Master's Thesis of Public Health

The impact of the copayment ceiling change in 2014 on household health expenditure and financial burden

2014년 본인부담상한제 개편이 가구 의료비 지출 및 의료비 부담에 미치는 영향

February 2023

Graduate School of Public Health
Seoul National University
Health Policy and Management Major

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Submitting a master's thesis of
Public Health

November 2022

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Confirming the master's thesis written by
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December 2022

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Abstract

The copayment ceiling is a policy to reduce the household health expenditure burden regardless of diseases. The copayment ceiling is determined according to the income deciles based on insurance premiums. Since 2009, the ceilings have been tiered based on income deciles and subdivided in 2014. The ceilings are decreased in lower deciles, while the ceiling was increased in the highest decile. Previous studies identified the impact of the tiered copayment ceiling, nevertheless, household burden and non-reimbursement expenditures were less addressed. The current study investigates the impact of the copayment ceiling change in 2014 on annual household Out of Pocket expenditure (OOP), the occurrence of catastrophic health expenditure (CHE), and annual household non-reimbursement health expenditures.

The study used the 2012~2016 Korean Health Panel to examine the effect of the copayment ceiling change in 2014 on household health expenditures, non-reimbursement expenditures, and the occurrence of catastrophic health expenditures. The ceilings were changed within each income group, the study compared the effect within each group: the lower 50%, the middle 30%, and the upper 20%. The reference groups are the groups whose ceiling was not changed. The panel ordinary least square (OLS) regression and Linear Probability Model (LPM) were used.

For the low-income group, the 4^{th} ~5^{th} deciles were set as control groups to compare the policy effect to the 1^{st} decile and 2^{nd}~3^{rd} deciles. The annual OOP expenditures decreased in the 1^{st} deciles significantly, while in the 2^{nd} ~3^{rd} didn' t. The chance of

catastrophic payments decreased at the 10% threshold, but the odds increased at the 20% threshold. The annual non-reimbursement expenditures increased in the 1st deciles, but the 2nd ~ 3rd decreased.

Among the middle-income group, the 6th ~7th deciles, whose ceiling had decreased, showed a decrease in annual OOP expenditures. The chance of catastrophic health expenditures increased, but not significantly. The annual non-reimbursement expenditure significantly increased after the policy.

In the high-income group, the ceiling for the 10th decile increased, and the annual OOP expenditure, the probability of CHE occurrence, and annual non-reimbursement expenditure increased, but not significantly.

There was a change according to the ceiling change, the policy showed the outcome differently. Since there was an increase in non-reimbursement health expenditures among most income groups, the ceiling level, and the policy interventions need to be adjusted to reduce the non-reimbursement expenditure.

Keyword: out-of-pocket spending, catastrophic health expenditure, non-reimbursement expenditure, copayment ceiling, panel data analysis
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Chapter 1. Introduction

1.1. Study Background

UHC (Universal Health Insurance) has been a desirable objective in the global health system that ensures financial protection and access to appropriate healthcare services for all populations. Achieving UHC is a nationwide target that makes progress to get affordable and effective healthcare services. Even though South Korea achieved national health insurance (NHI) for all populations in 1989, there have been criticized for the low coverage rate, high OOP (Out of Pocket) payments, and number of non-reimbursement services. In 2020, the NHI coverage rate is 65%, which is lower than the OECD average, 80%. (Jung et al, 2022). The government has tried to implement a series of policies that expand benefit coverage and ease the overall financial burden due to high OOP. The policies tried to reduce the high copayment due to the high disease burden such as cancer and cardiovascular-cerebrovascular disease. In addition, health policies such as copayment ceiling targeted to decrease catastrophic payments regardless of diseases (Kwon, 2019)

OOP payment in health insurance is to prevent excessive healthcare utilization which is known for moral hazards. It is also an extra source for improving the quality of healthcare services as an incentive. However, high out of pocket causes barriers to accessing healthcare services and leads households to financial hardships. Patients who have cancer, cardiovascular disease or rare diseases and low-income households are suffering from the high burden of

their health expenditure. The occurrence of catastrophic health expenditure where the amount of OOP expenditure exceeds the household income is one of the risk factors for accessing health services. A considerable body of research addressed the association between catastrophic health expenditure and financial hardship as well as negative health outcomes. Health policy should balance between preventing excessive utilization and making health care services more affordable.

Within the OOP expenditure, the increase in non-reimbursement expenditure, which is not covered by national health insurance, hinders the achievement of expanding benefit coverage policies. The expenditure on non-reimbursement expenditure increased 2.5 times in the last 10 years, while the expenditure on reimbursement services increased 2 times (Kim&Shin, 2017; Kong, 2020). Though increasing benefit packages relieves the burden for reimbursed services, the policy effect could be offset if the non-reimbursement expenditure also increases.

Copayment Ceiling

The copayment ceiling is one of the cost-specific approach coverage policies as well as income-differentiated policies (Kwon, 2019; Son & Choi, 2020). If an annual health expenditure exceeds the copayment ceiling, the NHI will reimburse the exceeded amount. The policy was introduced in 1979 and implemented in 1999 (President Kim's government). Regardless of income, there was a 50% reimbursement that exceeds ₩120000 for every 30 days. In 2004, the copayment ceiling was introduced, and it was combined with the previous policies. The beneficiaries of the policy were high

income households rather than low income. Considering equity, the income-differentiated copayment ceiling was introduced in 2009. The income was differentiated into 3 deciles (lower 50%, middle 30% and upper 20%), and the annual ceiling was ₩2000000, ₩3000000 and ₩4000000 respectively. In 2014, the Park government divided into 10 deciles. Since 2015, the ceilings have been raised with the increase in health services fees. [Table I] shows the change in copayment ceilings by different income groups and deciles. There was a policy change in 2018 considering the limits on the hospitalization of long-term care hospitals (LTCH) among low-income.

[Table 1] The changes in annual copayment ceilings

Year	LTH	The annual copayment Ceilings (low-income→high-income)						
	Hospitalization days	1st	2nd~3rd	4th~5th	6th~7th	8th	9th	10th
2009~2013		200 (lower 50%)			300 (middle 30%)		400 (upper 20%)	
2014		120	150	200	250	300	400	500
2015		121	151	202	253	303	405	506
2016		121	152	203	254	305	407	509
2017		122	153	205	256	308	411	514
2018	below 120 days	80	100	150	260	313	418	523
	exceed 120 days	124	155	208				

*unit: ₩10,000
LTH: Long-Term care Hospital
Reference: NHIS

1.2. Literature Review

Demand elasticities for healthcare

The concept of price elasticities of demand refers to the percent change of quantity demand in response to the percent change in the price (Folland, Goodman & Stano, 2013).

It can be denoted as

$$E_p = \frac{\Delta Q/Q}{\Delta P/P}$$

Elasticities less than 1 in absolute value are inelastic which means that the demand for goods or services is not sensitive to price, and vice versa. In general, healthcare services are inelastic goods as healthcare services are necessities. Within healthcare services, the price elasticity of demand depends on several factors including the income level or the type of services.

The demand for preventative care or prescription drugs had larger elasticity because those services have substitutes, which highly determine the demand elasticity, such as nutritional supplements and healthy foods. Comparing the elasticities of preventive care and acute care, acute and chronic care showed less price sensitive (−0.32, −0.23), while preventative care showed more sensitivity (−0.43). As income increases, the demand for health services increases as well. The price elasticity of demand depends on whether there is a substitute, degrees of necessity and income level (Hosek *et al*, 2002).

Copayment Ceiling

Previous studies showed the impact of the copayment ceiling

on healthcare utilization and OOP payments. Yoo & Lee (2016) and Lee & Cheong (2017) studied the ceiling change in 2009. Hwang (2019), Park (2020), and Lee (2021) examined the change in 2014. Those studies showed the impact of policy change in health expenditures and healthcare utilization patterns.

Yoo &Kim (2016) and Lee & Cheong (2017) showed the impact of the tiered copayment ceilings in 2009 by comparing income groups. Both studies identified the increase in OOP and health care utilization regardless of income status after the policy change. It also showed that there was a relatively small number of households benefiting from the tiered ceilings. For households with cancer patients, the policy change had no impact on decreasing catastrophic payments.

The policy change in 2014 was assessed by examining its impact on different populations. Hwang (2019) examined only the elderly over 65, while Park (2020) examined all income groups. Lee (2021) dealt with the impact on the low-income population. Hwang (2019) compared the expenditures and utilization in 2013 and 2016. The overall healthcare utilization decreased, albeit the OOP increased. The study identified that there were differences in utilization patterns between income groups. The lower the income level, the more clinic visits (primary care institutions) were shown, while the visits to the tertiary hospital increased as the higher income level. Park (2020) showed that the policy had a positive impact on reducing the OOP burden of low-income elderly. Since the target of the policy is low and middle-income groups, Lee (2021) investigated the impact of change among low-income groups. The overall health expenditure decreased after the ceiling

decreased, but it didn't show a significant change in healthcare utilization. The study predicted the long-term effect on patients with severe diseases. The health expenditure increased right after the policy change, but it showed a decreasing trend in the long run.

Although those studies assessed the copayment ceiling change in 2014, there need to investigate whether the policy ultimately accomplished its objectives, which targeted to decrease the burden of healthcare. With respect to health care utilization and expenditure, changes in household expenditure burden and non-reimbursement expenditure help to evaluate the policy effect.

Catastrophic Health Expenditure (CHE)

Catastrophic health expenditure (CHE) is one of the measures of financial protection in health policy. It is widely used as an indicator to evaluate the performance of the health care system. The definition of catastrophic expenditure is the proportion of health spending to the ability to pay exceeds some thresholds (Wagstaff, 2008). Households that experienced CHE have faced economic difficulties, even the incidence of impoverishment. CHE caused lower expenditure on other items. There is a significant decrease in food consumption, and a decrease in education, transportation, and cultural expenditures (Kim & Yang, 2011). Compared to different Asian countries, Korea showed a high rate of incidence of CHE due to high copayment for inpatient care (Van Doorslaer *et al*, 2007).

The incidence of catastrophic expenditure was differently calculated by defining the ability to pay and the thresholds. The ability to pay is measured by aggregate household income, non-

food expenditure, or total household consumption expenditures. The threshold for the incidence also depends on the ability to pay, most studies used a 10%, 20%, and 40% threshold (Jung *et al*, 2013).

Even though there were heterogeneous calculations of comparability of catastrophic health expenditure, most studies showed that the factors associated with the incidence of CHE are low-income households, female household heads, economic inactivity, low education status, and elderly households (Jung *et al*, 2013).

Several studies showed the factors associated with catastrophic health expenditure in Korea. Chronic disease is one of the factors of the incidence of catastrophic health expenditure. Since chronic diseases are a burden for individuals as well as society, the medical costs vary in terms of the type, severity, and duration of the disease. Choi *et al* (2015) examine which types of conditions caused the high probability of experiencing CHE. household with cerebrovascular disease, diabetes, or chronic kidney diseases had higher odds than other chronic diseases. As those conditions require scrutinizing the conditions regularly to prevent emergencies or hospitalization, frequent utilization and a high probability of unexpected expenditures could be one of the causes for the occurrence of CHE. Lee & Lee (2015) supports that households with frequent hospitalization had an association with a high probability of CHE. Even though the burden of chronic kidney disease is high, there still has been a lack of financial protection policy unlike other severe diseases such as rare diseases, cerebrovascular disease, and diabetes (Choi *et al*, 2015).

Changes in economic activities also affect the experience of

catastrophic health expenditure. Rather than discontinuing economic activities, change in economic activities from inactive to active had a higher odds of experiencing catastrophic health expenditure. Individuals who experienced job loss due to health-related issues were more likely to experience catastrophic health expenditures (Lee *et al*, 2020). It can be expected that the household head's economic activity status, which has the main responsibility for the household economy, is one of the factors of health expenditure and the CHE.

Lee *et al* (2016) compared the catastrophic health expenditure between households with disabled members and without disabled members. Households with disabled members spent about 1.2~1.4 times higher on their disposable income than those without members. The study showed that about one out of ten households with disabled members has spent more than 40% of their living expenditures. The households with disabled members, low-income families without medical aid, elderly disabled members, and disabled members with chronic diseases were more likely to experience catastrophic health expenditures (Roh, 2012; Lee *et al*, 2016).

Non-reimbursement expenditure

Non-reimbursement expenditures are expenses that aren't reimbursed by NHI. It includes a wide range of services; essential medical services, services that are not cost-effective (selective health benefit), and selective services including plastic surgery or skin care. It is hard to identify the relationship between non-

reimbursed services and imbursed services due to their heterogeneity. The non-reimbursed services can be either substitutes or complementary. One can expect that the essential non-reimbursed services are price inelastic to demand, while services such as skin care are price elastic.

Although the non-reimbursed services cover various services, it is evident that an increase in non-reimbursement expenditure negatively affects the health benefits expansion policy. There is relatively little research on non-reimbursement medical expenditure because the data for non-reimbursement expenditure is out of government management. The Korean Health Panel and the department of non-reimbursement at HIRA (Health Insurance Review and Assessment) collect the data for non-reimbursement medical expenditures.

Lee & Lee (2015) concluded that the non-reimbursement expenditure is involuntary regardless of income. Although the relationship between income and non-reimbursement expenditure, there were no significant differences between income levels. Non-reimbursement expenditure accounted for a considerable amount of household health expenditure among low-income households, and it caused a higher probability of occurring catastrophic health expenditures.

Kim & Shin (2017) examined the impact of the 4 main severe disease policy on health expenditure categories. Due to the data, they examined the short-term effect of policy only. The non-reimbursement expenditure somewhat increased among the patients with 4 main severe diseases. Although the services for those severe diseases were gradually included to the reimbursed services,

they stated that the new healthcare technologies, new non-reimbursed services and the expansion of private health insurance could affect the increase in non-reimbursement expenditure.

Yu (2020) analyzed the non-reimbursement expenditure by diseases. Diseases with low coverage rates showed an increase in non-reimbursement health expenditure by year. Especially for musculoskeletal diseases, it showed a high non-reimbursement expenditure. Although the government tried to relieve the expenditure for the four main severe diseases (cancer, cardiovascular disease, cerebrovascular disease, and rare disease), the expenditures were not decreased.

1.3. Purpose of Research

This study aims to evaluate the impact of the copayment ceiling change in 2014 on household health expenditures, the occurrence of catastrophic health expenditures and non-reimbursement expenditures. Since the primary aim of this policy is to reduce the burden of health expenditure among different income deciles, there needs to evaluate whether the policy helps relieve the financial burden. Unlike the change in 2009, there were changes in the ceilings depending on income status, examining the policy effect in terms of equity and validity is needed.

The study examines the summary statistics of household characteristics by income decile; lower 50%, middle 30%, and upper 20%. Then the study analyzes the annual household's OOP spending and the occurrence of catastrophic health expenditures. The annual household's OOP spending includes the annual emergency, inpatient, and outpatients OOP expenditures. For the catastrophic expenditure, 10% and 20%thresholds were used. The study examines the impact on household non-reimbursement expenditure as well. The hypotheses for the study are stated below.

1. Comparing the deciles with a decrease in ceilings in 2014 to the deciles with constant ceilings, the former will show a decrease in OOP expenditure.
2. Comparing the deciles with a decrease in ceilings in 2014 to the deciles with constant ceilings, the former will show a lower odds of the occurrence of catastrophic payments.
3. Comparing the deciles with a decrease in ceilings in 2014 to

the deciles with constant ceilings, the former will show an increase in non-reimbursement expenditure.

4. Comparing the deciles with an increase in ceiling in 2014 to the deciles with constant ceilings, the former will show an increase in OOP expenditure.
5. Comparing the deciles with an increase in ceiling in 2014 to the deciles with constant ceilings, the former will show a higher odds of the occurrence of catastrophic payments.
6. Comparing the deciles with an increase in ceiling in 2014 to the deciles with constant ceilings, the former will show a decrease in non-reimbursement expenditure.

Chapter 2. Methods

2.1. Data Source

The study used the 2012-2015 Korea Health Panel Survey (KHP) to evaluate the effect of the copayment ceiling change in 2014. This study used the data. The KHP data is a publicly available, de-identified secondary data set that includes a rich array of variables related to household characteristics as well as healthcare utilization and expenditures. The data is constructed by KIHASA (Korea Institute for Health and Social Affairs) and NHIS (Korea National Health Insurance Services) to examine the policy effect, access to healthcare services, and other factors that impact healthcare utilization. The analysis only included the households enrolled in the Korean NHI system because the copayment ceiling policy is applied only to NHI patients.

2.2. Study Variables

Defining Study Group

Since the study examines the impact of the copayment ceiling by different income groups and income deciles, the income groups are categorized into three income groups: low-income households (lower 50%), middle-income households (middle 30%), high -income households (upper 20%). The low-income household group includes from 1^{st} to 5^{th} income deciles. The middle-income household group includes from 6^{th} to 7^{th} income deciles. The high-income household group includes the last two income deciles.

Dependent Variables

The primary dependent variables of interest are annual household OOP expenditure, whether the household experienced catastrophic health expenditure and non-reimbursement expenditure. OOP spending, the KHP provides the annual OOP expenditures of emergency, outpatient, and inpatient visits. The data did not provide the amount of reimbursement, the study assumed that all patients had been reimbursed if they exceeded the copayment ceiling. Catastrophic expenditure is defined as if the proportion of household health expenditure to household annual income is greater than 10% and 20%. The non-reimbursement OOP expenditure is defined as the aggregate of reimbursed expenditures of emergency visits, inpatient visits, and outpatient visits.

Independent Variables

The primary independent variables are post-policy, income deciles, and the interaction term between post-policy and income deciles (post × income decile). The post-policy is denoted as time=1, and time=0 before 2014. For the income decile, the reference is the decile whose ceiling had not changed in 2014.

Covariates

The covariates are comprised of household head characteristics, household characteristics that can affect healthcare utilization. The household head' s characteristics include sex, education decile, economic activity status, residence, and marital status. The household characteristics that can influence healthcare

utilization include the number of household members, the presence of disabled members, 65+ elderly members, members who had been hospitalized, and members who have chronic diseases. Whether there is a member who enrolled in private insurance is included as well. [Table 2] shows the study variables in this study.

[Table 2] Study Variables

Variables		Descriptions
Dependent Variable	Annual OOP payment	ln (annual household OOP expenditure for emergency, inpatient and outpatient visits)
	Incidence of catastrophic payment	1= if the catastrophic payment occurs 0= the catastrophic payment has not occurred
	Annual non-reimbursement expenditure	ln (annual household non-reimbursement expenditures for emergency, inpatient and outpatient visits)
Independent Variables	Income decile	reference is the control group
	Intervention	1= 2014 and after (post policy) 0= before 2014
	Income decile × Intervention	interaction term between

[Table 3] (continued)

Variables			Descriptions
Covariates	household head characteristics	Sex	1=Male 0=Female
		Age	continuous
		Residence	2= neither Seoul metropolitan area nor the metropolitan area 1=metropolitan area 0=Seoul metropolitan area
		Education level	2=college graduate 1=high school graduate 0=middle school graduate and below
		Economic activities	1= Yes 0= No
		Marital status	1=married 0= not married, widowed, or divorced
	household characteristics	65+ elderly members	1=Yes 0= No
		Disabled members	1=Yes 0= No
		Experience of inpatient visits	1=Yes 0= No
		Enrolled in private insurance	1=Yes 0= No
		Members with chronic disease	1=Yes 0= No
		Number of household members	continuous

2.3. Statistical Analysis

Panel Data Analysis

The study will use panel data analysis to estimate the effect of policy change on OOP expenditure, non-reimbursement expenditure, and catastrophic health expenditure. Households' annual OOP expenditure and the non-reimbursement expenditure are continuous variables, and the occurrence of catastrophic health expenditure is a binary variable. The advantage of panel data is that it is chronologically obtained from multiple individuals, so it can estimate the dynamic relationships between variables. It can also handle the endogenous problems between entities and outcome variables. The study constructed an unbalanced panel data for 5 years (2012~2015).

The Fixed Effect (FE) model and Random Effect (RE) model are in panel data analysis. The fixed effect estimates the impact of predictors on outcome variables within observation by controlling unobservable time-invariant characteristics. From the (eq 1), where α is the fixed parameter and it is absorbed by the intercept. The advantage of the fixed effect model can minimize the bias from unobservable characteristics, so it can assess the net marginal effect of the predictors (Lee & Hwang, 2015; Min & Choi, 2013). The side effect is the fixed effect cannot investigate the time-invariant causes of the outcome variable, so it loses the degrees of freedom of time-invariant variables.

The random effect model assumes the variation across entities is assumed random and uncorrelated, it can be denoted as $cov(u_i, x_{it}) = 0$, where the regressors and between-entity errors are

not correlated (Min & Choi, 2013). The advantage of using the random effect model is that time-invariant variables can be included. From the (eq 2) the $(\alpha + u_i)$ is considered as a random parameter.

Fixed Effect: $Y_{it} = (\alpha + u_i) + \beta x_{it} + e_{it}$ (eq 1)

Random Effect: $Y_{it} = \alpha + \beta x_{it} + u_i + e_{it}$ (eq 2)

The Hausman test is one of the methods to choose either the fixed effect or random effects model. The null hypothesis is $H_0: cov(u_i, x_{it}) = 0$, where the random effect is appropriate. If the null is rejected at the 1% significance level, the fixed model is recommended. The study used a fixed effect model to identify the policy effect and presented a random effect model to compare. Since the study aimed for comparing the effect within the group, using a fixed effect model is a good way to estimate the marginal effect with consideration of the unobserved heterogeneity.

Linear Probability Model

In general, the logistic model or probit model can be used for estimating binary dependent variables. However, Ai & Norton (2003) pointed out the problem of using a logistic model if the model includes interaction terms. In the non-linear model, the coefficient for the interaction term cannot appropriately estimate the true interaction effect. They criticized that the coefficient for the interaction term does not imply the direction of the interaction effect. If the coefficient term for the interaction term is 0, it does not mean that the true interaction effect is not 0. It cannot test the statistical significance of coefficients using a t-test.

One of the methods for dealing with this problem is a linear probability model (LPM). The linear probability model can be for a binary dependent variable. It can be estimated with a linear model, so the interpretation of the interaction term is quite intuitive. Using a LPM model has the disadvantages of heteroskedasticity and possible to get the estimated probability less than 0 or above 1. The heteroskedasticity problem can deal with estimating robust standard error (Powers & Xie, 1999). Since the robust standard error is estimated, it is hard to do a Hausman test for choosing model.

Regression Model

$$Y_{it} = \beta_0 + \beta_1 time_{it} + \beta_2 incomedecile + \beta_3 time \times treated\ deciles + \beta_4 X_{it} + u_{it} + e_{it}$$

where $Y_{it}$is each outcome variable (annual OOP expenditure, probability of occurring catastrophic health expenditure, and annual reimbursement expenditure). Expenditure variables including OOP and non-reimbursement were taken logarithm to control skewness. i=individual, t=year, time= dummy (bef/aft 2014), income decile= the income deciles that the ceiling had not changed in 2014 are the reference decile, $\boldsymbol{X_{it}}$: covariates, including utilization of inpatient in a household, u_{it}: the unobservable factors , e_{it}: the error term

The statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC) and STATA (Version 17, Stata Corp, College Station, Texas).

Chapter 3. Result

3.1. Descriptive findings

In 2012~2016, a total of 28,242 households are included. [Table 3], [Table 4], and [Table 5] describe the average annual household OOP expenditure, the frequency of the occurrence of CHE, and the annual household non-reimbursement expenditures by different income groups respectively. For all three groups, the average OOP expenditures and non-reimbursement expenditures increased. For the low-income group, the occurrence of catastrophic health expenditure increases, while the highest-income group shows a decrease in CHE occurrence. The middle-income showed mixed outcomes.

[Table 3] Annual household OOP expenditure, the occurrence of CHE, and annual household non-reimbursement expenditure among low-income group

		2012	2013	2014	2015	2016
annual OOP	mean±sd	996,519 ± 1606919.10	1,000,193 ± 1417905.00	1,023,473 ± 1842341.00	1,133,503 ± 2154358.9	1,194,186 ± 2128798
che at 10%	N	469	434	529	595	572
	(%)	19.7	18.51	16.63	19.42	19.29
che at 20%	N	190	161	228	258	250
	(%)	7.98	6.87	7.17	8.42	8.43
annual non-reimbursement	mean±sd	532,249 ± 1,233,629	586,262 ± 1,184,802	554,482 ± 1,189,131	654,214 ± 1,613,884	666,122 ± 1,602,896

[Table 4] Annual Household OOP expenditure and the occurrence of CHE among middle-income group

		2012	2013	2014	2015	2016
annual OOP	mean±sd	1,269,555 ± 2,559,119	1,190,909 ± 1,852,138	1,203,248 ± 2,074,434	1,203,248 ± 1,691,039	1,359,781 ± 2,511,298
che at 10%	N	48	42	60	49	65
	(%)	2.99	2.78	3.02	2.57	3.6
che at 20%	N	20	12	18	15	18
	(%)	1.24	0.79	0.9	0.79	1
annual non-reimbursement	mean±sd	772,449 ± 2,155,875	747,084 ± 1,184,802	745,825 ± 1,749,887	722,693 ± 1,521,374	871,168 ± 1,981,454

[Table 5] Annual Household OOP expenditure and the occurrence of CHE among high-income group

		2012	2013	2014	2015	2016
annual OOP	mean±sd	1,359,872 ± 1,459,436	1,400,408 ± 2,120,618	1,378,786 ± 2,765,360	1,481,269 ± 1,982,383	1,473,329 ± 1,690,775
che at 10%	N	9	6	12	9	5
	(%)	0.89	0.65	0.97	0.78	0.43
che at 20%	N	1	2	5	2	2
	(%)	0.1	0.22	0.4	0.17	0.17
annual non-reimbursement	mean±sd	755,284 ± 1,343,083	856,436 ± 1,889,079	771,866 ± 1,535,268	890,989 ± 1,662,202	918,284 ± 1,778,510

[Table 6] shows the descriptive statistics for low-income households. Among low-income households, from 2012 to 2016, 13,936 households are included. The income deciles include the 1st to 5th income deciles. The household head's characteristics mostly include male, married, below middle school education level, currently doing economic activities, and residing in Seoul metropolitan area. For the household characteristics, the number of household members is 2 on average, and 31% of households have 65+ elderly members. The proportion of households that have a disabled member is 4%, and 29.92% of households have a member with a chronic disease. Within the population, 23.93% of households have at least one private insurance, and the households that experienced the inpatients visit in a year are 27%.

[Table 6] Descriptive statistics of low-income group

variables	sub-groups	Year	2012	2013	2014	2015	2016
		N	2,381	2,345	3,181	3,064	2,965
income deciles	1	N	348	347	491	529	516
		(%)	14.62	14.8	15.44	17.27	17.4
	2&3	N	949	953	1,312	1,272	1,203
		(%)	39.86	40.64	41.24	41.51	40.57
	4&5	N	1,084	1,045	1,378	1,263	1,246
		(%)	45.53	44.56	43.32	41.22	42.02
age		mean±sd	61.09±14.61	61.97±14.71	62.82±14.54	63.76±14.52	64.74±14.77
sex	Male	N	1,741	1,718	2,270	2,138	2,028
		(%)	73.12	73.26	71.36	69.78	68.4
	Female	N	640	627	911	926	937
		(%)	26.88	26.74	28.64	30.22	31.6
marital status	Yes	N	1,628	1,606	2,091	1,940	1,824
		(%)	68.37	68.49	65.73	63.32	61.52
	No	N	753	739	1,090	1,124	1,141
		(%)	31.63	31.51	34.27	36.68	38.48
education level	below middle school	N	1,318	1,293	1,752	1,698	1,638
		(%)	55.35	55.14	55.08	55.42	55.24
	high school graduates	N	713	688	939	874	833
		(%)	29.95	29.34	29.52	28.52	28.09
	college graduates	N	350	364	490	492	494
		(%)	14.70	15.52	15.40	16.06	16.66
economic activities	Yes	N	1,489	1,467	1,999	1,821	1,703
		(%)	62.54	62.56	62.84	59.43	57.44
	No	N	892	878	1,182	1,243	1,262

		(%)	37.46	37.44	37.16	40.57	42.56
number of household members		mean±sd	2.55±1.32	2.54±1.33	2.43±1.28	2.36±1.23	2.28±1.22
65+ members	Yes	N	872	861	851	853	806
		(%)	36.62	36.72	26.75	27.84	27.18
	No	N	1,509	1,484	2,330	2,211	2,159
		(%)	63.38	63.28	73.25	72.16	72.82
residence	seoul metropolitan	N	1,061	1,024	1,451	1,409	1,363
		(%)	44.56	43.67	45.61	45.99	45.97
	metropolitan city	N	544	541	694	687	670
		(%)	22.85	23.07	21.82	22.42	22.6
	others	N	776	780	1,036	968	932
		(%)	32.59	33.26	32.57	31.59	31.43
disabled members	Yes	N	141	140	116	109	110
		(%)	5.92	5.97	3.65	3.56	3.71
	No	N	2,240	2,205	3,065	2,955	2,855
		(%)	94.08	94.03	96.35	96.44	96.29
members with chronic disease	Yes	N	846	823	819	828	777
		(%)	35.53	35.1	25.75	27.02	26.21
	No	N	1,535	1,522	2,362	2,236	2,188
		(%)	64.47	64.9	74.25	72.98	73.79
having private insurance	Yes	N	671	682	631	661	622
		(%)	28.18	29.08	19.84	21.57	20.98
	No	N	1,710	1,663	2,550	2,403	2,343
		(%)	71.82	70.92	80.16	78.43	79.02
inpatient visits	Yes	N	616	601	873	840	827
		(%)	26.07	25.74	27.58	27.51	28
	No	N	1,747	1,734	2,292	2,213	2,127
		(%)	73.93	74.26	72.42	72.49	72

[Table 7] shows the descriptive statistics for middle-income households. Among middle-income households, from 2012 to 2016, 8,823 households are included in this study. The income deciles include the 6^{th} ~8^{th} deciles, which the 8^{th} decile's ceiling was not changed. Regarding household head characteristics, males, married, above college graduate, and doing economic activities are the most. For the household characteristics, the number of household members is 3 on average, and 36% of households have 65+ elderly members. Households that have a disabled member are 5%, and 34.65% of households have a member with a chronic disease. Within the study population, 28% of households have at least one private insurance, and the households that experienced the inpatients visit in a year are 26.6%.

[Table 7] Descriptive statistics of middle-income households

variables	sub-groups	Year	2012	2013	2014	2015	2016
		N	1,607	1,512	1,989	1,909	1,806
income deciles	6&7	N	524	511	664	625	582
		(%)	32.61	33.80	33.38	33	32.23
	8	N	1,083	1,001	1,325	1,284	1,224
		(%)	67	66	66.62	67	68
age		mean±sd	51.48±12.42	51.95±12.27	52.14±12.35	52.50±12.58	53.05±12.50
sex	Male	N	1,466	1,350	1,794	1,702	1,598
		(%)	91.23	89.29	90.2	89.16	88.48
	Female	N	141	162	195	207	208
		(%)	8.77	10.71	9.8	10.84	11.52
marital status	Yes	N	1,385	1,274	1,688	1,599	1,487
		(%)	86.19	84.26	84.87	83.76	82.34
	No	N	222	238	301	310	319
		(%)	13.81	15.74	15.13	16.24	17.66
education level	below middle school	N	384	361	433	393	374
		(%)	23.90	23.88	21.77	20.59	20.71
	high school graduates	N	604	570	737	737	662
		(%)	37.59	37.70	37.05	38.61	36.66
	college graduates	N	619	581	819	779	770
		(%)	38.52	38.43	41.18	40.81	42.64
economic activities	Yes	N	1,398	1,296	1,704	1,600	1,537
		(%)	86.99	85.71	85.67	83.81	85.11
	No	N	209	216	285	309	269
		(%)	13.01	14.29	14.33	16.19	14.89

number of household members		mean±sd	3.39±1.21	3.32±1.23	3.31±1.22	3.25±1.24	3.20±1.22
households with 65+ members	Yes	N	713	663	617	595	542
		(%)	44.37	43.85	31.02	31.17	30.01
	No	N	894	849	1,372	1,314	1,264
		(%)	55.63	56.15	68.98	68.83	69.99
residence	Seoul metropolitan	N	502	518	692	680	665
		(%)	31.24	34.26	34.79	35.62	36.82
	metropolitan city	N	395	348	521	489	439
		(%)	24.58	23.02	26.19	25.62	24.31
	others	N	710	646	776	740	702
		(%)	44.18	42.72	39.01	38.76	38.87
households with disabled members	Yes	N	97	111	98	87	66
		(%)	6.04	7.34	4.93	4.56	3.65
	No	N	1,510	1,401	1,891	1,822	1,740
		(%)	93.96	92.66	95.07	95.44	96.35
households with chronic disease members	Yes	N	687	642	592	565	518
		(%)	42.75	42.46	29.76	29.6	28.68
	No	N	920	870	1,397	1,344	1,288
		(%)	57.25	57.54	70.24	70.4	71.32
households with private insurance	Yes	N	560	514	466	469	414
		(%)	34.85	33.99	23.43	24.57	22.92
	No	N	1,047	998	1,523	1,440	1,392
		(%)	65.15	66.01	76.57	75.43	77.08
households with Inpatient visits	Yes	N	425	371	547	515	493
		(%)	26.48	24.63	27.54	27.03	27.37
	No	N	1,180	1,135	1,439	1,390	1,308
		(%)	73.52	75.37	72.46	72.97	72.63

[Table 8] shows the descriptive statistics for low-income households. Among high-income households, from 2012 to 2016, 5,483 households are included in this study. The income deciles include the 9^{th} ~10^{th} deciles, in which the 9^{th} decile's ceiling was not changed. Regarding household head characteristics, males, married, above college graduate, and doing economic activities are the most. For the household characteristics, the number of household members is 3 on average, and 41% of households have 65+ elderly members. Households that have a disabled member are 5.57%, and 38.83% of households have a member with a chronic disease. Within the study population, 31.16% of households have at least one private insurance, and the households that experienced the inpatient visit in a year are 25.75%.

[Table 8] Descriptive statistics of high-income households

		Year	2012	2013	2014	2015	2016
		N	1,007	923	1,239	1,161	1,153
variables	sub-groups	(%)	18.37	17	22.6	21	21
income deciles	9	N	511	470	639	605	610
		(%)	50.74	50.92	51.57	52.11	52.91
	10	N	496	453	600	556	543
		(%)	49.26	49.08	48.43	47.89	47.09
age		mean±sd	50.71±10.6	51.28±10.95	51.27±10.63	52.06±10.60	52.57±10.66
sex	Male	N	946	872	1,172	1,099	1,087
		(%)	93.94	94.47	94.59	94.66	94.28
	Female	N	61	51	67	62	66
		(%)	6.06	5.53	5.41	5.34	5.72
marital status	Yes	N	911	841	1,100	1,035	1,030
		(%)	90.47	91.12	88.78	89.15	89.33
	No	N	96	82	139	126	123
		(%)	9.53	8.88	11.22	10.85	10.67
education level	below middle school	N	305	277	396	360	374
		(%)	30.29	30.01	31.96	31.01	32.44
	high school graduates	N	143	110	145	133	133
		(%)	14.20	11.92	11.70	11.46	11.54
	college graduates	N	559	536	698	668	646
		(%)	55.51	58.07	56.34	57.54	56.03
economic activities	Yes	N	918	842	1,143	1,034	1,056
		(%)	91.16	91.22	92.25	89.06	91.59
	No	N	89	81	96	127	97
		(%)	8.84	8.78	7.75	10.94	8.41

number of household members		mean±sd	3±1	3.35±1.08	3.31±1.10	3.32±1.12	3.34±1.11
65+ members	Yes	N	503	454	434	397	413
		(%)	49.95	49.19	35.03	34.19	35.82
	No	N	504	469	805	764	740
		(%)	50.05	50.81	64.97	65.81	64.18
residence	Seoul metropolitan	N	257	233	365	336	334
		(%)	25.52	25.24	29.46	28.94	28.97
	metropolitan city	N	249	222	320	299	297
		(%)	24.73	24.05	25.83	25.75	25.76
	others	N	501	468	554	526	522
		(%)	49.75	50.7	44.71	45.31	45.27
disabled members	Yes	N	67	65	65	52	51
		(%)	6.65	7.04	5.25	4.48	4.42
	No	N	940	858	1,174	1,109	1,102
		(%)	93.35	92.96	94.75	95.52	95.58
members with chronic diseases	Yes	N	483	426	414	382	389
		(%)	47.96	46.15	33.41	32.9	33.74
	No	N	524	497	825	779	764
		(%)	52.04	53.85	66.59	67.1	66.26
having private insurance	Yes	N	385	343	327	297	328
		(%)	38.23	37.16	26.39	25.58	28.45
	No	N	622	580	912	864	825
		(%)	61.77	62.84	73.61	74.42	71.55
inpatient visits	Yes	N	276	234	289	320	286
		(%)	27.46	25.43	23.38	27.66	24.83
	No	N	729	686	947	837	866
		(%)	72.54	74.57	76.62	72.34	75.17

3.2. Low-income Population

The low-income group includes the 1st to 5th income deciles. The ceiling of the 4th ~5th income decile had not changed, the ceiling is ₩2,000,000, regarded as a reference group. The ceiling of the 2nd~3rd income decile had decreased to ₩1,500,000, and the ceiling of the 1st decile had decreased to ₩1,200,000. [Table 9], [Table 10] and [Table 11] show the estimation results for each dependent variable respectively. The validity of using a fixed effect regression rather than a pooled regression is shown with F-test; all the p-value for F-test is less than $p<0.0001$. The validity of using a random effect regression rather than a pooled regression is shown with LM (LaGrange Multiplier) test: all the p-value for F-test is less than $p<0.0001$. The reason why the time-invariant variables were estimated in a fixed effect model is that there were some changes in the household's head in the data.

Annual Household OOP expenditure

The Hausman test showed that the fixed effect is recommended. The policy change affected a significant decrease in annual OOP expenditure among the 1st income decile compared to the 4th~5th decile. The annual household OOP decreased by 21.6% ($p<0.01$), while the 2nd ~3rd deciles increased by 8.2% ($p=0.38$). The overall OOP expenditure increased by 3.1% on average sex, marital status, number of household members, residence, having a disabled member in the household and inpatient utilization are the covariates that showed a significant impact on the annual household OOP expenditure at the 5% significance level.

Catastrophic Health Expenditure

At the 10% threshold, the policy change significantly decreased the probability of occurring catastrophic health expenditure. Covariates including having a private insurance, residing a rural area, inpatient utilization and household income showed a significant impact on the chance of CHE.

The threshold at 20% showed that the policy change was effective reducing the chance of CHE for the 2^{nd} ~3^{rd} deciles, but not for the 1^{st} decile. Age, marital status, residence, having a private insurance, household income and inpatient utilization were the covariates that had a significant impact on the chance of CHE.

Annual non-reimbursement expenditure

The Hausman test showed that the fixed model is more recommended than the random effect model. The policy change didn't have a significant impact on household annual non-reimbursement expenditure. Covariates including age, marital status, having a disabled member, and inpatient utilization showed a significant impact on annual non-reimbursement expenditure.

[Table 9] Effect of the copayment ceiling change on annual household OOP expenditure among low-income group

Annual Household OOP Expenditure							
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income level	level1	0.025		0.06	0.004		0.06
	level 2&3	-0.230	**	0.10	-0.307	***	0.09
Time		0.031		0.05	0.100	**	0.05
Income decile ×Time	level1×time	-0.216	***	0.07	-0.187	***	0.06
	level 2&3×time	0.082		0.09	0.095		0.09
Sex	(ref: male)	0.338	*	0.19	0.817	***	0.09
Age		0.055	***	0.01	0.033		0.00
Education level	high school	0.046		0.27	-0.019		0.08
	middle and below	-0.036	*	0.26	0.018		0.08
Marriage	(ref: no)	0.452	***	0.14	1.255	***	0.09
Economic activities	(ref: no)	-0.059		0.06	-0.107	**	0.05
number of household members		0.253	***	0.06	0.257	***	0.03
65+ elderly in the household	(ref: no)	0.941		0.91	-0.106		0.17
Residence	Metropolitan	0.852	***	0.31	-0.093		0.08
	Others	0.518	*	0.28	-0.050		0.07
Private Insurance	(ref: no)	0.059		0.07	0.069		0.06
Household Income	(ref: no)	-0.029		0.03	0.018		0.03
Disabled members	(ref: no)	0.176	**	0.08	0.125	*	0.07
Members with chronic diseases	(ref: no)	0.163		0.16	0.125		0.15
Inpatient utilization	(ref: no)	0.845	***	0.04	0.977	***	0.03
Intercept		8.141	***	0.89	8.766	***	0.49
R-squared	within	0.0677			0.064		
	between	0.0738			0.210		
	overall	0.0536			0.158		
Hausman	P<0.001						

***: p<0.01 ; **: p<0.05; *:p<0.1

[Table 10] Effect of the copayment ceiling change on the occurrence of catastrophic health expenditure among a low-income group (threshold: 10%, 20%)

		Occurrence of Catastrophic Health Expenditure (Threshold:10%)				Occurrence of Catastrophic Health Expenditure (Threshold:20%)			
		Fixed Effect		Random Effect		Fixed Effect		Random Effect	
		β	SE	β	SE	β	SE	β	SE
Income level	level1	0.077	0.01	0.089	0.01	0.002	0.01	-0.004	0.01
	level 2&3	0.271	0.03	0.295	0.02	0.128 ***	0.02	0.114 ***	0.02
Time		0.003	0.01	0.001	0.01	0.002	0.01	0.003	0.00
Income decile ×Time	level1×time	-0.037 **	0.02	-0.035 ***	0.01	0.017 *	0.01	0.020 **	0.01
	level 2&3×time	-0.043 *	0.02	-0.050 **	0.02	-0.062 ***	0.02	-0.054 ***	0.02
Sex	(ref: male)	-0.012	0.05	0.003	0.01	0.019	0.04	0.007	0.01
Age		0.003	0.00	0.002 ***	0.00	0.003 **	0.00	0.000 **	0.00
Education level	high school	-0.066	0.06	0.001	0.01	-0.024	0.04	0.000	0.01
	middle and below	-0.046	0.06	0.005	0.01	-0.014	0.04	0.000	0.01
Marriage	(ref: no)	0.003	0.00	0.053	0.01	0.065 **	0.03	0.043 ***	0.01
Economic activities	(ref: no)	-0.024	0.01	-0.041 ***	0.01	0.000	0.01	-0.017	0.01
number of household members		-0.023	0.01	-0.013 ***	0.00	-0.005	0.01	-0.003	0.00
65+ elderly in the household	(ref: no)	0.164	0.27	-0.032	0.03	0.188	0.26	-0.018	0.02

Residence	Metropolitan	-0.019		0.06	0.001		0.01	-0.090	*	0.05	-0.001		0.01
	Others	-0.119	**	0.05	0.015	*	0.01	-0.107	*	0.05	0.012	**	0.01
Private Insurance	(ref: no)	0.043	***	0.01	0.029	**	0.01	0.022	**	0.01	0.017	**	0.01
Household Income		-0.066	***	0.01	-0.053	***	0.01	-0.065	***	0.01	-0.060		0.01
Disabled members	(ref: no)	0.013		0.02	0.000		0.02	0.012		0.01	-0.009		0.01
Members with chronic diseases	(ref: no)	0.002		0.03	0.004		0.03	-0.005		0.02	0.004		0.02
Inpatient utilization	(ref: no)	0.248	***	0.01	0.274	***	0.01	0.166	***	0.01	0.177	***	0.01
Intercept		1.033	***	0.26	0.842	***	0.16	0.844	***	0.20	0.966	***	0.13
R-squared	within	0.142			0.140			0.11			0.108		
	between	0.241			0.337			0.128			0.227		
	overall	0.1897			0.249			0.1062			0.168		
Hausman	cannot use the Hausman test due to estimating robust standard error												

***: p<0.01 ; **: p<0.05; *:p<0.1

[Table 11] Effect of the copayment ceiling change on household non-reimbursement spending among low-income group

Annual Household Non-Reimbursement Expenditure							
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income level	level1	-0.222		0.17	-0.281	*	0.15
	level 2&3	-0.362		0.26	-0.761	***	0.22
Time		0.227		0.15	0.379	***	0.11
Income decile ×Time	level1×time	0.091		0.19	0.160		0.16
	level 2&3×time	-0.073		0.24	0.002		0.22
Sex	(ref: male)	0.287		0.50	1.044	***	0.19
Age		0.094	***	0.03	0.022		0.00
Education level	high school	-0.127		0.72	0.130		0.15
	middle and below	0.190		0.69	0.278	*	0.16
Marriage	(ref: no)	1.058	***	0.38	2.447		0.19
Economic activities	(ref: no)	-0.116		0.15	-0.342		0.10
number of household members		0.105		0.16	0.289		0.06
65+ elderly in the household	(ref: no)	2.449		2.41	0.125		0.40
Residence	Metropolitan	0.501		0.82	0.090		0.16
	Others	0.856		0.74	0.167		0.13
Private Insurance	(ref: no)	0.172		0.18	0.269	*	0.16
Household Income		-0.010		0.09	0.117	*	0.07
Disabled members	(ref: no)	0.548	***	0.21	0.448	**	0.19
Members with chronic diseases	(ref: no)	0.047		0.43	-0.108		0.37
Inpatient utilization	(ref: no)	2.872	***	0.10	3.421		0.08
Intercept		1.185		2.38	2.934		1.14
R-squared	within	0.0943			0.092		
	between	0.0942			0.257		
	overall	0.0759			0.189		
Hausman	P<0.001						

***: p<0.01 ; **: p<0.05; *:p<0.1

3.3. Middle-income population

The middle-income group includes the 6th to 8th income deciles. The ceiling of the 8th income decile had not changed, the ceiling is ₩3,000,000, regarded as a reference group. The ceiling of the 6th~7th income decile had decreased to ₩2,500,000. [Table 12] and [Table 13], [Table 14] show the estimation results for each dependent variable respectively. The validity of using a fixed effect regression rather than a pooled regression is shown with F-test; all the p-value for F-test is less than $p<0.0001$. LM tests are showed with all the p-value for F-test is less than $p<0.0001$. Since the number of households that experienced CHE at the 20% thresholds is too small, estimation result for threshold at 10% is presented. The reason why the time-invariant variable was estimated in a fixed effect model is that there were some changes in the household's head in the data.

Annual Household OOP expenditure

The Hausman test showed that it is appropriate to use the fixed effect model. The policy change affected a decrease in OOP expenditure by 15.5%, compared to the 8th decile, but not significantly. The overall OOP expenditure significantly increased by 9.7% on average after the policy change. The households with 65+ elderly members, residing outside of Seoul metropolitan area and metropolitan area, and experience of inpatient visits showed a significant impact on annual household OOP expenditure.

Catastrophic Health Expenditure

The probability of occurring CHE had no significant change after the policy change. Compared to the 8th decile, reference group, the chance of CHE had increased but not significantly. Covariates including sex, age, marital status, having a 65+ elderly member in the household, household income and inpatient utilization had a significant impact on the probability of occurring CHE.

Annual Non-reimbursement expenditure

Based on the Hausman test, the fixed effect model is adopted. The 6th~7th deciles showed a significant increase in annual non-reimbursement expenditure compared to the 8th decile ($p<0,05$). Household income, the experience of inpatient utilization and marriage had a significant impact on annual non-reimbursement expenditure.

[Table 12] Effect of the copayment ceiling change on household OOP expenditure among a middle income group.

Annual Household OOP Expenditure							
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income decile	decile 6&7	0.196		0.09	0.229	***	0.08
Time		0.097	**	0.09	-0.033		0.07
Income decile ×Time	decile6&7×time	-0.155		0.10	-0.055		0.08
Sex	(ref: male)	-0.516		0.40	1.275	***	0.12
Age		0.004		0.02	0.029	***	0.00
Education level	high school	-0.362		0.41	-0.014		0.06
	middle and below	-0.287		0.36	0.067		0.79
Marriage	(ref: no)	0.234		0.27	1.823	***	0.11
Economic activities	(ref: no)	0.098		0.13	-0.067		0.08
number of household members		0.067		0.08	0.098	***	0.04
65+ elderly in household	(ref: no)	-0.219	**	0.11	-0.161	**	0.07
Residence	Metropolitan	-0.046		0.40	-0.031		0.08
	Others	-1.210	**	0.47	0.133	**	0.07
Private Insurance	(ref: no)	0.139		0.09	0.128		0.08
Household Income		0.520		0.23	0.856	***	0.17
Disabled members	(ref: no)	0.021		0.10	0.016		0.09
Members with chronic diseases	(ref: no)	0.316		0.19	0.275	**	0.12
Inpatient utilization	(ref: no)	0.814	***	0.05	0.983	***	0.04
Intercept		3.773	***	3.97	-5.774	***	2.99
R-squared	within	0.0527			0.045		
	between	0.0403			0.255		
	overall	0.0408			0.197		
Hausman	P<0.001						

***: p<0.01 ; **: p<0.05; *:p<0.1

[Table 13] Effect of the copayment ceiling change on the occurrence of catastrophic health expenditure among middle-income group

		Occurrence of Catastrophic Health Expenditure (Threshold:10%)					
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income decile	decile 6&7	0.003		0.01	-0.003		0.01
Time		-0.001		0.01	-0.002		0.01
Income decile ×Time	decile6&7×time	0.004		0.01	0.009		0.01
Sex	(ref: male)	-0.105	*	0.06	-0.005		0.01
Age		0.004	**	0.00		***	
Education level	high school	-0.077		0.04	0.000		0.00
	middle and below	-0.095		0.05	-0.003		0.01
Marriage	(ref: no)	-0.085	*	0.05	-0.001		0.01
Economic activities	(ref: no)	0.010		0.02	0.004		0.01
number of household members		0.008		0.01	0.002		0.00
65+ elderly in household	(ref: no)	-0.020	*	0.01	-0.014	**	0.01
Residence	Metropolitan	-0.058		0.05	-0.007		0.01
	Others	-0.013		0.02	0.004		0.01
Private Insurance	(ref: no)	0.014		0.01	0.010		0.01
Household Income		-0.047	*	0.02	-0.040	**	0.02
Disabled members	(ref: no)	-0.004		0.01	0.000		0.01
Members with chronic diseases	(ref: no)	0.006		0.02	0.018		0.01
Inpatient utilization	(ref: no)	0.049	***	0.01	0.071	***	0.01
Intercept		0.752	*	0.42	0.646	**	0.28
R-squared	within	0.0262			0.021		
	between	0.0184			0.082		
	overall	0.016			0.051		
Hausman	cannot use the Hausman test due to estimating robust standard error						

***: p<0.01 ; **: p<0.05; *:p<0.1

[Table 14] Effect of the copayment ceiling change on the non-reimbursement expenditure among middle-income group

Annual Household Non-reimbursement Expenditure							
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income level	decile 6&7	-0.152		0.23	-0.197		0.17
Time		-0.225		0.21	-0.035		0.19
Income decile ×Time	decile6&7×time	0.507	**	0.24	0.519	***	0.20
Sex	(ref: male)	1.133		0.99	1.331	***	0.25
Age		0.034		0.04	0.039		0.01
Education level	high school	-0.830		1.02	-0.073		0.13
	middle and below	0.239		0.89	0.254		0.17
Marriage	(ref: no)	1.164	*	0.67	2.596	***	0.23
Economic activities	(ref: no)	0.519		0.33	0.121		0.17
number of household members		0.194		0.19	0.066		0.08
65+ elderly in household	(ref: no)	-0.109		0.26	0.041		0.17
Residence	Metropolitan	-1.459		1.00	0.136		0.17
	Others	-1.281		1.17	0.189		0.14
Private Insurance	(ref: no)	-0.242		0.23	-0.043		0.19
Household Income		1.345	**	0.58	1.567	***	0.40
Disabled members	(ref: no)	0.010		0.25	-0.042		0.21
Members with chronic diseases	(ref: no)	0.187		0.48	0.154		0.29
Inpatient utilization	(ref: no)	2.527	***	0.13	3.065	***	0.10
Intercept		-16.436	*	9.80	-22.753	***	6.94
R-squared	within	0.078			0.076		
	between	0.134			0.221		
	overall	0.114			0.166		
Hausman	P<0.001						

***: p<0.01 ; **: p<0.05; *:p<0.1

3.4. High-income Population

The low-income group includes the 9th to 10th income decile. The ceiling of the 10^{th} group was increased to 5,000,000, while the reference 9th decile had a constant ceiling. [Table 15], [Table 16], and [Table 17] show the estimation results for each dependent variable respectively. The validity of using a fixed effect regression rather than a pooled regression is shown with F-test; F (18, 3187) =13.08 ($p<0.01$) and F (18, 3187) =14.66 ($p<0.01$), but not for the LPM model for the occurrence of CHE. LM test was used for testing the validity of using a random effect model rather than a pooled model; all model showed the p-value less than 0.05. Since the number of households that experienced CHE at the 20% thresholds is too small, estimation result for threshold at 10% is presented. The reason why the time-invariant variable was estimated in a fixed effect model is that there were some changes in the household's head in the data.

Annual household OOP expenditure

The increase of the ceiling affected the decrease of OOP expenditure for the 10th income decile, but not significant. The Hausman test showed that using the fixed effect model is recommended. Covariates including age, marital status, having a private insurance and inpatient utilization showed a significant impact on annual household OOP expenditure.

Catastrophic Health Expenditure

The fixed effect model was not fit to estimate, so the estimation result of the random effect model is interpreted. There is no big difference between both results. The impact of policy change for the highest decile showed insignificant increase of chance. It is because that the small number of people experienced CHE among the highest group. The descriptive statistics showed that the households who experienced the CHE at the 10% threshold was 50 households on average. Covariates including age, household income, having members with chronic diseases and experienced inpatient utilization showed a significant impact on the chance of CHE.

Non-reimbursement expenditure

The Hausman test showed the fixed effect is an appropriate model. Though the ceiling was increased, the non-reimbursement expenditure after the policy change among the highest deciles, but not significant. The households with the experience of inpatient utilization and having members with chronic diseases showed a significant impact on non-reimbursement expenditure.

[Table 15] Effect of the copayment ceiling change on household OOP spending among high-income group

Annual Household OOP Expenditure							
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income decile	decile 10	-0.008		0.11	-0.163	*	0.09
Time		-0.126		0.12	0.082		0.07
Income decile ×Time	decile10×time	0.012		0.12	-0.001		0.10
Sex	(ref: male)	0.277		0.46	1.784	***	0.18
Age		0.066	***	0.30	0.026	***	0.00
Education level	high school	-0.597		0.64	0.027		0.08
	middle and below	-0.058		0.45	0.234		0.12
Marriage	(ref: no)	1.393	***	0.35	2.606	***	0.15
Economic activities	(ref: no)	-0.103		0.17	-0.116		0.11
number of household members		0.092		0.09	0.228	***	0.04
65+ elderly in household	(ref: no)	-1.020		1.82	-0.133		0.21
Residence	Metropolitan	-0.367		0.56	-0.024		0.11
	Others	-0.194		0.59	0.072		0.09
Private Insurance	(ref: no)	0.003	**	0.10	-0.018		0.09
Household Income		0.006		0.16	0.231	*	0.13
Disabled members	(ref: no)	0.126		0.13	0.063		0.11
Members with chronic diseases	(ref: no)	0.421		0.21	0.266		0.18
Inpatient utilization	(ref: no)	0.911	***	0.07	1.069	***	0.06
Intercept		8.780	***	3.14	4.322	*	2.21
R-squared	Within	0.0688			0.064		
	between	0.1367			0.266		
	Overall	0.1284			0.235		
Hausman	P<0.001						

***: p<0.01 ; **: p<0.05; *:p<0.1

[Table 16] Effect of the copayment ceiling change on the occurrence of catastrophic health expenditure among high-income group

		Occurrence of Catastrophic Health Expenditure (Threshold:10%)					
		Fixed Effect			Random Effect		
		β		SE	β		SE
Income level	decile 10	-0.005		0.01	-0.001		0.00
Time		0.000		0.01	0.000		0.00
Income decile ×Time	decile 10×time	0.002		0.01	0.001		0.00
Sex	(ref: male)	0.062		0.04	-0.006		0.01
Age		0.000		0.00	0.000	***	0.00
Education level	high school	-0.014		0.01	0.002		0.00
	middle and below	0.005		0.00	-0.003		0.01
Marriage	(ref: no)	0.062		0.04	0.001		0.01
Economic activities	(ref: no)	0.006		0.01	-0.002		0.01
number of household members		0.008		0.01	0.001		0.00
65+ elderly in household	(ref: no)	-0.022	*	0.12	-0.007		0.01
Residence	Metropolitan	0.007		0.01	0.000		0.00
	Others	-0.001		0.00	0.002		0.00
Private Insurance	(ref: no)	-0.001		0.00	-0.002		0.00
Household Income		-0.016	**	0.01	-0.012	***	0.00
Disabled members	(ref: no)	-0.005		0.00	0.000		0.01
Members with chronic diseases	(ref: no)	0.015		0.01	0.011	**	0.00
Inpatient utilization	(ref: no)	0.015	***	0.00	0.022	***	0.00
Intercept		0.212		0.13	0.199	**	0.08
R-squared	within	0.0141			0.007		
	between	0			0.028		
	overall	0.0009			0.020		
Hausman	cannot use the Hausman test due to estimating robust standard error						

***: p<0.01 ; **: p<0.05; *:p<0.1

[Table 17] Effect of the copayment ceiling change on household non-reimbursement expenditure among high-income group

Annual Household Non-reimbursement Expenditure						
		Fixed Effect			Random Effect	
		β	SE	β		SE
Income level	decile 10	-0.446	0.28	-0.2		0.17
Time		0.008	0.26	0.218		0.22
Income decile ×Time	decile10×time	0.185	0.28	0.128		0.23
Sex	(ref: male)	-0.307	1.11	2.281	***	0.38
Age		-0.307	1.11		***	
Education level	high school	-0.072	1.53	-0.169		0.17
	middle and below	-0.375	1.07	0.345		0.24
Marriage	(ref: no)	1.193	0.83	3.561	***	0.32
Economic activities	(ref: no)	0.109	0.41	0.062		0.24
number of household members		0.125	0.21	0.375	***	0.08
65+ elderly in household	(ref: no)	-2.762	4.34	-0.825	*	0.46
Residence	Metropolitan	0.763	1.33	0.241		0.22
	Others	1.188	1.40	0.039		0.18
Private Insurance	(ref: no)	0.190	0.24	0.232		0.21
Household Income		0.330	0.30	0.300		0.28
Disabled members	(ref: no)	0.300	0.49	0.306		0.26
Members with chronic diseases	(ref: no)	1.231	** 0.49	0.828	**	0.41
Inpatient utilization	(ref: no)	2.168	*** 0.16	2.990	***	0.13
Intercept		-3.300	7.50	-2.262		4.93
R-squared	within	0.0765		0.073		
	between	0.1078		0.221		
	overall	0.1024		0.177		
Hausman	P<0.001					

***: p<0.01 ; **: p<0.05; *:p<0.1

Chapter 4. Discussion

4.1. Discussion

The current study showed how the copayment ceiling change in 2014 affected household healthcare expenditures. For each income group, the outcomes were shown differently. For all three income groups, the non-reimbursement expenditure increased among the deciles where the copayments had changed. Among the low income group, the OOP significantly decreased in the 1st income decile, while the 2nd ~3rd deciles didn't. The probability of CHE was reduced for both income deciles. Even though the aggregate OOP decreased, there was an increase in non-reimbursement expenditure among the 1st decile. Within the middle-income group, the 6th~7th deciles showed a decrease in OOP expenditure, but the chance of CHE was not. In the high-income group, the highest deciles showed an increase in both OOP expenditure and non-reimbursement expenditure.

For the low-income group, one key finding is that the occurrence of CHE decreased at the 10% threshold, while the 20% didn't. The study suggests that the decrease in ceilings was insufficient for full financial protection. Since the low-income deciles are a near-poor NHI group, previous studies showed that they have a higher probability of occurring CHE compared to the medical aid population, (Park, 2021; Lee&Lee, 2015; Sohn, 2010). One possible reason can be that the ability to pay is low for low-income households. In other words, the absolute amount of income accounts for the denominator, and a small denominator leads to a

higher chance of CHE. Another can be the increase in the numerator, which is the healthcare expenditure. The policy targeted only the reimbursed services. The lowest income decile showed a significant increase in non-reimbursement expenditure, while the household annual OOP expenditure decreased. It can be explained that the effect could be offset.

Among the middle-income group and high-income group, the changes in ceilings were positively related to the annual household OOP. For those groups, it is evident that the impacts of inpatient utilization for each dependent variable are significant. One possible reason can be the increase in inpatient visits in long-term care hospitals. Lim & Shin (2020) identified that a mild case with income deciles more than 7 showed significantly higher odds of overusing the long-term care hospitals.

For all three income groups, the experience of inpatient visits had a significant increase in both health expenditures and the occurrence of CHE. It is evident that the experience of hospitalization increased significantly in health expenditures and CHE (Yoo, 2016; Lee& Lee, 2015; Son, 2010). The study also showed that the experience of inpatient visits had a significant impact on non-reimbursement expenditures. The future study needs to reflect the factors associated with the non-reimbursement expenditures among people who experienced inpatient visits.

The study has several limitations. First, the data didn't provide the amounts of patients reimbursed. The reimbursement fee can be returned if the patient voluntarily claimed to the NHIS. A previous study pointed out that there were very few people who got reimbursed after the change in 2009 (Yoo & Kim, 2016). The

future study should address both pre- and post-reimbursements. Second, the study couldn't reflect the issue of supply-induced demand (SID). It can be expected not only for the patient's side moral hazard but also the provider's side moral hazards since the third party pays for it. Lastly, the effect size can be underestimated due to the small sample size. Though the total sample size to estimate was insufficient, the study conducted multiple sub-group analyses, which made the sample size much smaller. The effect could be underestimated.

Even though the study has those limitations, the study has some strengths. The study included various factors such as having private insurance that affect household healthcare utilization and expenditures. Furthermore, the study examined the impact on the household burden and non-reimbursement expenditure, which evaluated the policy effect from other perspectives. Nowadays, the current government tries to restructure the previous government's health policy. The copayment ceiling is one of its agendas. The ceiling for the upper 30% increased and 105 services for mild diseases at the tertiary hospitals are proposed. Despite considering the sustainability of health insurance financing, policy efforts should be targeted to relieve the burden of the low-income population as well. The study can provide references to improve the policy agenda, which assesses the overall burden.

Chapter 5. Conclusion

The study examined whether the copayment ceiling changes in 2014 improved financial protection by comparing the effect within the income group. The lowest income group showed a significant decrease in household OOP expenditure and the chance of CHE occurrence at the 10% threshold, but not at the 20% threshold. The 2^{nd}~3^{rd} income deciles showed a significant decrease in CHE occurrence at both thresholds. The OOP expenditure increased, while the non-reimbursement expenditure decreased but not significantly. The middle-income group showed a significant increase in non-reimbursement expenditure, while other outcomes showed small changes. The highest income showed a significant increase in non-reimbursement expenditure as well. The non-reimbursement expenditure of but not significantly the middle-income group showed a greater increase than the high-income group. Health policy needs to take into account the ceiling amount as well as the increase in non-reimbursement expenditures.

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국문 초록

2014년 본인부담상한제 개편이 가구 의료비 지출과 의료비 부담에 미치는 영향

홍영은

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본인부담상한제는 질병에 관계없이 가구 의료비 부담을 줄이는 정책으로 법정 본인 부담금에 대해 일정 금액 이상 지출 시 초과 금액을 건강보험공단에서 환급해주는 제도이다. 2009년부터 소득 수준에 따라 차등되기 시작했으며, 2014년도 더 세분화하여 차등하였다. 저소득층의 상한액을 낮추고, 고소득층의 상한액을 높였다. 이전 선행연구에서 본인부담상한제에 대한 여러 연구가 진행되었지만, 가구 의료비 부담과 비급여 의료비 변화까지 살펴본 연구는 부족하다. 본 연구에서는 소득 수준에 따라 본인부담 상한제 개편이 가구 연간 의료비 지출, 재난적 의료비 발생, 가구 연간 비급여 의료비에 미친 영향을 살펴보고자 한다.

본 연구는 2012~2016년 한국의료패널 자료를 활용하여 2014년 본인부담상한제 개편이 가구 의료비 지출, 비급여 의료비 지출, 재난적 의료비 발생에 미치는 영향을 살펴보았다. 본인부담상한제의 개편이 소득 수준 내에서 상한액의 조정되었기 때문에, 소득 수준을 하위 50%, 중위 30%, 상위 20%로 나누어 각각 효과를 비교하였다. 소득 수준 내에서 상한액에 변화가 없는 분위를 대조군으로 두어 상한액 조정에 따른 효과를 살펴보았다. 분석 방법으로는 패널 고정 효과 회귀분석과 선형 확률 모형 (LPM)을 사용하였다.

하위 50%에서는 4~5분위를 대조군으로 두어 상한액이 감소한 집단으로

1분위와 2~3분위의 효과를 비교하였다. 1분위의 연간 가구 의료비는 유의하게 감소하였으나, 2~3분위는 증가하였다. 1분위에서는 재난적 의료비 발생은 역치가 10%일 때 발생 확률이 감소하였으나, 20% 역치에서 증가하였다.2~3분위에서는 10%, 20% 역치 모두에서 재난적 의료비 발생 확률이 감소하였다. 연간 가구 비급여 의료비가 1분위에서 유의하게 증가하였고, 2~3분위에서 감소한 것으로 나타났다.

중위 30%에서는 상한액의 변화가 있는 6~7분위에서 연간 가구 의료비가 감소하였지만, 재난적 의료비 발생 확률이 증가하였고, 가구 비급여 의료비가 유의하게 증가하였다.

상위 20%에서는 상한액이 인상된 10분위에서 연간 가구 의료비, 재난적 의료비 발생 확률, 가구 비급여 의료비가 증가하였지만 모두 유의하지 않았다.

소득차등적 상한액 조정으로 소득집단에 따라 결과가 다르게 나타남을 확인하였다. 대부분의 집단에서 공통적으로 비급여 의료비 지출이 증가한 것으로 나타났다. 상한액 조정과 함께 비급여 의료비 지출을 줄이는 정책적 노력이 필요하다.