Jurnal Indonesia Sosial Sains
http://jiss.publikasiindonesia.id/
Vol. 3, No. 4, April 2022
E-ISSN:2723 – 6595
P-ISSN:2723 – 6692

Ex Ante Moral Hazard in the Health Insurance Market in Indonesia

Sri Hindarti
Universitas Indonesia
Email: srihindarti1987@gmail.com

Artikel info

Artikel history
Received: 08-04-2022
Revised: 18-04-2022
Accepted: 26-04-2022

Keywords: *ex ante moral hazard; health insurance; multivariate probit; obesity; smoking*

Abstract
This paper will empirically examine the existence of ex ante moral hazard in health insurance market in Indonesia with respect to lifestyle choices such as smoking and obesity. A key challenge in understanding the moral hazard problem is endogeneity. Decisions regarding having insurance and lifestyle choices are arguably sequential, not simultaneous. Then, it is difficult to decide which one precedes the other. To address this problem, this paper uses a multivariate probit analysis. This paper uses three waves from the IFLS (Indonesian Family Life Survey) over 2000, 2007, and 2014, as these have information about insurance status, smoking behavior, and obesity condition. This paper finds evidence of the existence of ex ante moral hazard in health insurance for obesity of the head of household, but not for smoking. The multivariate probit regression shows that having health insurance increases the propensity of being obese. Using a wider sample, including all members of households, there is not sufficient evidence of the existence of ex ante moral hazard for either smoking or obesity. Surprisingly, the decisions between smoking and obesity are substitutes. This means that there are non-observable elements that increase the tendency to smoke, but reduce the propensity of being obese, and vice versa.

Correspondence author: Sri Hindarti
Email: srihindarti1987@gmail.com
artikel dengan akses terbuka dibawah lisensi
CC BY SA
2022

Introduction

The government of Indonesia continues to focus on establishing a good healthcare policy to achieve a better health status. The national healthcare program launched in 2014 with a goal of to ensure that the entire population in Indonesia is protected by comprehensive, fair, and equitable health insurance (National Secutity Act, 2004). Public insurance has already covered 200 million people, about 80% of the population in mid 2018, and targeted having 257 million people covered by 2019 (Agustiyanti, 2018). It is a good achievement that almost all the population in Indonesia is insured, but in fact the costs of health expenditure are becoming steeply higher. Based on (Report, 2018) by the Healthcare and Social Security Agency (BPJS), the insurer made a deficit of about 9.75 trillion rupiah at the end of 2017 and failed to pay the medical fees of several hospitals. This shortfall is suspected to stem from low premiums, as many people are unable to pay despite the low premiums. Moreover, the medical fees for treatment of smoking-related diseases takes a significant share of the total expenses. The deficit is likely to be partially due to low premiums, but the health condition of those insured is arguably the main problem. One of the serious health problems facing

Doi: 10.36418/jiss.v3i4.580

insurers is the high numbers of smokers in Indonesia, with 33 percent smokers in 2018 (Riskesdas, 2018). More than 200 thousand deaths occur each year due to tobacco-related diseases and these deaths approximate to 14.7% of all deaths (Drope et al., 2018). Most tobacco-related deaths occur in people of a productive age. Obesity also has been a concern in Indonesia. According to the (Riskesdas, 2018), the number of people with obesity has increased from 14.8% in 2013 to 21.8% in 2018 using a measurement where the Body Mass Index (BMI) is equal to or greater than 27. Surveys on individuals over 15 years show that people with central obesity have increased from 18.8% in 2007 to 26.6% in 2013 and 31% in 2018. Both smoking and obesity are considered to be the key causes of chronic diseases such as heart disease, stroke, and cancer (WHO, 2021). And, these diseases are preventable if people implement a healthy lifestyle. However, with the existence of health insurance, people tend to be discouraged from choosing a healthier way of life. The relationships between health insurance and health behavior have been undertaken at both theoretical and empirical levels.

(Ehrlich & Becker, 1992) initially proposed interactions between market insurance and preventive activities. People have a tendency to lead a healthy life when losses through adverse events will be borne by themselves. Conversely, being insured means some of the loss will be shifted to the insurer, reducing the size of the loss endured by those who are insured. This shift might lead people to engage in riskier behavior that could increase the probability of an adverse event occurring. Those interactions between the effect of possessing insurance and personal preventive behavior are called ex ante moral hazard. (Zweifel & Manning, 2000) defined another type of moral hazard, an ex-post moral hazard, which refers to people use medical services more extensively after being insured since the costs will be covered by the insurance company. They argue that plenty of research showing the existence of ex post moral hazard has been undertaken, however, there is little evidence to of the support the existence of ex ante moral hazard. Therefore, this paper will empirically examine the existence of ex ante moral hazard in health insurance in Indonesia.

A key challenge in understanding the moral hazard problem is endogeneity. Decisions regarding having insurance and lifestyle choices are arguably sequential, not simultaneous. Then, it is difficult to decide which one precedes the other. Several studies attempt to address this endogeneity problem by using different method. (Stanciole, 2008) was one of the researchers who conducted a study to show the existence of ex ante moral hazard in the health insurance market using data from the U.S. Panel Study of Income Dynamics (PSID) from waves in 1999, 2001, and 2003. In this research, the study defines lifestyle choices as heavy smoking, heavy drinking, lack of exercise and obesity and uses a system of probits (univariate, bivariate, and multivariate probit models) to estimate recursive equations due to endogeneity in decision making about having insurance and health behaviors. The results found that health insurance has significant impacts on lifestyle choices, increasing the tendency to heavy smoking, lack of exercise, and obesity, but less likely to affect heavy drinking. The results using multivariate probit suggest that there is a significant correlation between the residuals of each equation.

(Dave & Kaestner, 2009) identified the possibility of direct effect of ex ante moral hazard and indirect effect of insurance on lifestyle choices in the US. They differentiated the direct and indirect effects of health insurance. Due to being insured, people can contact medicals professionals more easily and get more exposure to health promotion information.

These are called indirect effect of health insurance. Conversely, ex ante moral hazard is defined as the direct effect. In the US, people above 65 are automatically eligible for Medicare. The health insurance effect is measured using a difference-in-difference (DD) framework. The results confirm the existence of ex ante moral hazard for male elderly respondents. Having Medicare reduces the probability of engaging in physical exercise, quitting cigarette consumption and increases daily smoking prevalence. However, similar evidence could not be found for elderly female respondents.

(Courbage & Coulon, 2004) conducted research on the effect of different insurance plans (public or private) on health behaviors. Data for this study comes from the British Household Panel Survey, wave 10 (2000/2001). Variables such as physical activities (walking, swimming and practicing sport) and smoking are used to represent the lifestyle choices. This paper determines the effect of health insurance using probit model estimation. However, a simple probit regression will suffer from omitted variable bias due to endogeneity in both decisions; having health insurance and choosing a lifestyle. Therefore, (Courbage & Coulon, 2004) proposed an instrumental variable (IV) strategy to overcome the biased estimation. Political party preference is chosen as the IV, since of the two major parties in the UK, the Conservative Party is associated with private insurance, while the Labour Party is against it. However, this research could not find sufficient evidence of the existence of ex ante moral hazard.

(Tavares, 2014) attempted to show the existence of ex ante moral hazard and propitious selections in the private insurance market using data from the 4th Portuguese National Health Survey (2005). This study used voluntarily having private insurance as the interest variable affecting lifestyle choices such as smoking, doing sports, eating healthy snacks and drinking. This study also faced the endogeneity problem and a used similar strategy to (Stanciole, 2008), using multivariate probit estimates to determine the ex-ante moral hazard. The results show that people tend to decrease sports activity due to being insured. Indeed, there are unobserved variables affecting lifestyle decisions. However, the findings confirm that non-observed variables like risk aversion do not influence individuals' decisions. Unexpectedly, the results suggest that individuals tend to believe that smoking is safer due to higher coverage by insurance.

To sum up, previous research used several strategies to overcome the main challenge in showing the existence of ex ante moral hazard in health insurance, such as endogeneity, which lead to biased estimations. (Courbage & Coulon, 2004) used an instrumental variable (IV), political party affiliations in the UK, to control the non-observed determinants for health insurance and lifestyle choices. (Dave & Kaestner, 2009) proposed a solution by using the exogenous determinant in health insurance since people above 65 are eligible for Medicare coverage in the US. (Stanciole, 2008) found an appropriate approach for solving the non-observed variables that lead to biased estimations by using a multivariate probit model to estimate a system of equations. The advantage of the multivariate probit is that the estimation can be done within the equations without either IV or exogenous variables.

For the case in Indonesia, the first strategy by (Courbage & Coulon, 2004) seems inappropriate since the UK and Indonesia have differences in their political systems. Using the same method as the second proposal by (Dave & Kaestner, 2009) is also not suitable for research in Indonesia since the exogenous determinant (age above 65) for health insurance

does not exist. Finally, the strategy from (Stanciole, 2008) is considered applicable and appropriate for this research since this method does not require either an IV or an exogenous determinant of health insurance. The endogeneity problem between health insurance and health behavior decisions can be addressed using multivariate probit to estimate a recursive system within the equations.

The previous studies, mentioned above, were conducted in developed countries. Those researchers used different approaches to overcome the endogeneity problem, the challenge in studying ex ante moral hazard in health insurance. Those methods took into consideration the characteristics of the location. However, the approach by (Stanciole, 2008) and (Tavares, 2014) are arguably suitable to be implemented to solve the endogeneity issue without using IV or exogenous determinants when doing research on ex ante moral hazard in insurance. Unlike previous studies which used developed countries' data, my research tries to show the existence of ex ante moral hazard in Indonesia, a developing country with low-middle income. Hence, this study will be likely to contribute to the discussion of ex ante moral hazard in health insurance.

This study will follow the approach by (Stanciole, 2008) and (Tavares, 2014) to determine if ex ante moral hazard is evident in Indonesia. This paper uses three waves from the IFLS (Indonesian Family Life Survey) over 2000, 2007, and 2014, as these have information about insurance status, smoking behavior, and obesity condition. This paper finds evidence of the existence of ex ante moral hazard in health insurance for obesity of the head of household, but not for smoking. The multivariate probit regression shows that having health insurance increases the propensity of being obese. The residuals correlations are not significant between the insurance equation and both the smoking and the obesity equations. Using a wider sample, including all members of households, there is not sufficient evidence of the existence of ex ante moral hazard for either smoking or obesity. By using a multivariate probit model, the residuals correlations between insurance decisions and health behaviors are not significant. This suggests that the unobservable determinants affecting insurance decisions are not correlated to those influencing lifestyle decisions. Unexpectedly, the decisions between smoking and obesity are substitutes. This means that there are non-observable elements that increase the tendency to smoke, but reduce the propensity of being obese, and vice versa.

Research Method

1. Econometric Model

   The objective of this paper is to obtain empirical evidence of the effect of having health insurance on lifestyle choices such as smoking and obesity. Decisions about health insurance and health behavior are suspected to be sequential. However, it is difficult to decide which decision comes first. Both the decision to be insured and choosing health behaviors are influenced by variables such as health consciousness, risk averseness, information, media campaigns, and peer effects. These variables are difficult to observe, so if these problems are ignored, this will lead to biased estimates.

   This study uses the same approach as (Stanciole, 2008) to tackle the endogeneity problem by utilizing a multivariate probit model. This model has an advantage as it allows

the residuals to be freely correlated. By doing so, it can be concluded whether either health insurance or health behaviors suffer from endogeneity problems or not.

Let y_{iI} denote a dummy variable of health insurance status; 1 indicates that the respondent has health insurance, and 0 otherwise. y_{iS}, y_{iO} denote lifestyle choices; 1 if the respondent currently smokes and 1 for the respondent being obese, respectively, and 0 otherwise. The multivariate probit model can be written as follows:

$$y_{iI}^{*} = \beta_I' X_{iI} + \varepsilon_{iI}, \text{ (health insurance decision)}$$
$$y_{iS}^{*} = \gamma_S y_{iI} + \beta_S' X_{iS} + \varepsilon_{iS}, \text{ (smoking decision)}$$
$$y_{iO}^{*} = \gamma_O y_{iI} + \beta_O' X_{iO} + \varepsilon_{iO}, \text{ (obesity decision)}$$
$$y_{iI,S,O} = \begin{Bmatrix} 1 & if\ y_{iI,S,O}^{*} > 0 \\ 0 & otherwise \end{Bmatrix} \quad \text{..... (1)}$$

A multivariate probit model applies assumptions that residuals follow a multivariate normal distribution with a zero mean for each and the matrix of variance-covariance on the primary diagonal has a value of 1, and the correlation off-diagonal follows $\rho_{kj} = \rho_{jk}$. The multivariate probit is useful to fit the univariate probit model with panel data since this method allows the residuals to be freely correlated over time and this is the advantage of the multivariate probit. Cited from (Cappellari & Jenkins, 2003), the log-likelihood function is as follows:

$$L = \sum_{i=1}^{N} w_i \log \Phi_3(\mu_i, \Omega) \quad \text{..... (2)}$$

Where w_i is a weight for observation $i = 1, \dots, N$, and $\Phi_3(.)$ is the multivariate standard normal distribution with μ_i and Ω, where:

$$\mu_i = (K_{iI}\beta_I' X_{iI},\ K_{iS}\beta_S' X_{iS}, K_{iO}\beta_O' X_{iO}) \quad \text{..... (3)}$$

with $K_{ik} = 2y_{ik} - 1$, for each $i, k = 1, \dots, 3$. Matrix Ω has the elements of Ω_{jk}, where

$$\Omega_{IS} = \Omega_{SI} = K_{iI}\, K_{iS}\rho_{IS}$$
$$\Omega_{IO} = \Omega_{OI} = K_{iI}\, K_{iO}\rho_{IO}$$
$$\Omega_{SO} = \Omega_{OS} = K_{iS}\, K_{iO}\rho_{SO}$$
$$\begin{bmatrix} \varepsilon_{iI} \\ \varepsilon_{iS} \\ \varepsilon_{iO} \end{bmatrix} \xrightarrow{d} N\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_{IS} & \rho_{IO} \\ \rho_{SI} & 1 & \rho_{SO} \\ \rho_{OI} & \rho_{OS} & 1 \end{bmatrix} \right) \quad \text{..... (4)}$$

The multivariate standard normal distribution $\Phi_3(.)$ is the key for the simulated maximum likelihood function. The method that is most widely used for evaluating the likelihood function of multivariate normal distribution is the Geweke-Hajivassiliou-Keane (GHK) simulator. This method treats the multivariate normal distribution as a sequentially conditioned univariate normal distribution function, which is easier to apply. The likelihood function will be:

$$\Pr(y_{iI} = 1, y_{iS} = 1, y_{iO} = 1) = \Pr(\varepsilon_{iI} \le \beta_I' X_{iI}, \varepsilon_{iS} \le \beta_S' X_{iS}, \varepsilon_{iO} \le \beta_O' X_{iO}) \text{..... (5)}$$

With the application of Cholesky decomposition, from the correlation of the variance co-variance matrix:

$$E(\varepsilon\varepsilon') = C\varepsilon\varepsilon'C \quad \text{..... (6)}$$

We can get

$$\begin{bmatrix}\varepsilon_{iI}\\ \varepsilon_{iS}\\ \varepsilon_{iO}\end{bmatrix} \xrightarrow{d} N\left(\begin{bmatrix}0\\0\\0\end{bmatrix}, \begin{bmatrix}1 & \rho_{IS} & \rho_{IO}\\ \rho_{SI} & 1 & \rho_{SO}\\ \rho_{OI} & \rho_{OS} & 1\end{bmatrix}\right) \quad \text{..... (7)}$$

Then, the simulated maximum likelihood (SML) estimates can be done for a multivariate probit model.

Table 1.
Variable Definitions and Descriptive Statistics (Mean and Standard Deviation) for The Head of Household Level

Variable	Definition	Sample		
		Full	Uninsured	Insured
insured	1 if respondent is covered by health insurance, 0 otherwise	0.350 (0.477)		
smoker	1 if respondent currently smokes, 0 otherwise	0.571 (0.495)	0.595 (0.491)	0.528 (0.499)
heavy_smoker	1 if respondent smokes 12+ per day, 0 otherwise	0.335 (0.472)	0.345 (0.476)	0.317 (0.465)
obese	1 if respondent's body mass index is equal to or above 30, 0 otherwise	0.042 (0.202)	0.034 (0.181)	0.058 (0.235)
obese27	1 if respondent's body mass index is equal to or above 27, 0 otherwise	0.126 (0.332)	0.104 (0.305)	0.168 (0.374)
bad_health	1 if respondent's self-assessed health is fair/poor, 0 if good/very good	0.197 (0.398)	0.193 (0.395)	0.205 (0.403)
age_30	1 if respondent's age is below 31, 0 otherwise	0.061 (0.240)	0.063 (0.243)	0.058 (0.233)
age_31_40	1 if respondent's age is between 31 and 40, 0 otherwise	0.230 (0.421)	0.226 (0.418)	0.238 (0.426)
age_41_50	1 if respondent's age is between 41 and 50, 0 otherwise	0.270 (0.444)	0.259 (0.438)	0.291 (0.454)
age_51_60	1 if respondent's age is between 51 and 60, 0 otherwise	0.208 (0.406)	0.211 (0.408)	0.202 (0.401)
age_60	1 if respondent's age is above 60, 0 otherwise	0.231 (0.421)	0.241 (0.428)	0.210 (0.408)
gender	1 if respondent is male, 0 otherwise	0.827 (0.378)	0.817 (0.387)	0.846 (0.361)
unmarried	1 if respondent is single, 0 otherwise	0.023 (0.149)	0.023 (0.149)	0.023 (0.151)
married	1 if respondent is currently married, 0 otherwise	0.827 (0.378)	0.815 (0.388)	0.850 (0.358)
divorced	1 if respondent is divorced, 0 otherwise	0.023 (0.151)	0.026 (-0.160)	0.018 (0.133)
widowed	1 if respondent is widowed, 0 otherwise	0.121 (0.326)	0.130 (0.336)	0.104 (0.306)
chronic_disease	1 if respondent suffers from at least one chronic disease*, 0 otherwise	0.317 (0.465)	0.286 (0.452)	0.374 (0.484)

elementary	1 if respondent's last education is primary education, 0 otherwise	0.451 (0.498)	0.512 (0.500)	0.337 (0.473)
high_school	1 if respondent's last education is high school education, 0 otherwise	0.334 (0.472)	0.294 (0.456)	0.408 (0.492)
college	1 if respondent's last education is college education, 0 otherwise	0.099 (0.299)	0.050 (0.218)	0.191 (0.393)
employed	1 if respondent is currently employed or working, 0 otherwise	0.815 (0.388)	0.820 (0.384)	0.807 (0.395)
student	1 if respondent is student, 0 otherwise	0.004 (-0.060)	0.004 (0.062)	0.003 (0.057)
housekeeping	1 if currently keeping house, 0 otherwise	0.057 (0.233)	0.058 (0.233)	0.057 (0.232)
retired	1 if respondent is currently retired, 0 otherwise	0.065 (0.247)	0.056 (-0.230)	0.082 (0.274)
unemployed	1 if respondent is unemployed or looking for work, 0 otherwise	0.008 (0.090)	0.011 (0.105)	0.003 (0.053)
rural	1 if respondent lives in rural area, 0 otherwise	0.448 (0.497)	0.473 (0.499)	0.403 (0.490)
ln_hhexpenditure	log total monthly expenditure of the household	14.280 (1.063)	14.13 (1.072)	14.57 (0.985)
num_child	number of children in the household	0.926 (1.079)	0.941 (1.103)	0.899 (1.032)
wave1	1 for year 2000, 0 otherwise	0.292 (0.455)	0.374 (0.484)	0.141 (0.348)
wave2	1 for year 2007, 0 otherwise	0.297 (0.457)	0.316 (0.465)	0.262 (0.440)
wave3	1 for year 2014, 0 otherwise	0.411 (0.492)	0.311 (0.463)	0.597 (0.490)
Observations		22481	14616	7864

Note: *Chronic diseases include hypertension, diabetes, tuberculosis (TBC), asthma, heart diseases, liver, stroke, cancer or malignant tumor, rheumatism, high cholesterol, prostate illness, kidney, stomach or other digestive diseases, psychiatric problems, memory-related diseases, cough with phlegm, bloody cough, and difficulty breathing.

2. Data

The data used in this study comes from the Indonesian Family Life Survey (IFLS) by the (RAND, 2012). The IFLS is a longitudinal study representing 83 percent of the Indonesian population, covering more than 7,000 households across 13 provinces. This paper will analyze the information available in the waves from 2000, 2007, and 2014 about lifestyle choices, health insurance status, health condition status and related socio-demographic conditions. This study uses unbalanced panel data, 6,565 observations from the wave in 2000, 6,677 and 9,239 observations from the waves in 2007 and 2014, respectively. The primary sample only uses the heads of each household, aged 15 or above.

The main interest variables are the insurance status and lifestyle choices represented by smoking and obesity. Following (Stanciole, 2008), the primary sample does not differentiate among the diverse types of insurance. In the IFLS survey, types of coverage include public servant insurance, public insurance for poor people paid by the government, employer-provided health insurance, employer-provided clinics, private insurance, unit-linked insurance, and national healthcare. As long as respondents are being covered by any type insurance, then this is classified as being insured. The sample consists of 35 percent insured and 65 percent uninsured.

People who are currently smoking at the time of being interviewed are categorized as smokers. In this sample, 57.1 percent of respondents are smokers. This smoker variable uses a dummy variable instead of the number of cigarettes consumed per day because this paper uses another dummy variable for obesity as the lifestyle choices of interest. So, for consistency purposes and to support fitted estimation, both lifestyle decisions use a binary outcome.

Another interesting variable is having an obese condition. Globally, a person is classified as being obese if an individual has body mass index (BMI) equal to or greater than 30. The BMI is computed by dividing the weight (in kilograms) by the height (in meters) squared. This obesity variable uses the binary outcome of 1 if a respondent has a BMI equal to or greater than 30, and 0 otherwise. There are 4.2 percent of respondents who are obese.

The sample consists 82.7 percent male and 17.3 percent female as the head of households. Due to reliability issues, this paper uses information expenditure as a proxy of income (Hidayat & Thabrany, 2010). All control variables are available at individual level, except for expenditure and number of children, which are available at household level. Table 1 shows other variables and its definition as the determinants of decision-making of health insurance and health lifestyle choices.

By using pairwise correlations displayed in Table 2, it can be seen that the interest variables are significantly correlated. This correlation indicates the possibility of ex ante moral hazard. There is also the possibility correlation between smoking and obesity.

Table 2.
Dependent Variable Correlations

	Insured	**Smoker**	**Obese**
insured	1.000		
smoker	-0.0646***	1.000	
obese	0.0580***	-0.0793***	1.000

Note: *** p<0.01, ** p<0.05, * p<0.1

Result and Discussion

This section discusses the results for univariate, bivariate, and multivariate probit regressions, with the limited sample at head of household level (Table 3) and the full sample containing all members of households (Table 7).

1. The Effect of Health Insurance on Health Behaviors

Let us focus on the main interest of this study, the effect of having insurance on lifestyle decisions. Table 3 provides the results for univariate, bivariate, and multivariate probit regressions for decisions about becoming insured, smoking, and obesity equations.

When being insured, the propensity for being a smoker decrease. People who are insured might be more risk averse and because of this reason, they choose not to smoke. On the other hand, people have a greater tendency to be obese due to being insured. If you are more risk averse then you will take out insurance and lead a healthy life, not smoking and not being obese. There might exist unobserved variables affecting the decision to have insurance that govern health behavior. Moreover, there is a suspicion that the decisions about purchasing insurance and lifestyle come in order, but it is difficult to determine which one comes first. Hence, simple probit regressions lead to biased estimates as they ignore the endogeneity and heterogeneity variables.

Table 3.
Univariate, Bivariate, and Multivariate Probit Regressions for the Head of Household Level

	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
Variable	**Insured**	**Smoker**	**Obese**	**Insured**	**Smoker**	**Insured**	**Obese**	**Insured**	**Smoker**	**Obese**
insured		-0.085***	0.092**		0.847***		0.079		-0.091	0.184**
		(0.024)	(0.039)		(0.139)		(0.153)		(0.059)	(0.083)
bad_health	0.002	-0.081***	-0.034	0.007	-0.073***	0.002	-0.033	0.002	-0.074***	-0.031
	(0.025)	(0.027)	(0.044)	(0.025)	(0.026)	(0.026)	(0.044)	(0.026)	(0.027)	(0.044)
age_31_40	0.253***	0.024	0.262***	0.252***	-0.059	0.249***	0.263***	0.249***	0.021	0.255***
	(0.053)	(0.052)	(0.093)	(0.053)	(0.053)	(0.055)	(0.094)	(0.055)	(0.053)	(0.093)
age_41_50	0.333***	-0.081	0.395***	0.329***	-0.181***	0.338***	0.397***	0.338***	-0.073	0.385***

Variable	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
	Insured	**Smoker**	**Obese**	**Insured**	**Smoker**	**Insured**	**Obese**	**Insured**	**Smoker**	**Obese**
	(0.053)	(0.051)	(0.092)	(0.052)	(0.052)	(0.054)	(0.094)	(0.054)	(0.052)	(0.092)
age_51_60	0.269***	-0.135**	0.285***	0.261***	-0.207***	0.273***	0.286***	0.273***	-0.127**	0.275***
	(0.054)	(0.053)	(0.095)	(0.054)	(0.053)	(0.055)	(0.096)	(0.055)	(0.055)	(0.095)
age_60	0.265***	-0.190***	-0.021	0.250***	-0.255***	0.272***	-0.020	0.273***	-0.176***	-0.034
	(0.057)	(0.057)	(0.105)	(0.057)	(0.056)	(0.058)	(0.107)	(0.058)	(0.058)	(0.105)
gender	0.033	1.985***	-0.547***	0.028	1.809***	0.038	-0.547***	0.038	2.013***	-0.544***
	(0.038)	(0.051)	(0.058)	(0.037)	(0.074)	(0.038)	(0.058)	(0.038)	(0.052)	(0.058)
married	0.099	0.035	0.117	0.103	-0.003	0.088	0.118	0.089	0.031	0.115
	(0.072)	(0.080)	(0.118)	(0.071)	(0.077)	(0.073)	(0.118)	(0.073)	(0.082)	(0.118)
divorced	-0.062	0.178	-0.060	-0.051	0.169	-0.051	-0.060	-0.051	0.192	-0.054
	(0.098)	(0.114)	(0.163)	(0.096)	(0.109)	(0.100)	(0.163)	(0.100)	(0.118)	(0.162)
widowed	0.126	0.256***	0.071	0.127	0.185**	0.116	0.072	0.116	0.268***	0.070
	(0.079)	(0.091)	(0.127)	(0.078)	(0.089)	(0.081)	(0.127)	(0.081)	(0.094)	(0.126)
chronic_disease	0.123***	-0.176***	0.198***	0.117***	-0.199***	0.125***	0.198***	0.125***	-0.172***	0.193***
	(0.021)	(0.023)	(0.036)	(0.022)	(0.022)	(0.022)	(0.036)	(0.022)	(0.023)	(0.036)
elementary	0.178***	-0.146***	0.089	0.183***	-0.171***	0.190***	0.090	0.190***	-0.146***	0.085
	(0.036)	(0.043)	(0.072)	(0.036)	(0.040)	(0.037)	(0.073)	(0.037)	(0.044)	(0.072)
high_school	0.617***	-0.399***	0.389***	0.618***	-0.544***	0.634***	0.392***	0.634***	-0.400***	0.370***
	(0.039)	(0.048)	(0.077)	(0.039)	(0.047)	(0.040)	(0.085)	(0.040)	(0.049)	(0.078)
college	1.289**	-	0.550***	1.297**	-1.185***	1.292***	0.556***	1.292***	-	0.511***

Variable	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
	Insured	Smoker	Obese	Insured	Smoker	Insured	Obese	Insured	Smoker	Obese
	*	0.853***		*					0.846***	
	(0.051)	(0.058)	(0.087)	(0.051)	(0.066)	(0.052)	(0.109)	(0.052)	(0.063)	(0.092)
employed	0.094**	0.177***	-0.032	0.092**	0.125***	0.076*	-0.032	0.076*	0.135***	-0.037
	(0.044)	(0.046)	(0.078)	(0.044)	(0.046)	(0.046)	(0.078)	(0.046)	(0.048)	(0.078)
student	-0.096	-0.236	0.125	-0.093	-0.212	-0.055	0.125	-0.053	-0.310	0.135
	(0.186)	(0.234)	(0.281)	(0.185)	(0.226)	(0.189)	(0.281)	(0.189)	(0.243)	(0.280)
housekeeping	0.170**	0.009	0.057	0.162**	-0.047	0.155**	0.057	0.155**	-0.013	0.051
	*			*						
	(0.059)	(0.069)	(0.094)	(0.059)	(0.067)	(0.061)	(0.095)	(0.061)	(0.070)	(0.094)
retired	0.410**	-0.295***	-0.005	0.408**	-0.401***	0.393***	-0.003	0.392***	-0.337***	-0.014
	*			*						
	(0.057)	(0.062)	(0.108)	(0.057)	(0.060)	(0.059)	(0.110)	(0.059)	(0.064)	(0.108)
unemployed	-0.452**	0.226*	-0.170	-0.442**	0.292***	-0.440***	-0.171	-0.443***	0.165	-0.152
	*			*						
	(0.140)	(0.115)	(0.249)	(0.136)	(0.111)	(0.140)	(0.251)	(0.140)	(0.118)	(0.248)
rural	-0.089**	0.009	-0.054	-0.088**	0.035*	-0.086***	-0.055	-0.086***	0.007	-0.052
	*			*						
	(0.020)	(0.021)	(0.036)	(0.020)	(0.020)	(0.020)	(0.036)	(0.020)	(0.021)	(0.036)
ln_hhexpenditure	0.007	-0.009	0.028	0.008	-0.011	0.007	0.028	0.007	-0.013	0.028
	(0.012)	(0.012)	(0.021)	(0.012)	(0.012)	(0.012)	(0.021)	(0.012)	(0.012)	(0.020)
num_child	-0.002	0.001	-0.020	-0.001	0.002	0.004	-0.020	0.004	0.002	-0.020
	(0.009)	(0.009)	(0.016)	(0.009)	(0.009)	(0.009)	(0.016)	(0.009)	(0.009)	(0.016)
wave2	0.454**	0.001	0.301***	0.462**	-0.124***	0.461***	0.302***	0.461***	0.002	0.289***

Variable	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
	Insured	**Smoker**	**Obese**	**Insured**	**Smoker**	**Insured**	**Obese**	**Insured**	**Smoker**	**Obese**
	*			*						
	(0.026)	(0.023)	(0.048)	(0.026)	(0.031)	(0.027)	(0.050)	(0.027)	(0.025)	(0.048)
wave3	0.897**	0.009	0.297***	0.901**	-0.275***	0.907***	0.301***	0.907***	0.019	0.271***
	*			*						
	(0.030)	(0.030)	(0.055)	(0.030)	(0.054)	(0.030)	(0.069)	(0.030)	(0.034)	(0.058)
N	20750	20750	20009		20750		20009			20009
N_cluster	12498	12498	12135		12498		12135			12135
Wald chi2	3634	2715	485.6		6839		4024			6608
Prob > chi2	0	0	0		0		0			0
Pseudo R2	0.139	0.200	0.0759							
chi2					25.85		0.00779			21.73

Then, we take a look at the bivariate probit results in Table 3 column (2), which estimate the joint decision of health insurance with smoking and then with obesity. When the insurance equation and the smoking equation are both regressed at once, the sign of impact changes from a significant negative to a positive one and the coefficient becomes ten times bigger compared with the univariate probit regression, from (-0.085) to (+0.847). There also a change in bivariate probit result between insurance and obesity equations. The effect of insurance on obesity decision is no longer significant. However, both bivariate probit regression ignore the possibility of correlation between smoking and obesity decisions. Therefore, the estimations are suspected to be biased.

For further analysis, let us look into the multivariate probit model, in which decisions to be insured, a smoker, and obese are jointly estimated simultaneously. The multivariate probit allows residuals in all equations to be freely correlated and estimates the correlation between residuals to control the non-observable heterogeneity. The results in Table 3 column (3) show that health insurance has no effect on smoking decision but a positive impact on obesity decision. These findings are quite different from previous univariate and bivariate probit estimations. However, the residuals correlation between health insurance decisions and health behaviors are not significant. This suggests that the unobservable attributes influencing the decision to take out insurance are not correlated to those influencing smoking and obesity decisions. It can be concluded that there is evidence for ex ante moral hazard in health insurance only for obesity.

Table 4 shows an interesting finding; that the residuals between smoking and obesity decisions are negatively but significantly correlated. This relationship means that there exists a non-observable determinant which increases the propensity of being a smoker while reduces the tendency of being obese, and vice versa. People who are smokers tend to have lower BMI and obese people are more likely not to smoke. This relationship means that the choices between smoking and obesity are somehow substitutes.

Table 4.
Multivariate Probit Residuals Correlations

	Coef	P > |z|
rho21	0.005	0.876
rho31	-0.056	0.201
rho32	-0.097	0.000
Notes: Likelihood ratio test of rho21 = rho31 = rho32 = 0;		
chi2(3) = 21.7279 Prob > chi2 = 0.0001		

2. The Effect of Control Variables

Let us take a look at the effect of control variables displayed in Table 3. In general, most of the control variables have consistent sign and similar magnitude when being estimated through univariate, bivariate, and multivariate probit. People with poor self-assessed conditions do not have a tendency to be insured and be obese, but they have significant tendency to not smoking. It makes sense that if you have bad health, you will not smoke.

Individuals tend to have insurance as they get older. This result confirms that age is a significant determinant in the decision to take out insurance. However, more people at the ages of 51 or above are less likely to be a smoker than any other age group. Table 3 shows that age is also a determinant of obesity. When getting older, people will tend to have a slower metabolism that turns into weight gain. In general, after the age of 60, people do not have a tendency to smoke or be obese due to their declining health and being more health conscious. There are several age-related diseases such as blood pressure, osteoporosis, dementia, and diabetes. Therefore, the elderly has a tendency to pay attention to the type of food consumed. The consideration in selecting food may have resulted in not being obese.

Gender and marital status are not significant determinants for having health insurance. However, gender plays a significant role in the decisions to smoke and or become obese. The propensity of male adults to be smokers is twice larger than female adults. This result confirms the report from the Ministry of Health that smoking prevalence in male adults is much higher than for females (63 percent and 4.8 percent, respectively). Whilst men have a lower propensity to get obese compared to women. It can be seen that marital status does not affect the tendency to be either smoker or obese. However, being widowed increases the tendency to be a smoker than any other groups.

People with a history of suffering from chronic diseases are more likely to be insured and less likely to smoke. These tendencies have something to do with health awareness and risk aversion. Individuals with more risk aversion will be more likely to shift the risk of an adverse event since they have experience of having a chronic disease, so being insured is economical. Suffering from chronic diseases makes individuals be more aware of the harmful effects of smoking, consequently, they will quit smoking. However, having experience of chronic diseases increases the propensity of having obesity.

Education certainly has a significant effect on the decision to have insurance, and on lifestyle choices. Higher education is associated with higher exposure to information. People with higher education have a tendency to be insured and smoke less due to be more health conscious or having more health information. However, those with higher education have a higher propensity to be obese. The plausible explanation is that people with lower education levels are associated with blue-collar jobs that require more intense physical activity. On the other hand, higher educated people commonly work in an office, which is not intensely active.

Employment status has a significant effect on having health insurance and smoking, but not on obesity. Being employed may result in being insured due to getting health insurance or having more access to health facilities/clinics provided by the employer. However, people who are employed have tendency to be a smoker. On the other hand, unemployed individuals tend to be uninsured. People at the age above 60 are closed to the retirement period. Therefore, those are more likely to be insured, but less likely to smoke due to the deteriorating health.

Individuals who live in rural areas tend to be uninsured, but do not significant tendency to be either smoker or obese. Rural areas are generally known for lower access to information and healthcare facilities. Therefore, due to less information and facilities, people are less likely to have insurance.

Household expenditure as the proxy for income has no effect on smoking behavior. Smoking is addictive, so the demand for cigarettes might be inelastic with respect to expenditure. People continue smoking regardless of income. The number of children does not have significant effect on the decision to be insured, smoking, and obesity.

Over the years, there are more and more people getting insured with a significant effect on time variables. The magnitude for wave 3 (2014) is greater than for both wave 2 (2007), and the base level (2000). There is also a possibility that this effect is due to the bigger respondents in wave 3. Compared to wave 1, there are more people with obesity in wave 2 and wave 3. However, the smoking behavior does not change over the years since the effect of time variables is not significant.

Table 5.
Descriptive Statistics (Mean and Standard Deviation) for All Members of Households

Variable	Sample		
	Full	Uninsured	Insured
insured	0.308 (0.462)		
smoker	0.326 (0.469)	0.335 (0.472)	0.306 (0.461)
obese	0.056 (0.231)	0.047 (0.212)	0.078 (0.268)
bad_health	0.168 (0.374)	0.158 (0.365)	0.190 (0.392)
age_30	0.405 (0.491)	0.430 (0.495)	0.351 (0.477)
age_31_40	0.230 (0.421)	0.217 (0.412)	0.257 (0.437)
age_41_50	0.159 (0.365)	0.148 (0.355)	0.182 (0.386)
age_51_60	0.104 (0.305)	0.100 (0.301)	0.111 (0.314)

Variable	Sample		
	Full	Uninsured	Insured
age_60	0.103 (0.304)	0.104 (0.306)	0.099 (0.299)
gender	0.476 (0.499)	0.468 (0.499)	0.492 (0.500)
unmarried	0.223 (0.416)	0.235 (0.424)	0.195 (0.396)
married	0.688 (0.463)	0.672 (0.47)	0.725 (0.447)
divorced	0.020 (0.141)	0.022 (0.148)	0.016 (0.124)
widowed	0.063 (0.243)	0.064 (0.245)	0.060 (0.238)
chronic_disease	0.284 (0.451)	0.255 (0.436)	0.345 (0.475)
elementary	0.341 (0.474)	0.377 (0.485)	0.262 (-0.440)
high_school	0.467 (0.499)	0.452 (0.498)	0.501 (0.500)
College	0.110 (0.313)	0.074 (0.262)	0.191 (0.393)
employed	0.618 (0.486)	0.603 (0.489)	0.652 (0.476)
student	0.079 (0.27)	0.083 (0.275)	0.071 (0.258)
housekeeping	0.177 (0.382)	0.185 (0.388)	0.159 (0.365)
retired	0.029 (0.166)	0.026 (0.159)	0.034 (0.181)
unemployed	0.021 (0.144)	0.027 (0.163)	0.007 (0.086)
rural	0.449 (0.497)	0.470 (0.499)	0.402 (-0.490)
ln_hhexpenditure	14.290 (1.062)	14.140 (1.066)	14.62 (0.976)
num_child	0.924 (1.077)	0.938 (1.097)	0.893 (1.028)
wave1	0.287 (0.452)	0.362 (0.481)	0.118 (0.323)
wave2	0.327 (0.469)	0.351 (0.477)	0.272 (0.445)
wave3	0.386 (0.487)	0.286 (0.452)	0.610 (0.488)
Observations	88,773	61,387	27,383

3. All Members of Households as the Sample

Previously, this paper uses heads of households as the sample since the decision to have insurance is highly likely made by the head of family. Then, let us see the effect of health insurance on health behaviors with the bigger groups of respondents available in the data. In this full sample, there are 25,470 respondents in wave 1 (year of 2000), 29,032 in wave 2 (2007), and 34,271 in wave 3 (2014). The full sample has 30.8 percent insured, 32.6 percent smokers, 5.6 percent are people with obesity, and 47.6 percent are male respondents, see Table 5 for the descriptive statistics.

Table 6.
Dependent Variable Correlations

	Insured	Smoker	Obese
insured	1.000		
smoker	-0.0290***	1.000	
obese	0.0616****	-0.0864***	1.000
Note: *** p<0.01, ** p<0.05, * p<0.1			

We can see in Table 6 that the interest variables are significantly correlated. This correlation indicates the possibility of ex ante moral hazard. There is also the possibility correlation between smoking and obesity. The health insurance has a negative effect on

smoking behavior, but the effect is not significant for obesity. These findings show that there is no evidence of the ex-ante moral hazard in health insurance. These are different from the results with previous sample.

Table 7.
Univariate, Bivariate, and Multivariate Probit Regressions for All Members of Households

Variables	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
	Insured	Smoker	Obese	Insured	Smoker	Insured	Obese	Insured	Smoker	Obese
insured		-0.142***	0.077***		-0.548**		-0.145		-0.106***	0.077
		(0.016)	(0.019)		(0.242)		(0.147)		(0.038)	(0.051)
bad_health	0.035**	0.009	-0.009	0.034**	0.013	0.041***	-0.006	0.041***	0.018	-0.009
	(0.014)	(0.019)	(0.022)	(0.014)	(0.019)	(0.014)	(0.022)	(0.014)	(0.019)	(0.022)
age_31_40	0.165***	0.052***	0.291***	0.165***	0.071***	0.168***	0.302***	0.168***	0.066***	0.291***
	(0.017)	(0.019)	(0.026)	(0.017)	(0.022)	(0.018)	(0.027)	(0.018)	(0.020)	(0.027)
age_41_50	0.254***	0.005	0.437***	0.255***	0.037	0.260***	0.454***	0.260***	0.025	0.438***
	(0.019)	(0.022)	(0.028)	(0.019)	(0.028)	(0.019)	(0.030)	(0.019)	(0.022)	(0.028)
age_51_60	0.253***	0.002	0.358***	0.256***	0.032	0.259***	0.375***	0.258***	0.019	0.359***
	(0.022)	(0.026)	(0.033)	(0.022)	(0.031)	(0.022)	(0.034)	(0.022)	(0.027)	(0.033)
age_60	0.240***	0.040	-0.008	0.246***	0.066*	0.249***	0.010	0.248***	0.069**	-0.008
	(0.025)	(0.032)	(0.044)	(0.025)	(0.035)	(0.026)	(0.046)	(0.026)	(0.033)	(0.044)
gender	-0.012	2.276***	-0.504***	-0.013	2.239***	-0.014	-0.502***	-0.013	2.291***	-0.504***
	(0.013)	(0.021)	(0.023)	(0.013)	(0.048)	(0.013)	(0.023)	(0.013)	(0.022)	(0.023)
married	0.029	0.074***	0.190***	0.030	0.078***	0.023	0.191***	0.024	0.055**	0.190***
	(0.020)	(0.023)	(0.036)	(0.020)	(0.022)	(0.020)	(0.036)	(0.020)	(0.023)	(0.036)
divorced	-0.208***	0.285***	0.001	-0.210***	0.256***	-0.190***	-0.012	-0.190***	0.286***	0.001
	(0.043)	(0.055)	(0.071)	(0.044)	(0.059)	(0.044)	(0.072)	(0.044)	(0.057)	(0.071)
widowed	0.037	0.443***	0.063	0.037	0.440***	0.033	0.065	0.033	0.429***	0.062
	(0.031)	(0.042)	(0.054)	(0.031)	(0.042)	(0.032)	(0.053)	(0.032)	(0.043)	(0.054)
chronic_disease	0.114***	-0.111***	0.185***	0.115***	-0.093***	0.113***	0.193***	0.113***	-0.109***	0.185***

Variables	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
	Insured	**Smoker**	**Obese**	**Insured**	**Smoker**	**Insured**	**Obese**	**Insured**	**Smoker**	**Obese**
	(0.012)	(0.016)	(0.018)	(0.012)	(0.020)	(0.012)	(0.019)	(0.012)	(0.016)	(0.018)
elementary	0.213***	-0.303***	0.190***	0.213***	-0.276***	0.225***	0.203***	0.225***	-0.309***	0.190***
	(0.023)	(0.031)	(0.040)	(0.023)	(0.037)	(0.023)	(0.042)	(0.023)	(0.032)	(0.040)
high_school	0.621***	-0.476***	0.320***	0.622***	-0.397***	0.630***	0.363***	0.631***	-0.490***	0.320***
	(0.024)	(0.034)	(0.043)	(0.025)	(0.062)	(0.025)	(0.053)	(0.025)	(0.035)	(0.044)
college	1.143***	-0.807***	0.474***	1.144***	-0.645***	1.146***	0.558***	1.146***	-0.825***	0.474***
	(0.029)	(0.040)	(0.048)	(0.029)	(0.112)	(0.030)	(0.074)	(0.030)	(0.043)	(0.052)
employed	0.154***	0.221***	-0.037	0.155***	0.239***	0.153***	-0.025	0.153***	0.181***	-0.038
	(0.020)	(0.027)	(0.030)	(0.020)	(0.028)	(0.021)	(0.031)	(0.021)	(0.028)	(0.030)
student	-0.036	-0.795***	-0.191***	-0.037	-0.787***	-0.038	-0.193***	-0.038	-0.824***	-0.191***
	(0.031)	(0.041)	(0.060)	(0.031)	(0.042)	(0.032)	(0.060)	(0.032)	(0.042)	(0.060)
housekeeping	0.064***	-0.043	0.074**	0.063***	-0.031	0.063***	0.079**	0.063***	-0.062*	0.073**
	(0.023)	(0.036)	(0.032)	(0.023)	(0.036)	(0.024)	(0.032)	(0.024)	(0.037)	(0.032)
retired	0.339***	-0.267***	0.014	0.338***	-0.218***	0.353***	0.041	0.353***	-0.318***	0.014
	(0.036)	(0.047)	(0.067)	(0.036)	(0.057)	(0.038)	(0.069)	(0.038)	(0.050)	(0.067)
unemployed	-0.325***	0.158***	-0.090	-0.327***	0.140***	-0.312***	-0.104	-0.312***	0.117**	-0.087
	(0.052)	(0.048)	(0.093)	(0.052)	(0.049)	(0.053)	(0.093)	(0.053)	(0.049)	(0.093)
rural	-0.086***	-0.011	-0.061***	-0.086***	-0.021	-0.086***	-0.066***	-0.085***	-0.010	-0.060***
	(0.011)	(0.013)	(0.017)	(0.011)	(0.014)	(0.011)	(0.018)	(0.011)	(0.014)	(0.017)
ln_hhexpenditure	0.017**	0.013	0.030***	0.017**	0.015*	0.016**	0.031***	0.016**	0.010	0.030***
	(0.007)	(0.008)	(0.010)	(0.007)	(0.008)	(0.007)	(0.010)	(0.007)	(0.008)	(0.010)
num_child	-0.011**	-0.003	0.000	-0.012**	-0.004	-0.010*	-0.001	-0.010*	-0.000	0.000

Variables	Univariate Probit (1)			Bivariate Probit (2)				Multivariate Probit (3)		
	Insured	**Smoker**	**Obese**	**Insured**	**Smoker**	**Insured**	**Obese**	**Insured**	**Smoker**	**Obese**
	(0.005)	(0.006)	(0.008)	(0.005)	(0.006)	(0.005)	(0.008)	(0.005)	(0.006)	(0.008)
wave2	0.513***	-0.027	0.264***	0.508***	0.028	0.519***	0.295***	0.519***	-0.036*	0.264***
	(0.017)	(0.018)	(0.025)	(0.018)	(0.038)	(0.017)	(0.032)	(0.017)	(0.019)	(0.026)
wave3	0.990***	-0.017	0.339***	0.988***	0.110	1.000***	0.409***	1.000***	-0.022	0.338***
	(0.016)	(0.019)	(0.027)	(0.017)	(0.079)	(0.017)	(0.054)	(0.017)	(0.022)	(0.030)
N	69839	69839	66958		69839		66958			66958
N_cluster	47195	47195	45438		47195		45438			45438
Wald chi^2	12913	16024	2276		29757		14403			30244
Prob > chi^2	0	0	0		0		0			0
Pseudo R^2	0.149	0.415	0.0950							
chi^2					2.572		2.221			18.93
rho					0.245		0.135			
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1										

The results from univariate probit in Table 7 column (1) indicate that having insurance has a negative impact (-0.142) on smoking and a positive impact (0.077) on being obese. The bivariate probit estimation, Table 7 column (2), shows that there is still a negative impact on smoking behavior, but the magnitude gets bigger. There is no effect from being insured on obesity: the coefficient becomes negative but insignificant. Both residuals correlations in these two-bivariate probits are insignificant, indicating that the non-observable determinants that affect the decision to have insurance are not correlated with those affecting either smoking or obesity decision. However, the results of both univariate and bivariate regressions ignore the possible correlation between insurance decision and lifestyle choices and the correlation between smoking and obesity decisions which lead to bias estimates. Therefore, we analyze using the multivariate probit taking into account the residuals to be freely correlated.

The multivariate probit, Table 7 column (3) shows that there is no ex ante moral hazard of insurance for smoking and obesity. Due to being insured, the propensity for becoming a smoker reduces, while having insurance has no effect on obesity decision. The results are different from Section 6.1 which we can see in Table 3 column (3). When we use the primary sample at the head of households, there is evidence for the existence of the ex-ante moral hazard for obesity and there is no effect of health insurance on smoking behavior.

Table 8.
Multivariate Probit Residuals Correlations

	Coef	P > |z|
rho21	-0.018	0.367
rho31	0.000	0.997
rho32	-0.052	0.000
Notes:Likelihood ratio test of rho21 = rho31 = rho32 = 0;		
chi2(3) = 18.9251 Prob > chi2 = 0.0003.		

The result in Table 8 also confirms that there are no residuals correlations between insurance decisions and either smoking or obesity. Indeed, the choices between smoking and obesity are considered substitutes due to the residuals, which are negatively correlated. This supports that non-observable determinants influencing the smoking decision are correlated to those influencing obesity.

Conclusion

This paper shows of the existence of ex ante moral hazard in health insurance for obesity but not for smoking using the primary sample, at the head of household level. However, the multivariate probit regressions for the full sample, including all the members of households, show different findings that there is no sufficient evidence of the existence of ex ante moral hazard.

Both regressions at the primary sample and the full sample have similar results in that the residuals are not significantly correlated for insurance and lifestyle equations. This supports the hypothesis that the non-observable elements influencing health insurance are not correlated to those affecting health behavior, smoking and obesity. However, the residuals between the smoking and the obesity equations are significantly correlated but negative. This confirms that there are unobserved determinants that increase the tendency to smoke but reduce the propensity to being obese, and vice versa. Therefore, the choices between smoking and obesity are somehow substitutes.

For further extension, it would be interesting to explore the use of different multivariate probit models which allow a multiple binary outcome. Rather than grouping by insurance coverage and conducting estimations separately, the regression could be done simultaneously for all types of insurance coverage. The recent conditional mixed-process by (Roodman, 2011) gave a possible estimation for a multinomial probit but not for a multivariate probit so this could be employed as the estimating method. Further analysis in understanding the role of insurance coverage as part of public sector compensation would be of interest to the design of those packages.

References

Agustiyanti. (2018). *Peserta BPJS tembus 200 juta jiwa*. CNN Indonesia.

Cappellari, L., & Jenkins, S. P. (2003). *Multivariate probit regression using simulated maximum likelihood*. The STATA Journal, 3(3), 278–294. https://doi.org/doi: 10.1177/1536867x0300300305

Courbage, C., & Coulon, A. de. (2004). *Prevention and private health insurance in the UK*. The Geneva Papers on Risk and Insurance-Issues and Practice, 29(4), 719–727. https://doi.org/https://doi.org/10.1111/j.1468-0440.2004.00313.x

Dave, D., & Kaestner, R. (2009). *Health insurance and ex ante moral hazard: evidence from Medicare*. International Journal of Health Care Finance and Economics, 9(4), 367–390. https://doi.org/10.1007/s10754-009-9056-4

Drope, J., Schluger, N., Cahn, Z., Drope, J., Hamill, S., Islami, F., Liber, A., Nargis, N., & Stoklosa, M. (2018). *The Tobacco Atlas. Atlanta: American Cancer Society and Vital Strategies.* In the American Cancer Society. Inc. Www. Tobaccoatlas. Org.

Ehrlich, I., & Becker, G. S. (1992). *Market insurance, self-insurance, and self-protection*. In Foundations of Insurance Economics (pp. 164–189). Springer. https://doi.org/10.1007/978-94-015-7957-5_8

Hidayat, B., & Thabrany, H. (2010). *Cigarette smoking in Indonesia: examination of a myopic model of addictive behaviour*. International Journal of Environmental Research and Public Health, 7(6), 2473–2485. https://doi.org/10.3390/ijerph7062473

National Secutity Act. (2004). *Undang-Undang Jaminan Sosial Nasional Nomor 40 Tahun 2004. The Government of Indonesia*. Kemkes.Go.Id.

RAND. (2012) *Indonesian Family Life Survey (IFLS)*. Accessed 19 April 2019

Report, T. F. (2018). *Healthcare and Social Security Agency (Badan Penyelenggara Jaminan Sosial Kesehatan)*. Bpjs-Kesehatan.Go.Id.

Riskesdas. (2018). *Ministry of Health of Republic of Indonesia*. Depkes.Go.Id.

Roodman, D. (2011). *Fitting fully observed recursive mixed-process models with cmp*. The Stata Journal, 11(2), 159–206. https://doi.org/doi: 10.1177/1536867X1101100202

Stanciole, A. E. (2008). *Health insurance and lifestyle choices: Identifying ex ante moral hazard in the US market*. The Geneva Papers on Risk and Insurance-Issues and Practice, 33(4), 627–644. https://doi.org/10.1057/gpp.2008.27

Tavares, A. I. (2014). *Health insurance and lifestyles*. *Applied Economics*, *46*(16), 1910–1923. https://doi.org/10.1080/00036846.2014.889803

WHO. (2021). *Noncommunicable diseases*.

Zweifel, P., & Manning, W. G. (2000). *Moral hazard and consumer incentives in health care*.

In Handbook of health economics (Vol. 1, pp. 409–459). Elsevier. https://doi.org/https://doi.org/10.1016/S1574-0064(00)80167-5