Impact of Cost Sharing Exemption for Hospitalized Children Under the Age of Six on Healthcare Utilization

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Impact of Cost Sharing Exemption for Hospitalized Children Under the Age of Six on Healthcare Utilization

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Jieun Jang

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Impact of Cost Sharing Exemption for Hospitalized Children Under the Age of Six on Healthcare Utilization

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Background: Childhood health conditions are important to learning, prospective health, and future human resources. In January 2006, the government implemented a policy of cost sharing exemption for hospitalized children under the age of six, as part of their efforts to reduce the burden of healthcare expenditure and support children's health from a social perspective. This study aimed to analyze the effect of cost sharing exemption for hospitalized children under the age of six in terms of National Health Insurance (NHI) beneficiaries' healthcare utilization and healthcare expenditure and the quantity of healthcare services per episode.

Methods: The data for this study was taken from the National Health Insurance Database (NHID) between 2004 and 2007 covering the entire population of South Korea. Considering that the cost sharing exemption policy was applied to children

below six years of age, children classified as 1–5-year-olds who were enrolled in NHI from 2004 to 2007 were used as the case group, and the 7-year-olds were the control group.

To investigate the NHI beneficiaries' healthcare utilization, the case group (1–5-year-olds) included 2,720,180, 2,572,633, 2,333,808, and 2,230,946 subjects in 2004, 2005, 2006, and 2007, respectively. The control group (7-year-olds) included 649,225, 616,091, 584,144, and 600,370 subjects in 2004, 2005, 2006, and 2007, respectively. The dependent variables included the annual healthcare expenditure per NHI beneficiary, annual length of stay per NHI beneficiary, and annual number of admissions per NHI beneficiary.

To investigate the healthcare expenditure and the quantity of healthcare services per episode, the case group (episodes from 1–5-year-olds) included 620,611 episodes in the before policy intervention (2004–2005) and 771,371 episodes in the after policy intervention (2006–2007) categories. The control group (episodes from 7-year-olds) included 52,315 episodes in the before policy intervention (2004–2005), and 59,953 episodes in the after policy intervention (2006–2007) categories. The dependent variables included the healthcare expenditure per episode, the length of stay per episode, and the healthcare expenditure per day per episode.

Difference in differences was used to examine any changes in healthcare utilization among the case group (1–5-year-olds) in the before (2004–2005) and after (2006–2007) intervention periods, relative to changes in healthcare utilization of the control group (7-year-olds). This study constructed an interaction term

between the case group in the after policy intervention period and applied generalized linear models using the GENMOD procedure.

Results: The cost sharing exemptions for hospitalized children under the age of six were associated with an increase in healthcare utilization. Regarding the NHI beneficiaries' healthcare utilization, the mean annual healthcare expenditure per NHI beneficiary for inpatient service before and after intervention were KRW 57,002 and KRW 90,611, respectively, in the case group, and KRW 24,416 and KRW 32,570, respectively, in the control group. The mean annual number of admissions per NHI beneficiary for inpatient service before and after intervention were 0.12 and 0.17, respectively, in the case group, and 0.04 and 0.05, respectively, in the control group. The mean annual length of stay per NHI beneficiary for inpatient service before and after intervention were 0.64 and 0.95, respectively, in the case group, and 0.22 and 0.27, respectively, in the control group. The cost sharing exemption was found to be significantly associated with an increased annual healthcare expenditure per NHI beneficiary, annual number of admissions per NHI beneficiary, and the annual length of stay per NHI beneficiary (annual healthcare expenditure: $\beta = 0.1474$, $\exp(\beta)=1.1588$, SE = 0.0176, $P = <.0001$; annual number of admission: $\beta = 0.1535$, $\exp(\beta)=1.1659$, SE = 0.0068, $P = <.0001$; annual length of stay: $\beta = 0.1497$, $\exp(\beta)=1.1615$, SE = 0.0079, $P = <.0001$). There were no significant substitute effects were found between inpatient and outpatient services.

Regarding healthcare service and expenditure per episode, the mean expenditure per inpatient episode before and after intervention were KRW 486,139 and KRW 536,212, respectively, in the case group, and KRW 590,545 and KRW 643,494, respectively, in the control group. The mean lengths of stay per episode for inpatient service before and after intervention were 5.42 and 5.62, respectively, in the case group, and 5.30 and 5.42, respectively, in the control group. The mean healthcare expenditure per day per episode for inpatient service before and after intervention were KRW 101,539 and KRW 106,328, respectively, in the case group, and KRW 137,087 and KRW 144,697, respectively, in the control group. The cost sharing exemption was found to be slightly associated with increased healthcare expenditure per episode for inpatient services (healthcare expenditure per episode: $\beta = 0.0111$, $\exp(\beta)=1.0112$, SE = 0.0036, $P = 0.0018$). Results of inpatient service for mild disease analysis showed that the cost sharing exemption was associated with a decrease in healthcare expenditure per episode and length of stay per episode.

Conclusions: Overall, the cost sharing exemption for hospitalized children under the age of six had increased the cost of healthcare services, mainly due to an increase in the quantity of healthcare services rather than the price of the service. While planning a cost sharing policy, it is crucial to consider all possible outcomes of how this policy will change healthcare utilization. This study has made a meaningful contribution to Korea's health insurance policy by identifying the relationship between price and quantity responses to cost sharing exemptions.

Further research is needed to make cost sharing a useful tool in children's healthcare utilization.

Key words: Cost sharing, Child, Healthcare utilization, Health insurance coverage

I. Introduction

1. Background

Childhood health conditions are important to learning, prospective health, and future human resources (1-3). Many countries including the United States , Japan, Egypt, the Philippines, and Vietnam have introduced policies to reduce the economic burden of children's medical expenses (4-6). However, due to budget limitations, unlimited financial support is not possible. Moreover, excessive financial support could lead to moral hazards (7). To establish an appropriate level of cost sharing, it is important to quantify the impact of changes in cost sharing on healthcare utilization and supply.

When discussions arise regarding children's healthcare settings in Korea, the National Health Insurance coverage rate for total healthcare expenditure for children under the age of 6 was approximately 65%. In inpatient service, insurance coverage rate was over 70% between 2006 and 2007 and then fell under 70% after 2008 (Figure 1). In January 2006, the cost sharing for hospitalized children under six years of age was waived, and in January 2008, cost sharing increased to 10% of all healthcare expenditure again. These policy changes may lead to reduce health insurance coverage in 2008 compared to 2006 and 2007. Annual healthcare expenditure of children at ages 1–4 increased significantly since 2006, and the healthcare expenditure gap between children at ages 5–9 and 1–4 years increased

significantly since 2006 and 2007, when the cost sharing exemption policy for hospitalized children under age six was implemented (Figure 2). Furthermore, annual number of admissions are steadily increasing (Figure 3).

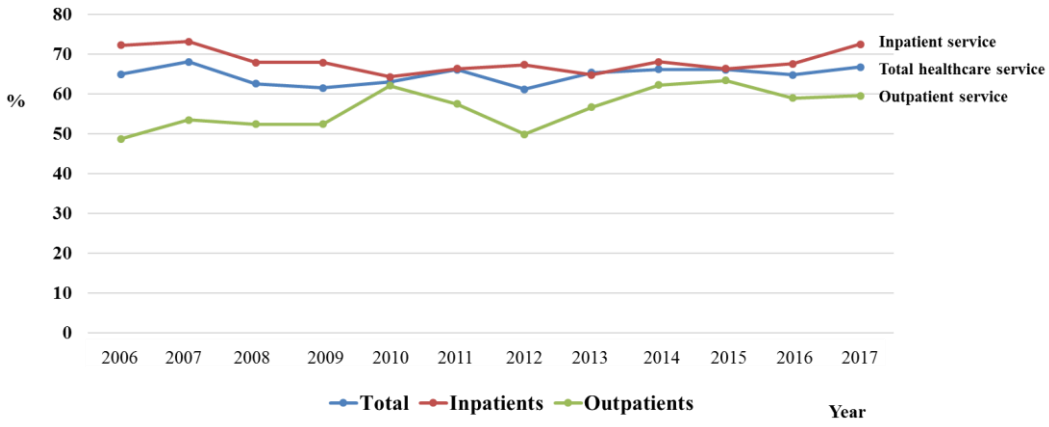

Figure 1. National Health Insurance coverage rate by type of health service from 2006 to 2017 Source: National Health Insurance Statistical Yearbook

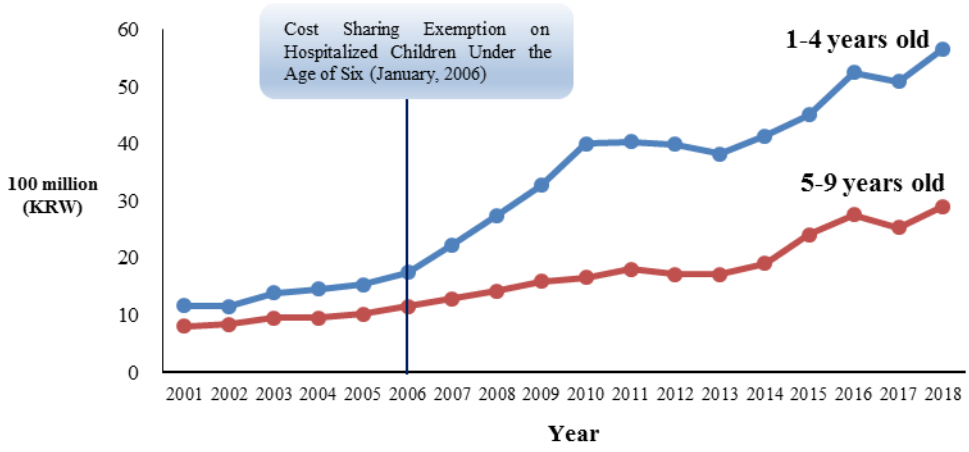

Figure 2. Total healthcare expenditure per year by age group
Source: National Health Insurance Statistical Yearbook 2001-2018

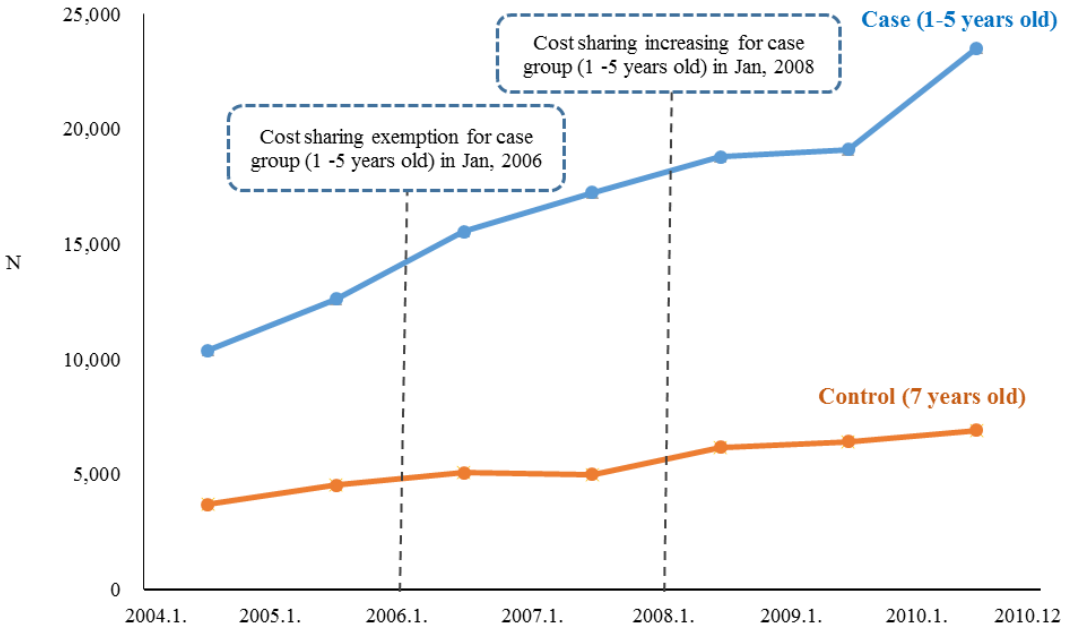

Figure 3. Annual number of admissions per 10,000 NHI beneficiaries

In January 2006, the government implemented a policy of cost sharing exemption for hospitalized children under the age of six to reduce the burden of healthcare expenditure and support children's health from a social perspective (Table 1). The cost sharing exemption policy was implemented under the "Enforcement Decree of the National Health Insurance Act," subparagraph 4 of attached Table 2. When patients under the age of six are hospitalized, an "F004" code is assigned to them and a claim of hospitalization and use of impatient services is presented for cost sharing. The healthcare costs of hospitalized children are reimbursed by the National Health Insurance (NHI), and waived for hospitalized children under the age of six. However, in children over the age of six, 20% of the costs for healthcare utilization are to be borne by the beneficiaries. Thus, the cost sharing exemption policy is applicable only to children under the age of six. As of January 1, 2008, the Enforcement Decree of the National Health Insurance Act (subparagraph 4 and 5 of attached Table 2) has been amended and this policy has been abolished. In 2008, if a child under the age of six is admitted, they would have to bear 10% of the total healthcare expenditure.

Table 1. Changes of coinsurance rate of inpatient care by age

Policy period	1 to 5 years old	7 years old
~ 2005. 12. 31.	20%	20%
2006. 01. 01. ~ 2007. 12. 31.	20% → 0%	20%
2008. 01. 01. ~ 2017. 09. 30.	0% → 10%	20%
2017. 10. 01. ~ 2019. 12. 31. (present)	10% → 5%	20% → 5%

The cost sharing exemption policy for hospitalized children under the age of six was the first cost sharing exemption policy targeting national health insurance beneficiaries in Korea. In other words, this was significantly different from other health insurance coverage expansion policies in that the subjects of the policy are not Medical aid population, but general national health insurance population, and the policy target population was set based on age. Furthermore, "The Presidential Commission on Aging Society and Population Policy" has announced a cost sharing exemption plan for children under the age of six by 2025. From the perspective of health insurance coverage expansion policy, it is important to examine whether this policy achieves its expected goals and develops an evidence-based health insurance coverage policy. Given that there are few studies exploring the relationship between cost sharing and healthcare utilization in the pediatric domain, and Korea has achieved universal coverage of health insurance, it is important to identify the effect of cost sharing exemption on children's healthcare utilization.

2. Study objectives

In January 2006, the government implemented a policy of cost sharing exemption for hospitalized children under the age of six. The purpose of this study was to examine how cost sharing exemption for hospitalized children under the age of six influences healthcare utilization. Details of the study objectives are as follows:

(1) To investigate the effect of cost sharing exemption for hospitalized children under the age of six in terms of National Health Insurance beneficiaries' healthcare utilization.

(2) To investigate the effect of cost sharing exemption for hospitalized children under the age of six in terms of episode healthcare expenditure and the quantity of healthcare services per episode.

II. Literature Review

1. Healthcare utilization model

A substantial and increasing number of studies have investigated factors associated with healthcare utilization. The most basic theory model used to explain healthcare utilization is the Anderson Model. The initial Andersen model was developed in the late 1960s to explain the "hows" and "whys" of healthcare utilization (8, 9). The initial Anderson Model discusses three main factors that affect healthcare utilization (Figure 4). First, individuals' predisposition to use services consisted of already inherent factors before the incidence of disease. Specifically, demographic, social structure, and health belief factors comprised the predisposing factors. Second, factors which enabled obtaining healthcare services such as income and health insurance. There are also need factors, which are perceived as a person's needs for care.

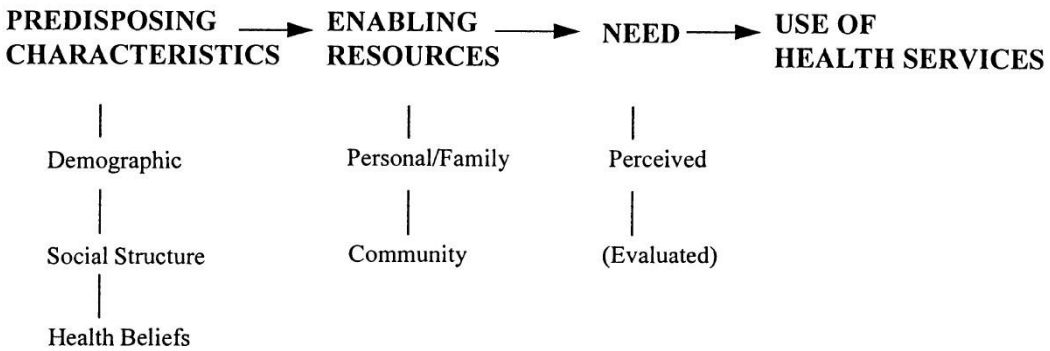

Figure 4. The initial behavioral model (1960s)

Aady and other collaborators developed the initial Anderson Model to suggest the importance of national health policy, resources, and the healthcare system in the 1970s (Figure 5) (8, 10, 11). The healthcare system was additionally included in the Extended Andersen Behavior Model with emphasis on health policy, resources, and organization of healthcare systems as important determinants of healthcare utilization.

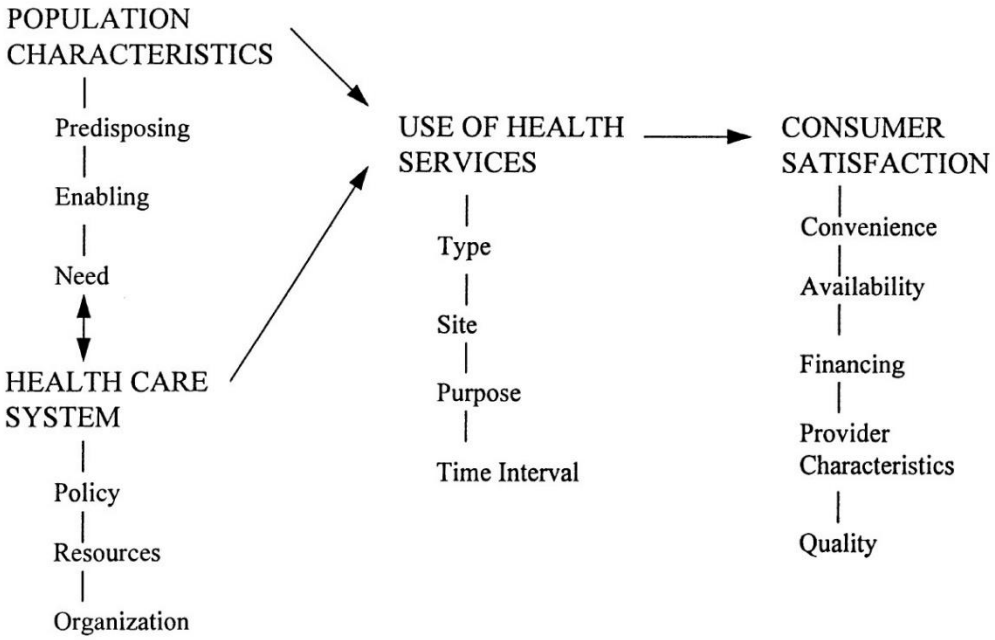

Figure 5. The model-phase 2 of the behavioral model (1970s)

The healthcare utilization model developed by Anderson and Davidson was announced in the year 2007, and in it healthcare utilization is explained as contextual determinants and individual determinants (12). The model explained the

circumstances and environment of healthcare utilization through contextual factors (Figure 6). Context indicated health organization, provider-related factors, and community characteristics (13). Contextual factors are measured aggregate levels from family size to national healthcare system (14). Along with individual determinants, contextual factors are divided into predisposing characteristics, enabling characteristics, and need characteristics. Contextual predisposing characteristics are people's predispositions to use healthcare services. Enabling factors are those that enable the obtaining of healthcare services, and need factors are needs or conditions that people or providers recognize as needs of healthcare utilization.

To explain the process of cost sharing exemption policy for hospitalized children under the age of six in Andersen's recent healthcare utilization model, cost sharing exemption policy was a type of change in terms of health policy of contextual enabling factors. These affected the rate of health insurance coverage of inpatient services for children in terms of financing contextual enabling factors. Subsequently, this affected the individual enabling characteristic, i.e., financing of health services. Financing of health services includes an individual's available wealth, and the price of healthcare service to the person determined by the rate of cost sharing. Based on the behavioral model that serves the cost sharing exemption policy and its likelihood to affect healthcare utilization, this study analyzed the effect of cost sharing exemption on children's healthcare utilization.

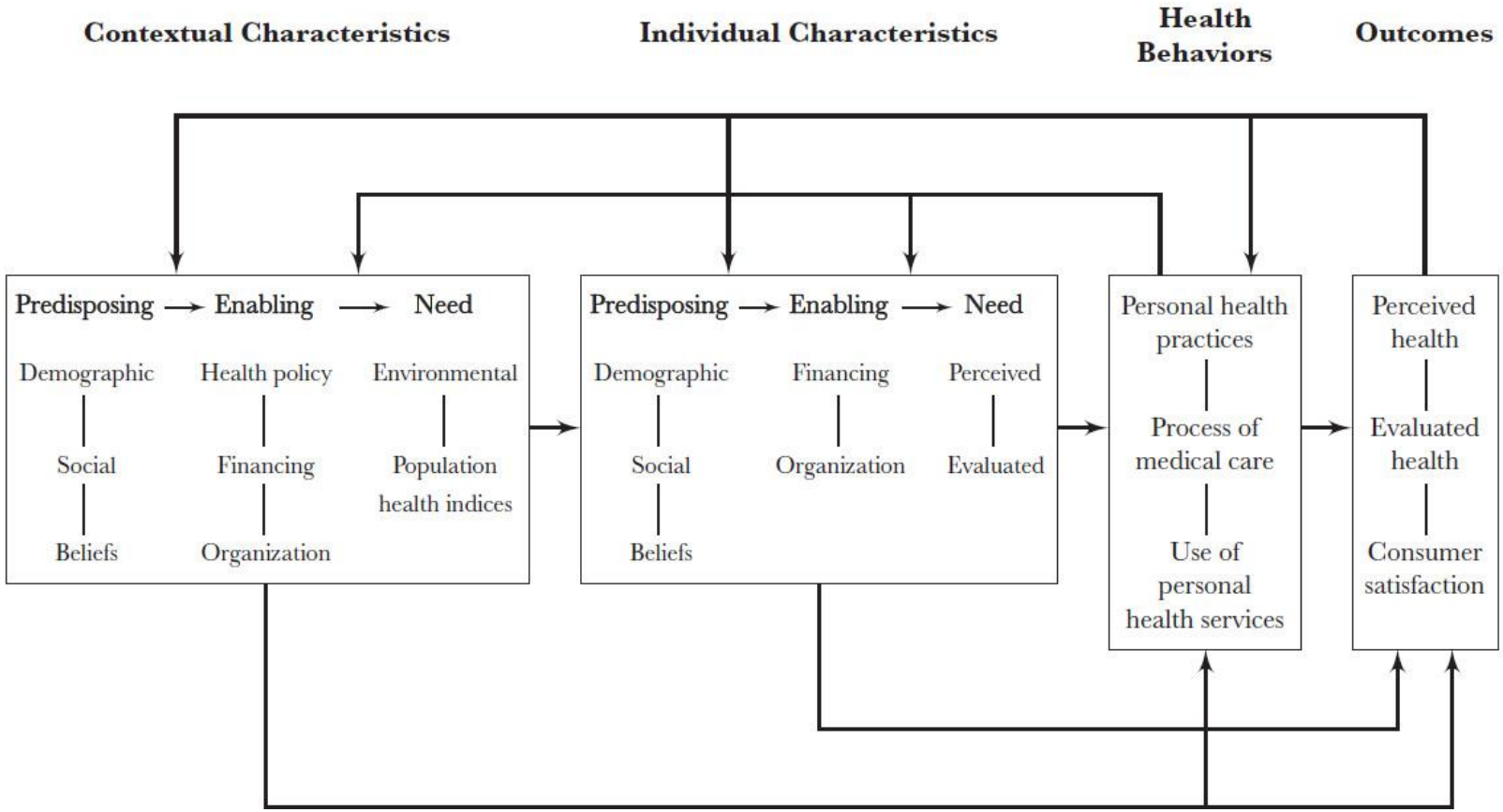

Figure 6. A behavioral model of health services use including contextual and individual characteristics
Source: Andersen and Davidson (2007)

2. Cost sharing in healthcare services

Health insurance raises the economic benefit of risk variance against future uncertainty due to illness, but causes moral hazards in patients' behavior. This implies an inefficient allocation of limited medical resources and is linked to increases in health care expenditure (15, 16). To minimize this problem, some form of cost sharing is introduced (17). Cost sharing enables patients to pay for their healthcare services directly (18). The basic purpose is to prevent overuse and inappropriate healthcare utilization, but it is not necessarily limited to this purpose (19). However, high levels of cost sharing could deteriorate the accessibility of healthcare services, timely appropriate healthcare utilization, and can be an economic burden of healthcare utilization particularly in low-income populations (19-24). There are several types of cost sharing such as coinsurance, copayment, deductible, and out-of-pocket maximum, depending on how the patient pays cost sharing of their healthcare utilization.

Coinsurance is type of cost sharing wherein patients pay a stated percentage rate per healthcare service (25). Low healthcare services could be proportionally cost shared under the coinsurance method. Because cost sharing increases as healthcare expenditures rise, patients with severe disease and high healthcare expenditure may experience the economic burden of healthcare utilization. In the coinsurance method, it is desirable to put an out-of-pocket maximum to reduce the economic burden of healthcare utilization.

Copayment is a cost sharing method where patients pay a fixed amount of money for their healthcare utilization (25). Because the amount of out-of-pocket money is fixed, patients with mild diseases are more likely to experience the economic burden of healthcare utilization than those with severe diseases. When copayment is exceptionally high, it may become an economic barrier to receive healthcare services for patients, and when copayment is too low, patients are less aware of healthcare expenditure.

Deductibles are a method to pay healthcare expenditure before the insurance coverage starts paying out (25). By having the patient pay a small amount of healthcare expenditure, there is an advantage of reducing unnecessary use of healthcare services. However, deductibles are more likely to reduce the accessibility of healthcare services in socially disadvantaged patients than other type of cost sharing.

Out-of-pocket maximum is a way to prevent patients from excessive healthcare expenditure by setting an upper limit on the cost sharing (26). The form is slightly different, and countries like France, Germany, Japan, and others have established an upper limit on patient's economic burden of healthcare expenditure. In Korea, a certain upper limit is determined by the level of insurance premiums for each beneficiary.

The effects of cost sharing have been evaluated in various studies. The most remarkably study on cost sharing are the Rand Health Insurance Experiment studies from the 1970s. These studies demonstrated how healthcare service utilization is price sensitive with a price elasticity of -0.17 (27, 28). Using Rand Health Insurance

Experiment data, there was also a study that investigated the relationship between cost sharing and children's healthcare utilization. This study found that in comparison to free healthcare plans, cost sharing health plans were associated with decreases in episodes during study year, as well as in the number of outpatient services, medical services, and pathology services (29). Recent studies have found similar results that confirm that cost-sharing implementation is associated with low healthcare utilization (Table 2). For example, increases in copayments for ambulatory care were associated with decreases in outpatient care among elderly patients (30). For inpatient services, Quan et al. (2017) found that health insurance with low cost sharing level was associated with patients' longer length of stays and higher total healthcare expenditure of inpatient service (31)

Table 2. Previous studies about cost sharing in healthcare services

Author(s)	Title	Source	Summary of Results
Trivedi AN, Moloo H, Mor V	Increased ambulatory care copayments and hospitalizations among the elderly	N Engl J Med 2010;362(4):320-8.	Increased copayments for ambulatory care led to reduction in outpatient visits and increase in hospital care.
Trivedi AN, Leyva B, Lee Y, et al.	Elimination of Cost Sharing for Screening Mammography in Medicare Advantage Plans	N Engl J Med 2018; 378(3), 262-269.	Eliminating cost sharing for screening mammography was associated with an increase in screening mammography among older women who is recommended the screening.
Lambregts TR, van Vliet RCJA	The impact of copayments on mental healthcare utilization: a natural experiment	Eur J Health Econ 2018; 19(6), 775-784.	Implementation of copayment for outpatient mental healthcare service led to a significant decreasing in outpatient mental healthcare utilization among adults.
Xu Y, Li N, Lu M et al.	The effects of patient cost sharing on inpatient utilization, cost, and outcome.	PLoS One 2017; 12(10), e0187096.	Patients with low cost sharing level of health insurance may have longer length of stays, higher total healthcare expenditure, higher medication expenditure, and higher number of specific procedure.
Kato H, Goto R	Effect of reducing cost sharing for outpatient care on children's inpatient services in Japan	Health Econ Rev 2017; 7(1), 28.	Reducing cost sharing for outpatient services led to an increase in inpatient service among low income area, and decrease among high income area.
Anderson GM, Brook R, Williams A	A comparison of cost-sharing versus free care in children: effects on the demand for office-based medical care.	Med Care 1991; 29(9), 890-898.	Children with cost sharing insurance plan were associated with decreased of episodes during study year, number of outpatient service, medical service, and pathology service than children with free care plan.

3. Moral hazards of health insurance

The main aspect of a moral hazard in health insurance can be explained as follows: when people are insured, they use more healthcare services than when they do not have health insurance (32-35). By decreasing the cost sharing of healthcare service, moral hazards could occur for consumers as well as providers. On the demand side, moral hazards result from the fact that insured people demand more health care when compared to uninsured and patient overconsumption with low cost sharing for services than at high cost sharing (34, 36-39). On the provider's side, Arrow stated that supplier induced demand rises from information asymmetry between patients and physicians (Figure 7) (40). As providers have more medical information than patients, they can shift the demand curve, that is, supplier induced demand (41, 42).

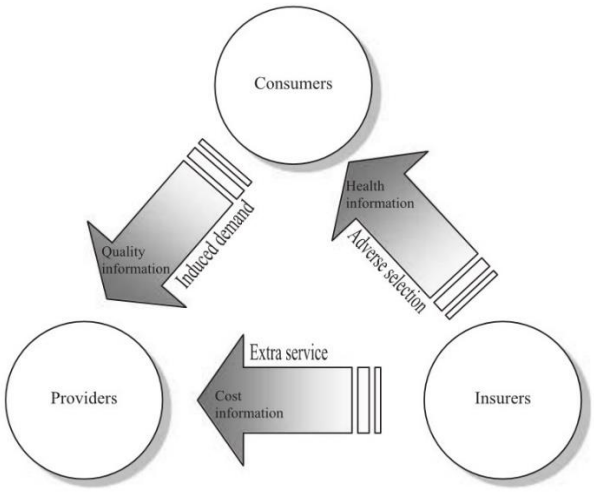

Figure 7. A model of the mechanism between three participants of health care services and the relative distributions of the amount of information (Mooney, 1994; Nichols, 1998)

Several studies regarding the demand side of moral hazard problems are found in the Rand Health Insurance Experiment and natural experiments that make use of comparisons of people with and without insurance (Table 3). The Rand Health Insurance Experiment identified that patients with no coinsurance health insurance plan exhibited 66% higher outpatient visit rates than patients with 95% coinsurance plans (27, 43, 44). Recent studies generally show that patients respond to supplemental insurance coverage with increasing healthcare utilization. In a study from France, extra complementary health insurance provided by a private insurer was significantly associated with outpatient services, largely in high probability of outpatient visits.

Table 3. Previous studies about moral hazards of health insurance

Author(s)	Title	Source	Summary of Results
Franc C, Perronnin M, Pierre A	Supplemental Health Insurance and Healthcare Consumption-A Dynamic Approach to Moral Hazard	Health Econ 2016; 25(12), 1582-1598.	Extra complementary health insurance was significant associated with high probability of outpatient visit, number of outpatient visits, and cost per episode.
Wong IO, Lindner MJ, Cowling BJ, et al.	Measuring moral hazard and adverse selection by propensity scoring in the mixed health care economy of Hong Kong	Health Policy 2010; 95(1), 24-35..	Patient with employment-based plans, which provide broad and generous insurance coverage, was significant associated with increasing both inpatient and outpatient care in Hong Kong.
Akosa Antwi Y, Moriya AS, Simon KI	Access to health insurance and the use of inpatient medical care: Evidence from the Affordable Care Act young adult mandate	J Health Econ 2015; 39, 171-187.	Expanding health insurance coverage for young adult led to an increase in mental healthcare inpatient service.
Jeon B, Kwon S	Effect of private health insurance on health care utilization in a universal public insurance system: A case of South Korea	Health Policy 2013; 113(1-2), 69-76.	Patient with private health insurance was associated with higher outpatient care and inpatient care expenditure compared to patient with no private health insurance.
Kim JH, Lee KS, Yoo KB, et al.	The Differences in Health Care Utilization between Medical Aid and Health Insurance: A Longitudinal Study Using Propensity Score Matching	PLoS One 2015; 10(3), e0119939.	Medical Aid beneficiaries was more likely to have outpatient visit, admission, and longer length of stay than National Health Insurance beneficiaries.
Liu, X, Nestic D, Vukina T	Estimating Adverse Selection And Moral Hazard Effects With Hospital Invoices Data In A Government-Controlled Healthcare System	Health Econ 2012; 21(8), 883-901.	There was difference in healthcare consumption between patient who has no insurance and patient who received the free insurance coverage due to moral hazard.

Numerous studies have addressed the supplier induced demand in the healthcare sector (45-50). Full insurance coverage or low cost sharing could allow consumers to receive healthcare services without recognizing the full cost of healthcare services, paid by the insurer not directly but by the medical user (41, 51). In particular, in Korea, compensation for healthcare services is determined by the amount of health care service and the contents of treatment, which are also called fee-for-service and lead to the incentive of oversupplying of the healthcare services by providers. Healthcare providers are in the most advantageous position as they usually know most about the health status of their patients (45, 52, 53). According to principal-agent models, providers who serve as agents to the patients will provide the right amount of medical care if they are the perfect agent, but could also act to maximize their own interests with low cost sharing setting (54-56). Therefore, they could create supplier-induced demand which thereby creates revenues for unnecessary medical treatments (32, 33).

4. Previous studies on the effects of cost sharing exemption on hospitalized children under the age of six

Several studies have investigated the effects of cost sharing exemption policy for hospitalized children under the age of six in Korea (Table 4). Jeon et al. (2008) compared descriptive statistics and used t-tests in their study and found that after the implementation of the cost sharing exemption policy, the increase in the rate of receiving inpatient service decreased, while the length of stay and healthcare expenditure per patient increased (57). Other studies conducted using the difference in differences analysis did not show consistent results when compared to the Medical Aid group with respect to length of stay and healthcare expenditure(58) . Kim et al. (2017) used the National Health Insurance Service-National Sample Cohort data and found that in terms of inpatient and outpatient services, length of stay, and healthcare expenditure per beneficiary had increased after cost sharing exemption (59). The most recent research that investigates the effects of cost sharing exemption used the Bayesian structural time series to increase the causality of analysis and found that length of stay and healthcare expenditure per 100,000 beneficiaries had increased after cost sharing exemption (60). However, this study considered only the periods six months before and after the implementation of the policy.

Although several studies have been conducted, there are few studies that analyze the cost of healthcare services in terms of price and the quantity in

individual units using a dataset for the entire population of South Korea. By considering that total healthcare expenditure is equal to the price of healthcare services multiplied by the quantity of healthcare utilization, this study aimed to investigate the effects of cost sharing exemption on healthcare utilization by identifying whether the effects are due to changes in the quantity or the price of healthcare services. To strengthen the causality of the result, it set up a control group such that its pre-trend of healthcare utilization was similar to that of the case group by using difference in differences analysis. In addition, the study period was analyzed to include a longer policy-effect period than the previous studies by considering two-year periods before and after the implementation of the policy. This study attempts to supplement the extant literature on the effects of cost sharing exemption on healthcare utilization.

Table 4. effects of cost sharing exemption on hospitalized children under the age of six

Author(s)	Title	Source	Study period	Control group	Method	Results
Jeon KS, Yoon S-J, Ahn H-S, et al.	The Effect of the Cost Exemption Policy for Hospitalized Children under 6 Years Old on the Medical Utilization in Korea	J Prev Med Public Health 2008;41(5):295-299	2004. 1. ~ 2006. 12.	Before cost sharing exemption period (2004 ~ 2005)	T-test, comparison of descriptive statistics	After the cost sharing exemption, the rate of increase in inpatient services has decreased. Length of stay and healthcare expenditure per patients was increased after policy implementation.
Kwak SY, Yoon S-J, Oh I-H, et al.	An evaluation on the effect of the copayment waiver policy for Korean hospitalized children under the age of six	BMC Health Serv Res 2015;15(1), 170.	2004. 8. ~2005. 11., 2006. 2. ~2007. 5. 31.	Medical Aid	Difference in differences	In terms of inpatient service, length of stay per episode and healthcare expenditure per episode did not change after cost sharing exemption. There was no significant increase in length of stay and healthcare expenditure.
Kim J	The effect of the cost exemption policy on health insurance: Evidence from hospitalized children under 6 years old	Korea Review of Applied Economics 2017; 19(2), 5-39.	2005.1. ~ 2006. 12.	6-10 years old	Difference in differences	Length of stay and healthcare expenditure increased after cost sharing exemption both inpatient service and outpatient service.
Kim J-H	Evaluation of User Fee Exemption Policy Under 6 children	[master's thesis] Seoul: Seoul University; 2019.	2005.7.-2006.6	7-10 years old	Bayesian structural time series model	Healthcare expenditure per 100,000 beneficiaries and length of stay per 100,000 were increased after cost sharing exemption. Healthcare expenditure per episode was increased after policy implementation.

III. Material and Methods

1. Framework of the Study Design

This study aimed to analyze the effects of cost sharing exemption for hospitalized children under the age of six on healthcare utilization in terms of NHI beneficiaries' healthcare utilization and healthcare expenditure and the quantity of healthcare services per episode. In Korea, the National Health Insurance System (NHIS) is a single payer system, where the policyholders (insured) pay the premium (Figure 8). Healthcare providers provide healthcare services to the insured, who pays his/her share of the cost to the providers. Then, the NHIS reimburses the provider with the remaining balance. In Figure 8, the information triangle indicates the information asymmetry in health insurance. The insured knows more about their health status than the NHIS and the providers are in the strongest position as they know more medical information than the patient. In other words, there are asymmetric information relationships in the healthcare system. This study aimed to investigate how cost sharing exemption affects children's healthcare utilization in this healthcare system. Considering that the cost sharing exemption for inpatient services could not only affect the utilization of inpatient service, but also the utilization of the substitute service, outpatient and total healthcare services (including inpatient and outpatient services) were analyzed in the analysis of healthcare utilization by NHI beneficiaries (61-65).

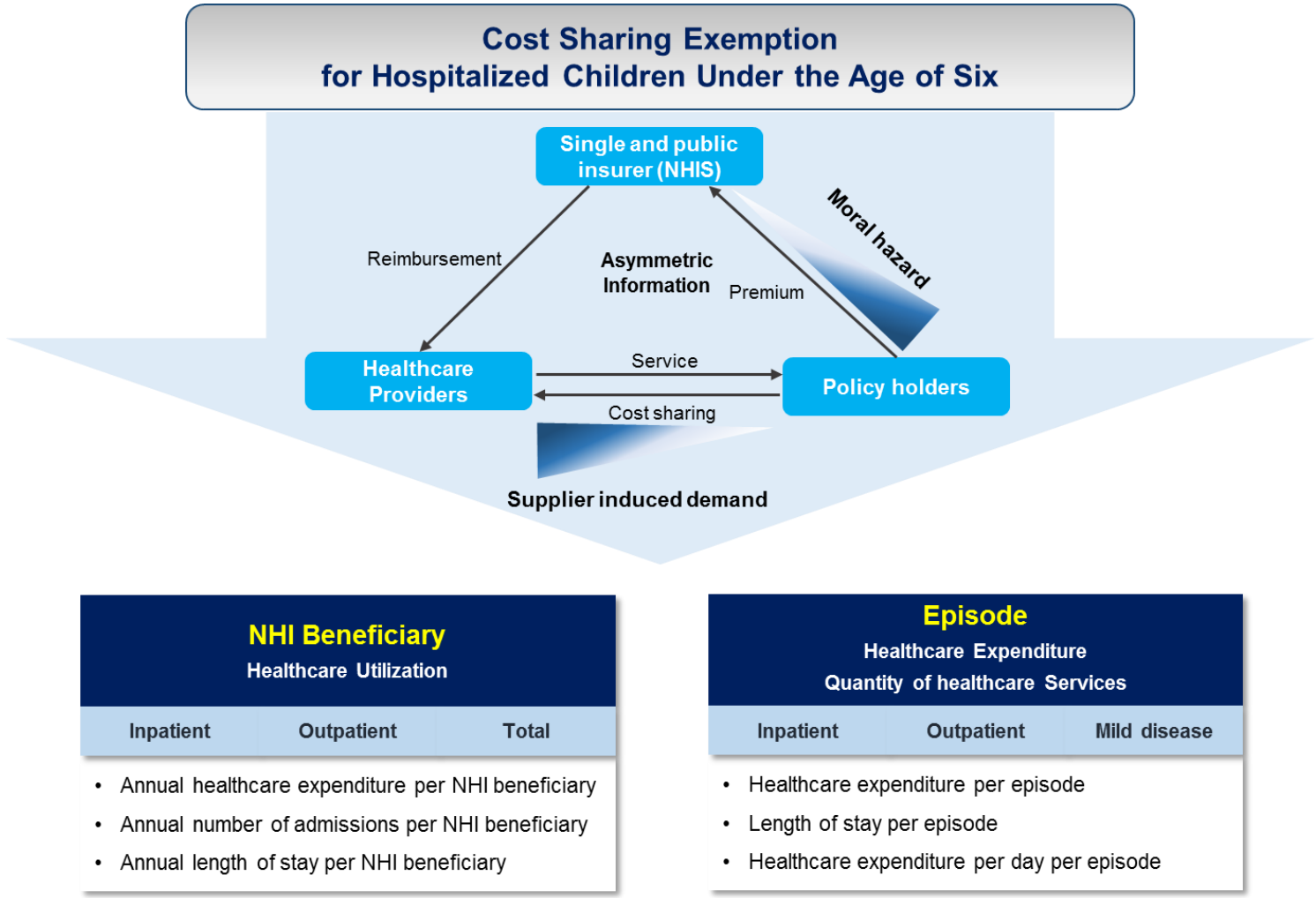

Figure 8. Conceptual framework of the study design

2. Data sources

The data used in this study were taken from the National Health Insurance Database (NHID) for the period 2004-2007. The NHID includes databases on healthcare utilization, health screening, socio-demographic variables, and death data for the entire population of South Korea. The people insured by the NHI pay premiums and receive healthcare services from healthcare providers (66). The NHIS pays the healthcare service costs according to the claims made by the healthcare providers (Figure 9). To manage these processes in the NHI, the NHIS constructed the NHID, which combines insurance eligibility information of the insured, healthcare utilization based on claim data, and information on medical institutions.

In this study, the databases on insurance eligibility, healthcare utilization, and medical institutions were used. The insurance eligibility information of the insured includes information on income-based insurance contributions, demographic factors, and death data. The healthcare utilization information includes claim data for inpatient and outpatient service utilization with respect to diagnoses, length of stay, costs, and types of services received.

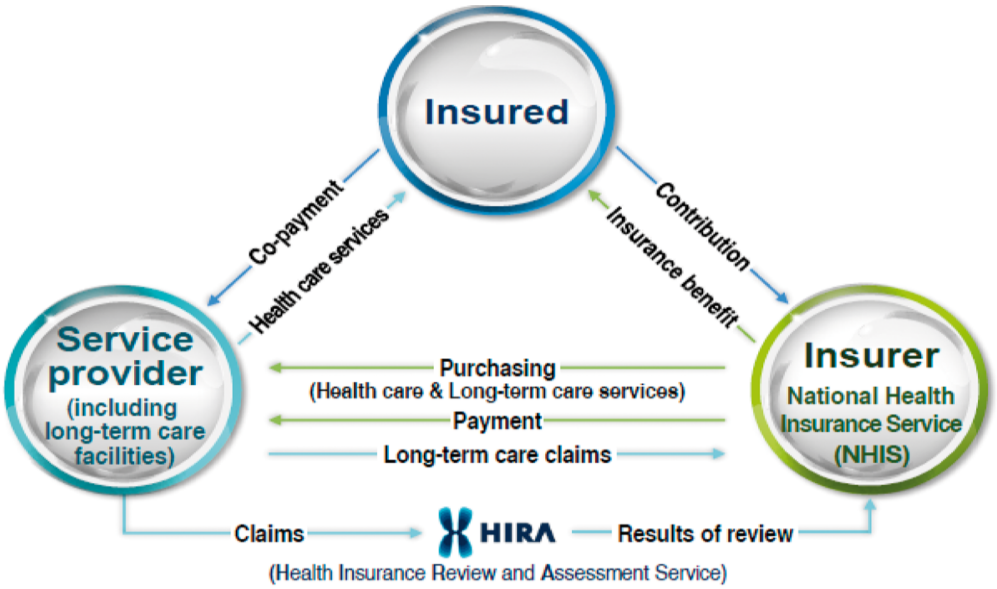

Figure 9. The governance of the National Health Insurance of South Korea

3. Study Subjects

1) Healthcare utilization by beneficiaries of the National Health Insurance

To analyze the effect of cost sharing exemption on hospitalized children under the age of six, the children's population was classified into two groups: the case group under the cost sharing exemption policy (1-5 years old) and the control group (7 years old). The 7-year-old children were selected as the control group for various reasons. As the cost sharing exemption policy is only applicable to children under the age of six, several studies have selected children over the age of six as the control group (5, 59, 60, 67, 68). Moreover, this study tested for parallel trends in the statistical model by using a case indicator, continuous time variable (year), and measuring the interaction between these two variables (69). The variable for policy intervention did not include since this analysis included the before policy intervention period only. This analysis did not reject the null hypothesis, and thereby indicated the assumption of parallel trends between the case group (1–5-year-olds) and control group (7-year-olds) before the policy intervention (Appendix 1, Appendix 2).

As healthcare utilization on children who are less than one-year-old was considered a part of maternity healthcare utilization until 2005 and age is based on year-end references, this study excluded children less than one-year-old and those who are six years old. Thus, children who were 1-5 years old and enrolled in the NHI during the period between 2004-2007 were classified under the case group and

those who were 7 years old under the control group. Subjects who died between January 2004 and December 2007 were excluded from the year of death in the study. After excluding the samples with missing data on the income level and region, case group (1-5 years old) included 2,720,180 subjects in 2004, 2,572,633 subjects in 2005, 2,333,808 subjects in 2006, 2,230,946 subjects in 2007. Control group (7 years old) included 649,225 subjects in 2004, 616,091 subjects in 2005, 584,144 subjects in 2006, 600,370 subjects in 2007 (Figure 10).

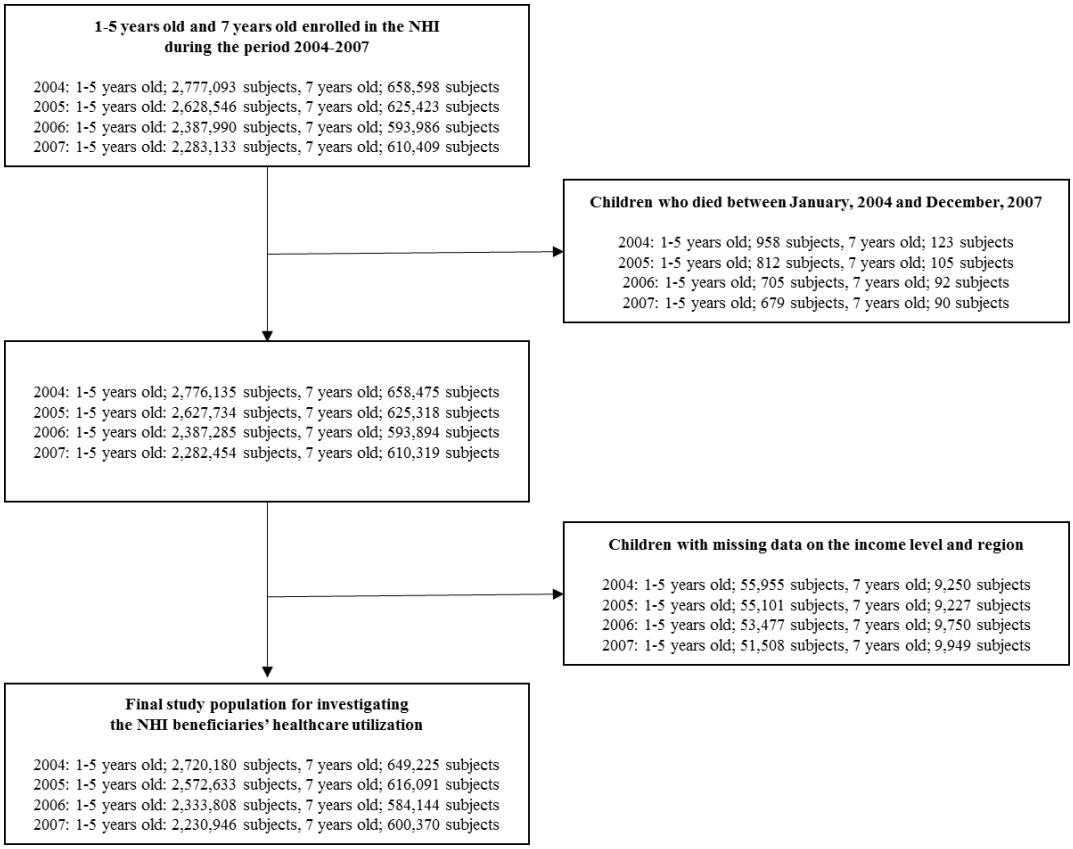

Figure 10. Flow chart of the study population

2) Healthcare expenditure and the quantity of healthcare services per episode

To analyze the policy effect on inpatient service episode, data on inpatient service for 1-5 year-old and 7-year-old children for the period 2004-2007 were included. First, 1,502,522 episodes of 1-5 year-old and 120,557 episodes of 7-year-old children for the period 2004-2007 were included. An episode was classified as a "same episode" when a patient who has received inpatient care at a particular medical institution has another episode and is admitted within an interval period of less than one day from the date of discharge of previous admission and the date of commencement of current admission. After classifying the same episodes, 1,449,748 episodes of 1-5 year-old and 117,237 episodes of 7-year-old children remained. Out of these, 57 episodes of 1-5 year-old and 9 episodes of 7-year-old children were excluded because of missing healthcare expenditure information, thus giving 1,449,691 episodes of the former and 117,228 episodes of the latter. Out of these, 754 episodes of 1-5 year-old and 94 episodes of 7-year-old children were excluded because they were from medical institutions other than tertiary hospitals, general hospitals, hospitals, and clinics. After excluding the samples with missing data on the characteristics of the patients (e.g., gender, region, income level, and disability) and medical institutions (e.g., region, number of beds, and number of doctors), 1,415,598 episodes of 1-5 year-old and 115,307 episodes of 7-year-old children remained. Out of these, 3,030 episodes of 1-5 year-old and 277 episodes

of 7-year-old children were excluded because they were from the children who died between January, 2004 and December, 2007 (Figure 11).

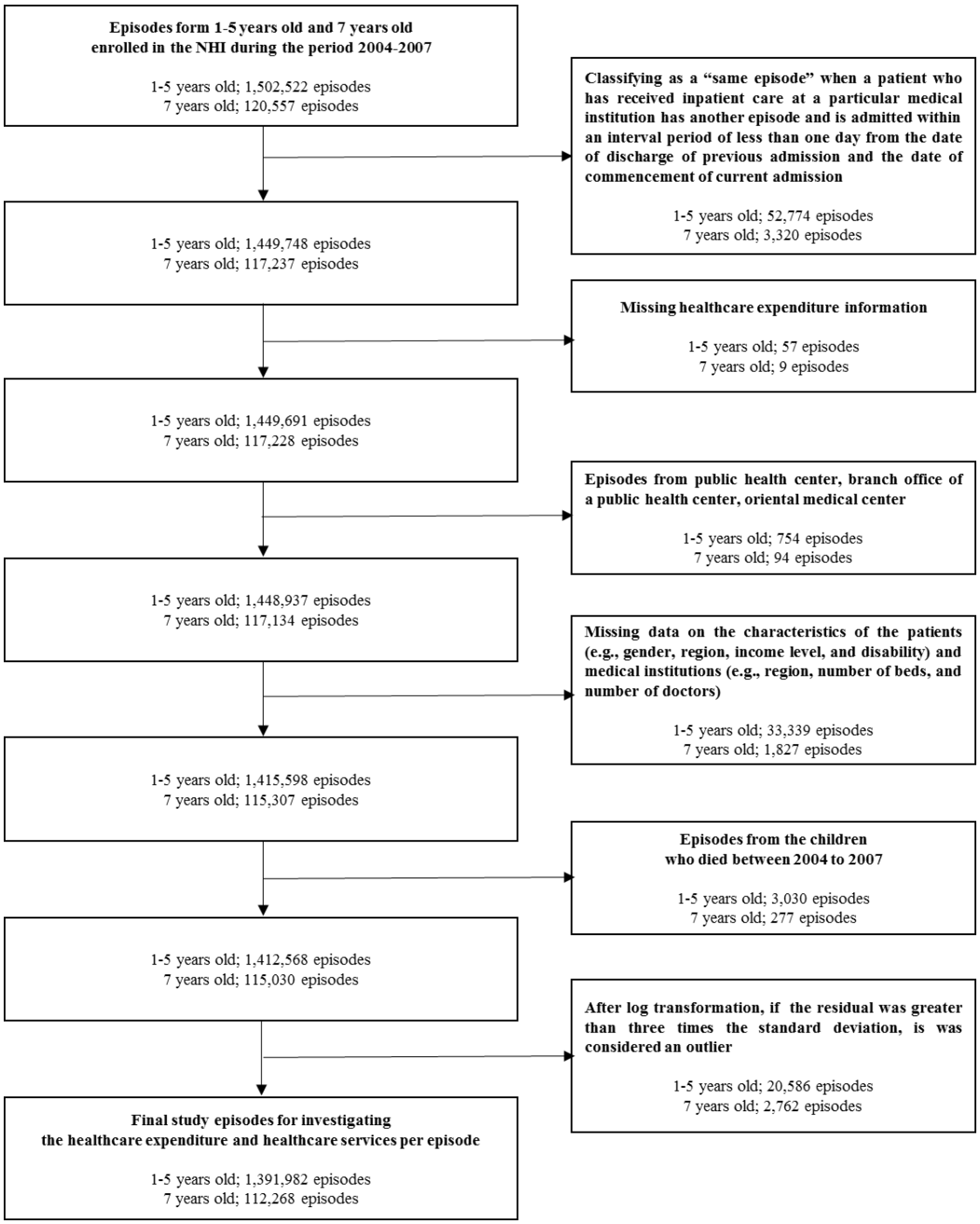

Figure 11. Flow chart of the study inpatient episodes

When normality test was conducted for healthcare expenditure per inpatient episode, the null hypothesis, that is “this distribution is normal,” was rejected by the Kolmogorovo-Smirnov normality test (p-value<0.0100) and Anderson-Darling test (p-value<0.0100). The histogram of healthcare expenditure was found to be positively skewed (Figure 12). To solve this problem, log transformation was performed. Then, if the residual was greater than three times the standard deviation, it was considered an outlier and excluded from the study. After excluding the outlier data, 1,391,982 episodes of 1-5 year-old and 112,268 episodes of 7-year-old children were finally included (Figure 11).

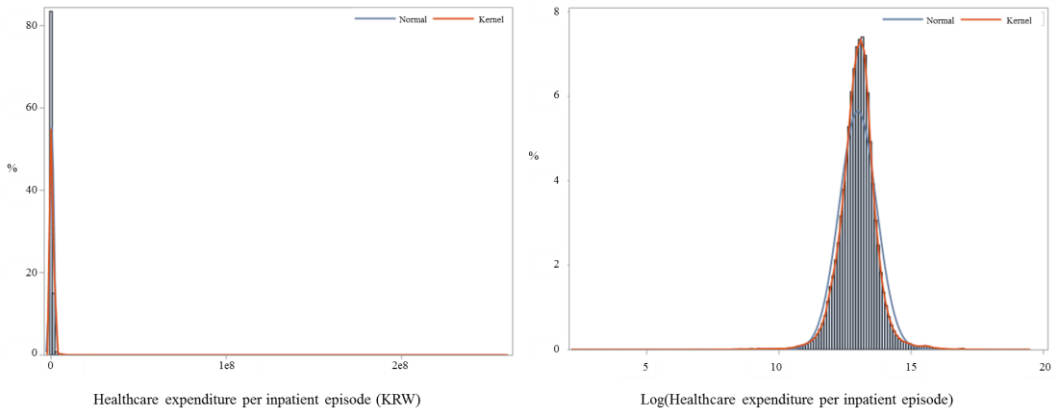

Figure 12. Histogram of healthcare expenditure per inpatient episode

To analyze the policy effect on outpatient service episode, data on outpatient service for 1-5 year-old and 7-year-old children for the period 2004-2007 were included. First, the 138,117,743 episodes of 1-5 year-old and 19,754,830 episodes of 7-year-old children for the period 2004-2007 were included. Out of these, 138,861 episodes of 1-5 year-old and 17,454 episodes of 7-year-old children were excluded because they were from medical institutions other than tertiary hospitals, general hospitals, hospitals, and clinics. After excluding the samples with missing data on the characteristics of the patients (e.g., gender, region, income level, and disability) and medical institutions (e.g., region, number of beds, and number of doctors), 134,977,098 episodes of 1-5 year-old and 19,439,508 episodes of 7-year-old children remained. Out of these, 18,289 episodes of 1-5 year-old and 1,829 episodes of 7-year-old children were excluded because they were from the children who died between January 2004 and December 2007 (Figure 13).

When normality test was conducted for healthcare expenditure per episode, the null hypothesis, that is "this distribution is normal," was rejected by the Kolmogorovo-Smirnov normality test (p-value<0.0100) and Anderson-Darling test (p-value<0.0050). The histogram of healthcare expenditure was found to be positively skewed (Figure 14). To solve this problem, log transformation was performed. Then, if the residual was greater than three times the standard deviation, it was considered an outlier and excluded from the study. After excluding the outlier data, 133,656,121 episodes of 1-5 year-old and 19,222,999 episodes of 7-year-old children were finally included (Figure 13).

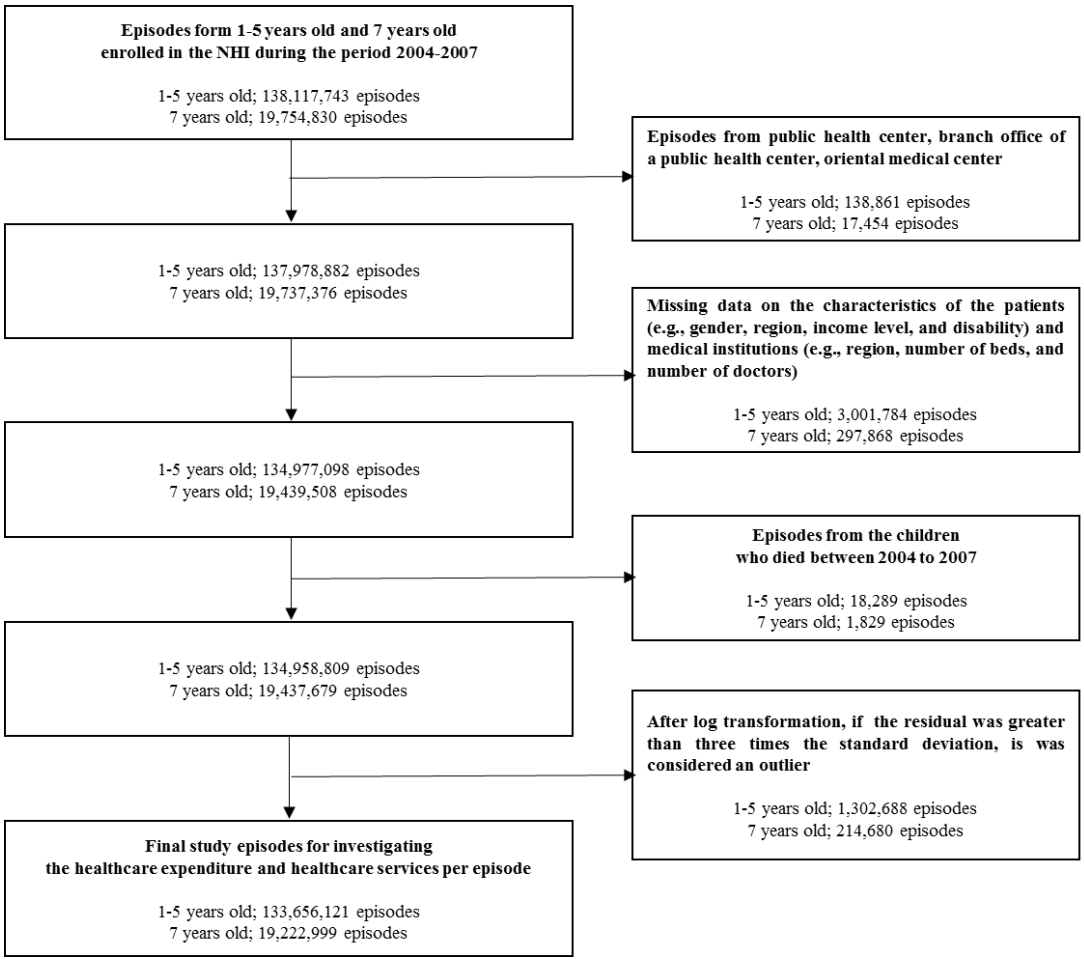

Figure 13. Flow chart of the study outpatient episodes

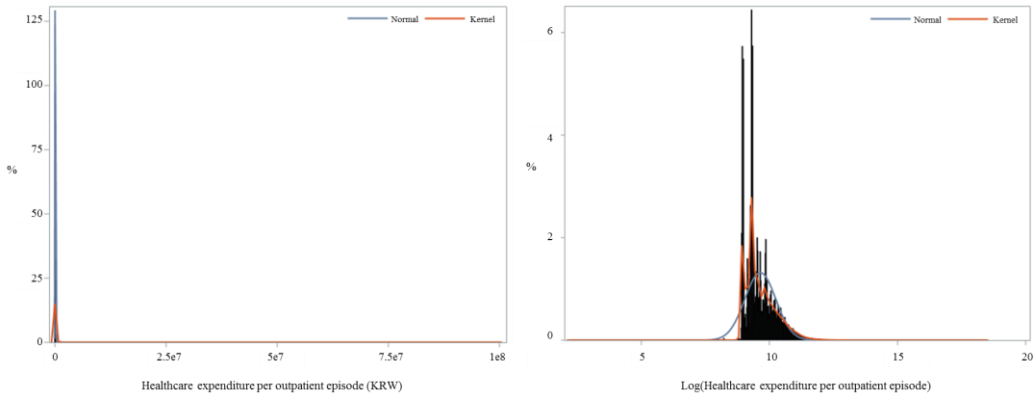

Figure 14. Histogram of healthcare expenditure per outpatient episode

To analyze the policy effect on mild disease, the inpatient services and outpatient service received by 1-5 year-old and 7 year-old children for mild diseases for the period 2004-2007 were included. Mild diseases included respiratory tract infections, which is the most frequent primary reason for pediatric admission. The diagnosis of respiratory tract infections was assigned codes J00-J06, J10-J18, and J20-J22 based on the ICD-10, which in turn determined the code assigned to the claim data (Table 5).

Table 5. International Classification of Disease 10th version Codes used in the determining respiratory infection disease (mild disease) in this study

Code	Description
J00	Acute nasopharyngitis
J01	Acute sinusitis
J02	Acute pharyngitis
J03	Acute tonsillitis
J04	Acute laryngitis
J05	Acute obstructive laryngitis
J06	Acute laryngopharyngitis
J10	Influenza due to identified seasonal influenza virus
J11	Influenza, virus not identified
J12	Viral pneumonia,
J13	Pneumonia due to Streptococcus pneumoniae
J14	Pneumonia due to Haemophilus influenzae
J15	Bacterial pneumonia,
J16	Pneumonia due to other infectious organisms,
J17	Pneumonia in diseases classified elsewhere
J18	Pneumonia, organism unspecified
J20	Acute bronchitis
J21	Acute bronchiolitis
J22	Unspecified acute lower respiratory infection

Out of the 1,391,982 inpatient episodes of 1-5 year-old and 112,268 inpatient episodes of 7-year-old children, 482,121 episodes of the former and 72,579 episodes of the latter were excluded because they were diagnoses of diseases other than diseases caused by respiratory tract infections. Finally, 909,861 inpatient episodes of 1-5 year-old and 39,689 inpatient episodes of 7-year-old children were included in this study (Figure 15).

Out of the 133,656,121 outpatient episodes of 1-5 year-old and 19,222,999 outpatient episodes of 7-year-old children, 36,368,278 episodes of the former and 7,639,991 episodes of the latter were excluded because they were diagnoses of diseases other than diseases caused by respiratory tract infections. Finally, 97,287,843 inpatient episodes of 1-5 year-old and 11,583,008 outpatient episodes of 7-year-old children were included in this study (Figure 16).

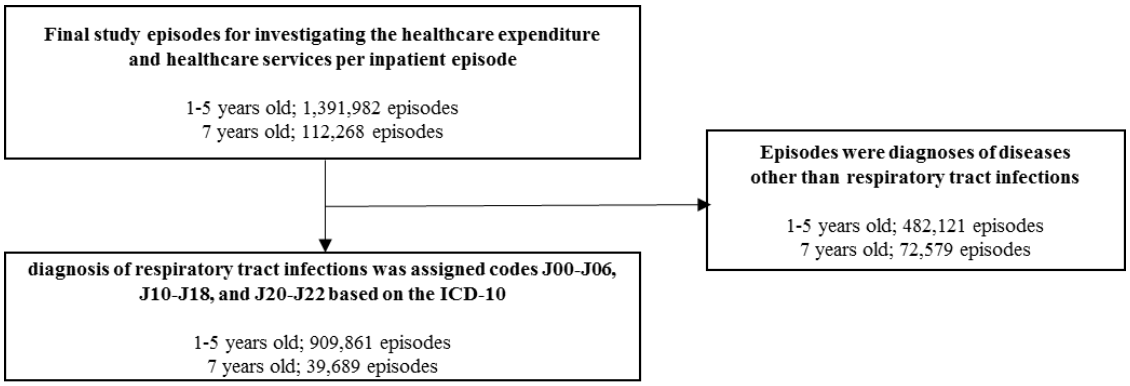

Figure 15. Flow chart of the study inpatient episode for mild disease

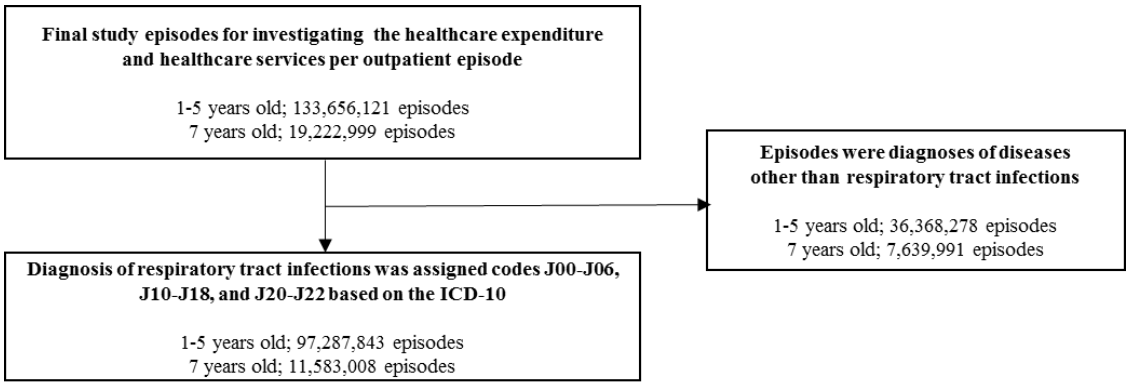

Figure 16. Flow chart of the study outpatient episode for mild disease

4. Variables

1) Dependent variables

In the unit analysis of NHI beneficiaries, the changes in healthcare utilization were examined for inpatient, outpatient, and total healthcare services (both inpatient and outpatient services). The unit analysis of NHI beneficiaries with respect to inpatient services included annual healthcare expenditure per NHI beneficiary, length of stay per NHI beneficiary, and number of admissions per NHI beneficiary (Table 6). The unit analysis of NHI beneficiaries with respect to outpatient services included annual healthcare expenditure per NHI beneficiary and number of visits per NHI beneficiary. The unit analysis of NHI beneficiaries with respect to total healthcare services included annual healthcare expenditure per NHI beneficiary, length of stay per NHI beneficiary, and number of visits per NHI beneficiary.

In the unit analysis of episodes, the changes in healthcare utilization were examined for inpatient and outpatient services (Table 6). The unit analysis of episodes with respect to inpatient services included healthcare expenditure per episode, length of stay per episode, and healthcare expenditure per day per episode. The unit analysis of episodes with respect to outpatient services included healthcare expenditure per episode.

In the unit analysis of episodes of mild disease, the changes in healthcare utilization were examined for inpatient and outpatient services (Table 6). The unit

analysis of episodes with respect to inpatient services for mild diseases included healthcare expenditure per episode, length of stay per episode, and healthcare expenditure per day per episode. The unit analysis of episodes with respect to outpatient services for mild diseases included healthcare expenditure per episode. Considering that healthcare expenditure is calculated by multiplying the relative value of healthcare service by a conversion factor, information of healthcare expenditure which was included in this study was converted based on the 2004 conversion factor (70).

Table 6. List of dependent variables

Unit of analysis	Type of care	Time unit for analysis	Variable	Definition
NHI beneficiary	Inpatient	Annual	Annual healthcare expenditure per NHI beneficiary	The sum of healthcare expenditure for all inpatient services received by each NHI beneficiary in a year
			Annual length of stay per NHI beneficiary	The sum of the length of stay during each admission of each NHI beneficiary in a year
			Annual number of admissions per NHI beneficiary	The sum of the number of admissions of each NHI beneficiary in a year
	Outpatient	Annual	Annual healthcare expenditure per NHI beneficiary	The sum of healthcare expenditure for all outpatient services received by each NHI beneficiary in a year
			Annual number of visits per NHI beneficiary	The sum of the number of visits of each NHI beneficiary in a year
	Total	Annual	Annual healthcare expenditure per NHI beneficiary	The sum of healthcare expenditure for all inpatient and outpatient services received by each NHI beneficiary in a year
			Annual length of stay per NHI beneficiary	The sum of the length of stay during each episode of each NHI beneficiary in a year
Episode	Inpatient	Monthly	Healthcare expenditure per episode	Healthcare expenditure per episode
			Length of stay per episode	Length of stay per episode
			Healthcare expenditure per day per episode	Obtaining the healthcare expenditure were divided by the length of stay per episode
	Outpatient	Monthly	Healthcare expenditure per episode	Healthcare expenditure per episode
Episode of mild disease	Inpatient	Monthly	Healthcare expenditure per episode	Healthcare expenditure per episode
			Length of stay per episode	Length of stay per episode
			Healthcare expenditure per day per episode	Obtaining the healthcare expenditure were divided by the length of stay per episode
	Outpatient	Monthly	Healthcare expenditure per episode	Healthcare expenditure per episode

2) Interesting variable

To evaluate the cost sharing exemption effect, this study included interaction term between the case variable and the policy variable as the interesting variable. 1-5 year-old children was defined as case group and coded "Case" variable as "1". 7-year-old children was defined as control group and coded "Case" variable as "0". Policy variable was the whether implementation of cost sharing exemption for hospitalized children under the age of six. Since this policy was implementation in January 1, 2006, the period between January 1, 2004 and December 31, 2005 was defined as the "before" policy intervention period and coded "Policy" variable as "0". The period from January 1, 2006 to December 31, 2007 was defined as the "after" policy intervention period and coded "Policy" variable as "1" (Figure 17).

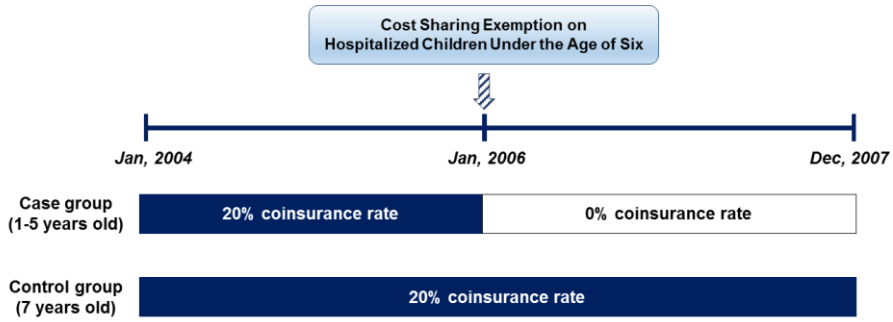

Figure 17. Changes of coinsurance rate for inpatient service by age

3) Independent variables

The unit analysis of NHI beneficiaries was controlled for a common before-intervention temporal trend using a continuous time variable (year, without interacting with the policy implementation indicator). This study controlled for temporal trend because possibility of secular changes in outcomes over time across case group and control group, independent of any policy intervention (71). Gender, income level, region, whether disability or not, Charlson Comorbidity Index (CCI) were included as covariates in the analysis (Table 7, Table 9). CCI was calculated annually using Quan's method (72, 73).

Table 7. List of independent variables (the unit analysis of NHI beneficiaries)

Variable	Definition
Gender	Male/Female
Income level	0-20 percentile(low)/21-40 percentile/41-60 percentile/61-80 percentile/81-100 percentile(high)
Region	Capital area/Metropolitan area/Rural area
Disability	No/Yes
Charlson Comorbidity Index (CCI)	0/1/2≤
Year	Continuous variable of year period

The unit analysis of episodes was controlled for a common before intervention temporal trend using a continuous time variable (month, without interacting with the policy implementation indicator). Patients' characteristic (gender, income level, region, whether disability or not, Charlson comorbidity

index), medical institution characteristic (type of medical institution, region, Number of doctors, Number of nurses) and seasonality were included as covariates in the analysis (Table 8, Table 9). CCI was calculated monthly using Quan's method (72, 73).

Table 8. List of independent variables (the unit analysis of episodes)

Variable	Definition
Gender	Male/Female
Income level	0-20 percentile(low)/21-40 percentile/41-60 percentile/61-80 percentile/81-100 percentile(high)
Region	Capital area/Metropolitan area/Rural area
Disability	No/Yes
Charlson Comorbidity Index (CCI)	0/1/2≤
Type of medcial institution	Tertiary hospital, general hospital, hospital, clinic
Medical insitution region	Capital area/Metropolitan area/Rural area
Number of doctors	≤49/50-99/100-299/300≤
Number of nurses	≤49/50-99/100-299/300≤
Season	Spring/summer/fall/winter

Table 9. Weighted index of Charlson Comorbidity Index

Assigned weights for disease	Conditions
1	Myocardial infarction
	Congestive heart failure
	Peripheral vascular disease
	Cerebrovascular disease
	Dementia
	Chronic pulmonary disease
	Connective tissue disease
	Ulcer disease
	Mild liver disease
	Diabetes
2	Hemiplegia
	Moderate or severe renal disease
	Diabetes with end organ damage
	Any tumor
	Leukemia / lymphoma
3	Moderate or severe liver disease
6	Metastatic solid tumor
	AIDS/HIV

5. Statistical methods

This study first summarized the general characteristics of the 1-5 year-old and 7-year-old beneficiaries of the NHI and their episodes for the periods 2004-2005 (before cost sharing exemption) and 2006-2007 (after cost sharing exemption) by reporting frequencies and percentages. Then, the means and standard deviations of the dependent variables for cost, price, and quantity of healthcare utilization were compared using the t-test and analysis of variance.

To investigate the effect of cost sharing exemption for hospitalized children under the age of six, difference in differences was used to examine any changes in healthcare utilization among the case group (1–5-year-olds) in the before (2004-2005) and after (2006-2007) intervention periods, relative to changes in healthcare utilization of the control group (7-year-olds). Difference in differences is generally used when evaluating policy effect in the healthcare service area (71). In the difference in differences analysis, policy effect evaluated by comparing the difference between after and before the policy change in the case group and the difference between after and before the policy change in the control group. This could allow the results to subtract out the before policy intervention temporal trend in outcomes. To investigate the NHI beneficiaries' healthcare utilization, apply a generalized linear model with log link and negative binomial distribution using the GENMOD procedure (74). To investigate the healthcare expenditure and the quantity of healthcare service per episode, a generalized linear model with identity link and normal distribution for log transformed dependent variables using the

GENMOD procedure. All analysis was performed using SAS software (version 9.4; SAS Institute, Care, NC) and differences were considered statistically significant at a *P*-value of <0.05.

1) Analysis of healthcare utilization by NHI beneficiaries

The unit analysis of NHI beneficiaries was conducted using generalized linear model with log link and negative binomial distribution to estimate the policy effect. The negative binomial distribution and log link function were considered appropriate because most children do not receive healthcare services. Table 10 showed the structure of data for difference in differences. The difference in differences analysis is expressed by the following equation:

Table 10. Structure of data for difference in differences

Person ID	Year	Wave	Age	Case	Policy	Healthcare expenditure (KRW)
1	2004	1	1	1	0	57,002
1	2005	2	2	1	0	64,253
1	2006	3	3	1	1	90,611
1	2007	4	4	1	1	80,005
2	2004	1	2	1	0	51.641
2	2005	2	3	1	0	59.665
2	2006	2	4	1	1	97,115
…						
43	2004	1	7	0	0	28,376
44	2005	2	7	0	0	23,139
45	2006	2	7	0	1	32,889
46	2007	4	7	0	1	36,818

$$g(E(Y_{git})) = \beta_0 + \beta_1 \times Wave_t + \beta_2 \times Case_g + \beta_3 \times Policy_t + \beta_4 \times Case_g \times Policy_t + \beta_5 \times X_{git}$$

for age group g in NHI beneficiary i at time t:

E: Expectation

g: link function

Y: dependent variables

t: time period (year)

Wave: yearly time variable started in 2004

$Case_g$: dummy variable which assigns 1 if the Case group (1-5 year olds)

$Policy_t$: dummy variable which assigns 1 if time is within the cost sharing exemption implementation period

X: Independent variables

2) Analysis of healthcare expenditure and the quantity of healthcare services per episode

As healthcare expenditure and the quantity of healthcare services per episode were positively skewed, the dependent variables were log transformed. The unit analysis of episodes was conducted using the generalized linear model with identity link and normal distribution to estimate the policy effect. Table 11 showed the structure of data for difference in differences. The difference in differences analysis is expressed by the following equation:

Table 11. Structure of data for difference in differences

Claim number	Year month	Time	Season	Age	Case	Policy	Healthcare expenditure (KRW)
1	200401	1	4	4	1	0	490,120
2	200401	1	4	5	1	0	480,566
3	200402	2	4	2	1	0	501,109
…							
202	200512	24	4	3	1	0	466,050
203	200512	24	4	4	1	0	485,618
204	200601	25	4	2	1	1	536,212
…							
401	200512	24	4	7	0	0	590,545
402	200512	24	4	7	0	0	594,442
403	200601	25	4	7	0	1	643,494
404	200601	25	4	7	0	1	648,996

$$g(E(Y_{gjt})) = \beta_0 + \beta_1 \times Time_t + \beta_2 \times Season_t + \beta_3 \times Case_g + \beta_4 \times Policy_t$$
$$+ \beta_5 \times Case_g \times Policy_t + \beta_6 \times X_{gjt}$$

for age group g in episode j at time t:

E: Expectation

g: link function

Y: dependent variables

t: time period (month)

Time: monthly time variable started in January, 2004

$Season_t$: seasonality (1=spring, 2=summer,3= fall, 4=winter)

$Case_g$: dummy variable which assigns 1 if the Case group (1-5 year olds)

$Policy_t$: dummy variable which assigns 1 if time is within the cost sharing exemption implementation period

X: Independent variables

6. Ethics statement

This study was approved by the Institutional Review Board, Yonsei University Health System (IRB number: Y-2019-0094).

IV. Results

1. NHI beneficiaries' healthcare utilization

1.1 Inpatient service

(1) General characteristics of study population

Table 12 shows the general characteristics and distribution of the study population. The case group (1–5-year-olds) included 2,720,180, 2,572,633, 2,333,808, and 2,230,946 subjects in 2004, 2005, 2006, and 2007, respectively. The control group (7-year-olds) included 649,225, 616,091, 584,144, and 600,370 subjects in 2004, 2005, 2006, and 2007, respectively. In both case group and control group, the number of subjects is decreasing.

Figure 18 shows the hospital admission rate among the study population. The hospital admission rate of the case group increased from 8.6% in 2004 to 13.1% in 2007. In control group, the admission rate slightly increased from 3.3% in 2004 to 4.4% in 2007.

Table 12. General characteristics of the NHI beneficiaries ages 1-5 and ages 7

Variables	Case (1-5 years old)								Control (7 years old)							
	2004		2005		2006		2007		2004		2005		2006		2007	
Total	2,720,180	(100.0)	2,572,633	(100.0)	2,333,808	(100.0)	2,230,946	(100.0)	649,225	(100.0)	616,091	(100.0)	584,144	(100.0)	600,370	(100.0)
Gender																
Male	1,420,026	(52.2)	1,341,153	(52.1)	1,214,030	(52.0)	1,158,778	(51.9)	337,187	(51.9)	322,768	(52.4)	305,345	(52.3)	314,400	(52.4)
Female	1,300,154	(47.8)	1,231,480	(47.9)	1,119,778	(48.0)	1,072,168	(48.1)	312,038	(48.1)	293,323	(47.6)	278,799	(47.7)	285,970	(47.6)
Income(percentile)																
0-20 (low)	178,784	(6.6)	214,677	(8.3)	186,519	(8.0)	176,357	(7.9)	50,212	(7.7)	58,828	(9.5)	54,026	(9.2)	54,838	(9.1)
21-40	447,844	(16.5)	330,426	(12.8)	346,986	(14.9)	280,726	(12.6)	93,467	(14.4)	71,650	(11.6)	76,286	(13.1)	67,387	(11.2)
41-60	661,024	(24.3)	705,273	(27.4)	556,893	(23.9)	543,103	(24.3)	134,731	(20.8)	141,853	(23.0)	117,318	(20.1)	120,676	(20.1)
61-80	882,381	(32.4)	792,311	(30.8)	768,617	(32.9)	733,576	(32.9)	203,728	(31.4)	181,253	(29.4)	185,822	(31.8)	182,190	(30.3)
81-100 (high)	550,147	(20.2)	529,946	(20.6)	474,793	(20.3)	497,184	(22.3)	167,087	(25.7)	162,507	(26.4)	150,692	(25.8)	175,279	(29.2)
Region																
Capital area	1,193,015	(43.9)	1,147,798	(44.6)	1,059,232	(45.4)	1,022,732	(45.8)	276,943	(42.7)	266,367	(43.2)	255,596	(43.8)	266,371	(44.4)
Metropolitan area	688,227	(25.3)	644,794	(25.1)	583,139	(25.0)	552,243	(24.8)	170,918	(26.3)	159,737	(25.9)	150,969	(25.8)	153,443	(25.6)
Rural	838,938	(30.8)	780,041	(30.3)	691,437	(29.6)	655,971	(29.4)	201,364	(31.0)	189,987	(30.8)	177,579	(30.4)	180,556	(30.1)
Disability																
No	2,710,310	(99.6)	2,563,041	(99.6)	2,325,771	(99.7)	2,223,551	(99.7)	645,452	(99.4)	611,852	(99.3)	580,167	(99.3)	596,196	(99.3)
Yes	9,870	(0.4)	9,592	(0.4)	8,037	(0.3)	7,395	(0.3)	3,773	(0.6)	4,239	(0.7)	3,977	(0.7)	4,174	(0.7)
CCI																
0	1,487,721	(54.7)	1,293,741	(50.3)	1,090,912	(46.7)	1,039,353	(46.6)	492,902	(75.9)	443,637	(72.0)	409,235	(70.1)	424,116	(70.6)
1	1,206,749	(44.4)	1,249,202	(48.6)	1,215,657	(52.1)	1,167,582	(52.3)	151,600	(23.4)	167,120	(27.1)	169,723	(29.1)	171,258	(28.5)
2≤	25,710	(0.9)	29,690	(1.2)	27,239	(1.2)	24,011	(1.1)	4,723	(0.7)	5,334	(0.9)	5,186	(0.9)	4,996	(0.8)

*N(%)

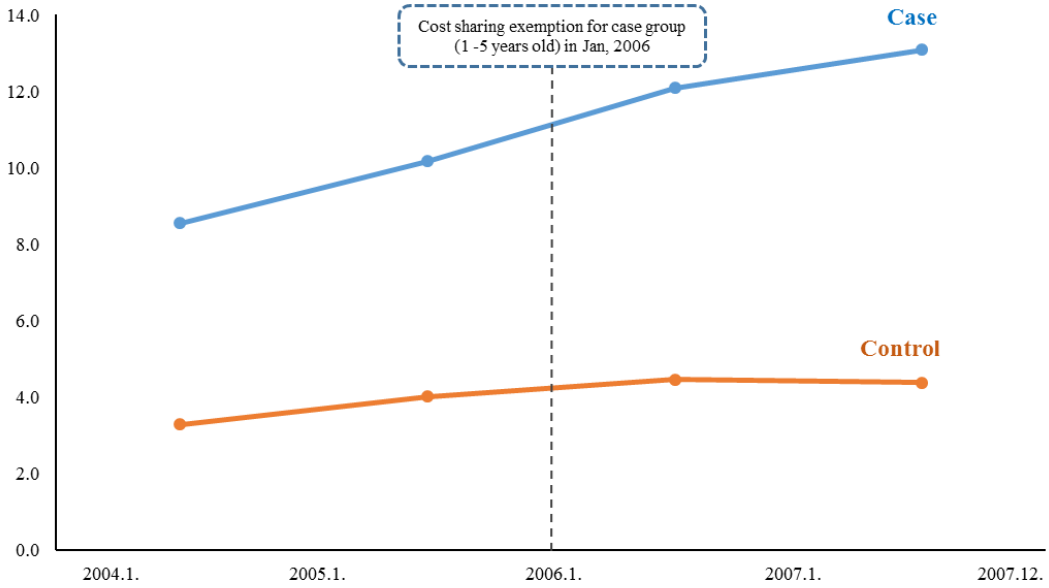

Figure 18. Changes of annual hospital admission rate among the NHI beneficiaries (%, year-month)

(2) Changes of healthcare utilization of NHI beneficiaries

Table 13 shows changes of annual healthcare expenditure NHI beneficiary by before and after cost sharing exemption among case group and control group. Overall, the case group had higher healthcare expenditure than control group (Figure 19). The mean annual healthcare expenditure per NHI beneficiary for inpatient service before and after intervention were KRW 57,002 and KRW 90,611, respectively, in the case group, and KRW 24,416 and KRW 32,570, respectively, in the control group.

Table 14 shows changes of annual number of admissions per NHI beneficiary by before and after cost sharing exemption among case group and control group. The mean annual number of admissions per NHI beneficiary for inpatient service before and after intervention were 0.12 and 0.17, respectively, in the case group, and 0.04 and 0.05, respectively, in the control group. Overall, the case group had higher number of admissions than control group, which means that the NHI beneficiary in case group was more frequent access the inpatient service (Figure 20).

Table 15 shows changes of annual length of stay per NHI beneficiary by before and after cost sharing exemption among case group and control group. Overall, the case group had higher length of stay than control group (Figure 21). The mean annual length of stay per NHI beneficiary for inpatient service before and

after intervention were 0.64 and 0.95, respectively, in the case group, and 0.22 and 0.27, respectively, in the control group.

Table 13. Changes of annul healthcare expenditure per NHI beneficiary of inpatient service (KRW)

Variables	Case (1-5 years old)							Control (7 years old)						
	Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	57,002	±	253,852	90,611	±	352,143		24,416	±	175,628	32,570	±	217,475	
Gender														
Male	64,253	±	269,648	100,409	±	369,696	<0001	28,376	±	189,802	36,818	±	232,997	<0001
Female	49,095	±	235,163	80,005	±	331,772	<0001	20,099	±	158,627	27,908	±	198,949	<0001
Income(percentile)														
0-20 (low)	60,744	±	257,756	99,307	±	367,436	<0001	23,736	±	157,562	32,875	±	198,086	<0001
21-40	61,672	±	263,852	105,862	±	386,180	<0001	23,614	±	166,794	33,529	±	214,401	<0001
41-60	59,665	±	258,982	98,505	±	365,598	<0001	23,971	±	170,701	32,805	±	215,588	<0001
61-80	55,520	±	249,200	86,867	±	343,202	<0001	24,383	±	172,832	33,109	±	226,797	<0001
81-100 (high)	51,204	±	245,390	74,370	±	319,079	<0001	25,455	±	192,146	31,265	±	215,616	<0001
Region														
Capital area	51,641	±	244,318	73,657	±	318,675	<0001	23,139	±	168,261	29,104	±	208,959	<0001
Metropolitan area	58,297	±	257,113	97,115	±	364,306	<0001	24,043	±	171,689	32,889	±	219,600	<0001
Rural	63,689	±	264,289	111,328	±	387,870	<0001	26,504	±	188,444	37,349	±	227,504	<0001
Disability														
No	55,726	±	245,058	88,760	±	339,958	<0001	23,417	±	165,245	31,484	±	207,544	<0001
Yes	402,935	±	1,064,506	636,403	±	1,520,305	<0001	181,188	±	749,368	189,249	±	794,867	<0001
CCI														
0	29,894	±	165,593	43,450	±	212,618	<0001	17,613	±	135,476	22,448	±	159,887	<0001
1	79,368	±	277,663	122,361	±	380,430	<0001	36,799	±	201,795	48,962	±	235,719	<0001
2≤	426,555	±	1,080,006	574,512	±	1,436,050	<0001	265,536	±	902,144	312,063	±	1,205,682	<0001

Table 14. Changes of annual number of admissions per NHI beneficiary of inpatient service (N)

Variables	Case (1-5 years old)							Control (7 years old)						
	Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	0.12	±	0.42	0.17	±	0.54		0.04	±	0.25	0.05	±	0.27	
Gender														
Male	0.13	±	0.45	0.19	±	0.56	<0001	0.05	±	0.28	0.06	±	0.29	<0001
Female	0.10	±	0.39	0.15	±	0.50	<0001	0.03	±	0.21	0.04	±	0.25	<0001
Income(percentile)														
0-20 (low)	0.13	±	0.44	0.19	±	0.57	<0001	0.04	±	0.23	0.05	±	0.25	<0001
21-40	0.13	±	0.45	0.20	±	0.59	<0001	0.04	±	0.25	0.05	±	0.27	<0001
41-60	0.12	±	0.43	0.18	±	0.56	<0001	0.04	±	0.23	0.05	±	0.27	<0001
61-80	0.11	±	0.41	0.16	±	0.52	<0001	0.04	±	0.25	0.05	±	0.27	<0001
81-100 (high)	0.10	±	0.40	0.14	±	0.47	<0001	0.04	±	0.28	0.05	±	0.27	<0001
Region														
Capital area	0.10	±	0.39	0.14	±	0.47	<0001	0.04	±	0.23	0.04	±	0.25	<0001
Metropolitan area	0.12	±	0.43	0.18	±	0.55	<0001	0.04	±	0.23	0.05	±	0.27	<0001
Rural	0.14	±	0.46	0.21	±	0.61	<0001	0.05	±	0.30	0.06	±	0.29	<0001
Disability														
No	0.12	±	0.42	0.17	±	0.53	<0001	0.04	±	0.24	0.05	±	0.26	<0001
Yes	0.48	±	1.13	0.71	±	1.66	<0001	0.23	±	1.11	0.21	±	0.76	<0001
CCI														
0	0.06	±	0.28	0.08	±	0.34	<0001	0.03	±	0.21	0.04	±	0.21	<0001
1	0.17	±	0.50	0.23	±	0.61	<0001	0.06	±	0.30	0.08	±	0.32	<0001
2≤	0.63	±	1.24	0.78	±	1.54	<0001	0.32	±	0.91	0.35	±	1.12	0.1107

Table 15. Changes of annual length of stay per NHI beneficiary of inpatient service (day)

Variables	Case (1-5 years old)							Control (7 years old)						
	Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
	Mean	**±**	**SD**	**Mean**	**±**	**SD**		**Mean**	**±**	**SD**	**Mean**	**±**	**SD**	
Total	0.64	±	2.84	0.95	±	3.69		0.22	±	1.89	0.27	±	2.01	
Gender														
Male	0.71	±	3.03	1.04	±	3.90	<0001	0.26	±	2.10	0.31	±	2.19	<0001
Female	0.56	±	2.62	0.85	±	3.46	<0001	0.18	±	1.62	0.24	±	1.79	<0001
Income(percentile)														
0-20 (low)	0.72	±	3.11	1.09	±	4.04	<0001	0.23	±	1.64	0.29	±	1.80	<0001
21-40	0.72	±	3.11	1.17	±	4.29	<0001	0.22	±	1.81	0.30	±	2.20	<0001
41-60	0.68	±	2.93	1.05	±	3.91	<0001	0.22	±	2.01	0.29	±	2.14	<0001
61-80	0.61	±	2.73	0.89	±	3.50	<0001	0.21	±	1.83	0.28	±	2.01	<0001
81-100 (high)	0.54	±	2.57	0.73	±	3.13	<0001	0.22	±	1.96	0.25	±	1.87	<0001
Region														
Capital area	0.51	±	2.43	0.68	±	2.90	<0001	0.19	±	1.50	0.22	±	1.56	<0001
Metropolitan area	0.67	±	3.02	1.05	±	3.96	<0001	0.22	±	1.71	0.28	±	2.14	<0001
Rural	0.78	±	3.21	1.28	±	4.45	<0001	0.27	±	2.44	0.35	±	2.42	<0001
Disability														
No	0.62	±	2.75	0.93	±	3.59	<0001	0.21	±	1.68	0.27	±	1.84	<0001
Yes	3.72	±	11.63	5.38	±	14.46	<0001	1.71	±	10.75	1.56	±	9.83	0.3423
CCI														
0	0.31	±	1.81	0.43	±	2.22	<0001	0.16	±	1.50	0.19	±	1.63	<0001
1	0.93	±	3.33	1.32	±	4.26	<0001	0.35	±	2.42	0.43	±	2.38	<0001
2≤	4.03	±	9.62	5.08	±	11.47	<0001	2.07	±	6.91	2.19	±	7.53	0.2171

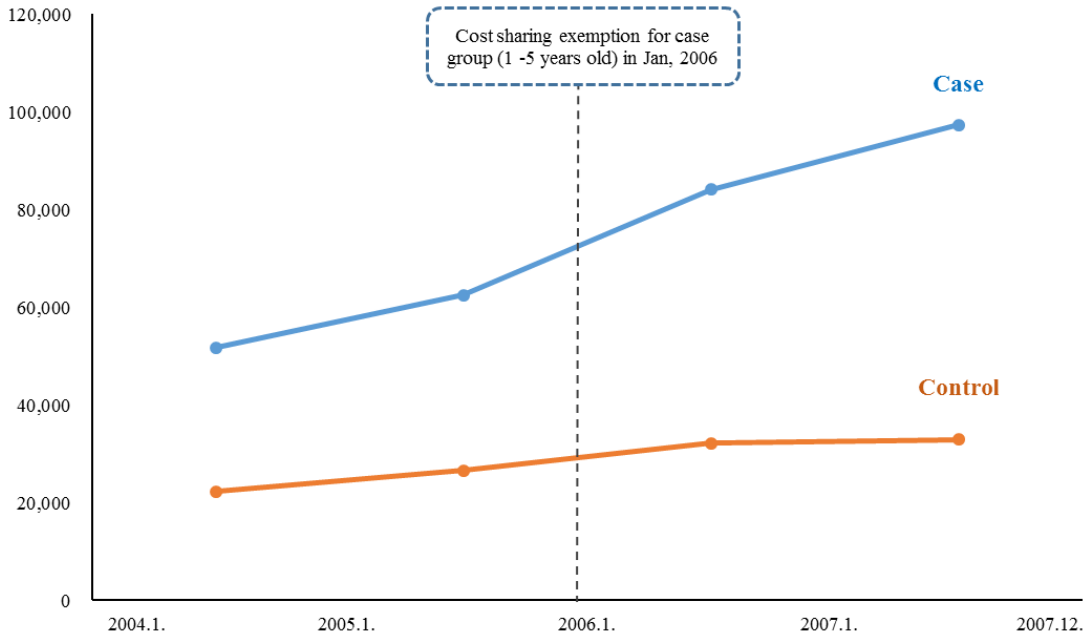

Figure 19. Changes of annual healthcare expenditure per NHI beneficiary of inpatient service (KRW, year-month)

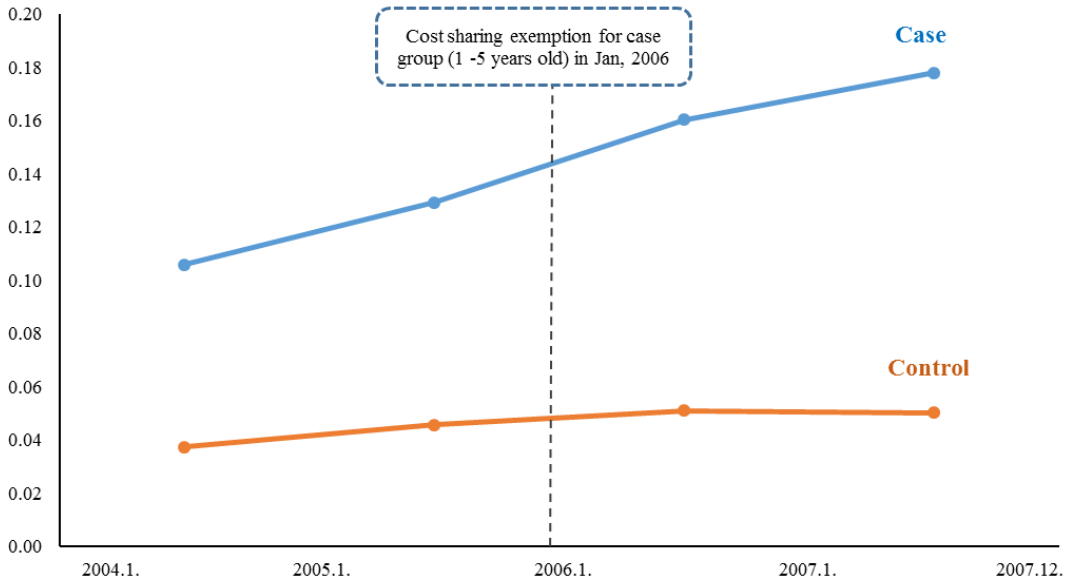

Figure 20. Changes of annual number of admissions per NHI beneficiary of inpatient service (N, year-month)

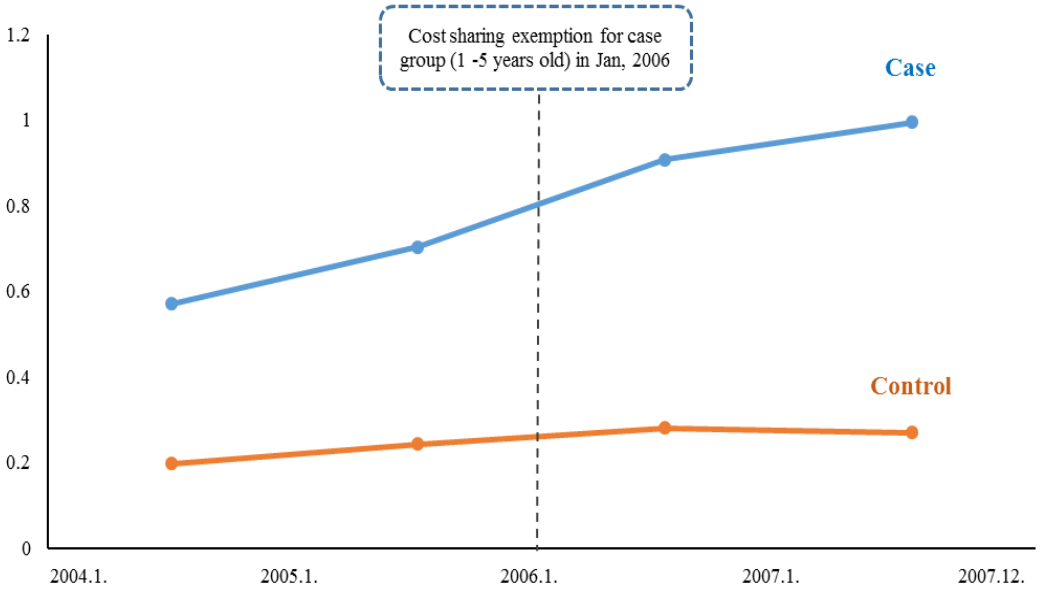

Figure 21. Changes of annual length of stay per NHI beneficiary of inpatient service (day, year-month)

(3) Results of difference-in-difference analysis

Table 16 shows the differential changes in annual healthcare expenditure per NHI beneficiary, annual number of admissions per NHI beneficiary, and the annual length of stay per NHI beneficiary. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be significantly associated with an increased annual healthcare expenditure per NHI beneficiary, annual number of admissions per NHI beneficiary, and the annual length of stay per NHI beneficiary (annual healthcare expenditure: $\beta = 0.1474$, $\exp(\beta)=1.1588$, SE = 0.0176, $P = <.0001$; annual number of admission: $\beta = 0.1535$, $\exp(\beta)=1.1659$, SE = 0.0068, $P = <.0001$; annual length of stay: $\beta = 0.1497$, $\exp(\beta)=1.1615$, SE = 0.0079, $P = <.0001$).

Table 16. Results of the generalized linear model of NHI beneficiaries' healthcare utilization (inpatient service)

Variables	Health care expenditure per NHI beneficiary				Number of admissions per NHI beneficiary				Length of stay per NHI beneficiary			
	β	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***
Wave (year)	0.1377	1.1476	0.0071	<.0001	0.1276	1.1361	0.0019	<.0001	0.1239	1.1319	0.0030	<.0001
Policy												
Before	Ref.				Ref.				Ref.			
After	-0.0188	0.9814	0.0211	0.3714	-0.0882	0.9156	0.0075	<.0001	-0.0585	0.9432	0.0093	<.0001
Case (1-5 years old)	0.6136	1.8471	0.0124	<.0001	0.8180	2.2660	0.0049	<.0001	0.7903	2.2041	0.0056	<.0001
Control (age 7)	Ref.				Ref.				Ref.			
Case*Policy (difference, case-control)	0.1474	1.1588	0.0176	<.0001	0.1535	1.1659	0.0068	<.0001	0.1497	1.1615	0.0079	<.0001
Gender												
Male	Ref.				Ref.				Ref.			
Female	-0.2507	0.7783	0.0071	<.0001	-0.2021	0.8170	0.0020	<.0001	-0.2156	0.8061	0.0030	<.0001
Income(percentile)												
0-20 (low)	Ref.				Ref.				Ref.			
21-40	0.0544	1.0559	0.0157	0.0005	0.0558	1.0574	0.0042	<.0001	0.0653	1.0675	0.0067	<.0001
41-60	0.0109	1.0110	0.0145	0.4487	-0.0004	0.9996	0.0039	0.9212	-0.0012	0.9988	0.0062	0.8436
61-80	-0.0580	0.9436	0.0140	<.0001	-0.0874	0.9163	0.0038	<.0001	-0.1105	0.8954	0.0060	<.0001
81-100 (high)	-0.1282	0.8797	0.0147	<.0001	-0.1699	0.8437	0.0041	<.0001	-0.2164	0.8054	0.0063	<.0001
Region												
Capital area	Ref.				Ref.				Ref.			
Metropolitan area	0.1365	1.1463	0.0088	<.0001	0.1731	1.1890	0.0025	<.0001	0.2844	1.3290	0.0038	<.0001
Rural	0.2221	1.2487	0.0084	<.0001	0.3060	1.3580	0.0023	<.0001	0.4323	1.5408	0.0036	<.0001
Disability												
No	Ref.				Ref.				Ref.			
Yes	1.5011	4.4866	0.0550	<.0001	1.0430	2.8377	0.0107	<.0001	1.4480	4.2546	0.0229	<.0001
CCI												
0	Ref.				Ref.				Ref.			
1	0.9451	2.5731	0.0073	<.0001	0.9510	2.5883	0.0021	<.0001	1.0321	2.8070	0.0031	<.0001
2≤	2.4890	12.0492	0.0351	<.0001	2.1690	8.7495	0.0061	<.0001	2.3874	10.8852	0.0146	<.0001

1.2 Outpatient service

(1) Changes of healthcare utilization of NHI beneficiaries

Table 17 shows changes of annual healthcare expenditure NHI beneficiary by before and after cost sharing exemption among case group and control group. Overall, the case group had higher healthcare expenditure than control group. The mean annual healthcare expenditure per NHI beneficiary for outpatient service before and after intervention were KRW 235,000 and KRW 266,125, respectively, in the case group, and KRW 124,408 and KRW 138,290, respectively, in the control group.

Table 18 shows changes of annual number of visits per NHI beneficiary by before and after cost sharing exemption among case group and control group. The mean annual number of visits per NHI beneficiary for outpatient service before and after intervention were 11.57 and 15.86, respectively, in the case group, and 7.03 and 8.72, respectively, in the control group. Overall, the case group had higher number of visits than control group, which means that the NHI beneficiary in case group was more frequent access the outpatient service.

Table 17. Changes of annual healthcare expenditure per NHI beneficiary of outpatient service (KRW)

Variables	Case (1-5 years old)						*P-value*	Control (7 years old)						*P-value*
	Before (2004-2005)			After (2006-2007)				Before (2004-2005)			After (2006-2007)			
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	235,000	±	161,788	266,125	±	177,371		124,408	±	109,581	138,290	±	123,115	
Gender														
Male	244,386	±	166,308	276,290	±	182,006	<0001	129,724	±	114,453	144,687	±	130,234	<0001
Female	224,763	±	156,067	255,123	±	171,536	<0001	118,613	±	103,700	131,270	±	114,385	<0001
Income(percentile)														
0-20 (low)	218,065	±	160,700	256,100	±	178,227	<0001	110,843	±	102,100	127,418	±	115,908	<0001
21-40	224,214	±	160,816	260,465	±	178,417	<0001	110,087	±	103,573	125,244	±	116,103	<0001
41-60	237,726	±	162,121	270,129	±	177,728	<0001	120,124	±	107,429	132,798	±	120,137	<0001
61-80	241,365	±	161,895	271,915	±	177,017	<0001	128,698	±	110,378	142,821	±	124,304	<0001
81-100 (high)	235,623	±	161,486	260,045	±	176,044	<0001	134,654	±	114,260	146,566	±	128,222	<0001
Region														
Capital area	239,199	±	163,699	268,474	±	180,590	<0001	133,765	±	115,807	146,602	±	129,964	<0001
Metropolitan area	236,452	±	161,628	268,138	±	176,512	<0001	125,208	±	109,270	139,235	±	123,744	<0001
Rural	227,734	±	158,866	260,801	±	172,905	<0001	110,741	±	99,038	125,373	±	110,595	<0001
Disability														
No	234,505	±	160,873	265,351	±	174,581	<0001	123,664	±	107,936	137,205	±	119,143	<0001
Yes	369,125	±	296,881	494,302	±	518,385	<0001	241,172	±	233,333	294,927	±	359,634	<0001
CCI														
0	177,656	±	135,261	196,449	±	147,236	<0001	104,081	±	95,569	113,384	±	105,746	<0001
1	296,598	±	163,341	324,968	±	175,392	<0001	179,936	±	122,262	194,751	±	134,059	<0001
2≤	383,348	±	209,969	425,985	±	286,641	<0001	257,593	±	180,562	285,924	±	258,722	<0001

Table 18. Changes of annual number of visits per NHI beneficiary of outpatient service (N)

Variables	Case (1-5 years old)						*P-value*	Control (7 years old)						*P-value*
	Before (2004-2005)			After (2006-2007)				Before (2004-2005)			After (2006-2007)			
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	11.57	±	6.40	15.86	±	10.52		7.03	±	5.07	8.72	±	7.03	
Gender														
Male	11.90	±	6.52	16.31	±	10.73	<0001	7.18	±	5.19	8.95	±	7.25	<0001
Female	11.22	±	6.25	15.38	±	10.27	<0001	6.86	±	4.94	8.47	±	6.78	<0001
Income(percentile)														
0-20 (low)	10.89	±	6.55	15.27	±	10.53	<0001	6.36	±	4.84	8.11	±	6.73	<0001
21-40	11.13	±	6.47	15.27	±	10.37	<0001	6.29	±	4.88	7.91	±	6.67	<0001
41-60	11.69	±	6.38	16.11	±	10.62	<0001	6.82	±	5.00	8.43	±	6.93	<0001
61-80	11.85	±	6.35	16.18	±	10.48	<0001	7.27	±	5.08	8.96	±	7.07	<0001
81-100 (high)	11.57	±	6.37	15.68	±	10.54	<0001	7.52	±	5.21	9.23	±	7.27	<0001
Region														
Capital area	11.66	±	6.42	16.13	±	10.85	<0001	7.49	±	5.29	9.24	±	7.39	<0001
Metropolitan area	11.50	±	6.30	15.72	±	10.33	<0001	6.97	±	4.96	8.68	±	6.98	<0001
Rural	11.51	±	6.45	15.56	±	10.15	<0001	6.44	±	4.78	7.99	±	6.46	<0001
Disability														
No	11.56	±	6.38	15.84	±	10.48	<0001	7.01	±	5.04	8.68	±	6.96	<0001
Yes	15.13	±	9.96	21.95	±	18.36	<0001	10.68	±	8.17	14.07	±	13.12	<0001
CCI														
0	9.33	±	5.79	12.25	±	9.03	<0001	6.05	±	4.59	7.26	±	6.12	<0001
1	13.99	±	6.09	18.95	±	10.66	<0001	9.74	±	5.25	12.09	±	7.68	<0001
2≤	16.74	±	7.11	22.19	±	12.72	<0001	12.52	±	6.60	15.50	±	10.53	<0001

(3) Results of difference-in-difference analysis

Table 19 shows the differential changes in annual healthcare expenditure per NHI beneficiary, and the annual visits per NHI beneficiary. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be slightly associated with an increased annual healthcare expenditure per NHI beneficiary, and significantly associated with an increased annual number of visits per NHI beneficiary (annual healthcare expenditure: β = 0.0115, exp(β)=1.0116, SE = 0.0014, *P* = <.0001; annual number of visits: β = 0.0869, exp(β)=1.0908, SE = 0.0009, *P* = <.0001).

Table 19. Results of the generalized linear model of NHI beneficiaries' healthcare utilization (outpatient service)

Variables		Health care expenditure per NHI beneficiary				Number of admissions per NHI beneficiary			
		β	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***
Wave (year)		0.0463	1.0474	0.0006	<.0001	0.2121	1.2363	0.0003	<.0001
Policy									
	Before	Ref.				Ref.			
	After	-0.0090	0.9910	0.0017	<.0001	-0.2403	0.7864	0.0011	<.0001
Case (1-5 years old)		0.5290	1.6972	0.0010	<.0001	0.4115	1.5091	0.0006	<.0001
Control (age 7)		Ref.				Ref.			
Case*Policy (difference, case-control)		0.0115	1.0116	0.0014	<.0001	0.0869	1.0908	0.0009	<.0001
Gender									
	Male	Ref.				Ref.			
	Female	-0.0668	0.9354	0.0006	<.0001	-0.0427	0.9582	0.0003	<.0001
Income(percentile)									
	0-20 (low)	Ref.				Ref.			
	21-40	0.0196	1.0198	0.0012	<.0001	0.0242	1.0245	0.0008	<.0001
	41-60	0.0640	1.0661	0.0011	<.0001	0.0576	1.0593	0.0007	<.0001
	61-80	0.0855	1.0893	0.0011	<.0001	0.0793	1.0825	0.0007	<.0001
	81-100 (high)	0.0686	1.0710	0.0012	<.0001	0.0611	1.0630	0.0007	<.0001
Region									
	Capital area	Ref.				Ref.			
	Metropolitan area	-0.0253	0.9750	0.0007	<.0001	-0.0330	0.9675	0.0004	<.0001
	Rural	-0.0838	0.9196	0.0007	<.0001	-0.0565	0.9451	0.0004	<.0001
Disability									
	No	Ref.				Ref.			
	Yes	0.4830	1.6209	0.0043	<.0001	0.2602	1.2972	0.0026	<.0001
CCI									
	0	Ref.				Ref.			
	1	0.5141	1.6721	0.0006	<.0001	0.4260	1.5311	0.0004	<.0001
	2≤	0.7499	2.1168	0.0028	<.0001	0.5867	1.7980	0.0017	<.0001

1.3 Total healthcare service

(1) Changes of healthcare utilization of NHI beneficiaries

Table 20 shows changes of annual healthcare expenditure NHI beneficiary by before and after cost sharing exemption among case group and control group. Overall, the case group had higher healthcare expenditure than control group. The mean annual healthcare expenditure per NHI beneficiary for total healthcare service before and after intervention were KRW 292,003 and KRW 356,737, respectively, in the case group, and KRW 148,824 and KRW 170,860, respectively, in the control group.

Table 21 shows changes of annual length of stay per NHI beneficiary by before and after cost sharing exemption among case group and control group. The mean annual length of stay per NHI beneficiary for total healthcare service before and after intervention were 12.21 and 16.81, respectively, in the case group, and 7.25 and 8.99, respectively, in the control group. Overall, the case group had higher length of stay than control group, which means that the NHI beneficiary in case group was more frequent access the total healthcare service.

Table 20. Changes of annual healthcare expenditure per NHI beneficiary of total healthcare service (KRW)

Variables	Case (1-5 years old)							Control (7 years old)						
	Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	292,003	±	325,769	356,737	±	425,144		148,824	±	219,828	170,860	±	264,349	
Gender														
Male	308,639	±	343,151	376,698	±	444,517	<.0001	158,100	±	234,970	181,505	±	281,946	<.0001
Female	273,858	±	304,652	335,128	±	402,008	<.0001	138,712	±	201,545	159,178	±	243,046	<.0001
Income(percentile)														
0-20 (low)	278,809	±	330,463	355,407	±	441,625	<.0001	134,579	±	201,159	160,293	±	244,341	<.0001
21-40	285,886	±	335,695	366,327	±	459,346	<.0001	133,701	±	208,951	158,774	±	259,269	<.0001
41-60	297,392	±	330,919	368,634	±	438,380	<.0001	144,095	±	214,284	165,603	±	261,283	<.0001
61-80	296,886	±	321,448	358,782	±	415,650	<.0001	153,082	±	217,944	175,930	±	272,961	<.0001
81-100 (high)	286,827	±	316,450	334,415	±	393,136	<.0001	160,109	±	236,422	177,830	±	264,965	<.0001
Region														
Capital area	290,840	±	317,976	342,131	±	395,748	<.0001	156,905	±	217,342	175,706	±	260,452	<.0001
Metropolitan area	294,748	±	328,455	365,253	±	436,047	<.0001	149,251	±	216,634	172,124	±	266,602	<.0001
Rural	291,423	±	334,550	372,129	±	457,704	<.0001	137,245	±	225,359	162,722	±	267,850	<.0001
Disability														
No	290,231	±	317,458	354,111	±	411,884	<.0001	147,081	±	209,571	168,689	±	253,003	<.0001
Yes	772,060	±	1,150,363	1,130,705	±	1,688,743	<.0001	422,360	±	815,018	484,176	±	904,604	<.0001
CCI														
0	207,550	±	228,764	239,899	±	277,419	<.0001	121,694	±	175,536	135,832	±	202,858	<.0001
1	375,966	±	346,167	447,329	±	446,968	<.0001	216,735	±	249,066	243,713	±	285,559	<.0001
2≤	809,903	±	1,122,709	1,000,498	±	1,498,738	<.0001	523,130	±	943,319	597,987	±	1,253,083	<.0001

Table 21. Changes of annual length of stay per beneficiary of total healthcare service (day)

Variables	Case (1-5 years old)							Control (7 years old)						
	Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	12.21	±	7.43	16.81	±	11.61		7.25	±	5.57	8.99	±	7.48	
Gender														
Male	12.60	±	7.64	17.35	±	11.91	<.0001	7.44	±	5.76	9.26	±	7.75	<.0001
Female	11.78	±	7.16	16.23	±	11.25	<.0001	7.04	±	5.34	8.71	±	7.16	<.0001
Income(percentile)														
0-20 (low)	11.60	±	7.74	16.36	±	11.82	<.0001	6.59	±	5.28	8.40	±	7.14	<.0001
21-40	11.86	±	7.66	16.44	±	11.80	<.0001	6.51	±	5.37	8.21	±	7.21	<.0001
41-60	12.36	±	7.47	17.16	±	11.82	<.0001	7.04	±	5.55	8.72	±	7.43	<.0001
61-80	12.46	±	7.31	17.08	±	11.47	<.0001	7.48	±	5.55	9.23	±	7.51	<.0001
81-100 (high)	12.10	±	7.23	16.41	±	11.37	<.0001	7.74	±	5.72	9.47	±	7.65	<.0001
Region														
Capital area	12.18	±	7.23	16.81	±	11.59	<.0001	7.67	±	5.64	9.46	±	7.69	<.0001
Metropolitan area	12.17	±	7.42	16.77	±	11.54	<.0001	7.18	±	5.41	8.96	±	7.48	<.0001
Rural	12.28	±	7.71	16.84	±	11.69	<.0001	6.71	±	5.55	8.34	±	7.11	<.0001
Disability														
No	12.18	±	7.36	16.77	±	11.52	<.0001	7.22	±	5.46	8.95	±	7.35	<.0001
Yes	18.85	±	16.16	27.33	±	24.78	<.0001	12.39	±	14.00	15.62	±	16.70	<.0001
CCI														
0	9.64	±	6.28	12.68	±	9.53	<.0001	6.20	±	4.94	7.44	±	6.45	<.0001
1	14.92	±	7.37	20.27	±	11.87	<.0001	10.09	±	5.94	12.52	±	8.18	<.0001
2≤	20.77	±	12.37	27.28	±	17.51	<.0001	14.59	±	9.80	17.69	±	13.09	<.0001

(3) Results of difference in differences analysis

Table 22 shows the differential changes in annual healthcare expenditure per NHI beneficiary, and the annual length of stay per NHI beneficiary. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be significantly associated with an increased annual healthcare expenditure per NHI beneficiary, and the annual length of stay per NHI beneficiary (annual healthcare expenditure: $\beta = 0.0916$, $\exp(\beta)=1.0959$, SE = 0.0009, P = <.0001; annual length of stay: $\beta = 0.0498$, $\exp(\beta)=1.0511$, SE = 0.0015, P = <.0001).

Table 22. Results of the generalized linear model of NHI beneficiaries' healthcare utilization (total healthcare service)

Variables		Healthcare expenditure per NHI beneficiary				Length of stay per NHI beneficiary			
		β	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***
Wave (year)		0.2069	1.2299	0.0004	<.0001	0.065	1.0672	0.0006	<.0001
Policy									
	Before	Ref.				Ref.			
	After	-0.2303	0.7943	0.0011	<.0001	-0.019	0.9812	0.0018	<.0001
Case (1-5 years old)		0.4258	1.5308	0.0007	<.0001	0.5406	1.7170	0.0011	<.0001
Control (age 7)		Ref.				Ref.			
Case*Policy (difference, case-control)		0.0916	1.0959	0.0009	<.0001	0.0498	1.0511	0.0015	<.0001
Gender									
	Male	Ref.				Ref.			
	Female	-0.0495	0.9517	0.0004	<.0001	-0.0994	0.9054	0.0006	<.0001
Income(percentile)									
	0-20 (low)	Ref.				Ref.			
	21-40	0.0267	1.0271	0.0008	<.0001	0.0284	1.0288	0.0014	<.0001
	41-60	0.0543	1.0558	0.0007	<.0001	0.0534	1.0549	0.0012	<.0001
	61-80	0.0695	1.0720	0.0007	<.0001	0.0559	1.0575	0.0012	<.0001
	81-100 (high)	0.0482	1.0494	0.0007	<.0001	0.0292	1.0296	0.0013	<.0001
Region									
	Capital area	Ref.				Ref.			
	Metropolitan area	-0.0189	0.9813	0.0004	<.0001	0.0077	1.0077	0.0008	<.0001
	Rural	-0.033	0.9675	0.0004	<.0001	-0.0201	0.9801	0.0007	<.0001
Disability									
	No	Ref.				Ref.			
	Yes	0.3639	1.4389	0.0027	<.0001	0.786	2.1946	0.0048	<.0001
CCI									
	0	Ref.				Ref.			
	1	0.454	1.5746	0.0004	<.0001	0.5995	1.8212	0.0006	<.0001
	2≤	0.7445	2.1054	0.0017	<.0001	1.3185	3.7378	0.003	<.0001

2. Healthcare expenditure and the quantity of healthcare services per episode

2.1 Inpatient service

(1) General characteristics of study episode

Table 23 shows the general characteristics and distribution of the study inpatient episodes. The case group (episodes from 1–5-year-olds) included 620,611 episodes in the before policy intervention (2004–2005) and 771,371 episodes in the after policy intervention (2006–2007) categories. The control group (episodes from 7-year-olds) included 52,315 episodes in the before policy intervention (2004–2005), and 59,953 episodes in the after policy intervention (2006–2007) categories.

Appendix 3 shows the general characteristics and distribution of the study inpatient episodes of mild disease. The case group (episodes from 1–5-year-olds) included 388,832 episodes in the before policy intervention (2004–2005) and 521,029 episodes in the after policy intervention (2006–2007) categories. The control group (episodes from 7-year-olds) included 16,517 episodes in the before policy intervention (2004–2005), and 23,172 episodes in the after policy intervention (2006–2007) categories.

Table 23. General characteristics of the inpatient episodes from 1-5 years old and 7 years old

Variables	Case (1-5 years old)				Control (7 years old)			
	Before (2004-2005)		After (2006-2007)		Before (2004-2005)		After (2006-2007)	
Total	620,611	(100.0)	771,371	(100.0)	52,315	(100.0)	59,953	(100.0)
Gender								
Male	361,978	(58.3)	441,125	(57.2)	31,648	(60.5)	35,165	(58.7)
Female	258,633	(41.7)	330,246	(42.8)	20,667	(39.5)	24,788	(41.3)
Income(percentile)								
0-20 (low)	49,672	(8.0)	67,264	(8.7)	4,454	(8.5)	5,566	(9.3)
21-40	98,838	(15.9)	123,534	(16.0)	6,518	(12.5)	7,406	(12.4)
41-60	167,969	(27.1)	202,178	(26.2)	11,140	(21.3)	12,133	(20.2)
61-80	191,460	(30.9)	243,664	(31.6)	16,044	(30.7)	18,929	(31.6)
81-100 (high)	112,672	(18.2)	134,731	(17.5)	14,159	(27.1)	15,919	(26.6)
Region								
Capital area	241,229	(38.9)	282,410	(36.6)	21,170	(40.5)	23,447	(39.1)
Metropolitan area	158,139	(25.5)	202,875	(26.3)	13,374	(25.6)	15,583	(26.0)
Rural	221,243	(35.6)	286,086	(37.1)	17,771	(34.0)	20,923	(34.9)
Disability								
No	611,196	(98.5)	760,410	(98.6)	50,442	(96.4)	58,215	(97.1)
Yes	9,415	(1.5)	10,961	(1.4)	1,873	(3.6)	1,738	(2.9)
Charlson Comorbidity Index								
0	370,156	(59.6)	430,092	(55.8)	40,818	(78.0)	44,163	(73.7)
1	237,182	(38.2)	326,135	(42.3)	9,914	(19.0)	13,955	(23.3)
2≤	13,273	(2.1)	15,144	(2.0)	1,583	(3.0)	1,835	(3.1)
Hospital type								
Tertiary hospital	170,122	(27.4)	180,951	(23.5)	16,158	(30.9)	16,498	(27.5)
General hospital	318,617	(51.3)	399,223	(51.8)	22,263	(42.6)	26,676	(44.5)
Hospital	84,247	(13.6)	128,685	(16.7)	7,295	(13.9)	9,734	(16.2)
Clinic	47,625	(7.7)	62,512	(8.1)	6,599	(12.6)	7,045	(11.8)
Number of beds								
≤99	99,775	(16.1)	146,137	(18.9)	9,967	(19.1)	11,783	(19.7)
100-499	232,188	(37.4)	309,878	(40.2)	17,335	(33.1)	22,292	(37.2)
500≤	288,648	(46.5)	315,356	(40.9)	25,013	(47.8)	25,878	(43.2)
Hospital region								
Capital area	246,756	(39.8)	286,683	(37.2)	22,605	(43.2)	24,803	(41.4)
Metropolitan area	178,807	(28.8)	224,439	(29.1)	14,611	(27.9)	16,969	(28.3)
Rural	195,048	(31.4)	260,249	(33.7)	15,099	(28.9)	18,181	(30.3)
Number of doctors								
≤49	257,456	(41.5)	359,140	(46.6)	22,379	(42.8)	27,738	(46.3)
50-99	54,638	(8.8)	73,284	(9.5)	3,427	(6.6)	4,377	(7.3)
100-299	204,422	(32.9)	215,608	(28.0)	16,049	(30.7)	16,171	(27.0)
300≤	104,095	(16.8)	123,339	(16.0)	10,460	(20.0)	11,667	(19.5)
Number of nurses								
≤49	128,104	(20.6)	195,727	(25.4)	13,476	(25.8)	16,772	(28.0)
50-99	107,811	(17.4)	126,905	(16.5)	7,094	(13.6)	8,401	(14.0)
100-299	163,690	(26.4)	198,326	(25.7)	12,034	(23.0)	13,405	(22.4)
300≤	221,006	(35.6)	250,413	(32.5)	19,711	(37.7)	21,375	(35.7)

*N(%)

(2) Changes of healthcare expenditure and the quantity of healthcare services per episode

Table 24 shows changes of healthcare expenditure per episode by before and after cost sharing exemption among case group and control group. Overall, the control group had higher healthcare expenditure per episode than case group. The mean expenditure per inpatient episode before and after intervention were KRW 486,139 and KRW 536,212, respectively, in the case group, and KRW 590,545 and KRW 643,494, respectively, in the control group.

Table 25 shows changes of length of stay per episode by before and after cost sharing exemption among case group and control group. The mean lengths of stay per episode for inpatient service before and after intervention were 5.42 and 5.62, respectively, in the case group, and 5.30 and 5.42, respectively, in the control group. Overall, length of stay per episode in the case group and control group shows similar trend.

Table 26 shows changes of healthcare expenditure per day per episode by before and after cost sharing exemption among case group and control group. Overall, the control group had higher healthcare expenditure per episode than case group. The mean healthcare expenditure per episode day for inpatient service before and after intervention were KRW 101,539 and KRW 106,328, respectively, in the case group, and KRW 137,087 and KRW 144,697, respectively, in the control group.

Appendix 4 shows changes of healthcare expenditure per episode of mild disease by before and after cost sharing exemption among case group and control group. Overall, the control group had higher healthcare expenditure per episode than case group. The mean expenditure per inpatient episode before and after intervention were KRW 463,384 and KRW 530,548, respectively, in the case group, and KRW 507,563 and KRW 589,817, respectively, in the control group.

Appendix 5 shows changes of length of stay per episode of mild disease by before and after cost sharing exemption among case group and control group. The mean lengths of stay per episode for inpatient service before and after intervention were 5.83 and 6.08, respectively, in the case group, and 5.64 and 6.01, respectively, in the control group.

Appendix 6 shows changes of healthcare expenditure per day per episode of mild disease by before and after cost sharing exemption among case group and control group. The mean healthcare expenditure per episode day for inpatient service before and after intervention were KRW 82,396 and KRW 90,238, respectively, in the case group, and KRW 96,360 and KRW 103,146, respectively, in the control group.

Table 24. Changes of healthcare expenditure per episode of inpatient service (KRW)

Variables		Case (1-5 years old)							Control (7 years old)						
		Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
		Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total		486,139	±	345,865	536,212	±	361,629		590,545	±	427,402	643,494	±	444,594	
Gender															
	Male	490,120	±	344,643	540,099	±	361,894	<.0001	591,727	±	426,025	648,877	±	447,769	<.0001
	Female	480,566	±	347,492	531,019	±	361,209	<.0001	588,734	±	429,507	635,857	±	439,945	<.0001
Income(percentile)															
	0-20 (low)	481,165	±	336,778	535,741	±	353,993	<.0001	581,094	±	410,887	642,996	±	447,736	<.0001
	21-40	485,618	±	343,638	537,917	±	356,807	<.0001	598,198	±	439,250	650,456	±	451,841	<.0001
	41-60	485,332	±	343,839	535,937	±	356,022	<.0001	595,154	±	424,127	643,475	±	438,716	<.0001
	61-80	485,633	±	345,717	535,534	±	364,444	<.0001	585,088	±	419,070	643,697	±	444,335	<.0001
	81-100 (high)	490,850	±	354,868	536,521	±	372,854	<.0001	592,553	±	438,668	640,201	±	444,867	<.0001
Region															
	Capital area	501,109	±	363,545	543,010	±	381,092	<.0001	593,851	±	425,029	647,910	±	453,715	<.0001
	Metropolitan area	491,406	±	338,236	543,502	±	355,894	<.0001	594,442	±	428,761	642,479	±	437,899	<.0001
	Rural	466,050	±	330,167	524,331	±	345,253	<.0001	583,674	±	429,134	639,300	±	439,157	<.0001
Disability															
	No	480,797	±	332,806	531,026	±	348,690	<.0001	583,694	±	412,099	636,207	±	430,839	<.0001
	Yes	832,918	±	756,917	895,992	±	798,199	<.0001	775,057	±	702,581	887,556	±	734,812	<.0001
Charlson Comorbidity Index															
	0	473,362	±	348,287	511,166	±	363,437	<.0001	578,568	±	403,568	628,237	±	428,446	<.0001
	1	487,313	±	294,878	553,034	±	321,304	<.0001	578,259	±	403,316	640,280	±	400,272	<.0001
	2≤	821,476	±	734,534	885,222	±	735,484	<.0001	976,308	±	815,921	1,035,110	±	814,315	<.0001
Hospital type															
	Tertiary hospital	603,928	±	458,051	649,841	±	484,011	<.0001	706,542	±	515,801	769,711	±	541,515	<.0001
	General hospital	473,414	±	285,895	537,499	±	316,512	<.0001	583,814	±	381,235	646,063	±	406,493	<.0001
	Hospital	382,175	±	265,827	448,058	±	284,130	<.0001	507,002	±	383,493	557,014	±	388,930	<.0001
	Clinic	334,419	±	211,552	380,543	±	228,053	<.0001	421,582	±	273,007	457,675	±	280,380	<.0001
Number of beds															
	≤99	354,675	±	241,473	414,854	±	257,061	<.0001	442,248	±	311,674	492,095	±	331,797	<.0001
	100-499	450,583	±	270,942	527,523	±	311,397	<.0001	562,306	±	379,494	629,297	±	401,815	<.0001
	500≤	560,182	±	406,838	600,987	±	427,645	<.0001	669,208	±	477,550	724,659	±	501,541	<.0001

Hospital region														
	Capital area	520,735	±	397,552	562,763	±	414,503	<.0001	616,150	±	461,675	671,335	±	486,814	<.0001
	Metropolitan area	490,931	±	329,133	543,044	±	348,970	<.0001	594,191	±	413,882	638,400	±	419,006	<.0001
	Rural	437,977	±	278,408	501,071	±	302,120	<.0001	548,683	±	381,231	610,266	±	403,082	<.0001
Number of doctors			±			±				±			±		
	≤49	409,177	±	255,349	480,704	±	287,849	<.0001	504,019	±	351,450	562,401	±	367,545	<.0001
	50-99	443,985	±	269,439	517,550	±	296,844	<.0001	578,968	±	391,506	652,403	±	407,892	<.0001
	100-299	525,424	±	343,482	567,491	±	368,254	<.0001	628,837	±	413,453	685,389	±	450,589	<.0001
	300≤	621,463	±	495,180	654,249	±	512,229	<.0001	720,706	±	549,240	774,878	±	561,628	<.0001
Number of nurses															
	≤49	378,327	±	267,907	439,541	±	283,783	<.0001	477,801	±	347,333	528,904	±	366,465	<.0001
	50-99	439,182	±	239,518	511,757	±	276,434	<.0001	539,583	±	347,090	606,604	±	373,247	<.0001
	100-299	495,935	±	313,742	556,654	±	332,562	<.0001	607,929	±	404,342	667,541	±	421,119	<.0001
	300≤	564,281	±	423,592	607,974	±	447,759	<.0001	675,354	±	492,139	732,825	±	513,717	<.0001

Table 25. Changes of length of stay per episode of inpatient service (day)

Variables		Case (1-5 years old)							Control (7 years old)						
		Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
		Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total		5.42	±	3.55	5.62	±	3.52	<.0001	5.30	±	4.90	5.42	±	4.30	<.0001
Gender															
	Male	5.38	±	3.56	5.59	±	3.55	<.0001	5.34	±	5.19	5.45	±	4.29	0.0030
	Female	5.47	±	3.54	5.66	±	3.48	<.0001	5.23	±	4.43	5.37	±	4.30	0.0010
Income(percentile)															
	0-20 (low)	5.68	±	3.70	5.86	±	3.60	<.0001	5.63	±	4.68	5.65	±	4.43	<.0001
	21-40	5.68	±	3.64	5.93	±	3.66	<.0001	5.65	±	5.02	5.83	±	5.09	<.0001
	41-60	5.50	±	3.56	5.74	±	3.54	<.0001	5.52	±	6.33	5.67	±	4.27	<.0001
	61-80	5.30	±	3.46	5.50	±	3.44	<.0001	5.15	±	4.21	5.35	±	4.20	<.0001
	81-100 (high)	5.14	±	3.51	5.25	±	3.41	<.0001	5.03	±	4.30	5.03	±	3.93	<.0001
Region															
	Capital area	4.98	±	3.44	5.00	±	3.30	<.0001	4.77	±	3.97	4.82	±	3.80	0.2291
	Metropolitan area	5.68	±	3.60	5.88	±	3.61	0.0293	5.39	±	4.55	5.53	±	4.37	0.0061
	Rural	5.70	±	3.60	6.05	±	3.57	<.0001	5.86	±	5.99	6.00	±	4.67	0.0077
Disability															
	No	5.38	±	3.43	5.59	±	3.42	<.0001	5.23	±	4.78	5.36	±	4.18	<.0001
	Yes	7.69	±	7.82	7.58	±	7.36	0.2645	7.32	±	7.20	7.30	±	6.98	0.9453
Charlson Comorbidity Index															
	0	5.06	±	3.60	5.20	±	3.53	<.0001	5.14	±	4.56	5.21	±	4.39	0.0167
	1	5.89	±	3.17	6.12	±	3.28	<.0001	5.68	±	5.79	5.92	±	3.72	<.0001
	2≤	7.04	±	6.16	6.90	±	5.77	0.0435	7.06	±	6.67	6.57	±	5.54	0.0179
Hospital type															
	Tertiary hospital	5.09	±	3.84	5.00	±	3.68	<.0001	5.94	±	5.92	4.67	±	3.59	0.0522
	General hospital	5.51	±	3.18	5.77	±	3.31	<.0001	5.15	±	3.90	5.44	±	3.83	<.0001
	Hospital	5.67	±	3.89	5.94	±	3.61	<.0001	4.86	±	3.83	6.03	±	5.08	0.4527
	Clinic	5.51	±	4.08	5.84	±	3.87	<.0001	4.66	±	4.03	6.22	±	5.77	0.0190
Number of beds															
	≤99	5.55	±	3.85	5.87	±	3.57	<.0001	5.97	±	6.85	6.15	±	5.35	0.0273

	100-499	5.69	±	3.37	6.04	±	3.52	<.0001	5.62	±	4.70	5.81	±	4.29	<.0001
	500≤	5.15	±	3.56	5.10	±	3.41	<.0001	4.81	±	3.98	4.75	±	3.61	0.0609
Hospital region															
	Capital area	5.05	±	3.64	5.04	±	3.46	0.8839	4.84	±	4.10	4.86	±	3.93	0.5247
	Metropolitan area	5.67	±	3.57	5.86	±	3.59	<.0001	5.36	±	4.47	5.45	±	4.32	0.0518
	Rural	5.65	±	3.38	6.05	±	3.43	<.0001	5.94	±	6.16	6.14	±	4.63	0.0003
Number of doctors			±			±				±			±		
	≤49	5.76	±	3.63	6.18	±	3.63	<.0001	5.94	±	5.92	6.12	±	4.89	0.0002
	50-99	5.30	±	3.02	5.57	±	2.98	<.0001	5.15	±	3.90	5.45	±	3.79	0.0006
	100-299	5.26	±	3.29	5.18	±	3.19	<.0001	4.86	±	3.83	4.85	±	3.49	0.6998
	300≤	4.94	±	4.00	4.81	±	3.75	<.0001	4.66	±	4.03	4.54	±	3.66	0.0184
Number of nurses															
	≤49	5.61	±	3.99	5.97	±	3.72	<.0001	6.04	±	6.55	6.22	±	5.36	0.0069
	50-99	5.88	±	3.16	6.14	±	3.26	<.0001	5.69	±	4.50	5.80	±	4.01	0.1100
	100-299	5.58	±	3.35	5.81	±	3.43	<.0001	5.27	±	4.06	5.41	±	3.78	0.0061
	300≤	4.96	±	3.56	4.94	±	3.44	0.0706	4.67	±	4.03	4.64	±	3.57	0.4359

Table 26. Changes of healthcare expenditure per day per episode of inpatient service (KRW)

Variables		Case (1-5 years old)							Control (7 years old)						
		Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
		Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total		101,539	±	68,877	106,328	±	69,062	<.0001	137,087	±	96,931	144,697	±	99,967	<.0001
Gender															
	Male	104,050	±	70,297	108,503	±	70,347	<.0001	136,206	±	94,297	143,913	±	95,921	<.0001
	Female	98,023	±	66,680	103,423	±	67,198	<.0001	138,436	±	100,819	145,809	±	105,433	<.0001
Income(percentile)															
	0-20 (low)	94,772	±	62,770	100,629	±	62,035	<.0001	126,889	±	91,001	137,459	±	96,795	<.0001
	21-40	95,382	±	62,696	99,704	±	61,509	<.0001	130,548	±	93,514	137,361	±	97,089	<.0001
	41-60	99,004	±	65,519	103,088	±	65,122	<.0001	133,393	±	93,409	137,589	±	95,049	<.0001
	61-80	103,863	±	70,676	108,642	±	71,418	<.0001	138,217	±	95,458	145,734	±	99,574	<.0001
	81-100 (high)	109,752	±	76,931	115,925	±	78,451	<.0001	144,930	±	103,784	154,824	±	105,434	<.0001
Region															
	Capital area	115,207	±	77,971	122,146	±	79,392	<.0001	151,038	±	100,816	161,756	±	106,950	<.0001
	Metropolitan area	96,927	±	64,491	101,990	±	65,563	<.0001	136,730	±	101,016	142,564	±	100,073	<.0001
	Rural	89,932	±	57,901	93,790	±	56,324	<.0001	120,735	±	85,870	127,167	±	87,878	<.0001
Disability															
	No	101,034	±	68,133	105,791	±	68,188	<.0001	136,969	±	96,092	144,086	±	99,047	<.0001
	Yes	134,325	±	101,324	143,560	±	108,113	<.0001	140,262	±	117,292	165,144	±	125,310	<.0001
Charlson Comorbidity Index															
	0	108,894	±	78,367	112,595	±	79,113	<.0001	141,501	±	101,066	151,045	±	106,092	<.0001
	1	88,630	±	46,747	96,379	±	49,238	<.0001	116,468	±	76,112	120,575	±	71,189	<.0001
	2≤	127,081	±	79,752	142,619	±	91,735	<.0001	152,392	±	86,366	175,354	±	103,682	<.0001
Hospital type															
	Tertiary hospital	136,584	±	88,728	148,253	±	97,016	<.0001	173,250	±	106,433	191,438	±	115,530	0.2253
	General hospital	93,302	±	48,963	100,261	±	48,757	<.0001	126,711	±	72,917	133,742	±	74,002	<.0001
	Hospital	73,244	±	43,640	80,299	±	45,738	<.0001	100,149	±	72,935	112,136	±	85,196	<.0001

	Clinic	81,519	±	87,369	77,297	±	67,535	<.0001	124,374	±	133,042	121,702	±	124,346	<.0001
Number of beds															
	≤99	75,684	±	67,212	77,642	±	53,753	<.0001	115,565	±	119,365	115,825	±	111,422	0.8679
	100-499	85,739	±	43,516	93,205	±	43,804	<.0001	114,088	±	63,582	122,798	±	68,849	<.0001
	500≤	123,186	±	78,834	132,517	±	84,887	<.0001	161,602	±	100,103	176,706	±	107,702	<.0001
Hospital region															
	Capital area	118,558	±	82,085	126,019	±	84,800	<.0001	154,761	±	105,756	166,432	±	110,952	<.0001
	Metropolitan area	97,187	±	64,299	102,385	±	64,322	<.0001	139,235	±	102,375	145,687	±	103,502	<.0001
	Rural	83,997	±	45,706	88,037	±	43,270	<.0001	108,546	±	66,200	114,119	±	67,686	<.0001
Number of doctors			±			±				±			±		
	≤49	79,108	±	52,564	83,162	±	45,217	<.0001	110,848	±	91,358	114,918	±	87,265	<.0001
	50-99	90,419	±	49,325	97,489	±	41,553	<.0001	127,552	±	76,741	131,482	±	65,982	0.0151
	100-299	108,735	±	55,613	118,785	±	62,309	<.0001	144,173	±	75,663	158,360	±	86,028	<.0001
	300≤	148,726	±	102,285	157,261	±	107,651	<.0001	185,475	±	120,428	201,511	±	125,291	<.0001
Number of nurses															
	≤49	78,497	±	64,071	80,109	±	51,051	<.0001	113,634	±	107,044	113,917	±	99,158	0.8114
	50-99	79,793	±	37,712	88,256	±	41,121	<.0001	107,180	±	58,459	119,336	±	71,031	<.0001
	100-299	96,559	±	52,848	103,701	±	53,737	<.0001	131,666	±	79,576	140,850	±	82,126	<.0001
	300≤	129,191	±	82,816	138,061	±	88,295	<.0001	167,194	±	101,912	181,226	±	108,458	<.0001

(3) Results of difference in differences analysis

Table 27 shows the differential changes in the healthcare expenditure per episode, the length of stay per episode, and the healthcare expenditure per day per episode. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be associated with an increased healthcare expenditure per episode, and the length of stay per episode (healthcare expenditure per episode: β = 0.0111, exp(β)=1.0112, SE = 0.0036, *P* = 0.0018; length of stay per episode: β = 0.0081, exp(β)=1.0081, SE = 0.0037, *P* =0.0267). However, these effects were small. The policy was not associated with healthcare expenditure per day per episode (healthcare expenditure per day per episode: β = 0.0030, exp(β)=1.0030, SE = 0.0024, *P* = 0.2202).

Appendix 7 shows the differential changes in the healthcare expenditure per episode, the length of stay per episode, and the healthcare expenditure per day per episode among mild disease. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be associated with a decreased healthcare expenditure per episode, and the length of stay per episode (healthcare expenditure per episode: β = -0.0246, exp(β)=0.9757, SE = 0.0054, *P* = 0.0001; length of stay per episode: β = -0.0344, exp(β)=0.9662, SE = 0.0053, *P* = <.0001).

Table 27. Results of the generalized linear model of healthcare expenditure and the quantity of healthcare service per episode (inpatient service)

Variables	Healthcare expenditure per episode				Length of stay per episode				Healthcare expenditure per day per episode			
	β	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***
Time (month)	0.0027	1.0027	0.0001	<.0001	-0.0009	0.9991	0.0001	<.0001	0.0036	1.0036	0.0000	<.0001
Policy												
Before	Ref.				Ref.				Ref.			
After	0.0403	1.0411	0.0038	<.0001	0.3999	1.4917	0.0039	<.0001	0.0004	1.0004	0.0026	0.8725
Case (1-5 years old)	-0.1964	0.8217	0.0026	<.0001	0.0300	1.0305	0.0027	<.0001	-0.2264	0.7974	0.0018	<.0001
Control (7 years old)	Ref.				Ref.				Ref.			
Case*Policy (difference, case-control)	0.0111	1.0112	0.0036	0.0018	0.0081	1.0081	0.0037	0.0267	0.0030	1.0030	0.0024	0.2202
Gender												
Male	Ref.				Ref.				Ref.			
Female	-0.0153	0.9848	0.0009	<.0001	0.0176	1.0178	0.0010	<.0001	-0.0330	0.9675	0.0006	<.0001
Income(percentile)												
0-20 (low)	Ref.				Ref.				Ref.			
21-40	0.0040	1.0040	0.0020	0.0450	0.0133	1.0134	0.0021	<.0001	-0.0093	0.9907	0.0014	<.0001
41-60	-0.0058	0.9942	0.0019	0.0019	-0.0068	0.9932	0.0019	0.0004	0.0010	1.0010	0.0013	0.4331
61-80	-0.0161	0.9840	0.0018	<.0001	-0.0410	0.9598	0.0019	<.0001	0.0249	1.0252	0.0012	<.0001
81-100 (high)	-0.0235	0.9768	0.0020	<.0001	-0.0681	0.9342	0.0020	<.0001	0.0447	1.0457	0.0013	<.0001
Region												
Capital area	Ref.				Ref.				Ref.			
Metropolitan area	0.1185	1.1258	0.0025	<.0001	0.0768	1.0798	0.0025	<.0001	0.0417	1.0426	0.0017	<.0001
Rural	0.1721	1.1878	0.0023	<.0001	0.0858	1.0896	0.0024	<.0001	0.0863	1.0901	0.0016	<.0001
Disability												
No	Ref.				Ref.				Ref.			
Yes	0.2193	1.2452	0.0038	<.0001	0.1864	1.2049	0.0039	<.0001	0.0330	1.0336	0.0026	<.0001
Charlson Comorbidity Index												
0	Ref.				Ref.				Ref.			
1	0.1290	1.1377	0.0010	<.0001	0.1828	1.2006	0.0010	<.0001	-0.0537	0.9477	0.0007	<.0001
2≤	0.3053	1.3570	0.0034	<.0001	0.2862	1.3314	0.0035	<.0001	0.0373	1.0380	0.0023	<.0001
Hospital type												
Tertiary hospital	0.3282	1.3885	0.0030	<.0001	0.1279	1.1364	0.0031	<.0001	0.2003	1.2218	0.0021	<.0001
General hospital	0.1711	1.1866	0.0024	<.0001	0.0976	1.1025	0.0025	<.0001	0.0734	1.0762	0.0017	<.0001
Hospital	Ref.				Ref.				Ref.			

Clinic	-0.1007	0.9042	0.0022	<.0001	-0.0364	0.9643	0.0023	<.0001	-0.0643	0.9377	0.0015	<.0001
Number of beds												
≤99	Ref.				Ref.				Ref.			
100-499	0.0818	1.0852	0.0026	<.0001	0.0434	1.0444	0.0027	<.0001	0.0385	1.0393	0.0018	<.0001
500≤	0.1368	1.1466	0.0031	<.0001	0.0587	1.0605	0.0032	<.0001	0.0780	1.0811	0.0021	<.0001
Hospital region												
Capital area	Ref.				Ref.				Ref.			
Metropolitan area	-0.0666	0.9356	0.0024	<.0001	0.0565	1.0581	0.0025	<.0001	-0.1230	0.8843	0.0017	<.0001
Rural	-0.1375	0.8715	0.0024	<.0001	0.0536	1.0551	0.0025	<.0001	-0.1911	0.8260	0.0017	<.0001
Number of doctors												
≤49	Ref.				Ref.				Ref.			
50-99	-0.0605	0.9413	0.0021	<.0001	-0.1193	0.8875	0.0021	<.0001	0.0588	1.0606	0.0014	<.0001
100-299	0.0173	1.0175	0.0023	<.0001	-0.1022	0.9028	0.0023	<.0001	0.1195	1.1269	0.0016	<.0001
300≤	0.0083	1.0083	0.0031	0.0081	-0.2392	0.7873	0.0032	<.0001	0.2475	1.2808	0.0021	<.0001
Number of nurses												
≤49	Ref.				Ref.				Ref.			
50-99	0.0119	1.0120	0.0024	<.0001	-0.0031	0.9969	0.0024	0.2029	0.0150	1.0151	0.0016	<.0001
100-299	0.0363	1.0370	0.0025	<.0001	-0.0244	0.9759	0.0026	<.0001	0.0607	1.0626	0.0017	<.0001
300≤	-0.0592	0.9425	0.0029	<.0001	-0.1210	0.8860	0.0030	<.0001	0.0618	1.0637	0.0020	<.0001
Season												
Spring	Ref.				Ref.				Ref.			
Summer	0.0173	1.0175	0.0013	<.0001	-0.0316	0.9689	0.0014	<.0001	0.0490	1.0502	0.0009	<.0001
Fall	0.0501	1.0514	0.0014	<.0001	0.0062	1.0062	0.0014	<.0001	0.0440	1.0450	0.0009	<.0001
Winter	-0.0083	0.9917	0.0013	<.0001	-0.0284	0.9720	0.0013	<.0001	0.0202	1.0204	0.0009	<.0001

2.2 Outpatient service

(1) General characteristics of study episode

Table 28 shows the general characteristics and distribution of the study outpatient episodes. The case group (episodes from 1–5-year-olds) included 61,256,080 episodes in the before policy intervention (2004–2005) and 72,400,041 episodes in the after policy intervention (2006–2007) categories. The control group (episodes from 7-year-olds) included 8,893,553 episodes in the before policy intervention (2004–2005), and 10,329,446 episodes in the after policy intervention (2006–2007) categories.

Appendix 8 shows the general characteristics and distribution of the study outpatient episodes. The case group (episodes from 1–5-year-olds) included 45,006,258 episodes in the before policy intervention (2004–2005) and 52,281,585 episodes in the after policy intervention (2006–2007) categories. The control group (episodes from 7-year-olds) included 5,502,353 episodes in the before policy intervention (2004–2005), and 6,080,655 episodes in the after policy intervention (2006–2007) categories.

Table 28. General characteristics of the outpatient episodes from 1-5 years old and 7 years old

Variables	Case (1-5 years old)				Control (7 years old)			
	Before (2004-2005)		After (2006-2007)		Before (2004-2005)		After (2006-2007)	
Total	61,256,080	(100.0)	72,400,041	(100.0)	8,893,553	(100.0)	10,329,446	(100.0)
Gender								
Male	32,849,685	(53.6)	38,696,673	(53.4)	4,738,485	(53.3)	5,545,411	(53.7)
Female	28,406,395	(46.4)	33,703,368	(46.6)	4,155,068	(46.7)	4,784,035	(46.3)
Income(percentile)								
0-20 (low)	4,282,914	(7.0)	5,542,387	(7.7)	693,555	(7.8)	882,739	(8.5)
21-40	8,666,020	(14.1)	9,587,596	(13.2)	1,038,707	(11.7)	1,135,762	(11.0)
41-60	15,965,466	(26.1)	17,719,891	(24.5)	1,885,013	(21.2)	2,006,377	(19.4)
61-80	19,850,313	(32.4)	24,311,161	(33.6)	2,797,875	(31.5)	3,297,122	(31.9)
81-100 (high)	12,491,367	(20.4)	15,239,006	(21.0)	2,478,403	(27.9)	3,007,446	(29.1)
Region								
Capital area	27,297,867	(44.6)	33,590,435	(46.4)	4,068,152	(45.7)	4,824,832	(46.7)
Metropolitan area	15,331,075	(25.0)	17,842,565	(24.6)	2,303,480	(25.9)	2,642,764	(25.6)
Rural	18,627,138	(30.4)	20,967,041	(29.0)	2,521,921	(28.4)	2,861,850	(27.7)
Disability								
No	60,961,624	(99.5)	72,061,373	(99.5)	8,808,010	(99.0)	10,210,000	(98.8)
Yes	294,456	(0.5)	338,668	(0.5)	85,543	(1.0)	114,660	(1.1)
Charlson Comorbidity Index								
0	48,830,048	(79.7)	54,780,235	(75.7)	7,792,946	(87.6)	8,802,729	(85.2)
1	12,301,724	(20.1)	17,465,511	(24.1)	1,081,098	(12.2)	1,500,466	(14.5)
2≤	124,308	(0.2)	154,295	(0.2)	19,509	(0.2)	26,251	(0.3)
Hospital type								
Tertiary hospital	1,045,786	(1.7)	1,060,668	(1.5)	146,556	(1.6)	150,186	(1.5)
General hospital	3,302,536	(5.4)	3,814,305	(5.3)	288,982	(3.2)	356,554	(3.5)
Hospital	2,260,796	(3.7)	2,938,563	(4.1)	220,833	(2.5)	285,234	(2.8)
Clinical	54,646,962	(89.2)	64,586,505	(89.2)	8,237,182	(92.6)	9,537,472	(92.3)
Number of beds								
≤99	56,212,247	(91.8)	66,832,545	(92.3)	8,363,682	(94.0)	9,714,546	(94.0)
100-499	2,846,865	(4.6)	3,298,350	(4.6)	272,323	(3.1)	342,002	(3.3)
500≤	2,196,968	(3.6)	2,269,146	(3.1)	257,548	(2.9)	272,898	(2.6)
Hospital region								
Capital area	26,941,781	(44.0)	33,135,073	(45.8)	4,076,838	(45.8)	4,829,625	(46.8)
Metropolitan area	15,863,898	(25.9)	18,324,448	(25.3)	2,339,288	(26.3)	2,676,869	(25.9)
Rural	18,450,401	(30.1)	20,940,520	(28.9)	2,477,427	(27.9)	2,822,952	(27.3)
Number of doctors								
≤49	58,229,033	(95.1)	69,071,811	(95.4)	8,574,332	(96.4)	9,972,833	(96.5)
50-99	615,069	(1.0)	753,204	(1.0)	44,584	(0.5)	57,782	(0.6)
100-299	1,765,108	(2.9)	1,816,611	(2.5)	175,507	(2.0)	188,054	(1.8)
300≤	646,870	(1.1)	758,415	(1.0)	99,130	(1.1)	110,777	(1.1)
Number of nurses								
≤49	56,717,119	(92.6)	67,451,806	(93.2)	8,437,736	(94.9)	9,807,627	(94.9)
50-99	1,236,958	(2.0)	1,275,894	(1.8)	109,420	(1.2)	129,338	(1.3)
100-299	1,694,243	(2.8)	1,923,884	(2.7)	146,316	(1.6)	171,716	(1.7)
300≤	1,607,760	(2.6)	1,748,457	(2.4)	200,081	(2.2)	220,765	

*N(%)

(2) Changes of healthcare expenditure per episode

Table 29 shows changes of healthcare expenditure per episode by before and after cost sharing exemption among case group and control group. Overall, the case group had higher healthcare expenditure per episode than control group. The mean expenditure per inpatient episode before and after intervention were KRW 20,305 and KRW 16,779, respectively, in the case group, and KRW 17,700 and KRW 15,858, respectively, in the control group.

Appendix 9 shows changes of healthcare expenditure per episode of mild disease by before and after cost sharing exemption among case group and control group. The mean expenditure per inpatient episode before and after intervention were KRW 20,518 and KRW 16,619, respectively, in the case group, and KRW 16,619 and KRW 14,484, respectively, in the control group.

Table 29. Changes of healthcare expenditure per episode of outpatient service (KRW)

Variables		Case (1-5 years old)							Control (7 years old)						
		Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
		Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total		20,305	±	14,001	16,779	±	12,961		17,700	±	12,022	15,858	±	11,445	
Gender															
	Male	20,542	±	14,235	16,942	±	13,186	<.0001	18,067	±	12,472	16,170	±	11,919	<.0001
	Female	20,031	±	13,720	16,592	±	12,695	<.0001	17,281	±	11,474	15,497	±	10,859	<.0001
Income(percentile)															
	0-20 (low)	20,033	±	13,831	16,768	±	12,872	<.0001	17,427	±	11,836	15,714	±	11,246	<.0001
	21-40	20,136	±	13,907	17,053	±	13,090	<.0001	17,500	±	11,888	15,843	±	11,372	<.0001
	41-60	20,344	±	14,043	16,769	±	12,986	<.0001	17,626	±	11,933	15,752	±	11,342	<.0001
	61-80	20,363	±	14,024	16,802	±	12,983	<.0001	17,709	±	12,002	15,941	±	11,493	<.0001
	81-100 (high)	20,374	±	14,031	16,586	±	12,844	<.0001	17,907	±	12,215	15,886	±	11,544	<.0001
Region															
	Capital area	20,511	±	14,193	16,640	±	13,041	<.0001	17,865	±	12,152	15,860	±	11,554	<.0001
	Metropolitan area	20,559	±	14,186	17,063	±	13,150	<.0001	17,973	±	12,232	16,038	±	11,598	<.0001
	Rural	19,794	±	13,544	16,760	±	12,663	<.0001	17,185	±	11,597	15,689	±	11,111	<.0001
Disability															
	No	20,285	±	13,970	16,752	±	12,925	<.0001	17,652	±	11,939	15,801	±	11,349	<.0001
	Yes	24,397	±	18,977	22,524	±	18,335	<.0001	22,588	±	18,095	20,966	±	17,307	<.0001
Charlson Comorbidity Index															
	0	19,414	±	13,178	16,274	±	12,255	<.0001	17,348	±	11,725	15,657	±	11,200	<.0001
	1	23,768	±	16,330	18,298	±	14,774	<.0001	20,089	±	13,525	16,893	±	12,520	<.0001
	2≤	27,538	±	20,996	24,141	±	19,799	<.0001	26,070	±	20,028	24,189	±	19,359	<.0001
Hospital type															
	Tertiary hospital	33,130	±	22,758	33,836	±	23,067	<.0001	31,831	±	21,890	32,542	±	21,950	<.0001
	General hospital	26,847	±	19,427	27,089	±	19,753	<.0001	26,946	±	19,945	27,088	±	20,107	0.0048
	Hospital	22,878	±	15,965	23,202	±	16,032	<.0001	23,150	±	16,221	23,415	±	16,465	<.0001
	Clinical	19,558	±	13,035	15,598	±	11,424	<.0001	16,978	±	10,893	14,950	±	9,971	<.0001
Number of beds			±			±				±			±		

	≤99	19,638	±	13,123	15,836	±	11,660	<.0001	17,057	±	10,993	15,080	±	10,139	<.0001
	100-499	26,023	±	18,354	26,364	±	18,732	<.0001	26,068	±	18,721	26,443	±	19,116	<.0001
	500≤	29,959	±	21,809	30,626	±	22,233	<.0001	29,742	±	21,535	30,287	±	21,693	<.0001
Hospital region															
	Capital area	20,596	±	14,267	16,688	±	13,124	<.0001	17,921	±	12,219	15,916	±	11,632	<.0001
	Metropolitan area	20,582	±	14,212	17,113	±	13,185	<.0001	18,026	±	12,295	16,109	±	11,677	<.0001
	Rural	19,643	±	13,390	16,630	±	12,491	<.0001	17,028	±	11,394	15,522	±	10,880	<.0001
Number of doctors															
	≤49	19,852	±	13,362	16,180	±	12,074	<.0001	17,271	±	11,307	15,373	±	10,602	<.0001
	50-99	26,344	±	19,155	26,686	±	19,425	<.0001	26,794	±	20,221	26,718	±	20,096	0.5480
	100-299	28,695	±	21,429	28,504	±	21,669	<.0001	28,640	±	21,381	28,555	±	21,405	0.2269
	300≤	32,457	±	22,275	33,432	±	22,901	<.0001	31,346	±	21,559	32,362	±	21,851	<.0001
Number of nurses															
	≤49	19,687	±	13,179	15,929	±	11,774	<.0001	17,126	±	11,098	15,185	±	10,310	<.0001
	50-99	26,046	±	17,933	26,456	±	18,161	<.0001	26,029	±	18,165	26,318	±	18,506	<.0001
	100-299	27,410	±	19,996	27,471	±	20,216	0.0039	27,792	±	20,603	27,738	±	20,653	0.4591
	300≤	30,199	±	21,979	30,725	±	22,394	<.0001	29,955	±	21,524	30,398	±	21,652	<.0001

(3) Results of difference in difference analysis

Table 30 shows the differential changes in the healthcare expenditure per episode. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be significantly associated with a decreased healthcare expenditure per episode (healthcare expenditure per episode: β = -0.0816, exp(β)=0.9216, SE = 0.0003, *P* = <.0001).

Appendix 10 shows the differential changes in the healthcare expenditure per episode of mild disease. In the analysis in which this study assessed the interaction term for cost sharing exemption effects, the cost sharing exemption was found to be significantly associated with a decreased healthcare expenditure per episode (healthcare expenditure per episode: β = -0.0798, exp(β)=0.9233, SE = 0.0003, *P* = <.0001).

Table 30. Results of the generalized linear model of healthcare expenditure per episode (outpatient service)

Variables	Healthcare expenditure per episode			
	β	exp(β)	SE	*P-value*
Time (month)	-0.0138	0.9863	0.0000	<.0001
Policy				
Before	Ref.			
After	0.2356	1.2657	0.0003	<.0001
Case (1-5 years old)	0.0997	1.1048	0.0002	<.0001
Control (7 years old)	Ref.			
Case*Policy (difference, case-control)	-0.0816	0.9216	0.0003	<.0001
Gender				
Male	Ref.			
Female	-0.0129	0.9872	0.0001	<.0001
Income(percentile)				
0-20 (low)	Ref.			
21-40	-0.0046	0.9954	0.0002	<.0001
41-60	0.0030	1.0030	0.0002	<.0001
61-80	0.0007	1.0007	0.0002	<.0001
81-100 (high)	-0.0005	0.9995	0.0002	0.0067
Region				
Capital area	Ref.			
Metropolitan area	0.0113	1.0114	0.0003	<.0001
Rural	0.0083	1.0083	0.0003	<.0001
Disability				
No	Ref.			
Yes	0.0623	1.0643	0.0006	<.0001
Charlson Comorbidity Index				
0	Ref.			
1	0.1136	1.1203	0.0001	<.0001
2≤	0.1422	1.1528	0.0010	<.0001
Hospital type				
Tertiary hospital	0.3275	1.3875	0.0009	<.0001
General hospital	0.0961	1.1009	0.0006	<.0001
Hospital	Ref.			
Clinical	-0.2497	0.7790	0.0003	<.0001
Number of beds				
≤99	Ref.			
100-499	0.0667	1.0690	0.0005	<.0001
500≤	0.1110	1.1174	0.0007	<.0001
Hospital region				
Capital area	Ref.			
Metropolitan area	-0.0045	0.9955	0.0003	<.0001
Rural	-0.0265	0.9738	0.0003	<.0001
Number of doctors				
≤49	Ref.			
50-99	-0.0358	0.9648	0.0006	<.0001
100-299	-0.0441	0.9569	0.0006	<.0001
300≤	-0.0328	0.9677	0.0010	<.0001
Number of nurses				
≤49	Ref.			
50-99	-0.0147	0.9854	0.0006	<.0001
100-299	-0.0285	0.9719	0.0007	<.0001
300≤	-0.0915	0.9126	0.0008	<.0001
Season				
Spring	Ref.			
Summer	-0.1309	0.8773	0.0001	<.0001
Fall	-0.0969	0.9076	0.0001	<.0001
Winter	-0.0876	0.9161	0.0001	<.0001

V. Discussion

1. Discussion of the study method

This study evaluated the effect of a change in cost sharing for hospitalized children under the age of 6 on healthcare utilization. The data were sourced from the national health insurance corporation between 2004 and 2007 and were nationally collected from the entire Korean population. Even though certain previous studies have used cohort data, most have largely used nationally collected sample data. Given that Korea has achieved universal coverage of health insurance and a single payer system, this study included all policy target populations (75). This increased the accuracy of results in the effect of cost sharing exemption on hospitalized children under the age of six.

The difference in differences method of analysis was used to identify changes in target policy subjects after the cost sharing exemption policy. The effect of policy change on subsequent outcomes change was often addressed by before and after assessments. Any underlying time-dependent trends in outcomes could make it difficult to prove the causality between policy change and outcomes. The difference in differences analysis can reduce this problem by using a control group that already has a similar trend with the treatment group before the policy change and no policy target group (71). For this reason, difference in differences is extensively used when evaluating policy change effects in the area of public health.

This study included the effect of cost sharing exemption on healthcare utilization for all kinds of diseases, not just a specific disease. Previous studies are generally limited to certain diseases, and this makes it difficult to identify the overall policy effect on the policy target population. Considering the cost sharing exemption implemented for hospitalized children for all kinds of diseases, it is necessary to analyze the impact on inpatient services for all kinds of diseases under the age of 6 and not specific diseases.

To investigate the change of healthcare utilization after cost sharing exemption, this study analyzed quantity and price of healthcare service as well as the change in total healthcare expenditure. Numerous related studies that have studied this policy have focused on price per episode or total healthcare expenditure. This study analyzed total healthcare expenditure and then split it into price and the quantity of healthcare service. Based on total healthcare cost is equal to price multiplied by the quantity, this study's approach allows for a more detailed identification of changes in healthcare utilization.

Although this study showed meaningful findings, the results should be interpreted carefully as several limitations emerged. First, the case group in this study was children under the age of 6 who targeted cost sharing exemption policy, and the control group included children aged 7. Generally, the age of 7 is the reference age for entrance to elementary schools in Korea. These factors could demonstrate different characteristics of healthcare utilization compared to children under the age of 6. However, parallel trends were assumed between groups ranging between 1–5 and those aged 7, and several studies where those aged over 7 were

the control group and were compared to those under the age of 6. Next, because this study used insurance claim data, non-reimbursement data were excluded from the study. The effect derived from the non-reimbursement episodes could not be confirmed. Nevertheless, considering the cost sharing exemption policy, changes were observed in reimbursement healthcare services—a valuable finding of this study. Third, there were no private insurance data, the study could not consider health care utilization, which was private insurance coverage. Fourth, due to data limitations, analysis of national health insurance data could not incorporate several factors that could affect health care utilization, including education level, household size, and parents' characteristic information. The income level information is classified by the amount paid for the health insurance premium, not the actual salary, and there could be differences in information on actual income levels. However, health insurance premiums seem to be reasonably interpretable into income levels because health insurance premiums were determined by income level, and prior studies have extensively used health insurance premiums as proxies of actual income levels. Finally, there may be unobserved confounding variables that are not controlled in the study. However, using variables that could be accessed, this study controlled the factors that could affect healthcare utilization.

Due to the limitations of the National Health Insurance Database (NHID) used in our study, the repeated measurement of healthcare utilizations by NHI beneficiaries could not be taken into account during the unit of analysis. Because this study analyzed all populations between the ages of 1-5, and 7 from 2004 to 2007, individual subjects may have been repeatedly included in the statistical model

up to four times. Therefore, correlations between error terms of the observation may exist. Various problems including storage capacity and the inability to analyze data outside of the National Health Insurance Service server hindered our ability to address this problem. However, we attempted to control for the problem by employing a generalized linear model as the maximum number of repeated measurements per subject was relatively small.

Despite these limitations, this study made meaningful contributions to Korea's child cost sharing policy in determining the relationship between price and quantity responses to cost sharing exemption. This finding is even more noteworthy, considering that the government has announced national health insurance plan towards for full coverage of healthcare service for children under the age of six.

2. Discussion of the results

This study was conducted with an aim to investigate the impact of cost sharing exemption for hospitalized children under the age of 6 on healthcare utilization in Korea. This study identified cost sharing exemptions for hospitalized children under the age of 6 associated with an increase in healthcare utilization. Given that the total cost of healthcare services is a combination of price and quantity of healthcare service, we then investigated the price and quantity of healthcare services (76, 77). In terms of quantity of healthcare services, cost sharing exemption was found to be significantly associated with increased number of admissions. In terms of price of healthcare service, cost sharing exemption was associated with a slight increase in price per episode and the volume of services provided per episode. Overall, cost sharing exemption had increased the cost of healthcare services, mainly due to an increase in the quantity of healthcare services rather than the price of the service.

Moreover, considering that the cost sharing exemption for inpatient services could not only affect the utilization of inpatient service, but also the utilization of the substitute service, outpatient and total healthcare services (including inpatient and outpatient services) were analyzed (61-65). The results indicate that the cost sharing exemption for inpatient service is associated with an increase in total healthcare costs, with a significant increase in inpatient costs and a slight increase in outpatient costs.

Cost sharing exemption for hospitalized children led to an increase in inpatient services utilization and there are several reasons for this. First, health coverage expansion for inpatient services may increase the accessibility of inpatient services, and that increases the inpatient service utilization (78). The general purpose of cost sharing in health insurance system is to induce proper healthcare utilization by recognizing and sharing the cost of healthcare service received by patients. However, cost sharing could also interrupt the assessment of appropriate healthcare (19, 79). The exemption of cost sharing for hospitalization reduces the economic burden on patients and renders them less aware of the cost of inpatient services. This increases the accessibility of the patients' inpatient service use. Thus, the use of medically necessary inpatient services may have increased, which may be part of the increase in costs after cost sharing exemption for hospitalized children. Given that the cost of inpatient services did not decrease after policy abolition in 2008, this is a possible explanation.

Second, there was a possibility the part of the increasing in cost of inpatient services is due to the overuse of healthcare services (79). In general, it is known that the demand curve of healthcare services tends to slope downwards when the marginal cost of healthcare services is on the individual (80) (81). In the situation of cost sharing exemptions, patients receive healthcare services without recognizing the cost of healthcare services, which makes the demand curve slope drop significantly. As a result, there is a theoretical possibility that an individual's healthcare utilization may be more than an efficient healthcare utilization than the cost sharing exemption. Empirical studies have explored the relationship between

cost sharing and healthcare utilization (67, 82-84), and demonstrated that healthcare utilization increases when an individual's amount of cost sharing is lower due to of the expansion of insurance coverage.

Considering that the healthcare system consists of consumer, providers, and insurers, it is possible that healthcare utilization could be affected by providers, like the individuals, after cost sharing exemptions. Due to differences in the amount of healthcare information among various stakeholders in healthcare system, information asymmetry abounds in the healthcare system (85, 86). With high medical information, providers can play a decisive role in healthcare utilization (87). Providers may consider patients' ability to pay for healthcare services(88) . With the cost sharing exemption, providers do not have to consider the ability of patients to pay for healthcare services. Given that providers were reimbursed for healthcare services via a fee-for-service, their behavior could change the following cost sharing exemption (86, 89). However, this study cannot separately analyze the changes in suppliers' behavior, and the interpretation should be handled with caution.

The results of the present study are in line with previous studies. Wang et al. (2013) investigated the policy change to free access to health services in public facilities for children under the age of 6 in Vietnam using the difference in differences method (67). Compared to the policy's non-beneficiaries, beneficiaries in the age group of 4–5 years were more likely to access healthcare services. A study conducted in Sweden found that when cost sharing for doctor visits were free for children, the number of doctor visits increased by 5–10% (90).

The present study also found that cost sharing exemptions had increased the cost of healthcare services, mainly due to the increase in the quantity of healthcare services rather than price of services. The price and type of healthcare services offered for each hospitalization may be fixed according to the type of disease. The proportion of hospitalizations for mild diseases such as respiratory infections diseases are high in pediatrics, and it is known that respiratory infection disease tend to show the small variance of price of services (91, 92). These could lead the only slight changes of price of services. In addition, the basic truth is that large amounts of healthcare expenditures are intensive in the early phases of patient admission and lower in later phases (93). In short, high healthcare expenditure costs are incurred in the initial hospitalization stage. Considering that hospital revenues related with high bed turnover rates, increasing the number of hospitalizations could be a better choice in terms of healthcare revenue than increasing the length of stay per episode (94, 95). In Korea, patients can easily access inpatient service without referrals (96). After cost sharing was exempted, and patients who did not require inpatient treatment could be hospitalized without financial burden, the number of hospitalizations would have easily increased. For these reasons, the increase in hospitalization costs of children mainly driven by the quantity of healthcare service.

The results of the analysis of hospitalization for mild disease showed that cost sharing exemption was associated with a slight decrease in healthcare expenditure and length of stay per episode. However, healthcare expenditure per episode-day showed marginal increase. As regards total hospitalizations, the number of hospitalizations due to any disease increased significantly, while the

percentage of hospitalizations due to mild diseases increased from 62% before policy intervention to 67% after it in case group (Appendix 11). Based on these results, in the case hospitalization due to respiratory tract infections, there was a possibility that the number of hospitalizations increased. Therefore, it can be inferred that for mild diseases, the length of stay and price per episode may have decreased while the number of admissions increased.

There was no substitution effect between inpatient and outpatient services due to the cost sharing exemption for hospitalization. After the cost sharing exemption for hospitalization of children under the age of 6, it was found that the total outpatient service cost slightly increased, the price per episode slightly decreased, and the number of episodes significantly increased. This could be associated with increases in outpatient service referrals to hospitalization and an effect of reduction in outpatient cost sharing introduced in August 2007 (58). Another possible explanation is that the financial burden of hospitalization has been reduced, so the economic burden of ongoing follow-up outpatient services after inpatient service has been reduced, and the use of outpatient care could slightly increase. However, this study did not analyze outpatient service referrals, and considering reduction in cost sharing for outpatient service. Thus, careful interpretation is needed for this study.

VI. Conclusion

The current study supplements the body of evidence supporting the effect of cost sharing exemptions on healthcare utilization among children who covered by National Health Insurance. This study systematically deconstructs the cost sharing exemption effect for hospitalized children into price and quantity effects. Although it is too early to conclude based on these results, the cost sharing exemption for hospitalized children under the age of 6 is associated with increases in healthcare utilization. In addition, increases in healthcare utilization are mainly caused by quantity increases rather than price increases. There were no significant substitute effects between inpatient and outpatient services.

While planning a cost sharing policy, it is crucial to consider all possible outcomes of how this policy will change healthcare utilization. This study has made a meaningful contribution to Korea's health insurance policy by identifying the relationship between price and quantity responses to cost sharing exemptions. Further research is needed to make cost sharing a useful tool in children's healthcare utilization.

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Appendix

Appendix 1. Statistical analysis of test for parallel trends

Statistical equation of test for parallel trends is:

$$g(E(Y_{git}))= \beta_0 + \beta_1 \times Year_t + \beta_2 \times Case_g + \beta_3 \times Case_g \times Year_t + \beta_4 \times X_{git}$$

for age group g in NHI beneficiary i at time t:

E: Expectation

g: link function

Y: dependent variables

t: time period (year) until December, 2005

Year: yearly time variable started in 2004

$Case_g$: dummy variable which assigns 1 if the Case group (1-5 year olds)

X: Independent variables

Appendix 2. Results of the test for parallel trends for NHI beneficiaries' healthcare utilization (inpatient service)

Variables	Case*Year (interaction effect)		
	β	**SE**	***P-value***
Health care expenditure per NHI beneficiary	0.0035	0.0262	0.8926
Number of admissions per NHI beneficiary	-0.0064	0.0117	0.5848
Length of stay per NHI beneficiary	0.0034	0.0099	0.7325

Appendix 3. General characteristics of the inpatient episodes for mild disease from 1-5 years old and 7 years old

Variables	Case (1-5 years old)				Control (7 years old)			
	Before (2004-2005)		After (2006-2007)		Before (2004-2005)		After (2006-2007)	
Total	388,832	(100.0)	521,029	(100.0)	16,517	(100.0)	23,172	(100.0)
Gender								
Male	222,468	(57.2)	293,227	(56.3)	9,616	(58.2)	13,024	(56.2)
Female	166,364	(42.8)	227,802	(43.7)	6,901	(41.8)	10,148	(43.8)
Income(percentile)								
0-20 (low)	32,455	(8.3)	46,831	(9.0)	1,491	(9.0)	2,218	(9.6)
21-40	64,314	(16.5)	86,464	(16.6)	2,151	(13.0)	3,009	(13.0)
41-60	107,086	(27.5)	139,484	(26.8)	3,551	(21.5)	4,933	(21.3)
61-80	118,340	(30.4)	162,466	(31.2)	5,035	(30.5)	7,253	(31.3)
81-100 (high)	66,637	(17.1)	85,784	(16.5)	4,289	(26.0)	5,759	(24.9)
Region								
Capital area	138,723	(35.7)	173,265	(33.3)	6,100	(36.9)	7,991	(34.5)
Metropolitan area	102,837	(26.4)	142,148	(27.3)	4,376	(26.5)	6,237	(26.9)
Rural	147,272	(37.9)	205,616	(39.5)	6,041	(36.6)	8,944	(38.6)
Disability								
No	384,789	(99.0)	516,343	(99.1)	16,061	(97.2)	22,685	(97.9)
Yes	4,043	(1.0)	4,686	(0.9)	456	(2.8)	487	(2.1)
Charlson Comorbidity Index								
0	188,807	(48.6)	239,940	(46.1)	10,225	(61.9)	12,881	(55.6)
1	194,061	(49.9)	274,214	(52.6)	5,911	(35.8)	9,784	(42.2)
2≤	5,964	(1.5)	6,875	(1.3)	381	(2.3)	507	(2.2)
Hospital type								
Tertiary hospital	79,591	(20.5)	87,638	(16.8)	3,386	(20.5)	3,919	(16.9)
General hospital	219,654	(56.5)	292,572	(56.2)	8,764	(53.1)	12,379	(53.4)
Hospital	59,526	(15.3)	95,931	(18.4)	2,674	(16.2)	4,438	(19.2)
Clinical	30,061	(7.7)	44,888	(8.6)	1,693	(10.3)	2,436	(10.5)
Number of beds								
≤99	68,046	(17.5)	108,353	(20.8)	3,052	(18.5)	4,815	(20.8)
100-499	168,467	(43.3)	236,260	(45.3)	7,242	(43.8)	10,732	(46.3)
500≤	152,319	(39.2)	176,416	(33.9)	6,223	(37.7)	7,625	(32.9)
Hospital region								
Capital area	137,706	(35.4)	170,897	(32.8)	6,269	(38.0)	8,030	(34.7)
Metropolitan area	115,886	(29.8)	156,288	(30.0)	4,737	(28.7)	6,608	(28.5)
Rural	135,240	(34.8)	193,844	(37.2)	5,511	(33.4)	8,534	(36.8)
Number of doctors								
≤49	185,477	(47.7)	276,984	(53.2)	8,343	(50.5)	12,914	(55.7)
50-99	37,674	(9.7)	53,227	(10.2)	1,264	(7.7)	1,977	(8.5)
100-299	122,706	(31.6)	137,367	(26.4)	5,107	(30.9)	5,972	(25.8)
300≤	42,975	(11.1)	53,451	(10.3)	1,803	(10.9)	2,309	(10.0)
Number of nurses								
≤49	85,531	(22.0)	143,510	(27.5)	4,134	(25.0)	6,937	(29.9)
50-99	83,231	(21.4)	101,284	(19.4)	3,368	(20.4)	4,435	(19.1)
100-299	109,694	(28.2)	142,288	(27.3)	4,439	(26.9)	5,929	(25.6)
300≤	110,376	(28.4)	133,947	(25.7)	4,576	(27.7)	5,871	(25.3)

*N(%)

Appendix 4. Changes of healthcare expenditure per episode for inpatient service of mild disease (KRW)

Variables		Case (1-5 years old)							Control (7 years old)						
		Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
		Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total		463,384	±	288,000	530,548	±	312,442		507,563	±	361,785	589,817	±	380,247	
Gender															
	Male	466,240	±	290,394	533,292	±	315,181	<.0001	509,016	±	363,493	589,425	±	384,093	<.0001
	Female	459,564	±	284,723	527,015	±	308,846	<.0001	505,538	±	359,407	590,319	±	375,271	<.0001
Income(percentile)															
	0-20 (low)	462,414	±	283,980	531,901	±	307,766	<.0001	508,070	±	360,288	585,895	±	379,018	<.0001
	21-40	466,091	±	287,463	538,071	±	315,409	<.0001	518,801	±	388,308	588,203	±	379,937	<.0001
	41-60	464,838	±	286,045	533,571	±	312,564	<.0001	509,932	±	357,902	589,505	±	354,012	<.0001
	61-80	462,087	±	288,786	527,202	±	310,987	<.0001	502,562	±	350,730	592,435	±	390,499	<.0001
	81-100 (high)	461,208	±	292,140	523,647	±	314,295	<.0001	505,660	±	364,514	589,141	±	389,488	<.0001
Region															
	Capital area	477,849	±	305,716	535,976	±	325,799	<.0001	519,870	±	370,733	604,491	±	394,042	<.0001
	Metropolitan area	472,834	±	281,480	541,251	±	312,070	<.0001	514,755	±	355,110	595,301	±	377,784	<.0001
	Rural	443,159	±	273,791	518,574	±	300,584	<.0001	489,926	±	356,760	572,882	±	368,616	<.0001
Disability															
	No	460,011	±	277,630	527,772	±	304,574	<.0001	502,794	±	350,663	586,530	±	371,513	<.0001
	Yes	784,377	±	732,950	836,369	±	733,681	0.0010	675,539	±	617,873	742,902	±	653,717	0.1048
Charlson Comorbidity Index			±			±				±			±		
	0	437,826	±	293,076	494,550	±	311,027	<.0001	482,568	±	359,181	553,007	±	373,465	<.0001
	1	480,561	±	259,090	555,983	±	296,182	<.0001	530,994	±	317,766	623,198	±	351,225	<.0001

	2≤	713,530	±	641,422	772,413	±	627,415	<.0001	814,831	±	726,146	880,845	±	738,108	0.1844
Hospital type															
	Tertiary hospital	566,363	±	393,204	624,114	±	413,349	<.0001	642,731	±	475,074	739,530	±	489,741	<.0001
	General hospital	469,620	±	254,396	550,389	±	295,842	<.0001	523,229	±	328,448	616,640	±	360,863	<.0001
	Hospital	374,745	±	215,006	453,886	±	248,031	<.0001	403,683	±	288,915	491,831	±	309,001	<.0001
	Clinic	320,681	±	186,559	382,388	±	208,409	<.0001	320,204	±	213,351	391,169	±	239,342	<.0001
Number of beds															<.0001
	≤99	349,376	±	203,647	421,392	±	229,682	<.0001	347,178	±	241,401	433,435	±	268,955	<.0001
	100-499	447,613	±	240,427	539,863	±	291,521	<.0001	493,981	±	315,864	594,210	±	354,613	<.0001
	500≤	531,757	±	344,266	585,115	±	362,887	<.0001	602,027	±	425,434	682,385	±	438,997	<.0001
Hospital region															
	Capital area	487,689	±	328,255	544,647	±	343,209	<.0001	531,830	±	397,370	612,469	±	407,360	<.0001
	Metropolitan area	474,829	±	280,477	543,159	±	312,939	<.0001	519,864	±	358,119	597,282	±	374,552	<.0001
	Rural	428,828	±	243,807	507,950	±	280,664	<.0001	469,385	±	316,568	562,723	±	355,803	<.0001
Number of doctors															
	≤49	409,453	±	226,880	494,711	±	272,566	<.0001	432,873	±	288,814	526,506	±	319,834	<.0001
	50-99	436,192	±	232,762	529,195	±	274,799	<.0001	512,804	±	350,560	617,945	±	370,845	<.0001
	100-299	515,509	±	305,017	570,803	±	333,252	<.0001	578,396	±	372,313	657,827	±	407,106	<.0001
	300≤	571,149	±	427,320	614,148	±	433,798	<.0001	648,868	±	523,965	743,924	±	523,359	<.0001
Number of nurses															
	≤49	366,220	±	221,909	443,581	±	251,850	<.0001	380,540	±	275,857	470,510	±	301,881	<.0001
	50-99	441,720	±	218,043	526,720	±	267,824	<.0001	479,276	±	289,139	579,861	±	324,752	<.0001
	100-299	491,937	±	282,699	570,244	±	309,974	<.0001	552,241	±	348,413	641,146	±	383,533	<.0001
	300≤	526,635	±	355,360	584,450	±	377,849	<.0001	599,796	±	445,949	686,472	±	453,807	<.0001

Appendix 5. Changes of length of stay per episode of inpatient service for mild disease (KRW)

Variables		Case (1-5 years old)							Control (7 years old)						
		Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
		Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total		5.83	±	3.22	6.08	±	3.25		5.64	±	4.22	6.01	±	3.92	
Gender															
	Male	5.82	±	3.25	6.06	±	3.26	<.0001	5.60	±	4.33	5.93	±	3.90	<.0001
	Female	5.85	±	3.19	6.10	±	3.23	<.0001	5.69	±	4.07	6.11	±	3.94	<.0001
Income(percentile)															
	0-20 (low)	6.07	±	3.43	6.29	±	3.32	<.0001	5.99	±	4.10	6.27	±	4.35	<.0001
	21-40	6.06	±	3.30	6.38	±	3.47	<.0001	5.99	±	4.86	6.33	±	4.89	<.0001
	41-60	5.91	±	3.26	6.19	±	3.29	<.0001	5.82	±	4.91	6.17	±	3.71	<.0001
	61-80	5.74	±	3.14	5.96	±	3.14	<.0001	5.49	±	3.71	5.96	±	3.78	<.0001
	81-100 (high)	5.56	±	3.11	5.72	±	3.04	<.0001	5.35	±	3.83	5.68	±	3.46	<.0001
Region															
	Capital area	5.42	±	3.11	5.48	±	3.00	<.0001	5.13	±	3.62	5.52	±	3.55	<.0001
	Metropolitan area	6.11	±	3.24	6.34	±	3.34	<.0001	5.88	±	4.36	6.08	±	3.60	0.0084
	Rural	6.03	±	3.27	6.40	±	3.31	<.0001	5.98	±	4.62	6.41	±	4.37	<.0001
Disability															
	No	5.81	±	3.14	6.06	±	3.19	<.0001	5.60	±	4.15	5.99	±	3.85	<.0001
	Yes	7.97	±	7.37	7.83	±	6.59	0.3612	6.80	±	6.11	6.79	±	6.23	0.9810
Charlson Comorbidity Index			±			±				±			±		
	0	5.51	±	3.29	5.73	±	3.24	<.0001	5.42	±	4.34	5.79	±	4.15	<.0001
	1	6.11	±	3.00	6.35	±	3.14	<.0001	5.93	±	3.80	6.26	±	3.43	<.0001
	2≤	7.23	±	5.72	7.34	±	5.37	0.2568	7.02	±	6.20	6.97	±	5.83	0.8997
Hospital type															
	Tertiary hospital	5.61	±	3.62	5.58	±	3.37	0.0482	5.30	±	3.71	5.62	±	3.50	0.0002
	General hospital	5.92	±	3.04	6.21	±	3.22	<.0001	5.69	±	4.04	6.10	±	3.70	<.0001
	Hospital	5.86	±	3.32	6.19	±	3.25	<.0001	5.98	±	5.09	6.26	±	4.89	0.0214
	Clinic	5.72	±	3.12	5.97	±	3.08	<.0001	5.51	±	4.53	5.76	±	3.60	0.0496
Number of bed															
	≤99	5.74	±	3.10	6.04	±	3.03	<.0001	5.54	±	4.31	5.88	±	3.76	<.0001

	100-499	6.04	±	3.17	6.41	±	3.37	0.5320	5.93	±	4.55	6.36	±	4.29	0.0002
	500≤	5.65	±	3.31	5.66	±	3.15	<.0001	5.34	±	3.73	5.60	±	3.38	<.0001
Hospital region															
	Capital area	5.47	±	3.28	5.51	±	3.11	0.0004	5.21	±	3.82	5.56	±	3.65	<.0001
	Metropolitan area	6.13	±	3.23	6.33	±	3.34	<.0001	5.87	±	4.16	6.06	±	3.54	0.0111
	Rural	5.95	±	3.12	6.37	±	3.22	<.0001	5.92	±	4.65	6.41	±	4.37	<.0001
Number of doctor															
	≤49	6.04	±	3.22	6.46	±	3.35	<.0001	5.94	±	4.68	6.32	±	4.26	<.0001
	50-99	5.67	±	2.82	5.97	±	2.88	<.0001	5.62	±	3.95	6.03	±	3.89	0.0039
	100-299	5.66	±	3.08	5.61	±	2.97	<.0001	5.26	±	3.40	5.51	±	3.15	<.0001
	300≤	5.57	±	3.83	5.42	±	3.43	<.0001	5.31	±	4.16	5.55	±	3.57	0.0482
Number of nurse															
	≤49	5.82	±	3.29	6.18	±	3.24	<.0001	5.73	±	4.44	6.16	±	4.44	<.0001
	50-99	6.21	±	3.05	6.50	±	3.18	0.0039	6.09	±	4.66	6.35	±	3.84	0.0071
	100-299	5.98	±	3.18	6.27	±	3.32	<.0001	5.73	±	3.98	6.16	±	3.86	<.0001
	300≤	5.42	±	3.29	5.46	±	3.13	<.0001	5.13	±	3.84	5.43	±	3.25	<.0001

Appendix 6. Changes of healthcare expenditure per day per episode of inpatient service for mild disease (KRW)

Variables	Case (1-5 years old)							Control (7 years old)						
	Before (2004-2005)			After (2006-2007)			*P-value*	Before (2004-2005)			After (2006-2007)			*P-value*
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	82,396	±	31,976	90,238	±	33,820		96,360	±	47,298	103,146	±	45,177	
Gender														
Male	83,204	±	32,263	91,017	±	34,177	<.0001	97,937	±	48,950	104,430	±	45,474	<.0001
Female	81,315	±	31,557	89,236	±	33,327	<.0001	94,161	±	44,805	101,498	±	44,741	<.0001
Income(percentile)														
0-20 (low)	79,047	±	29,389	87,213	±	32,055	<.0001	90,040	±	41,730	98,008	±	39,692	<.0001
21-40	79,610	±	29,983	87,210	±	31,365	<.0001	91,970	±	45,067	98,855	±	42,268	<.0001
41-60	81,519	±	31,644	88,839	±	31,808	<.0001	94,705	±	47,341	100,719	±	43,214	<.0001
61-80	83,498	±	32,457	91,400	±	34,989	<.0001	97,301	±	48,904	104,102	±	46,247	<.0001
81-100 (high)	86,168	±	34,169	95,018	±	37,254	<.0001	101,023	±	47,762	108,242	±	48,249	<.0001
Region														
Capital area	91,862	±	36,261	101,370	±	38,949	<.0001	108,938	±	55,724	115,769	±	53,293	<.0001
Metropolitan area	79,558	±	28,371	87,527	±	29,940	<.0001	93,304	±	41,904	101,329	±	40,547	<.0001
Rural	75,461	±	27,584	82,732	±	28,887	<.0001	85,872	±	37,858	93,135	±	36,868	<.0001
Disability														
No	82,164	±	31,522	90,030	±	33,341	<.0001	96,035	±	46,989	102,800	±	44,754	<.0001
Yes	104,518	±	57,233	113,225	±	64,439	<.0001	107,797	±	55,996	119,261	±	59,608	0.0024
Charlson Comorbidity Index														
0	83,201	±	35,965	89,827	±	36,782	<.0001	96,859	±	51,705	102,294	±	49,848	<.0001
1	81,025	±	26,263	90,094	±	29,857	<.0001	93,899	±	36,657	102,664	±	35,862	<.0001
2≤	101,522	±	53,150	110,307	±	59,157	<.0001	121,125	±	60,726	134,111	±	66,027	<.0001
Hospital type														
Tertiary hospital	106,242	±	41,274	77,495	±	21,612	<.0001	127,974	±	55,428	137,076	±	53,055	<.0001
General hospital	81,863	±	25,443	90,345	±	25,999	<.0001	96,951	±	37,160	105,423	±	37,518	<.0001
Hospital	64,995	±	16,356	104,720	±	34,920	<.0001	71,335	±	25,908	81,475	±	25,792	<.0001
Clinic	57,615	±	27,102	118,953	±	52,123	<.0001	69,596	±	61,400	76,468	±	55,476	<.0001
Number of beds														
≤99	61,789	±	21,738	70,494	±	21,727	<.0001	69,909	±	48,948	78,641	±	43,682	<.0001
100-499	76,415	±	22,568	86,356	±	25,070	<.0001	88,216	±	33,040	97,169	±	32,031	<.0001
500≤	98,217	±	36,826	107,564	±	41,068	<.0001	118,808	±	50,681	127,033	±	50,535	<.0001
Hospital region														

Capital area	92,851	±	37,394	102,425	±	40,103	<.0001	109,651	±	56,804	116,461	±	53,806	<.0001
Metropolitan area	79,475	±	28,082	87,798	±	30,278	<.0001	93,413	±	40,431	102,153	±	40,857	<.0001
Rural	74,254	±	25,600	81,462	±	26,543	<.0001	83,773	±	35,537	91,386	±	34,922	<.0001
Number of doctors														
≤49	69,041	±	21,124	77,495	±	21,612	<.0001	78,012	±	37,791	86,760	±	34,694	<.0001
50-99	78,881	±	23,078	90,345	±	25,999	<.0001	94,960	±	35,849	106,018	±	34,016	<.0001
100-299	94,362	±	31,536	104,720	±	34,920	<.0001	114,335	±	43,172	123,406	±	46,217	<.0001
300≤	108,957	±	46,088	118,953	±	52,123	<.0001	131,325	±	63,333	139,934	±	57,563	<.0001
Number of nurses														
≤49	64,103	±	23,064	72,674	±	22,289	<.0001	72,765	±	45,216	80,796	±	39,426	<.0001
50-99	72,684	±	17,971	82,428	±	20,782	<.0001	82,560	±	25,117	93,764	±	26,710	<.0001
100-299	84,602	±	26,369	93,849	±	29,041	<.0001	100,770	±	38,461	108,806	±	38,911	<.0001
300≤	101,703	±	39,335	111,127	±	43,214	<.0001	123,554	±	54,111	130,926	±	51,872	<.0001

Appendix 7. Results of the generalized linear model of healthcare expenditure and the quantity of healthcare service per episode (inpatient service for mild disease)

	Healthcare expenditure per episode				Length of stay per episode				Healthcare expenditure per day			
	β	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***	**β**	**exp(β)**	**SE**	***P-value***
Time (month)	0.0035	1.0035	0.0001	<0001	-0.0013	0.9987	0.0001	<0001	0.0048	1.0048	0.0000	<.0001
Policy												
Before												
After	0.0935	1.0980	0.0056	<0001	0.1007	1.1059	0.0055	<0001	-0.0072	0.9928	0.0027	0.0082
Case (1-5 years old)	-0.0750	0.9277	0.0041	<0001		1.0000			-0.1269	0.8808	0.0020	<0001
Control (7 years old)												
Case*Policy (difference, case-control)	-0.0246	0.9757	0.0054	<.0001	-0.0344	0.9662	0.0053	<0001	0.0098	1.0098	0.0026	0.0002
Gender												
Male												
Female	-0.0016	0.9984	0.0011	0.1257	0.0109	1.0110	0.0011	<0001	-0.0125	0.9876	0.0005	<0001
Income(percentile)												
0-20 (low)												
21-40	0.0066	1.0066	0.0022	0.0029	0.0116	1.0117	0.0022	<0001	-0.0050	0.9950	0.0011	<0001
41-60	-0.0052	0.9948	0.0021	0.0114	-0.0055	0.9945	0.0020	0.0074	0.0003	1.0003	0.0010	0.8020
61-80	-0.0197	0.9805	0.0020	<0001	-0.0341	0.9665	0.0020	<0001	0.0144	1.0145	0.0010	<0001
81-100 (high)	-0.0316	0.9689	0.0022	<0001	-0.0591	0.9426	0.0022	<0001	0.0274	1.0278	0.0011	<0001
Region												
Capital area												
Metropolitan area	0.0665	1.0688	0.0030	<0001	0.0674	1.0697	0.0030	<0001	-0.0009	0.9991	0.0015	0.5515
Rural	0.0973	1.1022	0.0029	<0001	0.0916	1.0959	0.0029	<0001	0.0057	1.0057	0.0014	<0001
Disability												
No												
Yes	0.2136	1.2381	0.0054	<0001	0.1497	1.1615	0.0053	<0001	0.0640	1.0661	0.0026	<0001
Charlson Comorbidity Index												
0												
1	0.1586	1.1719	0.0011	<0001	0.1212	1.1289	0.0011	<0001	0.0374	1.0381	0.0005	<0001
2≤	0.2978	1.3469	0.0045	<0001	0.1939	1.2140	0.0045	<0001	0.1042	1.1098	0.0022	<0001
Hospital type												
Tertiary hospital	0.3420	1.4078	0.0034	<0001	0.1116	1.1181	0.0034	<0001	0.2305	1.2592	0.0017	<0001
General hospital	0.1950	1.2153	0.0026	<0001	0.0780	1.0811	0.0026	<0001	0.1170	1.1241	0.0013	<0001
Hospital												
Clinic	-0.1406	0.8688	0.0025	<0001	-0.0032	0.9968	0.0024	0.1936	-0.1375	0.8715	0.0012	<0001

Number of beds												
≤99												
100-499	0.0448	1.0458	0.0028	<0001	0.0568	1.0584	0.0028	<0001	-0.0120	0.9881	0.0014	<0001
500≤	0.1024	1.1078	0.0034	<0001	0.0937	1.0982	0.0034	<0001	0.0087	1.0087	0.0017	<0001
Hospital region												
Capital area												
Metropolitan area	-0.0049	0.9951	0.0030	0.1038	0.0514	1.0527	0.0030	<0001	-0.0564	0.9452	0.0015	<0001
Rural	-0.0494	0.9518	0.0030	<0001	0.0135	1.0136	0.0030	<0001	-0.0629	0.9390	0.0015	<0001
Number of doctors												
≤49												
50-99	-0.0716	0.9309	0.0022	<0001	-0.1084	0.8973	0.0022	<0001	0.0368	1.0375	0.0011	<0001
100-299	0.0213	1.0215	0.0025	<0001	-0.0894	0.9145	0.0025	<0001	0.1107	1.1171	0.0012	<0001
300≤	-0.0223	0.9779	0.0037	<0001	-0.1645	0.8483	0.0036	<0001	0.1422	1.1528	0.0018	<0001
Number of nurses												
≤49												
50-99	0.0309	1.0314	0.0026	<0001	0.0099	1.0099	0.0025	<0001	0.0209	1.0211	0.0013	<0001
100-299	0.0547	1.0562	0.0028	<0001	-0.0071	0.9929	0.0028	0.0100	0.0618	1.0637	0.0014	<0001
300≤	-0.0543	0.9471	0.0034	<0001	-0.1239	0.8835	0.0033	<0001	0.0695	1.0720	0.0016	<0001
Season												
Spring												
Summer	-0.0021	0.9979	0.0015	0.1676	-0.0330	0.9675	0.0015	<0001	0.0008	1.0008	0.0008	<0001
Fall	0.0590	1.0608	0.0015	<0001	0.0258	1.0261	0.0015	<0001	0.0007	1.0007	0.0007	<0001
Winter	0.0095	1.0095	0.0015	<0001	-0.0045	0.9955	0.0015	0.0019	0.0007	1.0007	0.0007	<0001

Appendix 8. General characteristics of the outpatient episodes for mild disease from 1-5 years old and 7 years old

Variables	Case (1-5 years old)				Control (7 years old)			
	Before (2004-2005)		After (2006-2007)		Before (2004-2005)		After (2006-2007)	
Total	45,006,258	(100.0)	52,281,585	(100.0)	5,502,353	(100.0)	6,080,655	(100.0)
Gender								
Male	23,893,020	(53.1)	27,659,284	(52.9)	2,869,010	(52.1)	3,183,860	(52.4)
Female	21,113,238	(46.9)	24,622,301	(47.1)	2,633,343	(47.9)	2,896,795	(47.6)
Income(percentile)								
0-20 (low)	3,158,020	(7.0)	4,009,796	(7.7)	436,492	(7.9)	525,250	(8.6)
21-40	6,401,061	(14.2)	6,962,594	(13.3)	655,324	(11.9)	681,712	(11.2)
41-60	11,799,837	(26.2)	12,870,823	(24.6)	1,186,456	(21.6)	1,198,878	(19.7)
61-80	14,578,806	(32.4)	17,541,050	(33.6)	1,731,478	(31.5)	1,943,134	(32.0)
81-100 (high)	9,068,534	(20.1)	10,897,322	(20.8)	1,492,603	(27.1)	1,731,681	(28.5)
Region								
Capital area	20,048,410	(44.5)	24,294,393	(46.5)	2,513,240	(45.7)	2,852,850	(46.9)
Metropolitan area	11,319,152	(25.2)	12,936,143	(24.7)	1,434,251	(26.1)	1,558,425	(25.6)
Rural	13,638,696	(30.3)	15,051,049	(28.8)	1,554,862	(28.3)	1,669,380	(27.5)
Disability								
No	44,849,318	(99.7)	52,114,546	(99.7)	5,461,262	(99.3)	6,030,708	(99.2)
Yes	156,940	(0.3)	167,039	(0.3)	41,091	(0.7)	49,947	(0.8)
Charlson Comorbidity Index								
0	35,971,272	(79.9)	39,873,168	(76.3)	4,795,838	(87.2)	5,145,462	(84.6)
1	8,970,542	(19.9)	12,332,409	(23.6)	698,376	(12.7)	925,094	(15.2)
2≤	64,444	(0.1)	76,008	(0.1)	8,139	(0.1)	10,099	(0.2)
Hospital type								
Tertiary hospital	402,087	(0.9)	394,797	(0.8)	24,472	(0.4)	23,758	(0.4)
General hospital	2,011,559	(4.5)	2,303,408	(4.4)	112,308	(2.0)	135,516	(2.2)
Hospital	1,420,801	(3.2)	1,947,076	(3.7)	95,000	(1.7)	123,223	(2.0)
Clinical	41,171,811	(91.5)	47,636,304	(91.1)	5,270,573	(95.8)	5,798,158	(95.4)
Number of beds								
≤99	42,191,956	(93.7)	49,195,374	(94.1)	5,328,060	(96.8)	5,882,417	(96.7)
100-499	1,792,343	(4.0)	2,058,677	(3.9)	117,403	(2.1)	139,812	(2.3)
500≤	1,021,959	(2.3)	1,027,534	(2.0)	56,890	(1.0)	58,426	(1.0)
Hospital region								
Capital area	19,755,907	(43.9)	23,943,509	(45.8)	2,511,275	(45.6)	2,849,158	(46.9)
Metropolitan area	11,682,264	(26.0)	13,243,316	(25.3)	1,448,774	(26.3)	1,568,368	(25.8)

Rural	13,568,087	(30.1)	15,094,760	(28.9)	1,542,304	(28.0)	1,663,129	(27.4)
Number of doctors								
≤49	43,457,814	(96.6)	50,603,883	(96.8)	5,420,652	(98.5)	5,990,453	(98.5)
50-99	382,408	(0.8)	471,360	(0.9)	17,447	(0.3)	23,824	(0.4)
100-299	953,202	(2.1)	941,103	(1.8)	50,830	(0.9)	50,708	(0.8)
300≤	212,834	(0.5)	265,239	(0.5)	13,424	(0.2)	15,670	(0.3)
Number of nurses								
≤49	42,460,230	(94.3)	49,535,001	(94.7)	5,358,626	(97.4)	5,917,621	(97.3)
50-99	817,294	(1.8)	822,414	(1.6)	49,228	(0.9)	54,549	(0.9)
100-299	1,018,939	(2.3)	1,157,948	(2.2)	54,814	(1.0)	64,955	(1.1)
300≤	709,795	(1.6)	766,222	(1.5)	39,685	(0.7)	43,530	(0.7)

*N(%)

Appendix 9. Changes of healthcare expenditure per episode of outpatient service for mild disease (KRW)

Variables	Case (1-5 years old)						*P-value*	Control (7 years old)						*P-value*
	Before (2004-2005)			After (2006-2007)				Before (2004-2005)			After (2006-2007)			
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	20,518	±	13,817	16,619	±	12,718		16,619	±	10,487	14,484	±	9,593	
Gender														
Male	20,731	±	14,007	16,745	±	12,899	<0001	16,819	±	10,693	14,597	±	9,779	<0001
Female	20,277	±	13,596	16,477	±	12,511	<0001	16,401	±	10,253	14,361	±	9,383	<0001
Income(percentile)														
0-20 (low)	20,209	±	13,642	16,626	±	12,658	<0001	16,343	±	10,300	14,370	±	9,364	<0001
21-40	20,349	±	13,745	16,954	±	12,893	<0001	16,413	±	10,338	14,565	±	9,584	<0001
41-60	20,578	±	13,882	16,641	±	12,775	<0001	16,576	±	10,450	14,453	±	9,562	<0001
61-80	20,582	±	13,843	16,638	±	12,739	<0001	16,647	±	10,492	14,583	±	9,672	<0001
81-100 (high)	20,563	±	13,802	16,347	±	12,520	<0001	16,791	±	10,626	14,398	±	9,597	<0001
Region														
Capital area	20,711	±	13,949	16,417	±	12,714	<0001	16,757	±	10,619	14,395	±	9,639	<0001
Metropolitan area	20,827	±	14,080	16,952	±	13,007	<0001	16,953	±	10,772	14,731	±	9,856	<0001
Rural	19,977	±	13,381	16,659	±	12,465	<0001	16,089	±	9,974	14,407	±	9,256	<0001
Disability														
No	20,517	±	13,815	16,617	±	12,715	<0001	16,610	±	10,474	14,479	±	9,580	<0001
Yes	20,702	±	14,467	17,202	±	13,581	<0001	17,796	±	12,067	15,063	±	11,064	<0001
Charlson Comorbidity Index														
0	19,493	±	12,816	15,960	±	11,784	<0001	16,046	±	9,842	14,031	±	8,898	<0001
1	24,601	±	16,615	18,733	±	15,139	<0001	20,491	±	13,449	16,965	±	12,435	<0001
2≤	24,079	±	17,446	19,475	±	16,337	<0001	21,765	±	15,776	18,249	±	15,054	<0001
Hospital type														
Tertiary hospital	30,135	±	21,325	31,187	±	21,908	<0001	28,996	±	21,583	29,495	±	22,036	0.0121
General hospital	25,544	±	17,994	25,677	±	18,283	<0001	23,639	±	17,230	23,624	±	17,373	0.8290
Hospital	22,000	±	15,123	22,855	±	15,533	<0001	18,979	±	12,504	19,097	±	12,473	0.0283
Clinical	20,127	±	13,348	15,806	±	11,813	<0001	16,369	±	10,079	14,111	±	8,983	
Number of beds														

≤99	20,181	±	13,406	16,033	±	12,016	<0001	16,397	±	10,107	14,181	±	9,054	<0001
100-499	24,490	±	16,961	24,900	±	17,429	<0001	21,925	±	15,513	22,161	±	15,874	<0001
500≤	27,457	±	20,084	28,093	±	20,582	<0001	26,453	±	20,336	26,660	±	20,564	0.0858
Hospital region														
Capital area	20,780	±	14,002	16,442	±	12,769	<0001	16,776	±	10,641	14,405	±	9,659	<0001
Metropolitan area	20,843	±	14,096	16,991	±	13,030	<0001	16,963	±	10,787	14,744	±	9,876	<0001
Rural	19,856	±	13,271	16,574	±	12,348	<0001	16,041	±	9,911	14,375	±	9,197	<0001
Number of doctors														
≤49	20,297	±	13,522	16,280	±	12,266	<0001	16,483	±	10,228	14,317	±	9,255	<0001
50-99	25,016	±	17,428	25,464	±	17,796	<0001	22,730	±	16,477	23,179	±	16,883	0.0070
100-299	26,773	±	19,789	26,446	±	20,088	<0001	25,903	±	19,929	25,610	±	20,026	0.0195
300≤	29,472	±	20,895	30,815	±	21,888	<0001	28,498	±	21,357	29,336	±	22,079	<0001
Number of nurses														
≤49	20,191	±	13,415	16,082	±	12,059	<0001	16,415	±	10,129	14,215	±	9,099	<0001
50-99	25,005	±	16,977	25,273	±	17,087	<0001	22,255	±	15,473	22,218	±	15,521	0.6998
100-299	25,769	±	18,346	26,010	±	18,741	<0001	24,257	±	17,931	24,246	±	18,039	0.9160
300≤	27,390	±	20,232	27,893	±	20,778	<0001	26,663	±	20,643	26,761	±	20,867	0.4986

Appendix 10. Results of the generalized linear model of healthcare expenditure per episode (outpatient service for mild disease)

Variables		Healthcare expenditure per episode			
		β	exp(β)	SE	*P-value*
Time (month)		-0.0155	0.9846	0.0000	<.0001
Policy					
	Before				
	After	0.2524	1.2871	0.0004	<.0001
Case (1-5 years old)		0.1570	1.1700	0.0002	<.0001
Control (7 years old)					
Case*Policy (difference, case-control)		-0.0798	0.9233	0.0003	<.0001
Gender					
	Male				
	Female	-0.0096	0.9904	0.0001	<.0001
Income(percentile)					
	0-20 (low)				
	21-40	-0.0040	0.9960	0.0002	<.0001
	41-60	0.0050	1.0050	0.0002	<.0001
	61-80	0.0013	1.0013	0.0002	<.0001
	81-100 (high)	-0.0018	0.9982	0.0002	<.0001
Region					
	Capital area				
	Metropolitan area	0.0129	1.0130	0.0003	<.0001
	Rural	0.0096	1.0096	0.0003	<.0001
Disability					
	No				
	Yes	-0.0168	0.9833	0.0008	<.0001
Charlson Comorbidity Index					
	0				
	1	0.1489	1.1606	0.0001	<.0001
	2≤	0.1152	1.1221	0.0013	<.0001
Hospital type					
	Tertiary hospital	0.3386	1.4030	0.0012	<.0001
	General hospital	0.1594	1.1728	0.0008	<.0001
	Hospital				
	Clinical	-0.2433	0.7840	0.0003	<.0001
Number of beds					
	≤99				
	100-499	-0.0594	0.9423	0.0007	<.0001
	500≤	-0.0240	0.9763	0.0010	<.0001
Hospital region					
	Capital area				
	Metropolitan area	-0.0071	0.9929	0.0003	<.0001
	Rural	-0.0300	0.9704	0.0003	<.0001
Number of doctors					
	≤49				
	50-99	-0.0190	0.9812	0.0008	<.0001
	100-299	-0.0454	0.9556	0.0008	<.0001
	300≤	-0.0255	0.9748	0.0014	<.0001
Number of nurses					
	≤49				
	50-99	-0.0063	0.9937	0.0007	<.0001
	100-299	-0.0265	0.9738	0.0009	<.0001
	300≤	-0.0868	0.9169	0.0012	<.0001
Season					
	Spring				
	Summer	-0.1531	0.8580	0.0002	<.0001
	Fall	-0.1090	0.8967	0.0001	<.0001
	Winter	-0.0925	0.9116	0.0001	<.0001

Appendix 11. Admission rates due to respiratory infection

Variables	Case (1-5 years old)		Control (7 years old)	
	Before (2004-2005)	**After (2006-2007)**	**Before (2004-2005)**	**After (2006-2007)**
Number of admissions for respiratory infection	388,832	521,029	16,517	23,172
Number of admissions for all disease	620,611	771,371	52,315	59,953
Admission rates due to respiratory infection (%)	62.7	67.5	31.6	38.7

국문요약

6 세 미만 입원 본인부담금 면제 정책이 소아 의료이용에 미치는 영향

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장지은

서론: 아동의 건강은 미래 인적자본을 형성하는 핵심적 가치로서 평생 건강의 초석이 된다. 2006 년 1 월 1 일부터 정부는 아동의 의료비용에 대한 가계부담을 덜어주고, 아동의 건강에 대한 사회적 지원여건 조성을 위해 만 6 세미만 입원 아동이 요양기관에 입원할 경우 보험급여 적용 의료비 중 법정본인부담금을 면제하는 정책을 시행하였다. 그러나 건강보험재정 악화로 인해 2008 년 1 월부터 6 세 미만 아동의 입원에 대해 10% 본인부담금을 부과하였다. 이 연구는 6 세미만 입원본인부담 면제 정책 도입에 따른 소아 의료이용 변화를 분석하였다.

연구방법: 이 연구는 국민건강보험공단 맞춤형 데이터 2004-2007 년 자료를 활용하여 한국 소아 인구 전수 자료를 활용하였다. 입원본인부담 면제 정책 대상이 만 6 세 미만 건강보험 가입인구라는 점을 고려하여 2004-2007 년 1-5 세 건강보험 인구를 실험군으로, 2004-2007 년 7 세 건강보험 연구를

대조군으로 설정하였다. 정책 도입에 따른 6 세미만 건강보험 가입자의 의료이용 변화를 분석하기 위해 실험군(1-5 세 인구)은 2004 년 2,720,180 명, 2,572,633 명, 2006 년 2,333,808 명, 2007 년에 2,230,946 명을 포함하였다. 대조군(7 세 인구)은 2004 년 649,225 명, 2005 년 616,091 명, 2006 년 584,144 명, 2007 년 600,370 명을 포함하였다. 종속변수는 건강보험 가입자당 연간 진료비, 건강보험 가입자당 연간 재원일수와 건강보험 가입자당 연간 의료이용 횟수를 포함하였다. 정책도입에 따른 진료건당 의료비와 의료서비스량 변화를 분석하기 위해 실험군(1-5 세 인구)의 입원진료건은 정책도입 이전(2004-2005 년) 620,611 건, 정책도입 이후(2006-2007 년) 771,371 건을 포함하였다. 대조군(7 세 인구)의 입원진료건은 정책도입 이전(2004-2005 년) 52,315 건, 정책 도입 이후(2006-2007 년) 59,953 건이 포함되었다. 종속변수는 진료건 당 진료비, 진료건당 재원일수와 진료건당 일당 진료비가 포함되었다. 이중차분법(difference in differences)을 활용하여 실험군과 대조군에서 6 세미만 입원본인부담 면제 정책 도입 전과 후 소아 의료이용 변화를 분석하였다.

연구결과: 6 세 미만 입원본인부담 면제 정책은 소아의료이용 증가와 관련 있었다. 6 세미만 입원본인부담 면제 정책 도입 전, 후 건강보험 가입자당 연간 입원 진료비 평균은 실험군에서 51,002 원과 90,611 원이었고, 대조군에서 24,415 원과 32,570 원이었다. 정책 도입 전, 후 건강보험 가입자당 연간 입원건수 평균은 실험군에서 0.12 회와 0.17 회, 대조군에서 0.04 회와 0.05 회였고, 건강보험 가입자당 연간 재원일수 평균은 실험군에서 0.64 일과 0.95 일, 대조군에서 각각 0.22 일 및 0.27 일이었다. 이중차분법 분석결과 6 세미만 입원본인부담면제는 건강보험 가입자당 연간 입원 진료비 증가, 건강보험 가입자당 연간 입원건수 증가 및 건강보험 가입자당 연간 재원일수 증가와 관련 있는 것으로 확인되었다 (연간 입원진료비: β = 0.1474, exp(β)=1.1588, SE = 0.0176, P = <.0001; 연간 입원건수: β = 0.1535, exp(β)=1.1659, SE = 0.0068, P = <.0001; 연간 재원일수: β = 0.1497,

exp(β)=1.1615, SE = 0.0079, P = <.0001). 전체(입원과 외래) 의료서비스에서 건강보험 가입자당 연간 진료비가 실험군이 대조군에 비해 증가하였고, 외래서비스에서 약간 증가한 것을 통해 입원과 외래의 대체재 효과는 관찰되지 않았다 (전체 의료서비스 건강보험 가입자당 연간 진료비: β = 0.0916, exp(β)=1.0959, SE = 0.0009, P = <.0001; 외래서비스 건강보험 가입자당 연간 진료비: β = 0.0115, exp(β)=1.0116, SE = 0.0014, P = <.0001). 6 세미만 입원본인부담 면제 정책 전, 후 입원건당 진료비 평균은 실험군에서 486, 139 원과 536,212 원, 대조군에서 각각 590,545 원, 643,494 원이었다. 정책 도입 전, 후 입원건당 재원일수 평균은 실험군에서 5.42 일 및 5.62 일이었고, 대조군에서 5.30 일 및 5.42 일이었다. 정책 도입 전, 후 입원건당 일당 진료비 평균은 실험군에서 101,539 원과 106,328 원, 대조군에서 각각 137,087 원 및 144,697 원이었다. 이중차분법 분석결과 6 세 미만 입원본인부담면제 도입 이후 실험군에서 입원건당 의료비 평균이 약간 증가하였다 (입원건당 진료: β = 0.0111, exp(β)=1.0112, SE = 0.0036, P = 0.0018). 경증질환 입원건당 분석 결과 정책 도입 후 실험군에서 진료건당 의료비와 진료건당 재원일수가 약간 감소하였다.

결론: 전반적으로 6 세미만 입원본인부담 면제정책은 전체적인 의료서비스 비용을 증가시켰고, 이는 의료서비스 가격 측면보다 정책대상자의 의료서비스 이용량 증가에서 비롯된 결과임을 확인하였다. 건강보험의 본인부담금 설정 시 다양한 연구를 통해 본인부담 정도에 따른 가능한 의료이용 반응을 고려할 필요가 있다. 이 연구는 6 세미만 입원본인부담 면제정책을 의료서비스 가격과 의료이용량 측면에서 나누어 분석함으로써 한국의 건강보험 보장성 강화정책 설계에 참고자료를 마련하였다. 추후 본인부담과 소아의료이용에 대한 활발한 연구를 통해 소아가 건강을 위한 다양하고 발전적인 건강보험 보장성 강화 정책 근거들이 제시되기를 기대한다.