note: Standard errors of coefficients are shown in parentheses. \*\*\*, \*\*, and \* denote significance at the 1, 5, and 10 percent level, respectively. Year dummies are also included in the first- and second-stage equations.

**Table 4: The effect of a deterioration in health on household income**

Dependent variable	Log of real household equivalent income					
	Number of illnesses		Lifestyle diseases		Three killer diseases	
Health variable	2SLS					
Estimation method	(A)	(B)	(C)	(D)	(E)	(F)
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Health status	-0.053 (0.053)	-0.110 (0.07)	-0.125 (0.183)	-0.363 (0.226)	0.748 (0.497)	-0.763 (0.704)
Age	0.006 * (0.002)	0.006 *** (0.002)	0.006 *** (0.002)	0.006 *** (0.002)	0.005 * (0.003)	0.008 * (0.003)
Educational attainment						
Junior high school	-0.119 * (0.046)	-0.131 *** (0.045)	-0.116 ** (0.048)	-0.115 ** (0.046)	-0.141 *** (0.05)	-0.136 *** (0.046)
University	0.176 *** (0.033)	0.183 *** (0.035)	0.176 *** (0.033)	0.186 *** (0.034)	0.162 *** (0.036)	0.182 *** (0.036)
Employment status						
Regular employment	0.666 *** (0.057)	0.642 *** (0.064)	0.689 *** (0.051)	0.691 *** (0.052)	0.767 *** (0.075)	0.618 *** (0.093)
Part-time employment	0.204 *** (0.056)	0.187 *** (0.061)	0.222 *** (0.051)	0.225 *** (0.051)	0.297 *** (0.072)	0.164 * (0.087)
Self-employed/Other	0.233 *** (0.049)	0.226 *** (0.055)	0.248 *** (0.045)	0.255 *** (0.047)	0.311 *** (0.063)	0.206 *** (0.077)
Prefectural unemployment rate	-0.023 (0.02)	-0.032 (0.022)	-0.019 (0.019)	-0.030 (0.021)	0.008 (0.023)	-0.034 (0.028)
Constant	5.162 *** (0.214)	5.255 *** (0.225)	5.097 *** (0.193)	5.175 *** (0.195)	4.928 *** (0.207)	5.137 *** (0.204)
First-stage regression						
BMI at age 30	0.081 *** (0.02)	0.079 *** (0.019)	0.024 *** (0.005)	0.024 *** (0.005)	0.008 ** (0.003)	0.008 ** (0.003)
Both parents have a history of lifestyle diseases	0.532 *** (0.203)	-	0.092 * (0.048)	-	-	-
One parent has a history of lifestyle diseases	0.250 ** (0.119)	-	0.096 *** (0.028)	-	-	-
Both parents have a history of at least one of the three killer diseases	-	-	-	-	0.014 (0.026)	-
One parent has a history of at least one of the three killer diseases	-	-	-	-	0.054 *** (0.02)	-
Respondent's body height	-	-	-	-	0.001 (0.002)	0.001 (0.002)
Test statistic for weak instruments						
F-statistic for excluded instruments	8.93 ***	17.54 ***	12.95 ***	27.96 ***	3.13 **	3.15 **
Test statistic for overidentifying restrictions						
p-value of Sargan statistic	0.088 *	-	0.063 *	-	0.003 ***	0.034 **
Number of observations	1203	1318	1203	1318	1203	1318

Note: Standard errors of coefficients are shown in parentheses. \*\*\*, \*\*, and \* denote significance at the 1, 5, and 10 percent level, respectively. Year dummies are also included in the first- and second-stage equations.

**Table 5: The effect of a deterioration in health on an individual's income (by age group)**

Dependent variable	Log of real income			
Health variable	Number of illnesses		Lifestyle diseases	
Age	≤59	60≤	≤59	60≤
Estimation method	2SLS			
	(A)	(B)	(C)	(D)
	Coef.	Coef.	Coef.	Coef.
Health status	-0.021 (0.177)	-0.439 ** (0.19)	-0.215 (0.731)	-1.152 ** (0.55)
Age	-0.005 (0.012)	0.007 (0.007)	-0.005 (0.011)	0.002 (0.006)
Educational attainment				
Junior high school	0.009 (0.216)	-0.222 ** (0.101)	0.037 (0.241)	-0.188 ** (0.095)
University	0.159 (0.105)	0.204 ** (0.087)	0.170 (0.11)	0.229 *** (0.075)
Employment status				
Regular employment	2.815 *** (0.243)	0.546 *** (0.155)	2.811 *** (0.24)	0.640 *** (0.133)
Part-time employment	2.036 *** (0.282)	0.071 (0.144)	2.006 *** (0.304)	0.261 *** (0.098)
Self-employment/Other	2.340 *** (0.251)	0.121 (0.13)	2.334 *** (0.253)	0.282 *** (0.086)
Prefectural unemployment rate	0.002 (0.053)	-0.082 * (0.049)	-0.001 (0.054)	-0.070 * (0.042)
Constant	3.028 *** (0.753)	5.035 *** (0.553)	3.061 *** (0.746)	5.203 *** (0.515)
First-stage regression				
BMI at age 30	0.057 *** (0.017)	0.067 *** (0.021)	0.018 *** (0.005)	0.017 *** (0.005)
Both parents have a history of lifestyle diseases	0.545 *** (0.179)	0.266 (0.203)	0.089 (0.056)	0.070 (0.046)
One parent has a history of lifestyle diseases	0.402 *** (0.096)	0.140 (0.127)	0.087 *** (0.03)	0.083 *** (0.029)
Test statistic for weak instruments				
F-statistic for excluded instruments	11.42 ***	4.1 ***	6.97 ***	7.03 ***
Test statistic for overidentifying restrictions				
p-value of Sargan statistic	0.735	0.4986	0.763	0.098 *
Number of observations	768	1143	768	1143

Note: Standard errors of coefficients are shown in parentheses. \*\*\*, \*\*, and \* denote significance at the 1, 5, and 10 percent level, respectively. Year dummies are also included in the first- and second-stage equations.

**Table 6: The effect of a deterioration in health on household income (by age group)**

Dependent variable	Log of real household equivalent income			
Health variable	Number of illnesses		Lifestyle diseases	
Age	≤59	60≤	≤59	60≤
Estimation method	2SLS			
	(A)	(B)	(C)	(D)
	Coef.	Coef.	Coef.	Coef.
Health status	0.017 (0.107)	-0.143 (0.094)	0.049 (0.316)	-0.487 (0.307)
Age	0.019 *** (0.005)	0.006 (0.005)	0.019 *** (0.005)	0.003 (0.004)
Educational attainment				
Junior high school	-0.011 (0.08)	-0.163 *** (0.058)	-0.012 (0.08)	-0.138 ** (0.058)
University	0.153 *** (0.054)	0.175 *** (0.051)	0.154 *** (0.049)	0.191 *** (0.049)
Employment status				
Regular employment	0.779 *** (0.132)	0.619 *** (0.09)	0.775 *** (0.118)	0.659 *** (0.09)
Part-time employment	0.190 (0.124)	0.181 ** (0.08)	0.199 (0.152)	0.241 *** (0.064)
Self-employment/Other	0.368 *** (0.116)	0.175 ** (0.072)	0.370 *** (0.122)	0.215 *** (0.058)
Prefectural unemployment rate	-0.014 (0.027)	-0.037 (0.034)	-0.015 (0.024)	-0.036 (0.032)
Constant	4.275 *** (0.429)	5.366 *** (0.347)	4.300 *** (0.335)	5.487 *** (0.37)
First-stage regression				
BMI at age 30	0.064 *** (0.023)	0.091 *** (0.029)	0.022 *** (0.007)	0.027 *** (0.006)
Test statistic for weak instruments				
F-statistic for excluded instruments	7.55 ***	10.02 ***	10.48 ***	17.42 ***
Number of observations	532	786	532	786

Note: Standard errors of coefficients are shown in parentheses. \*\*\*, \*\*, and \* denote significance at the 1, 5, and 10 percent level, respectively. Year dummies are also included in the first- and second-stage equations.