

Honda, Chika; Ohkusa, Yasushi

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Discussion Paper No. 546

**INTERNATIONAL COMPARISON
OF SUBJECTIVE HEALTH EVALUATION
– USA, UK AND JAPAN –**

Chika Honda
and
Yasushi Ohkusa

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The Institute of Social and Economic Research
Osaka University
6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

International Comparison of Subjective Health Evaluation -USA, UK and Japan-

Chika Honda

Yao Public Health Centre, Osaka Prefecture

and

Yasushi Ohkusa

Institute of Social and Economic Research, Osaka University

Abstract

This paper tries to calculate quality of life (QOL) from subjective health evaluations in Japan following Cutler and Richardson (1997) and Groot (2000). It then extends the model in several ways. Firstly, while previous studies define the domain of QOL in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents, this paper suggests a more rigorous alternative measure. Secondly, heterogeneity among individuals that is inevitable in micro-data is accounted for in the estimation process. Thirdly, economic variables such as income or job status that are considered to affect subjective health status are also accounted for. The estimation results show the following: using the same model as previous work, similar tendencies are found, but coefficients are smaller for many symptoms and diseases. Economic variables help to clarify the effect of symptoms or diseases on subjective health evaluation. The QOL measures defined in this paper are smaller for most symptoms and diseases, and thus the measures in previous research are likely to overestimate of damage to QOL by symptoms and diseases and may be inappropriate.

JEL Classifications:

Correspondence: Yasushi Ohkusa, Institute of Social and Economic Research, Osaka University, 6-1 Mihogaoka Ibaraki Osaka, Japan

Tel: 81-6-6879-8566 Fax: 81-6-6878-2766

e-mail: ohkusa@iser.osaka-u.ac.jp

1 Introduction

Cost effectiveness analysis has been widely used in evaluation of new medical technology and in analysis of health policy. Though QALYs, DALYs and other methods are used to measure outcomes, each method has issues to be clarified. The Rating Scale, the Standard Gamble and the Time Trade-Off are the most widely used methods [1].

In the Rating Scale approach, there are several ways to ask subjects to describe preferences. The scale can have numbers, categories, or a ten-centimetre line on a page. Health states are placed between two clearly defined endpoints on a line. The most preferred health state is placed at one end and the least preferred at the other end. Though this method is relatively easy for subjects to understand, it is subject to measurement biases.

The Standard Gamble measure asks for preference under uncertainty. Alternative 1 is a treatment for a given health state with two possible outcomes: to live healthily for an additional t years with probability p , and to die immediately with probability $(1 - p)$. Alternative 2 is to live an additional t years with the given state. Probability p is varied until the respondent feels indifferent between two alternatives, and the preference score for the health state is p . This is based on the fundamental axioms of utility theory of Von Neumann and Morgenstern and although theoretically justified, it is complicated for general population to comprehend.

The Time Trade-Off method asks subjects to select from two alternatives. One is to live with state i for t years followed by death, and the other is to live healthily for x years (where $x < t$) followed by death. x is varied until the respondent is indifferent between two alternatives. The preference for state i is x/t . This also has some minor difficulties [2,3].

When the focus of analysis is a whole society or other aggregate, for both technical and cost considerations it is no longer possible to ask such complex questions. Subjective health status analysis is an efficient approach, but several issues remain. As the answer is subjective, comparability among different individuals is problematic, i.e. it is impossible

to sum up across a whole society. Fortunately, surveys of this kind have been performed over a long period, and some knowledge about bias by age and sex has been collected [3-6].

What is of more concern in evaluation of disease-related cost and medicine is adaptation to illness. The longer a person suffers from a disease, the smaller is the loss caused by the disease likely to be recognized. This tendency is not specific to this kind of model, and is also observed in QOL evaluations involving the difference among people with and without a disease [7].

In this paper, we try to calculate QOL from subjective health evaluation in Japan following Cutler and Richardson [3] and Groot [4], and then extend the model in several ways. Firstly, while previous studies define the domain of QOL in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents, this paper suggests a more rigorous alternative measure. Secondly, heterogeneity among individuals, inevitable in micro-data, is accounted for in the estimation process. Thirdly, economic variables such as income or job status are used as variables.

This paper is organized as follows. In the next section, the data used in this paper are explained, and then the proposed estimation models are shown in Section 3. The QOL definition is shown in Section 4, and in Sections 5 and 6 the results of the estimation of QOL are shown.

2 Data

A Living Standard Survey has been conducted every three years since 1986. The purpose of the survey is to investigate health, medical services, pensions, welfare, incomes and other factors affecting living standards. Questionnaires consist of four parts - family, individual, income and saving components. The number of subjects in the family and individual parts is approximately 780,000 individuals (280,000 families), selected randomly, and that of the income and saving surveys is approximately 120,000 individuals (40,000 families), also

selected randomly. The data used in this study were collected in 1998.

Subjective health responses range from excellent to good, fair, poor and very poor. In previous studies, respondents were asked to evaluate their health in comparison with their age peers. Note that in Cutler and Richardson [23], subjective health is measured in the opposite order.

Symptoms and diseases are surveyed in more detail than in other studies. Symptoms are fever, fatigue, sleeplessness, irritation, failing memory, headache, dizziness, bleary eyes, difficulty in seeing, tinnitus, difficulty in hearing, palpitation, difficulty in breathing, chest pain, coughs and sputum expectoration, the sniffles, noisy breathing, retching, diarrhoea, constipation, appetite lost, stomach ache, haemorrhoids, toothache, dental problems, difficulty in chewing, rash, itching, stiff shoulder, back pain, arthralgia, impairments of hands and feet, numbness, frigid hands and feet, foot edema, disuria, frequent urination, incontinence, paramenia/merorrhagia, broken bones and sprain, wounds, and other symptoms. The respondents mark the symptoms multiply, but the survey does not have information about whether they have considered seeing a doctor, or the seriousness of the symptoms.

Diseases they suffer from and are consulting a doctor about are diabetes, obesity, hyperlipidaemia, diseases of thyroid gland, dementia, psychosis, neurosis, autonomic imbalance, cataracts, retinopathy, tympanitis, deafness, hypertension, stroke, angina/AMI, other circulatory problems, acute nasopharyngitis, allergic rhinitis, asthma, other respiratory problems, gastritis/duodenitis, gastric/duodenal ulcer, hepatitis/cirrhosis, cholelithiasis/cholecystitis, other digestive problems, tooth decay, oral problems, atopic dermatitis, contact dermatitis, urticaria, boldness, gout, chronic rheumatoid arthritis, arthritis, stiff shoulder, lumbago, osteoporosis, kidney problems, prostatic hypertrophy, pre-menopausal or post-menopausal problems, fractures, injuries and burns, anaemia/haemopathy, malignant neoplasm, pregnancy, and others. The respondents also mark the symptoms multiply, and they choose the one that is of most concern.

3 Models for estimation

The basic models following previous studies are as follows. The dependent variable H_i is defined to be 1 when the i th individual assesses his or her health to be excellent, 2 good, 3 fair, 4 poor and 5 very poor. The independent variables are as follows. The vector X_i represents demographic characteristics. D_i defines diseases they suffer and S_i indicates their symptoms. The estimation method is the ordered probit method with

$$\begin{aligned}
 H_i^* &= \alpha_0 + X_i\alpha_X + D_i\alpha_D + S_i\alpha_S + \varepsilon_i \\
 H_i &= \begin{cases} 1 & \text{if } H_i^* < 0 \\ 2 & \text{if } H_i^* > 0 \text{ \& } H_i^* < C_2 \\ 3 & \text{if } H_i^* > C_2 \text{ \& } H_i^* < C_3 \\ 4 & \text{if } H_i^* > C_3 \text{ \& } H_i^* < C_4 \\ 5 & \text{if } H_i^* > C_4 \end{cases} \quad (1)
 \end{aligned}$$

where C_1 , the threshold between $H_i = 0$ and $H_i = 1$, is normalized to be 0.

Groot [4] extended the ordered probit model to explain the change in the threshold of subjective health according to these conditions:

$$\begin{aligned}
 H_i^* &= \alpha_0 + X_i\alpha_X + D_i\alpha_D + S_i\alpha_S + \varepsilon_i \\
 H_i &= \begin{cases} 1 & \text{if } H_i^* < 0 \\ 2 & \text{if } H_i^* > 0 \text{ \& } H_i^* < \beta_0^2 + X_i\beta_X^2 + D_i\beta_D^2 + S_i\beta_S^2 \\ 3 & \text{if } H_i^* > \beta_0^2 + X_i\beta_X^2 + D_i\beta_D^2 + S_i\beta_S^2 \text{ \& } H_i^* < \beta_0^3 + X_i\beta_X^3 + D_i\beta_D^3 + S_i\beta_S^3 \\ 4 & \text{if } H_i^* > \beta_0^3 + X_i\beta_X^3 + D_i\beta_D^3 + S_i\beta_S^3 \text{ \& } H_i^* < \beta_0^4 + X_i\beta_X^4 + D_i\beta_D^4 + S_i\beta_S^4 \\ 5 & \text{if } H_i^* > \beta_0^4 + X_i\beta_X^4 + D_i\beta_D^4 + S_i\beta_S^4 \end{cases} \quad (2)
 \end{aligned}$$

Hereafter, eq. (1) is called the constant threshold model and eq. (2) the function threshold model.

In the following, the economic variables E_i are used in the estimation as an alternative specification. Then all the coefficients are estimated by a heterogeneity consistent estimation method, which is appropriate for micro-data such as that used here.

4 QOL Definition

In previous studies, the effect of the j disease on QOL is defined in the constant threshold model as

$$QOL_{CR,G}^c = -\frac{\hat{\alpha}_D^j}{\hat{C}_4} \quad (3)$$

where $\hat{\cdot}$ indicates estimation and α_D^j is the coefficient of the j th disease dummy. So as to avoid unnecessary complexity, $\alpha_D^j > 0$ is assumed. In the function threshold model, QOL is defined by

$$QOL_{CR,G}^f = 1 + \frac{Z_i \hat{\alpha}_Z}{Z_i \hat{\beta}_Z^4} - \frac{Z_i \hat{\alpha}_Z + \hat{\alpha}_D^j}{Z_i \hat{\beta}_Z^4 + \hat{\beta}_D^{4j}} = 1 - \frac{Z_i \hat{\beta}_Z^4 \hat{\alpha}_D^j - Z_i \hat{\alpha}_Z \hat{\beta}_D^{4j}}{Z_i \hat{\beta}_Z^4 (Z_i \hat{\beta}_Z^4 + \hat{\beta}_D^{4j})} \quad (4)$$

Formulations of this kind are easy to understand, but there are some problems. Firstly, the domain of QOL is set in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents. Originally the QOL concept requires 0 to represent dead and 1 to represent perfect health. Thus all the respondents should be less than 1 and greater than 0. However, the previous studies assign 1 to "excellent" and 0 to "very poor". This is inconsistent with the QOL concept and QOL may thereby be overestimated.

Secondly, the denominator may be very small in comparison with the numerator, and thus the QOL measure cannot be limited to $[0, 1]$, but it is obviously defined over $[-\infty, \infty]$. Thirdly, in the constant threshold model, the QOL effect of a disease is assumed to be the same across respondents. However, there is no evidence for this and it seems to be more natural to consider QOL to be dependent upon the health status of the respondent. For example, the effect of flu is different between healthy people and ill elderly people.

To overcome such shortcomings, a new definition of QOL is proposed in this paper as

$$QOL_{HO} = \Phi(Z_i \hat{\alpha}_Z) - \Phi(Z_i \hat{\alpha}_Z + \hat{\alpha}_D^j) \quad (5)$$

where Φ is the cumulative distribution function of the standard normal distribution. This is favoured more when comparing to $QOL_{CR,G}^c$ and $QOL_{CR,G}^f$ on several counts. Firstly, QOL_{HO} defines all the respondents without excluding "excellent" and "very poor". Secondly, QOL_{HO} is always below 1 and positive. Thirdly, QOL differs among respondents even in the constant threshold model according to their health status. Fourthly, QOL is evaluated according to the true distribution of QOL_{HO} unlike $QOL_{CR,G}^c$ and $QOL_{CR,G}^f$. QOL_{HO} which is thought to have damaging or negative effects through certain symptoms or diseases on the QOL.

The term QOL_{HO} is a marginal effect of the dummy variables in the probit model. $QOL_{CR,G}^c$ and $QOL_{CR,G}^f$ defines QOL between $[-\infty, \infty]$ and causes the problem mentioned above.

Since QOL_{HO} varies among individuals, the social or aggregate QOL is

$$\int [\Phi(Z_i \hat{\alpha}_Z) - \Phi(Z_i \hat{\alpha}_Z + \hat{\alpha}_D^j)] f(di) \quad (6)$$

where $f(\cdot)$ represents the probability distribution function of individuals in this society.

5 Estimation Results

5.1 Check for Goodness of Fit

We first need to check the goodness-of-fit before evaluating the results. For the ordered probit, especially the function threshold model, it is not obvious how to evaluate goodness-of-fit. In this paper, following Kenkel [4], the estimated distribution of the subjective health evaluation will be compared with the actual distribution for the purposes of verification. While the percentages in the distribution in the actual observation show 5.44%, 13.22%, 43.94%, 32.87% and 4.51% for "excellent" to "very poor" respectively, the estimated ones in the constant threshold model for all symptoms and sicknesses are 5.49%, 13.25%, 44.09%, 32.52% and 4.62%, and in the function threshold model they are 5.50%, 13.44%, 43.87%,

32.52% and 4.65%. Therefore, both are very similar and fit well. As in the other estimated model with the economic variables and the restrictive model, the results are almost the same, so that checking for goodness-of-fit is omitted so as to save space.

5.2 Constant Threshold Model

In Table 2, age is seen not to be significant, and that females evaluate their health significantly worse than males do, which is the same result as in the UK. The number of children makes their health evaluation better, a result opposite to that in the UK.

Concerning symptoms and diseases, almost all show worse health evaluation, although some symptoms and diseases raise health evaluation in significance, such as failing memory, the sniffles, toothache, dental problems, wounds, hyperlipidemia, hypertension, allergic rhinitis, tooth decay, oral problems, and stiff shoulder. In the UK and USA studies, there is no such a counter-intuitive case. Three reasons can be offered in explanation.

Firstly, information of symptoms and sickness in the Japanese data set is more detailed than in the others. If a kind of symptom or sickness is typical at an earlier stage, or typically has co-morbidity with the others, its effect would raise health evaluation.

Secondly, as this survey is conducted for the household member as explained above, those who suffered a certain symptom or sickness would feel better than an inpatient. Hence the health evaluation in this survey is contaminated by such a severe selection, it does not reflect the whole impact of these symptoms and diseases. Thirdly, maybe the most important point is that the reference group that is used by the respondents when they evaluate their health may be falsely imagined. That is, the word "the same age group" is missing in the survey, though it is included in the others. Thus they may compare the current situation with the situation when they were admitted to hospital. Currently they are discharged and enjoying better health, even though they have not recovered completely. In this case, biased sampling excluding inpatients causes counter-intuitive results.

5.3 The Function Threshold Model

Though Groot [4] cannot find significant symptoms or diseases consistently across all threshold functions, Tables 3 indicates that there are many consistently significant variables such as marital status, bleary eyes, the sniffles, retching, appetite loss, stiff shoulder(s), back pain, paramnesia/merrorhalgia, hypertension, other circulatory problems, and gastritis/duadentis. Moreover the coefficients for toothache, oral problems, difficulty in chewing, fractures, wounds, and injuries are consistently negative but insignificant, and thus these symptoms or diseases raise the criterion for good health.

5.4 The Model with Economic Variables

In general, economic situations other than pure health conditions also may affect health-related QOL, but the concept excludes such a non-health condition. Therefore, by estimating it using economic variables, we can control and eliminate the effect of economic conditions and thus measure the pure health related QOL. If not, the estimated QOL is biased by the economic situation.

Table 4 shows the results. Though it shows that aging significantly reduces subjective health evaluation, many variables are almost the same as the number in Table 2. On the other hand, in the function threshold model summarized in Table 5, the number of significant variables in the threshold function decreases. Only bleary eyes, the sniffles, retching, back pain, broken bones and sprain, hypertension, and other circulatory problems are consistently significant in the threshold function.

5.5 Restrictive Estimation Comparing the UK and USA

Since the data set in Japan is more detailed than for the UK or the USA, as mentioned above comparison among countries may be affected. To control for this problem, a restrictive model that includes only variables comparable with the UK and USA study as explanatory variables is performed in this subsection.

In the constant threshold model summarized in Table 6, cataracts, hypertension, allergic rhinitis, atopic dermatitis, and contact dermatitis remain as counter-intuitive results in which these diseases raise subjective health evaluation. On the other hand, the function threshold model in Table 7 shares results with the non-restrictive model, which means that there are many consistently significant variables in the threshold function, except for the sniffles.

To sum up, such a restriction does not have much effect and thus the more detailed information in Japan does not cause counter-intuitive phenomena.

6 Estimation Results for QOL

Table 8 summarizes the QOL. In the case of diabetes, we observe 0.86 in the UK, 0.66 in the USA, and 0.954 in Japan. For hypertension, while it is 0.86 in USA, it is 1.004 in Japan.

Conversely, the QOL values for difficulty in seeing are 0.93, 0.92 and 0.985, and difficulty in hearing are 0.93, 0.97 and 0.996 in USA, UK and Japan, respectively. In some symptoms or diseases, the QOL among countries are almost the same. However, for most symptoms or diseases, QOLs are higher in Japan than in UK and USA.

Next, Table 9 shows QOL in the function threshold model. For diabetes, we observe 0.85 for the UK and 0.942 for Japan, and for difficulty of seeing, 0.94 for the UK and 0.979 for Japan. Hence, even in the function threshold model, the QOL in Japan is higher than in UK and USA.

Estimation results with economic variables can isolate pure QOL which is not affected by such economic conditions, but these are not considered in the existing literature. The QOL in the constant threshold model is shown in Table 10, and the function threshold model in Table 11. Though the number of significant coefficients decreases, QOL is not so much affected by introducing economic variables; for instance in the case of diabetes, it is

0.955 in both models.

QOL_{HO} , our original QOL definition which is to be $[0,1]$ by definition, is also shown in the tables. In comparison with Cutler and Richardson [3] and Groot [4], $QOL_{CR,G}^f$ s are adjusted for the loss of QOL by certain of symptoms or diseases, $1 - QOL_{CR,G}^f$. Overall, QOL_{HO} is smaller than $1 - QOL_{CR,G}^f$. For instance, in the case of diabetes, while $1 - QOL_{CR,G}^f$ is 0.059, QOL_{HO} is only 0.015. In the case of hypertension, $0.032(1 - QOL_{CR,G}^f)$ is compared to $0.009(QOL_{HO})$. In other words, this discrepancy indicates the possibility of systematic overestimation of damage to QOL in the existing literature because of appropriateness of QOL_{HO} as discussed above.

7 Concluding Remarks

This paper applies the same procedure as in the existing literature to Japan, and then improves upon it. Firstly, while the previous studies define the domain of QOL in an ad hoc manner, i.e. excluding "excellent" or "very poor" respondents, this paper suggests a more rigorous alternative measure. Secondly, heterogeneity among individuals, which is inevitable in micro-data, is accounted for in the estimation. Thirdly, economic variables such as income or job status that are considered to affect subjective health status are also accounted for. The estimation results show that in the same model as the previous ones, similar tendencies are found, but coefficients are smaller for many symptoms and diseases. Economic variables help to clarify the effect of symptoms or diseases on subjective health evaluation. The damage of QOL by symptoms and diseases defined in this paper is smaller for most symptoms and diseases, and thus the measures in the previous research are likely to overestimate it and may be inappropriate.

Finally, we make suggestions for further research. As emphasized above, the most important difference between Japan and others appears to be the lack of the phrase "comparison with the same age group." This lack seems to contaminate the result heavily. To overcome

this problem, a survey including such a phrase should be performed. Moreover, longer macro QOLs should be calculated for evaluating health care.

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References

- [1] Torrance, G.W. (1986), "Measurement of Health State Utilities For Economic Appraisal A Review", *Journal of Health Economics* 5, pp.1-30.
- [2] Drummond, M.F., O'Brien, B., Stoddart, G.L. and Torrance, G.W. (1986), "Methods for the Economic Evaluation of Health Care Programmes", *Oxford Medical Publications*
- [3] Cutler, D. and Richardson, E. (1997), "Measuring the Health of the U.S. Population", *Brookings Papers Microeconomics*, pp.217-271.
- [4] Groot, W. (2000), "Adaptation and Scale of Reference Bias in Self-Assessments of Quality of Life", *Journal of Health Economics* 19, pp.403-420.
- [5] Kenkel, D.S. (1995), "Should You Eat Breakfast? Estimates From Health Production Functions", *Health Economics* 4, pp.15-29.
- [6] Kerkhofs, M. and Lideboom, M. (1995), "Subjective Health Measures and State Dependent Reporting Errors", *Health Economics* 4, pp.221-235.
- [7] Ubel, P.A., Richardson, J. and Menzel, P. (2000), "Societal Value, the person trade-off, and the dilemma of whose values to measure for cost-effectiveness analysis", *Health Economics* 9, pp.127-136.

Table1. Average of Variables

Symptoms and Others		Diseases	
subjective health	1.917984	diabetes	0.0762411
age	44.27781	obesity	0.0130053
age ²	2701.441	hyperlipidemia	0.0748662
female	0.5602294	thyroid gland disease	0.0180939
age*female	25.46679	dementia	0.0061259
age ² *female	1578.155	psychosis	0.0106469
marital status	0.6403086	neurosis	0.017179
number of children	0.5552163	autonomic imbalance	0.0224535
fever	0.0312671	cataract	0.0787169
fatigue	0.1377711	retinopathy	0.018363
sleeplessness	0.0952363	tympanitis	0.0137637
irritation	0.0812276	deafness	0.0236669
failing memory	0.133876	hypertension	0.23321
headache	0.1161468	stroke	0.0340399
dizziness	0.0699599	angina/AMI	0.0486011
bleary eyes	0.1787417	other circulatory problems	0.038326
difficulty in seeing	0.1334128	acute nasopharynx	0.0267641
tinnitus	0.0947807	allergic rhinitis	0.0410514
difficulty in hearing	0.1188347	asthma	0.0343922
palpitation	0.0924953	other respiratory problems	0.0260693
difficulty in breathing	0.0745687	gastritis/duodentis	0.0333695
chest pain	0.0444178	gastric/duodenal ulcer	0.0424116
coughs and sputum	0.1548852	hepatitis/cirrhosis	0.0240877
the sniffles	0.1181969	cholecytolithiasis/cholesystitis	0.010642
noisy breathing	0.0555488	other digestive problems	0.0293672
retching	0.1074151	tooth decay	0.1158393
diarrhoea	0.0347446	oral problems	0.0515711
constipation	0.1163898	atopic dermatitis	0.0346515
appetite loss	0.0336284	contact dermatitis	0.0217
stomach ache	0.069474	urticaria	0.0144732
hemorrhoids	0.0283287	baldness	0.0018104
toothache	0.0827917	gout	0.0164108
dental problems	0.0656928	chronic rheumatoid arthritis	0.0185979
difficulty in chewing	0.0895113	arthritis	0.0668565
rash	0.0546149	stiff shoulder	0.0920402
itching	0.1298822	back pain	0.1430927
stiff shoulder	0.285109	osteoporosis	0.0339763
lumbago	0.3278792	kidney disease	0.0208242
arthralgia	0.219234	prostatic hypertrophy	0.0163423
dysfunction of hands and feet	0.117263	pre/post menopausal problem	0.007677
numbness	0.127908	fractures	0.0170713
frigid hands and feet	0.0917512	injuries	0.0207361
foot oedema	0.0847431	anaemia/haemopathy	0.0181575
disuria	0.0340005	malignant neoplasm	0.0093405
frequent urination	0.073278	pregnancy	0.0084305
incontinence	0.0283135	others	0.0574328
paramenia/merorrhagia	0.0202044	unknown	0.0033272
broken bones and sprain	0.0462401		
wounds	0.0155272		
other symptoms	0.0616534		

Table 2. Estimation for All Diseases and Symptom using Constant Threshold Model

Symptoms and Others		Diseases	
age	0.0012754	diabetes	0.1697026 ***
age ²	-0.0000181	obesity	-0.0263429
female	0.1120654 ***	hyperlipidemia	-0.0633322 ***
age*female	-0.0054758 ***	thyroid gland disease	0.0219745
age ² *female	0.000064 ***	dementia	0.51905 ***
marital status	0.0868877 ***	psychosis	0.4817143 ***
number of children	-0.0535595 ***	neurosis	0.2258609 ***
fever	0.2185153 ***	autonomic imbalance	0.2368975 ***
fatigue	0.3539237 ***	cataract	-0.0120686
sleepless	0.166908 ***	retinopathy	0.1067936 ***
irritation	0.1233707 ***	tympanitis	-0.0384437
failing memory	-0.0665805 ***	deafness	0.0693713 ***
headache	0.156798 ***	hypertension	-0.0133124 *
dizziness	0.1544221 ***	stroke	0.3767259 ***
bleary eyes	-0.0055684	angina/AMI	0.1450976 ***
difficulty in seeing	0.0545099 ***	other circulatory problems	0.1633805 ***
tinnitus	0.0102757	acute nasopharynx	0.1090831 ***
difficulty in hearing	0.014291	allergic rhinitis	-0.0744289 ***
palpitation	0.1215845 ***	asthma	0.2026944 ***
difficulty in breathing	0.1193986 ***	other respiratory problems	0.2352146 ***
chest pain	0.1690001 ***	gastritis/duodentis	0.074635 ***
coughs and sputum	0.0877521 ***	gastric/duodenal ulcer	0.1208477 ***
the sniffles	-0.022202 *	hepatitis/cirrhosis	0.2191137 ***
noisy breathing	0.1173261 ***	cholecytolithiasis/cholecystitis	0.0156953
retching	0.0180103	other digestive problems	0.2106226 ***
diarrhoea	0.0434183 **	tooth decay	-0.1682704 ***
constipation	0.0625886 ***	oral problems	-0.0556608 ***
appetite loss	0.3303635 ***	atopic dermatitis	-0.0430956 **
stomach ache	0.1926602 ***	contact dermatitis	-0.1232689 ***
hemorrhoids	0.0269012	urticaria	-0.0152446
toothache	-0.0647493 ***	baldness	-0.1475272 **
dental problems	-0.0340799 **	gout	-0.0079463
difficulty in chewing	-0.0077916	chronic rheumatoid arthritis	0.423467 ***
rash	0.0192724	arthritis	0.0616562 ***
itching	-0.0624505 ***	stiff shoulder	-0.0488696 ***
stiff shoulder	0.0163343 *	back pain	0.1717006 ***
lumbago	0.0810385 ***	osteoporosis	0.1914227 ***
arthralgia	0.0897176 ***	kidney disease	0.3458195 ***
dysfunction of hands and feet	0.3514808 ***	prostatic hypertrophy	0.0695951 ***
numbness	0.1933389 ***	pre/post menopausal problem	0.0827177 ***
frigid hands and feet	0.0507956 ***	fractures	0.1512625 ***
foot oedema	0.0893828 ***	injuries	-0.0047846
disuria	0.0810874 ***	anaemia/haemopathy	0.1246096 ***
frequent urination	0.0471401 ***	malignant neoplasm	0.3025623 ***
incontinence	0.0532676 ***	pregnancy	0.0531608
paramenia/merorrhagia	0.0564094 **	others	0.0988508 ***
broken bones and sprain	0.0352011 *	unknown	0.3435841 ***
wounds	-0.1560601 ***		
other symptoms	0.1637302 ***		
Threshold1	-1.226018		
Threshold2	-0.462085		
Threshold3	0.8718563		
Threshold4	2.458695		
obs.	120533		
log likelihood	-144278.32		

Table 3. Estimation for All Diseases and Symptoms using Function Threshold Model

	α	β_2	β_3	β_4
age	0.0042067 **	-0.0007967	0.0053878 **	0.005723 **
age ²	-0.0000638 **	9.52E-06	-0.0000749 **	-0.0000857 **
female	0.1891781 **	0.0335431	0.1252132 **	0.2164378 **
age*female	-0.0068266 **	-0.0006203	-0.0031531	-0.0007825
age ² *female	0.0000932 **	0.0000143	0.0000492 *	0.0000231
marital status	0.131527 **	0.0249685 *	0.0613944 **	0.1043468 **
number of children	-0.043291 **	0.0141064	0.0039074	0.0141605
fever	0.0388714	-0.0700141	-0.233428 **	-0.2356717 **
fatigue	0.3944257 **	0.0633725 **	-0.0338203	0.1724376 **
sleepless	0.1232244 **	-0.0094989	-0.0746207 **	-0.0390842
irritation	0.1383607 **	0.021358	0.006852	-0.0096302
failing memory	-0.0445137 *	0.0066161	0.0272982	0.042052
headache	0.1790717 **	0.0293233	-0.0151728	0.0571147 *
dizziness	0.1943544 **	0.0756623 *	-0.0075553	0.0526154
bleary eyes	0.0593635 **	0.0371226 *	0.081464 **	0.0864494 **
difficulty in seeing	0.0645836 **	0.018876	0.0105878	-0.0254778
tinnitus	-0.0085392	-0.0289912	-0.0264931	-0.0081487
difficulty in hearing	0.0416103	-0.0037868	0.0343238	0.0639086 *
palpitation	0.1865242 **	0.0935613 **	0.0217363	0.101949 *
difficulty in breathing	0.0664398 *	-0.007298	-0.0911354 **	-0.0617185
chest pain	0.1655775 **	0.0312478	-0.0464544	-0.0186958
coughs and sputum	0.1357792 **	0.0393829 *	0.0366015	0.1339313 **
the sniffles	0.0585331 *	0.0729973 **	0.0845288 **	0.1055161 **
noisy breathing	0.1300517 **	0.0322288 **	-0.032276	0.0612361
retching	0.1353203 **	0.0772492 **	0.1143216 **	0.1862846 **
diarrhoea	0.0844929 *	0.024818	0.0344406	0.0767288
constipation	0.1085264 **	0.0646523 *	0.0477717 *	0.0415165
appetite loss	0.1089299 *	-0.0972504 *	-0.3218465 **	-0.2333836 **
stomach ache	0.2983146 **	0.0936775 **	0.0536898	0.1924463 **
hemorrhoids	0.1322659 **	0.0759612	0.1124126 **	0.1360437 *
toothache	-0.0817357 **	-0.015743	-0.0367583	-0.0432595
dental problems	-0.0551063 *	-0.0266903	-0.0307767	-0.0334424
difficulty in chewing	-0.0435043 *	-0.0346451	-0.0325875	-0.0805892 **

rash	0.0111807	0.0024693	-0.0353247	-0.0209091
itching	-0.0513809 **	-0.0020846	0.0187997	0.0197552
stiff shoulder	0.112183 **	0.0389185 **	0.120987 **	0.2143167 **
lumbago	0.1640864 **	0.0471623 **	0.0869505 **	0.1938533 **
arthralgia	0.12597 **	0.0380341 **	0.0242877	0.058502 *
dysfunction of hands and feet	0.2385121 **	0.0053909	-0.1462933 **	-0.1540611 **
numbness	0.1385571 **	0.0142188	-0.0932226 **	-0.0724577 *
frigid hands and feet	0.0352482	-0.0309315	-0.0027648	-0.0568816
foot oedema	0.1419216 **	0.094147 **	0.0324249	0.0226809
disuria	0.045535	0.0505123	-0.0521713	-0.0954346 *
frequent urination	0.0243181	0.0060802	-0.0477596	-0.011168
incontinence	0.0452278	0.0578143	-0.0326386	-0.0273468
paramenia/merorrhagia	0.1865629 **	0.1065834 *	0.1313118 *	0.1901745 **
broken bones and sprain	-0.0532463	-0.0714505 **	-0.1253986 **	-0.1545356 **
wounds	-0.1584505 **	-0.0173905	0.0107057	-0.1065616
other symptoms	0.1092469 **	-0.0155937	-0.0753646 **	-0.1418608 **
diabetes	0.1862889 **	0.0244563	0.0013312	0.0312848
obesity	-0.0236551	-0.0482371	0.0012454	0.027117
hyperlipidemia	0.0304333	0.0496067 *	0.1177515 **	0.1427992 **
thyroid gland disease	0.1055232 *	0.0190468	0.0906554	0.1666355 *
dementia	0.3050839 **	-0.0108747	-0.130568	-0.3684098 **
psychosis	0.3068375 **	0.0109848	-0.2231934 **	-0.2113881 *
neurosis	0.2383542 **	0.0643844	-0.049406	0.0658447
autonomic imbalance	0.2568061 **	0.1131436 **	-0.077494	0.0361826
cataract	0.0326415	0.0328153	0.0434861	0.0723345 *
retinopathy	0.1213969 *	0.0053982	-0.0050346	0.0264954
tympanitis	-0.0336737	0.0382555	-0.0367689	0.0093552
deafness	-0.0039495	0.0021958	-0.1329797 **	-0.0838721
hypertension	0.1063538 **	0.0503854 **	0.1508057 **	0.1927715 **
stroke	0.3014442 **	0.0545467	-0.1410958 **	-0.0415305
angina/AMI	0.2129149 **	0.0622137 *	0.0302774	0.1727507 **
other circulatory problems	0.3007487 **	0.1173104 **	0.1222149 **	0.2256034 **
acute nasopharynx	0.1449663 **	0.0499627	-0.0288558	0.1378687 *
allergic rhinitis	0.0053835	0.0497381	0.0925406 *	0.159018 **
asthma	0.2578688 **	0.0670264	0.0267716	0.1159971 *
other respiratory problems	0.1046581 **	-0.0307042	-0.1867093 **	-0.183923 **

gastritis/duodentitis	0.1712518 **	0.0824518 *	0.0785051 *	0.1697933 **
gastric/duodenal ulcer	0.1822771 **	0.0884328 **	0.0267819	0.1648612 **
hepatitis/cirrhosis	0.2486234 **	0.0738173	-0.0381413	0.1159348 *
cholecystolithiasis/cholesystitis	0.0127031	-0.0256931	-0.0125238	0.0304506
other digestive problems	0.268822 **	0.0467593	0.0345433	0.1148234 **
decayed tooth	-0.1201139 **	-0.0034207	0.0866057 **	0.0537116
oral problems	0.0452734	0.0633749 **	0.1238042 **	0.1625539 **
atopic dermatitis	0.023303	0.0839974 *	0.070006 *	-0.0259632
contact dermatitis	-0.0718748 *	0.0228814	0.0697947	0.0543836
urticaria	-0.0393189	-0.0461518	-0.0314674	-0.047414
boldness	-0.1744188	0.0232579	-0.035291	-0.1850385
gout	-0.0325299	-0.0254903	-0.0507218	-0.0005958
chronic rheumatoid arthritis	0.3346562 **	0.0291305	-0.1513698 *	-0.0859148
arthritis	0.0718011 *	0.0390654	-0.0380022	0.0362003
stiff shoulder	0.0033625	0.0244542	0.050035 *	0.1031927 **
back pain	0.1673819 **	0.0328302	-0.0572424 **	0.0223099
osteoporosis	0.1783902 **	0.0516927	-0.0746382 *	0.0044115
kidney problems	0.2591669 **	0.0095231	-0.1334767 *	-0.1110609 *
prostatic hypertrophy	0.1527116 **	-0.0115682	0.0846179	0.2566638 **
pre/post menopausal problem	0.1537784 *	0.0252443	-0.0054494	0.2379708 *
fractures	0.0272902	0.0087999	-0.1940061 **	-0.2402818 **
injuries	-0.0725695 *	-0.002486	-0.1789057 **	-0.1522778 **
anaemia/haemopathy	0.1559362 **	0.0596901	-0.0196217	0.0715271
malignant neoplasm	0.2182945 **	0.0222118	-0.0959881	-0.1906292 *
pregnancy	-0.0236894	0.0132769	-0.1757445 *	-0.0801186
others	0.1043899 **	0.0604108 **	-0.0329014	-0.0548851
unknown	0.1956959 *	-0.1656202	-0.2488479 **	-0.0127613
constant	1.010211 **	0.6083787 **	1.920268 **	3.100168 **
obs.	120533			
log likelihood	-142452.57			

Table4. Estimation Result for Constant Threshold Model Including Economic Variables

Symptoms and Others		Diseases	
age	0.0052451 ***	diabetes	0.1663039 ***
age ²	-0.0000553 ***	obesity	-0.0284185
female	0.1163004 ***	hyperlipidemia	-0.0497002 ***
age*female	-0.0060423 ***	thyroid gland disease	0.0399927
age ² *female	0.0000653 ***	dementia	0.5326999 ***
marital status	0.0620826 ***	psychosis	0.4822869 ***
number of children	-0.0667627 ***	neurosis	0.226076 ***
ln consumption	-0.0183901 ***	autonomic imbalance	0.2399747 ***
self employed	-0.0880772 ***	cataract	-0.030436 **
employer	-0.1320287 ***	retinopathy	0.108105 ***
employee(1-4)	-0.1148464 ***	tympanitis	-0.0409712
employee(5-29)	-0.0755713 ***	deafness	0.0697405 ***
employee(30-99)	-0.0761312 ***	hypertension	-0.0244341 ***
employee(100-499)	-0.0567253 ***	stroke	0.3609254 ***
employee(500-999)	-0.0530168 *	angina/AMI	0.1391634 ***
employee(over 1000)	-0.0435447 **	other circulatory problems	0.1709842 ***
employee(government)	-0.0289478	acute nasopharynx	0.0895221 ***
part-time employee	-0.061145 ***	allergic rhinitis	-0.0771816 ***
fever	0.222474 ***	asthma	0.198407 ***
fatigue	0.3577707 ***	other respiratory problems	0.2390279 ***
sleepless	0.1717508 ***	gastritis/duodentis	0.0612717 ***
irritation	0.1250377 ***	gastric/duodenal ulcer	0.1037974 ***
failing memory	-0.0760967 ***	hepatitis/cirrhosis	0.1989473 ***
headache	0.1583902 ***	cholecytolithiasis/cholesystitis	-0.0118848
dizziness	0.1616778 ***	other digestive problems	0.2006465 ***
bleary eyes	-0.0027497	decayed tooth	-0.1518817 ***
difficulty in seeing	0.0554029 ***	oral problems	-0.0600077 ***
tinnitus	0.0179138	atopic dermatitis	-0.0367474
difficulty in hearing	0.0096214	contact dermatitis	-0.1182354 ***
palpitation	0.1248892 ***	urticaria	-0.0187831
difficulty in breathing	0.1066174 ***	baldness	-0.177578 **
chest pain	0.1698277 ***	gout	-0.0258118
coughs and sputum	0.0864311 ***	chronic rheumatoid arthritis	0.4298735 ***
the sniffles	-0.0051721	arthritis	0.0595476 ***
noisy breathing	0.0914565 ***	stiff shoulder	-0.0431522 ***
retching	0.0243291 **	back pain	0.1766237 ***
diarrhoea	0.0357954 *	osteoporosis	0.1641502 ***
constipation	0.0544138 ***	kidney disease	0.3401546 ***
appetite loss	0.3087564 ***	prostatic hypertrophy	0.0683069 ***
stomach ache	0.2058353 ***	pre/post menopausal problem	0.0956038 ***
hemorrhoids	0.0432084 **	fractures	0.182868 ***
toothache	-0.0580303 ***	injuries	0.0335989
dental problems	-0.029903 **	anaemia/haemopathy	0.1316393 ***
difficulty in chewing	-0.0066211	malignant neoplasm	0.2836612 ***
rash	0.0344986 *	pregnancy	0.1047172 *
itching	-0.067233 ***	others	0.1042576 ***
stiff shoulder	0.0198855 **	unknown	0.3769129 ***
lumbago	0.0786534 ***		
arthralgia	0.0927909 ***		
dysfunction of hands and feet	0.3521446 ***		
numbness	0.1977863 ***		
frigid hands and feet	0.0493587 ***		
foot oedema	0.0891646 ***		
disuria	0.0824567 ***		
frequent urination	0.0417701 ***		
incontinence	0.0469824 **		
paramenia/merorrhagia	0.0790112 ***		
broken bones and sprain	0.0434207 **		
wounds	-0.1255881 ***		
other symptoms	0.1559789 ***		
Threshold1	-1.243526		
Threshold2	-0.4700815		
Threshold3	0.8662303		
Threshold4	2.469363		
obs.	99618		
log likelihood	-118687.08		

Table5. Estimation Result for Function Threshold Model Including Economic Variables

	α	β_2	β_3	β_4
age	0.003383	-0.00543 **	0.000231	0.001857
age ²	-4.6E-05 *	4.85E-05 **	-1.2E-05	-7.75E-06
female	0.139317 **	0.034176	0.008319	0.236485 **
age*female	-0.00388	0.000114	0.002954	0.002821
age ² *female	5.65E-05 **	4.60E-06	-1.2E-05	-2.9E-05
marital status	0.101132 **	0.024907	0.054419 **	0.072492 **
number of children	-0.03807	-0.00227	0.029907	0.140712 *
ln consumption	0.009239	0.030145 **	0.029941 **	0.039573 **
self employed	-0.05692 **	0.028009	0.01789	0.10431 **
employer	-0.06773	0.021752	0.083085 *	0.132166 **
employee(1-4)	-0.09095	0.038149	0.015172	0.089815
employee(5-29)	0.027933	0.039923	0.129744 **	0.288421 **
employee(30-99)	-0.00844	-0.01765	0.111697 **	0.229112 **
employee(100-499)	0.030152	0.018908	0.107178 **	0.307319 **
employee(500-999)	0.004498	-0.0229	0.077547	0.271657 **
employee(over 1000)	0.00076	0.0245	0.017092	0.248107 **
employee(government)	0.117154 **	0.129786 **	0.141117 **	0.345718 **
part-time employee	-0.0149	-0.00828	0.080066 *	0.107541 **
fever	0.088798	-0.02117	-0.18209 **	-0.18438 **
fatigue	0.413522 **	0.081215 **	-0.01122	0.170139 **
sleepless	0.118245 **	-0.00955	-0.08626 *	-0.0556
irritation	0.128165 **	0.00065	-0.00931	0.002582
failing memory	-0.04406	0.023452	0.033121	0.049383
headache	0.201177 **	0.049449 *	0.009793	0.07439 *
dizziness	0.192659 **	0.08099 **	-0.02035	0.037408
bleary eyes	0.060677 **	0.036559 *	0.078265 **	0.085306 **
difficulty in seeing	0.061867 **	0.023899	0.006086	-0.03754
tinnitus	0.008989	-0.02156	-0.01461	0.004229
difficulty in hearing	0.021421	-0.00638	0.015897	0.024804
palpitation	0.206759 **	0.110437 **	0.040514	0.122288 **
difficulty in breathing	0.075036 *	0.014691	-0.07118	-0.02907
chest pain	0.181907 **	0.038844	-0.02646	0.000956
coughs and sputum	0.141718 **	0.040067	0.046901 *	0.142019 **

the sniffles	0.071428 **	0.057525 *	0.080388 **	0.116182 **
noisy breathing	0.06669	0.007867	-0.08096	0.014067
retching	0.126402 **	0.065351 *	0.095033 **	0.17152 **
diarrhoea	0.034168	-0.01086	-0.01824	0.033161
constipation	0.087295 **	0.044999 *	0.03226	0.038717
appetite loss	0.089584	-0.09621	-0.31098 **	-0.24031 **
stomach ache	0.302168 **	0.085539 **	0.043296	0.18107 **
hemorrhoids	0.137087 **	0.087445 *	0.087726	0.119053 **
toothache	-0.07645 **	-0.02239	-0.03778	-0.0342
dental problems	-0.03863	-0.01936	-0.01716	-0.01072
difficulty in chewing	-0.01965	-0.01933	-0.00987	-0.03587
rash	0.005078	-0.01611	-0.06166	-0.04992
itching	-0.0473 *	0.00944	0.026271	0.035826
stiff shoulder	0.102087 **	0.027462	0.106896 **	0.189734 **
lumbago	0.171036 **	0.052884 **	0.098468 **	0.199464 **
arthralgia	0.116349 **	0.028298	0.007186	0.043921
dysfunction of hands and feet	0.236363 **	0.00476	-0.14957 **	-0.14706 **
numbness	0.147321 **	0.026279	-0.08826 **	-0.06868 *
frigid hands and feet	0.037603	-0.02877	0.001847	-0.04378
foot oedema	0.149095 **	0.106335 **	0.040132	0.02132
disuria	0.055607	0.054471	-0.03693	-0.101
frequent urination	0.041191	0.031987	-0.02413	0.002746
incontinence	0.046012	0.064849	-0.0212	-0.03633
paramenia/merorralgia	0.176544 **	0.060428	0.10497	0.131253
broken bones and sprain	-0.08174 *	-0.12834 **	-0.15536 **	-0.19134 **
wounds	-0.1272 **	0.001706	-0.00028	-0.09348
other symptoms	0.102996 **	-0.01669	-0.07423 *	-0.1288 **
diabetes	0.168452 **	0.028796	-0.0212	0.003828
obesity	-0.03687	-0.07025	0.002534	0.015324
hyperlipidemia	0.03346	0.043135	0.101268 **	0.129861 **
thyroid gland disease	0.158576 **	0.067501	0.117292 *	0.214456 **
dementia	0.335413 **	0.006622	-0.11804	-0.31156 *
psychosis	0.374317 **	0.076305	-0.16706 *	-0.0854
neurosis	0.235471 **	0.056595	-0.05005	0.068778
autonomic imbalance	0.281136 **	0.111985 *	-0.04191	0.05276
cataract	0.027995	0.035613	0.063346 **	0.087734 **

retinopathy	0.142698 **	0.017998	0.01821	0.050382
tympanitis	-0.0665	0.002715	-0.07431	0.007213
deafness	0.020088	0.029798	-0.11756 *	-0.0347
hypertension	0.095428 **	0.05212 **	0.148617 **	0.193006 **
stroke	0.278679 **	0.041882	-0.13686 *	-0.05764
angina/AMI	0.201014 **	0.057455	0.02282	0.166932 **
other circulatory problems	0.307071 **	0.131855 **	0.103885 *	0.238692 **
acute nasopharynx	0.150968 **	0.078475	0.00634	0.140671 *
allergic rhinitis	-0.01067	0.027488	0.087688 *	0.129029 *
asthma	0.249797 **	0.074172	0.016199	0.111019
other respiratory problems	0.103704 *	-0.03817	-0.18837 **	-0.18271 **
gastritis/duodentis	0.152347 **	0.076058 *	0.076065	0.157789 **
gastric/duodenal ulcer	0.184494 **	0.106103 **	0.043486	0.203673 **
hepatitis/cirrhosis	0.220297 **	0.080187	-0.04295	0.08651
cholecystolithiasis/cholesystitis	0.001938	-0.02508	0.018939	0.048645
other digestive problems	0.253326 **	0.048724	0.027982	0.102852 *
decayed tooth	-0.11885 **	-0.01945	0.077798 **	0.020905
oral problems	0.034611	0.05756 *	0.121607 **	0.155604 **
atopic dermatitis	0.019296	0.042816	0.082066 *	-0.01607
contact dermatitis	-0.07773 *	0.001183	0.057262	0.082274
urticaria	-0.03671	-0.04246	-0.02028	-0.03081
balddness	-0.1987	0.014639	0.012073	-0.2095
gout	-0.0677	-0.04338	-0.07038	-0.0248
chronic rheumatoid arthritis	0.334516 **	0.047042	-0.15714 **	-0.09693
arthritis	0.072811 **	0.053873 *	-0.03537	0.021974
stiff shoulder	0.002205	0.020962	0.038865	0.097796 **
back pain	0.157827 **	0.01148	-0.07154 *	0.012798
osteoporosis	0.13629 **	0.034606	-0.09058 *	-0.0103
kidney disease	0.234318 **	0.011828	-0.14446 *	-0.14894 **
prostatic hypertrophy	0.137809 *	-0.01495	0.060354	0.258334 **
pre/post menopausal problem	0.170139 *	0.026598	-0.01243	0.2772 *
fractures	0.079636	0.05815	-0.17597 **	-0.21179 **
injuries	-0.03453	0.000684	-0.17012 **	-0.12666 *
anaemia/haemopathy	0.132884 **	0.051772	-0.05409	0.016821
malignant neoplasm	0.197763 **	0.000518	-0.10176	-0.17343 *
pregnancy	0.030249	-0.01249	-0.13634	-0.12607

others	0.106289 ***	0.051905 *	-0.03395	-0.04479
unknown	0.184116	-0.20039 *	-0.28883 **	-0.10911
constant	1.013544 ***	0.660967 ***	1.900783 ***	2.89862 ***
obs.	99618			
log likelihood	-117110			

Table6. Constant Threshold Model Including Comparable Variables

	Estimator	QOL _{CR,G}	QOL _{HO}
age	0.0007427		
age ²	5.53E-06		
female	0.1804947 ***		
age*female	-0.006092 ***		
age ² *female	0.0000646 ***		
married	0.0511207 ***		
number of children	-0.09494 ***		
headache	0.3247664 ***	0.9080899	0.1168756
difficulty in seeing	0.1776396 ***	0.9497273	0.0645748
coughs and sputum	0.1594266 ***	0.9548817	0.0580028
difficulty in hearing	0.0912832 ***	0.9741665	0.0332885
palpitation	0.2212611 ***	0.9373823	0.080241
difficulty in breathing	0.2549084 ***	0.92786	0.0922417
chest pain	0.296762 ***	0.9160153	0.1070501
the sniffles	0.0368511 ***	0.989571	0.0134515
diabetes	0.2073829 ***	0.9413099	0.0752692
psychosis	0.5801214 ***	0.8358235	0.202405
neurosis	0.3535213 ***	0.8999522	0.126888
autonomic imbalance	0.3713721 ***	0.8949003	0.133062
cataract	-0.036545 ***	1.0103424	-0.01334
deafness	0.0588666 ***	0.9833405	0.0214814
hypertension	-0.037888 ***	1.0107224	-0.01383
stroke	0.4684302 ***	0.8674325	0.1660061
angina/AMI	0.0675742 ***	0.9808763	0.0246552
other circulatory problems	0.15434 ***	0.9563212	0.0561644
acute nasopharynx	0.1238462 ***	0.9649511	0.04512
allergic rhinitis	-0.089567 ***	1.0253477	-0.032664
asthma	0.1780959 ***	0.9495982	0.0647393
other respiratory problems	0.1840755 ***	0.947906	0.0668931
gastritis/duodentis	0.1754832 ***	0.9503376	0.0637976
gastric/duodenal ulcer	0.2042853 ***	0.9421865	0.0741578
hepatitis/cirrhosis	0.3077566 ***	0.9129037	0.110916
atopic dermatitis	-0.09175 ***	1.0259655	-0.033458
contact dermatitis	-0.142465 ***	1.040318	-0.051868
urticaria	0.0068883	0.9980506	0.0025148
chronic rheumatoid arthritis	0.58555 ***	0.8342872	0.2041279
arthritis	0.1801596 ***	0.9490142	0.0654828
kidney disease	0.4366981 ***	0.8764128	0.1553586
fractures	0.2369127 ***	0.9329528	0.0858332
injuries	0.0531965 **	0.9849452	0.019414
obesity	0.0316582	0.9910406	0.0115565
Threshold_1	-1.295431		
Threshold_2	-0.544666		
Threshold_3	0.7382223		
Threshold_4	2.238092		
obs.	104293		
log likelihood	-128576		

Table7. Function Threshold Model Including Comparable Variables

	α	β_2	β_3	β_4	QOL _{CRG}	QOL _{HO}
age	0.0037582	-0.003092	0.0057887 **	0.0116333 ***		
age ²	-4.31E-05	0.0000288	-7.96E-05 ***	-0.00014 **		
female	0.1882828 **	0.039075	-0.014052	0.1251576		
age*female	-0.003607	0.0001869	0.0033064	0.0045955		
age ² *female	0.0000554 *	4.96E-06	-1.29E-05	-3.49E-05		
marital status	0.113438 ***	0.0311868 **	0.0809903 ***	0.1184712 ***		
number of children	-0.067449 *	-0.001245	0.0247849	0.1740376 **		
headache	0.3736407 ***	0.0811605 ***	0.0042858	0.1124313 ***	0.8804839	0.0345643
difficulty in seeing	0.1725356 ***	0.0337275	-0.018649	-0.03599	0.9420605	0.0154125
coughs and sputum	0.2039139 ***	0.0456992 **	0.0272888	0.1193535 ***	0.9349183	0.0182862
difficulty in hearing	0.0933361 ***	0.0081015	-0.008039	0.0228582	0.969264	0.0082797
palpitation	0.2781128 ***	0.107165 **	0.0116738	0.0961774 *	0.9105754	0.02523
difficulty in breathing	0.2147876 ***	0.0355671	-0.089241 *	-0.027862	0.9280681	0.01929
chest pain	0.280373 ***	0.0438926	-0.064293	-0.008567	0.9067065	0.0254453
the sniffles	0.0876353 ***	0.057931 **	0.0460921	0.0769936 **	0.9716468	0.0077713
diabetes	0.2040879 ***	0.0289591	-0.018958	-0.017834	0.9318802	0.0183023
psychosis	0.4288475 ***	0.0210399	-0.198886 *	-0.186013 **	0.8483477	0.0402082
neurosis	0.3417371 ***	0.053111	-0.062027	0.0165476	0.8872302	0.0313904
autonomic imbalance	0.3887591 ***	0.1112066 **	-0.076323	0.0683011	0.8738675	0.0360901
cataract	0.0223378	0.0390716	0.0643749 *	0.0877508 **	0.992798	0.0019761
deafness	0.0021339	0.017858	-0.113206 *	-0.043707	0.9992815	0.0001888
hypertension	0.0854074 ***	0.0521797 **	0.1616283 ***	0.2051076 ***	0.9734673	0.0075728
stroke	0.3531316 ***	0.0452714	-0.171446 **	-0.157233 ***	0.8763811	0.032517
angina/AMI	0.1561814 ***	0.0678083 *	0.0649464	0.1909554 ***	0.9512665	0.0139269
other circulatory problems	0.3077542 ***	0.1456933 ***	0.139408 **	0.2310907 ***	0.9051587	0.0280736
acute nasopharynx	0.1484511 ***	0.0551731	-0.025453	0.0978075	0.9522919	0.0132273
allergic rhinitis	-0.030239	0.0208637	0.0842266 **	0.1351021 ***	1.009603	-0.002675
asthma	0.2170612 ***	0.059721	0.0018233	0.1036185 *	0.9303725	0.0195004
other respiratory problems	0.0538966	-0.033715	-0.17707 ***	-0.16885 ***	0.9810557	0.0047718
gastritis/duodentitis	0.3119781 ***	0.1130501 ***	0.1119813 ***	0.2542468 ***	0.9045382	0.0284825
gastric/duodenal ulcer	0.3155546 ***	0.1375403 ***	0.060533	0.2598531 ***	0.9036092	0.0288294
hepatitis/cirrhosis	0.334305 ***	0.0980641 **	-0.043643	0.1055715 *	0.892831	0.0306595
atopic dermatitis	-0.051457	0.0413671	0.065923	-0.032261	1.0172583	-0.004555
contact dermatitis	-0.127391 ***	-0.004449	0.0318748	0.0154631	1.0420528	-0.011329

urticaria	-0.057787	-0.064958	-0.088726 *	-0.078531	1.0196868	-0.005117
chronic rheumatoid arthritis	0.4624963 ***	0.0475239	-0.187839 **	-0.160151 **	0.8379308	0.0437506
arthritis	0.1748005 ***	0.0659838 **	-0.059616 **	0.0081405	0.9421571	0.0156189
kidney disease	0.3329927 ***	0.0197318	-0.144349 **	-0.156689 **	0.8834532	0.0305308
fractures	-0.024331	-0.069565 *	-0.35456 ***	-0.438551 ***	1.0094477	-0.002152
injuries	-0.119293 ***	-0.078333 **	-0.264342 ***	-0.300241 ***	1.0439611	-0.010602
obesity	0.0719617	-0.017772	0.031332	0.1115047	0.9769748	0.0063761
constant	1.15481 ***	0.7017268 ***	1.874219 ***	3.013847 ***		
obs.	104293					
log likelihood	-127734					

Table8. QOL Estimation for All Diseases and Symptoms using Constant Threshold Model

Symptoms	1-QOL _{CR,G}	QOL _{HO}	Diseases	1-QOL _{CR,G}	QOL _{HO}
fever	0.059303	0.075313	diabetes	0.046056	0.058622
fatigue	0.096052	0.120863	obesity	-0.00715	-0.00913
sleepless	0.045297	0.057663	hyperlipidemia	-0.01719	-0.02194
irritation	0.033482	0.042686	thyroid gland disease	0.005964	0.007617
failing memory	-0.01807	-0.02307	dementia	0.140866	0.174261
headache	0.042554	0.054192	psychosis	0.130733	0.162438
dizziness	0.041909	0.053375	neurosis	0.061297	0.077815
bleary eyes	-0.00151	-0.00193	autonomic imbalance	0.064292	0.081567
difficulty in seeing	0.014794	0.018888	cataract	-0.00328	-0.00418
tinnitus	0.002789	0.003562	retinopathy	0.028983	0.036968
difficulty in hearing	0.003878	0.004954	tympanitis	-0.01043	-0.01332
palpitation	0.032997	0.042071	deafness	0.018827	0.024033
difficulty in breathing	0.032404	0.041317	hypertension	-0.00361	-0.00461
chest pain	0.045865	0.058381	stroke	0.10224	0.128395
coughs and sputum	0.023815	0.03039	angina/AMI	0.039378	0.050169
the sniffles	-0.00603	-0.0077	other circulatory problems	0.04434	0.056452
noisy breathing	0.031841	0.040602	acute nasopharynx	0.029604	0.037758
retching	0.004888	0.006243	allergic rhinitis	-0.0202	-0.02578
diarrhoea	0.011783	0.015047	asthma	0.05501	0.069916
constipation	0.016986	0.021685	other respiratory problems	0.063835	0.080996
appetite loss	0.089658	0.113033	gastritis/duodentis	0.020255	0.025854
stomach ache	0.052286	0.066486	gastric/duodenal ulcer	0.032797	0.041817
hemorrhoids	0.007301	0.009324	hepatitis/cirrhosis	0.059466	0.075517
toothache	-0.01757	-0.02243	cholecystolithiasis/cholecystitis	0.00426	0.00544
dental problems	-0.00925	-0.01181	other digestive problems	0.057161	0.072622
difficulty in chewing	-0.00211	-0.0027	tooth decay	-0.04567	-0.05813
rash	0.00523	0.00668	oral problems	-0.01511	-0.01929
itching	-0.01695	-0.02164	atopic dermatitis	-0.0117	-0.01494
stiff shoulder	0.004433	0.005662	contact dermatitis	-0.03345	-0.04265
lumbago	0.021993	0.028069	urticaria	-0.00414	-0.00528
arthralgia	0.024349	0.031069	baldness	-0.04004	-0.051
dysfunction of hands and feet	0.095389	0.120053	gout	-0.00216	-0.00275
numbness	0.052471	0.066719	chronic rheumatoid arthritis	0.114925	0.143688
frigid hands and feet	0.013786	0.017602	arthritis	0.016733	0.021362
foot oedema	0.024258	0.030953	stiff shoulder	-0.01326	-0.01693
disuria	0.022006	0.028085	back pain	0.046598	0.059307
frequent urination	0.012793	0.016336	osteoporosis	0.051951	0.066063
incontinence	0.014456	0.018458	kidney disease	0.093853	0.118175
paramenia/merorrhagia	0.015309	0.019546	prostatic hypertrophy	0.018888	0.02411
broken bones and sprain	0.009553	0.0122	pre/post menopausal problem	0.022449	0.028649
wounds	-0.04235	-0.05394	fractures	0.041051	0.052289
other symptoms	0.044435	0.056572	injuries	-0.0013	-0.00166
			anaemia/haemopathy	0.033818	0.043114
			malignant neoplasm	0.082113	0.103738
			pregnancy	0.014427	0.018421
			others	0.026827	0.034225
			unknown	0.093246	0.117432

Table9. QOL Estimation for All Diseases and Symptoms using Function Threshold Model

Symptoms	1-QOL _{CR,G}	QOL _{HO}	Diseases	1-QOL _{CR,G}	QOL _{HO}
fever	0.01357	0.003095	diabetes	0.05949	0.015016
fatigue	0.120523	0.033164	obesity	-0.00756	-0.00188
sleepless	0.040255	0.009862	hyperlipidemia	0.009384	0.002423
irritation	0.044769	0.01109	thyroid gland disease	0.032302	0.008433
failing memory	-0.01417	-0.00355	dementia	0.11168	0.025108
headache	0.056717	0.014421	psychosis	0.106217	0.025262
dizziness	0.061645	0.015684	neurosis	0.075285	0.019367
bleary eyes	0.018629	0.004731	autonomic imbalance	0.081881	0.020934
difficulty in seeing	0.021005	0.005148	cataract	0.010289	0.002599
tinnitus	-0.00276	-0.00068	retinopathy	0.038826	0.009714
difficulty in hearing	0.013151	0.003314	tympanitis	-0.01083	-0.00268
palpitation	0.05825	0.015036	deafness	-0.00131	-0.00031
difficulty in breathing	0.021866	0.005297	hypertension	0.032298	0.0085
chest pain	0.053733	0.013312	stroke	0.098555	0.02479
coughs and sputum	0.041984	0.01088	angina/AMI	0.065054	0.017229
the sniffles	0.018259	0.004664	other circulatory problems	0.09043	0.024729
noisy breathing	0.041137	0.010415	acute nasopharynx	0.04477	0.011627
retching	0.041175	0.010843	allergic rhinitis	0.001652	0.000428
diarrhoea	0.026596	0.006742	asthma	0.080179	0.021025
constipation	0.034544	0.008675	other respiratory problems	0.035888	0.008363
appetite loss	0.037997	0.008708	gastritis/duodentis	0.052371	0.013777
stomach ache	0.090601	0.024516	gastric/duodenal ulcer	0.055827	0.014685
hemorrhoids	0.040871	0.010595	hepatitis/cirrhosis	0.077306	0.020237
toothache	-0.02674	-0.00652	cholecystolithiasis/cholecystitis	0.004058	0.001011
dental problems	-0.01797	-0.00439	other digestive problems	0.083615	0.021963
difficulty in chewing	-0.01441	-0.00346	tooth decay	-0.03808	-0.00961
rash	0.003631	0.00089	oral problems	0.013876	0.003606
itching	-0.01647	-0.00409	atopic dermatitis	0.00758	0.001855
stiff shoulder	0.033846	0.00897	contact dermatitis	-0.02278	-0.00573
lumbago	0.049813	0.013189	urticaria	-0.01288	-0.00313
arthralgia	0.039881	0.010085	baldness	-0.05983	-0.01404
dysfunction of hands and feet	0.080958	0.01938	gout	-0.01049	-0.00259
numbness	0.045763	0.011106	chronic rheumatoid arthritis	0.111025	0.027724
frigid hands and feet	0.011582	0.002807	arthritis	0.022893	0.005725
foot oedema	0.045446	0.011379	stiff shoulder	0.00105	0.000268
disuria	0.015154	0.003627	back pain	0.053605	0.01346
frequent urination	0.007873	0.001936	osteoporosis	0.05746	0.014365
incontinence	0.014719	0.003602	kidney disease	0.086704	0.021136
paramenia/merorrhagia	0.0567	0.015039	prostatic hypertrophy	0.045493	0.012259
broken bones and sprain	-0.01808	-0.00424	pre/post menopausal problem	0.046067	0.012346
wounds	-0.05293	-0.01273	fractures	0.009542	0.002173
other symptoms	0.036929	0.008733	injuries	-0.02462	-0.00579
			anaemia/haemopathy	0.049165	0.012522
			malignant neoplasm	0.075027	0.017679
			pregnancy	-0.00784	-0.00189
			others	0.034279	0.008342
			unknown	0.063385	0.015795

Table10. QOL Estimation Including Economic Variables using Constant Threshold Model

Symptoms	1-QOL _{CR,G}	QOL _{HO}	Diseases	1-QOL _{CR,G}	QOL _{HO}
fever	0.059919	0.076094	diabetes	0.044791	0.057028
fatigue	0.096359	0.121256	obesity	-0.00765	-0.00978
sleepless	0.046258	0.058883	hyperlipidemia	-0.01339	-0.01709
irritation	0.033677	0.042937	thyroid gland disease	0.010771	0.013756
failing memory	-0.0205	-0.02616	dementia	0.143473	0.177321
headache	0.04266	0.05433	psychosis	0.129895	0.161489
dizziness	0.043545	0.055451	neurosis	0.06089	0.077312
bleary eyes	-0.00074	-0.00095	autonomic imbalance	0.064633	0.082003
difficulty in seeing	0.014922	0.019053	cataract	-0.0082	-0.01047
tinnitus	0.004825	0.006163	retinopathy	0.029116	0.03714
difficulty in hearing	0.002591	0.00331	tympanitis	-0.01103	-0.01409
palpitation	0.033637	0.042887	deafness	0.018783	0.023979
difficulty in breathing	0.028715	0.03663	hypertension	-0.00658	-0.00841
chest pain	0.04574	0.058228	stroke	0.097209	0.122293
coughs and sputum	0.023279	0.029708	angina/AMI	0.037481	0.047767
the sniffles	-0.00139	-0.00178	other circulatory problems	0.046052	0.058622
noisy breathing	0.024632	0.031433	acute nasopharynx	0.024111	0.030769
retching	0.006553	0.008369	allergic rhinitis	-0.02079	-0.02653
diarrhoea	0.009641	0.012313	asthma	0.053437	0.067943
constipation	0.014655	0.018713	other respiratory problems	0.064378	0.081684
appetite loss	0.083158	0.105043	gastritis/duodentis	0.016502	0.02107
stomach ache	0.055438	0.070462	gastric/duodenal ulcer	0.027956	0.035664
hemorrhoids	0.011637	0.014862	hepatitis/cirrhosis	0.053583	0.068126
toothache	-0.01563	-0.01996	cholecytolithiasis/cholesystitis	-0.0032	-0.00409
dental problems	-0.00805	-0.01029	other digestive problems	0.054041	0.068703
difficulty in chewing	-0.00178	-0.00228	tooth decay	-0.04091	-0.05211
rash	0.009292	0.011867	oral problems	-0.01616	-0.02064
itching	-0.01811	-0.02312	atopic dermatitis	-0.0099	-0.01264
stiff shoulder	0.005356	0.006841	contact dermatitis	-0.03184	-0.04061
lumbago	0.021184	0.027039	urticaria	-0.00506	-0.00646
arthralgia	0.024992	0.03189	baldness	-0.04783	-0.06087
dysfunction of hands and feet	0.094844	0.119405	gout	-0.00695	-0.00888
numbness	0.05327	0.067732	chronic rheumatoid arthritis	0.115779	0.144737
frigid hands and feet	0.013294	0.016976	arthritis	0.016038	0.020477
foot oedema	0.024015	0.030646	stiff shoulder	-0.01162	-0.01484
disuria	0.022208	0.028345	back pain	0.04757	0.060541
frequent urination	0.01125	0.014367	osteoporosis	0.044211	0.056294
incontinence	0.012654	0.016159	kidney disease	0.091615	0.115451
paramenia/merorrhagia	0.02128	0.027162	prostatic hypertrophy	0.018397	0.023486
broken bones and sprain	0.011695	0.014935	pre/post menopausal problem	0.025749	0.032855
wounds	-0.03382	-0.04313	fractures	0.049252	0.062665
other symptoms	0.04201	0.053508	injuries	0.009049	0.011557
			anaemia/haemopathy	0.035455	0.045195
			malignant neoplasm	0.076399	0.096673
			pregnancy	0.028204	0.035979
			others	0.02808	0.035822
			unknown	0.101515	0.127535

Table11. QOL Estimation Including Economic Variables using the Function Threshold Model

Symptoms	1-QOL _{CR,G}	QOL _{HO}	Diseases	1-QOL _{CR,G}	QOL _{HO}
fever	0.058038	0.006672	diabetes	0.044791	0.012757
fatigue	-0.01265	0.033001	obesity	-0.00765	-0.00276
sleepless	0.011049	0.008905	hyperlipidemia	-0.01339	0.002507
irritation	0.050939	0.009662	thyroid gland disease	0.010771	0.011994
failing memory	0.12965	-0.0033	dementia	0.143473	0.026213
headache	0.133056	0.015306	psychosis	0.129895	0.029547
dizziness	0.079353	0.014639	neurosis	0.06089	0.018018
bleary eyes	0.095256	0.004552	autonomic imbalance	0.064633	0.021703
difficulty in seeing	0.009374	0.004641	cataract	-0.0082	0.002098
tinnitus	0.048389	0.000673	retinopathy	0.029116	0.010774
difficulty in hearing	-0.02288	0.001605	tympanitis	-0.01103	-0.00499
palpitation	0.007014	0.015745	deafness	0.018783	0.001505
difficulty in breathing	0.030866	0.005633	hypertension	-0.00658	0.007173
chest pain	0.098092	0.013801	stroke	0.097209	0.021502
coughs and sputum	0.065572	0.010698	angina/AMI	0.037481	0.015293
the sniffles	0.097877	0.005361	other circulatory problems	0.046052	0.023839
noisy breathing	0.049672	0.005004	acute nasopharynx	0.024111	0.011409
retching	-0.00352	0.009527	allergic rhinitis	-0.02079	-0.0008
diarrhoea	0.082999	0.002561	asthma	0.053437	0.019164
constipation	0.038184	0.006558	other respiratory problems	0.064378	0.007801
appetite loss	0.049845	0.006731	gastritis/duodentis	0.016502	0.011515
stomach ache	0.05947	0.023432	gastric/duodenal ulcer	0.027956	0.014003
hemorrhoids	0.073798	0.010344	hepatitis/cirrhosis	0.053583	0.016812
toothache	0.000658	-0.00574	cholecytolithiasis/cholesystitis	-0.0032	0.000145
dental problems	0.084401	-0.0029	other digestive problems	0.054041	0.019447
difficulty in chewing	-0.04071	-0.00147	tooth decay	-0.04091	-0.00895
rash	0.011332	0.00038	oral problems	-0.01616	0.002594
itching	0.006694	-0.00355	atopic dermatitis	-0.0099	0.001446
stiff shoulder	-0.02607	0.007678	contact dermatitis	-0.03184	-0.00584
lumbago	-0.0128	0.012957	urticaria	-0.00506	-0.00275
arthralgia	-0.07389	0.008761	baldness	-0.04783	-0.01511
dysfunction of hands and feet	-0.02356	0.018089	gout	-0.00695	-0.00508
numbness	0.119398	0.011128	chronic rheumatoid arthritis	0.115779	0.026137
frigid hands and feet	0.02493	0.002818	arthritis	0.016038	0.005465
foot oedema	0.000736	0.011265	stiff shoulder	-0.01162	0.000165
disuria	0.05421	0.00417	back pain	0.04757	0.011937
frequent urination	0.047186	0.003087	osteoporosis	0.044211	0.010283
incontinence	0.085216	0.003449	kidney disease	0.091615	0.017926
paramenia/merorrhagia	0.043653	0.013384	prostatic hypertrophy	0.018397	0.010399
broken bones and sprain	0.053573	-0.00614	pre/post menopausal problem	0.025749	0.012888
wounds	0.02964	-0.00959	fractures	0.049252	0.00598
other symptoms	-0.01246	0.007747	injuries	0.009049	-0.00259
			anaemia/haemopathy	0.035455	0.010022
			malignant neoplasm	0.076399	0.015039
			pregnancy	0.028204	0.002267
			others	0.02808	0.007997
			unknown	0.101515	0.013973