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Abstract

Health checkups have been commonly considered as an important measure to improve population health. The Japanese government has urged health insurers to promote health checkups, including the specific health checkups (SHC) which was recently implemented in 2008 to cover the whole population between ages 40 and 74. However, there remains a large gap between the actual prevalence and the goals set by the government. Using the Comprehensive Survey of Living Conditions (CSLC) survey data from 1995 to 2013 in Japan, we conduct an empirical study to answer three questions: Which factors determinate the prevalence of general health checkups in Japan at the regional level? Which factors affect the decisions on taking health checkups at the individual level? Does SHC have any effects on various health outcomes? Our results suggest that there is a great regional disparity in the prevalence of health checkups in Japan, even after accommodating for various socio-economic factors. In addition, despite the government's promotion policies, little improvement is observed in the prevalence of health checkups from 1995 to 2013. Moreover, at the individual level, the participation rate for health checkups by non-regular/part-time workers and by the enrollees of the National Health Insurance is lower than that of their counterparts. Lastly, although SHC since 2008 appeared to have a positive effect on the probability of taking health checkups, so far it has little effect on health status, smoking behavior, and medical expenses.

Keywords: Health checkups, Specific health checkups, *Metabo* law, Regional disparity, Health outcomes

JEL codes: I18, I14, I11

[1]This study is conducted as a part of the "Research on the Quality and Measurement of Health and Education" project undertaken at the Research Institute of Economy, Trade and Industry (RIETI). This study utilizes the micro data of the questionnaire information based on the "Comprehensive Surveys of Living Conditions in Japan" which is conducted by the Ministry of Health, Labour and Welfare (MHLW). The authors are grateful for helpful comments and suggestions by Makoto Yano, Masayuki Morikawa, Kyoji Fukao, and Discussion Paper seminar participants at RIETI. Tomohiko Inui gratefully acknowledges financial support from the Japan Society for the Promotion of Science (JSPS KAKENHI Grants No. 16H06322)

1. Introduction

Health checkups have been commonly considered as an important measure to improve population health. Presumably, the health checkups result in early detection and early treatment of conditions, reducing the incidence of serious diseases and delaying the onset of poor health, and consequently reducing medical expenses. As the world population are getting older and medical expenses are rising rapidly, periodic health checkups have gained attention as the means to mitigate the cost of unhealthy aging.

The Japanese government has long been emphasizing the importance of regular health checkups. Employers of 50 and more workers in Japan are mandated by law to provide their employees free annual general health checks since 1972. Furthermore, with the concern of chronic health conditions, a new law was implemented in 2008, known as the Metabo Law, which requires each insurer to provide the Specific Health Checkups (SHC) for their beneficiaries aged 40-74, where individuals are screened by the risk factors to the metabolic syndrome. Based on waist length and BMI, together with the exam results on various other behavioral factors, individuals who are diagnosed with metabolic syndrome are urged to receive a series of counseling sessions throughout a period up to six months.

Despite the substantial efforts made to promote regular health checkups, there remains a gap between the goals set by the government and the actual participation. For example, about 19% of employees did not take the annual health checkups provided to them by their employers in 2012, almost the same as in 2007 (MHLW, 2012). As for the SHC, only 46.2% of the target individuals received the checkups in 2014, far from the goal of 70% set by the government, Ministry of Health, Labor and Welfare (MHLW, 2016). The reasons for the gaps are manifold but mainly lie in the behavioral choices made by individuals. According to the Grossman model (Grossman, 1972) which is often used to analyze the demand for healthcare services, individuals seek the optimal amount of healthcare (a type of “input”), to produce good health for monetary and utility gains in the future (a type of “output”), subject to budget and time constraints. Analogously, health checks can be considered as a type of healthcare service and thus various factors can affect its demand. In order to provide individuals incentives to take health checkups, it is critical to develope a comprehensive understanding of these factors.

This study makes use of the data collected from the Comprehensive Survey of Living Conditions (CSLC) in Japan from 1995 to 2013 to investigate: (a) the factors of the prevalence of health checkups in Japan at the regional level; (b) how individuals make decisions on taking health checkups at the individual level; (c) the causal effects of SHC on various health outcomes including health status, smoking behaviors, mental stress and medical expenses.

The study contributes to the literature in the following three ways. First, to our knowledge, this is the first attempt that comprehensively examines the behavioral choices of health checkups at both the regional and individual levels. Secondly, the rich CSLC data allow us to investigate the impacts of important factors which are often missed in previous studies. These factors include health insurances, working hours and employment status. Lastly, exploiting the changes caused by the newly introduced *Metabo Law* that requires each insurer to urge individual with age 40-74 to take the SHC, the study also investigates the causal impacts of health checkups, taking care of the endogeneity issue by adopting a regression discontinuity design (RDD) approach.

In sum, the study finds that there is a large difference in the prevalence of general health checkups at regional level in Japan. The difference remains after status in incomes, education levels, and gender compositions are controlled. In addition, little improvement is observed for the participation rates over time, despite the promotion of preventive care by the government.

At the individual level, besides income and gender, age also appears to be an important factor, i.e. the older, the more likely he/she will take health checkups. The type of health insurance also has a significant impact on the participation to health checkups, The participation is smallest for the beneficiaries of the National Health Insurance and the largest for those in the Corporate Health Insurance.[2] Moreover, gender differences are observed: men tend to miss health checkups when weekly working hours increase but are more likely to take health checkups when they have more children (under age 15). The case is opposite for women, probably because women who work longer are more likely to be full-time employees, while women who have more children are more occupied with housework.

Lastly, the RD analysis based on the 2010 and 2013 data suggests that the Metabo Law significantly increases the prevalence of health checkups in both years. The effect is stronger for high-income earners and those who have children. Unfortunately, it has little impacts on individuals' self-assessed health status, smoking behaviors and medical expenses. On the other hand, stress level appears to decrease upon taking SHC in 2013.

The rest of the paper is organized as follows. Section 2 provides a brief review of the literature. Section 3 describes the data and background. Section 4 explains the identification strategies and the main results. The last section contains conclusions we

[2] Among the corporate health insurance, insured family members are less likely to take health checkups compared to the insured employees. The difference comes from the regulation (obligation) that employers at workplaces with 50 or more employees have to provide annual health checkups to all the workers. Since this is a regulation for workers' safety, their non-working family members are out of this system.

draw from the estimation results as well as their policy implications.

2. Background and Literature Review

2.1 Population health and general health checkups in Japan

The nation-wide general health checkups have been considered as one of the successful health policies in epidemiological reviews. Ikeda et al (2011) state that Japan has had the world's longest life expectancy at birth since the mid-1980s is in part because a series of post-World War II public health policies were instrumental on reducing chronic diseases. Johansson and Mosk (1987) and Iwasaki (1974) report that the disease control in the 1950s' reconstruction period effectively reduced mortality from tuberculosis. Ikegami et al. (2011) show that the establishment of universal health insurance (1961) and the introduction of nationwide annual general health checkup systems in workplaces (1972) and municipalities (1982) tremendously contributed to early detection and pharmacological treatment of hypertension. Furthermore, many epidemiological studies in Japan, such as Ueshima et al. (1987), Iso (1998), and Ikeda (2008), state that high participation rates to annual health checkups significantly reduce stroke mortality.

However, the longer life expectancy have brought aging society and steep rise in healthcare expenditure. Among the OECD economies, the percentage of elderly people in Japan has marked the fastest growth rates, accelerated with low fertility rates. According to the Census conducted every 5 years in Japan, the proportion of people aged 65 years and older increased from 14.6% in 1995 to 20.2% in 2005 and 26.7% in 2015. Accordingly, Japan's total healthcare expenditure as a share of GDP gradually rose from 6.4% in 1995 to 8.1% in 2005 and 11.2% in 2015, according to the OECD Health Statistics 2014. A report by the OECD (2014) also confirms that a high growth rate in pharmaceutical spending is another factor for the rising health spending in Japan. As elderly people use more drugs then young people do, aging may result in over-proportional growth in the usage of medicine. Therefore, wellness programs to avoid heavy medication at the clinical stage is now in need for public health.

Currently, it is getting harder for Japanese people to avoid medication, due to gradually increasing severity of life-style diseases. Udagawa et al. (2008) describe the slowly-increasing prevalence of overweight, pre-diabetes, type 2 diabetes and its complications in Japan. Sakane et al. (1997), Rakugi et al. (2005), and Ahuja et al. (2015) alert that mild abdominal obesity can lead to insulin resistance, impaired glucose metabolism, and cardiovascular sequelae in Japanese individuals.

To prevent severe lifestyle diseases in the aging society of Japan, the Ministry of Health Labor and Welfare (MHLW) began a new approach to systematically detect hyperglycemia, hypertension, and dyslipidemia earlier, possibly at the preclinical stage, and treat them without drugs.

To protect workers' safety and health, the mandatory health checkup for working people has been active since 1972, in the setup of the *Industrial Health and Safety Act*. The law forces annual health checkups at workplaces with 50 or more employees. Yet, the majority of the population are employees at small workplaces (with less than 50 workers) and non-workers, and thus they have been out of the target. As a result, the policy planning for wider mandatory checkups has been in action since the early 2000s.

2.2 Specific Health Checkups and Specific Health Guidance since 2008

A large number of previous studies (e.g. Sakane et al., 2011, Knowler et al., 2002, Tuomilehto et al., 2001, Eriksson et al. 1991) show clear evidence that lifestyle modification can be more effective than medication at clinical stage for reducing metabolic syndrome risk factors. Based on the *Metabo Law* passed in 2008, the MHLW introduced the Specific Health Checkups (SHC) and the Specific Health Guidance (SHG).[3] Under this government mandate starting from April 2008, the existing health checkup systems in workplaces (supported by employers under the *Industrial Health and Safety Act*) were retained and a new health counseling component (supported by employer-based health insurers) was added.[4] The existing health checkup systems in municipalities (supported by national and local taxes) were replaced by new health checkup and health counseling service systems (supported by municipality-based health insurers). All health insurers in Japan, therefore, were required to provide health checkup programs to all enrollees and their dependents of age between 40 and 74 and to implement lifestyle improvement counseling for participants with elevated risk factors of metabolic syndromes.

This reform aims to detect metabolic abnormalities that are still in the preclinical stage and treat them without any costly pharmacological intervention. This is expected to reduce lifestyle-associated non-communicable diseases, mitigate the health care expenditure, and increase quality of life.

The SHC features annual laboratory tests, questionnaire, and physical examination to evaluate metabolic syndrome risk factors. Measurement methods, cut-off values, and protocols are described in the "Operational Guide to Specific Health Checkups and

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[3] It refers to a set of guidelines – the Standards Concerning Implementation of Special Health Examinations and Special Public Health Guidance under the Ministry of Health, Welfare, and Labor Order 159, based on the revision of *Act on Assurance of Medical Care for Elderly People* and *National Health Insurance Act.*

[4] For employees and employers who have already been following the Industrial Health and Safety Act (or the mandatory implementation of checkup), the addition of new policy (the *Metabo Law*) had only minor effects. The participation rates on SHC, calculated by insurer's type, have been high above the nation-wide target rates.

Specific Health Guidance" by the MHLW (2013). In brief, participants in SHC are initially classified by obesity indicators (Waist Circumference and Body Mass Index), then by the number of additional metabolic risk factors, smoking status, and age (see Figure 1).[5]

There are two types of SHG in this program: Intensive HG is offered to those who have two or more risk factors with abdominal obesity or three or more risk factors with overweight (BMI $\geq$ 25) but without abdominal obesity. Motivational HG is offered to those who have one risk factor with abdominal obesity or one or two risk factors with overweight without abdominal obesity. Both types of SHG include an initial counseling and a final evaluation after six months. At the initial counseling, participants are briefed about their health condition and lifestyle by reviewing their SHC results sheets. They are instructed to set personalized behavioral goals.[6] In the Intensive HG program, participants receive personalized follow-up consultation through e-mails, phone calls, and/or in-person or group sessions at their convenience for 3 to 6 months.[7] Both programs are considered to be completed when participants receive a specific amount of cumulative consultation time, for example, four 15-minute phone consultations or five e-mail consultations (Intensive HG only), and finished the 6-month evaluation (Figure 2). The average per capita cost is about US$180 (18,000 Japanese Yen) for the Intensive HG and about US$60 (6,000 Japanese Yen) for the Motivational HG. For National Health Insurance, the prefecture and the central government support two thirds of the expenditure, and the remaining one third of the cost is covered by municipalities (insurers). A

[5] Individuals who are on pharmacological therapy for diabetes, hypertension or dyslipidemia are not eligible for SHG.

[6] The goals are customized for each participants so that they could be achievable. For instance, "walking extra 10 minutes whenever possible," or "reducing body weight by 3-5%," and "reducing waist circumference by 3cm," are proposed.

[7] The Motivational HG program does not include continuous support.

municipal can charge individuals for checkup costs, but almost all the insurers support free checkups. This is because each insurer is requested to make an effort to promote its enrollees' participation. According to the achievement status of each medical insurer (such as the participation rates to SHC and SHG, the percentage of metabolic abnormalities, and the reduction rates of those through SHG), the insurer's mandatory social security burden will be changed. The better the achievement, the less the imposed burden.

2.3 Participation and effects of health checkups

There is a large body of literature that has investigated the individual demand for health checkups. Kenkel (1990) shows that older people demand more about their health information. Kenkel (1994) additionally shows that income has a positive effect on the demand for preventive medical cares. Phelps and Newhouse (1974) and Coffey (1983) claim that time costs (opportunity costs) are major determinants. They show that the demand for health checkups has a larger time-price elasticity than the demand for other medical inputs. Since a health checkup is considered to be a time-consuming health input, the opportunity cost (wage and working hours) is an important determinant of health checkup decisions. They find that people with high wage level, or with short leisure hours (=long working hours) are less motivated to take health checkups. Hsieh and Lin (1997) show that better health literacy (associated with education level) has positive effects on the usage of preventive care. However, it should also be noted that better health literacy is in some sense associated with bad health conditions, as good health conditions weaken the incentive to collect health information. The individual backgrounds (such as age, sex, income, hourly wage, working hours, literacy, education, and health condition) are overall found as the key determinants to the participation of health checkups.

Another line of study investigates whether some social environments are the determinants. For example, Carrieri and Bilger (2011) show that an assistance through GP (general practitioner) plays a minor role in prevention use but accessibility to clinics are strong determinants of the preventive care demand in Italy. However, according to a research in the UK, Labeit, et al. (2013) conclude that the common determinants for having health checkups are age, screening history, and a GP visit. They consider that GP plays the central role in promoting screening examinations and in preserving a high level of uptake. Since these social environments have different meaning in each community or country, the behavioral impacts to residents are diverse in the literature.

In Japan, the Comprehensive Surveys of Living Conditions (hereafter CSLC) contains the questionnaire asking participation and interests in health checkups to each. The statistics, therefore, clarifies the motivation for checkups. For example, Yamada and Yamada (2003) find a gender difference in the demand for health checkups, after controlling for socioeconomic and demographic conditions. Men are more likely to take checkups than female. Moreover, they also find the age difference: the older, the more likely to take checkups. They also show that the insurers' type, and employer size are also key factors. Finally, they find a strong negative correlation of health checkup rates with the probability of being ill, as well as with the duration of hospitalization. Although the correlation does not explain the causality, the willingness to take checkups is found as one of the important components of healthy life.

Ohshige et al. (2004) evaluate a health checkup program provided by a municipal government, by measuring the public's willingness to pay (WTP) for maintaining the program. A questionnaire-based study of a health checkup program targeting people on the National Health Insurance system was conducted. The WTP was about US$54 (5,410 Japanese Yen) per person, an amount substantially below the government cost for providing the service. The aggregate WTP was also estimated to be lower than the current expense to the municipal government. The travel cost method in their analysis might reflect a short-term private benefit produced by the health checkup program but cannot take into account a long-term private benefit or overall ensuring social benefits.

These low WTP (or perceived personal benefit) for health checkup may reflect the low nationwide participation rates to the SHC and SHG, far below the program targets of 70% and 45%, respectively. To tackle this problem, the ministry facilitates information-sharing among health insurers, expands health care provider training, and incorporates successful strategies and lessons learned from existing similar interventions. Sakane et al. (2014) discuss the effectiveness of an assistance program through periodical phone calls. Similar efforts are taken at other countries. For example, Griffin et al. (2014) report an RCT for UK checkup programs. The United Nations' General Assembly on the Prevention and Control of NCDs published a political declaration urging governments to generate effective responses for the prevention and control of NCDs through the efforts and engagements of all sectors of society.[8]

Suzuki et al. (2015) have also investigated the effects of the SHC during 2008-2010. Using the panel data for the enrollees of the National Health Insurance, they find that the SHC has no effect on the waist circumference, but a very small positive effect on the BMI.

Tamura and Kimura (2015) report that initial intervention was effective to prevent

[8] United Nations General Assembly Sixty-sixth session. Agenda item 117. Follow-up to the outcome of the Millennium Summit. Draft resolution submitted by the President of the General Assembly. Political declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases. Available at https://ncdalliance.org/sites/default/files/resource_files/UN%20Political%20Declaration%20on%20NCDs.pdf (accessed 1/25/2017)

metabolic syndrome, but the effects deteriorate quickly. For example, the trial of ICT-based follow-up has not been successful enough to keep the initial improvement right after the official program period.

The above research projects regarding the SHC have covered only a specific population in Japan. The investigation covering the nationwide residents are limited to the report by MHLW. The Work Group for Studying the Effects of the Specific Health Checkups and Specific Health Guidance on Health Care Expenditures sponsored by MHLW released a series of reports (2014, 2015, 2016, for the first, second and the final interim reports, respectively). By using the records stored in National Data Base (NDB), the work group shows a clear difference between participants and non-participants in clinical records in almost all the examined subjects, keeping the significant differences for three follow-up years. Similar to the findings by Yamada and Yamada (2003), the difference reflects the correlation, not the causality. The SHC programs are not RCT designs, and the participation to the SHG is decided by the willingness of the individuals. Therefore, we have to be conservative about the interpretation of the SHC results so far and we need further long-term research on this issue.

3. Data and Variables

We make use of the rich micro-survey data collected through the Comprehensive Survey of Living Conditions (CSLC) to examine the determinants of taking annual health checkups and the impact of SHC on health outcomes in Japan. The survey has been conducted by Japan’s Ministry of Health, Labour, and Welfare (MHLW) every three years since 1986.[9] It is a nationally representative household survey where the subjects are

[9] In years in-between, a small-scale survey has also been conducted. Yet, as the small-scale survey

drawn on the stratified random sampling basis. Since the health checkups reform was implemented in 2008, only the data from the latest two waves, in 2010 and 2013, are used for the analysis of the effect of the SHC.

In the survey, households are first sampled in each stratum. Selected households are visited by enumerators and given a set of 5 distinct questionnaires: household, health, nursing care, income, and savings. Among them, household and health questionnaires are administered to all the selected households, whereas the nursing care, income, and savings questionnaires are distributed to the subset of those, by a random sampling of geographical strata.[10] Household, health, nursing care, and income questionnaires are collected by re-visiting enumerators, while the savings questionnaire is to be sealed and mailed for collection.[11] The survey based on household, health, and nursing care questionnaires is conducted in June, followed by income- and savings-related survey in July.[12] The June round in 2013 included about 740,000 individuals from 300,000 households, whereas the July follow-up targeted around 90,000 individuals from 40,000 households.

Household and health questionnaires are the major components of the survey, covering questions on household formation, job status, social security and insurance participation, recent clinical symptoms and officially diagnosed diseases, medical care service utilization status, and so forth. Income questionnaire asks the subjects to refer to

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does not contain questionnaires on health, nursing care, and savings, we do not use it.

[10] Sampling for the household questionnaire excludes households of a single person living away from his or her family for a business or study purpose (for three months or longer), and also individuals of selected households who are put in social welfare facilities or are long hospitalized with the officially registered residential address moved to the hospital, foster children put out to nurse, those who are imprisoned, and those who live away for some other reasons.

[11] In some instances, the health and income questionnaires are allowed to be sealed and mailed, too, due mainly to a confidentiality issue.

[12] Sampling for the income questionnaire excludes those who move out or into the sampled household after the survey in June and those who form a single-person household and serve as a live-in worker.

their official income tax return documents when inputting amounts earned, as well as taxes paid, by each category of income sources and tax types. Thus designed, the MHLW attempts to reduce some recall biases in such self-report based survey.

The main outcome of our study is a dummy variable that takes the value one if the subject had taken any type of health checkups in the past year and zero if otherwise. Those who answered yes to this question were then asked whether their health check-up was carried out by the local government in their resident district, their workplace, or their school, while those who reportedly had not taken any type of health checkups the past year were asked why not. Regardless of the response to the above question, whether the subject had gone through particular types of cancer tests, including stomach, lung, intestine, uterus, and breasts, were also asked. These questions were queried to all subjects aged 20 or above.

Health outcomes we examine include self-assessed health status, a dummy variable of whether the subject had a worry or felt stress in daily life, a dummy variable of whether the subject is a non-smoker, and per capita household medical expenditure in the past year. The self-assessment of health status was reported on the scale of 1 (very good) through 5 (very bad). Medical expenditure was questioned only in 2010, and only about the household total expenditure: thus, we calculated per capita medical expenditure for each household.[13]

The statistic description of main variables thus prepared are summarized in Table 1, where those aged younger than 40 years old are referred to as the control group and those aged 40 or above are designed as the treatment group –which gives the cutoff age of the

[13] For this, we computed the adult equivalence scale following the so-called modified OECD scale, which assigns the weight of 1 to the household head, 0.5 to other household members aged 15 years or above, and 0.3 to the others.

Specific Health Checkups at age 40. From Panel A, it is found that those in the treatment group are more likely to take health checkups. They also report worse self-health assessment, higher stress, and lower probability of smoking. Medical expenditure is higher for the older individuals in the treatment group. These patterns are the same in both 2010 and 2013.

Panel B of Table 1 lists major covariates. There are slightly more females than males in the treatment group. Perhaps as they are older, the working hours of those in the treatment are shorter relatively. National Health Insurance, which encompasses the whole of those who are not covered by any other health insurances such as corporate group or industry group health insurance, has a wider coverage in the treatment group. The treatment group subjects belong to a larger household size on average with nearly three members including him- or herself. Moreover, the treatment subjects are those with generally low-education level.

Most regional level variables (47 prefectures) are computed from our CSLC data, but some are drawn from national census and Survey of Medical Institutions by MHLW, and then linearly interpolated. Such variables include population density (number of residents per square kilometer), the number of hospitals per 100,000 people, and the proportions of the population with the highest education level. The summary of statistics description of regional level variables is shown in Table 2 by the years used in the analysis at the regional level. Most notably, it is observed that the household size has been getting smaller, the proportion of the population with high-level education has increased, and the number of hospitals has become less accessible in the past two decades.

Overall, the data we have at hand are rich in the variety of variables and the number of observations. Incorporating all of the above information, we attempt to establish whether or not the introduction of specific checkups caused a positive behavioral change for preventive health care, such as taking health checkups and/or screening tests for cancer.

4. Empirical Strategies and Results

4.1. Factors affect the prevalence and trend of annual health checkups at regional level

We investigate the prevalence and trend of annual health checkups over the period of 1995-2013. The dataset used for this study shows the total rate of health checkups (including both general and specific health checkups) increased slightly from 57 percent in 1995 to 63 percent in 2013.

Equation (1) is utilized to analyze the trend and pattern of health checkups at the regional level.

$$HE_{jt} = \alpha_0 + \alpha_1 X_{jt} + \alpha_2 Z_j + T + \varepsilon_{jt} \tag{1}$$

where HE_{jt} is the percentage of individuals who have taken health checkups in prefecture j in year t, and we use the sample of age twenty and over. X_{jt} is a set of time-variant prefectural economic and demographic characteristics, and Z_j regional fixed effects, T year dummies (years 1995, 1998, 2001, 2004, 2007, and 2013) and ε_{jt} an idiosyncratic error. X include log of average income (Real GDP per capita by prefecture), log of average income squared, log of population density (people per square km of land area), log of hospital bed density (the number of hospital beds per 100,000 people), average age, male ratio in total population, average health status, average number of household members, educational backgrounds, and type of health insurance. We group the 47 prefectures into 7 broader regions (Tohoku & Hokkaido, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu & Okinawa), and include 6 dummies in the estimation, leaving Kanto area as the reference group.

Equation (1) is estimated by ordinary least squares (OLS) regression, and the results are shown in Table 3. The estimated coefficient on income is statistically significant, and the coefficient value of income is positive, whereas that of income squared is negative. These results imply that the rate of taking health checkups increases as income increases in the low- and middle-income groups, while it decreases as individuals become richer. The results can be explained that there exist an opportunity cost of lost working hours when an individual receives the healthcare services. According to the Grossman model (Grossman, 1972), it is thought that an individual in high-income group may be more concerned with his health status. Our results, however, suggests that his opportunity cost of taking health checkups might also be higher.

The estimated coefficient value of population density is negative and statistically significant. A possible explanation is that people living in densely populated areas are usually very busy, which prevents them from taking health checkups. The estimated coefficient value of hospital density is also negative and statistically significant. High availability of hospital resources in the region may reduce the opportunity cost of seeking health care when getting sick, and lead to less demand for health checkups.

We expect people living in an aging prefecture more health conscious and more likely take their health checkups. We do observe a positive coefficient on age, yet statistical insignificant. The rate of male population in a prefecture is positively and statistically significantly correlated to the rate of taking health checkups. As pointed out in Yamada and Yamada (2003), males are more likely to take health checkups than female, because they usually face higher health risks.

The coefficients on subjective evaluation of health status are negative but statistically insignificant. The estimated coefficient of family size is positive and significant. This result indicates increased family responsibility leads to higher health consciousness. On the other hand, the proportion of population aged younger than 15 years old has a negative correlation to the rate of taking health checkup, which may be because that the time necessary for child care becomes an important constraint for taking health checkups. Both higher education and more enrollment to the Employer-sponsored Health Insurance program lead to higher rate of taking health checkups.

Even after controlling for the prefectural economic and demographic characteristics, we still find statistically significant difference in the rate of taking health checkups by regions. The rates in both Kinki and Shikoku regions are lower than that in Kanto region by 2 to 4 percent points. In addition, the estimated coefficients on year dummies do not show an increasing trend in the rate of taking health checkups in Japan. Compared the rate in 2010, the coefficients of 1995 and 2007 year dummy variables indicate that the rates in these years were lower by approximately 5 and 3 percentage points, respectively. However, our estimation results also indicate the rate was lower in 2013 than that in 2010. The Japanese government is keen to promote health checkups, but our results indicate that after controlling important socioeconomic factors that affect the health checkup demand, the rates of taking checkups were almost unaffected during the period from 1995 to 2013.

4.2. Factors affect the demand for taking health checkups at individual level

Next, we examine the factors that affect the demand for taking health checkups at the individual level. To examine the factors affect the demand, we estimate the equation below by a logit model.

$$h_{ijt} = \beta_0 + \beta_1 x_{ijt} + \beta_2 R + \beta_3 T + \varepsilon_{ijt} \quad (2)$$

where h_{ijt} is whether the individual i has taken health checkups or not (a dummy variable that equals 1 if the individual *i* has a health checkups and 0 otherwise). Following the health demand model (Grossman, 1972) and the previous empirical study on the demand for taking health checkups in Japan (Yamada and Yamada, 2003), we investigate the following factors: (1) income, (2) monetary and time costs, and (3) individual and household characteristics that can affect the preference for health, such as economic resources, working conditions and household composition. More specifically, age, weekly working hours, marrital status, number of child aged under 15 years old, household incomes, employment status, and the types of health insurance program are included as explanatory variables, x_{ijt} in the estimation. R and T are the dummy variables used to control for the prefecture and time fixed effects.

We use the pooled data in the 2000's (2003, 2007, 2010 and 2013) for the estimation, and focus on the sample aged 20-60. In addition to the estimation using the total sample, we also report the results for male and female subsamples separately. The estimation results are shown in Table 4, and the marginal effects of the estimated coefficients are reported in the Table l. The estimated coefficients on age for both male and female groups are positive and statistically significant at 1% level. The age effect is much stronger for females (0.244) than that for males (0.102). After controlling other socioeconomic factors, females tend to increase their demand for health checkups than males as age increases. The coefficients on income are also positive and statistically significant, but the magnitude of the effect is not very different between male and female groups.

The sign of the estimates on marital status is positive and statistically significant for male, but not for female. We obtain statistically significant coefficients on both weekly working hours and the number of children aged younger than 15 years old for both male and female groups, but the signs on the coefficients are different between male and female groups. For working hours, they are negative for a male but positive for female. It can be explained as follows. When a man is very busy, he might be more likely to skip the health checkups due to the time costs. Whereas, for female workers, most of them are irregular workers (e.g. part-time workers) and their working hours are shorter relatively than the male workers. Therefore female workers who work for longer hours are more likely to be regular workers who are often faced with more pressure to fulfill the obligation of taking health checkups by large-size firms.

There also exists a gender disparity in the impact of the number of children under 15 years old. The probability of taking health checkups is lower for a female with more small children; however, it is higher for a male with more children. When a man becomes a father, the responsibility he feels for his family members (e.g. his children, his wife), as well as his health consciousness, may outweigh the time costs. On the other hand, there exists a gender role segregation in Japan, just as it is usually said that “women at home and men at work.” Working mothers also take on nearly as much of the housework and child-care responsibilities as non-working mothers (Ma, 2007). Therefore, the effects of children on the probability to take health checkups are different by gender.

Employment status also appears to be an important factor in the demand for health checkups. Probabilities of taking health checkups are substantially lower for part-time workers and temporary workers, especially for the latter. The probability of taking checkups for the part-time worker is 11 percent lower than that for regular workers. The difference in taking health checkups between different types of health insurance program is also substantially large. For example, the probability of taking health checkups for a person enrolled in the National Health Insurance operated by municipalities is about 20 percent lower than that for an individual enrolled in the Employer-sponsored Health Insurance.

Lastly, the type of health insurance also has a significant impact on the probability of taking health checkups - which is the smallest for the individuals who participate in the National Insurance and the largest for those in the Employer-sponsored Health Insurance. Because of large-size firms' greater efforts to promote health checkups than small- and middle-sized firms, it is not surprising that the probability of taking health checkups is greatest for the group who participate in the Employer-sponsored Health Insurance.

4.3. The effect of health checkups on health outcomes in Japan

The last part examines the effect of the Specific Health Checkups (SHC) on health outcomes. Since the decision on taking health checkups, the estimates based on an ordinary least square model or a standard panel model at the regional level may suffer from omitted variable bias. A typical issue is that a person who takes health checkups and a person who does not take health checkups can differ in terms of unobserved characteristics correlated with the health outcome. We, therefore, make use of the introduction of the Metabo law in 2008, which requires each insurer to facilitate the Specific Health Checkups, so that the enrollees aged 40-74 can participate. The goal of our study is to estimate the effect of the exposure to SHC on health-related activities at the individual level. In our setting, those aged 40 and over were all exposed to the treatment, which let us use the sharp regression discontinuity design (RDD). Letting Y be the health outcomes, z the assignment variable age, c the cutoff, the local average treatment effect (LATE) τ can be written as

$$\tau = \lim_{z \downarrow c} E[Y|z] - \lim_{z \uparrow c} E[Y|z]. \tag{3}$$

We estimate the LATE parameter non-parametrically using the local linear regression. For this, we follow Calonico et al. (2014) that formalize the estimator as

$$\hat{\tau} = \hat{\mu}_{+} - \hat{\mu}_{-}$$

where $\hat{\mu}_{+}$ and $\hat{\mu}_{-}$ are the first arguments of the solution to

$$\min_{\mathrm{b}_0,\mathrm{b}_1} \sum_{i=1}^{n} \mathbb{1}\{c \leq z_i \leq c + h\}(Y_i - b_0 - b_1 z_i)^2 K((z_i - c)/h)$$

and

$$\min_{\mathrm{d}_0,\mathrm{d}_1} \sum_{i=1}^{n} \mathbb{1}\{c - h \leq z_i \leq c\}(Y_i - d_0 - d_1 z_i)^2 K((z_i - c)/h),$$

respectively, given some bandwidth h. $\mathbb{1}\{\cdot\}$ is an indicator function that takes the value one if the condition in the bracket holds and zero if otherwise. We estimate the bandwidth by the method proposed by Calonico et al. (2014) (CCT hereafter) and Imbens and Kalyanaraman (2012) (IK hereafter), denoted h_{CCT} and h_{IK}.[14] Due to the optimality property at the boundary point, we use the triangular kernel such that

$$K(u) = (1 - u) \cdot \mathbb{1}\{0 \leq u \leq 1\}.$$

We estimate the equation (3) by employing individual level data in 2010 and 2013, respectively. Our outcome variables are (a) a dummy variable indicating whether one takes health checkups, (b) a categorical variable that measures self-assessed health status; ranging from 1 (poorest) to 5 (best); (c) a continuous variable of per capita household medical expenditures, (d) a dummy variable indicating whether one suffers from mental stress, (e) a dummy variable indicating smoking status which equals 1 if not smoking, and (f) the total number of subjective symptoms, ranging from 0 to 42. In addition to full

[14] In this current version of our draft, we have not performed the bandwidth selection without the regularization term, which tends to yield a small bandwidth estimate.

sample estimation, we also estimate the equation by dividing the sample holding different types of health insurance (e.g. National Health Insurance or Employer-sponsored Health Insurance).

Before showing the econometric results, we show the scatterplots of the output variables against age. Figure 3 shows the distribution of the rate of taking health checkups (averaged by age) against age in 2010. From figure 3, we can see a clear discontinuity in the rate at age 40. The magnitude of discontinuity at age 40 is large for the sample of National Health Insurance holders and Employer-sponsored family insurance holders. On the other hand, no remarkable jump can be found for the sample of Employer-sponsored Health Insurance holders. Figure 4 shows the distribution of the rate of taking health checkups (average by age groups) against age in 2013, and we find the patterns of discontinuity in Figure 4 similar to those in Figure 3.

Figures 5 and 6 show the distributions of self-assessed health status (averaged by age) against age in 2010 and 2013, respectively. These figures do not show any large jumps of health status at the threshold age for each sample both in 2010 and 2013. Figure 7 shows the distribution of log of per capita household medical expenditure (averaged by age) against age in 2010[15], and there is only a small increase in medical expenditure at age 40. Figures 8 and 9 show the distributions of stress status (averaged by age) against age in 2010 and 2013, respectively. There is no clear discrepancy in 2010, but there are quite large declines in stress reporting rate, especially among National Health Insurance holders and Employer-sponsored Health Insurance holders in 2013. Figures 10 and 11 show the distributions of non-smoking rates (averaged by age) against age in 2010 and 2013, respectively. Different from our presumption, non-smoking rate declines among National

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[15] Data on per capita household medical expenditure is not available in 2013.

Health Insurance holders. Figures 12 and 13 show the distributions of a number of subjective symptoms (averaged by age) against age in 2010 and 2013, respectively. Some significant reduction of a number of symptoms is observed among National Health Insurance holders.

These results are confirmed by the econometric estimation of equation (3), and results using 2010 data are shown in Table 5 and those using 2013 data in Table 6, respectively. The average treatment effect on the rate of taking health checkups is around 2.0 and 3.6 percent points increase in 2010 and 2013, and they are statistically significant. The rate among National Health Insurance holders shows the largest increase and statistically significant, but the rate is almost flat for Employer-sponsored Health Insurance holders. We further estimate LATE by dividing the sample between high-, middle-, and low-income groups, and between groups with or without children. The significant effects are found only among the high-income group and the group with children. Unfortunately, the estimation results indicate that there are no statistically significant effects on health status, medical expenditure, and smoking status. But we found some improvements in mental health status and the total number of subjective symptoms. Mental health status is improved slightly in 2013. The number of symptoms is decreased by around 0.2 among National Health Insurance holders in 2013.

5. Conclusions

Using the Comprehensive Survey of Living Conditions (CSLC) survey data from 1995 to 2013 in Japan, we conduct an empirical study to analyze the factors determinate the decisions on taking health checkups. We have also investigated whether any causal effects of the Specific Health Checkups on health outcomes (e.g. health status, smoking behaviors, mental stress, and medical expenses) were observed in RDD.

Our results indicate that there exist great regional disparities in the prevalence of health checkups in Japan, even after controlling for the variations in income, education level, and demographic proportion. In addition, the relation between the prevalence of health checkups and income is not linear-shaped, -i.e. the proportion of the population who take health checkups increases as the income increases among low and middle-income groups; whereas, for the high-income regions, it tend to decrease as income increases. Moreover, unfortunately, little improvement in the prevalence of health checkups is observed over time, despite the continuous promotion policies made by the government for the preventive health care. It might be because that the efforts of the local governments are not enough, or there exist some problems in the policy operation process. For instance, there may be a lack of financial support for local governments to promote the policy. Our results call for a more careful investigation on the effectiveness of the current policies to reduce regional disparity in preventive care (e.g. health checkups) and inequality in health care service among the low-income groups (e.g. non-regular workers and non-working individuals).

Second, we find that the probability to take health checkups can be affected by age, gender, working hours, the total number of children under 15, employment status and the type of health insurance. The results suggest rich policy implications. For example, policies to promote the diffusion of the knowledge on health checkups among no working group and to enforce the local clinic to promote taking health checkups should be considered by local government.

Interestingly, there seems to exist a differential effect of working hours and number of children under 15 between females and males. The probability of taking health checkups is lower for men with longer working hours but higher for their female counterparts. On the other hand, men with more children under 15 are more likely to take health checkups while women with more children under 15 are less likely to take health checkups than their male counterparts. This suggests that policymakers need to take into account gender differences when designing and implementing a policy. It is thought that mother's healthy status affects children's development greatly, so it is important to consider how to promote health checkups to improve mothers' health. The policies to provide one-day free child care service or allow fathers to take a day off when mothers take health checkups may increase mothers' probability of taking health checkups.

Lastly, the RDD estimation results based on the 2010 and 2013 survey data show that the *Metabo* Law significantly increases the prevalence of taking health checkups in both 2010 and 2013, and the effect being greater for the high-income group and those who have children. We also find that mental health status was improved upon taking health checkups in 2013. However, it has little impacts on individuals' self-assessed health status, smoking behaviors and medical expenses.

The research presented in this study could be expanded in a number of directions. One such direction would try to fix the remaining endogenous biases in our estimation results. For this purpose, we should consider an individual decision for choosing a specific health insurance type and other unobserved personal characteristics. We would like to leave these issues as our future tasks.

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Table 1. Summary statistics of major variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	2010						2013					
	Aged 20-39 (Control)			Aged 40-60 (Treatment)			Aged 20-39 (Control)			Aged 40-60 (Treatment)		
	N	mean	sd	N	mean	sd	N	mean	sd	N	mean	sd
Panel A. Outcome variables.												
1 if having taken medical checkup *1	125,822	0.645	0.478	165,039	0.731	0.443	119,953	0.615	0.487	162,273	0.711	0.453
Self-rated health status (1 best, 5	116,537	2.424	0.977	148,887	2.653	0.938	120,113	2.398	0.965	162,522	2.610	0.942
Number of symptoms (max. 42)	124,700	0.954	3.593	165,583	1.379	4.987	120,128	0.895	3.463	162,662	1.245	4.252
1 if stressed out	119,214	0.552	0.497	153,024	0.574	0.495	120,194	0.518	0.500	162,512	0.543	0.498
1 if do not smoke	118,316	0.692	0.462	151,694	0.718	0.450	119,802	0.716	0.451	162,076	0.729	0.445
Log(per capita hh medical	70,307	1.158	5.673	86,896	1.961	5.640	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)
Panel B. Major covariates.												
1 if female	131,907	0.508	0.500	174,328	0.511	0.500	123,906	0.505	0.500	167,306	0.513	0.500
Hours worked per day *2	95,986	8.308	2.313	131,001	8.034	2.341	90,790	8.302	2.353	128,037	8.046	2.340
1 if health insurance = national	131,907	0.206	0.404	174,328	0.266	0.442	123,906	0.188	0.390	167,306	0.240	0.427
1 if health insurance = employee, self	131,907	0.564	0.496	174,328	0.523	0.499	123,906	0.580	0.493	167,306	0.547	0.498
1 if health insurance = employee,	131,907	0.203	0.402	174,328	0.185	0.388	123,906	0.201	0.401	167,306	0.185	0.389
1 if health insurance = others	131,907	0.016	0.127	174,328	0.016	0.126	123,906	0.015	0.123	167,306	0.018	0.131
Per capita hh income (1,000 yen) *3	3,731	747.3	937.8	9,194	892.8	1,203	3,761	734.2	907.6	8,951	889.6	1,163
Number of household members *3	38,639	2.640	1.429	83,124	3.065	1.452	38,568	2.600	1.440	79,462	2.983	1.407
1 if highest degree = junior high school	120,287	0.049	0.215	157,179	0.083	0.276	112,323	0.048	0.214	149,784	0.063	0.244
1 if highest degree = high school	120,287	0.384	0.486	157,179	0.505	0.500	112,323	0.363	0.481	149,784	0.484	0.500
1 if highest degree = vocational	120,287	0.159	0.366	157,179	0.098	0.298	112,323	0.160	0.367	149,784	0.110	0.313
1 if highest degree = 2-year college *4	120,287	0.115	0.319	157,179	0.104	0.305	112,323	0.105	0.307	149,784	0.116	0.320
1 if highest degree = 4-year college	120,287	0.266	0.442	157,179	0.196	0.397	112,323	0.292	0.455	149,784	0.210	0.407
1 if highest degree = graduate school	120,287	0.027	0.163	157,179	0.014	0.118	112,323	0.032	0.175	149,784	0.017	0.130

Notes. In Japan, health insurance is categorized as National Health Insurance (kokumin kenko hoken), Employer-sponsored Health Insurance (koyosha kenko hoken, which is further decomposed to either the registerer's self, or family of a registerer who is covered by the Employer-sponsored self health insurance), and others, which include such insurance as sailors'. *1) Medical checkup variables are queried about people's take-up experience in the past year. *2) This variable is answered by those who reportedly had a job, and calculated as hours worked in the previous week divided by days worked in the previous week. *3) These variables are observed at the household level, and therefore only the household head are counted, which creates the modestly large difference in the sample size between the control and the treatmet groups. *4) This includes those graduates from the 5-year technical high school.

Table 2. Summary statistics of major variables: prefectural characteristics.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	1995	1998	2001	2004	2007	2010	2013
Male ratio	0.490	0.493	0.492	0.491	0.489	0.489	0.489
	(0.013)	(0.012)	(0.011)	(0.011)	(0.012)	(0.011)	(0.013)
Health status (1 best, 5 worst)	2.220	2.352	2.421	2.404	2.532	2.551	2.520
	(0.06)	(0.053)	(0.051)	(0.046)	(0.042)	(0.039)	(0.038)
% highest degree = junior high school	32.03	29.35	26.85	24.37	21.89	19.42	16.94
	(6.412)	(6.119)	(5.792)	(5.424)	(5.068)	(4.726)	(4.401)
% highest degree = high school	45.88	46.36	46.44	45.67	44.89	44.12	43.35
	(2.497)	(2.62)	(3.001)	(3.64)	(4.382)	(5.183)	(6.02)
% highest degree = vocational school / 2-year college	9.529	10.36	11.04	11.46	11.87	12.29	12.71
	(1.818)	(1.869)	(1.859)	(1.705)	(1.57)	(1.459)	(1.377)
% highest degree = 4-year college / graduate school	10.79	11.70	12.49	13.24	13.99	14.75	15.50
	(3.576)	(3.706)	(3.787)	(3.819)	(3.86)	(3.908)	(3.964)
1 if having taken medical checkup	0.576	0.648	0.629	0.641	0.660	0.693	0.669
	(0.063)	(0.06)	(0.051)	(0.053)	(0.047)	(0.039)	(0.038)
Ratio of population under 15	0.166	0.156	0.148	0.142	0.138	0.135	0.131
	(0.013)	(0.011)	(0.011)	(0.01)	(0.01)	(0.01)	(0.01)
Household income (1,000 yen)	3,400	3,470	3,380	3,252	3,098	2,928	2,919
	(389)	(371.8)	(340.4)	(325.1)	(365.8)	(316.1)	(319.7)
Age	40.54	40.65	41.05	41.38	41.92	42.02	41.79
	(0.663)	(0.601)	(0.62)	(0.573)	(0.7)	(0.651)	(0.515)
Number of HH members	2.958	2.861	2.771	2.695	2.619	2.543	2.467
	(0.24)	(0.227)	(0.217)	(0.206)	(0.197)	(0.188)	(0.18)
Population density (persons per square kilometers)	630.7	636.4	642.2	647.4	652.0	655.7	654.5
	(1101)	(1101)	(1117)	(1136)	(1158)	(1177)	(1184)
Number of beds per 100,000 people *1	7.772	7.523	7.434	7.317	7.172	7.043	6.981
	(3.056)	(3.021)	(2.928)	(2.828)	(2.818)	(2.83)	(2.814)

Notes. Reported are the mean across prefectures and, in parentheses, standard deviation. Number of observations is 47, except for 1995 when the data for Hyogo prefecture are missing for some of the variables. *1) Data are obtained from MHLW's Survey of Medical Institutions. Hospitals here refer to *ippan byoin* , or the medical institutions that can accommodate 20 or more bedridden persons and do not specialize only in the treatment of psychological diseases or tuberculosis.

Table 3. Estimates of the determinants of prevalence of health checkups at regional level

ln(Average income)	5.883	***	6.407	***	4.931	***
	4.06		4.20		3.06	
ln(Average income) squared	-0.367	***	-0.404	***	-0.322	***
	-4.14		-4.30		-3.27	
Population density	-0.003		-0.002		-0.007	**
	-0.92		-0.71		-2.09	
Hospital density	-0.041	***	-0.040	***	-0.038	***
	-4.13		-4.03		-3.62	
ln(Average age)	0.166		0.287		0.271	
	0.74		1.26		1.19	
Male ratio	0.851	***	0.838	***	0.973	***
	3.62		3.60		4.24	
Health Status	-0.026		-0.048		-0.013	
	-0.52		-0.93		-0.25	
ln(Number of family)	0.090	**	0.101	**	0.056	
	1.98		2.20		1.20	
Under 15 ratio	-1.270	***	-1.335	***	-0.888	***
	-4.50		-4.69		-2.88	
Educational Record[High school]						
Junior high school			0.000		-0.001	
			0.26		-1.26	
Two year college/career college			0.002	*		
			1.75			
Two year college/career college					-0.007	***
					-2.78	
Underguraduated/graduated university					0.007	***
					4.29	
Health Insurance Type[National health insurance]						
National health insurance for unions	0.046		0.029		-0.008	
	0.29		0.18		-0.05	
Employee insurance(employee)	0.399	***	0.391	***	0.338	***
	6.60		6.44		5.40	
Employee insurance(family)	-0.129		-0.136		-0.053	
	-1.48		-1.57		-0.62	
Other insurance	-0.033		-0.036		-0.035	
	-1.08		-1.20		-1.26	
Area[Kanto]						
Tohoku&Hokaido	0.017		0.020	*	0.007	
	1.46		1.72		0.60	
Chubu	-0.008		-0.009		-0.006	
	-1.15		-1.27		-0.86	
Kinki	-0.026	***	-0.026	***	-0.032	***
	-3.36		-3.43		-4.12	
Chugoku	-0.002		-0.005		-0.019	*
	-0.22		-0.44		-1.77	
Shikoku	-0.038	***	-0.041	***	-0.050	***
	-3.24		-3.49		-4.20	
Kyushu&Okinawa	0.017		0.016		-0.001	
	1.39		1.28		-0.04	
Year[2010]						
1995	-0.067	***	-0.049	*	-0.013	
	-2.96		-1.96		-0.49	
1998	-0.001		0.017		0.055	**
	-0.08		0.82		2.54	
2001	-0.032	**	-0.018		0.016	
	-2.34		-1.07		0.90	
2004	-0.022		-0.013		0.013	
	-1.59		-0.86		0.81	
2007	-0.022	***	-0.017	*	-0.003	
	-2.76		-1.94		-0.28	
2013	-0.032	***	-0.034	***	-0.036	***
	-5.70		-5.66		-6.23	
Constant	-23.830	***	-26.140	***	-19.570	***
	-4.06		-4.19		-2.92	
Observations	328		328		328	
Adjusted R2	0.778		0.779		0.788	
F	50.94		49.44		50.38	

Notes) Reported in the table are coefficients by OLS and t statistics estimated by White's robust standard errors. Asterisks *, **, *** indicate zero hypothesis is rejected at the significant level 10%, 5%, 1%, respectively.

Table 4. Estimates of the determinants of probability of taking health checkups at individual level

ln(Age)	0.158	***	0.102	***	0.244	***
	25.19		14.25		21.94	
Male dummy	0.006	*				
	1.79					
Number of children under15	-0.003	*	0.003		-0.010	***
	-1.78		1.29		-3.28	
ln(Weekly Job Hours)	-0.009	**	-0.038	***	0.012	**
	-2.11		-6.25		2.03	
Marrital Status[Unmarried]						
Married	0.037	***	0.052	***	-0.001	
	8.32		10.58		-0.11	
Widows	0.045	***	-0.020		0.035	*
	3.24		-1.03		1.75	
Divorced	-0.007		-0.007		-0.034	***
	-1.05		-0.74		-3.04	
ln(Households income)	0.051	***	0.053	***	0.050	***
	21.23		17.94		13.05	
Employment Status[Regular employee]						
Part time worker	-0.077	***	-0.053	***	-0.090	***
	-15.19		-5.00		-12.71	
Temporary worker	-0.117	***	-0.100	***	-0.138	***
	-17.34		-11.16		-13.02	
Dispatched worker from temporary labour agency	-0.097	***	-0.075	***	-0.114	***
	-10.39		-5.68		-8.18	
Contract employee	-0.010		-0.010		-0.002	
	-1.51		-1.13		-0.18	
Entrusted employee	-0.047	***	-0.065	***	-0.012	
	-3.72		-4.14		-0.55	
Other	-0.081	***	-0.055	*	-0.095	**
	-3.24		-1.72		-2.36	
Health Insurance Type[National health insurance]						
National health insurance for unions	0.088	***	0.090	***	0.098	***
	7.28		5.92		5.11	
Employee insurance(employee)	0.218	***	0.201	***	0.232	***
	46.86		35.76		30.09	
Employee insurance(family)	0.054	***	0.071	***	0.064	***
	9.37		5.25		8.10	
Other insurance	0.120	***	0.133	***	0.100	***
	11.05		10.52		5.30	
Year Dummy[2007]						
2004	-0.021	***	-0.026	***	-0.016	**
	-5.31		-5.46		-2.32	
2010	0.026	***	0.025	***	0.027	***
	6.21		4.93		3.94	
2013	-0.012	***	-0.019	***	-0.005	
	-3.12		-3.91		-0.83	
Constant	-0.838	***	-0.558	***	-1.188	***
	-26.44		-13.75		-22.66	
Observations	77977		42431		35546	
Psuedo R2	0.139		0.145		0.122	
Chi2	9275.6		4451.2		4174.5	
Log Liklihood	-34516.1		-16436.7		-17875.2	

Notes) Reported in the table are marginal effects by logit model and pseudo t statistics estimated by White's robust standard errors. Asterisks *, **, *** indicate zero hypothesis is rejected at the significant level 10%, 5%, 1%, respectively.

Table 5. RDD estimates of the effects of SHC in 2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bandwidth selector [selected bandwidth]	IK [6.397]				CCT [2.312]			
Estimation sample	All sample	National HI	Empl.'s self	Empl.'s family	All sample	National HI	Empl.'s self	Empl.'s family
	Panel A. Effect on 1 if having taken medical checkup.							
Estimated discontinuity	0.036	0.075	0.001	0.091	0.020	0.075	-0.003	0.028
Standard errors	(0.007)	(0.016)	(0.007)	(0.016)	(0.013)	(0.03)	(0.013)	(0.03)
Bias-corrected z-statistic	[2.93]***	[2.6]***	[0.83]	[2.53]**	[2.66]***	[3.47]***	[-0.09]	[2.54]**
Observations within bandwidths	99,196	20,155	56,628	20,289	38,922	7,990	21,994	8,118
	Panel B. Effect on self-assessed health status (1 best, 5 worst).							
Estimated discontinuity	-0.018	0.002	-0.019	-0.037	-0.007	-0.044	-0.003	0.009
Standard errors	(0.015)	(0.034)	(0.019)	(0.031)	(0.028)	(0.065)	(0.036)	(0.059)
Bias-corrected z-statistic	[-0.95]	[-0.07]	[-0.83]	[-0.61]	[-0.34]	[-0.31]	[-0.59]	[0.29]
Observations within bandwidths	92,280	18,263	52,876	19,276	36,272	7,246	20,551	7,752
	Panel C. Effect on Log(per capita household medical expenditure).							
Estimated discontinuity	0.108	-0.025	0.104	0.214	0.037	0.072	-0.086	0.249
Standard errors	(0.108)	(0.249)	(0.143)	(0.23)	(0.206)	(0.479)	(0.273)	(0.434)
Bias-corrected z-statistic	[0.51]	[0.74]	[-0.23]	[0.62]	[0.73]	[0.29]	[0.09]	[1.05]
Observations within bandwidths	55,948	10,914	32,005	11,727	22,031	4,302	12,491	4,741
	Panel D. Effect on 1 if stress reported.							
Estimated discontinuity	-0.003	-0.020	0.007	-0.009	0.014	0.009	0.028	-0.013
Standard errors	(0.007)	(0.016)	(0.01)	(0.016)	(0.014)	(0.031)	(0.018)	(0.029)
Bias-corrected z-statistic	[0.99]	[0.45]	[0.98]	[0.17]	[1.21]	[0.17]	[1.64]	[-0.21]
Observations within bandwidths	94,328	18,781	53,987	19,630	37,053	7,436	20,976	7,892
	Panel E. Effect on 1 if do not smoke.							
Estimated discontinuity	-0.005	-0.011	-0.007	0.007	-0.002	0.020	-0.014	0.014
Standard errors	(0.007)	(0.016)	(0.009)	(0.011)	(0.013)	(0.031)	(0.018)	(0.021)
Bias-corrected z-statistic	[-0.98]	[-0.33]	[-1.1]	[0.15]	[0.11]	[0.7]	[-0.51]	[0.78]
Observations within bandwidths	93,512	18,579	53,489	19,539	36,754	7,371	20,798	7,855
	Panel F. Effect on number of symptoms (1 - 42).							
Estimated discontinuity	0.020	0.046	0.004	0.047	-0.067	0.006	-0.152	0.119
Standard errors	(0.058)	(0.153)	(0.075)	(0.103)	(0.106)	(0.286)	(0.14)	(0.178)
Bias-corrected z-statistic	[0.13]	[0.64]	[-0.88]	[1]	[-0.44]	[0.23]	[-1.04]	[0.58]
Observations within bandwidths	98,762	20,159	56,344	20,100	38,745	8,001	21,881	8,035

Notes. Reported in the table are the estimated discontinuity at the cutoff of the outcome, along with the standard errors in parenthses and its bias-corrected z-statistic in brackets. Significance is denoted by *** if p<0.01, ** if p<0.5, and * if p<0.1. Also reported is the number of observations within bandwidths such that 40 - h < age < 40 + h. For each outcome in each year, regressions are run for all the sample, as well as sub-samples according to the type of their health insurance that are either National Health Insurance (National HI, *Kokumin kenko hoken* in Japanese), employee's self health insurance (Empl.'s self, *Hiyosha kenko hoken hon-nin* in Japanese), or employee's family (Empl.'s family, *Hiyosha kenko hoken kazoku* in Japanese).

Table 6. RDD estimates of the effects of SHC in 2013

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bandwidth selector [selected bandwidth]	IK [7.751]				CCT [1.866]			
Estimation sample	All sample	National HI	Empl.'s self	Empl.'s family	All sample	National HI	Empl.'s self	Empl.'s family
	Panel A. Effect on 1 if having taken medical checkup.							
Estimated discontinuity	0.034	0.048	0.008	0.077	0.027	0.045	0.004	0.065
Standard errors	(0.006)	(0.014)	(0.006)	(0.014)	(0.005)	(0.012)	(0.005)	(0.012)
Bias-corrected z-statistic	[4.54]***	[1.97]**	[1.35]	[4.51]***	[5.31]***	[3.72]***	[0.83]	[5.47]***
Observations within bandwidths	115,760	22,221	67,816	22,882	25,663	4,780	15,017	5,262
	Panel B. Effect on self-assessed health status (1 best, 5 worst).							
Estimated discontinuity	0.001	0.001	0.001	0.013	-0.006	-0.005	-0.010	0.019
Standard errors	(0.012)	(0.029)	(0.016)	(0.027)	(0.01)	(0.025)	(0.013)	(0.022)
Bias-corrected z-statistic	[-0.83]	[-0.12]	[-0.83]	[0.2]	[-0.54]	[-0.21]	[-0.72]	[0.85]
Observations within bandwidths	115,863	22,242	67,864	22,882	25,699	4,784	15,041	5,264
	Panel C. Effect on Log(per capita household medical expenditure).							
Estimated discontinuity	-	-	-	-	-	-	-	-
Standard errors	-	-	-	-	-	-	-	-
Bias-corrected z-statistic	-	-	-	-	-	-	-	-
Observations within bandwidths	-	-	-	-	-	-	-	-
	Panel D. Effect on 1 if stress reported.							
Estimated discontinuity	-0.006	-0.010	-0.011	0.005	-0.013	-0.023	-0.015	-0.002
Standard errors	(0.006)	(0.015)	(0.008)	(0.014)	(0.005)	(0.012)	(0.007)	(0.012)
Bias-corrected z-statistic	[-1.7]*	[-1.06]	[-1.59]	[-0.19]	[-2.38]**	[-1.88]*	[-2.08]**	[-0.17]
Observations within bandwidths	115,886	22,257	67,877	22,893	25,688	4,792	15,024	5,266
	Panel E. Effect on 1 if do not smoke.							
Estimated discontinuity	0.004	-0.012	0.002	0.012	0.002	-0.031	0.003	0.013
Standard errors	(0.006)	(0.014)	(0.008)	(0.009)	(0.005)	(0.012)	(0.007)	(0.008)
Bias-corrected z-statistic	[-0.56]	[-1.83]*	[-0.36]	[0.92]	[0.33]	[-2.6]***	[0.49]	[1.64]
Observations within bandwidths	115,581	22,165	67,712	22,870	25,625	4,771	15,003	5,252
	Panel F. Effect on a number of symptoms (1 - 42).							
Estimated discontinuity	0.022	-0.147	0.069	0.065	0.013	-0.203	0.073	0.045
Standard errors	(0.046)	(0.126)	(0.053)	(0.104)	(0.042)	(0.059)	(0.054)	(0.108)
Bias-corrected z-statistic	[-0.47]	[-1.07]	[0.61]	[-0.27]	[0.31]	[-3.42]***	[1.35]	[0.42]
Observations within bandwidths	115,855	22,254	67,859	22,861	25,679	4,787	15,022	5,259

Notes. Reported in the table are the estimated discontinuity at the cutoff of the outcome, along with the standard errors in parentheses and its bias-corrected z-statistic in brackets. Significance is denoted by *** if $p<0.01$, ** if $p<0.5$, and * if $p<0.1$. Also reported is the number of observations within bandwidths such that $40 - h < age < 40 + h$. For each outcome in each year, regressions are run for all the sample, as well as sub-samples according to the type of their health insurance that are either National Health Insurance (National HI, *Kokumin Kenko Hoken* in Japanese), employee's self health insurance (Empl.'s self, *Hiyosha Kenko Hoken Hon-nin* in Japanese), or employee's family (Empl.'s family, *Hiyosha Kenko Hoken in Japanese).*

Figure 1: The Process to Define the Targets of SHG

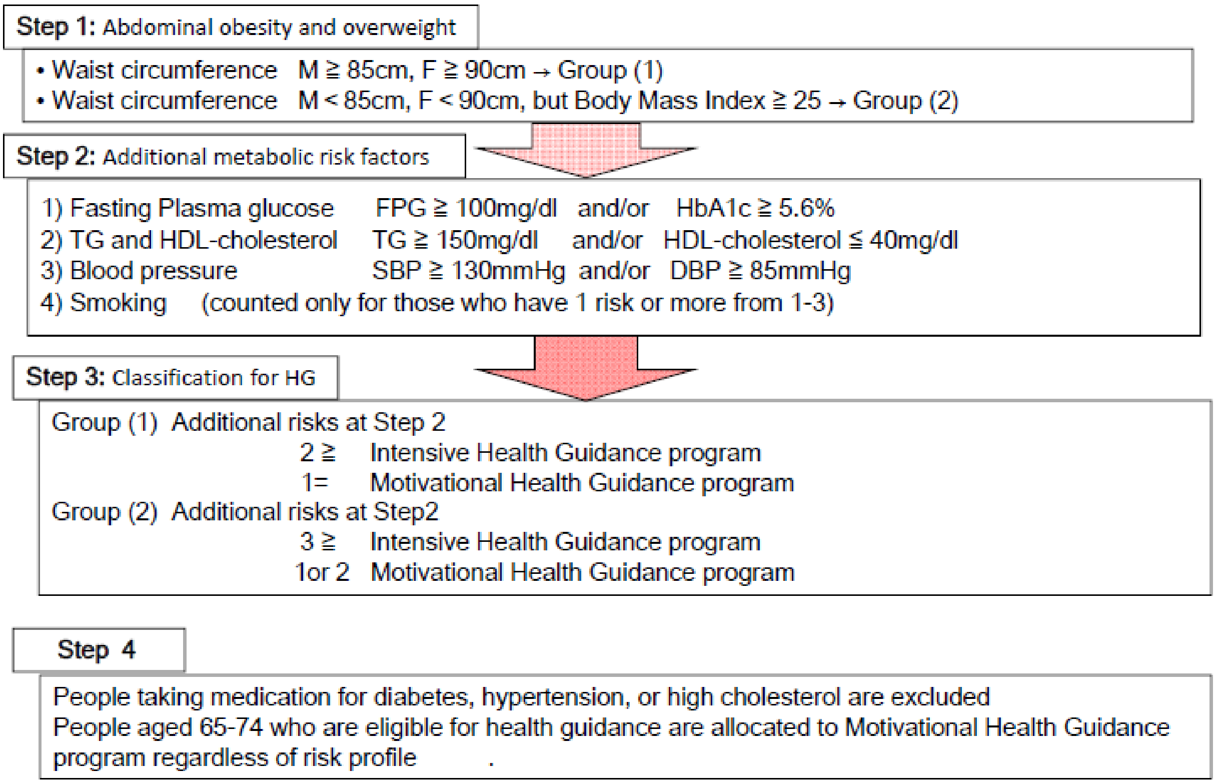
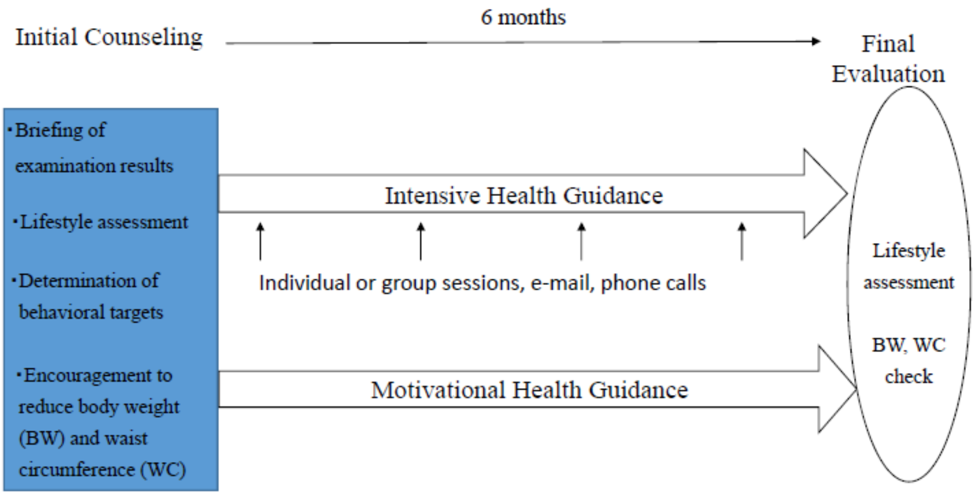
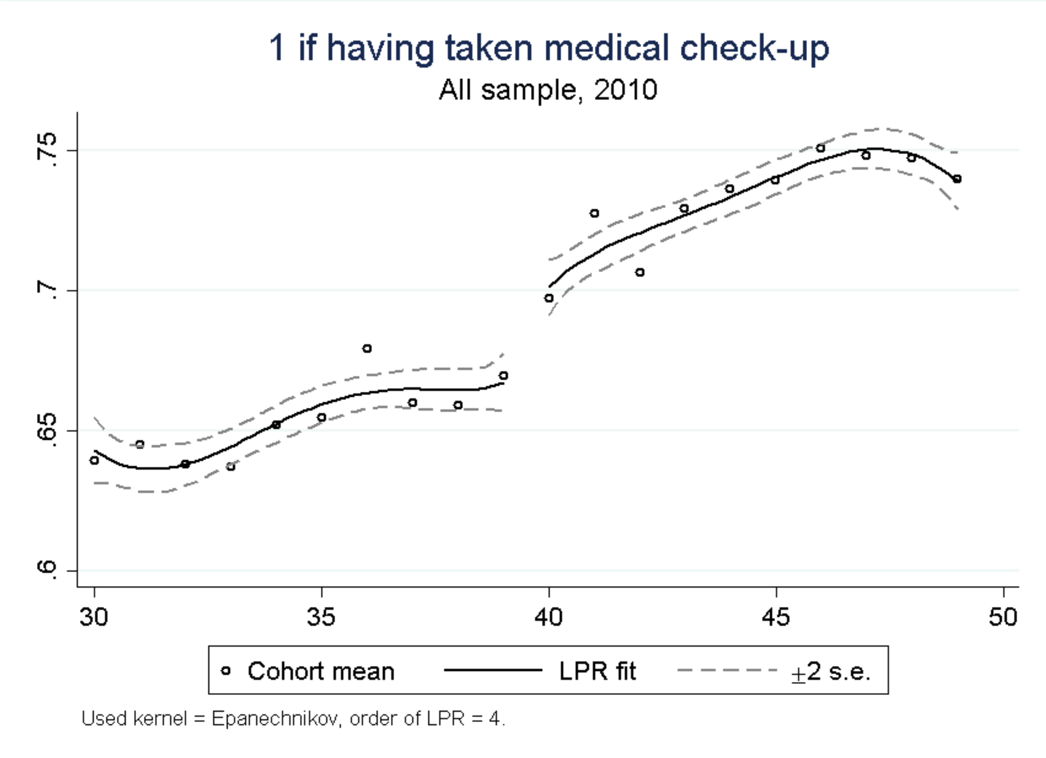


Figure 2. Schedule of Intensive/Motivational Health Guidance



Source: The Work Group for Studying the Effects of the Specific Health Checkups and Specific Health Guidance on Health Care Expenditures, MHLW (2014) (2015)(2016)

Figure 3A: The distribution of participation rate of health checkups against age in 2010 (all sample and National Health Insurance holder)



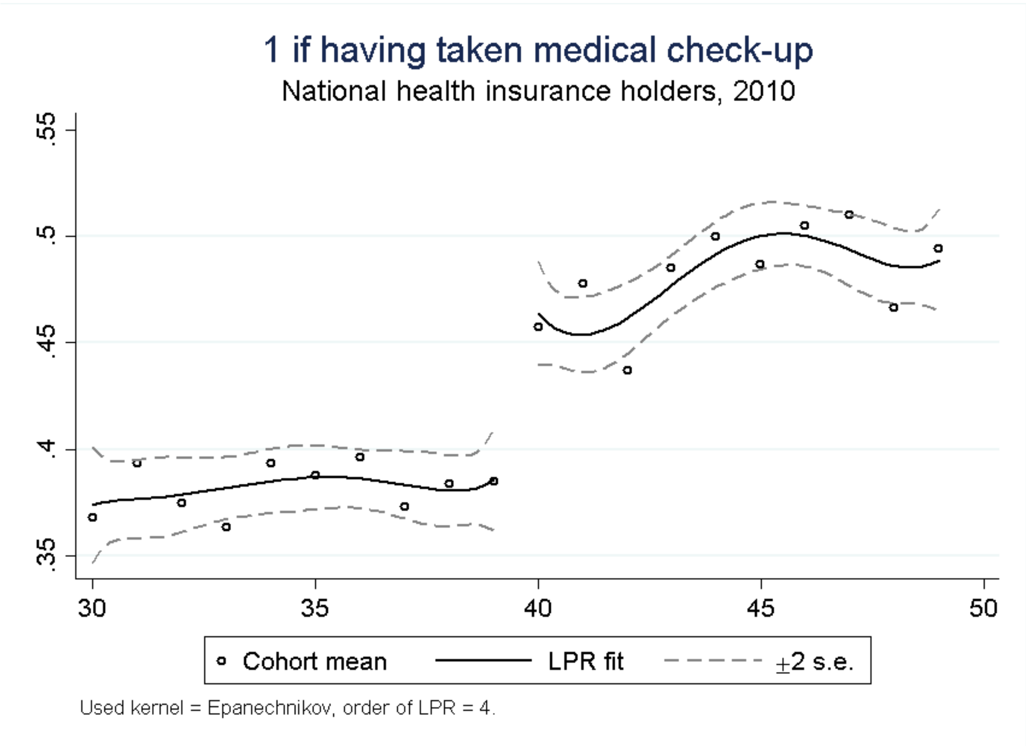
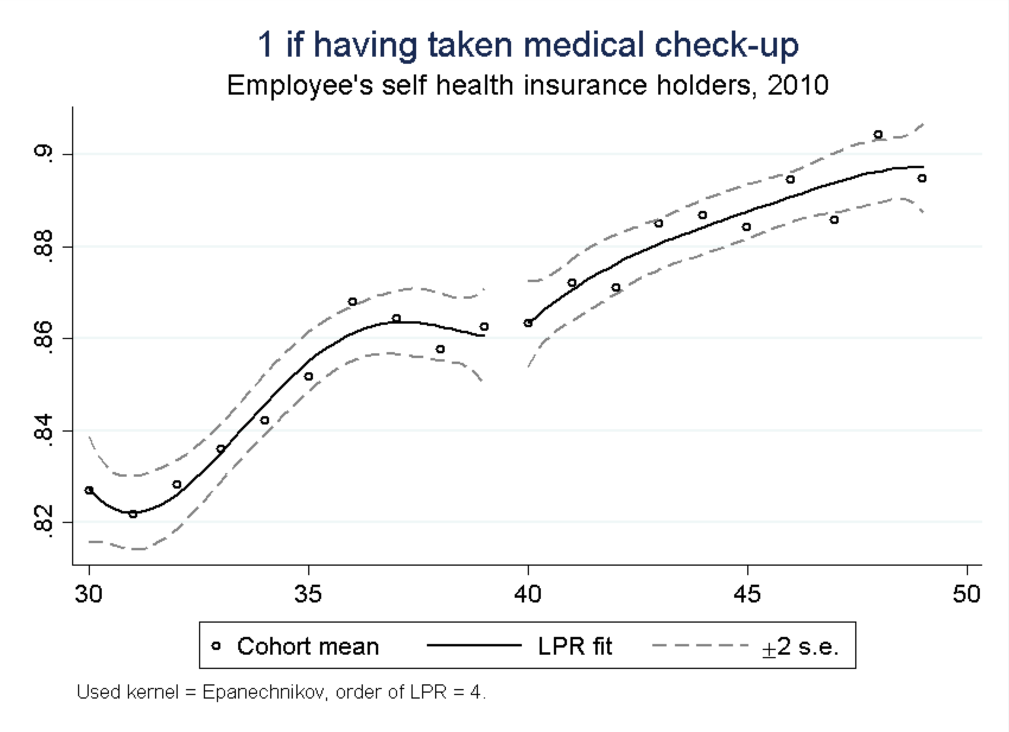


Figure 3B: The distribution of participation rate of health checkups against age in 2010 (employee's self health insurance holder and employee's family health insurance holder)



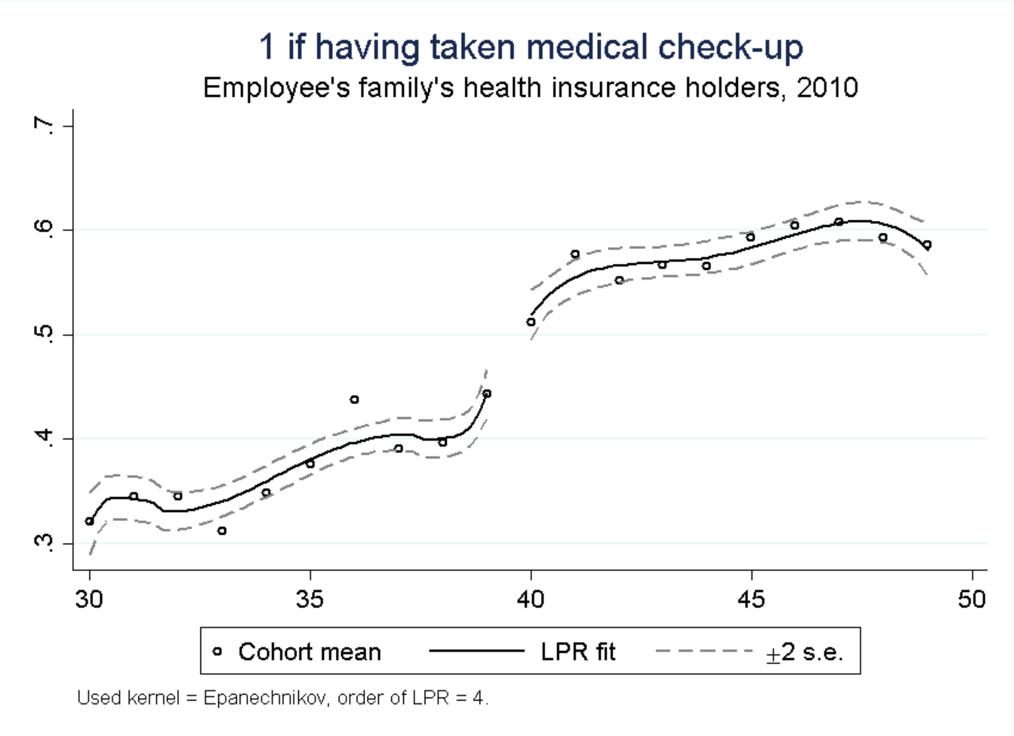
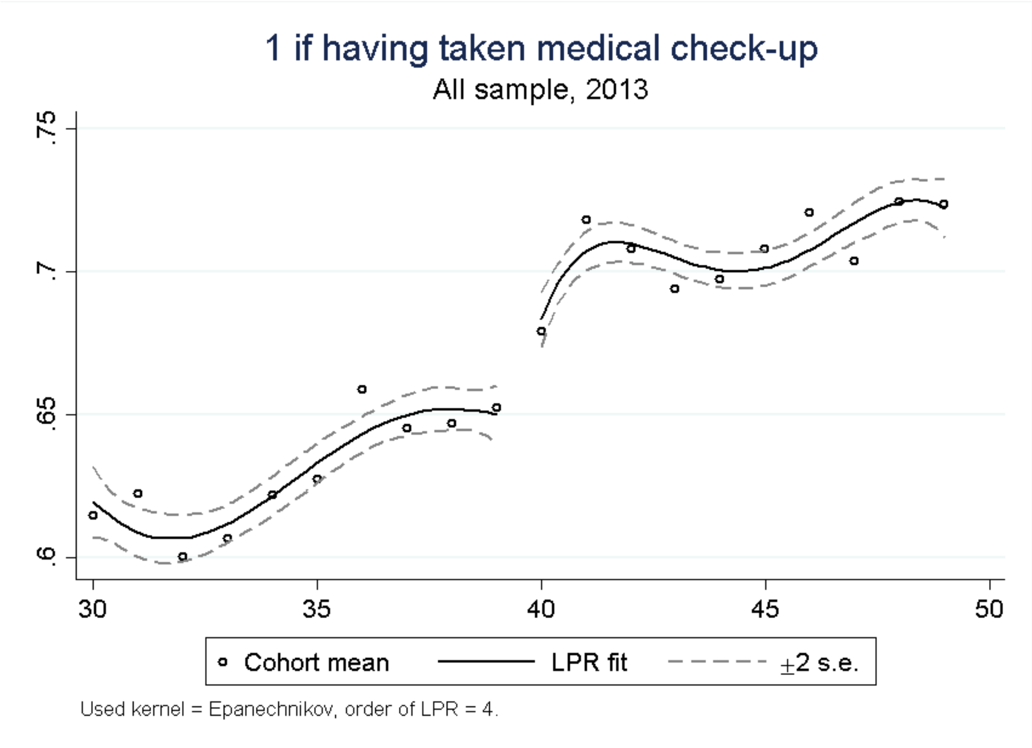


Figure 4A: The distribution of participation rate of health checkups against age in 2013 (all sample and National Health Insurance holder)



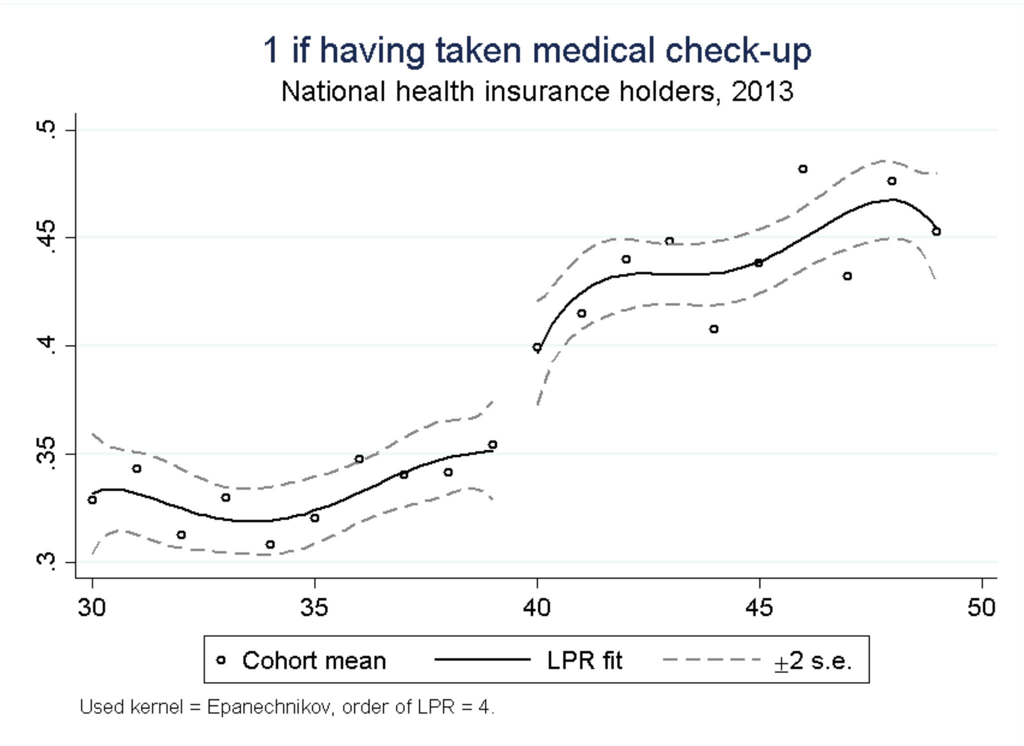
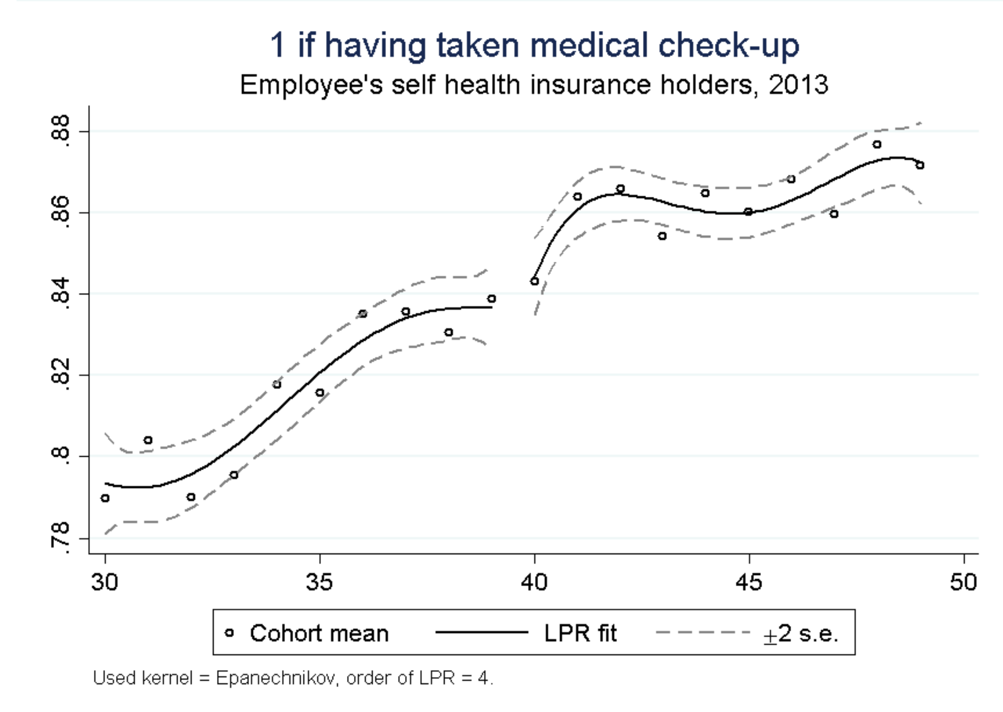


Figure 4B: The distribution of participation rate of health checkups against age in 2013 (employee's self-health insurance holder and employee's family health insurance holder)



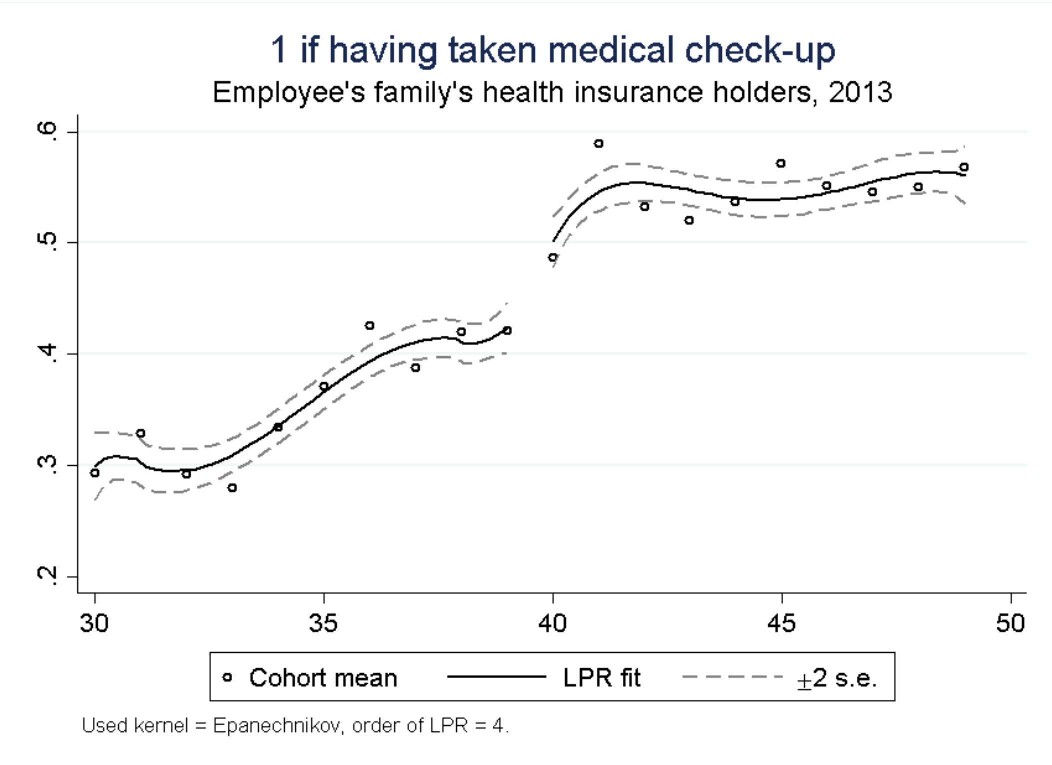
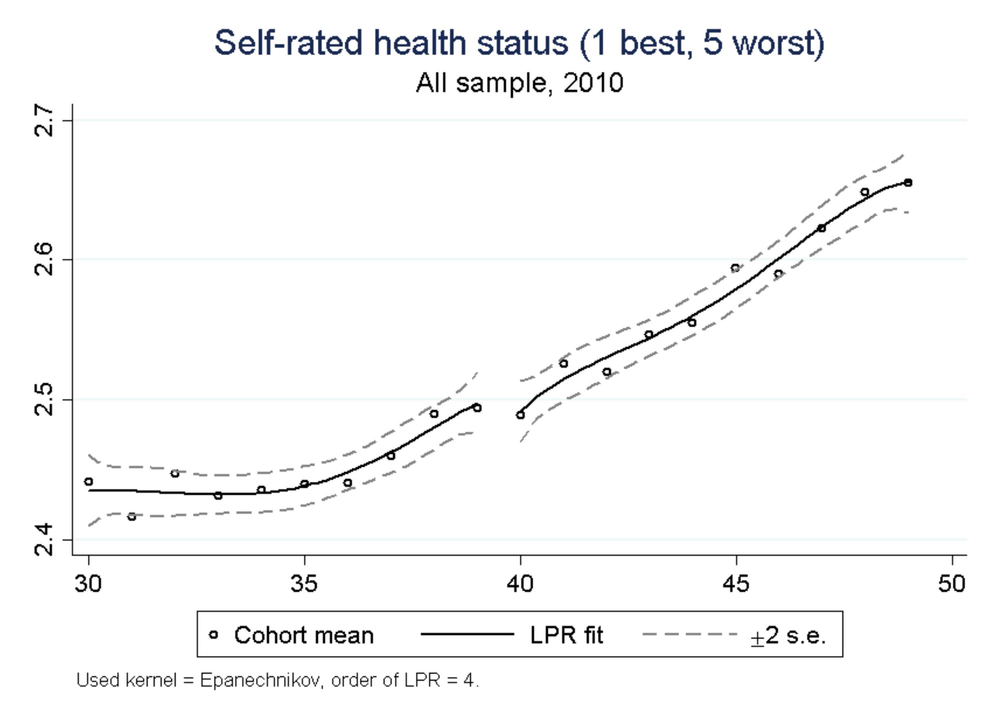


Figure 5A: The distribution of self-assessed health status against age in 2010 (all sample and National Health Insurance holder).



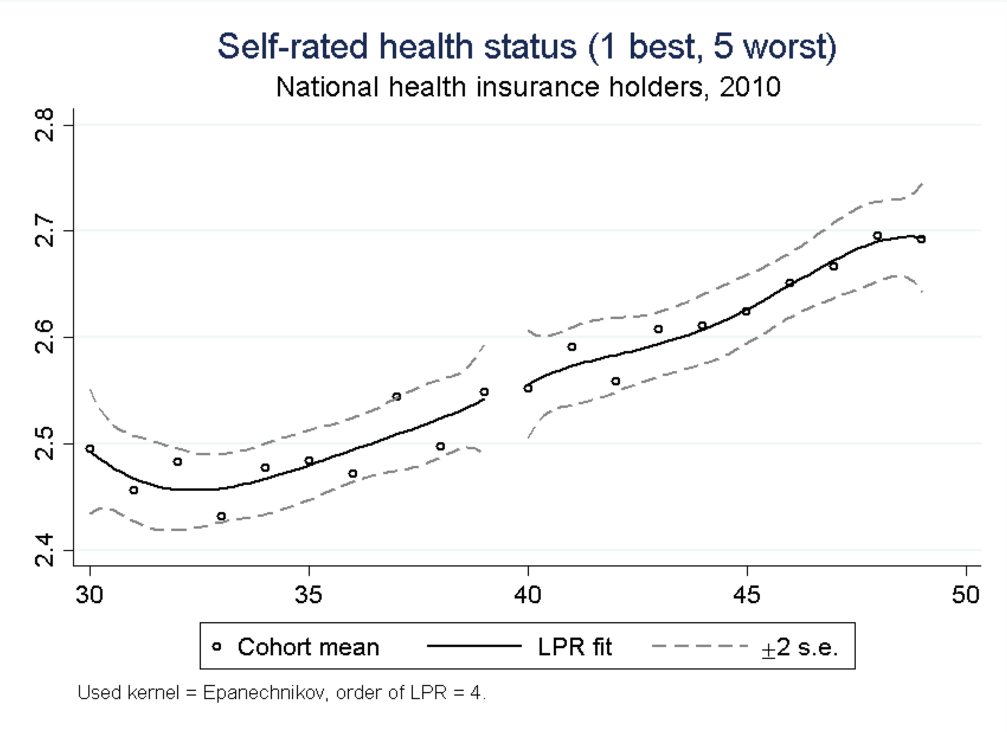


Figure 5B: The distribution of self-assessed health status against age in 2010 (employee's self-health insurance holder and employee's family health insurance holder).

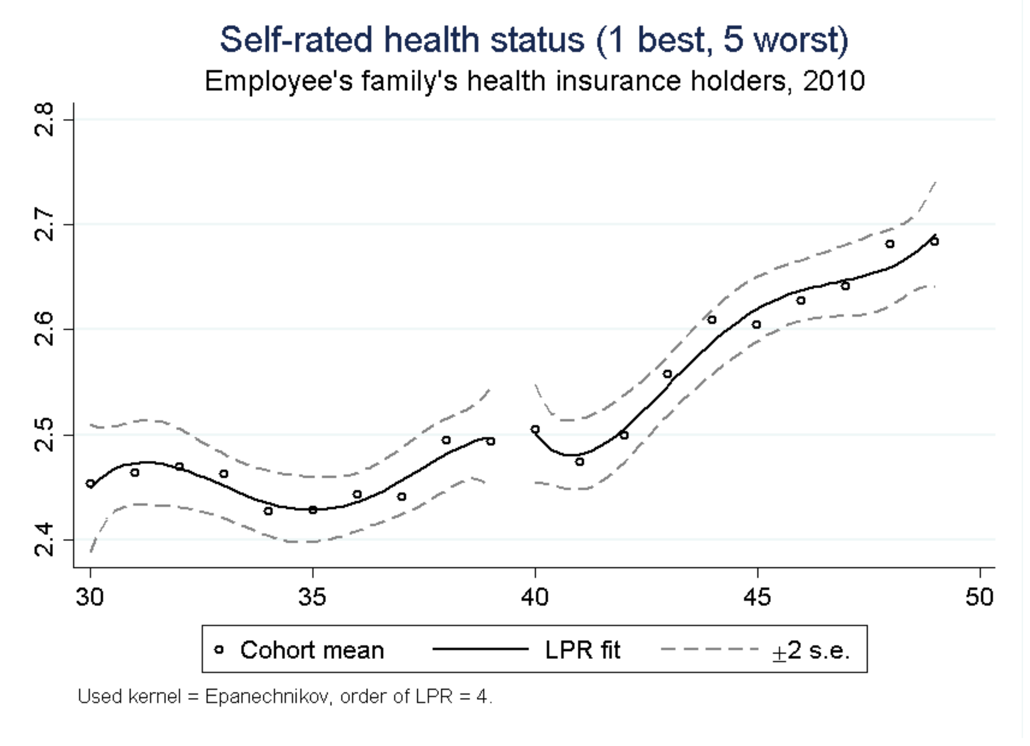
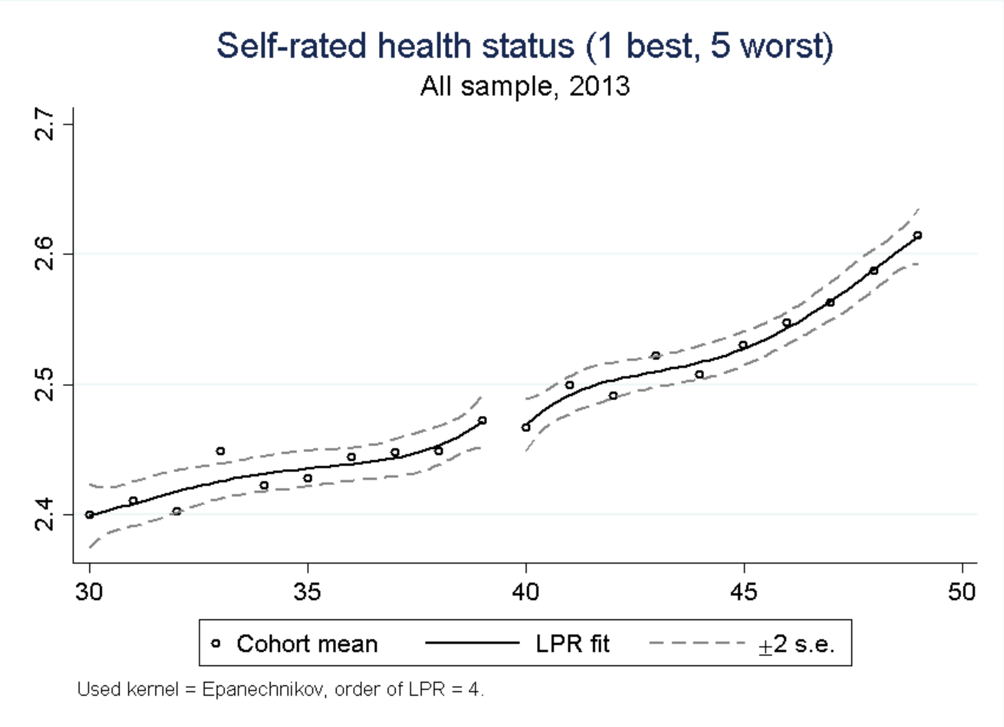


Figure 6A: The distribution of self-assessed health status against age in 2013 (all sample and National Health Insurance holder).



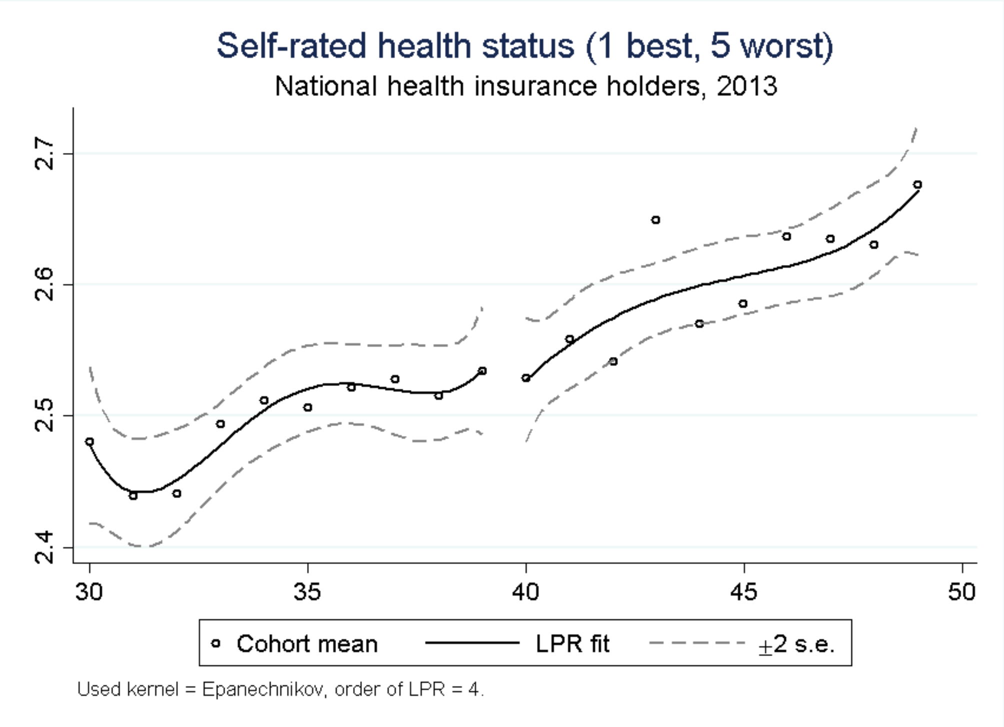


Figure 6B: The distribution of self-assessed health status against age in 2013 (employee's self-health insurance holder and employee's family health insurance holder).

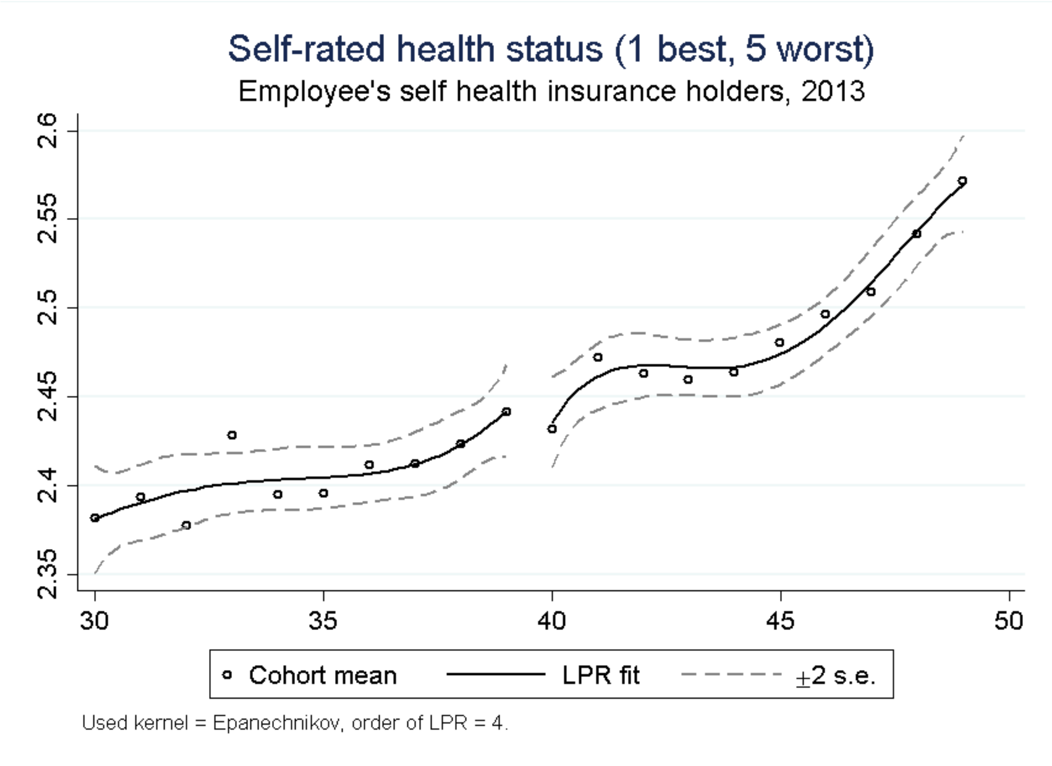
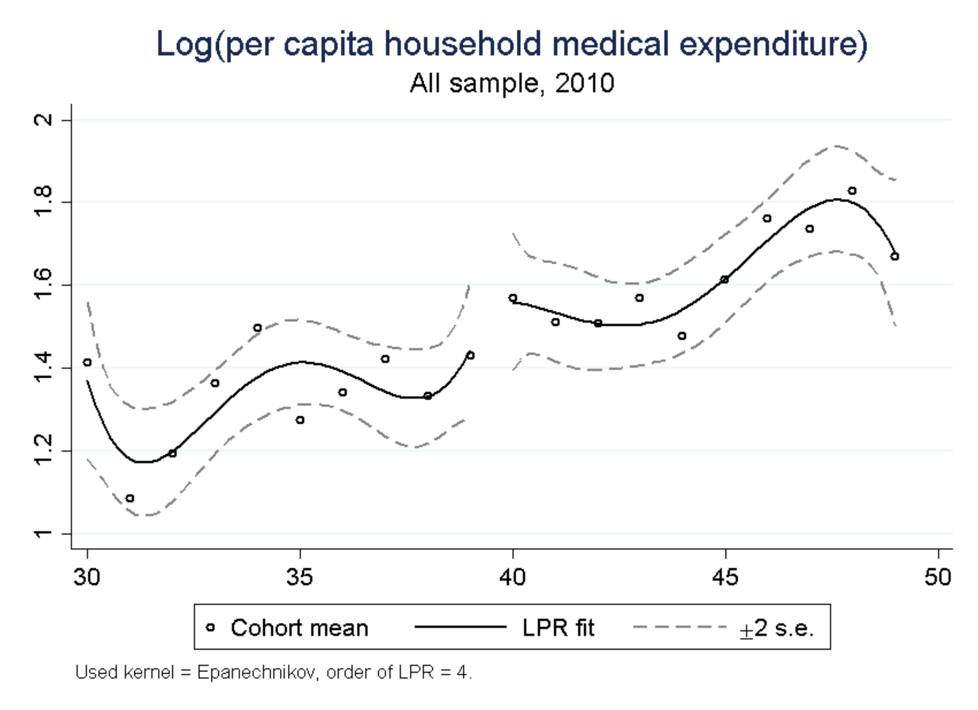


Figure 7A: The distribution of log of per capita household medical expenditure against age in 2010 (all sample and National Health Insurance holder).



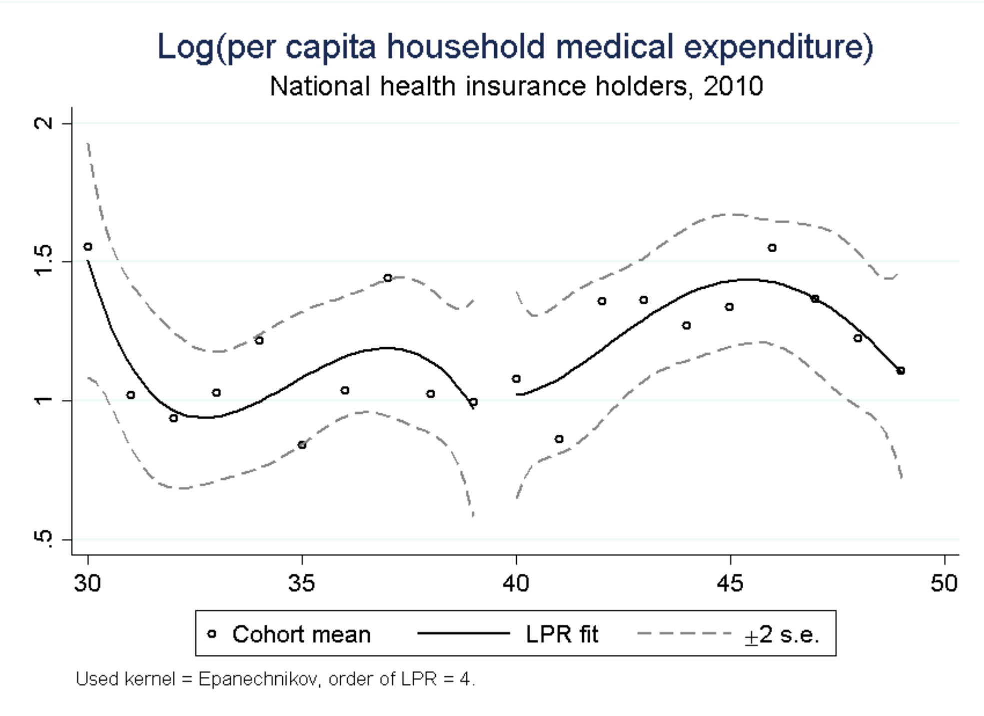
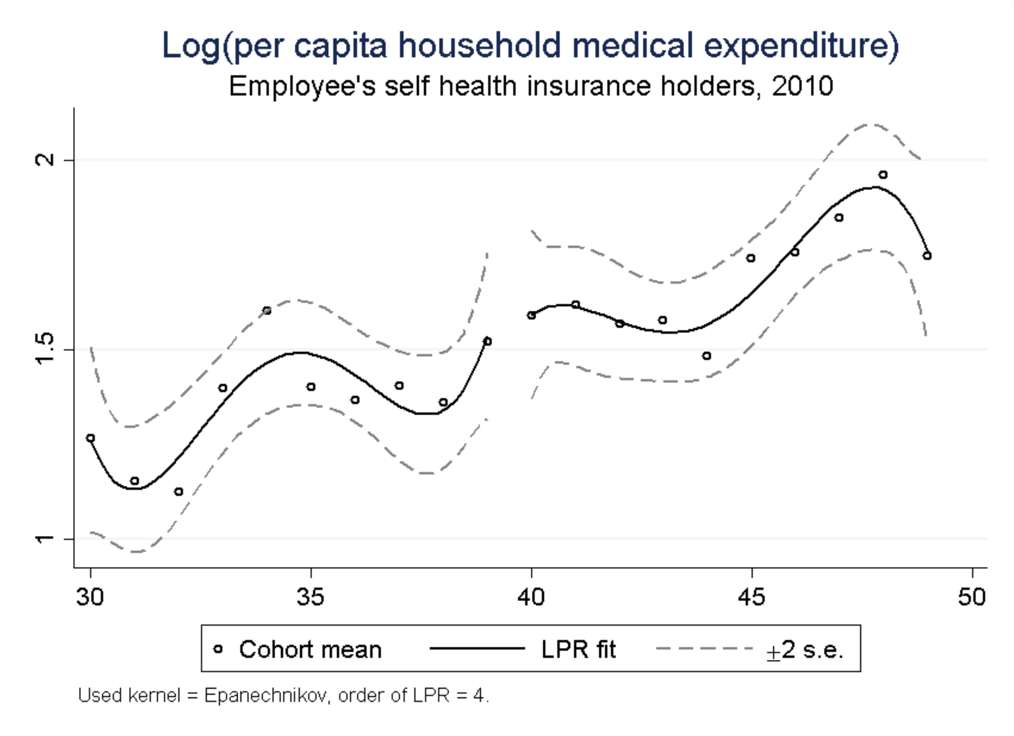


Figure 7B: The distribution of log of per capita household medical expenditure against age in 2010 (employee's self-health insurance holder and employee's family health insurance holder).



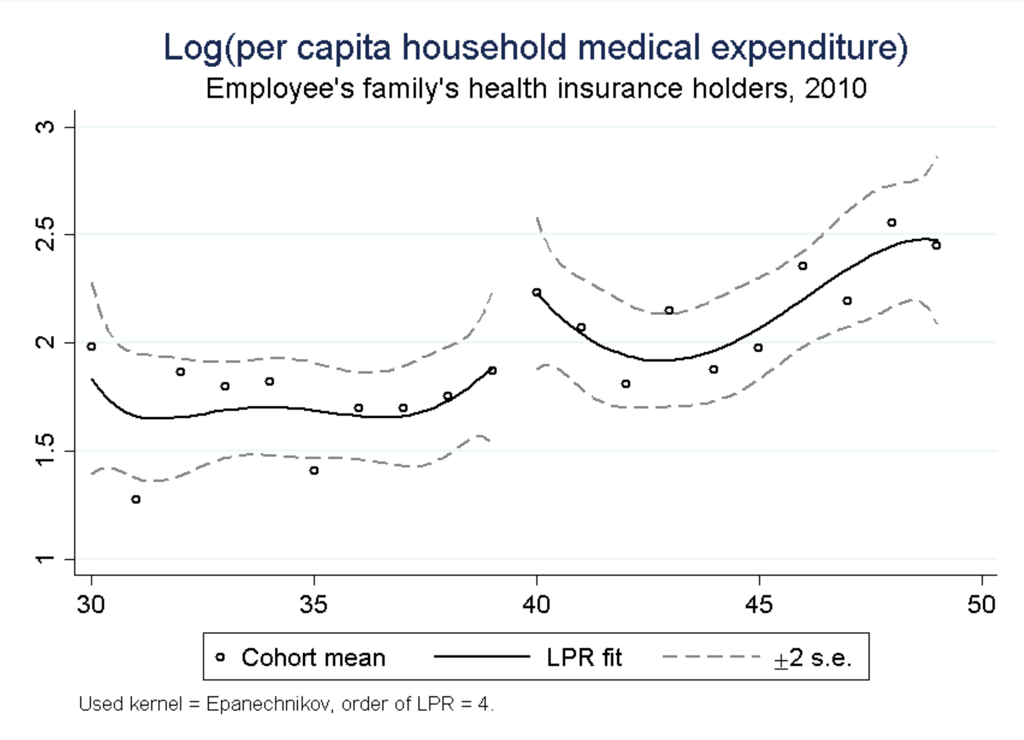
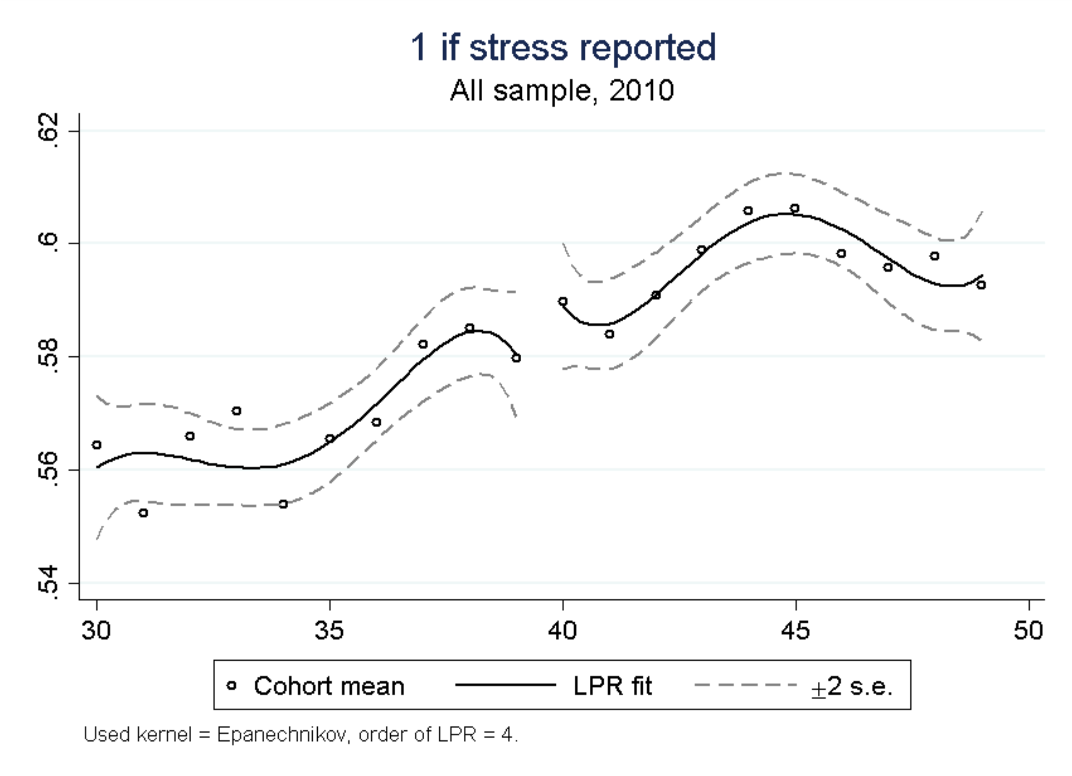


Figure 8A: The distribution of stress status against age in 2010 (all sample and National Health Insurance holder)



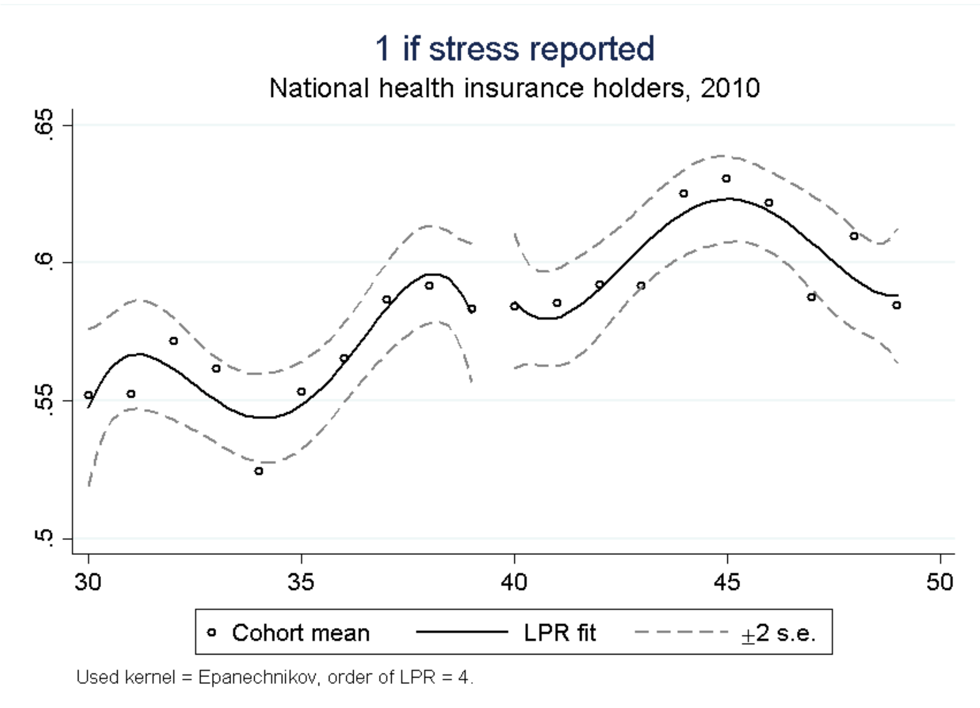
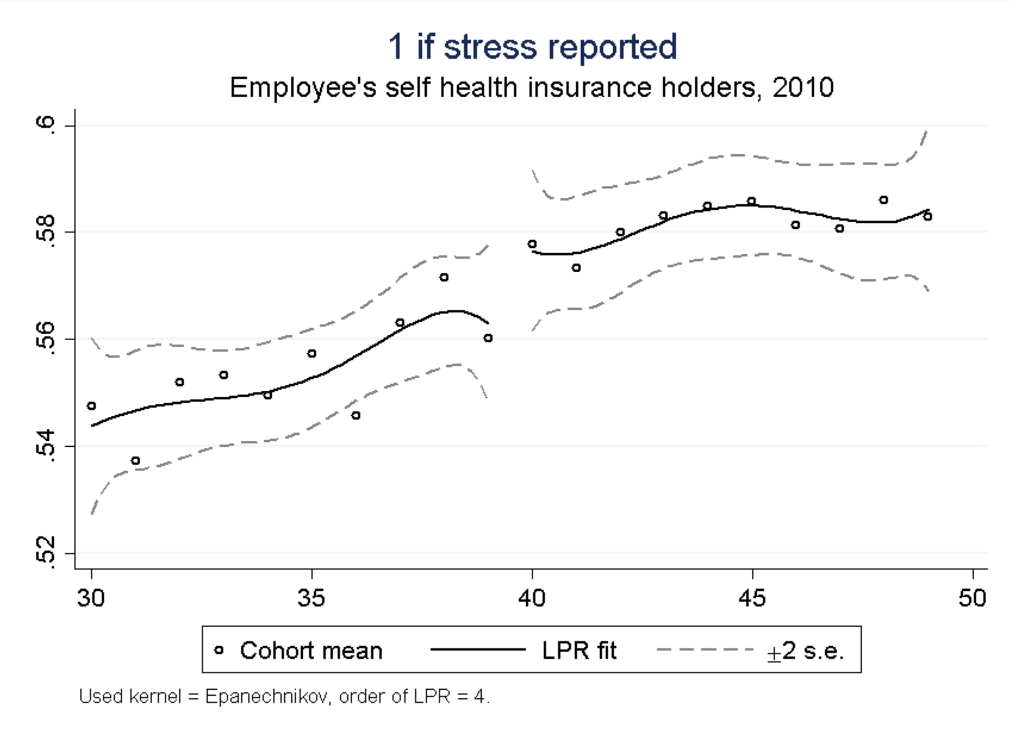


Figure 8B: The distribution of stress status against age in 2010 (employee's self-health insurance holder and employee's family health insurance holder).



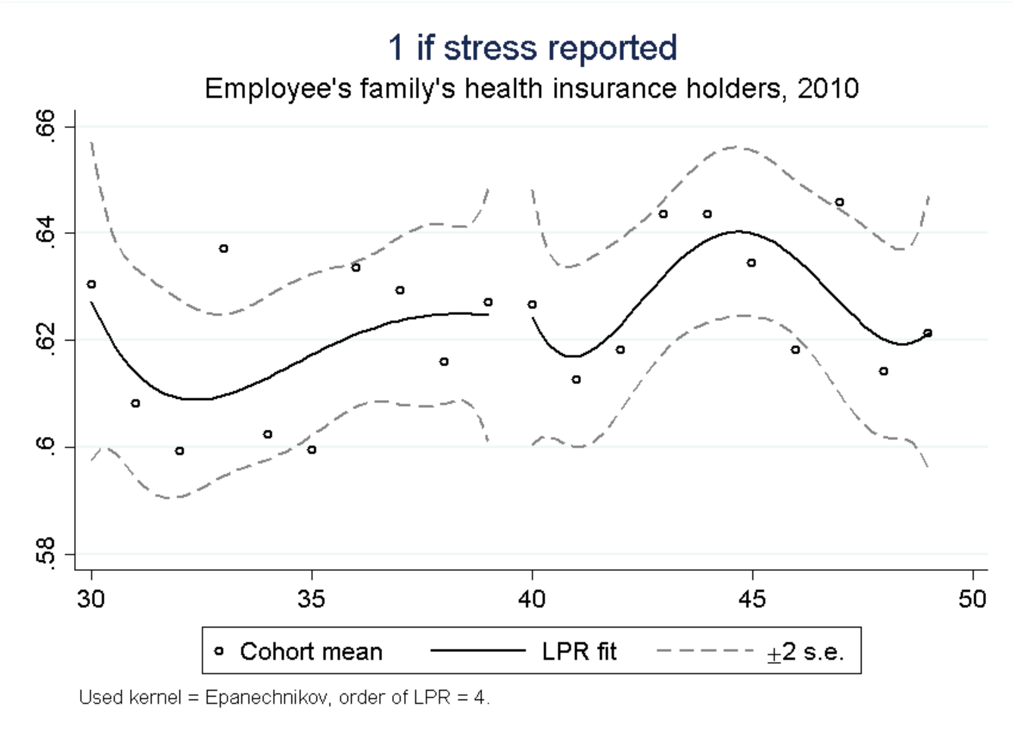
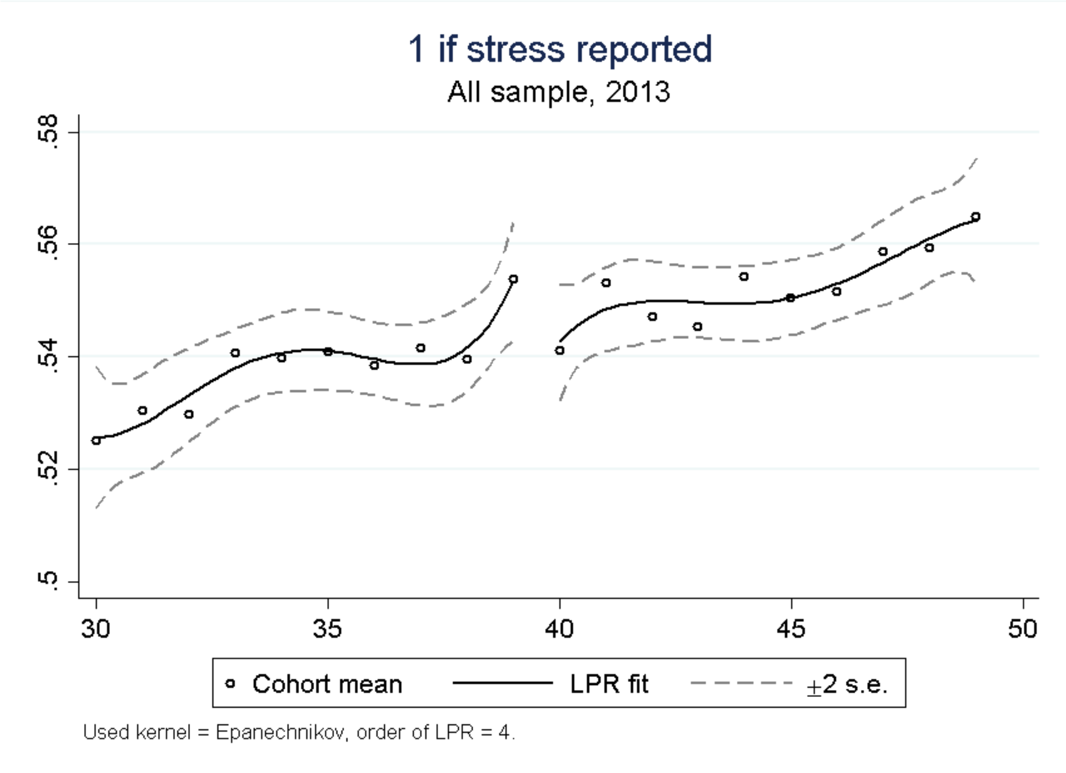


Figure 9A: The distribution of stress status against age in 2013 (all sample and National Health Insurance holder)



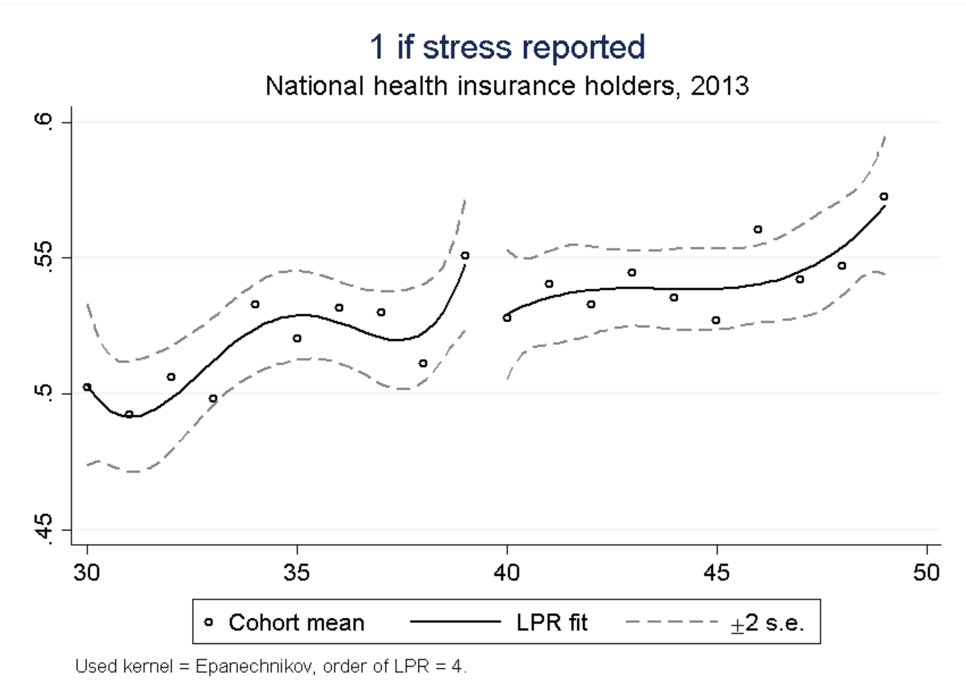


Figure 9B: The distribution of stress status against age in 2013 (employee's self-health insurance holder and employee's family health insurance holder).

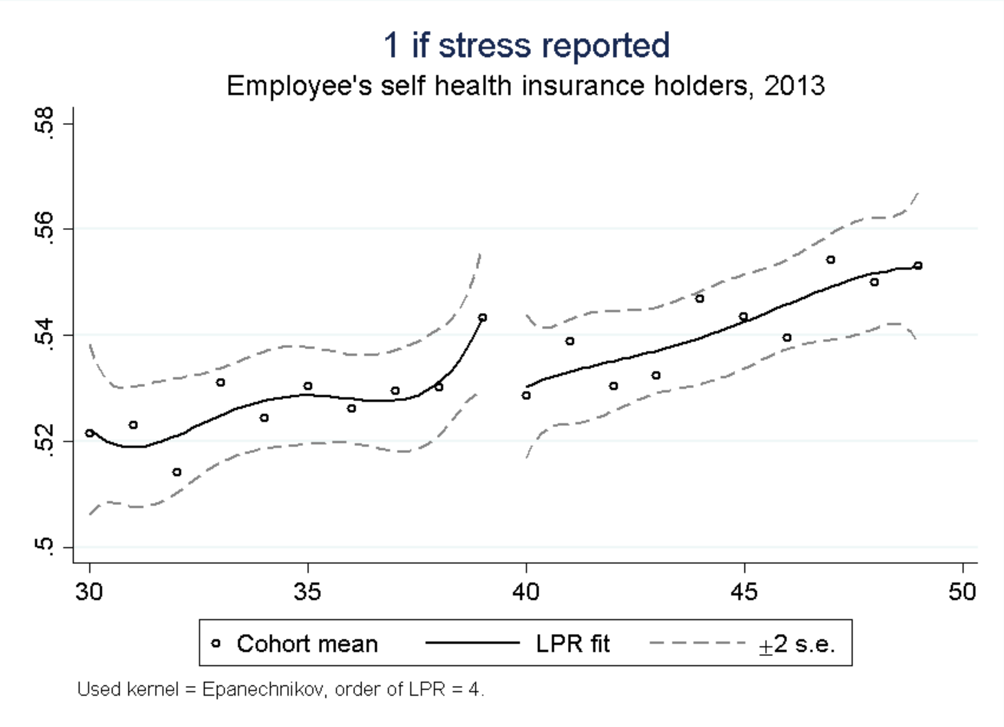
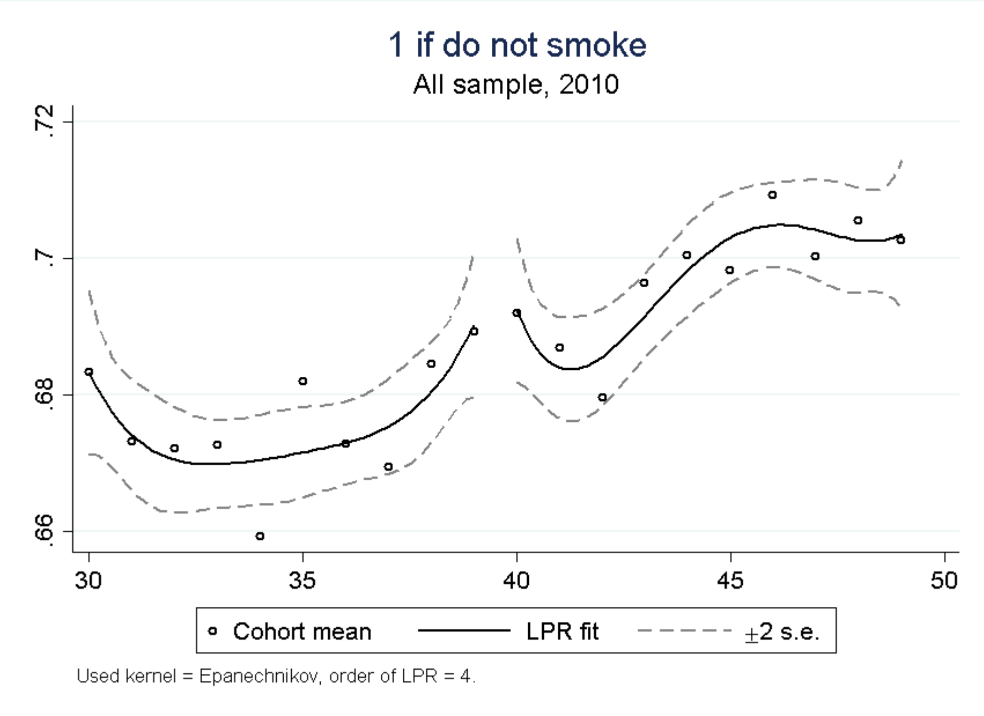


Figure 10A: The distribution of non-smoking rates against age in 2010 (all sample and National Health Insurance holder)



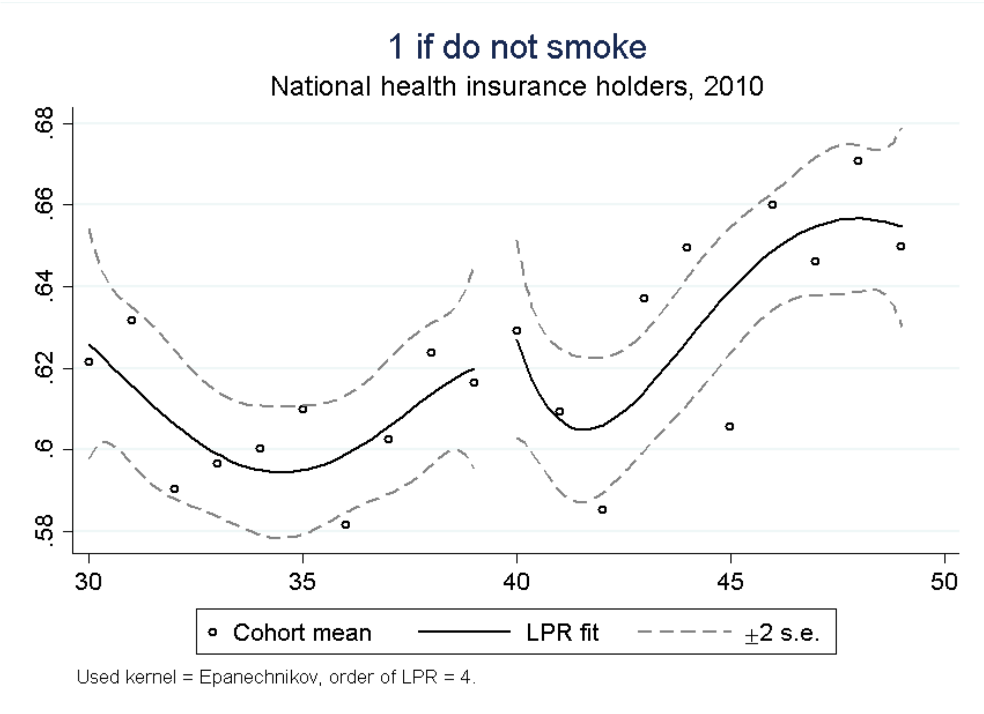
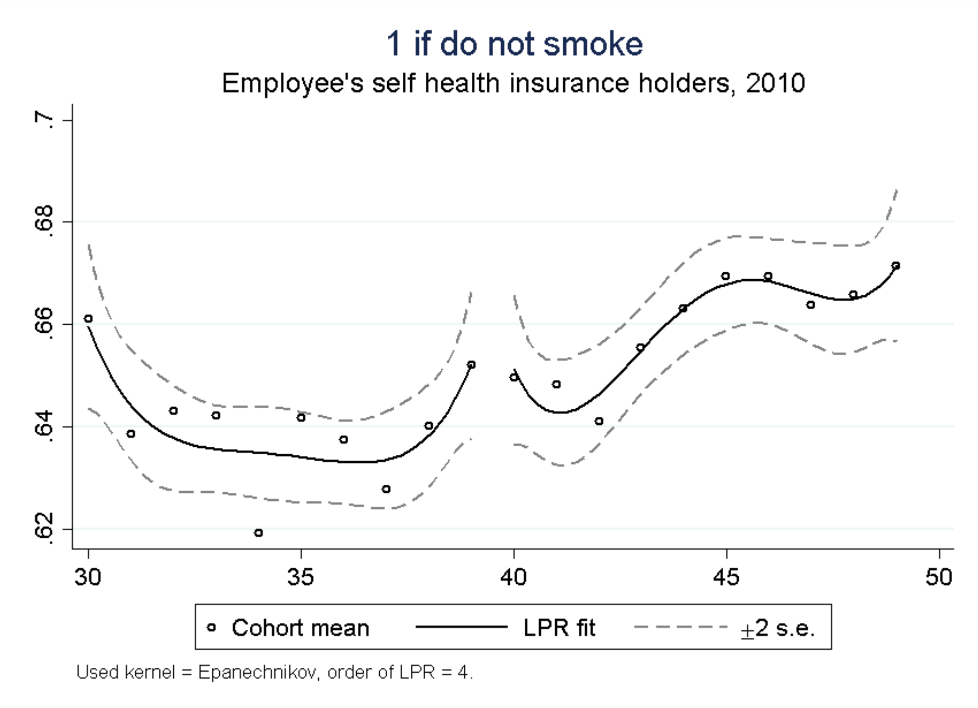


Figure 10B: The distribution of non-smoking rates against age in 2010 (employee's self-health insurance holder and employee's family health insurance holder)



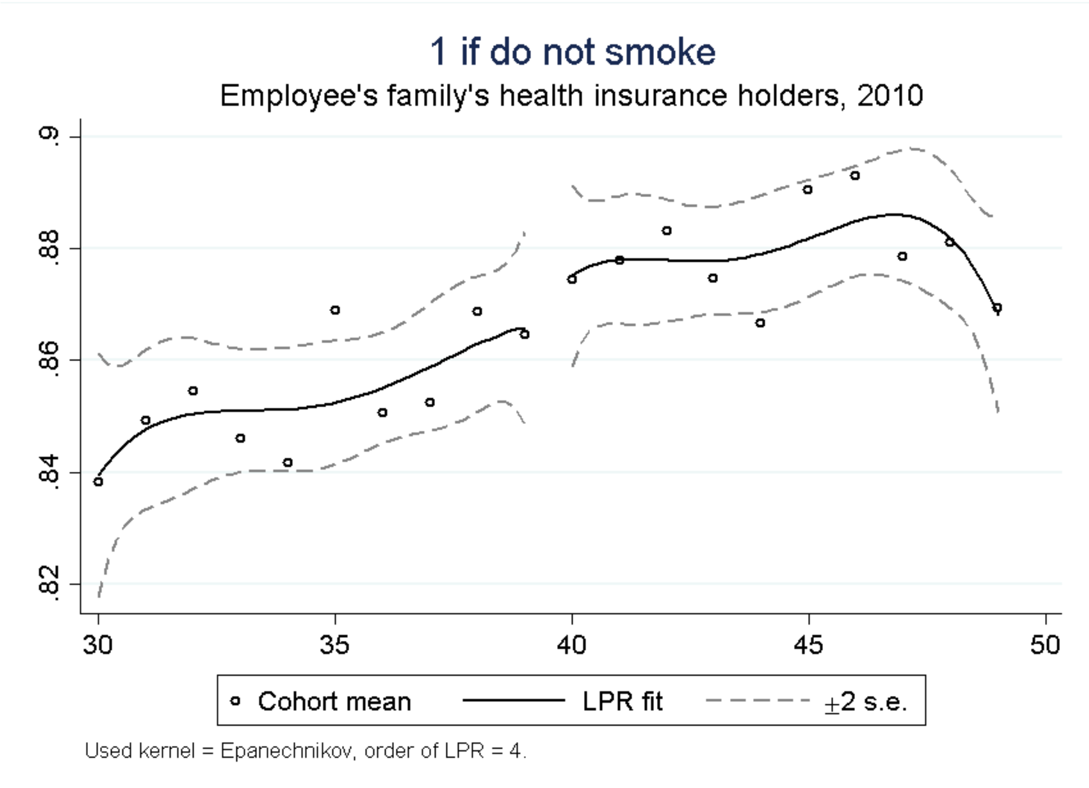
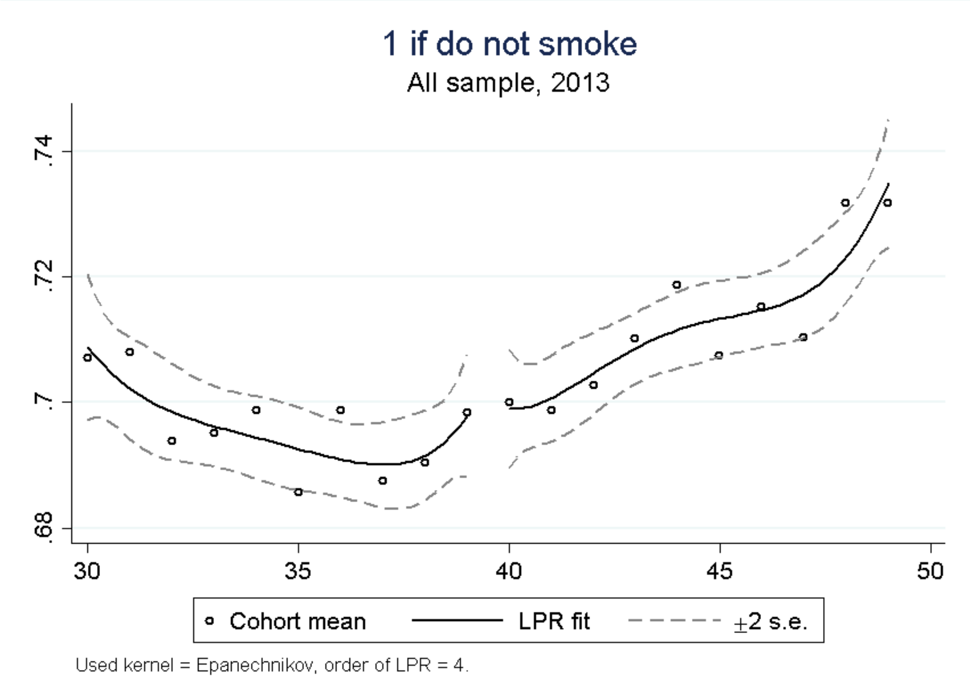


Figure 11A: The distribution of non-smoking rates against age in 2013 (all sample and National Health Insurance holder)



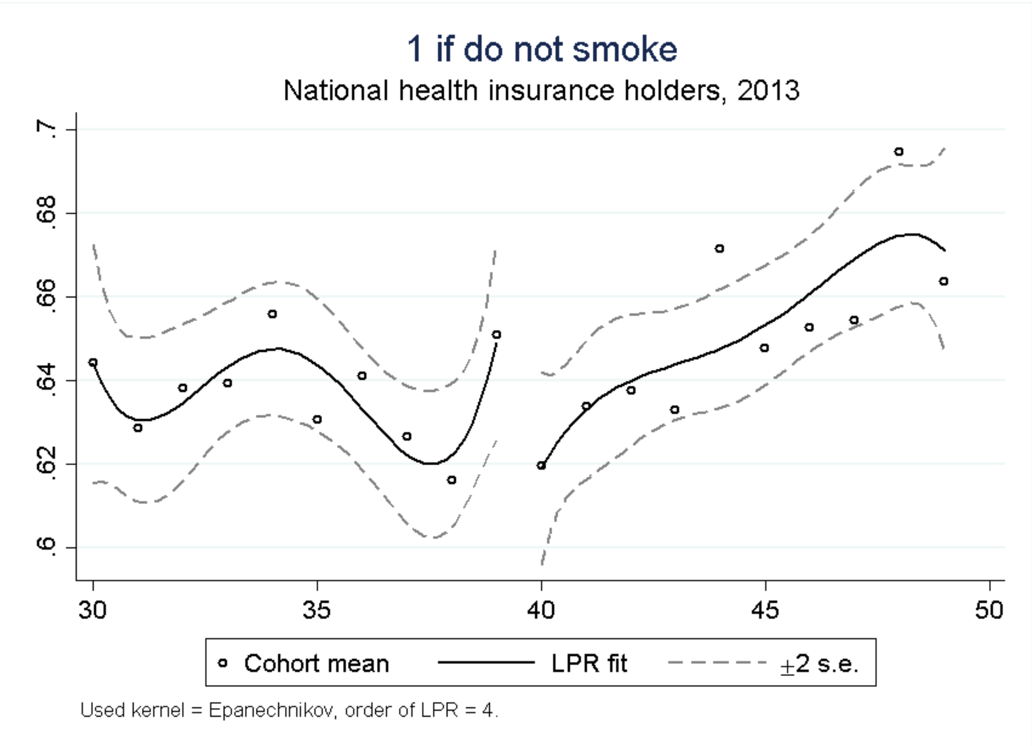
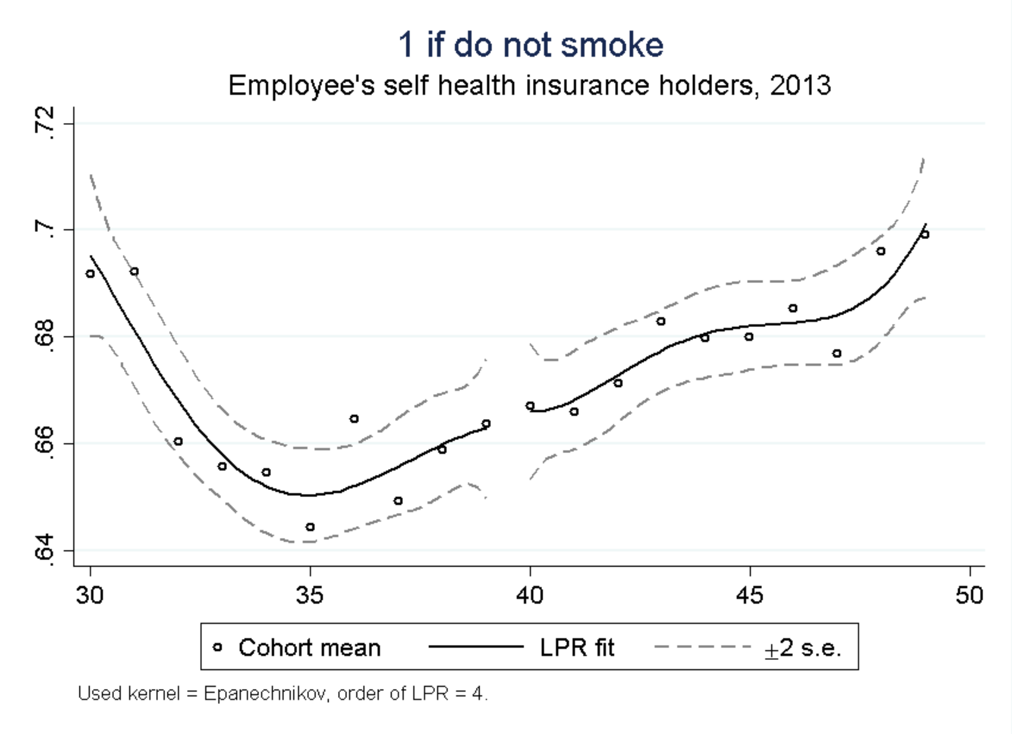


Figure 11B: The distribution of non-smoking rates against age in 2013 (employee's self-health insurance holder and employee's family health insurance holder)



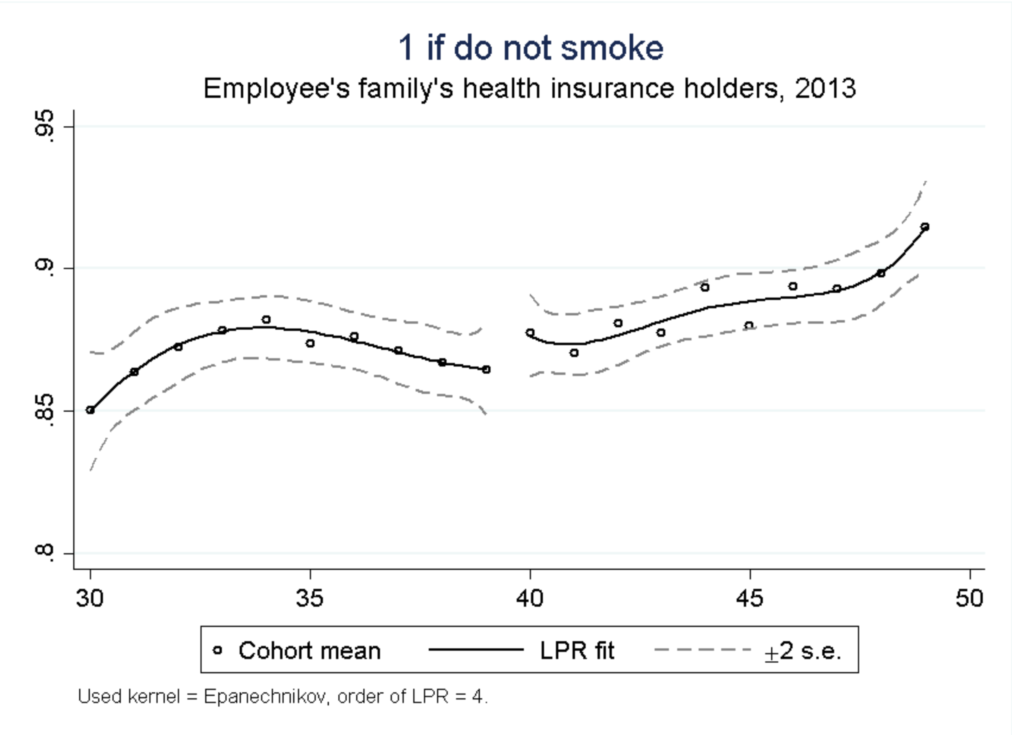
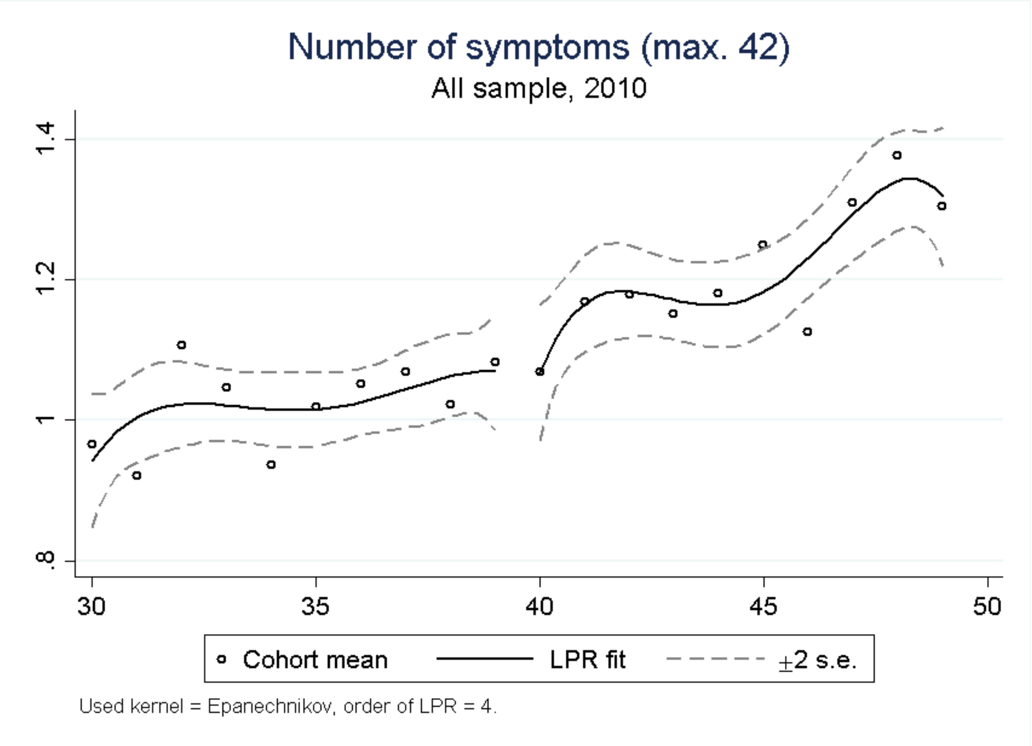


Figure 12A: The distribution of number of subjective symptoms against age in 2010 (all sample and National Health Insurance holder)



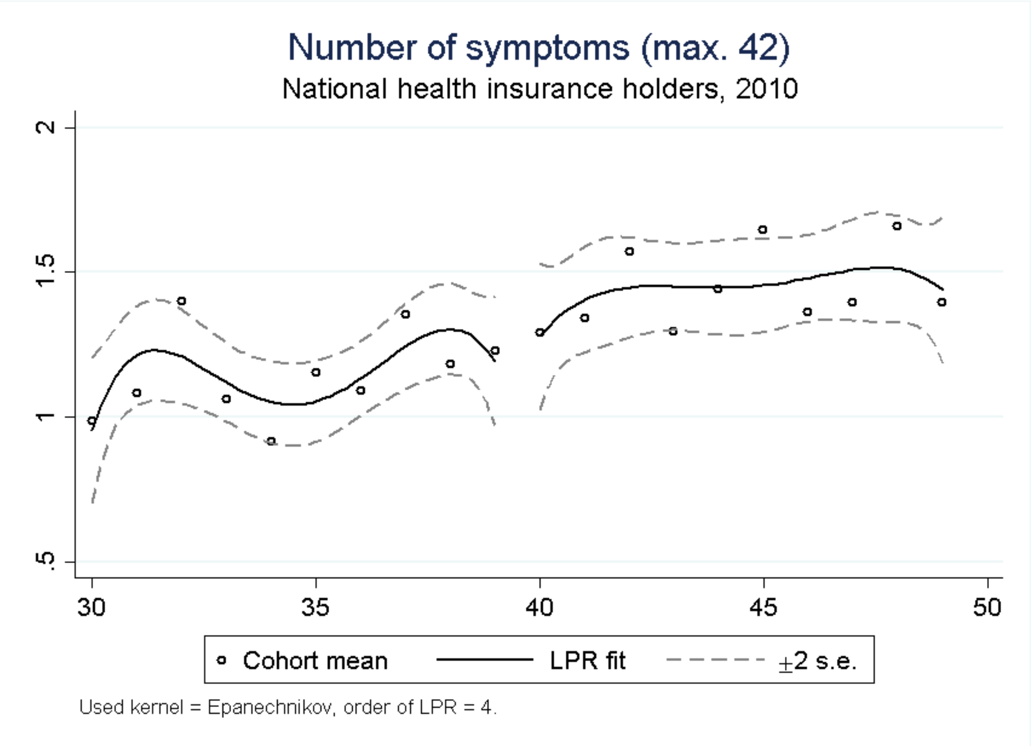
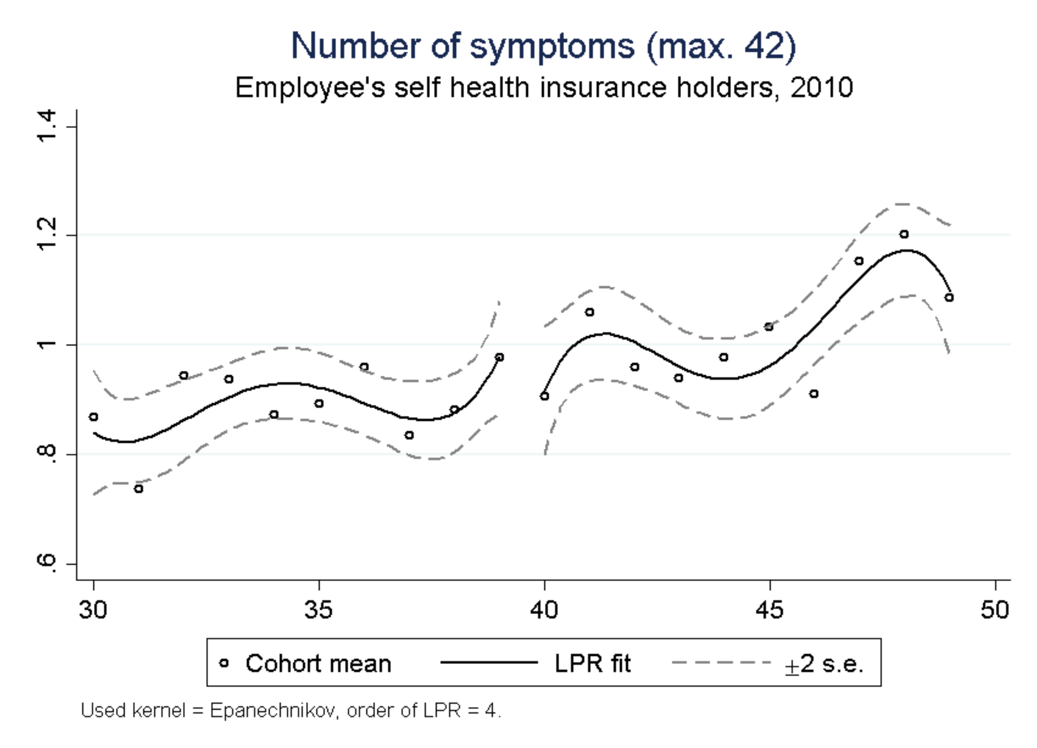


Figure 12B: The distribution of number of subjective symptoms against age in 2010 (employee's self-health insurance holder and employee's family health insurance holder)



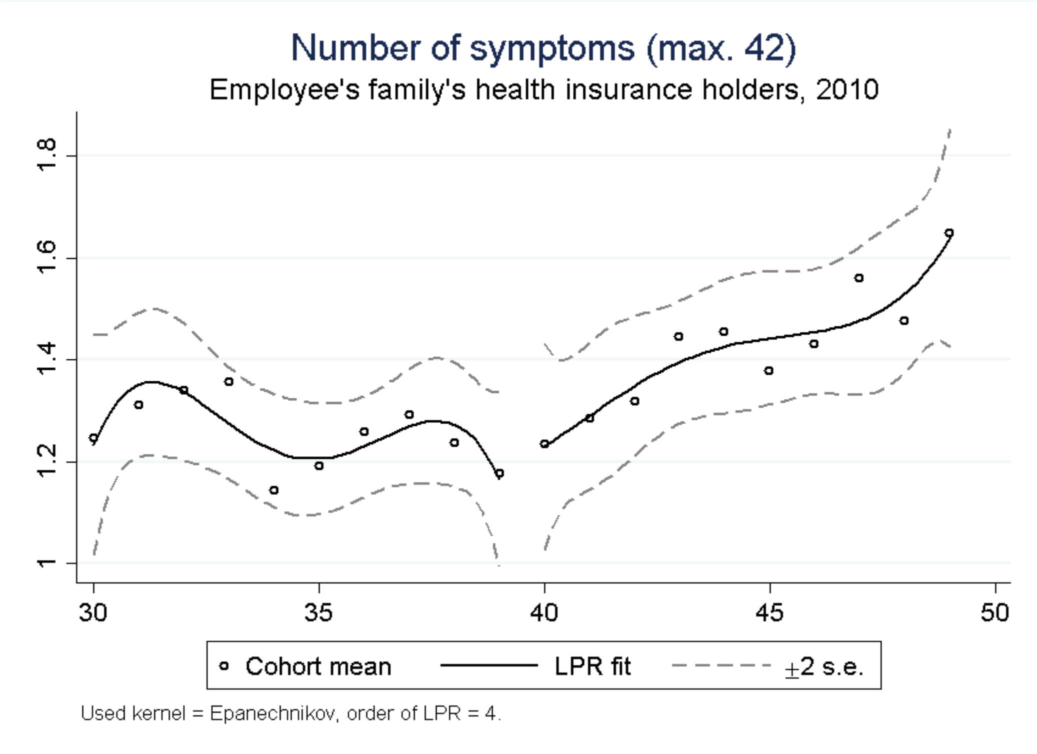
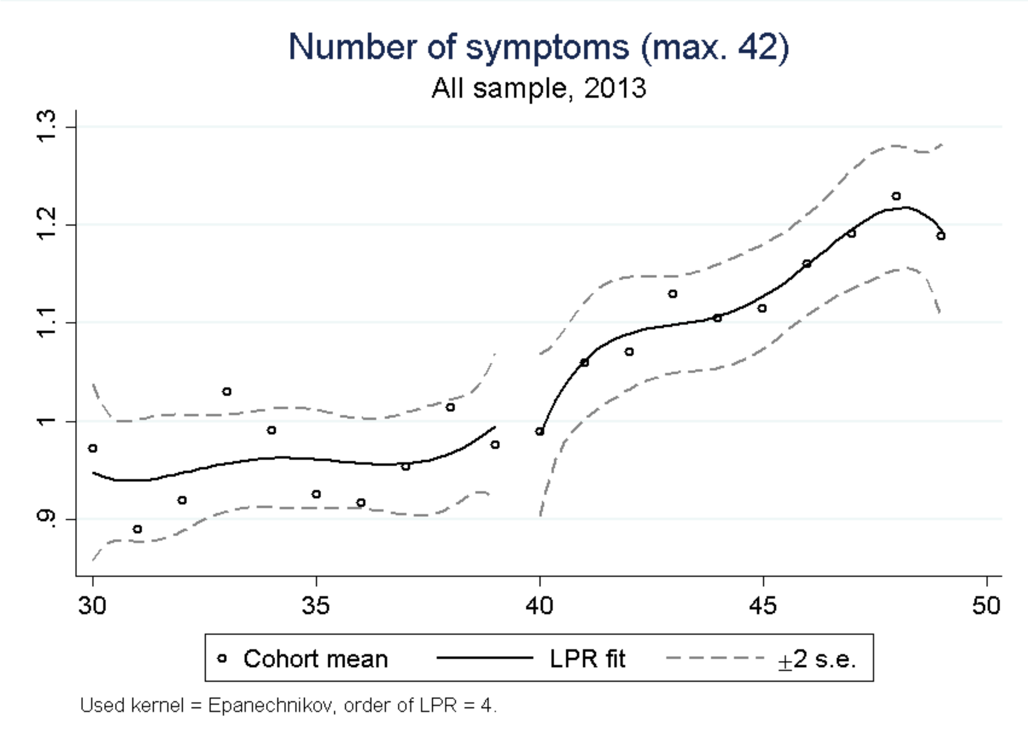


Figure 13A: The distribution of number of subjective symptoms against age in 2013 (all sample and National Health Insurance holder)



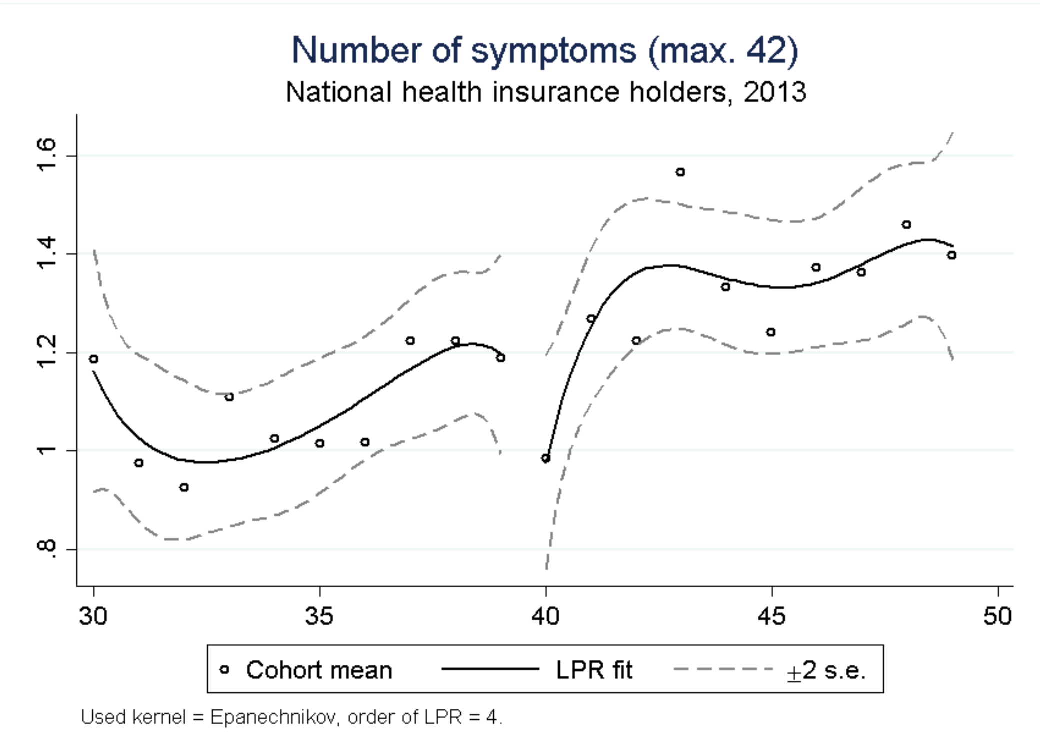


Figure 13B: The distribution of number of subjective symptoms against age in 2013 (employee's self-health insurance holder and employee's family health insurance holder)