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Aging Risk and Health Care Cost in Korea

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1. Introduction

It is generally perceived that health care cost is increasing because of population aging. In Korea, the number of people over 65 years of age was 3.1 percent of the population in 1970, 5.1 percent in 1990, 7.2 percent in 2000, and 9.1 percent in 2005. These figures show that the period of time in which an aging population increases by 2 percent is getting shorter; thus aging has been accelerating.

An analysis of how aging affects health care expenditures can be approached in a variety of ways. The first and simplest way is to observe how health care expenses relating to age change as time passes. This approach shows simply the relationship between aging and health care expenses. However, this approach overlooks other factors that influence health care costs other than aging.

The second approach uses a multivariate regression analysis. To analyze the determining factors of the national health care cost, the panel analysis using the time-series and cross-sectional data has been widely adopted recently. In this approach the researcher controls several factors that can influence the national health care cost, and then can analyze the effects of aging itself. With this approach, the results show that income is a significant factor that influences health care costs; aging, however, does not seem to be significant. The reason is that as aging proceeds, the income level also increases, and thus income effects overwhelm the influences of aging. Therefore, this approach is useful for analyzing the income elasticity of health care expenditures.

The third approach is to disassemble the factors that consist of the health care costs, and then analyze how much the change in population structure ('aging') affects the increase of health care expenditures. Health care cost can be disassembled into factors: the population covered, the population aging structure, the medical fees, the utilization rate of health care services, and so on. We would then analyze the contribution of each factor to the health care cost. This approach extracts the genuine effect of aging on health care cost. However, this approach has shortcomings, in that extracting the sole factor of aging is not easy and the availability of data is limited.

The fourth approach is to consider the diseases related to aging. As aging continues, the prevalence rate of chronic diseases increases, the treatment days become prolonged, and health care costs increase. In addition, the types and composition of the chronic diseases may change, and those changes also can contribute to an increase in health care costs. This approach suggests many significant points about the relationship between diseases and aging. However, this approach overlooks other factors besides diseases.

The fifth approach illustrates the Sisyphus syndrome. Health care costs increase and contribute to a longer life span, and as the expected life span becomes longer, it requires additional health care expenditures. The former describes the health production function, and the latter is about aging as the determining factor of health care expenditures.

The sixth approach is based on the argument that aging increases acute care and, in some sense, traditional medical cost and also increases long-term care cost. Whether to include long-term care cost in health care cost can be controversial. Because long-term care cost has aspects of both medical service and social service, it is difficult to separate those two exclusively. Also, among countries that have long-term care systems, some countries emphasize medical service and others emphasize social service.

Besides these six approaches, there are many other ways to analyze the effects of aging on health care costs. This paper considers the first three approaches and briefly discusses some of the others.

2. Methods

The three approaches for analyzing the impact of aging on health care cost, and the calculation methods for each approach, are presented in this section.

2.1 Age–Medical Cost Profile Approach

The age–medical cost approach is limited by its requirement of the data of health care cost according to age groups. Therefore, I used the data produced from the National Health Insurance (NHI) in Korea. I calculated, by age groups, the yearly medical costs per person, and thus constituted the medical expenditures structure regarding age. This enables us to observe how medical expenditures have changed in accordance to the age structure shift. I measured the profiles for the years 1991, 1996, and 2001, and in addition measured a profile for 2003. Measuring the visiting days (summing the annual hospitalized and outpatient days) by age shows the changes in medical service usage by age. However, when the medical-cost profile of aging is compared with the prices of each corresponding year, it is difficult to see the effects of aging separately. Therefore, to observe the health care costs in accordance with genuine change in age structure, it is necessary to find a way of standardization. The method for this is to calculate the relative indices of medical cost by age and observe the structural changes by year. The volume utilization of patients by age can also be calculated using this method.

2.2 Econometric Approach Based on Regression Analysis

The research on the factors that determine national health care costs have usually utilized the simple or multivariable regression analysis model based on cross-sectional data in the late 1970s and the early 1990s. In the late 1990s, research using various econometric models based on panel data was prevalent. The existing research results point out that the gross domestic product (GDP) per capita is the most influential factor that can explain changes in the national health care cost, and in addition to income, many other socioeconomical factors and health care system–related variables have been discussed in terms of how they have influenced the national health care cost. The influence of socioeconomic factors and health care system factors on health care costs has been estimated in a variety of ways regarding the methods and data used.

Table 1 summarizes the previous research results, and the income elasticity of medical costs is shown mostly as statistically positively significant. In addition, it has shown robust results regardless of estimation method, choice of explanatory variables, data used, or calculation of income with nominal exchange rate or purchasing power parity. However, whether the elasticity of income is larger or smaller than 1 has varied research results. A population structure like aging is usually known to influence national health care costs insignificantly.

In this research we used the panel data on 33 countries during the period of 1970 to 2001. All the countries were members of the Organisation for Economic Co-operation and Development (OECD). In addition, analysis based on the time series data of Korea was compared with the analysis of OECD countries, and some implications were found. The analysis in the case of Korea has two time spans: from 1997, the year that public medical insurance was introduced, until 2000, and from 1985 to 2000.

The following is the full model used in the analysis:

$$NHE_{jt} = a1 + a2 \cdot Socio - econ \cdot factors_{jt} + a3 \cdot health \cdot system \cdot factors_{jt} + a4 \cdot country_{t} + a5 \cdot year_{j} + e_{jt}$$

where NHE is the national health expenditure, *j* is the country, and *t* is the year.

For the socioeconomic variables, I used GDP per capita, the ratio of people older than 65 to the total population, and the ratio of women in the work force to the whole work force. As the quantitative variables related to health system factors, government health costs, health insurance coverage population ratio, number of doctors per one thousand people, hospitalization cost, and new medical technology are used. As the systematic variables related to health system factors, the payment method to doctors and the existence of primary treatment are used. Each quantitative variable is converted into natural logarithms to express elasticity. The variables used in the models are defined in Table 2.

Table 1. Results from the studies of the determinants of national health expenditures

	Newhouse (1977)	Leu (1986)	Gerdtham (1992a)	Gerdtham (1992b)	Gerdtham (1992)	Hitiris and Posnett (1992)	Gerdtham (1998)	Barros (1998)	Robert (1998)
Data	13 countries 1971 cross-sectional	19 countries 1974 cross-sectional	19 countries 1987 cross-sectional	19 countries panel (1974, '80, '87)	22 countries panel (1972–87)	20 countries panel (1960–87)	22 countries panel (1970–91)	24 countries panel (1960–90)	20 countries panel (1960–93)
Per capita GDP	Above 1.0	1.1–1.3	1.33	1.27	0.74	1.026 (exchange rate) 1.16 (PPP)	0.74	Below 1.0	Above 1.0
Share of public finance	-	0.2– 0.3	- 0.48	-	- 0.12	-	Not significant	Not significant	0.7
Share of 65+ population	-	-	-	-	-	-	Not significant	Not significant	Not significant
Price index	-	-	-	-	-0.16	-	-	-	-
Share of inpatient exp.	-	-	0.22	0.31	-	-	0.06	-	-
No. of doctors	-	-	-	-	-	-	-0.14*	-	-
Share of public beds	-	0.8–0.9	-	-	-	-	-0.32	-	-
NHS	-	-0.21–-0.24	-	-	-	-	-	-	-
Primary care	-	-	-	-	-	-	-0.18	Not significant	-
Fee-for-service	-	-	1.12	1.13	-	-	Not significant	-	-

*Not significant under the fee-for-service payment

Table 2. Definitions of variables on the determinants of national health expenditures

	Variables	Definition
Quantitative variables	THE	Per-capita real national health expenditures (PPP US dollar of 1995)
	GDP	Per-capita real GDP (PPP US dollar of 1995)
	GOV	Per-capita real government health expenditures (PPP US dollar of 1995)
	Coverage	National health insurance covered population of total population (%)
	Doctor	Number of doctors per one thousand people
	Inpatient	Share of inpatient expenditures of national health expenditures (%)
	65+	Share of 65+ population of total population (%)
	flabor	Share of female labor force (%)
	TEC	New technologies (number of CT, MRI)
Payment system	FFS	Fee-for-service
	CAP	Capitation
	WAS	Wage and salary
Primary care	GTK	Existence of gatekeeper

Note: Government health expenditures do not include social insurance expenditures.

2.3 Approach to Decomposition of Medical Costs

The increase in medical costs can be broken down into several factors: the increase in population coverage, the aging of the population structure, increased fees for medical services, and the increased volume of medical services used. Through this analysis, the effect of aging can be singled out. The data used in this analysis is the NHI data. The health insurance costs could be analyzed by the following method:

Health insurance cost = covered population × visit days per capita × cost per visit day

Visit days per capita = rate of change in demographic structure(1) × adjusted visit days per capita

Cost per visit day = rate of change in demographic structure(2) × adjusted cost per visit day

Adjusted cost per visit day = fee × readjusted cost per visit day

*Note: Fee does not include the whole medical cost, and is confined to the service charges. It excludes the prices of drugs and supplies. Therefore, the ratio of service charges to whole medical charges is utilized; that is 0.68. Also, visit days are the number of patient visits to medical procedures.

Therefore,

Health insurance cost = covered population × (rate of change in demographic structure(1) × adjusted visit days per capita) × (rate of change in demographic structure(2) × fee × readjusted cost per visit day)

And,

Rate of change in health insurance cost = rate of change in covered population + (rate of change in demographic structure(1) + rate of change in adjusted visit days per capita) + (rate of change in demographic structure(2) + rate of change in fee + rate of change rate in readjusted cost per visit day)

* Note: Rate of change in fee and rate of change in adjusted cost per visit day include price change. Therefore, fee and cost can be calculated in real terms separate from the inflation effect.

Here, the rate of change in demographic structure is calculated from time point *a* to time point *b*. (The detailed data for calculation is included in appendix A.)

Rate of change in demographic structure(1) = $[\sum_j$ covered population$_{b,j}$ * (covered population$_a$/covered population$_b$) * visit days per capita$_{a,j}$] /[$\sum_j$ covered population$_{a,j}$ * visit days per capita $_{a,j}$]

Rate of change in demographic structure(2) = [$\sum_j$ visit days$_{b,j}$ * (total visit days$_a$/total visit days$_b$) * cost per visit day$_{a,j}$] /[$\sum_j$ visit days$_{a,j}$ * cost per visit day$_{a,j}$]

Rate of change in adjusted visit days per capita and in adjusted or readjusted cost per visit day are calculated as follows:

Rate of change in adjusted visit days per capita = rate of change in visit days per capita ÷ rate of change in demographic structure(1)

Rate of change rate in adjusted cost per visit day = rate of change in cost per visit day ÷ rate of change in demographic structure(2)

Rate of change rate in readjusted cost per visit day = rate of change in adjusted cost per visit day ÷ rate of change in fee level

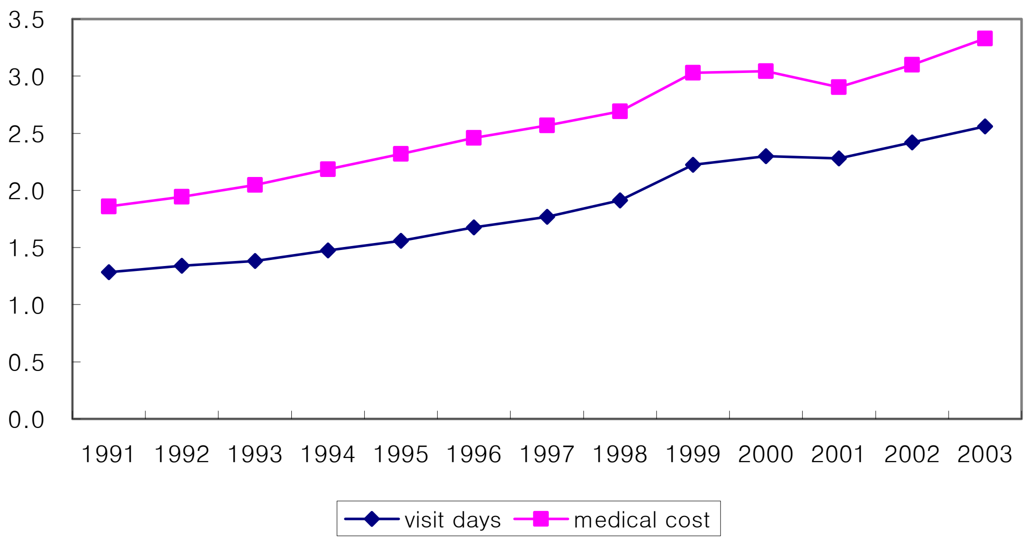
Three periods of analysis were selected: 1991 to 1999, 1999 to 2003, and 1991 to 2003. The three periods were separated because the separation policy of prescribing and dispensing drugs was introduced in July 2000, and this policy impacted health care costs in many ways.

3. Results

3.1 Age–Medical Cost Profile Analysis

As the proportion of older people increases, their medical costs tend to increase accordingly. The ratio of the medical cost of someone over 65 to that of someone under 65 during the period from 1991 to 2003 is shown in Figure 1. (Specific numbers are provided in appendix B.)

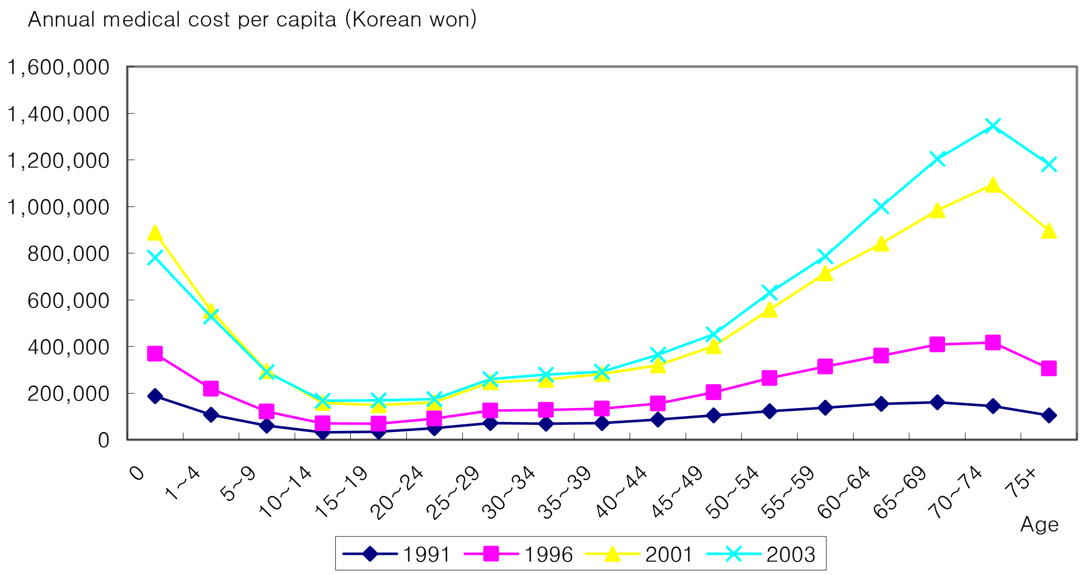
Figure 1. Ratio of medical utilization of 65+ to 65- in terms of medical expenditures and visit days per capita



The cause of this phenomenon is that people over 65 have more medical needs than those under 65. However, the fulfillment of the medical needs of those over 65 can be achieved by the burden of the labor force of the population. Thus, when productivity of the labor force is improving and income levels are getting higher, it becomes easier to fulfill the medical needs of older people.

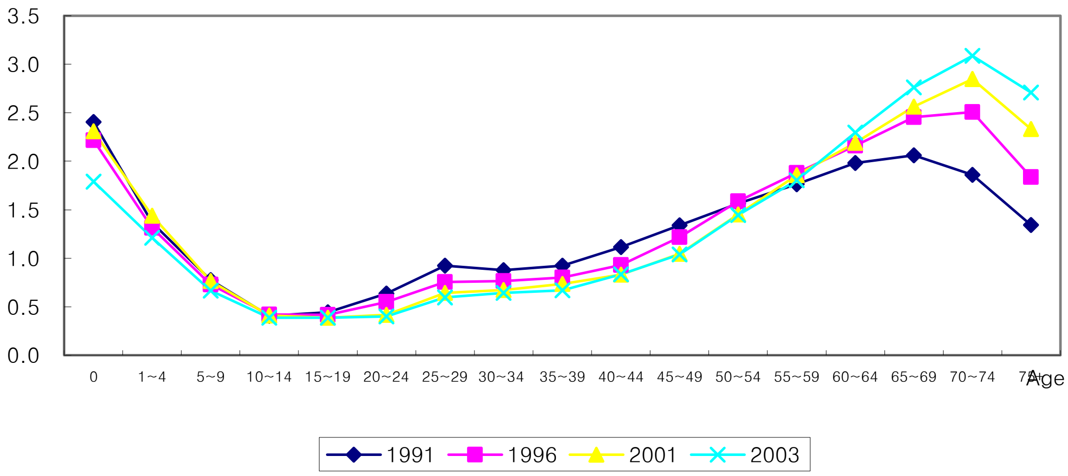
When we look at the trend of medical cost by age groups, we see that the medical cost per capita is high for infants and children, it decreases among the youth, it increases in middle age, and then it increases rapidly in later years. On a graph, this trend is a U curve, as shown in Figure 2. When measured in a gap of five years as times goes on, the U curve develops a steeper valley.

Figure 2. Structure of age–medical cost profile (current prices)



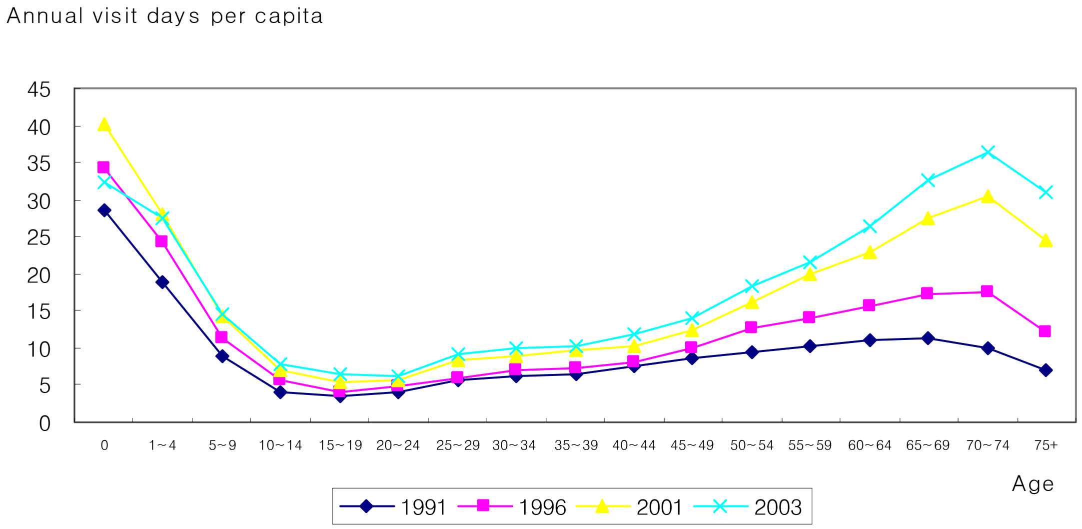
To correct the problem that occurs when comparing with current prices of each year, the relative magnitude of medical costs by ages in each year is calculated, as shown in Figure 3. Compared to the medical costs of 1991, those of 2003 were relatively higher for older people and relatively lower for younger people. Especially for youth and middle-aged people, medical costs were relatively low. This shows that as the data moves closer to the present, the medical costs for older patients are increasing. This implies also that medical resources distributed for older people are increasing. So to extend the lives of those who are older, the structure of medical resources allocation is shifting to use more resources for them. (Specific numbers are provided in appendix C.)

Figure 3. Structure of age–medical cost profile (standardization)



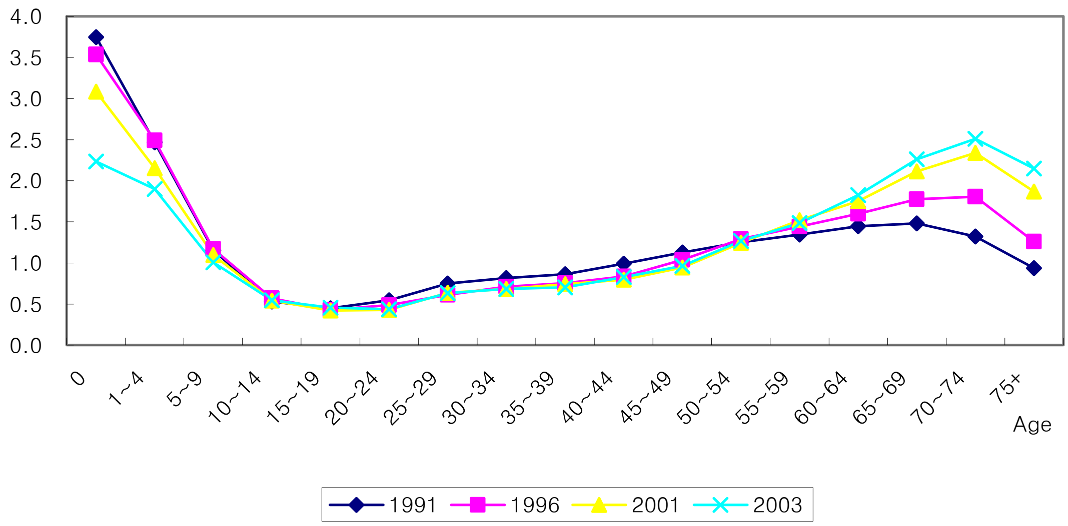
A question that arises is whether the volume of medical services used is following a trend similar to that of medical cost. The cost per service unit applied to older people could be increased. Even without these price-related factors, we can observe whether the steep U-shaped form could stay the same. As shown in Figure 4, as aging progresses in the whole age structure, the visit days increase, and for older people the visit days increase faster.

Figure 4. Structure of age–visit days profile



The visit days, with the average growth of visit days subtracted, are shown in Figure 5. The visit days increase among older people and decrease relatively among the young, which shows a similar pattern to the changes in medical costs. Thus, even on the quantitative structure without the price factor, older people have more share in medical resources. (Specific data is provided in appendix D.)

Figure 5. Structure of age–visit days profile (standardization)



From these observations is it possible for us to regard aging as the factor that results in the increase of medical costs? The answer is not that simple. To this day we have observed only the relationship between aging and medical costs. For instance, as aging continues, we can watch medical costs increasing for people who are 70 years old. However, the causes of the increased expenditures will be complex; since the income level rises, there could be more resources involved in curing older people, and advances in medical technology could have invested more in medical services for that population. If the income level includes the concept of technological advancement, the phenomenon of medical costs rising according to aging may be explained not by aging itself, but by the improvement of income level—that is, more usable resources. In addition, if the extended life span is possible because the income level rose, the rise of medical costs related to aging will be related to higher income levels.

Therefore, speaking strictly, aging is not an independent variable that influences medical costs. Aging can occur as a result of an increase in medical services or better nutritional state, higher education and awareness on health, and so on. Therefore, the cause of the rise in medical costs should be explained by the factors that contribute to aging, rather than by aging itself.

3.2 Panel Analysis Determining National Health Expenditures

The panel analysis shows that the results are influenced by the time span chosen and the choice of explanatory variables used. Aging does not appear to be a significant variable. However, in model 2, shown in Table 3, aging seems to be significant under the significance level of 10 percent, but the elasticity is only 0.16, which is not that significant. The determining factors that significantly affect national health care cost are both income and women's participation in the labor force, although the elasticity varies widely because the model is constructed differently.

Table 3. Determinants of national health expenditures in OECD countries

	Model 1 (1984–2001)	Model 2 (1970–2001)	Model 3 (1970–2001)	* Pooled Regression results (1984–2001)
ln(GDP)	0.588**	0.814**	1.043**	1.147**
ln(GOV)	0.261**	0.203**	-0.004	-0.007
ln(coverage)	0.043	-0.002	-0.275**	-0.320**
ln(doctor)	-0.104	-0.303**	0.534**	0.224**
Ln(inpatient)	0.082**	0.144**	-0.094*	0.153*
ln(65+)	0.140	0.160*	-0.020	0.089
ln(flabor)	1.261**	0.274**	0.565**	0.612**
ln(TEC)	0.075**	-	-	-0.027
FFS	-	-	0.185**	-
CAP	-	-	0.106**	-
WAS	-	-	0.086**	-
GTK	-	-	0.049**	-
No. of observations (no. of countries)	120 (33)	283 (33)	283 (33)	120 (33)
R^2	0.995	0.992	0.956	0.939
Degree of freedom	111	225	240	111
Characteristics	Two-way Random effect model	Two-way Fixed Effect model	Two-way Fixed Effect model	-

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

The results of an analysis that uses the time series data of Korea are shown in Table 4. When we regard model 1 as trustworthy because it has a relatively long analyzing period, the results show that aging was an insignificant factor.

Table 4. Determinants of national health expenditures in Korea

	Model 1 (1977–2000)	Model 2 (1985–2000)	Model 3 (1985–2000)
ln(GDP)	0.962**	1.041**	0.958**
ln(GOV)	-	-	0.287*
ln(coverage)	0.228**	0.300**	0.148
ln(doctor)	-0.996**	-0.886	-1.117**
ln(inpatient)	-	-	-0.288
ln(65+)	0.304	1.691	0.799
ln(flabor)	-0.321	-1.169	-1.621
Year	0.056*	0.001	0.036
R^2	0.988	0.983	0.990
F-value	229.769	84.732	85.198
No. of observations (degree of freedom)	24 (17)	16 (9)	16 (7)

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

Income, national health insurance coverage, and number of doctors were significant in a 5-percent significance level, and the income elasticity, especially, was close to 1. The elasticity of insurance coverage expansion was positive (+0.228), which is inconsistent with the results from other OECD countries. This is because Korea expanded the insurance coverage population in a short period, leading to a sharp increase in medical costs. The increase in the number of doctors has an effect on containing medical costs, a result that is similar to that in other OECD countries. Korea rejects the supplier-induced demand hypothesis that claims that the increase of doctors is the main cause of the rise of medical expenditures. Therefore, we can temporarily conclude that the consumer’s expanded demand, which originated by the extension of the insurance-covered population, is a stronger factor than the producer-induced demand for health care. However, women’s participation in the work force did not affect medical costs significantly.

In research conducted for the recent period, income and health insurance coverage of the population were both significant, but aging was not. In conclusion, the leading cause of rising medical costs was related to the increase in national income and the expansion of the health insurance–covered population. The increase in the number of doctors was an influence in containing the increase in medical costs, and aging was not as significant a factor as in other OECD countries.

3.3 Decomposition Analysis of Medical Costs

When the period from 1991 to 2003 is selected, the contribution of aging to the rise in medical costs appears to be 6.6 percent. But if price level is excluded, the contribution of aging increases to 9.2 percent. Table 5 shows the rise in medical costs and the factors contributing to medical costs according to the periods of analysis. On this basis, we calculated the contribution of each factor to increased medical costs.

Table 5. Increasing rates of medical expenditure and factors causing medical expenditure

Period	Medical expenditure	population	Visit days			Medical expense per day per capita					
			Demographic change(1)	Visit days per capita	Adjusted visit days per capita	Demographic change(2)	Medical expense per day	Adjusted medical expense per day	Price GDP deflator)	Real medical price	Readjusted medical expense per day
1991-1999	3.5818	1.1089	1.0289	1.5316	1.4886	1.0508	2.1106	2.0086	1.5419	1.1353	1.1475
1999-2003	1.8044	1.0425	1.0070	1.2397	1.2311	1.0516	1.3959	1.3274	1.1017	1.2465	0.9666
1991-2003	6.4630	1.1560	1.0247	1.8987	1.8529	1.1064	2.9463	2.6629	1.6988	1.5781	0.9933
Annual increasing rate											
1991-1999	1.1729	1.0130	1.0036	1.0547	1.0510	1.0062	1.0979	1.0911	1.0556	1.0160	1.0173
1999-2003	1.1590	1.0105	1.0017	1.0552	1.0533	1.0127	1.0870	1.0734	1.0245	1.0566	0.9915
1991-2003	1.1683	1.0122	1.0020	1.0549	1.0527	1.0085	1.0942	1.0850	1.0451	1.0388	0.9994

Table 6 presents the results that include the increase of price levels as a factor contributing to the rise of medical costs. This table shows that the contribution of change in demographic structure was 6.6 percent in 1991 to 2003, and 9.5 percent in 1999 to 2003, which shows that aging became a more influential factor in medical cost increase. The effect of aging on the rise of medical costs is less than 10 percent. The volume of medical utilization, which is a quantitative factor, affects the medical cost increase by 30 to 35 percent. The increased volume reflects both the increased demand of medical services according to higher income level and the induced demand from the suppliers, and also includes the expansion of medical use originated by the longer period of insurance coverage. The contribution of increased fee level is 39 percent, but after the introduction of the separation policy of prescribing and dispensing drugs, increased fee level contributed up to 47 percent. The contribution of cost per visit day after adjusting the increasing fee is 13.8 percent, but after the introduction of the separation policy the influence decreased drastically. The cost per visit day includes the increasing cost of pharmaceuticals and medical supplies and will also include the intensity of treatment and the services increased due to the expanded coverage of health insurance. However, as the fee and the cost per visit day include the increasing prices, their contribution to rising medical costs includes a natural increase by the price index.

Table 6. Decomposition of increasing medical expenditures by causes: Including price factor

	Population	Demographic change (aging)	Adjusted visit days per capita	Fees	Readjusted medical expense per day	Sum
1991–1999	7.98	6.00	31.29	32.11	22.61	100
1999–2003	6.90	9.51	35.23	46.89	1.47	100
1991–2003	7.64	6.60	33.15	38.84	13.77	100

Table 7 separates the price-index factor and analyzes the breakdown of medical costs. The contribution of changes in demographic structure occurs almost identically. On the one hand, the contribution of raised price levels was 28.4 percent in 1991 through 2003, and the contribution of fee was 24.4 percent. On the other hand, the contribution of cost per visit day was almost close to zero. Especially after the separation policy, the contribution of fee was very large, and the contribution of cost per visit day resulted in a minus (-) value. This shows that the policy containing medical costs was strong enough to escape from the financial crisis resulting from the separation policy.

The results after excluding the effect of price index are shown in Table 8. The contribution of change in demographic structure is 9.2 percent, and after the separation policy it is 11.4 percent, illustrating further growth in aging. The largest contributor is a medical utilization volume that is 46 percent. This is because, first, the demand for medical treatment increased as the income level rose; second, after the introduction of health insurance, the burden of individual payment decreased and the demand for medical services increased; and third, the insurance coverage widened. The contribution of fees, which is 34 percent, is impressive. Because this contribution was only 15 percent before the separation of prescribing and dispensing drugs, it is clear that increased fees led the medical cost increase after the separation policy.

Table 7. Decomposition of increasing medical expenditures by causes: Separating price factor

	Population	Demographic change (aging)	Adjusted visit days per capita	Price (GDP deflator)	Fees	Readjusted medical expense per day	Sum
1991–1999	8.00	6.01	31.33	34.18	9.82	10.66	100
1999–2003	6.93	9.55	35.35	16.24	37.54	-5.61	100
1991–2003	7.66	6.61	33.23	28.44	24.41	-0.35	100

Table 8. Decomposition of increasing medical expenditures by causes: Excluding price factor

	Population	Demographic change (aging)	Adjusted visit days per capita	Fees	Readjusted visit days per day	Sum
1991–1999	12.15	9.13	47.60	14.92	16.19	100
1999–2003	8.27	11.40	42.21	44.82	-6.69	100
1991–2003	10.70	9.24	46.43	34.12	-0.49	100

The aging factor as a contributing factor to the rise in medical costs is less than 10 percent. Medical costs increased mainly due to the increase in both medical volume of utilization and the increasing fees. This implies that the higher level of income and the introduction and expansion of health insurance affected the increase in medical utilization, and in return the increasing utilization produced the increased medical costs.

4. Discussion and Conclusion

To analyze the impact of aging on medical costs we used three approaches. The approach using observation of medical cost profile by age showed that, as the data was closer to the present, the medical costs for older people increased. The treatment quantity excluding price index was also increasing for older people. This implies that the medical resources that are allocated to older people are increasing, due to the increased resources applied to extend the expected life span that was enabled through higher income levels, rather than aging itself. Therefore, aging cannot be considered an independent variable that contributes to the rise in medical costs. Instead, the factors that make aging possible will be the ultimate determining factors, such as income, education level, and sanitation.

Some research attributes the rise in medical costs to aging alone, explaining it by citing the Sisyphus syndrome. This research claims that medical cost increase leads to a longer life span (“provokes aging”) and that the extended life span leads to a higher demand for public health services and finally increases the medical cost (Zweifel and Ferrari 1992, 327). The former relates to the discussion of health production function that explains that the increase in medical cost will increase the expected life span, and the latter is explained by the relationship that as older people continue to age, their political influence increases. However, Zweifel and Ferrari were not able to prove that hypothesis with the regression analysis using OECD health data. Later, Zweifel and Steinman (2002) tried the regression analysis again with the same data source. During the period of 1970 through 1991 the Sisyphus syndrome existed, but in 1992 through 1999 it disappeared. Ryu, Kim, and Lim (2005) verified that the Sisyphus syndrome did exist in Korea from 1977 through 1998. However, in the analysis for OECD countries, the Sisyphus syndrome existed weakly in 1977 through 1998, but in later years negative effects became influential and the results showed no Sisyphus syndrome. Therefore, it was difficult to verify the Sisyphus syndrome statistically because aging coincided with economic growth historically, and the increased medical cost has been explained mostly by the increased rate of income. The research results conducted by Ryu, Kim, and Lim (2005) in the case of Korea is difficult to interpret. Older people generally do not have enough power to develop political influence in Korea, and considering that income level rose faster than the speed of aging, the conclusion that aging is a factor in increasing medical costs seems unusual.

To overcome the limitation of neglecting other factors besides aging in observing the medical cost profile by age, we applied the second approach, in which we used panel regression analysis. The result of this analysis shows that, generally in OECD countries, aging was not a significant variable contributing to increased medical cost. Also, similar results were shown in the Korean analysis using time series data. The analyses of relatively recent periods, which show a somewhat faster aging rate, show also that aging was not a significant factor in the increase of medical costs.

The main causes of increased medical costs are thought to be both income level and the expanded application of national health insurance. In the approaches using regression analysis, the effect of higher income on medical cost increase could have overwhelmed the influence of aging in determining medical costs. However, because it is complex, it is difficult to verify statistically. Therefore, we used an alternative approach, in which we broke down the factors contributing to increased medical costs and singled out the contribution of the change in demographic structure. During the period of 1991 to 2003, the aging factor contributed 6.6 percent to increasing medical costs. However, excluding the fee increase due to inflation, the contribution of aging was 9.2 percent. In this approach, the contribution of aging to increased medical costs was considered less than 10 percent. The main reason for the medical cost increase was both the increased utilization of volume and the increased fee levels. Beneath these factors there would be the raised level of income and the introduction of health insurance.

Finally, the influence of aging on the rise in medical costs can be viewed as superficial. The reality is that the factors that cause aging contribute to higher medical expenditures.

Aging is thought to be an endogenous variable rather than an independent variable in how it impacts medical costs. It functions as a mediator in the process of explaining the causes of increasing medical costs. Despite these facts there still is the necessity to continue the research on the influence of aging and the political influence of older people related to medical costs.

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Appendix A: Data for Calculation of Demographic Structure Change by Ages

	1991			1999			2003		
Age group	Population	Visit days per capita	Med. Cost per day	Population	Visit days per capita	Med. cost per day	Population	Visit days per day	Med. cost per day
0	596,197	28.49	6,584	542,215	37.96	13,568	440,422	32.23	24,208
1– 4	2,440,863	18.76	5,685	2,643,523	27.31	11,643	2,270,202	27.37	19,262
5–9	3,333,088	8.77	6,900	3,389,172	13.19	13,269	3,335,953	14.51	19,942
10–14	3,676,286	4.04	7,864	2,987,566	6.07	15,513	3,285,293	7.86	21,406
15–19	3,962,564	3.42	10,135	3,675,729	4.73	20,344	3,023,589	6.58	25,611
20–24	4,118,905	4.15	11,966	3,672,719	5.12	22,927	4,019,538	6.29	27,734
25–29	4,128,382	5.68	12,661	4,514,821	6.81	25,100	3,913,403	9.09	28,555
30–34	4,220,936	6.19	11,048	4,309,290	7.64	22,849	4,570,971	9.85	28,379
35–39	3,201,607	6.56	10,967	4,270,569	8.41	22,525	4,260,392	10.14	28,736
40–44	2,317,100	7.54	11,526	3,776,972	9.13	23,605	4,329,836	11.94	30,482
45–49	2,037,280	8.56	12,210	2,638,961	11.21	24,855	3,590,153	13.88	32,591
50–54	1,947,689	9.52	12,829	2,172,347	14.12	26,184	2,511,498	18.26	34,547
55–59	1,570,815	10.23	13,455	2,030,856	17.79	27,451	2,054,699	21.45	36,626
60–64	1,126,154	10.99	14,052	1,699,636	20.53	28,376	1,955,699	26.35	37,993
65–69	837,432	11.26	14,265	1,154,766	24.15	28,182	1,482,244	32.61	36,923
70–74	584,943	10.05	14,423	768,481	26.85	27,653	944,519	36.26	37,131
75–79	644,908	7.13	14,706	936,328	21.52	28,622	1,114,375	30.99	38,107
Sum or average	40,745,149	7.60	10,254	45,183,951	11.64	21,642	47,102,786	14.43	30,211

Appendix B: Population over 65 and Medical Utilization of 65+ and 65-

	65+		Visit days			Med. cost per day			Med. cost per capita		
	Population	Share	65-	65+	Ratio	65-	65+	Ratio	65-	65+	Ratio
1991	2,067,283	5.07	7.50	9.63	1.28	9,969	14,413	1.45	74,667	138,780	1.86
1992	2,163,350	5.23	7.68	10.30	1.34	11,117	16,105	1.45	85,331	165,909	1.94
1993	2,245,691	5.32	8.14	11.27	1.38	11,859	17,555	1.48	96,540	197,763	2.05
1994	2,369,434	5.48	8.13	12.00	1.48	12,823	19,003	1.48	104,347	228,041	2.19
1995	2,483,440	5.64	8.95	13.94	1.56	14,125	21,030	1.49	126,340	293,197	2.32
1996	2,588,749	5.80	9.35	15.68	1.68	16,411	24,051	1.47	153,346	377,126	2.46
1997	2,695,727	6.00	9.79	17.31	1.77	17,811	25,881	1.45	174,383	448,120	2.57
1998	2,808,835	6.32	9.83	18.82	1.91	20,046	28,215	1.41	197,254	530,925	2.69
1999	2,858,823	6.33	10.80	24.01	2.22	20,664	28,152	1.36	223,298	676,239	3.03
2000	3,019,434	6.58	10.90	25.07	2.30	23,224	30,240	1.30	225,157	685,378	3.04
2001	3,216,228	6.93	11.99	27.35	2.28	28,309	36,016	1.27	339,444	985,021	2.90
2002	3,344,770	7.17	12.77	30.90	2.42	27,804	35,621	1.28	355,065	1,100,557	3.10
2003	3,541,138	7.52	12.91	33.07	2.56	28,728	37,333	1.30	370,997	1,234,718	3.33
Annual inc. rate	4.59	-	4.64	10.83		9.22	8.25		14.29	19.98	-

Appendix C: Age Profile of Medical Costs

Age	Medical cost per capita (current price, Korean won)				Ratio of medical cost to average medical cost				Increasing rate, %
	1991	1996	2001	2003	1991	1996	2001	2003	
0	187,592	368,858	887,305	780,219	2.406	2.216	2.309	1.790	12.61
1–4	106,640	218,839	552,887	527,221	1.368	1.315	1.439	1.209	14.25
5–9	60,480	121,403	293,504	289,392	0.776	0.729	0.764	0.664	13.93
10–14	31,770	69,691	157,771	168,220	0.407	0.419	0.411	0.386	14.90
15–19	34,649	69,248	148,451	168,602	0.444	0.416	0.386	0.387	14.09
20–24	49,618	91,294	160,759	174,496	0.636	0.549	0.418	0.400	11.05
25–29	71,923	125,301	246,633	259,477	0.922	0.753	0.642	0.595	11.28
30–34	68,365	127,358	257,699	279,660	0.877	0.765	0.671	0.642	12.46
35–39	71,926	133,469	282,256	291,365	0.922	0.802	0.735	0.668	12.36
40–44	86,941	154,691	318,929	363,957	1.115	0.929	0.830	0.835	12.67
45–49	104,485	202,831	401,213	452,411	1.340	1.219	1.044	1.038	12.99
50–54	122,107	264,067	558,507	630,870	1.566	1.587	1.454	1.447	14.67
55–59	137,590	312,993	713,639	785,678	1.765	1.881	1.857	1.802	15.63
60–64	154,450	359,503	841,176	1,000,951	1.981	2.160	2.189	2.296	16.85
65–69	160,612	408,752	984,845	1,203,966	2.060	2.456	2.563	2.762	18.28
70–74	145,009	417,132	1,093,825	1,346,194	1.860	2.506	2.847	3.088	20.40
75 +	104,781	305,353	896,143	1,181,136	1.344	1.835	2.332	2.709	22.37
Average	77,974	166,439	384,213	435,931	1.000	1.000	1.000	1.000	15.42

Appendix D: Age Profile of Medical Visit Days

Age	Visit days per capita				Ratio of visit days to average visit days				Increasingrate, %
	1991	1996	2001	2003	1991	1996	2001	2003	
0	28.49	34.35	40.24	32.23	3.747	3.535	3.082	2.234	1.03
1–4	18.76	24.21	28.11	27.37	2.467	2.492	2.153	1.897	3.20
5–9	8.77	11.35	14.33	14.51	1.153	1.168	1.097	1.006	4.29
10–14	4.04	5.54	7.09	7.86	0.531	0.570	0.543	0.545	5.70
15–19	3.42	4.16	5.51	6.58	0.450	0.428	0.422	0.456	5.61
20–24	4.15	4.74	5.62	6.29	0.545	0.488	0.430	0.436	3.54
25–29	5.68	5.97	8.27	9.09	0.747	0.614	0.634	0.630	3.99
30–34	6.19	6.88	8.89	9.85	0.814	0.708	0.681	0.683	3.95
35–39	6.56	7.32	9.68	10.14	0.862	0.754	0.741	0.703	3.70
40–44	7.54	8.09	10.37	11.94	0.992	0.833	0.794	0.827	3.90
45–49	8.56	10.07	12.29	13.88	1.125	1.037	0.942	0.962	4.11
50–54	9.52	12.56	16.21	18.26	1.252	1.292	1.242	1.266	5.58
55–59	10.23	14.03	19.87	21.45	1.345	1.444	1.522	1.487	6.37
60–64	10.99	15.55	22.85	26.35	1.445	1.600	1.750	1.826	7.56
65–69	11.26	17.23	27.60	32.61	1.481	1.773	2.114	2.260	9.27
70–74	10.05	17.55	30.55	36.26	1.322	1.805	2.340	2.513	11.28
75 +	7.13	12.25	24.40	30.99	0.937	1.260	1.869	2.148	13.03
Average	7.60	9.72	13.06	14.43	1.00	1.00	1.00	14.43	5.48