Health Care Utilization and Impacts of Illness on Ageing Populations

Suwimon Nunta
National Institute of Development Administration

Abstract The proportion of older citizens in the population of most countries throughout the world is increasing. Maintaining the well-being of this cohort usually demands more attention and resources. The elderly as a group are generally in poorer health than the rest of the population. They are more likely to suffer from disabilities and to visit the doctor more often. Those with chronic ailments in particular, need continuing treatment, and some require long-term care in a nursing facility. For this more intensified health care, a larger portion of their income goes to health care. To meet the higher and more frequent medical expenditures, individual or family savings are usually tapped. In developing countries, many elderly do not normally have enough earnings to cover recurring and higher health care expenditures. Fortunately, in many societies, including Thailand, the traditional value of intergeneration caring remains strong. The younger, productive generation takes care of the welfare of their parents and, in many cases, grandparents. Nevertheless, public health care and welfare spending, such as public insurance, will likely increase. The higher spending will be driven by the more frequent demand for health care from the growing number of elderly, chronically ill patients, and the higher cost of medical care. On top of this, governments are investing in improvements in health care systems and medical technology.

This article presents an advanced analysis of the utilization of health care in Thailand focusing on the demand for health care services and resources by the treatment of illnesses and chronic diseases of the elderly. The study takes a micro-analytic approach. An econometric model will be developed to analyze a bivariate effect. This would enable an inference of the incidences of chronic diseases and illnesses, health status of the population and health-related behavior (e.g., exercise). Additionally, health care utilization will be measured in the case of people who are admitted as inpatients for chronic diseases, e.g., hypertension, diabetes, heart conditions, and cancer. The analysis is disaggregated into different groups by occupation, age-cohort, economic status, and other attributes and informs a forecast of the magnitude of financial requirements of health care. The research results aid in the formulation of policy by providing the probability and magnitude of the elderly facing acute and chronic diseases.

Keywords: Health care utilization, bivariate probitmodel, poisson regression, chronic, illness, ageing

1. Introduction

In the 21st century, the graying of populations will be the most important demographic phenomenon. The proportion of older citizens in the population of most countries is rapidly increasing. In the Asia-Pacific region by 2025 there will be more than one billion people aged 60 and over, amounting to 14.4 percent of the region’s total population (United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), 1999). By 2050, there will be nearly two billion (Chan, 2005: 269). Among Asian countries, this demographic transition is becoming more pronounced in China, Japan, Singapore and the Republic of Korea. Thailand is now in the early stages of this shift. In 2005, 10.3 percent of the country's population was aged 60 and over. This cohort has been projected to increase to 11.8 percent, 14 percent, 16.8 percent, and 19.8 percent every five years from 2010, 2015, 2020, and 2025, respectively (Institute for Population and Social Research, Mahidol University, (2006). Furthermore, the ageing index is high in many countries along with life expectancy (see Table 1). This rapid increase in the proportion of the Thai elderly is a warning sign to the government to be well prepared to provide public health services.

Maintaining the well-being of the elderly usually demands more attention and resources. As a group the elderly are generally in poorer health than the rest of the population, more likely to suffer from a disability, and to visit the doctor more often. Those with chronic ailments need continuing treatment, and some require long-term care in a nursing facility. For this more intensified health care, a larger portion of their income goes to health care. To meet the higher and more frequent medical expenditures, individual or family savings are usually tapped. In developing countries, many elderly do not normally have sufficient savings to cover recurring and higher health care expenditures. Fortunately, the traditional value of intergeneration caring remains in many societies, as in Thailand., where the younger, productive generation takes care of their parents and, in many cases, grandparents. Nevertheless, public health care and welfare spending, such as for public insurance, will likely increase. The higher spending will be driven by the more frequent demand for health care from the growing number of elderly, chronically ill patients, and the higher cost of medical care. On top of this, governments are investing in improvements in health care systems and medical technology. The public health system in Thailand underwent a major reform in 2001, when the government launched the universal health coverage (UC) program that covered millions who formerly lacked health insurance. The program has proved to be beneficial and has, to some extent, lessened the financial burden for millions of poor people (Viroj NaRanong and Anchana NaRanong, 2006). Nevertheless, inequity in health care still exists, usually expressed in high morbidity and short life-expectancy among the poor.

This study proposes an advanced analysis of the utilization of health care services and takes into consideration the burden on the elderly from illnesses and chronic diseases. It takes a micro-analytic approach. An econometric model will be developed to analyze a bivariate effect. This would enable an inference of the incidences of chronic diseases and illnesses, health status of the population and health-related behavior (e.g., exercise). Moreover, health care utilization will be measured of people who have chronic diseases, such as hypertension, diabetes, heart conditions, and cancer, and who had been admitted as inpatients. The analysis will be made of different groups disaggregated into occupation, age-cohort, economic status, and other attributes. Finally, possible scenarios will be constructed based on the projections of demographic change, urbanization, and other changes in society. These exercises would inform the future financial requirements of health care. The research results aid in the formulation of policy by providing the probability and magnitude of elderly facing acute and chronic diseases.

Following this introduction in section 1, the rest of the paper has the following structure. Section 2 introduces the research methodology and the model used in this study. Section 3 describes the empirical study and the variables. And finally, section 4 contains some final remarks and conclusions.

Table 1. Population Ageing in Some Asian Countries, 2008

Country or Area	Mid-2008 Population (thousands)	Life Expectancy at Birth (years)		Percentage of Population Aged		Ageing Index
		Males	Females	0-14	60+	
China	1,336,311	71	75	20	12	58
Japan	128,026	79	86	14	29	212
Republic of Korea	48,607	76	82	17	15	89
Hong Kong	6,977	79	85	13	17	125
Cambodia	14,656	58	62	35	5	16
Indonesia	234,342	69	73	27	9	32
Lao PDR	5,963	63	66	37	5	14
Malaysia	27,663	72	77	30	7	25
Myanmar	49,221	59	65	26	8	32
Philippines	90,457	70	74	35	6	18
Singapore	4,490	78	82	17	15	85
Thailand	63,121	70	77	22	11	52
Vietnam	86,373	70	73	29	9	30

Source: 2008 ESCAP Population Data Sheet

2 Research Methodology

This paper contributes to the existing literature on health economics as well as to econometric methodology that is appropriate to the research on this field analysis. The measurements of the outcomes in health economics are often limited to dependent or qualitative variables. These variables are integer counts such as variables, e.g., the number of inpatients days or the number of visits to the doctor; and binary response variables, e.g. as in whether or not the individual has a chronic disease or whether or not the individual has taken medicines (Jones, 2007: 2-3). In this study, a bivariate probit model is adapted in which illness and chronic diseases dummy are dependent variables in the probability equations. Moreover, the poisson estimation technique is also applied to analyze the health care utilization in the case of people who have chronic diseases, e.g., hypertension, diabetes, heart conditions, and cancer.

2.1 Research Model

2.1.1 The Bivariate Probit Model

The bivariate probit model is applied when there are two separate binary outcome variables. Technically, two independent binary probit models are used and the results are estimated together. The relationship of the two outcomes is explained with some conditions on the explanatory variables, **x**. The relatedness occurs via the correlation of the errors between the binary outcome models. Generally, the two outcomes are determined by two latent variables, y_1^*, y_2^*, that are assumed to be linear functions of a set of explanatory variables, **x**.

$$y_1^* = \mathbf{x}_1'\beta_1 + \varepsilon_1,$$
$$y_2^* = \mathbf{x}_2'\beta_2 + \varepsilon_2, \qquad (1)$$

and the error terms, ε_1 and ε_2, are jointly normally distributed with mean of 0, the variances of 1 and the correlations of ρ (Cameron and Trivedi, 2009: 515; Greene, 2003: 710-712).

$$y_1 = \begin{cases} 1 \text{ if } y_2^* > 0 \\ 0 \text{ if } y_2^* > 0 \end{cases} \text{ and } \quad y_2 = \begin{cases} 1 \text{ if } y_2^* > 0 \\ 0 \text{ if } y_2^* > 0 \end{cases} \qquad (2)$$

$$E[\varepsilon_1 \mid \mathbf{x}_1,\mathbf{x}_2] = E[\varepsilon_2 \mid \mathbf{x}_1,\mathbf{x}_2] = 0,$$

$$\text{Var}[\varepsilon_1 \mid \mathbf{x}_1, \mathbf{x}_2] = \text{Var}[\varepsilon_2 \mid \mathbf{x}_1,\mathbf{x}_2] = 1,$$
$$\text{Cov}[\varepsilon_1, \varepsilon_2 \mid \mathbf{x}_1,\mathbf{x}_2] = \rho.$$

If ρ =0, the model would collapse into two separate probit models for y_1 and y_2. Essentially, if the two variables (or errors) are correlated, $\text{cov}(\varepsilon_1, \varepsilon_2) \neq 0$ then, for each individual *i*th, there are

$$\varepsilon_{1i} = \eta_i + u_{1i}$$
$$\varepsilon_{2i} = \eta_i + u_{2i}.$$

If it is assumed that all three types of errors are normally distributed, then the ε_{si} will also be normal. However, each ε_{si} depends on the value of η_i and they are related to one another. To find the joint probabilities between y_1 and y_2 from the standard model, there are

$$Pr(y_{1i} = 1) = Pr(\varepsilon_{1i} > -x_{1i}\beta_i)$$
$$= Pr(\varepsilon_{1i} + \eta_i > -x_{1i}\beta_i)$$

and

$$Pr(y_{2i} = 1) = Pr(\varepsilon_{2i} > -x_{2i}\beta_i)$$
$$= Pr(\varepsilon_{2i} + \eta_i > -x_{2i}\beta_i).$$

If y_1 and y_2 are independent,

$$Pr(y_1=1,y_2=1) = F(y_1) \text{ x } F(y_2)$$
$$Pr(y_0=1,y_2=1) = [1-F(y_1)] \text{ x } F(y_2)$$
$$Pr(y_0=1,y_2=0) = [1-F(y_1)] \text{ x } [1-F(y_2)].$$

The log-likelihood function is derived from these probabilities and the parameters are estimated by Maximum Likelihood estimation. Since they both depend on the value of η_i, the bivariate joint distribution will be considered for the joint probabilities of non-independent events (Davis, 2006: 1-14).

For two standard-normally distributed ε_is, the joint density will be:

$$\varphi(\varepsilon_1, \varepsilon_2) = \frac{1}{2\pi\sigma_{\square 1}\sigma_{\square 2}\sqrt{1-\sigma^2}} \exp\left[-\frac{1}{2}\left(\frac{\square_1^2 + \square_2^2 - 2\rho\square_1\square_2}{1-\rho^2}\right)\right]$$

(3)

where ρ is a correlation parameter.

2.1.2 Poisson Regression Model

Count data are not well estimated by using OLS regression because they seem to be non-normal (University of California at Los Angeles. UCLA Academic Technology Services. Statistical Consulting Group, 2006b). If the response variable is a count variable, the Poisson regression applied has been used widely to analyze this kind of data. Hence, y_i is a responsible variable to the equation with parameter λ_i related to the regressors x_i. The equation of the model is

$$\text{Prob}(Y_i = y_i \mid x_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!},\ y_i = 0, 1, 2, \ldots.$$

And the parameter λ_i is the loglinear model, $\ln\lambda_i = x_i'\beta$ which can be shown as

$$E[y_i \mid x_i] = \text{Var}[y_i \mid x_i] = \lambda_i = e^{x_i'\beta}, \quad (4)$$

then the marginal effect is:

$$\frac{\partial E[y_i \mid x_i]}{\partial x_i} = \lambda_i\beta. \quad (5)$$

The log-likelihood function is

$$\ln L = \sum_{i=1}^{n}[-\lambda_i + y_i x_i'\beta - \ln y_i!]$$

which is maximized by the maximum likelihood estimator (MLE).

The Poisson MLE solves the associated first order condition, and the likelihood equations are

$$\frac{\partial \ln L}{\partial \beta} = \sum_{i=1}^{n}(y_i - \lambda_i)\mathbf{x}_i = \mathbf{0}.$$

The estimates are given so the prediction for observation i is $\hat{\lambda}_i = \exp(x'\hat{\beta})$ (Greene, 2003: 740-741).

2.2 Definition

Some of the variables used in this paper are adapted from their definition. For instance, an illness is a disease of the body or the condition of being ill (Longman Dictionary of Contemporary English, 2009) Chronic disease, according to the definition of the U.S. National Center for Health Statistics, is a disease that lasts for a long time, at least three months or more (Medicinenet.com, 2009). It is also characterized as a disease that the patient cannot completely recover from and for which one has to receive consecutive treatments to control and prevent it from worsening (Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 24). The World Health Organization (WHO) defines a chronic disease as one that lasts for a long duration and is generally of slow progression. Chronic diseases tend to become more common with age. According to WHO, half of the 35 million people who died from chronic diseases were less than 70 years old and half of them were women. The major chronic diseases in developing countries are cardiovascular disease, i.e. stroke and heart attack; cancer, i.e. breast and colon cancer; diabetes; obesity; epilepsy and seizures; and oral health problems (WHO, 2010). In this study, according to the available data, a respondent who has diabetes or hypertension is considered to have a chronic disease. The result would thus be underestimated because of the lack of information on other chronic diseases.

Furthermore, the elderly are defined as those aged 60 and over. Additionally, older persons are separated into three subgroups, namely, the young-old group (aged 60-69 years), the old-old group (70-79 years), and the oldest-old group (80 years and over). The range of the age in this study starts at 45 years old. The study also compares the different effects of having health problems before and after retirement of the population.

2.3 Data Description

The datasets used in this research are from the Health and Welfare Survey (HWS) and Socio-Economic Survey (SES) in 2007 conducted by the National Statistical Office (NSO) of Thailand. They were conducted during the same period, January to December, 2007. The two datasets were merged by using a personal identification number with 69,679 individual observations from 21,539 households. This is in accordance with the number of HWS observations.

SES and HWS were designed as cross-section surveys and represent random samples of the population. In principle, each individual had an equal probability of being selected in the survey and each observation is independent. The total number of households can be obtained directly from these national representative samples and it can be used to extrapolate the results to the whole population. Merging the two datasets provided a full set of control variables comprising individual health problems, some socioeconomic variables, and some health risk behaviors, including a sedentary lifestyle, smoking, and drinking.

3. Empirical Study

This research is designed to use economic regression models to answer hypothetical questions. The objective of the study is to investigate health care utilization and identify the burden from chronic diseases and illnesses in the situation of rapidly increasing numbers of ageing people in the national population. The health status of individuals is identified by the probabilities of having a chronic disease and/or an illness. The probabilities of being ill are predicted in some conditions. Furthermore, the impact of chronic disease and illness of a household member on household wealth are clarified.

3.1 Description of the variables

The datasets used in this research were collected by the National Statistical Office (NSO) of Thailand. The datasets provide the necessary variables for the research. The first part of the empirical study is the analysis of people's health care status. This part uses the bivariate probit regression technique to explain the probabilities of being ill and having a chronic disease and to predict the probabilities of being ill with some conditions. In this part, the variables used to explain health status are being ill, having a chronic disease, gender, living area, asset group, age group, region, and work status. *ill1* is a dummy variable of being ill; *ill1* equals 1 if ill and 0 if not, *chronic* is a dummy variable of whether a person has a chronic disease or not, if *chronic* equals 1 the person has one or more of these diseases: diabetes, hypertension, heart disease, and cancer; if 0 the person does not have any particular disease; *female* equals 1 and male equals 0; *rural* equals 1 if people live in a non-municipal area, 0 if they live in a municipal area.

The second part analyzes health care utilization. The variables are chronic diseases, e.g., diabetes, cancer, heart problems, and hypertension; moreover, exercise is also introduced to the model. The other variables are the same as in the previous part.

3.2 Empirical Results

3.2.1 Estimation of probability of having illness and chronic diseases

The bivariate probit model considers two binary outcomes and the relatedness between outcomes in the form of the correlation of the error terms of the binary outcomes model (Cameron and Trivedi, 2009: 515; Greene, 2003: 710-712).

The two outcomes are determined by two unobserved latent variables,

$$y_1^* = x_1'\beta_1 + \varepsilon_1$$
$$y_2^* = x_2'\beta_2 + \varepsilon_2$$

where the error terms ε_1 and ε_2 are jointly normally distributed with means 0, variances 1, and correlation ρ. This technique is used to estimate the probability of someone who is reported as “having an illness” together with the probability of being a “chronic” patient with explanatory variables of his/her socioeconomic characteristics, e.g. gender, age and social status, such as occupation, work status, living area and social class.

In the bivariate probit model, the random error terms between two regression equations are assumed to be correlated. In this case, it is assumed that there are some correlations between chronic disease and illness. Hence, the correlation between the two outcomes is tested under the hypothesis H_0: $\rho = 0$. The two dependent variables used to analyze the binary outcomes are *ill1* and *chronic* representing those people who are having illnesses and chronic diseases respectively in 12 months before the interview. In this research model, dummy variable *ill1*equals 1 if someone is reporting having an illness and 0 otherwise, and *chronic* equals 1 if someone is reporting having a chronic disease and 0 otherwise. The explanatory variables are gender and age group. Other socio-economic variables are also applied, e.g., living area, occupation, region, asset group, and work status (see Appendix for the list of variables and their description).

The results of this analysis are shown in Table 2: Females have a significantly higher probability of having both illnesses and chronic diseases than males; people who live in rural areas have a higher chance of having illnesses than those who live in urban areas but this does not apply to the probability of having chronic diseases. Furthermore, the asset group categories show some important relationships with illness. (Of the five categories of asset group, the first category, _Iassetgr_250000, is omitted as a reference group). The result shows that a person who has more assets has less probability of having an illness. This implies that, in general, the wealthier a person is, the healthier he or she will be. However, asset does not have the same impact on having chronic diseases as it does on illness. It cannot be concluded from the results that one who has more assets will have less probability of having chronic diseases, but it does show a higher probability of having chronic diseases in the higher asset group. The reason could be that some chronic diseases such as diabetes, cancer, obesity, cardiovascular diseases are associated with a number of health risk factors such as dietary habits, physical activity, and personal behavior (Puska, Waxman and Porter, 2010: 1-2). Age group has a significant impact on the probability of having illnesses and chronic diseases. In the older age groups relative to the youngest group age below 59 years, the probability of having illnesses is 18.8 percent, 32.1 percent, 25.2 percent and the probability of having chronic diseases is 30.4 percent, 38 percent, 25[1] percent higher than the youngest group in the young-old, the old-old, and the oldest-old group, respectively, with 99 percent significance. Furthermore, people who live in the northern part of Thailand have a significantly higher probability of having both illnesses and chronic diseases than those who live in the Bangkok metropolitan area.

From the hypothesis testing of bivariate probit, the result is significantly different from zero of rho; rho is equal to 0.42.

[1] 70 percent significance

This means that there is some covariance of error terms between the probability of having illnesses and having chronic diseases. The conditional probability analysis after probit regression shows that the probability of having illness together with chronic disease (p11) is 9.8 percent; the probability of being ill with no chronic disease (p10) is 17.67 percent; the probability of having chronic diseases but not being ill (p01) is 8.9 percent; and the probability of having neither having illness nor chronic disease (p00) is 63.63 percent. These results show the high probability of having health problem in the ageing population; 37 percent have either illness or chronic diseases.

Table 2. Bivariate Probit Regression Result

Bivariate probit regression					Number of obs =	24725
					Wald chi2(46) =	1654.30
Log likelihood = -24798.708					Prob> chi2 =	0.0000

	Coef.	Std. Err.	Z	P>|z|	[95 percent Conf. Interval]	
ill1						
Female	0.262218	0.0197292	13.29	0.000	0.22355	0.300887
Rural	0.034938	0.0189323	1.85	0.065	-0.00217	0.072044
_Iass~500000	0.170427	0.0298188	5.72	0.000	0.111983	0.228871
_Ias~1000000	0.106555	0.0279298	3.82	0.000	0.051813	0.161296
_Ia~10000000	0.048543	0.0259641	1.87	0.062	-0.00235	0.099431
_Ia~45000000	-0.03472	0.1051338	-0.33	0.741	-0.24078	0.171337
_Iagegr_69	0.187677	0.0225989	8.30	0.000	0.143384	0.23197
_Iagegr_79	0.320925	0.0284366	11.29	0.000	0.26519	0.37666
_Iagegr_99	0.251875	0.0425761	5.92	0.000	0.168427	0.335322
_Ireg_2	0.097953	0.0446611	2.19	0.028	0.010419	0.185487
_Ireg_3	0.227923	0.0447666	5.09	0.000	0.140182	0.315664
_Ireg_4	0.045112	0.0451548	1.00	0.318	-0.04339	0.133614

_Ireg_5	0.026399	0.0484514	0.54	0.586	-0.06856	0.121362
_Iocc_2	0.04126	0.0568588	0.73	0.468	-0.07018	0.152701
_Iocc_3	0.013687	0.0952954	0.14	0.886	-0.17309	0.200463
_Iocc_4	0.04686	0.0399516	1.17	0.241	-0.03144	0.125164
_Iocc_5	-0.01355	0.0362166	-0.37	0.708	-0.08454	0.057431
_Iocc_6	0.067998	0.0511239	1.33	0.183	-0.0322	0.168199
_Iocc_7	0.013584	0.0644111	0.21	0.833	-0.11266	0.139828
_Iocc_8	0.136558	0.0456303	2.99	0.003	0.047124	0.225991
_Iocc_9	0.214278	0.0491693	4.36	0.000	0.117908	0.310648
_Iwkstatus_1	0.142419	0.0356577	3.99	0.000	0.072531	0.212306
_Iwkstatus_2	0.045583	0.0496863	0.92	0.359	-0.0518	0.142966
_cons	-1.17777	0.060647	-19.42	0.000	-1.29664	-1.0589
chronic						
Female	0.35488	0.0219208	16.19	0.000	0.311916	0.397844
Rural	-0.06452	0.0208624	-3.09	0.002	-0.10541	-0.02363
_Iass~500000	0.158126	0.0333305	4.74	0.000	0.092799	0.223453
_Ias~1000000	0.171341	0.0307601	5.57	0.000	0.111053	0.23163
_Ia~10000000	0.235569	0.0279054	8.44	0.000	0.180876	0.290263

_Ia~45000000	0.299393	0.1044917	2.87	0.004	0.094594	0.504193
_Iagegr_69	0.304099	0.0244293	12.45	0.000	0.256219	0.35198
_Iagegr_79	0.380307	0.0300955	12.64	0.000	0.321321	0.439293
_Iagegr_99	0.052353	0.0465432	1.12	0.261	-0.03887	0.143576
_Ireg_2	0.153525	0.0475747	3.23	0.001	0.060281	0.24677
_Ireg_3	0.120786	0.0479496	2.52	0.012	0.026806	0.214765
_Ireg_4	-0.03812	0.0484568	-0.79	0.431	-0.13309	0.056853
_Ireg_5	-0.03298	0.0523364	-0.63	0.529	-0.13556	0.069598
_Iocc_2	-0.05892	0.064637	-0.91	0.362	-0.18561	0.067765
_Iocc_3	0.023615	0.1057786	0.22	0.823	-0.18371	0.230937
_Iocc_4	0.088134	0.0433291	2.03	0.042	0.003211	0.173058
_Iocc_5	-0.09938	0.0402985	-2.47	0.014	-0.17836	-0.0204
_Iocc_6	0.036028	0.0576264	0.63	0.532	-0.07692	0.148974
_Iocc_7	-0.08404	0.0764318	-1.10	0.272	-0.23385	0.065759
_Iocc_8	-0.02273	0.0518947	-0.44	0.661	-0.12445	0.078978
_Iocc_9	0.396318	0.0551931	7.18	0.000	0.288142	0.504495
_Iwkstatus_1	0.204966	0.0416904	4.92	0.000	0.123254	0.286677
_Iwkstatus_2	0.109697	0.0576883	1.90	0.057	-0.00337	0.222764

_cons	-1.59327	0.0673033	-23.67	0.000	-1.72518	-1.46136
/athrho	0.453739	0.0130027	34.90	0.000	0.428255	0.479224
rho	0.424968	0.0106544			0.403862	0.445622

Likelihood-ratio test of rho=0: chi2(1) = 1313.71 Prob> chi2 = 0.0000

Table 3. Outcome Variables and Predicted Probabilities from Bivariate Probit Regression

Variable	Obs	Mean	Std. Dev.	Min	Max
ill1	24725	0.274459	0.44625	0	1
chronic	24725	0.1871385	0.390031	0	1
biprob1	24725	0.2742663	0.075557	0.112662	0.546823
biprob2	24725	0.1870205	0.090145	0.036304	0.496472
biprob11	24725	0.0976475	0.05467	0.015177	0.285352
biprob10	24725	0.1766188	0.032817	0.082569	0.309528
biprob01	24725	0.089373	0.038137	0.020978	0.251047
biprob00	24725	0.6363607	0.105312	0.350713	0.854844

3.2.2 Health Care Utilization

The utilization of health care services is measured in many forms, such as the number of times an individual visits the doctor during a given period, the number of prescriptions dispensed to a patient, or the number of days admitted to the hospital as an inpatient (Jones, 2007: 49). The analytical tool is poisson regression and the purpose is to analyze the severity of a particular chronic disease. Severity of a disease is an indication of its being a burden to the individual and the public health system. In this analysis, the variable "exercise" is introduced in the model. The purpose is to assess the effect of exercise on the severity of a disease, specifically, to compare how many days the patient spends in the hospital as an inpatient, with and without performing exercises. The response variable is the number of days the respondent had been admitted to the hospital as an inpatient 12 months before the interview (*ipday*). The predictor variables, or those that may have an effect on the number of inpatient days, are diabetes (*diabetes*), cancer (*cancer*), heart problem (*heartpb*), hypertension (*hyperts*), gender (*female*), living area (*rural*), exercise (*exercise*), age cohort (*agegr*), income class (*assetgr*), health insurance scheme (*insscheme*), work status (*wkstatus*), and region (*reg*).

The results, which appear in Table 4, show the poisson regression coefficient comparing a person who has the particular characteristic predictor variables with one who does not have those characteristics, with the other variables held constant in the model. The difference in the logs of expected inpatient days is expected to be 0.14 units higher for a person who has diabetes compared to one who does not. A person who has cancer has logs of expected inpatient days 0.63 units higher than one who does not. Similarly, a person who has a heart condition has logs of expected inpatient days 0.19 units higher than one who does not. However, a person who has hypertension has logs of expected inpatient days 0.01 units lower than one who does not have this disease. This means that a person with hypertension has less probability of being admitted to hospital than one without hypertension. This result is not surprising because hypertension is not a serious chronic problem. But one who does not have hypertension may have other more severe diseases such as diabetes. However, from the analysis sample, 43.31 percent have both hypertension and diabetes.

As to gender and area of residence, the difference in the logs of expected inpatient days is expected to be less for females than males by 0.20 units, while a person who lives in a rural area has logs of expected inpatient days 0.09 shorter than one who lives in an urban area. By age group, the oldest-old has logs of expected inpatient days 0.13 units higher than the youngest group, whose age is less than 60. In comparison between the regions and the Bangkok metropolis, the logs of expected inpatient days for a person who does not live in the Bangkok Metropolis is expected to be lower than for one who lives there, and a person who lives in the southern part of Thailand seems to be healthier than those living elsewhere. It was also revealed that patients insured under a private, government, or state enterprise insurance scheme tend to stay in the hospital longer.

The results could be described in another form: the term of incidence rate ratios (irr) or the log of the ratio of expected count could be used to explain each event. For instance, a person who has diabetes is expected to have a rate 1.155 times longer inpatient days than one without diabetes, other variables being held constant. A person who has cancer would have a rate 1.874 times longer inpatient days than one who does not, and a person with a heart condition would have a rate 1.208 times longer inpatient days than someone with a healthy heart. On the other hand, a person who has hypertension is expected to have a rate 0.905 times shorter than one who does not have hypertension. The finding on the exercise variable confirms the value of exercise: a person who performs some exercise is expected to stay in the hospital 0.815 inpatient days less than someone that does not.

Overall, the results indicate that persons who have health problems are expected to spend more days as an inpatient than those who are healthier. By age group, the oldest-old group is expected to stay in hospital 1.141 times longer than the youngest group (age less than 60) and the oldest-old group has the highest probability of staying longer as an inpatient than the other age groups.

Table 4. Poisson Regression Result

Poisson regression					Number of obs =	2031
					LR chi2(25) =	1342.51
					Prob> chi2 =	0.0000
Log likelihood = -10186.924					Pseudo R2 =	0.0618

Ipday	Coef.	Std. Err.	z	P>|z|	[95 percent Conf. Interval]	
Diabetes	0.144523	0.0275336	5.25	0.000	0.090558	0.198488
Cancer	0.62807	0.0325237	19.31	0.000	0.564325	0.691815
Heartpb	0.189351	0.0233084	8.12	0.000	0.143667	0.235035
Hyperts	-0.09993	0.0236827	-4.22	0.000	-0.14635	-0.05352
Female	-0.19505	0.0191759	-10.17	0.000	-0.23264	-0.15747
Rural	-0.09401	0.0191233	-4.92	0.000	-0.13149	-0.05653
Exercise	-0.20517	0.0209258	-9.80	0.000	-0.24619	-0.16416
_Iagegr_69	-0.03584	0.0246049	-1.46	0.145	-0.08406	0.012389
_Iagegr_79	-0.18879	0.0274728	-6.87	0.000	-0.24263	-0.13494
_Iagegr_99	0.131878	0.0324702	4.06	0.000	0.068237	0.195518
_Iass~500000	0.028126	0.0296951	0.95	0.344	-0.03008	0.086327
_Ias~1000000	-0.03807	0.0293328	-1.30	0.194	-0.09556	0.019424
_Ia~10000000	0.046591	0.0258522	1.80	0.072	-0.00408	0.097261
_Ia~45000000	-0.43746	0.0994668	-4.40	0.000	-0.63241	-0.24251

_Iinsschem~1	0.056989	0.0824335	0.69	0.489	-0.10458	0.218555
_Iinsschem~2	-0.11753	0.0999922	-1.18	0.240	-0.31351	0.078455
_Iinsschem~3	0.18774	0.0834664	2.25	0.024	0.024149	0.351331
_Iinsschem~4	0.421897	0.1185516	3.56	0.000	0.18954	0.654254
_Iwkstatus_1	-0.34995	0.0231262	-15.13	0.000	-0.39528	-0.30463
_Iwkstatus_2	-0.52966	0.0484666	-10.93	0.000	-0.62465	-0.43467
_Iwkstatus_3	-0.20795	0.0419164	-4.96	0.000	-0.2901	-0.1258
_Ireg_2	-0.243	0.049271	-4.93	0.000	-0.33957	-0.14644
_Ireg_3	-0.40603	0.0497206	-8.17	0.000	-0.50348	-0.30858
_Ireg_4	-0.41802	0.0496053	-8.43	0.000	-0.51524	-0.32079
_Ireg_5	-0.43415	0.0545274	-7.96	0.000	-0.54102	-0.32727
_cons	2.438575	0.0959212	25.42	0.000	2.250573	2.626577

Table 5. in IRR form

Poisson regression					Number of obs	= 2031
					LR chi2(25)	= 1342.51
					Prob> chi2	= 0.0000
Log likelihood = -10186.924					Pseudo R2	= 0.0618

Ipday	IRR	Std. Err.	z	P>|z|	[95 percent Conf. Interval]	
Diabetes	1.155488	0.0318147	5.25	0.000	1.094785	1.219557
Cancer	1.87399	0.060949	19.31	0.000	1.75826	1.997338
Heartpb	1.208465	0.0281674	8.12	0.000	1.1545	1.264953
Hyperts	0.904899	0.0214305	-4.22	0.000	0.863855	0.947892
Female	0.822791	0.0157778	-10.17	0.000	0.792441	0.854303
Rural	0.910276	0.0174075	-4.92	0.000	0.87679	0.945042
Exercise	0.814507	0.0170442	-9.80	0.000	0.781776	0.848607
_Iagegr_69	0.964799	0.0237388	-1.46	0.145	0.919376	1.012466
_Iagegr_79	0.827965	0.0227465	-6.87	0.000	0.784561	0.873769
_Iagegr_99	1.140969	0.0370475	4.06	0.000	1.070619	1.215941
_Iass~500000	1.028525	0.0305422	0.95	0.344	0.970372	1.090163
_Ias~1000000	0.962649	0.0282371	-1.30	0.194	0.908866	1.019614
_Ia~10000000	1.047694	0.0270852	1.80	0.072	0.99593	1.102148
_Ia~45000000	0.645672	0.064223	-4.40	0.000	0.531307	0.784654

_Iinsschem~1	1.058644	0.0872677	0.69	0.489	0.900705	1.244278
_Iinsschem~2	0.889117	0.0889048	-1.18	0.240	0.730879	1.081615
_Iinsschem~3	1.20652	0.1007038	2.25	0.024	1.024443	1.420958
_Iinsschem~4	1.524851	0.1807735	3.56	0.000	1.208693	1.923706
_Iwkstatus_1	0.704721	0.0162975	-15.13	0.000	0.673492	0.737399
_Iwkstatus_2	0.588805	0.0285374	-10.93	0.000	0.535447	0.64748
_Iwkstatus_3	0.812248	0.0340465	-4.96	0.000	0.748185	0.881795
_Ireg_2	0.784268	0.0386417	-4.93	0.000	0.712074	0.863782
_Ireg_3	0.66629	0.0331283	-8.17	0.000	0.604423	0.734489
_Ireg_4	0.658352	0.0326578	-8.43	0.000	0.597357	0.725575
_Ireg_5	0.647818	0.0353239	-7.96	0.000	0.582156	0.720887

4. Conclusion

The health status of an individual is clarified by the bivariate effect of having chronic and acute illness. Since economic status has an influence on an individual's health status, the probability of having an illness is less in a person with a high income. Therefore, it could be said that in general, wealthier people tend to be healthier than poorer people. However, the same conclusion does not apply to chronic disease, probably because some chronic diseases or disorders, such as diabetes, cancer, obesity, and cardiovascular diseases are associated with health risk factors such as improper or poor dietary habits, a sedentary lifestyle, or personal behavior. Age has a significant impact on the likelihood of a person having an illness or chronic disease; the older a person is, the more likely it is that he or she will have an illness and/or chronic disease. The observed covariance of error terms between the probabilities of having illness and having chronic diseases indicates the interdependence of the two adoption decisions, which has an important implication on a public health care policy. The ageing population in Thailand has an almost 37 percent probability of contracting an illness and developing a chronic disease. This situation is already rather serious and it demands urgent attention in health care policy. A 17.6 percent probability of having only a chronic disease should not be ignored either.

Chronic disease and acute illness affect household wealth. If a household member has a chronic disease or an acute illness, the household wealth is certain to become depleted, because health care is expensive and is becoming even more so due to advances in treatment and medical technology. Yet too many people cannot afford the medication they need, with some prescription medicines accounting for large share of out-of-pocket medical expenses. Households with a high dependency ratio (the ratio of working age to non-working age members such as the young and the aged) should prepare an effective contingency plan for unexpected medical expenses.

The utilization of health care services by people who have a chronic disease or an illness is also an important concern. From the empirical study, people with these health problems stay in hospital longer than those who reported they had neither problem. Gender and location of residence, as well, are related to health care utilization; males and people who live in municipal areas are expected to stay longer in hospital. Age definitely is a major factor: in the age group analysis, the oldest-old group is expected to stay 1.558 times longer than the youngest group. This finding highlights the vulnerability of the elderly, which suggests a different and special type of care and health service for this population group.

Finally, it has been shown that persons who exercise are expected to have an inpatient time 0.874 times shorter than those who are less active. Exercise, therefore, is an important element in the public health care program; it makes the public healthier and reduces the burden on the national health care system.

References

Cameron, A. Colin and Trivedi, Pravin K. 2009. **Microeconometrics Using Stata**. College Station: Stata Press Publication.

Chan, Angelique. 2005. Aging in Southeast and East Asia: Issues and Policy Directions. **Journal of Cross-Cultural Gerontology**. 20 (4): 269-284.

Davis, David R. 2006. POLS570 - Limited Dependent Variables: Bivariate Probit. Retrieved 20 December, 2008 from http://userwww.service.emory.edu/~poldd/bivprobit.pdf

Foundation of Thai Gerontology Research and Development Institute (TGRI). 2007. **Situation of the Thai Elderly 2006**. Bangkok: TGRI.

Greene, William H. 2003. **Econometric Analysis**. Upper Saddle River, New Jersey: Pearson Education.

Jones, Andrew. 2007. **Applied Econometrics for Health Economists: A Practical Guide**. 2nd ed. Oxford: Radcliffe.

Longman Dictionary of Contemporary English Online. Accessed 30/11/2009 from http://www.ldoceonline.com/dictionary/illness

Mahidol University. Institute for Population and Social Research. 2006. Mahidol University Population Projections for Thailand, 2005 - 2025. Retrieved 10 October, 2009 from http://www.ipsr.mahidol.ac.th/IPSR/AllAboutPopulation/Projection2005/

Medicinenet.com. 2009. Definition of chronic disease. Medicinenet Inc. Accessed 30/11/2009 from http://www.medterms.com/script/main/art.asp?articlekey=33490

Puska, P., Waxman, A., and Porter, D. 2010. The Global Strategy on Diet, Physical Activity and Health. World Health Organization (WHO). Retrieved 22 February, 2010 from http://www.who.int/dietphysicalactivity/publications/facts/chronic/en/index.html

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 1999. Population Ageing and Development: Implications for Asia and the Pacific, 1999. Retrieved 20 October, 2008 from http://unescap.org/ageing

University of California at Los Angeles. UCLA Academic Technology Services. Statistical Consulting Group. 2006b. Stata Data Analysis Examples: Poisson Regression. Retrieved 20 October, 2008 from http://www.ats.ucla.edu/stat/stata/dae/poissonreg.htm

Viroj NaRanong and Anchana NaRanong. 2006. Universal Health Care Coverage: Impacts of the 30-Baht Health-Care Scheme on the Poor in Thailand. **TDRI Quarterly Review**. 21 (3): 3-10.

World Health Organization (WHO). 2010. Chronic Diseases and Health Promotion. Retrieved 22 February, 2010 from http://www.who.int/chp/en/index.html

APPENDIX

Variables Used in the Study

Variable	Description
ill1	Illness=1, no illness=0
chronic	Chronic=1, no chronic=0
diabetes	One has diabetes =1, otherwise = 0
cancer	One has cancer =1, otherwise = 0
heartpb	One has heart problem =1, otherwise = 0
hyperts	One has hypertension = 1, otherwise = 0
female	Female=1, male=0
rural	Rural=1, urban=0
age	Age
ipday	Admission days as inpatient
_Iass~250000	Those have assets between 0-250,000 Baht*
_Iass~500000	Those have assets between 250,001-500,000 Baht*
_Ias~1000000	Those have assets between 500,001-1,000,000 Baht*
_Ias~10000000	Those have assets between 1,000,00-10,000,000 Baht*
_Ia~45000000	have asset > 10,000,000 Baht*
_Iagegr_59	Aged 45-59 years old
_Iagegr_69	Aged 60-69 years old (young old)
_Iagegr_79	Aged 70-79 years old (old old)
_Iagegr_99	Aged 80-99 years old (oldest old)
_Iwkstatus_0	Unemployed
_Iwkstatus_1	Employer
_Iwkstatus_2	Government and state enterprise employee
_Iwkstatus_3	Private company employee
_Ireg_1	Bangkok Metropolis
_Ireg_2	Central region
_Ireg_3	northern region
_Ireg_4	northeastern region
_Ireg_5	southern region
_Iocc_1	economically inactive occupation
_Iocc_2	legislators, senior officials
_Iocc_3	professionals, technicians and associate professionals
_Iocc_4	clerks and secretarial workers

_Iocc_5	service workers/shop and market
_Iocc_6	skilled agricultural and fishery workers
_Iocc_7	craftspersons and related workers
_Iocc_8	plant and machine operators and assemblers
_Iocc_9	elementary occupation
_Iedu_1	primary education level
_Iedu_2	lower secondary/vocational level
_Iedu_3	upper secondary education/vocational level
_Iedu_4	high vocational level
_Iedu_5	Bachelor’s degree level
_Iedu_6	Master’s degree and higher education level
insscheme_1	no health insurance
insscheme_2	universal health care (UCS)
insscheme_3	social security scheme (SSS)
insscheme_4	civil servant medical benefit scheme (CSMBS)
insscheme_5	private insurance

*1 $ US ≈ 33 Thai Baht