

Comparison of Out-of-Pocket Expenditure and Catastrophic Health Expenditure for Severe Disease by Health Security System: based on End-stage Renal Disease in South Korea

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Research

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Abstract

Background: Korea's health security system named National Health Insurance and Medical Aid has revolutionized the nation's mandatory health insurance and continues to reduce excessive copayments. However, few have been studied on healthcare utilization and expenditure according to the health security system in case of severe disease. This study looked at reverse discrimination within end-stage renal disease between National Health Insurance and Medical Aid.

Methods: Subjects were a total of 305 diagnosed with end-stage renal disease in Korea Health Panel from 2008 to 2013. Chi-square, t-test, and ANCOVA were conducted to identify healthcare utilization rate, out-of-pocket expenditure, and prevalence of catastrophic expenditure. Mixed effect panel analysis was used to evaluate total out-of-pocket expenditure over a 6-year trend by National Health Insurance and Medical Aid.

Results: There were no significant differences in healthcare utilization rate in emergency-room visits, admission, or out-patient department visits between National Health Insurance and Medical Aid because healthcare service was essential for a serious disease such as End-stage Renal Disease.

Meanwhile, each out-of-pocket expenditure for admission and out-patient department in National Health Insurance was 2.6 and 3.1 times higher than Medical Aid ($P<0.05$). A total of out-of-pocket expenditure including emergency-room visits, admission, out-patient department visits, and prescribed drug expenditure was 2.9 times higher in National Health Insurance than those of Medical Aid ($P<0.001$). Over a 6-year trend for a total of out-of-pocket expenditure, subjects with National Health Insurance spent more than those of Medical Aid ($P<0.01$). If total household income decile was less than the median and subjects were covered by National Health Insurance, the catastrophic health expenditure rate was 92.2%, but 58.8% in Medical Aid ($P<0.001$).

Conclusion: Serious disease such as end-stage renal disease can result in reverse discrimination depending on the type of health security system. It is necessary to consider those who belong to National Health Insurance but are still poor.

Background

In most countries, the economic gap between the rich and the poor has become more serious in modern society. If healthcare intervention is necessary to sustain life, poverty will be intensified. Therefore, strengthening health equity through inclusive and universal healthcare is an important health agenda in most countries. Health insurance is having a positive effect on dispersing the risk of health financing for people, and the utilization of healthcare services has also increased. However, with the social equity worsening, the level of catastrophic health expenditure (CHE) that each individual or household can't afford was also increasing [1-3]. The CHE is an indicator of how much the burden on healthcare expenditure compared to the household capacity to pay [2]. The basic approach on capacity to pay is consumption or income. Xu et al. (2003) defined CHE exceeding 40% of household consumption expenditure excluding subsistence expenditure (SE) [4]. On the other hand, Wagstaff & van Doorslaer (2003) reported that prepaid income excluding food consumption was the household's capacity to pay. Also, CHE is defined when the out-of-pocket (OOP) medical expenditure exceed 2.5%, 5%, 10%, 15% 20%, 25%, 30% or 40% of household's capacity to pay [5].

Each country has a different type of health security system. Korea National Health Insurance (NHI) system is a major health system that requires mandatory enrollment and is operated by premiums. On the other hand, the Korean Medical Aid (MA) system is operated by a national tax and local tax as a national guarantee for all services used. NHI has been registered by the entire population since 1989, and about 97% of Koreans except MA are currently registered [6-8]. But people have to pay separate premiums every month to guarantee NHI. At this time, the monthly premium is determined by each individual's income and property. In other words, premiums of the richer are much more expensive

than the poor, so the government has already introduced vertical equity. In addition, the government continues to maintain a policy to control the price of medical expenses, thereby providing high-quality medical services at low prices. However, NHI covers only about 56% of the total healthcare costs charged by the utilization of healthcare services [9]. The rest, whether pay more or less, must be paid by the personal OOP expenditure. Therefore, the logic of horizontal equality can be applied to personal co-payment. Therefore, excessive OOP expenditure for the poor can be CHE.

Korea's MA recipients, who account for only about 3% of the population, are the lowest income or inability to maintain a job. It is a way to guarantee the health rights of all people without missing one. MA recipients do not pay a monthly premium. When using healthcare services, there is little or no OOP expenditure. Therefore, it is the largest beneficiary of vertical equity who does not pay any premium and has little personal cost. The nation has chosen MA based on strict screening criteria such as assets, income, and income of family members. Korea's MA system has greatly contributed to the improvement of basic health security for vulnerable groups in low-income families since entering 1977. However, according to the principle of tax reduction, Korea has been providing customized health insurance benefits since 2015 through NHI, and as of 2019, the number of MA recipients was 1,489,000, decrease 19% from 1,841,000 in 2008 [6, 7]. This policy is based on the assumption that there will be no discomfort even if the MA subject goes to NHI.

Different types of health security systems and different coverage rates have created limiting the need for healthcare services or a moral hazard of overusing unnecessary healthcare services. High co-payment is a mechanism for limiting the abuse of medical services, and it is in line with horizontal equity in terms of the need for anyone to pay. Unmet healthcare utilization in previous studies was higher in NHI patients than in MA [8, 10-12]. Also, even with the same disease, the healthcare utilization rate for MA patients was higher than for NHI patients, and the gap continues to rise [13-16]. This is because the price of medical services that each individual has to pay depends on the health security system. However, if healthcare services were vital for life sustaining, even NHI patients couldn't reduce healthcare utilization further. Also, if subjects have a serious illness, whether they have an NHI or MA, healthcare providers may have managed the appropriate treatment following standardized care guidelines. Therefore, the OOP expenditure for the serious disease will vary depending on the type of healthcare coverage, and in some types, poverty can be more likely.

In this study, subjects of serious disease where healthcare intervention is essential such as end-stage renal disease (ESRD) studied to understand the financial burden on each type of health security system. ESRD is stage five chronic kidney disease (CKD) and it requires dialysis, transplantation, and conservative care. For hemodialysis (HD) of ESRD in Korea, the health care expenditure was \$1,561 million in 2014 which increased 32.2% based on that of 2009. The number of patients of dialysis and kidney transplantation (KT) in Korea was 1,446 per million people. Among them, HD was 69.8%, peritoneal dialysis (PD) was 10.0%, and KT was 20.2% [17]. However, the gross expenditure will be larger because the personal co-payment is not included there yet. Even though ESRD is a serious high-cost illness in most countries, healthcare expenditure has not yet clear. In particular, there have been few studies on OOP expenditure on ESRD.

Therefore, it is necessary to understand the financial burden of illness depending on the health security system. Few studies have assessed the fairness of healthcare utilization between the poor who are public guaranteed health benefits from the nation and the general population that was required to set aside insurance expenses to the NHI Corporation. This study aimed to compare healthcare utilization, OOP expenditure, and CHE for ESRD patients between NHI and MA and analyzed a 6-year (2008-2013) Korea Health Panel (KHP) data cross-sectionally and longitudinally. This study can estimate reverse discrimination of ESRD for different types of the healthcare security system. It will also be able to provide basic data for international comparisons of the OOP burden of ESRD patients.

Methods

Design

Using data from 2008 to 2013, this study performed two analyzes, one of which was a pooled time series cross-section analysis (N*T). Another one was a longitudinal analysis that was used to know a time series.

Data source

This study used KHP data from 2008 to 2013 co-organized by the Korea Institute for Health and Social Affairs (KIHASA) and NHI Corporation. KHP data has been nationally representative for decision making about healthcare policy. The KHP is using the extraction framework for the entire 90% of the 2005 census to maintain the national scale for the survey. KHP subjects were selected according to the probability-proportional stratified sampling method and surveyed repeatedly for the same variables annually since 2008. The baseline sample was 7,866 households, 24,616 household members. However, in 2012, 5,856 households and 17,417 household members remained due to panel attrition such as death or rejection of investigation. Accordingly, approximately 2,500 households were extracted as additional samples nationwide and included in the survey starting from the 8th survey in 2013.

The KHP survey primarily surveys about 500 variables. Demographic and sociological characteristics such as households and household members' assets and income per year, family, health security type, registration and type of disability et al.; Health care characteristics such as diagnosed disease, utilization of emergency room, outpatient, and hospitalization and copays per case, medication costs, medical use satisfaction, complementary medical use and costs et al.; additional investigations such as health behaviors and quality of life et al.; private insurance information such as private insurance subscription and types, receipt of private insurance et al. are being investigated. In addition, KIHASA and NHI Corporation generated the total household income decile using the primary data. That was, this was the total household income per year divided by the square root of the number of household members [4], which are classified as the 1st (minimum) and the 10th (maximum). In addition, it applied sampling weight considering the attrition rate of panel data. For this study, IRB formally approved the use of KHP data (KIHASA 2016-01).

Data collection

The panel data were collected annually by trained interviewer visiting house and face-to-face interviewing subjects. To reduce the recall bias about medical records, subjects recorded the OOP expenditure on the medical household account book with the reason for healthcare utilization immediately after visiting the clinics or hospitals. The collection of receipts, the importance of quick records, and how to fill out a medical household account book are continuously educated through guide materials and counseling every year. In addition, the visited interviewer reviewed receipts and confirmed to determine if the records of medical households were accurate. In some cases, to improve accuracy, the actual hospital claim data was checked in a cross. Since it is data over a long period of time, the actual cost was recorded without applying the consumer price index so that even the price fluctuation of the medical service could be known. The collected data will be released to the researchers approximately three years after confirming that it is complete data after undergoing verification of data entry editing, imputation, building weight, variance estimation, and trial data conference finally.

Using variables

This study used the variables of the raw data as possible. For example, gender, survey year, type of health security system (NHI or MA), type of disability, number of comorbidities, visits to the care center: emergency- room (ER), outpatient department (OPD) and inpatient, OOP expenditure, and total household income decile et al.

Comorbidity means any chronic disease diagnosed by medical doctors and had over the past year such as hypertension, diabetes, hyperlipidemia, arthritis, tuberculosis, ischemic heart disease, cerebrovascular disease and others. The various chronic disease presented by the subjects were checked by a trained interviewer and entered into a standardized disease code.

To date, medical expenditure has been analyzed the cost of insurance coverage billed by each hospital. OOP expenditure for each individual was few studied because insurance claims data do not represent individual OOPs. It is very useful to know the gross amount of healthcare expenditure. Therefore, KHP has investigated annual OOP expenditure to decide health policy. OOP expenditures are non-insured benefits or copayments. The copayment is that each person must pay after excluding insured coverage for ER, admission, OPD visits, and prescription drug purchases. Therefore, the copayment of dialysis, transplantation, and conservation care of ESRD were included in OOP expenditure. OOP expenditures were analyzed separately by using them in the ER, admission and OPD visits. Also, to know OOP expenditure of the drug, drug costs were added to the OOP expenditure of ER, admission and OPD visits, then referred to as personal total OOP medical expenditure. The newly created variable for this study using raw data was total household income per year; SE and CHE; a type of healthcare service: dialysis, KT and conservative care.

Originally KHP data generated total household income per year by adding gross earned income and gross asset income in household. Household gross earned income is the sum of all household members' earned income: months worked. Total asset income was a sum of real estate and property income, financial income, social insurance, private insurance, government subsidies, private subsidies, and other income. In this study, total household income per year was adjusted for household size according to the OECD's square root index method [18].

KHP data investigated monthly average living expenses, which excludes savings. For the SE, only the food cost can be applied to apply the extreme poverty line. But when applying the wide poverty line, including food consumption can be applied [5]. In other words, SE was not standardized in all countries. Korea's Ministry of Health and Welfare announced that SE is the minimum cost necessary to maintain a healthy and cultural life. Therefore, in this study, SE was defined as the cost of living after excluding saving and then the consumption equivalence scale was applied to adjust the size of the household [18]. There are several equivalent methods, but we used the OECD square root index. This is a method of calculating equalized personal income by dividing household income by the square root of the number of household members.

In this study, the household capacity to pay was created by subtracting the SE from the total household income, which was adjusted for household size. Then, if it exceeded 40% of the household capacity to pay, it was defined as CHE. In addition, if the household capacity to pay was zero or a negative value, the person was defined as the medical poor [5].

Type of healthcare service such as dialysis, KT and conservative care was a newly created variable for this study. In KHP data, since the type of healthcare service or fee for service of each disease was not investigated. Therefore, we classified the type of healthcare service using disability type. It was classified as dialysis in case of dialysis-disabled by law; KT in case of KT-disabled by law; conservative service in case of absence of disability by law. This is because dialysis patients and undergoing KT are enrolled as Grade 2 and 5 kidney-disabled respectively under the Disabled Welfare Act in Korea.

Study subjects

Of the 111,869 KHP subjects from 2008 to 2013, 305 (0.28%) were diagnosed with ESRD (N18-N19 according to Korea Classification of Diseases-6 code) by medical doctors. When looking at 305 subjects by year, there were 34 in 2008, 47 in 2009, 56 in 2010, 60 in 2011, 52 in 2012, and 56 in 2013.

Statistical analysis

This study conducted cross-sectional analysis and panel analysis. In pooled time series cross-section analysis, chi-square and t-tests were performed to compare demographic characteristics, CHE and the medical poor ratios between NHI and MA. In addition, ANCOVA confirmed total OOP expenditures due to ER, admission and OPD visits, and prescription between NHI and MA. At this time, gender, age, type of healthcare service, and comorbidities were used as covariables. Every OOP expenditure (South Korean Won, KRW) converted to USD (\$) based on the exchange rate on July 1, 2008 (1\$=1,050.89 KRW) [19].

In the panel analysis, the total OOP expenditure trend of subjects for 6 years from 2008 to 2013 were identified. We built three models; a saturated model with an unstructured covariance matrix, a saturated model with a compound symmetry covariance matrix, and the main effects model with a compound symmetry covariance matrix. Then, the final results were presented by the main Effects model, which had the lowest Akaike's Information Criterion and Bayesian Information Criterion.

The statistical test was done after excluding missing data of each variable using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). P values of less than 0.05 were regarded as statistically significant.

Definitions of terms

NHI and MA among Health Security system

In Korea, the health security system has NHI and MA. NHI is an obligatory system for the national people. The people have to pay an insurance fee to NHI Cooperation and then can receive medical benefits if they need it. Their copayment of individuals has been from 20% up to 60% of the total medical fee for each medical service [10, 11]. They pay copayment in admission about 20% of the total fee, and also copayment in OPD visits about 30% ~60% of total fee [11]. In this study, subjects with NHI were 237.

Meanwhile, MA is one of public healthcare assistance program which supports the lowest income group or the person with an incapacity for maintaining their life. Their medical expenses are covered by the national tax and local tax under government responsibility. MA consists of type 1 and types 2. MA type 1 includes persons who are poor and the incapacity of working. MA subjects do not pay any copayment in admission and do pay copayment (\$0.95 or \$1.93) at only OPD visits [11]. MA Type 2 includes people who are poor but can work, different from MA Type 1. There were 68 subjects with MA in this study, which consisted of type 1 (n = 55) and type 2 (n = 3), but we did not classify them separately, because of a small number of subjects.

Table 1. Representative programs of Korean Health Security System

Criteria	NHI	MA
System	Social insurance	Public assistance (Type 1, Type 2)
Subject	All people except MA (Mandatory subscription)	Selecting people who have difficulty living
Finance method	Premiums and Treasury	Tax
Operation& management	Nation & public corporation	National & local government
Insurance premium burden	Proportion of burden according to income level	Non premium
Insurance benefits	Uniformity	Promiscuity
Population (2020)	97.2%	2.8%
Copayment	Admission	20% of total medical expenses
	OPD	60%~30% of total medical expenses
		None
		About \$ 0.95~ \$ 1.93
		Type 1: 5% of special equipment service fee
		Type 2: 15% of special equipment service fee & 15% of medical benefit costs when using secondary or tertiary medical institutions

Results

Sociodemographic characteristics of subjects

Among a total of 305 subjects for 6 years, 237 subjects (77.7%) have NHI and 68 subjects (22.3%) have MA. By year, 34 subjects were in 2008, 47 in 2009, 56 in 2010, 60 in 2011, 52 in 2012, and 56 in 2013. Male was only 41.8% in NHI but was 63.2% in MA. The mean age of subjects with NHI was 61.8 years and MA was 53.9 years. The subjects at and over 65 years were 46.4% in NHI and that of MA was only 19.1%. In terms of healthcare service type, dialysis (n=128) was 39.2% and 51.5% in NHI and MA, renal transplantation (n=21) was 8.0% and 2.9% in NHI and MA, and conservative treatment (n=156) was 52.7% and 45.6% in NHI and MA, respectively. There was no statistical difference. The average of the decile of total household income (lowest 0 to highest 10) was 4.5 in NHI and 2.6 in MA (p<.0001). There were no statistical differences in the number of chronic diseases with 4.5 in NHI and 5.0 in MA (Table 2).

Table 2. Sociodemographic characteristics of study subjects for 6-year

Classification	Total		NHI ¹⁾		MA ²⁾		t or χ^2 score	p-value	
	n	%	n	%	n	%			
All	305	100	237	100	68	100			
Age \pm SD	60.1 \pm 13.6		61.8 \pm 13.5		53.9 \pm 12.2		4.63	<0.0001	
Gender	Male	142	46.6	99	41.8	43	63.2	9.78	0.002
	Female	163	53.4	138	58.2	25	36.8		
Group of age	<65 years	182	59.7	127	53.6	55	80.9	16.36	<.0001
	\geq 65 years	123	40.3	110	46.4	13	19.1		
Survey year	2008	34	11.2	26	11.0	8	11.8	0.98	0.964
	2009	47	15.4	37	15.6	10	14.7		
	2010	56	18.4	43	18.1	13	19.1		
	2011	60	19.7	46	19.4	14	20.6		
	2012	52	17.1	39	16.5	13	19.1		
	2013	56	18.4	46	19.4	10	14.7		
Type of healthcare service ³⁾	Dialysis (HD or PD)	128	42.0	93	39.2	35	51.5	4.39	0.11
	Kidney transplant	21	6.9	19	8.0	2	2.9		
	Conservative care	156	51.2	125	52.7	31	45.6		
Total household income decile \pm SD	4.1 \pm 2.7		4.5 \pm 2.8		2.6 \pm 1.6		7.36	<.0001	
Number of comorbidity \pm SD	4.6 \pm 2.7		4.5 \pm 2.6		5.0 \pm 3.0		-1.24	0.21	

¹⁾ National Health Insurance

²⁾ Medical Aid, type 1 for the incapable of working (n=55) and type 2 for the capable of working (n=13)

³⁾ Of the Type of healthcare service, dialysis was a case that has already been registered for dialysis by law, and kidney transplantation was a case that has already been registered for kidney transplantation by law. However, conservative treatment was an ESRD, but was not subject to registration as by law.

Healthcare utilization according to NHI and MA

The proportion of annual healthcare utilization for pooled 6-year data was identified in NHI and MA; 24.1% and 27.9% in the ER visits; 39.2% and 50.0% in admission; 99.2% and 98.5% in OPD visits, respectively. There were no significant differences. Besides, the annual mean frequency of healthcare utilization in NHI and MA was 1.7 and 1.6 times in ER visits; 2.0 and 2.1 times in admission; and 75.2 and 92.2 times in OPD visits, respectively. There were also no significant differences (Table 3).

Table 3. Annual healthcare utilization according to NHI and MA for 6-year

Classification		NHI ¹⁾ n=237 (%)	MA ²⁾ n=68 (%)	χ^2 score	<i>p</i> -value
				F score	
Emergency-room (n=76)	Visit rate (%)	57 (24.1)	19 (27.9)	0.43	0.513 ₃₎
	Number of visits \pm SE ⁴⁾	1.7 \pm 0.2	1.6 \pm 0.4	0.08	0.701 ₃₎
Admission (n=127)	Admission rate (%)	93 (39.2)	34 (50.0)	2.52	0.113 ₃₎
	Number of admission \pm SE ⁴⁾	2.0 \pm 0.2	2.1 \pm 0.3	0.55	0.816 ₃₎
Out-patient department visits (n=302)	Visits rate (%)	235 (99.2)	67 (98.5)	0.21	0.644 ₃₎
	Number of visits \pm SE ⁴⁾	75.2 \pm 62.6	92.2 \pm 71.9	0.25	0.620 ₃₎

1) National Health Insurance

2) Medical Aid, Medical Aid type 1 (n=55) and Medical Aid type 2 (n=13)

3) The p-value for the h_0 was ≥ 0.05 (h_0 : The utilization rate or frequency is same between NHI and MA)

4) Adjusting for gender, age, type of healthcare service, and number of comorbidities

Means of annual OOP expenditure according to NHI and MA

Using data for 6-year from 2008 to 2013, we compared the annual means of OOP expenditure in ER, admission and OPD visits between NHI and MA. The results were like that in admission, \$2,020.8 and \$692.1 (2.9 times higher in NHI than MA) ($P=0.01$), and in OPD visits, \$1,120.6 and \$290.2 (3.9 times higher in NHI than MA) ($P<0.001$). Also, the total annual OOP expenditure was \$2,154.2 and \$657.5 in NHI and MA (3.2 times higher in NHI than MA) ($P<0.001$). Thus, the expenditure of NHI was several times higher than that of MA (Table 4).

Table 4. Means of annual out-of-pocket medical expenditure (\$¹⁾) by ANCOVA¹⁾ for pooled 6-year

Classification		NHI ³⁾	MA ⁴⁾	F score	p-value	NHI:MA
		Mean ±SE	Mean ±SE			
OOP medical expenditure	Emergency-room visits (n=76)	141.7±34.1	34.2±78.7	1.34	0.250	4.1:1
	Admission (n=127)	2,020.8±251.8	692.1±432.0	6.11	0.01	2.9:1
	Out-patient department visits (n=302)	1,120.6±75.1	290.2±145.5	24.7	<0.001	3.9:1
Total out-of-pocket medical expenditure (n=304) ⁵⁾		2,154.2±142.2	657.5±274.5	22.4	<0.001	3.2:1

1) South Korean Won (KRW) converted to USD (\$) based on exchange rate on July 1, 2008

2) Adjusting for gender, age, type of healthcare service, and number of comorbidities

3) National Health Insurance

4) Medical Aid, Medical Aid type 1 (n=55) and Medical Aid type 2 (n=13)

5) Including expenditure of emergency-room visits, admission, out-patient department plus prescribed drug

A six-year trend for total OOP expenditure by panel analysis

This study analyzed a 6-year trend from 2008 to 2013 for total OOP expenditure according to NHI, and MA. The subjects with NHI had more expenditure over a 6-year trend than that of MA ($P<0.001$). However, there was no significant within differences in NHI or MA over a 6-year trend ($P=0.926$) (Table 5, Fig 1).

Table 5. Trend for personal total out-of-pocket medical expenditure¹⁻³⁾ according to NHI and MA

Classification		Year						F/ p-value	
		2008	2009	2010	2011	2012	2013	A 6-year trend between NHI and MA	A 6-year trend within NHI or MA
NHI ⁴⁾ (n=236)	Subjects	26	36	43	46	39	46	8.13/0.005	0.01/0.911
	Mean ±SE	2,963.6 ±683.9	1,738.9 ±333.1	1,537.1 ±222.7	2,339.1 ±350.4	2,428.5 ±295.2	2,228.1 ±331.7		
MA ⁵⁾ (n=68)	Subjects	8	10	13	14	13	10		
	Mean ±SE	927.0 ±1,365.9	375.2 ±683.6	838.7 ±416.5	663.1 ±655.2	569.5 ±532.7	378.8 ±779.9		

1) Including expenditure of emergency-room visits, admission, out-patient department, and prescribed drug

2) South Korean Won (KRW) converted to USD (\$) based on exchange rate on July 1, 2008

3) Adjusting for gender, age, type of healthcare service, and number of comorbidities

4) National Health Insurance

5) Medical Aid, Medical Aid type 1 (n=55) and Medical Aid type 2 (n=13)

Comparison of catastrophic health expenditure between NHI and MA

In order to know the relationship between OOP expenditure and CHE, the household capacity to pay was calculated after adjusting for the total household income and SE according to the OECD equivalence scale. In group1, there were no statistical differences in CHE for 62.1% and 58.8% in NHI and MA. However, CHE was 92.2% and 58.8% among the NHI under median of total household income decile and MA. The medical poor, in which the household's capacity to pay became more negative, was 21.5% in NHI and 16.2% in MA. In addition, among households with under median household income decile, the medical poor was 34.4%. (Table 6).

Table 6. Comparison of CHE prevalence between NIH and MA

Criteria	Group 1 (n=305)					Group 2 (n=136)				
	All NHI		All MA		F or χ^2 / <i>p</i> -value	NHI with under median of total household income decile		All MA		F or χ^2 / <i>p</i> -value
	n	Mean \pm SE or %	N	Mean \pm SE or %		n	Mean \pm SE or %	n	Mean \pm SE or %	
Total household income per year ¹⁾²⁾	232	15,905.6 \pm 560.9	68	7,356.4 \pm 1,072.6	47.8 / $<$.0001	64	7,037.8 \pm 503.8.	68	8,354.1 \pm 485.4	2.88 /0.09
Subsistence expenditure \pm ubs ¹⁾³⁾	237	11,951.6 \pm 356.4	68	6,809.1 \pm 689.7	42.0 / $<$.0001	68	7,034.3 \pm 362.6	68	7,210.8 \pm 6,493.4	0.10 /0.76
household capacity to pay ¹⁾⁴⁾	232	3,803.7 \pm 368.6	68	478.3 \pm 704.9.	16.8 / $<$.0001	64	215.9 \pm 278.1	68	1,173.5 \pm 268.0	10.53 /0.002
Annual total OOP expenditure ¹⁾⁵⁾	237	2,145.8 \pm 141.8	68	655.1 \pm 274.3	22.32 / $<$.0001	68	1,920.7 \pm 1,549.7	68	617.3 \pm 246.3	19.62 / $<$.0001
Prevalence of CHE ⁶⁾	144	62.1	40	58.8	0.23 /0.63	59	92.2	40	58.8	19.57 / $<$.0001
Medical Poor ⁷⁾	50	21.5	11	16.2	0.94 /0.62	22	34.4	11	16.2	20.70 / $<$.0001

- 1) South Korean Won (KRW) converted to USD (\$) based on exchange rate on July 1, 2008; Adjusting for gender, age, type of healthcare service, and number of comorbidities
- 2) Adding gross earned income and gross asset income in households, and adjusted for household size according to a consumption equivalence scale.
- 3) Minimum cost necessary to maintain a healthy and cultural life excluding savings.
- 4) Household capacity to pay refers to the income that a household can actually use after excluding subsistence expenditure
- 5) Including expenditure of emergency room, admission, out-patient department plus prescribed drug
- 6) The OOP expenditure exceeds 40% of the household capacity to pay
- 7) The household capacity pay is zero or has a negative value, which is a case where the negative value becomes larger when the copayment is paid.

Discussion

Regardless of the difference between the rich and the poor, the right to human health must be guaranteed. To this end, most countries are implementing various policies to ensure the health of the people. In particular, in Korea, there is NHI system that practices universal medical care through horizontal equity that emphasizes the health rights of all people. This is a system that prevents people from falling into poverty due to medical care, as medical services are guaranteed through insurance premiums paid by the people. On the other hand, it has MA system for the inclusive health of low-income families through vertical equity. MA is a public assistance program that supports the right to health of people without living ability under the responsibility of the nation and local governments. The selection of MA beneficiaries is for persons recognized by the Minister of Health and Welfare as needing medical benefits, recipients for basic life security, people without family guard, homeless people, disaster victims, adoptive children, etc. MA is a social safety net that resolves poverty after health problems happen without paying premiums.

Actually, resources are finite. Health policy for vertical equity requires financial resources and may be unfair from the standpoint of certain classes that value horizontal equity. In other words, new blind spots, reverse discrimination can emerge with the reinforcement of inclusive medical care that emphasizes vertical equity. However, the scientific evidence for these health care issues is important for policy development. Health equity, fairness, and the relationship between poverty and health must be explored in a variety of ways. One of them is the difference in OOP expenditure under the health care system. In particular, ESRD is a high-cost chronic disease that requires kidney replacement therapy such as HD, PD, and KT. Therefore, it prioritizes the life-sustaining effect as a disease serious enough that the efficiency cannot be considered. However, few studies have been done on OOP expenditure on ESRD, especially the comparison of NHI and MA. In addition, most ESRD patients need lifelong treatment. Therefore, it is important to understand the OOP tendency of ESRD by the health security system.

In this study, 305 (0.27%) out of 111,869 subjects in the 6-year panel data were diagnosed with ESRD. The prevalence per 1 million was 2,726 which was higher than the prevalence of 1,446 Koreans published in 2013. This can be inferred because of the basic nature of the panel data that oversamples the vulnerable person such as low-income and disabled, etc. Among them, 77.7% belong to NHI and 22.3% belong to MA, which was a much higher distribution than only about 3% of MA among the Korea population. It could be interpreted that ESRD subjects are frail enough to warrant protection by the country. The elderly subjects were 46.4% among NHI, and that of MA was only 19.1%. The

mean age of subjects with MA was 53.9 years, which was younger than 61.8 years of NHI. The reason why the MA subjects are relatively younger can be thought of as a large number of innately vulnerable people including the genetic disorder, disabled, homeless and adopted person, etc. So, people in MA can live longer in ESRD status than in NHI subjects. Also, the common causes of ESRD are chronic diseases like diabetes and high blood pressure. It will be more increased due to aging in most societies [17, 20]. Therefore, we should also consider preventive strategies to ease the burden on individuals and countries due to ESRD.

For a severe disease such as ESRD, healthcare utilization did not differ significantly between NHI and MA. This was a different result from the previous study. In previous studies, including all diseases, MA subjects were using more health care than NHI beneficiaries. This was because the burden of copayment was relatively low than NHI. They used 1.4 times more OPD and 1.6 times more admission [13-15]. In particular, patients with NHI but low income had significantly lower medical use than patients with MA [8, 21-24]. In contrast, in this study, there was no statistical difference in the rate and frequency of healthcare utilization in ER, admission and OPD visits between NHI and MA. Therefore, in the case of serious disease such as ESRD, health care can no longer be reduced regardless of the type of healthcare system. Because the treatments they receive are essential for survival.

Regardless of the equivalent healthcare utilization, annual OOP expenditure was significantly unequal between NHI and MA. Subjects with NHI had more OOP expenditure than MA. OOP expenditure of admission was 2.9 times (\$ 2,020.8 vs. \$ 692.1) ($P=0.01$) and of OPD visits was 3.9 times (\$ 1,120.6 vs. \$ 290.2) ($P<0.001$). Also, ESRD subjects with NHI expended more OOP expenditure over 6-year than that of MA ($P=0.005$). In addition, in a previous study that included all diseases, the OOP expenditure of NHI was 1.5 times that of MA, which was relatively lower than with ESRD disease [8]. Thus, subjects with a serious disease like ESRD with the NHI faced a much greater economic burden than those with MA. Furthermore, subjects with high OOP expenditure are more likely to face the risk of CHE [25-28]. CHE was compared between subjects with NHI under the median of household income decile and with MA. CHE was 92.2% and 58.8% among the NHI and MA. Also, the medical poor, in which the household's capacity to pay became more negative, was 34.4% in NHI and 16.2% in MA.

The meaning of this study is to identify the actual burden on ESRD because the cost studies in the previous have been based on insurance claims data [17, 29-34]. The detailed meaning is as follows. First, in serious diseases such as ESRD, the NHI subject's medical use was equivalent to MA. Second, in subjects with NHI, OOP expenditure was higher and more CHE than MA. Third, the higher OOP expenditure burden in NHI than MA was identified over a 6-years trend from 2008 to 2013. Higher OOP expenditure has been reported to have disadvantages that impede healthcare utilization when inevitably seek health care [35-40]. Therefore, NHI subjects with a severe disease such as ESRD have a greater financial burden than MA. Health policies should be able to provide more medical care to those who need more medical care [41]. We noted the possible factors leading to this discrimination. Korea has recently emphasized universal and inclusive medical welfare. However, unlike this phenomenon, the number of recipients of MA has gradually decreased in Korea. In 2006, it was 1,711,076 people, which was 3.8% of Korea's total population. In 2020, it is 1,496,000, which is 2.8% of the nation. About 215,000 people have decreased in MA [11, 14]. This was because there has been a transformation in the MA system for stabilizing national healthcare finances. Therefore, people who have to be covered by MA are likely to be included in NHI. Also, the possibility of CHE would be increased.

Healthcare policymakers should consider to mitigate the medical burdens of those who belong to the NHI but are poor. Suggestions for this study is first, in the selection criteria of MA, not only the subject's property and workability are considered, but disease requiring long-term treatment and CHE should be used as selection indicators. Second, if the size of MA cannot be increased according to the policy, if it belongs to NHI but is medical poor, it is necessary to find a way to pay health subsidies. Third, for those who have not yet converted from CKD to ESRD, it is necessary to seek a

program to prevent further progress by being registered by an academic society or public interest social group. In addition, a new prevention policy model, such as the payment of prevention incentives to the subject, could be considered.

Even though, this study aimed to identify OOP expenditure and CHE of serious diseases such as ESRD according to the health security system, but there are many limitations. First, in this study, OOP expenditure was not analyzed fee for service of ESRD but integrated expenditure on ESRD. This is because, the fee for services such as dialysis, KT and conservative care of ESRD could not be distinguished from the raw data. Second, the data of this study have accumulated data of relatively rare ESRD over the years, and despite a large number of survey variables, the patient's disease history could not be explored. It is necessary to explore inequity according to disease progression. Third, this study found the reverse discrimination of ESRD by health security system, but it was the result of not controlling household income in the baseline. Therefore, the causal relationship between disease and poverty has not been revealed. If the number of subjects who are included is more and the follow-up period is longer, an attempt to know causal relationship is necessary. Fourth, the OOP expenditure of this study excluded indirect costs such as transportation and salary stoppages. Therefore, it must be estimated to be less than the actual cost of health care. Fifth, although the subject of ESRD is characterized by a relatively rare and serious disease, it is not possible to exclude the possibility of type 2 error because of the small size of the subject.

Conclusion

Strengthening health equity is an important health agenda in most countries. In Korea, in the case of ESRD subjects, healthcare utilization between NHI and MA was the same because of the severity. Meanwhile, a 6-year trend showed that the OOP expenditure in NHI was higher consistently than those of MA. In other words, the healthcare service of severe disease such as ESRD with NHI was that they could no longer reduce medical services to survive despite higher medical expenditure than MA. As a result, NHI subjects are experiencing more CHE than MA subjects. The significance of this study was to identify inequity between NHI and MA through serious disease such as ESRD. Therefore, healthcare policymakers should consider to mitigate the medical burdens of those who belong to the NHI but are poor.

Abbreviations

CHE: catastrophic health expenditure

SE: subsistence expenditure

OOP: out-of-pocket

NHI: National Health Insurance

MA: Medical Aid

ESRD: end-stage renal disease

CKD: chronic kidney disease

KT: kidney transplantation

HD: hemodialysis

PD: peritoneal dialysis

KHP: Korea Health Panel

KIHASA: Korea Institute for Health and Social Affairs

ER: emergency-room

OPD: out-patient department

KRW: South Korean Won

Declarations

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Availability of data and materials

The authors submitted the study plan to the Korea Health Commission (KHP) Data Management Agency (KIHASA) and received the data officially. This data information found to the following link sites:

<https://www.khp.re.kr:444/eng/main.do>

Authors' contributions

Author, Sun Mi Shin, described the manuscript after planning the study design, performing statistical analysis, and verifying the quality of data.

Author, Hee Woo Lee, edited the manuscript after first review, planning the study design, re-analyzed data, and verifying the quality of data.

References

1. Kazemi-Galougahi MH, Dadgar E, Kavosi Z, Majdzadeh R. Correction to: Increase of catastrophic health expenditure while it does not have socio-economic anymore; finding from a district on Tehran after recent extensive health sector reform. *BMC Health Serv Res.* 2019;19(1):702.
2. Woo KS, Shin Y. The Effect of Catastrophic Health Expenditure on Household Economy: Focusing on Financial Coping and Poverty. *Health and Social Welfare Review.* 2015;35(3):166-98
3. Mehraban, S., Hajimoladarvish, N., &Raghfar, H. The Place of Health Insurance in Reducing Catastrophic Health Expenditure. *ehraban, S., Hajimoladarvish, N., &Ra*2018;7(2):239-254.
4. Xu K, Evans DB, Kawabata K, Zeramdini R, Klavus J, Murray CJ. Household catastrophic health expenditure: a multicountry analysis. *Lancet.* 2003;362(9378):111-17.

5. Wagstaff A, van Doorslaer E. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993-1998. *Health Econ.* 2003;2(11):921-34.
6. National Health Insurance System of Korea. Available from: https://www.nhis.or.kr/menu/retrieveMenuSet.xx?menuId=B1000_ Accessed 30 July 2020.
7. National Health Insurance Service. Medical-Aid Statistics annual report 2012. Available from: https://minwon.nhis.or.kr/menu/retrieveMenuSet.xx?menuId=MENU_WBMAD01. Accessed 30 July 2020.
8. Choi JW, Park EC, Chun SY, Han KT, Han E, Kim TH. Health care utilization and costs among medical-aid enrollees, the poor not enrolled in medical-aid, and the near poor in South Korea. *Int J Equity Health.* 2015;4:128.
9. OECD. Health at a glance 2013: OECD indicators. Available from: <https://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf>. Accessed 22 Nov 2019.
10. Lee JE, Shin HI, Do YK, Yang EJ. Catastrophic Health Expenditures for Households with Disabled Members: Evidence from the Korean Health Panel. *J Korean Med Sci.* 2016;31(3):336-44.
11. Korea Insurance Charge Review Association. Available from: <https://www.hira.or.kr/dummy.do?pgmid=HIRAA030057020000>. Accessed 24 Nov 2019.
12. Heo J, Oh J, Kim J, Lee M, Lee JS, Kwon S, Subramanian SV, et al. Poverty in the midst of plenty: unmet needs and distribution of health care resources in South Korea. *PLoS One.* 2012;7(11):e51004.
13. Kim JH, Lee KS, Yoo KB, Park EC. The differences in health care utilization between Medical Aid and health insurance: a longitudinal study using propensity score matching. *PLoS One.* 2015 Mar 27;10(3):e0119939.
14. Shin SM, Kim ES, Park CK, Lee HW. [The medical use of the disabled among overusers of Medical Aid in Korea]. *J Prev Med Public Health.* 2010;43(1):35-41.
15. Shin SM, Kim ES, Lee HW. The contributing factors to surplus medicine by long-term users of medical aid in Korea. *J Prev Med Public Health.* 2009;42(6):403-7.
16. Shin SM, Kim MJ, Kim ES, Lee HW, Park CG, Kim HK. Medical Aid service overuse assessed by case managers in Korea. *J Adv Nurs.* 2010;66(10):2257-65.
17. Jin DC. Dialysis registries in the world: Korean Dialysis Registry. *Kidney Int Suppl* (2011). 2015;5(1):8-11.
18. 20OECD (2011), Divided We Stand world: Korean Dialysis Registry. KidneAvailable from: <http://www.oecd.org/social/inequality.htm>_Accessed 30 July 2020.
19. Historic Exchange Rates (South Korean Won). Available from: <http://www.x-rates.com/historical/?from=KRW&amount=1&date=2017-07-20>. Accessed 24 Nov 2019.
20. Kim SH, Kim YK, Yang CW. The efficacy of dialysis adequacy. *J Korean Med Assoc.* 2013; 56: 583-91.
21. Joo JM, Kwon SM. Difference in outpatient medical expenditure and physician practice patterns between medicaid and health insurance patients. *Korean J. of Health Policy & Administration.* 2009;19:125-41.
22. Kim CW. A difference in utilization of cancer inpatient services by income class of residents in Juju Island. *Korean J. of Health Policy & Administration.* 2003;13:104-28.

23. Cheng TM. Taiwan's new national health insurance program: genesis and experience so far. *Health Aff (Millwood)*. 2003 May-Jun;22(3):61-76.
24. Lu JF, Hsiao WC. Does universal health insurance make health care unaffordable? Lessons from Taiwan. *Health Aff (Millwood)*. 2003;22(3):77-88.
25. Aregbeshola BS, Khan SM. Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria 2010. *Int J Health Policy Manag*. 2018;7(9):798-806.
26. Bose M, Dutta A. Inequity in hospitalization care: a study on utilization of healthcare services in West Bengal, India. *Int J Health Policy Manag*. 2014;22;4(1):29-38.
27. Chiang JK, Chen JS, Kao YH. Comparison of medical outcomes and health care costs at the end of life between dialysis patients with and without cancer: a national population-based study. *BMC Nephrol*. 2019;20(1):265
28. Wachterman MW, Hailpern SM, Keating NL, Kurella Tamura M, O'Hare AM. Association between hospice length of stay, health care utilization, and medicare costs at the end of life among patients who received maintenance hemodialysis. *JAMA Intern Med*. 2018;178(6):792-9.
29. Jin DC, Yun SR, Lee SW, Han SW, Kim W, Park J, Kim YK. Lessons from 30 years' data of Korean end-stage renal disease registry, 1985-2015. *Kidney Res Clin Pract*. 2015;34(3):132-9.
30. Liao M, Li Y, Kianifard F, Obi E, Arcona S. Cluster analysis and its application to healthcare claims data: a study of end-stage renal disease patients who initiated hemodialysis. *BMC Nephrol*.2016;17:25.
31. Jin DC, Yun SR, Lee SW, Han SW, Kim W, Park J. Current characteristics of dialysis therapy in Korea: 2015 registry data focusing on elderly patients. *Kidney Res Clin Pract* 2016; 35: 204-11.
32. Berger A, Edelsberg J, Inglese G, Bhattacharyya S, Oster G. Identification of patients receiving peritoneal dialysis using health insurance claims data. *Clin Ther*. 2009;31(6):1321-34.
33. Taneja C, Berger A, Inglese GW, Lamerato L, Sloand JA, Wolff GG, et al. Can dialysis patients be accurately identified using healthcare claims data? *Perit Dial Int*. 2014;34(6):643-51.
34. De Vecchi AF, Dratwa M, Wiedemann ME. Healthcare systems and end-stage renal disease (ESRD) therapies—an international review: costs and reimbursement/funding of ESRD therapies. *Nephrol Dial Transplant*. 1999;14 Suppl 6:31-41.
35. Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T. Protecting households from catastrophic health spending. *Health Aff (Millwood)*. 2007;26(4):972-83.
36. Masiye F, Kaonga O. Determinants of Healthcare utilisation and Out-of-Pocket Payments in the context of Free public primary healthcare in Zambia. *Int J Health Policy Manag*. 2016;5(12):693703..
37. Masiye F, Kaonga O, Kirigia JM. Does User Fee Removal Policy Provide Financial Protection from Catastrophic Health Care Payments? Evidence from Zambia. *PLoS One*. 2016;11(1):e0146508.
38. Nundoochan A, Thorabally Y, Monohur S, Hsu J. Impact of out of pocket payments on financial risk protection indicators in a setting with no user fees: the case of Mauritius. *Int J Equity Health*. 2019;18(1):63.
39. Aregbeshola BS, Khan SM. Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria 2010. *Int J Health Policy Manag*. 2018;7(9):798-806.

40. Koch KJ, Cid Pedraza C, Schmid A. Out-of-pocket expenditure and financial protection in the Chilean health care system-A systematic review. *Health Policy*. 2017 May;121(5):481-494.
41. Wang SI, Yaung CL. Vertical equity of healthcare in Taiwan: health services were distributed according to need. *Int J Equity Health*. 2013;12:12. Published 2013 Jan 31. doi:10.1186/1475-9276-12-12

Figures

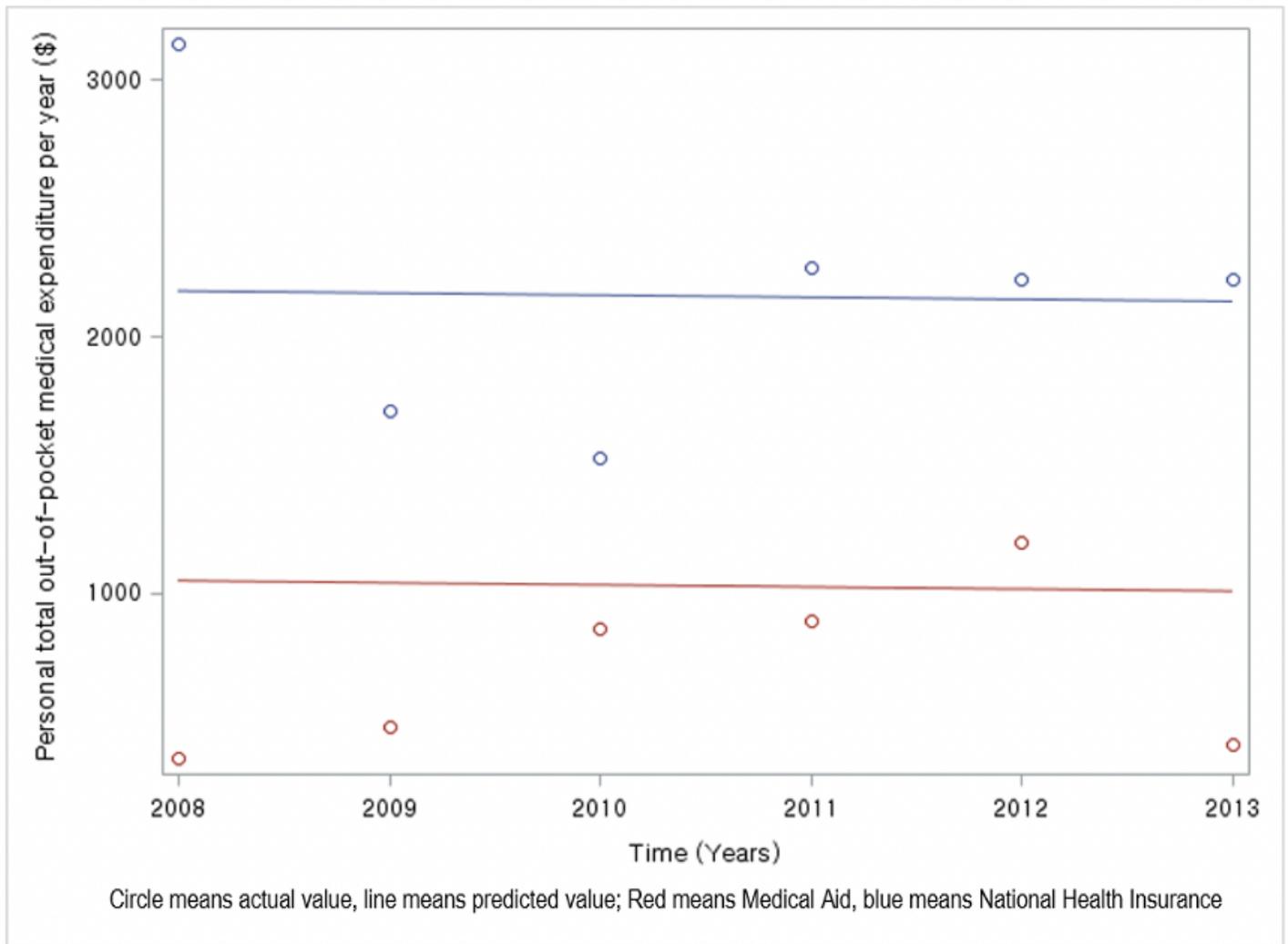


Figure 1

Personal total out-of-pocket healthcare expenditure by health security system¹⁾ 1) Adding all expenditure of emergency-room visits, admissions, OPD visits, and of buying the prescribed drugs. There was a difference between NHI and MA over the 6-year trend for total personal out-of-pocket medical expenditure ($P < 0.01$).