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RESEARCH ARTICLE

Grossman's Generalised Health Demand Model: An Application on Türkiye

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Abstract

Health is the main source of economic activity and human capital. Each individual wants to be healthy throughout her life in order to maximize his/her individual benefit and strives for this. In this study, which examined the health demand of individuals, Grossman's health demand (consumption and investment) model, which pioneered research on health demand, was referenced. The demands of 25825 individuals for medical care included in the 2016 and 2019 health research micro datasets in Türkiye were examined using the negative binomial regression model. In addition, the effects of human capital components (education, income, etc.) on the general health status of individuals were analyzed using the ordinal logit model. Health demand is influenced by economic variables as well as social and cultural factors and individuals' life behaviors. Such variables are also included in the analysis. According to the results, it was seen that individuals with chronic diseases are more likely to receive medical care than those who do not have such a disease. Besides, it was concluded that education, income, and sports exercises improve the health status of individuals, whereas aging and an increase in the number of diseases worsen the health status.
Keywords: *Health Demand, Grossman Model, Poisson Regression, Ordered Logit Regression*
Jel Codes: *D11, I12, R22*

Grossman'ın Genelleştirilmiş Sağlık Talebi Modeli: Türkiye Üzerine Uygulama

Özet

*Sağlık, ekonomik faaliyetlerin ve beşeri sermayenin ana kaynağıdır. Her birey bireysel faydasını maksimize etmek için yaşamı boyunca sağlıklı olmak ister ve bunun için çabalar. Bireylerin sağlık talebini inceleyen bu çalışmada, sağlık talebi konusunda araştırmalara öncülük eden Grossman'ın sağlık talebi (tüketim ve yatırım) modeli referans alınmıştır. Türkiye'de 2016 ve 2019 sağlık araştırması mikro veri setinde yer alan 25825 bireyin tıbbi bakım talepleri negatif binom regresyon modeli kullanılarak incelenmiştir. Ayrıca, beşeri sermaye bileşenlerinin (eğitim, gelir vb.) bireylerin genel sağlık durumu üzerindeki etkileri ordinal logit modeli kullanılarak analiz edilmiştir. Sağlık talebi, ekonomik değişkenlerin yanı sıra sosyal ve kültürel faktörlerden ve bireylerin yaşamsal davranışlarından etkilenmektedir. Bu tür değişkenlere de analizde yer verilmiştir. Sonuçlara göre, kronik hastalığı olan bireylerin böyle bir hastalığı olmayanlara göre tıbbi bakım alma olasılıklarının daha yüksek olduğu görülmüştür. Ayrıca, eğitim, gelir ve spor egzersizlerinin bireylerin sağlık durumunu iyileştirdiği, yaşlanma ve hastalık sayısındaki artışın ise sağlık durumunu kötüleştirdiği sonucuna varılmıştı*r.
Anahtar kelimeler: *Sağlık Talebi, Grossman Modeli, Possion Regresyon, Sıralı Lojit Regresyon*
Jel Kodu: *D11, I12, R22*

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1. INTRODUCTION

A healthy life is an important component of the labor supply chain and human capital. Health is the main source of the continuous process of creating, producing, and consuming value for individuals. Every rational individual desires to invest in himself/herself in order to be healthy and increase welfare with an innate instinct/belief. The main motivations that are effective in determining the health-seeking behavior of individuals attracted the attention of researchers (Bentham (1789), Arrow (1963), Becker (1964), Acton (1975), Anderson and Newman (1973)) in every period. The first economic explanation for health-related decision-making was Michell Grossman's 1972 study. Grossman considers household health demand as a consumer product that directly contributes to the benefit function as well as an investment product that affects the accumulation of human capital by increasing productive time.

The purchasing power created by individuals acting on the motive of benefit maximization in terms of factor income over the expected lifetime constitutes the main constraint of the benefit function (Kök et al. 2018: 2-4). In order to maintain their health, individuals should maximize their expected life expectancy over a certain rate of depreciation (discount) over time. In this context, each individual wants to maximize the utility index over the basket of goods he or she consumes during his or her lifetime (Henderson & Quandt, 1998: 267).

$$\mathrm{U} = U(q_{11}, \dots, q_{nT}) + \lambda \sum_{t=1}^{T} \left(y_t - \sum_{j=1}^{n} p_{jt} q_{jt} \right) (1 + \varepsilon_{1t})^{-1} \quad (1)$$

In Equation 1, U refers to the utility index, $(q_{11}, \dots, q_{nT})$ manufactured consumer goods, λ common utility, which equates the rate of substitution between each pair of goods in two periods, y_t income constraint that each individual provides depending on the choice between free time and working hours in active working life, $p_{jt}q_{jt}$ expenditures on manufactured consumer goods, $(1 + \varepsilon_{1t})^{-1}$ discount rate defined over the depreciation, respectively. When we equate the partial derivative of Equation 1 to zero and make a simplification:

$$-\frac{\partial \mathrm{q_{jt}}}{\partial \mathrm{q_{k\tau}}} = \frac{\partial \mathrm{U}/\partial \mathrm{q_{k\tau}}}{\partial \mathrm{U}/\partial \mathrm{q_{jt}}} = \frac{\mathrm{p_{k\tau(1+\varepsilon_{1\tau})}}}{\mathrm{p_{jt(1+\varepsilon_{1t})}}} \quad (2)$$

$$(\mathrm{j, k} = 1, \dots\dots, \mathrm{n})$$
$$(\mathrm{t}, \tau = 1, \dots\dots, \mathrm{T})$$

We can associate the reduced price phenomenon in the Equation 2 system with the reduced life expectancy with an analogical approach. The depreciation (discount) rate $(1 + \varepsilon_t)^{-1}$ that may arise in the health stock will cause a decrease in the goods produced/consumed during the lifetime of the individual, as well as a decrease in the life expectancy due to less consumption.

According to Grossman (1999), individuals' demand for healthcare services was evaluated as an effort to compensate for the health stock worn out by the effects of diseases and similar factors. Therefore, an average one-year additional increase in the expected life expectancy during life from the time of birth of each individual decreases at the marginal $(1 + \varepsilon_t)^{-1}$ discount rate. In order to gain additional life, the total return on an individual's investment in their own health can be expressed in an analogous approach as follows (Kök et al. 2018: 2-4);

$$\mathrm{bt}(1 + \mathrm{it})(1 + \mathrm{it} + \mathrm{l}).\dots\dots(1 + \mathrm{i}, \dots\dots\dots\dots 1) \quad (3)$$

In Equation 3, bt refers to the age of onset, and it refers to the average discount rate. The total return of an individual's investment in himself/herself during the activity period corresponding to his/her expected life span can be expressed in Equation 4.

$$\varepsilon_{t\tau} = \frac{J}{b_t} = \frac{dJ}{db_t} = (1 + i_t)(1 + i_{t+1}) \ldots\ldots (1 + i_{\tau-1}) - 1 \tag{4}$$

While human life ends depending on age, on the one hand, additions to the health stock turn into a supply chain through the phenomenon of labor value. The current value of this profit, similar to unearned income arising from the continuity of life, can be calculated in real terms as follows:

$$\pi = \sum_{k=1}^{\infty} \pi_k = \frac{\int_0^T Z(t)e^{-it}dt - I_0 + S(T)e^{-iT}}{1 - e^{-iT}} \tag{5}$$

In equation 5, π is the gain from the expected life, k the amount of goods produced and consumed, and $Z(t)e^{-it}$ is the decrease in the planned life by the depreciation rate in the year and the expected life expectancy per year. I_0 indicates the initial value of the expected age, $S(T)e^{-iT}$ is the reduced rate of material savings left to society when it is deducted by the amount spent from the income in its expected life, and $1 - e^{-iT}$is the reduction ratio of the infinite sum of geometric progress.

Grossman's health demand model is a theoretical model that considers health as a consumption and investment good. The Model mathematically models the effort to recover the health stock that naturally wears off over time. There are numerous studies on the empirical testing of the Grossman model, whose theoretical framework is briefly mentioned. Some of these studies deal with the health production of households (Nocera & Zweifel (1998), Jacobson (2000), Batinti (2015), Jones et al. (2019). There are also studies examining the investment aspect of health (Eisenring (2000), Burggraf et al. (2016), Hartwing & Sturm (2018)). There are critical studies (Phelps (1973), Dowie (1974), Cropper (1977), Muurinen (1982), Sepehri (2015) stating that Grossman's health demand is a hypothetical model and that many of his assumptions are far from real life.

In this study, the consumption and investment dimensions of Grossman's health demand model were examined using econometric analysis techniques. In the first part of the study, Grossman's health demand model was explained in general terms. Grossman's health demand was examined within the framework of two different models using the micro-health survey data set for 2016 and 2019 published by the Turkish Statistical Institute (TUIK) in the analysis section. In the first model, the relationship between the number of people receiving health care and chronic diseases was revealed. In the second model, the relationship between human capital indicators and the general health status of individuals was examined.

1.1 Grossman's Health Demand Model: An Overview

Grossman, one of the pioneers of health demand studies, assumed that individuals are born with a certain health heritage that wears down over time and that health can be replaced by investment in the health stock. After perceiving the disease state, the person turns to healthcare providers by showing help-seeking behavior to regain his/her health (Kara & Kurutkan: 2018: 39). What individuals buy when they claim health care is actually a state of being healthier (Grossman, 1972: 223). Grossman considers healthcare demand as input and health and wellness as output.

In the Grossman model, health is seen as a durable good within the scope of consumer behavior on the one hand and as an element of human capital (stock investment) on the other hand. Health as a consumer good positively affects the benefit functions of individuals, and individuals do not like being unhealthy. As an investment good, health determines the time individuals can devote to market or non-market activities (Kara & Kurutkan: 2018: 54). Consumers not only buy healthcare from the market but also the time they spend improving their health. According to Grossman, an increase in a person's stock of knowledge and skills affects their market and non-market productivity, increasing the accumulation of human capital; however, health stock determines the total time they can spend making money and producing goods and services (Grossman, 1999: 2).

According to Grossman's human capital theory, an increase in a person's human capital or knowledge increases labor productivity in sectors such as the home economy, market, and non-market sectors where the goods included in that person's utility function are produced. In order to realize potential gains in productivity, individuals have a desire to invest in formal education and on-the-job training. The cost of these investments includes the opportunity cost of the time required for individuals to recover their direct and alternative expenditures for market goods (Grossman, 1999: 2). According to the model, health is an intrinsic variable and partly depends on the allocation of production resources (Jacobson, 2000: 612).

1.2 How the Model Works

The basic equations of Grossman's model (1972, pp. l-9) are as follows: Each individual maximizes life-time utility, which is a function of Z_T,, a composite consumption good, and h_T,, the services of the health stock: healthy time per period. Thus, the maximand is

$$U = U(h_0, \dots, h_T; Z_0, \dots, Z_T) \tag{6}$$

where h_t is produced from the health stock, K_t^h, according to

$$h_t = \phi_t(K_t^h), \quad \phi'_T > 0. \tag{7}$$

The health stock changes over time as shown by

$$K_{t+1}^h - K_t^h = I_t^h - \delta_t K_t^h \tag{8}$$

where I_t^h: is new investment in health and δ_t, a time-dependent rate of depreciation on health. T, the last period of life, is determined by

$$K_t^h > \overline{K}^h, \quad \text{axcept at T} \quad K_T^h \leq \overline{K}^h, \tag{9}$$

where $\overline{K}^h$ is a given minimum stock of health, the 'death stock'. Both I_t^h and Z_t, are produced from time and market good inputs,

$$Z_t = Z_t(X_t^Z, T_t^Z, E_t) \tag{10}$$

$$I_T^h = I_t^h(X_t^h, T_t^h, E_t) \tag{11}$$

where X_t^Z is the market good input in producing Z, T_t^Z the respective time input, X_t^h: medical care, and T_t^h time spent in investing in health. E_t is the level of education at t which operates as a production function efficiency factor. Total time per period, Ω, equals the uses of time plus any sick time,

$$\Omega_t = T_t^W + T_t^Z + T_t^h + T_t^U \tag{12}$$

where T_t^W is working time and T_t^U sick time. Thus, using (7), one gets

$$\Omega_t - T_t^U = h_t = \phi_t(K_t^h) \tag{13}$$

Finally, the consumer is faced with a life-time budget constraint

$$\sum_{t=0}^{T}\frac{P_t^Z X_t^Z + P_t^h X_t^h}{(1+r)^t} = \sum_{T=0}^{T}\frac{W_t T_t^W}{(1+r)^t} + A_0 \quad (14)$$

where r is a constant rate of interest, P_t^Z and P_t^h the prices of X_t^Z and X_t^h, respectively, W_t the wage rate, and A_0, the discounted value of non-wage income.

Maximisation of (6) subject to the constraints (8), (9), (12) and (14), taking into account (7), (10) and (11), gives, after rearranging, the following marginality condition for new health investment:

$$\frac{U_{\phi_t}(1+r)^t}{\lambda}\frac{\phi_t'}{MC_{t-1}^h} + \frac{W_t\phi_t'}{MC_{t-1}^h} = r + \delta_t - \widetilde{MC}_{t-1}^h \quad (15)$$

where $U_{\phi_t} = \partial U/\partial\phi_t$, is the marginal utility of healthy time, λ marginal utility of wealth, ϕ_t'; the marginal productivity of health in creating healthy time, MC_{t-1}^h the marginal cost of health investment in period $t-1$, and $\widetilde{MC}_{t-1}^h$ the percentage rate of change in marginal costs between periods $t-1$ and t. (15) can be seen as the basic equation of Grossman's model. It states that the sum of the marginal benefits of health equals the user cost of health capital at the margin. In the consumption submodel, the second term on the right-hand side of (15) is assumed to equal zero. Thus, the condition in this case becomes

$$\frac{U_{\phi_t}(1+r)^t}{\lambda}\frac{\phi_t'}{MC_{t-1}^h} = r + \delta_t - \widetilde{MC}_{t-1}^h \quad (16)$$

Analogously, his investment model is based on a version of (A.lO15) where the consumption benefits of health are absent,

$$\frac{W_t\phi_t'}{MC_{t-1}^h} = r + \delta_t - \widetilde{MC}_{t-1}^h \quad (17)$$

Eq. (17) provides the fundamental condition Grossman utilises as the basis of his empirical derivations.

2. METHOD

The Turkey Health Survey (2016 and 2019) data set was used for the analysis of health demand within the framework of the generalized Grossman model. Two different models were used for the analysis of health demand. In the first model, the number of people receiving services was used as a dependent variable. 15 different chronic diseases (asthma, diabetes, etc.), and obesity stages (class 1, class 2, and class 3) determined according to body mass index were used as explanatory variables. With this model, the effect of those with chronic diseases on the number (demand) of receiving health care services compared to those without was examined. Negative binomial regression analysis was used in the first model since the dependent variable is in the form of counting data.

In the second model, data on the general health status of individuals was used as a dependent variable. In addition to human capital indicators (education and household income), the age of individuals who demand health care, how much individuals exercise (walking), and the total number of chronic diseases individuals have were used as independent variables. In the second model, it was aimed at determining the relationship between individuals' health investments and their general health status. In this model, since the dependent variable was categorical data, the ordered logit regression method was used. Descriptive information regarding the variables used in both models is summarized in the table below.

Table 1: Variable Definition and Source

Variable	Variable Description	Source
number of service received	Number of applications made by individuals for family physician, specialist physician, outpatient service, inpatient service.	Health Survey Micro Data Set for 2016 and 2019 (Turkey Statistical Institute)
general health status	The general health status of the individual is expressed in 5 categories. 1: General health is very poor; 2: General Health is poor; 3: General health status is moderate; 4 General health is good and 5: General health is very good	Health Survey Micro Data Set for 2016 and 2019 (Turkey Statistical Institute)
diabetes	A value of 1 is assigned if the individual has the disease, or 0 if they do not.	Health Survey Micro Data Set for 2016 and 2019 (Turkey Statistical Institute)
asthma		
bronchi		
infarction		
heart		
hypertension		
stroke		
arthrosis		
waist		
neck		
allergy		
kidney		
urinary incontinence		
liver failure		
depression		
Class1	Those with a body mass index between 30-34.9	Health Survey Micro Data Set for 2016 and 2019 (Turkey Statistical Institute)
Class2	Those with a body mass index between 35-39.9	
Class3	Those with a body mass index of 40 and above	
education	Education variable consists of 8 categories. (1: primary school, 2: middle school, 3: high school, 4: college, 5: associate degree, 6: undergraduate, 7: master, 8: doctorate)	Health Survey Micro Data Set for 2016 and 2019 (Turkey Statistical Institute)
income	The income variable consists of 5 categories.	

duration of walking	Weekly walking for exercise purposes	
SGK (Social Security Institution)	If he/she has social insurance, 1 if not 0	
age	Individual's age (less than 15 years of age were not included in the analysis)	

In this study, the negative binomial regression model was used in the first model, and the ordered logit regression model was used in the second model. The working algorithm of both methods is briefly explained below.

There are cases where the dependent variable takes discrete values but is not categorical. Such situations are called counting data. The most commonly used method for counting data is the Poisson regression method. With this model, the probability of counting is determined by the Poisson distribution. Probability function for the Poisson distribution (Kunter et al. 2005: 147):

$$f(y) = \begin{cases} \dfrac{e^{-\mu}\mu^{y}}{y!}, y = 0,1,2,3 \dots \\ 0, diğer\ durumlarda \end{cases} \tag{18}$$

In equation 18, $f(y)$ indicates the possible outcome of y and $y! = y(y-1) \dots 3.2.1$. The Poisson regression model is used for effective parameter estimation when variance and mean are equal. However, in cases of overdispersion, it is insufficient to analyze the count data. In this case, the negative binomial regression model is applied, which is one of the methods to eliminate the effect of overdispersion.

In the negative binomial regression model, the dependent variable has a negative binomial distribution. In the case where p' is known, the negative binomial distribution function is shown in Equation 19 (Güneri & Durmuş, 2020: 53).

$$f(y;\beta) = \binom{y+p-1}{p-1}\beta^{p}(1-\beta)^{y} \tag{19}$$

Equation 19 is a two-parameter distribution for a positive integer y, where the probability of success in each attempt is p. The Poisson distribution may be generalized by including a gamma noise variable, which has a mean of 1 and a scale parameter of ν. The negative binomial distribution, with the propagation parameter α, is expressed as in equations 20 and 21 below.

$$\mathrm{P}(\mathrm{Y_i}|\lambda_i,\alpha) = \frac{\Gamma(\mathrm{Y_i}+\alpha^{-1})}{\Gamma(\mathrm{Y_i}+1)\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\lambda_i}\right)^{\alpha^{-1}}\left(\frac{\lambda_i}{\alpha^{-1}+\lambda_i}\right)^{\mathrm{Y_i}} \tag{20}$$

$$\lambda_i = t_i\lambda, \quad \alpha = \frac{1}{v} \tag{21}$$

The variance equation for the negative binomial model is calculated by equation 22

$$\mathrm{Var}(\mathrm{Y_i}|\mathrm{x_i}) = \lambda_i + \alpha\lambda_i^{2} \tag{22}$$

According to this model, the negative binomial regression model t_i, exposure time and, $\beta_1, \beta_2, \ldots \ldots \beta_k$ unknown parameters are represented by Equation 23.

$$\lambda_i = \exp(\ln(t_i)\, \beta_{1i}x_{1i}, \beta_{2i}x_{2i}, \ldots \ldots \beta_{ki}x_{ki}) \tag{23}$$

Pearson statistics ($P = \sum_{t=1}^{n} \frac{(y_i - \widehat{\lambda})^2}{\widehat{\omega}_i}$), Deviance statistics ($G^2 = 2\sum_{t=1}^{n} y_i \ln \frac{(y_i)}{\widehat{\lambda}_i}$), Akaike Information Criterion ($AIC = -2\log(\mathcal{L}) + 2k$) and Bayesian Information Criteria ($BIC = -2\log(\mathcal{L}) + k\log(n)$) are commonly used criteria in testing the goodness of fit of regression models.

In the cases where dependent variable is categorical and ordinal, ordered logit probability estimates can be used. The ordered logit regression model is defined by equation 24 (Emeç, 2002: 16):

$$G\big(Prob(Y \leq j)\big) = \propto_j + \beta' x \quad j = 1, \ldots, k \tag{24}$$

In the model, j indicates the number of levels of the dependent variable, with $j = 1, \ldots, k$. $\propto_j$ k being the constant cutting parameter. β' represents the slope coefficient, which does not contain the term constant cutting. If the model is opened for each level, it will be as follows:

$$P(Y = 1) = \frac{\exp\big(\propto_j + \beta' x\big)}{1 + \exp\big(\propto_j + \beta' x\big)} = P_1 \tag{25}$$

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$$P(Y \leq k) = \frac{\exp(\propto_k + \beta' x)}{1 + \exp(\propto_k + \beta' x)} = P_k$$

The logit model consists of cumulative sums, taking into account the order of the levels of the dependent variable. In this case, the model is represented by Equation 26.

$$logit(P_1 + P_2 + .. + P_k) = log\left(\frac{P_1 + P_2 + .. + P_k}{1 - (P_1 + P_2 + .. + P_k)}\right) = \propto_k + \beta' x \tag{26}$$

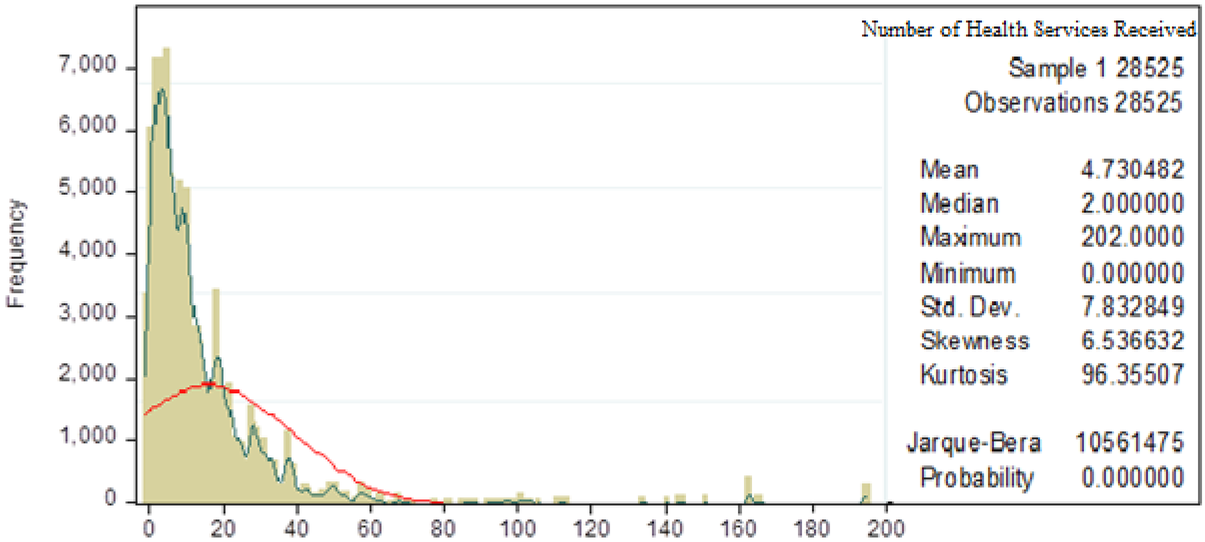
This model is known as the proportional difference model because the odds ratio of a $Y \leq j$ event is independent of the j category. The probability of observing an observation value defines the minimum value of the category variable i = 1 and the next ordinal value i = 2 is defined as the ordered values of… .i = J.

$$P(Y = i) = \frac{1}{1 + \exp\big(-cut_i + \sum \beta_j x_j\big)} - \frac{1}{1 + \exp\big(-cut_{i=1} + \sum \beta_j x_j\big)} \tag{27}$$

3. ANALYSIS RESULTS

Grossman's model, whose basic views are summarized above, has been analyzed with two different models. In the first model, the effect of worn-out health stocks (chronic diseases) on the health service use of individuals was examined. The number of individuals receiving health services, which is the dependent variable, counts data and expresses the number of times individuals have visited their family physician, hospital, and specialist physician. The descriptive statistics of the dependent variable are shown in Figure 1.

Figure 1: Descriptive Statistics of the Dependent Variable (Number of Health Services Received)



It was generalized if the dependent variable was count data and also showed over-propagation. The Poisson regression model or negative binomial regression model is preferred. Which regression model to use is determined by comparing the AIC, BIC and Deviance information criteria of both models.

Table 2: Goodness of Fitstat in Model

Goodness of Fitstat	Measures of Fit for Poisson Regression	Measures of Fit for Negative Binomial Regression
	Value	Value
Log-Lik Full Model	-130589.606	-72790.080
LR(18)	25357.060	3137.554
Prob > LR	0.0000	0.0000
McFadden's Adj R2	0.0880	0.0211
Deviance (Value/df)	6.69	1.408
Pearson Chi-Square	10.41	1,825
Akaike's Information Criterion (AIC)	259697,659	146822,874
Bayesian Information Criterion (BIC)	259854,571	146979,786

When Table 2 is examined, it is seen that the deviance (volue/df) value is closer to 1 in the negative binomial model, and the AIC and BIC values are smaller than the poisson regression model. Therefore, it is understood that the appropriate model is the negative binomial regression model. The negative binomial model results are shown in Table 3. Incidence Ratio Rate (IRR) values were calculated to interpret the coefficients of the models.

Table 3: Negative Binomial Regression Results (Dependent Variable - Number of Service Received)

hizalmasay	Coef.	exp(B) (IRR)	Std. Err.	z	P>z	[95% Conf.	Interval]
_cons	1.138126	3.120914	.0106212	107.16	0.000	1.117309	1.158943
diabetes	.3113119	1.365215	.0284652	10.94	0.000	.2555211	.3671028
asthma	.190549	1.209914	.0309979	6.15	0.000	.1297942	.2513038
bronchi	.1743774	1.190505	.0336877	5.18	0.000	.1083508	.240404
infarction	.1651276	1.179544	.0626176	2.64	0.008	.0423995	.2878558
heart	.2053114	1.227907	.0349768	5.87	0.000	.1367582	.2738646
hypertension	.2890006	1.335093	.0242206	11.93	0.000	.2415291	.3364721
stroke	.6260059	1.870126	.099344	6.30	0.000	.4312953	.8207165
arthrosis	.1704901	1.185886	.0287603	5.93	0.000	.1141209	.2268592
waist	.2181537	1.243778	.018956	11.51	0.000	.1810007	.2553068
neck	.164072	1.178299	.0214787	7.64	0.000	.1219745	.2061695
allergy	.1770955	1.193745	.0238302	7.43	0.000	.1303891	.2238019
kidney	.3686982	1.445851	.0342	10.78	0.000	.3016674	.4357289
urinary incontinence	.1803059	1.197584	.035911	5.02	0.000	.1099217	.2506901
liver failure	.2527077	1.287507	.0637316	3.97	0.000	.1277961	.3776193
depression	.3631469	1.437847	.0268307	13.53	0.000	.3105597	.4157342
Class1	.0597601	1.061582	.0213732	2.80	0.005	.0178694	.1016508
Class2	.1140326	1.120789	.0377031	3.02	0.002	.0401359	.1879292
Class3	.1693868	1.184578	.0674783	2.51	0.012	.0371318	.3016418
/lnalpha	.3649725		.0105577			.3442797	.3856652
alpha	1.440474		.0152081			1.410973	1.470592
Number of obs		28525					
LR chi2(18)		3137.55					
Prob > chi2		0.0000					

According to the results of Table 3, it is seen that individuals with chronic diseases receive more health services compared to people without chronic diseases. When the IRR coefficients in Table 3 were examined, it was seen that individuals with stroke (1.87 times), kidney (1.44 times), and diabetes (1.36 times) disease were more likely to receive health care than individuals with other diseases. Diseases that are least likely to affect the number of service recipients are listed as obese patients with a body mass index of 30-34.9 (1.06 times), those with neck region pain (1.17 times), and bronchitis patients. Grossman hypothesized that individuals engage in health-seeking behavior in order to recover worn-out health stocks (chronic illnesses wear out the health stock). Analytical findings confirm this assumption.

In Grossman's original model, the investment aspect of health demand is strongly emphasized. In addition, it was predicted that individuals who are cyclically equipped with human capital will be more willing to protect their health, and this will increase their health status. In the second model, the investment aspect of health was analyzed. In the second model, the extent to which human capital components such as education, income, and exercise affect the general health status, which is the dependent variable, was examined using the ordered logit model. The analysis results are shown in Table 4.

Table 4: Ordered Logistic Regression Results (Dependent Variable - General Health Status)

General Health Status	Coef.	Odds ratio	Std. Err.	z	P>z	[95% Conf.Interval]	
Income	0.10509	0.899	0.01425	-7.37	0.000	-0.13304	-0.07715
Education	0.17850	0.837	0.00888	-20.11	0.000	-0.19592	-0.16112
Age	-0.03579	1.036	0.00105	34.24	0.000	0.03375	0.03784
SSI	0.24706	0.781	0.03744	-6.60	0.000	-0.32042	-0.17366
Number Diseases	-0.60963	1.840	0.00864	70.53	0.000	0.59274	0.62662
Weekly Walking Minutes	0.00392	0.996	0.00031	-12.29	0.000	-0.00454	-0.00329
/cut1	-1.578249		.0601726			-1.696185	-1.46031
/cut2	2.013275		.0604873			1.894722	2.131828
/cut3	4.612013		.0674749			4.479765	4.744261
/cut4	7.598652		.1011859			7.400321	7.796973
Number Of Obs	28525						
LR chi2(5)	114266.80						
Prob > chi2	0.0000						
Pseudo R2	0,1778						
Log likelihood	-26417.508						

Note: General Health Status (1: very poor; 5: very good)

When Table 4 is analyzed, it is seen that an improvement in income level is likely to improve the general health status by 0.89 times. Similarly, it is understood that the increase in education level and weekly walking time have the probability of improving the general health status by 0.83 and 0.99 times, respectively. On the other hand, it was observed that individuals covered by health insurance (SGK) showed a 0.78 times improvement in their health status. Besides, it seems that the increase in the age of individuals and the increase in the number of chronic diseases that individuals have in total have a worsening effect on their general health status. For example, it is seen that the increase in the age of individuals is likely to decrease the general health status by 1.03 times, and the increase in the number of diseases tends to decrease the general health status by 1.84 times. The results obtained are in accordance with the predictions of Grossman's health investment model. Age (natural wear) and chronic diseases (wear due to illness) worsen the general health of individuals. On the other hand, the prediction that individuals 'self-investment will increase their health status (stocks) was confirmed.

5. DISCUSSION

The focus of the Grossman model is the response of individuals to the age-related depreciation of the initial health stock they inherit from birth. Grossman's model fails to explain the fact that stochastic shocks such as suicide, injury, abortion, and traffic accidents suddenly erode individuals' health stock. In addition, the link between health status in the womb, infancy, and childhood and chronic diseases in adulthood was neglected in the model. For criticisms directed at the Grossman model, Muurinen (1982), Zweifel (2012), and Sepehri (2015) can be examined.

In the original Grossman model, the depreciation rate of the healthcare stock is largely attributed to age. However, many studies (Dunlop et al., (2000), Moos et al., (2005) Jones et al., (2019)) stated that the effects of lifestyle (alcohol, smoking, drug use) have an effect on the depreciation of the health stock. The model sees a health-seeking individual as a health producer isolated from other individual behaviors. The fact that the individual who spent her life with other people was affected by the behavior pattern of the social group she belongs to in health-seeking behavior was neglected in the model. Moreover, the original model assumes that individuals are fully rational. This situation can be considered an extremely mechanical interaction. (Hren, 2012: 67-68).

In the Grossman model, the wage that an individual receives during a productive time period is considered external and assumed to be constant throughout his or her life cycle. In reality, diseases not only negatively affect the number of healthy days and therefore, the number of working days, but are also likely to affect the level of wages. In a similar way, the level of education is determined externally and takes into account the gross investment function and the production function as an efficiency parameter (Hren, 2012: 70-71). It was ignored that a health problem in early life can affect the life-long socio-economic conditions of the individual. Furthermore, the possible effects of inequalities in the initial health stock of individuals on lifetime income and education are not taken into account in the model (Jacobson, 2000: 613).

The model is built under the assumption that there is no health insurance. However, there is a strong link between healthcare demand and health insurance due to the unpredictability of the disease and treatment costs. The close relationship of health insurance and general health insurance with health demand was expressed in many studies (Acton J.P. (1975), Liljas (2000), Tabata & Okhusa (2000)).

Although there are many criticisms of the Grosman model (Phelps (1973), Phelps-Newhouse (1974), Dowie (1975), Keeler et al. (1977), and Cropper (1977)), it is a very impressive model that reveals the theoretical justification of individuals' health claim behavior. The model has guided the examination of health demand with many applied studies (Nandakumar et al. (2000), Gupta & Dasgupta (2002), Ichoku & Leibbrandt (2003), Mocan et al. (2004), Lindelow (2005), Ssewanya et al. (2006), Geitona et al. (2007), Kara & Yıldırım (2020)) . Depending on developments in econometric and statistical methods and improvements in the health database, it is possible to eliminate different and missing aspects of the model. In this context, contributions to the applied literature with examples of different countries are quite meaningful.

In this study, empirical testing of Grossman's model was carried out with a large-scale data set. Analysis results obtained using econometric methods confirm the validity of Grossman's health demand model. In addition, the results obtained appear to show similar results with examples from many countries (Jacobson (2000), Eisenring (2000), Hartwing & Sturm (2018), Batinti (2015), Lepine & LeNestour (2011), Ssewanya et al. (2006)). The basic setup of the Grossman model offers a wide perspective on the studies to be made on health demand. If there is a comprehensive data set on the health-seeking behavior of individuals, it will be possible to examine different dimensions of health demand (such as the place of birth of the household, ethnic origin, distance to health centers, its scope if there is private insurance, etc.) with various analysis techniques. In this study conducted in Türkiye, the nature of the questions posed to households in the micro-health survey conducted by the official statistical agency did not allow it to be modeled to include more different dimensions of the study. The number of studies examining Grosman's health demand in Türkiye is very few. It is believed that this study will contribute to country-based studies.

6. CONCLUSION

Within the framework of the generalized Grossman model, the demand for health services has been analyzed with two different models. In the first model in which the Negative Binomial Regression method was used, it was concluded that there was a direct relationship between the number of healthcare services and chronic diseases. When the results are evaluated within the framework of Grossman's health demand model, it confirms the assumption that individuals attempt to seek health care in health institutions in order to recover their worn-out health stocks. In the second model, which examines the investment dimension of health demand, the ordered logit regression method was used. When the results of the second model are examined, it is concluded that increases in income level and increases in education level improve the general health status of individuals. These results are compatible with the original Grosman model. Health increases the level of education and income due to the increase in the productive time period, and increasing income and education level provides a higher health status. Besides, in the second model, in addition to the Grossman model, it is seen that individuals' health insurance coverage improves their general health status. In addition, it was concluded that doing exercise (walking) improves general health status.

Based on the results of this study, in which the generalized Grossman model was examined, some suggestions were developed. Developing and monitoring policies that improve Türkiye's education system will also contribute to improvements in the health stock. As can be seen in the results of the research, a more educated individual can also be described as a more conscious and therefore healthier individual. In this regard, the state should include more courses in the curriculum, such as health knowledge, in schools, especially in institutions where basic education is provided. To ensure the sustainability of health systems, the infrastructure of public health institutions should be improved, health personnel and equipment should be increased, access to health services should be facilitated, and different financing models should be developed. By establishing public-private partnership models, access to health care can be increased and the financing burden of the public sector can be reduced. Accessible health policies that respect the health beliefs and practices of different cultural groups in society can be developed.

Based on the conclusion that people in the high-income group are generally healthier, policymakers should focus on activities that improve the income status of individuals. Decision-makers should produce policies that increase national income per capita, and policies to eliminate income inequality should be funded through public means. New business areas should be created for people who are not actively employed (especially women and disabled people). The number of areas open to common use should be increased, as it will encourage and make individuals' sports habits attractive.

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