Estimation of the demand for health for urban households using Grossman's model in Shiraz, Iran

Jafari A.[1], Ravangard R.[1*], Kavosi Z.[1], Sajjadnia Z.[2]

[1] Health Human Resource Research Centre, School of Management and Medical Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[2] Department of Statistics, Science College, Shiraz University, Shiraz, Iran

ABSTRACT

Purpose: To study the effects of socioeconomic variables on health stock using Grossman model in Shiraz, Iran.
Materials and Methods: This was an applied, cross-sectional and analytical-descriptive study conducted in Iran, Shiraz in 2012. A sample of 1538 individuals from 769 households was determined using stratified sampling proportional to size and systematic random sampling methods. Health stock was measured using Quality of Life SF36 questionnaire, and an ordered probit model was used to econometrically estimate the demand for health equation.
Results: The results showed that being male and having high school and university degrees had positive and significant effects on health stock ($p<0.05$). Also, ages over 44 years and being unemployed had negative, and significant effects on health stock ($p <0.05$). However, the estimated effects of monthly income level, public health insurance coverage status and supplementary health insurance coverage status were positive, but not significant.
Conclusions: According to the results, the following suggestions can be made for improving individuals' health status: providing education opportunities and facilities for all, increasing health and wellness education programs at different education levels, providing health education for all people through the media at the appropriate time, implementing health subsidies and exemption from payment policies for the elderly, increasing recreational, and sports facilities for women, etc.
Key words: Demand for health, health stock, health production, Grossman's model.

***Corresponding author:**
Health Human Resource Research Centre
School of Management and Medical Information Sciences
Shiraz University of Medical Sciences, Shiraz, Iran
Iran, Shiraz, Almas build., 29 valley Ghasr dasht St.,
School of Management and Medical Information Sciences
Department of Health Services Management, PO.COD: 71336-54361
Tel.: +98-711 2340774; Fax: +98-711 2340039
e-mail: ra_ravangard@yahoo.com

Received: 31.01.2014
Accepted: 28.03.2014
Progress in Health Sciences
Vol. 4(1) 2014 pp 31-40

INTRODUCTION

Over the past few years, much attention has been paid to the fact that several determinants affect health, including food, housing conditions, work environment, etc., among which medical care is only one. In other words, socioeconomic factors are important non-medical factors affecting health. The first economic model of the socioeconomic determinants of health was made by Grossman [1]. He made a model indicating that individuals used non-market and market inputs such as smoking, diet, exercise, drug, medical services, etc. to produce health. Grossman's human capital model provides a conceptual framework for the interpretation of socioeconomic determinants of health in relation to an individual's consumption needs, preferences and resource constraints during the life cycle. This model has been one of the most important models studying the health behavior and has provided insights into the demand for medical care, as well as, other determinants of health. It, therefore, develops conceptual apparatus for analyzing the interrelationships between socioeconomic determinants of health, as well as studying several health policy issues such as inequalities in health and developing prevention policies [1-4].

According to the Grossman model, an individual's health stock (health status) is determined through the primary level of health stock. The stock of health decreases with age until death at an increasing rate and can be increased (decreased) by positive (negative) investment in health over time. When health stock is less than critical level at some points of time, death occurs. In addition, Grossman states that health can be viewed both as a consumption commodity and as an investment commodity. In consumption perspective, health makes people feel better, and in the view of investment, it increases the number of healthy days to work and to earn income [5, 6].

Because better health results in having more healthy time for allocating to work or leisure, and on the other hand, higher income rates mean more return on healthy time devoted to work or leisure, the income rate becomes a significant determinant of the demand for health. In the Grossman's study, age and education level directly included in the model, since they affected the cost of achieving higher levels of health; because age was positively associated with the rate of depreciation and education level was positively associated with an individual's ability to produce health. Also, unlike when health was viewed as an investment commodity, income or wealth had the usual positive effect on the demand for health when health was considered as a consumption commodity because although wealth does not have any effect on the rate of return on health investment, it provides more ability to buy health investments and other goods and services for consuming [7,8].

There are several studies on demand for health and its associated factors conducted in other countries some of which have been mentioned bellow:

Lo and Hsieh [9] studied the long-term development of the old people's health by including the concept of the health investment process in Grossman's (1972) model. Their results showed that educational attainments and most socio-demographic backgrounds influenced the old people mortality by affecting the development of the health stock. Also, Cutler and Lleras-Muney [10] used various data sets from two countries and studied possible reasons for the relationship between education and health behaviors. They concluded that education gradients had large and positive effects on health behaviors [10].

Birch and colleagues [11] studied neighborhood variations in the smoking–health relationship using data from a survey of adults in four distinct neighborhood clusters in Hamilton, Ontario and estimated equations to interpret variations in self-reported health. The results indicated that the relative odds of being unhealthy among smokers compared to non-smokers in the downtown neighborhood were less than one-half of that among the rest of the city and the size of health risk of smoking for individuals living in the downtown neighborhood was significantly smaller than that for those living in other neighborhoods.

Gerdtham and Johannesson [12] estimated the demand for health as a function of age, gender, income, education level, living alone, unemployment, overweight, wage, living in big city, and health problems in family. The results showed that the demand for health increased with income and education level, and decreased with age, male gender, being single, living in big cities, and overweight. The estimated effect of unemployment was negative [12].

Nocera and Zweifel [13] estimated the demand for health as a function of age, gender, education level, wage rate, living alone, overweight, sporting activities and smoking using two panel data sets. In the first data set, the effects of all variables were in the expected direction and most variables had significant relationships with the demand for health.

However, in the second one, the results did not confirm the Grossman's demand for health model completely because smoking had a positive and significant effect and the wage rate had a negative and non-significant effect on health stock.

Finally, Wagstaff [14], also, estimated the demand for health as a function of income, education level, gender and age in two separate age-groups (under and over 41 years) using two equations. He concluded that age had negative and significant effect only in the over-41 year's equation. In addition, the results showed that though income and education level had the expected signs in both equations, the effect of income was not significant in the under-41 year equation and the effect of education level was not significant in the over - 41 year equation. In addition, gender had no significant effect on health in both studied equations.

According to the importance of estimating the population demand for health in healthcare planning and its associated factors, the present study was conducted for the first time in Iran to study the effects of socioeconomic variables on health stock using Grossman's model in Shiraz, Iran.

MATERIALS AND METHODS

This was an applied, cross-sectional and analytical-descriptive study conducted in Iran, Shiraz in 2012. Iran is a country in Asia which, according to the WHO statistics, its total population in 2012 has been more than 76 million inhabitants. In 2011, its total expenditure on health per capita and total expenditure on health as percent of GDP have respectively been 929$ and 6%. On the other hand, Shiraz is the fifth most populous city of Iran and the capital of Fars Province which has been located in the southwest of Iran. In the present study, a sample of 1538 individuals was determined using the findings of previous studies and the following formula (assuming α=0.05, σ=2 and d=0.1), who were between 18 and 88 years old).

$$n = \left(\frac{Z_{1-\frac{\alpha}{2}}\sigma}{d} \right)^2 = 1538$$

Because 2 persons of each household were asked to respond to the questionnaire inquiries, 769 households were determined as the household sample size. First, Shiraz was divided into nine regions based on its municipality divisions and each region was considered as a stratum. The samples of households in determined strata were selected using stratified sampling proportional to size. Then, in each stratum the required samples of households were selected using systematic random sampling method. In all analytical and statistical tests used in this study, a p-value <0.05 was considered statically significant.

An approval for conducting this study was obtained from the ethical committee of Shiraz University of Medical Sciences. The informed consents were obtained from all respondents to participate in this study before administering the questionnaire. All respondents were assured of the confidentiality of their responses.

The studied variables in this study have been discussed below.

Dependent variable (Ht)

The dependent variable in this study was the stock of health (Ht) which was measured by Quality of Life SF36 questionnaire. This questionnaire has been naturalized in Iran by Montazeri and colleagues. They confirmed the reliability and validity of this questionnaire using statistical analysis of internal consistency and convergence validity method (Cronbach's α =0.98) [15].

This questionnaire assesses eight dimensions including: Physical functioning, Role limitations due to physical problems, Bodily pain, General health perceptions, Vitality, Social functioning, Role-limitations due to emotional problems, and Mental health. Based on the questionnaire, minimum and maximum possible scores for each mentioned dimension of health stock (health status) and total health stock is between zero and 100. In the current study, the health stock was classified into three point scales including poor health, fair health and good health stock so that the score higher than 75 equaled to good health stock, the score between 50 and 75 meant fair health stock, and the score below 50 equaled to poor health stock. It has been shown that important information on persons' health can be obtained and the mortality can be predicted accurately using this type of categorical health stock (16-20).

For estimating the demand for health model we considered health stock as an ordered variable with three categories. The ordered probit model is an econometric model that is used to deal with ordered categorical variables and is designed to model a discrete dependent variable that takes ordered multinomial outcomes. For instance, y = 0, 1, 2, … . It should be emphasized that y is measured on an ordinal scale and the numerical values of y are arbitrary, except that they must be in ascending order [21, 22].

We, therefore, used an ordered probit model in the present study. Using the ordered probit model, the probability of each category is estimated. A positive regression coefficient means that an increase in the respective variable decreases the probability of being in poor health and increases the probability of being in good health.

Independent variables

Respondents were asked about their demographic characteristics such as age, education level, monthly income level, public and supplementary health insurance coverage status, etc.

Non-wage income and the wage rate

Grossman's investment model anticipated an unclear positive relationship between the wage rate and health stock because an increase in the wage rate raised the monetary return on an investment in health. Again, because the hourly wage rate was not accessible in the National Opinion Research Centre (NORC) data set for Grossman to be used for estimating the model, he used the weekly wage rate adjusted for net earnings lost per work-loss week. Where sick time resulted in a low wage rate, the adjustment for lost earnings decreased the probability that a misleading and deceptive negative relationship would be created between sick time and the wage rate. However, Grossman states that: "To the extent that people with higher stocks of health work more hours per week than those with lower stocks, the causal relationship that goes from health to the wage has not been entirely eliminated" [23].

As mentioned, the Grossman's model is based on the working population in which the wage rate assesses the opportunity cost of time. Because there was not any information about the opportunity cost of time in the non-working population, one income variable (gross income) rather than non-wage income and wage-rate had to be included in the present study. However, the researchers used dummy variables rather than a continuous income variable to avoid the functional relationship between income and health stock.

Education level

Education level, as a criterion for human capital, is predicted to be directly related to the health stock. Based on Grossman's (2000) theoretical terms, "… an increase in education level raises the marginal products of the direct inputs in the gross investment production function, lowers marginal cost, and shifts the marginal efficiency of health capital (MEC) schedule to the right. Therefore, the demand for health increases". In other words, people with higher education level are more able to produce health, and in that sense, producing health is 'less expensive' to obtain and, therefore, more health is requested [7]. In the current study, we included two dummies for the education levels of the individuals and as mentioned above, we expected that the demand for health would be increased with higher education levels.

Public health insurance and supplementary health insurance coverage status

An important criticism of the Grossman's model has been that it is not able to take the uncertainty of the future health stock and the uncertainty of the effects of investments on health production into account [24, 25]. In the present study, we also included two dummy variables for public health insurance coverage status and supplementary health insurance coverage status. In addition, Ehrlich and Chuma [26] have criticized the Grossman's model and have pointed out that the marginal cost of investment is constant under the constant returns to scale (CRTS) conditions in health production process and no interior equilibrium for health investment exists. They argue that this is a main limitation that introduces a type of uncertainty problem in regard to optimal investment and health maintenance choices.

Variables affecting the rate of depreciation in health

We included age as a variable that affected the health status because health stock decreases with age. Instead of imposing a functional form on the relationship between health and age, we used three 0-1 dummies for age groups. Gender was also included in the model and was represented by a 0-1 dummy for being male. In addition, we included one dummy variable for being single and a dummy variable for being unemployed. Both these variables were expected to increase the rate of depreciation.

Estimation methods

As stated earlier, for estimating the demand for health model we considered health stock as an ordered variable with three categories including bad health, fair health and good health. A suitable tool for analyzing such ordered categorical data is the ordered probit model [21,27].

Let h_i^* be a continuous, latent variable which could be interpreted as a proxy for the health of an individual on a continuous scale.

We assumed a linear dependence between the latent variable h_i^* and X_i, β and ε_i:

$$h_i^* = \beta' X_i + \varepsilon_i,\ \varepsilon_i \sim N(0,1),$$

$$h_i = j \text{ if } \mu_{j-1} < h_i^* \leq \mu_j,\ j=1,\ldots, m,$$

where hi* is the exact but unobserved dependent variable (health stock), X_i is the vector of independent variables, ε_i is error term with the mean of 0 and variance of 1 and β' is the vector of regression coefficients which should be estimated. The threshold values (μ) denote to the cut-offs where an individual shifts from reporting one category of self-assessed health to another.

The variable h_i* defines a variable h_i which was related to the above mentioned categories in the following way:

$$h_i = \begin{cases} 0 \text{ if } h_i^* \le 0 \\ 1 \text{ if } 0 < h_i^* \le \mu_1 \\ 2 \text{ if } \mu_1 < h_i^* \le \mu_2 \end{cases}$$

Similar to the binary probit model, independent variables are introduced into the model by making the unobserved variable h_i*, a linear function of the X_i and adding a normally distributed error term. This means that the probability of an individual reporting a particular value of h_i=j is determined by the difference between the probability of the respondent having a value of h_i* less than μ_j and the probability of having a value of h_i* greater than μ_{j-1}, that is $h_i = j$ if $\mu_{j-1} < h_i^* \le \mu_j$, j=1,2. Using these probabilities, it is possible to use maximum likelihood estimation to estimate the parameters of the model including the β the coefficients on the X variables) and the unknown cut-off values (the μ) [22]. Greene [21] indicates that the explanation of the estimates is difficult and complicated. A positive estimate shows that an increase in the respective variable moves weight from category 0 to category 2, which means that the probability of category 2 increases and the probability of category 0 decreases.

RESULTS

Demographic characteristics of the studied sample have shown in Table 1.

The results showed that most of studied sample had good health stock (52.27%), were male (54.17%), in the 18-34 years age group (52.77%), married (58.76%), employed (94.96%), insured (86.17%), supplementary uninsured (65.07%), had academic and university degrees (44.81%)and less than 7 million Rials monthly income (56.98%).

The results of the ordered probit estimated effects of the covariates on the categorical health stock have been reported in Table 2. In order to be able to interpret the size of the regression coefficients, the predicted probability of being in good health for each category of the dummy variables, have been shown in Table 3.

The results showed that being male and having high school and university degrees had positive and significant effects on health stock ($p<0.05$). Also, ages over 44 years and being unemployed had negative and significant effects on health stock ($p<0.05$).

Contrary to expectations, the estimated effects of being male was positive and significant ($p=0.001$) so that being male increased the predicted probability of being in good health from 0.8096 to 0.8472.

Table 1. Demographic characteristics of the sample.

Variables		Frequency (%)	Variables		Frequency (%)
Health Stock	Poor Health	175 (11.36)	**Gender**	Male	833 (54.17)
	Fair Health	559 (36.38)		Female	705 (45.83)
	Good Health	804 (52.27)	**Marital Status**	Single	634 (41.24)
Age (years)	18-34	812 (52.77)		Married	904 (58.76)
	35-44	238 (15.49)	**Education Levels**	Less than High School Degrees	337 (21.92)
	45-64	397 (25.81)		High School Degrees	512(33.27)
	> 64	91 (5.93)		Academic and University Degrees	689 (44.81)
Employment Status	Employed	1461 (94.96)	**Public Health Insurance Coverage Status**	Insured	1170 (86.16)
	Unemployed	77 (5.04)		Uninsured	188 (13.84)
Monthly Income Levels (Rials)	< 7 million	876 (56.98)	**Supplementary Health Insurance Coverage Status**	Supplementary Insured	537 (34.93)
	7-14 million	589 (38.30)		Supplementary Uninsured	1001(65.07)
	14-21 million	49 (3.19)			
	> 21 million	24 (1.53)			

However, the estimated effects of being single was positive but not significant (p=0.239) and being single increased the predicted probability of being in good health from 0.7265 to 0.7691.

Table 2. The relationships between studied independent variables and health stock using ordered probit maximum likelihood estimation.

Variables	Coefficients	Standard Deviation (SD)	P-value [a]
Gender			
Male	0.4158	0.0612	0.001
Age (years)			
35-44	0.1217	0.0898	0.176
45-64	-0.1489	0.0739	0.044
> 64	-0.3564	0.1301	0.006
Marital Status			
Single	0.0768	0.0653	0.239
Education Levels			
High School Degrees	0.4330	0.0820	<0.001
Academic and University Degrees	0.7735	0.0858	<0.001
Employment Status			
Unemployed	-0.4271	0.1349	0.002
Monthly Income Levels (Rials)			
7-14 million	0.0309	0.0644	0.631
14-21 million	0.1427	0.1759	0.417
> 21 million	0.1766	0.2607	0.498
Public Health Insurance Coverage Status			
insured	0.0290	0.0905	0.74
Supplementary Health Insurance Coverage Status			
Supplementary health insured	-0.0991	.0668	0.138
Log likelihood	1384.74		

[a] A p-value < 0.05 was considered statically significant.

As expected, increasing age significantly decreased the demand for health. The predicted probabilities of being in good health were 0.9131 in the youngest age group and 0.6523 in the oldest one.

Education levels had a positive and significant effect on health stock (p<0.001), indicating that individuals with higher education degrees were more efficient producers of health. The predicted probability of being in good health was 0.9167 for individuals having academic and university degrees and 0.7561 for individuals having less than high school degrees.

The estimated effects of being unemployed was negative, as expected, and significant (p=0.002) so that being unemployed decreased the predicted probability of good health from 0.9297 to 0.8121.

The estimated effects of monthly income levels on the demand for health were positive, as expected, but not significant (p>0.05). The estimated probability of being in good health increased from 0.7612 in the lowest monthly income level to 0.7786 in the highest one**.**

Finally, the estimated effect of public health insurance coverage status was positive but not significant (p=0.74) so that being insured, as expected, increased the predicted probability of being in good health from 0.7045 to 0.7155. In addition, the estimated effect of supplementary health insurance coverage status was, against all expectations, negative but not significant (p=0.138) so that being uninsured increased the predicted probability of being in good health from 0.7967 to 0.8051.

Table 3. Predicted probabilities of being in good health.

Variables	Predicted Probabilities
Gender	
Male	0.8472
Female	0.8096
Marital Status	
Single	0.7691
Married	0.7265
Age (years)	
18-34	0.9131
35-44	0.8706
45-64	0.7720
> 64	0.6523
Education Levels	
Less than High School Degrees	0.7561
High School Degrees	0.8672
Academic and University Degrees	0.9167
Employment Status	
Employed	0.9297
Unemployed	0.8121
Monthly Income Levels (Rials)	
< 7 million	0.7612
7-14 million	0.7618
14-21 million	0.7721
> 21 million	0.7786
Public Health Insurance Coverage Status	
Insured	0.7155
Uninsured	0.7045
Supplementary Health Insurance Coverage Status	
Supplementary Insured	0.7967
Supplementary Uninsured	0.8051

DISCUSSION

Researchers in this study estimated the Grossman's model of demand for health and studied the effects of socioeconomic variables on health stock using this model in Shiraz, Iran in 2012. The results showed that higher education level, being male ages over 44 years and being unemployed had significant effects on the demand for health.

The estimated effect of being male was positive and significant. The reason could be that welfare and recreational services and facilities such as sport facilities, etc. is more provided for men than women. Lo and Hsieh [9], Gerdtham and Johannesson [12], and Nocera and Zweifel's [13] study results are inconsistent with the present study results.

Based on the results of the present study, increasing age significantly decreased the demand for health. Because depreciation rate of health increases as a result of aging and, therefore, health stock decreases.

The results of Lo and Hsieh [9], Hauck and Rise [28], Gerdtham and Johannesson [12], Gerdtham and colleagues [29], Nocera and Zweifel [13] and Wagstaff's [14] studies are similar to the present study results.

According to the present study results, higher education levels had positive and significant effects on health stock. The reason can be that better educated people and those with higher education degrees are more informed about the effects of smoking, unhealthy life style, obesity, diet and exercise on health status, and adopt healthier lifestyles faster than those with lower education degrees. In other words, education increases efficiency in producing health.

The results of Lo and Hsieh [9], Cutler and

Lleras-Muney [10], Hauck and Rise [28], Gerdtham and Johannesson [12], Gerdtham and colleagues [29], Nocera and Zweifel [13], Grossman and Kaestner [30], and Wagstaff's [14] studies confirm the present study results.

In addition, the results showed that unemployment had a negative and significant effect on health stock. It can be said that unemployment not only has effects on individuals' ability to access health care, but also increases their exposure to stress, depression, and anxiety. The results of Gerdtham and Johannesson's study [12] also showed that the estimated effect of unemployment was negative, but not significant. However, the results of Browning and colleagues' study [31] are inconsistent with the current study results.

The present study results showed that there was a positive, but not significant, relationship between monthly income levels and health stock. It can be said that the increase in individual's monthly income can increase his/her ability to pay and access to health services, which results in having better health. The results of Cutler and Lleras-Muney [10], Hauck and Rise [28], Gerdtham and Johannesson [12], Gerdtham and colleagues [29], and Wagstaff's [14] studies confirm the results of present study.

On the other hand, the results of current study demonstrated that, contrary to expectations, there was a positive relationship between being single and health stock. A possible reason can be that unlike singles, the monthly income of married people is divided among family members. Therefore, the low share of household income per person and the high costs of health services can result in the decrease in the ability to pay and access to quality care which, in turn, reduce the possibility of enjoying from better health. The results of Gerdtham and Johannesson's study [12] do not confirm the present study results.

In the present study, there were no significant relationships between public health insurance coverage status, supplementary health insurance coverage status and health stock. One possible reason is designing and implementing public insurance plans without considering important factors such as individuals' socio-economic status, demographic characteristics, and epidemiologic patterns of diseases in the country. Also, in Iran, public health insurance benefit packages are limited and a wide range of services are not covered and, therefore, participation rate of the insured in paying the health services fees in some insurance programs is high. In addition, drugs and new health technologies that have recently been made may take some time to get into the benefit packages due to its long-term legal processes. Furthermore, the parallel health insurance organizations, such as MSIO (Medical Services Insurance Organization) and SSO (Social Security Organization) are very different from each other in terms of their premium, benefit packages, population coverage, etc. and in some cases they have different objectives. Therefore, some reforms in these two organizations are required in order to achieve efficient resource allocation and financial sustainability and ensure universal coverage. Lo and Hsieh [9], and Cutler and Lleras-Muney [10] in their studies found that health insurance had an effect on health. The direction of public health insurance effect on health in these three studies is similar.

Limitations

The present study had several limitations one of which is its cross-sectional design because determining the causal relationship in a cross-sectional study is difficult. Another its limitation is that there may be some omitted variables affecting the demand for health which could lead to omitted variables bias. Also, applying a single method (i.e. questionnaire) for data collection and studying the individuals' health status through their self-reported health can be a limitation.

CONCLUSIONS

The results of the present study showed that the demand for health increased with higher education degrees and being male and, on the other hand, decreased with ages over 44 years and being unemployed. However, the estimated effects of monthly income level, health insurance coverage status and supplementary health insurance coverage status on the demand for health were positive, but not significant. According to these results, the following suggestions can be made for improving individuals' health status: providing education opportunities and facilities for all, increasing health and wellness education programs at different education levels, providing health education for all people through the media at the appropriate time, implementing health subsidies and exemption from payment policies for the elderly, increasing recreational and sports facilities for women, performing cost-effective screening tests for detecting chronic diseases, devising a single universal and comprehensive health insurance scheme for covering health services for all Iranian regardless of their employment status, implementing required reforms in health insurance organizations, etc.

For future studies it is suggested conducting a similar research in Iran to review the effects of other factors having predictable effects on health, such as work environments, psychological stress, healthy

eating and sleeping habits, etc., as well as, estimating the demand for health care or medical care equation.

ACKNOWLEDGMENT
This article was extracted from a research project supported financially by Shiraz University of Medical Sciences, grant's No. 90-01-68-4249. The researchers would like to thank all the research participants for their valuable contributions to this study for collecting and analyzing the required data.

Conflicts of Interest
The authors declare they have no conflicts of interest**.**

Financial Disclosure
This article was extracted from a research project supported financially by Shiraz University of Medical Sciences, grant's No. 90-01-68-4249.

Authors' Contribution
AJ and RR conceived and designed. ZK performed data collection and ZS analyzed and interpreted the data. All authors were responsible for writing and editing of the relevant methods, results and discussion sections of the manuscript. Therefore, all authors read and approved the final manuscript.

REFERENCES

1. Grossman M. The demand for health: a theoretical and empirical investigation. 1 ed. U.S.A., Cambridge: National Bureau of Economic Research, Inc; 1972.
2. Nocera S, Zweifel P. The demand for health: an empirical test of the Grossman model using panel data. Dev Health Econ Public Policy. 1998 6: 35-49.
3. Case A, Deaton AS. Broken down by work and sex: How our health declines. In: Wise DA, editor. Analyses in the Economics of Aging: University of Chicago Press; 2005. p 185-212. [Cited 2013 Dec 22]. Available from: www.nber.org/chapters/ c10361.pdf.
4. Leibowitz AA. The demand for health and health concerns after 30 years. J Health Econ. 2004 Jul; 23(4): 663-71.
5. Galama T, Kapteyn A. Grossman's missing health threshold, RAND Working Paper No. WR-684. 2009 December. [Cited 2013 Dec 22]. Available from: http://www. rand.org/content/dam/rand/ pubs /working_papers/2009/RAND_WR684.pdf.
6. Tica J, Smolic S. Multivariate Cointegration Technique Estimation of Health Demand Function: The Case of Croatia. 2007 May. [Cited 2013 Dec 22]. Avalable from: http://web. efzg.hr/repec/ pdf/Clanak %2007-06.pdf.
7. Grossman M. Handbook of health economics. In: (eds) AJCaJPN, editor. 1 ed. Amsterdam: Elsevier; 2000. Chapter 7. The human capital model. p 347-408.
8. Galama T, Kapteyn A, Fonseca R, Michaud P-C. Grossman's health threshold and retirement, RAND Working Paper No. WR-658. 2009 December. [Cited 2013 Dec 22].Available from: http://www.rand. org/content/ dam/rand/pubs/ working_papers/2009/RAND_WR658.pdf.
9. Lo T-F, Hsieh C-R. Dynamic profile of health investment and the evolution of elderly health. Soc Sci Med. 2013 Jan; 76: 134-42.
10. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. J Health Econ. 2010 Jan; 29(1): 1-28.
11. Birch S, Jerrett M, Wilson K, Law M, Elliott S, Eyles J. Heterogeneities in the production of health: smoking, health status and place. Health Policy. 2005 Jan; 72(3): 301-10.
12. Gerdtham U-G, Johannesson M. New estimates of the demand for health: results based on a categorical health measure and Swedish micro data. Soc Sci Med. 1999 Nov; 49(10): 1325-32.
13. Nocera S, Zweifel P. Health, the medical profession, and regulation. Springer.1998. The demand for health: an empirical test of the Grossman model using panel data**:** 35-49.
14. Wagstaff A. The demand for health: an empirical reformulation of the Grossman model. Health Econ. 1993 Jul; 2(2): 189-98.
15. Montazeri A, Gashtasebi A, Vahdaninia M. Translating, determining the reliability and validity of Persian format of SF-36 questionnaire. Payesh J. 2005 5(1): 49-56.
16. Vuorisalmi M, Sarkeala T, Hervonen A, Jylhä M. Among nonagenarians, congruence between self-rated and proxy-rated health was low but both predicted mortality. J Clin Epidemiol. 2012 May; 65(5): 553-9.
17. Bond J, Dickinson HO, Matthews F, Jagger C, Brayne C. Self-rated health status as a predictor of death, functional and cognitive impairment: a longitudinal cohort study. Eur J Ageing. 2006 Dec; 3(4): 193-206.
18. Vuorisalmi M, Lintonen T, Jylha M. Comparative vs. global self-rated health: associations of age and functional ability. Aging Clin Exp Res. 2006 Jun; 18(3): 211-7.
19. Vuorisalmi M, Lintonen T, Jylhä M. Global self-rated health data from a longitudinal study predicted mortality better than comparative self-rated health in old age. J Clin Epidemiol. 2005 Jul; 58(7): 680-7.

20. Wannamethee G, Shaper A. Self-assessment of health status and mortality in middle-aged British men. Int J Epidemiol. 1991 Mar; 20(1): 239-45.
21. Greene W. Econometric Analysis. 2 ed. New York: Macmillan Publishing Company; 1993.
22. Jones AM. Applied econometrics for health economists: a practical guide. 2 ed: Radcliffe Publishing; 2007.
23. Grossman M. On the concept of health capital and the demand for health. The Journal of Political Economy. 1972 Mar-Apr; 80(2): 223-55.
24. Zweifel P, Breyer F, Kifmann M. Health economics. 2 ed: Springer; 2009.
25. Van Doorslaer EK. Health, Knowledge, and the Demand for Medical Care: An Econometric Analysis. 1 ed: Van Gorcum Maastricht/ Wolfeboro, Hampshire; 1987.
26. Ehrlich I, Chuma H. A Model of the Demand for Longevity and the Value of Life Extension. J Polit Econ. 1990 Aug; 98(4): 761-82.
27. Jones AM. Health econometrics. Handbook of health economics. 2000 1: 265-344.
28. Gerdtham U-G, Johannesson M, Lundberg L, Isacson D. The demand for health: results from new measures of health capital. Eur J Polit Econ. 1999 Sep; 15(3): 501-21.
29. Galama T. A contribution to health capital theory, RAND Working Paper No. WR-831. 2011 January. [cited 2013 Dec 22]. Available from: http://works. bepress. com/titus_galama/1.
30. Grossman M, Kaestner R. Effects of education on health. In J.R. Behman and N. Stacey, eds., The Social Benefits of Education.: Michigan Press, Ann Arbor, MI; 1997.
31. Browning M, Moller Dano A, Heinesen E. Job displacement and stress-related health outcomes. Health Econ. 2006 Oct; 15(10): 1061-75.