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Effects of private health insurance on healthcare services during the MERS Pandemic: Evidence from Korea☆

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ABSTRACT

This study investigates how private health insurance impacted healthcare services during the MERS pandemic in Korea. Using the Korea Health Panel Study (KHPS), this study examines the difference in healthcare utilization between insured and uninsured individuals during the pandemic. If insured individuals use fewer healthcare services than the uninsured during the MERS pandemic, it could be evidence of moral hazard. During the MERS outbreak, the probability of outpatient medical services utilization was lower by 19 % than during non-pandemic periods. All individuals decreased the number of outpatient visits by 7 %. Insured individuals reduced outpatient visits more than the uninsured in response to the MERS pandemic. The increased outpatient utilization by private health insurance could be attributed to both moral hazard and adverse selection. However, given that people with poor health cannot enroll in private health insurance due to the insurance company's screening process, moral hazard leads to increase healthcare utilization rather than adverse selection.

1. Introduction

Pandemics prevent people from using healthcare services for a wider range of reasons. In the perspective of healthcare services' demand, fear of infection might reduce the demand of healthcare services. Emergencies such as the spread of infectious disease can cause workers to temporarily lose their jobs and employer sponsored health insurance, which also leads to reduced healthcare demand. In addition, social distancing policies, such as stay-at-home, work from home, and closure of daycare or school, also reduce medical demand by restricting mobility. From the perspective of the supply of healthcare services, medical providers can temporarily restrict the treatment of patients to focus on the treatment of infected patients [1–7]. Finally, the spread of infectious diseases can change an individual's healthy behaviors. If an epidemic poses a health risk such as infection, people will be able to change their healthy behaviors as much as possible to reduce their health risks. Healthy behaviors such as wearing masks, handwashing, quitting smoking or drinking, and physical activities can unintentionally improve their health [8–11].

Before the worldwide COVID-19 pandemic, the 2015 Middle East respiratory syndrome (MERS) was another example of an infectious disease outbreak. The MERS outbreak in Korea began with Korean traveler who had visited the Middle east. The Korea Disease Control and Prevention Agency confirmed the first MERS patient on May 20, 2015, and was followed by 186 people infected and 38 fatalities as of 2016. The World Health Organization (WHO) declared the end of the MERS outbreak in Korea on December 23, 2015

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[12].

This study first examines changes in healthcare services such as inpatient, outpatient, and emergency department services before, during and after the MERS pandemic. Second, this study also examines the difference in the utilization of healthcare services between those with and without private health insurance. During the 2015 MERS pandemic, demand for essential healthcare services might be maintained, while demand for non-essential medical care could decrease sharply. Especially, compared between two groups: those who have private health insurance and those who have not. That difference in reduced medical services might be the measure of moral hazard for individuals with private health insurance. Moral hazard refers to the situation where individuals with health insurance are more likely to use healthcare utilization than individuals without health insurance, because more of medical expenses are covered by the insurance [13,14]. If the MERS epidemic affected two groups, comparing the magnitude of decline can uncover the extent of excessive medical care by moral hazard of those who have private health insurances.

This study contributes to literature in several ways. First, the 2015 MERS pandemic provides an opportunity for considering the difference in healthcare utilization between those who have private health insurance and those who have not. Unlike the COVID-19 pandemic, the MERS pandemic lasted only about two months and had a relatively small number of cumulative confirmed cases. During the pandemic, fear of infection mainly caused patients or potential patients to decrease their demand for healthcare services. Due to a relatively short period of pandemic, there is no need to consider other demand and supply factors to contribute to the decrease in the use of medical services. Second, to the best of my knowledge, this is the first to provide some new evidence on moral hazard of those who have private health insurances using the exogenous shock such as the 2015 MERS outbreak in Korea.

2. Background and literature

2.1. Background

2.1.1. MERS

MERS is an acute respiratory infection caused by a coronavirus. In 2015, South Korea experienced a significant outbreak of Middle East Respiratory Syndrome (MERS), which prompted widespread concern and had a noteworthy impact on the nation. The MERS outbreak in South Korea commenced in May 2015, following the infection of a South Korean who had previously traveled to the Middle East, subsequently contracting the virus. Since he was later diagnosed with MERS, the virus rapidly disseminated within the country, primarily attributable to transmission within healthcare settings. This epidemic was declared over on December 2015 [12]. (.

2.1.2. Health insurance in Korea

The health insurance system in Korea has a unique structure. First, public health insurance, which had been launched in 1977, was completed for the entire population in 1989. Almost the whole population was covered by public health insurance in a short period by firstly setting high level of patient cost sharing and low insurance coverage in return for low prices for medical procedures and low premium.

Medical expenses are divided into two parts: insured benefits and non-insured benefits. Insured benefits are covered by the National Health insurance, while the non-insured benefits are covered by patients' out of pocket expenses. Medical fees for the insured benefits are determined by the Health Insurance Review and Assessment Service. The National Health Insurance typically covers a significant portion of the costs associated with inpatient services, including hospitalization, surgeries, and treatments for various medical conditions. Insured outpatient services, which are visit to hospital, diagnostic tests, prescription medication, and other treatment, are also covered by the National Health Insurance. On the other hand, those for the non-insured benefits are determined by individual medical service providers. Non-insured benefits in South Korea are those services or treatments that are not covered by the National Health Insurance, and patients are responsible for the full cost. These services typically include elective or cosmetic procedures, certain prescription medications, and alternative therapies. Additionally, there may be restrictions on the frequency or extent of coverage for some treatments. Therefore, private health insurance has focused on providing coverage for non-insured benefits. However, because the coverage of the National Health Insurance is not comprehensive, the demand for private health insurance for actual medical cost has increased as the population ages and the proportion of out-of-pocket medical expenses increases. The private health insurance has around 34 million policy holders and guarantees cost-sharing for the insured benefit parts and covers non-insured benefits that are not covered by the National Health Insurance. Overall, of the total medical expenses in Korea, 65.3 % are covered by the National Health Insurance, with the statutory patient cost-sharing being 19.5 % and the non-insured part being 15.2 %. Private health insurance in Korea typically covers various aspects of healthcare. This covers co-payments, deductibles, and services not fully covered by the National Health Insurance.

2.2. Literature

2.2.1. MERS

There are several previous literatures that analyze the impact of MERS on medical service utilization. Among them, Seo (2016) used data from the Health Insurance Review and Assessment Service to find that there was a reluctance to use medical institutions for outpatient visits in June during the MERS pandemic, and that the number of outpatient visits to tertiary hospitals decreased as well [15]. confirmed a decrease in emergency room visits for unnecessary mild patients in tertiary hospitals and a decrease in emergency room stay time for hospitalized patients during the MERS epidemic. Since the first reported case in Saudi Arabia in 2012, MERS has occurred only in the Middle East region, and the only epidemic case outside of the Middle East region occurred in Korea in 2015.

Therefore, studies analyzing the impact of MERS infection on medical services use are very rare.

2.2.2. Private health insurance and healthcare utilization

Previous studies including [13,14]; explained that health insurance leads to excessive medical care due to information asymmetry between insurers and insured, which is called "Moral Hazard". If moral hazard exists, it becomes impossible to provide the first-best insurance contract. Therefore, the existence and size of moral hazard should be considered for designing optimal insurance [16]. However, estimating the effect of moral hazard is empirically challenging. In addition to moral hazard, adverse selection occurs when insurance premiums rise, and individuals with lower risks may reduce their coverage or withdraw from insurance. Accurately identifying this effect depends on separating the effect of adverse selection [17].

The ideal research design for this type of study is a policy evaluation using a randomized assignment. RAND experiment in the 1970s examined the impact of cost sharing on medical services use [18]. The Oregon Health Insurance experiment is another example of evaluating the effect of health insurance on medical services use [19–21]. Both found that expanding coverage or providing Medicaid led to an increase in medical service use. However, due to a wide range of limitations on experiment, previous studies use exogenous variation on insurance to make quasi-experimental situation as similar as possible to random assignment experiment. First, some previous studies found that low-income adults in states that expanded Medicaid eligibility under the Affordable Care Act experienced improvements in coverage and increased health care utilization compared to low-income adults in states that did not expand their Medicaid programs [22]; Brevoort et al., 2018 [23–25]; Countermanche et al., 2017, 2018; [26–28]. Second, other studies examine the effect of Medicare coverage on medical services by using Medicare eligibility age. When older adults reach the age of 65, hospitalization, outpatient medical services, and preventive care services all increase [29–31]. Third, the Affordable Care Act (ACA) provides a new opportunity to examine the effect of health insurance on health care services. The ACA expands health insurance coverage by expanding Medicaid and the Dependent Coverage law, which increases access to health care services for insurers [32–34].

This study examines the impact of supplementary private health insurance on healthcare utilization and expenses, specifically in the context of South Korea. Some previous studies also examine the effect of supplementary private insurance in France, Belgium, and Austria and they found that existence of private health insurance led to an increase in healthcare utilization and medical expenditure [35,36]. Also, Other previous research on supplementary private health insurance examined the impact of Medigap, a supplementary private insurance of Medicare in the United States, on medical utilization and medical expenses [37,38]. Both studies found that medical utilization and expenses increased due to moral hazard.

3. Methods

3.1. Data

The Korea Health Panel Study (KHPS) is used to consider the difference in healthcare utilization between those who have health insurance and those who have not. The KHPS provides a wider range of variables including healthcare utilization, health behaviors, pharmaceutical expenditure as well as health insurance status and expenditure.[1] This study focuses on detailed information on health insurance and healthcare utilization. I consider this data from 2012 to 2018, including the time of MERS pandemic, 2015.

The sample used in the study is an unbalanced panel data from 2012 to 2018. The initial study participants included approximately 8000 households across the nation and their family members residing together. The Korea Health Panel Survey uses 90 % of the 2015 Population and Housing data (Census data)[2] as its sampling frame to maintain national representativeness. The data is divided into household and individual data, and individual data provides information such as sociodemographic characteristics, economic activity status, health status, prescription drug use, use of medical services, national health insurance, private medical insurance, and health habits.

This study constructed the sample by merging personal data including medical insurance and the use of medical services with data including basic personal characteristics. However, sub-data related to medical services or private medical insurance are only investigated for individuals who have used medical services or have private medical insurance. Therefore, after merging, data for individuals who do not use medical services or do not have private medical insurance were also included as a zero value in those observed variables. Also, in June and July of 2015, MERS (Middle East Respiratory Syndrome) was prevalent. To control the seasonality of healthcare utilization, only data from June and July of each year were used in the analysis. I also restricted the sample to main four healthcare providers: tertiary general hospitals, general hospital, hospital, and clinics. I excluded public health centers, nursing homes, and oriental medical hospitals.

3.2. Model

Unobserved factors, which affect private health insurance status, also influence healthcare utilization. To control unobserved factors, I use exogenous shock such as the period of MERS pandemic, which had an influence on healthcare utilization for both insured and uninsured individuals. If those who have private health insurance utilize less healthcare services than uninsured individuals during the MERS pandemic, it could be one of evidence of moral hazard. In addition, to estimate a change in healthcare utilization between

[1] The website of the KHPS, which is a public data, should be accessed in order to download the data. https://www.khp.re.kr:444/.
[2] https://kostat.go.kr/ansk/.

insured and uninsured, I use the panel regression method to compare the change before, during and after the MERS pandemic. With the panel regression, time-invariant unobserved characteristics are included in the model. I estimate the following regression model using logit fixed and random effect model and clustered the standard errors at the region. This study employs panel data methods for count-dependent variables that take non-negative integer values, such as the number of outpatients, hospitalized, and emergency department visits.

$$\ln(Visit_{it}) = \exp\left(\alpha + \beta MERS + \gamma PHI_{it} + \delta MERS * PHI_{it} + X_{it}^{'}\rho + Year\ FE + Region\ FE + \varepsilon_{it}\right) \quad (1)$$

where conditional expectation of $\ln(Visit_{it})$ follows Poisson distribution. $\ln(Visit_{it})$ is the log-transformed number of inpatient, outpatient, or emergency department visits for each individual (i) in June and July of year (t). Two indicator variables are included in the model: *MERS* and PHI_{it}. *MERS* is a binary variable that takes the value of 1 if the observation is included in June and July 2015, the period in which the MERS pandemic occurred. PHI_{it} is also an indicator variable that is equal to 1 if the individual (i) has private health insurance in year (t). Demographic characteristics such as sex, race, household income, educational attainments, and self-rated health are included in the model as covariates denoted as X_{it}. Nonlinear trends of healthcare utilization over time and by region are captured by year and region fixed effects, denoted as *Year FE and Region FE*, respectively. Healthcare utilization may be associated with a wider range of demographic factors such as sex, educational attainment, race and household income. Especially individuals with higher household income generally have better access to healthcare services, because they can afford health insurance and out-of-pocket costs. Also, education is often associated with better health literacy, which can lead to more informed healthcare decision.

The coefficient β represents the effect of the MERS pandemic on healthcare utilization, regardless of whether the individual (i) has a private health insurance or not. If the sign of β is negative, that suggests that the MERS pandemic decreases healthcare utilization. On the other hand, coefficient γ captures the effect of obtaining private health insurance, irrespective of when an individual (i) uses healthcare utilization. δ indicates combined effect of private health insurance and the MERS pandemic on healthcare utilization. Technically, in order to measure that effect, all coefficients, β, γ, and δ, should be considered altogether.

This study also estimates the effect of MERS pandemic on healthcare services in the extensive margin. Focusing on whether an individual uses healthcare services such as outpatient, inpatient, emergency department visits, I estimate the following poisson model.

$$Visit_{it} = \exp(\alpha + \beta MERS + \gamma PHI_{it} + \delta MERS * PHI_{it} + \rho X_{it} + Year\ FE + Region\ FE + \varepsilon_{it}) \quad (2)$$

where $Visit_{it}$ is a dummy variable that is equal to 1 if an individual used healthcare service at least once and otherwise it is 0.

4. Results

4.1. Basic statistics

Similar to other previous literature on the effect of private health insurance, the key issue is to distinguish between moral hazard and adverse selection. However, in the case of Korea, private health insurance companies conduct a screening process based on factors such as the individual's medical history over the past three months, the need for additional tests within a year, the diagnosis of a severe illness within five years, and hospitalization or surgery. Therefore, the insured individual of private health insurance for actual expense are more likely to be younger and healthier than the uninsured individuals. As a result, when estimating the effects of private health insurance, advantageous selection is more likely to occur than adverse selection.

Table 1 presents summary statistics regarding healthcare services and demographic variables. Columns (1) and (2) show summary statistics between two groups: those who have private health insurance and not. Those who possess private health insurance exhibit a lower number of visits to outpatient, inpatient and emergency department services than those without such insurance in the sample periods. Moreover, individuals with private health insurance have a comparatively lower frequency of healthcare services compared to those who lack such coverage. 51.73 % among those with private health insurance used outpatient services compared to 64.22 % for uninsured individuals. The second panel in Table 1 presents the mean values of demographic variables. This summary statistics provide evidence on advantageous selection. As a result of screening, those who have private health insurance are more likely to be younger, married and educated. And they tend to have a higher probability of working and a higher household income. It is evident that differences in demographic characteristics account for differences in healthcare services utilization between the two groups.

Columns (3) and (4) compare the mean values of variables between the period of MERS (2015) and the period outside of MERS. The mean values of outpatient visit status and number of outpatient visits during the MERS period are lower compared to those outside of the MERS period. During the Merce pandemic (2015), 58.21 % utilized outpatient services and average number of visits was 2.77. These numbers are lower than 60.45 % and 3.00 during the periods outside of the MERS (2012–2018 except 2015).

4.2. Findings

Table 2 shows estimation results, which compare outpatient medical service usage in two groups in the extensive and intensive margins. Using a logistic regression model, I investigated the impact of private health insurance on whether or not individuals utilized outpatient services during the months of June and July each year from 2012 to 2018. Although individuals with private health

Table 1
Basic statistics.

	Private Health Insurance		Merce	
	Yes	No	During Merce	Other Period
Healthcare Services				
Outpatient	51.73 %	64.22 %	58.21 %	60.45 %
Number of Outpatient Visits	2.0168	3.4304	2.7706	3.0001
Inpatient	2.45 %	3.34 %	3.17 %	3.02 %
Number of Inpatient Visits	.0290	.0415	.0378	.0373
Emergency Dep	1.35 %	1.84 %	1.51 %	1.71 %
Number of Emergency Dep Visits	.0153	.0220	.0175	.0202
Demographic Characteristics				
Age	48.21	59.66	55.75	55.91
Married	84.69 %	72.19 %	76.53 %	76.26 %
Male	44.14 %	48.43 %	47.10 %	46.99 %
Education				
Middle School	2156 [8.95 %]	6681 [13.63 %]	1360 [12.05 %]	7477 [12.10 %]
High School	9836 [40.85 %]	14,509 [29.60 %]	3757 [33.30 %]	20,588 [33.31 %]
College	9538 [39.61 %]	11,607 [23.68 %]	3277 [29.04 %]	17,868 [28.91 %]
Above	822 [3.41 %]	1378 [2.81 %]	341 [3.02 %]	1859 [3.01 %]
Household Income				
1st Quintile	1007 [4.18 %[	11.050 [22.55 %]	1945 [17.24 %]	10,112 [16.36 %]
2nd Quintile	3881 [16.12 %]	11,189 [22.83 %]	2330 [20.65 %]	12,740 [20.61 %]
3rd Quintile	5753 [23.89 %]	9995 [20.39 %]	2287 [20.27 %]	13,461 [21.78 %]
4th Quintile	6685 [27.76 %]	8758 [17.87 %]	2465 [21.85 %]	12,978 [21.00 %]
5th Quintile	6753 [28.05 %]	8019 [16.36 %]	2256 [19.99 %]	12,516 [20.25 %]
Economic Status				
Working	18,233 [75.72 %]	27,406 [55.92 %]	6893 [61.09 %]	38,746 [62.69 %]
Not Working	5846 [24.28 %]	21,605 [44.08 %]	4390 [38.91 %]	23,061 [37.31 %]
Chronic Diseases	22,071 [91.66 %]	45,086 [91.99 %]	11,283 [100 %]	55,874 [90.40 %]
Observation	24,079	49,011	11,283	61,807

Note: Basic statistics of variables are compared between those who have private health insurance and those who have not. Basic statistics during the MERS pandemics are compared to those during the periods outside of the MERS.

insurance showed an increase in outpatient services by approximately 4 %–20 % points compared to those without private health insurance, the coefficient in random effect model was not statistically significant.[3] According to fixed effect model, those with private health insurance are more likely to use outpatient service more than those without insurance by approximately 20 % points. On the other hand, during the MERS pandemic, individuals were less likely to utilize outpatient medical services in the extensive margin, reducing their probability of using such services. The coefficients for *MERS* variables were 0.7904 and 0.8105 in random and fixed effect models, respectively. The odd ratio implies that during the MERS period, an individual's probability of using outpatient medical services was lower than during the period outside of the pandemic by about 21 % or 19 %. These were statistically significant at conventional levels. Finally, coefficients on *Health Insurance* * *Merce* shows the effect of private health insurance on outpatient utilization during the MERS pandemic. If the sign of this coefficient is less than 1, that means those who have private health insurance are less likely to utilize outpatient service than those without private health insurance during the MERS pandemic. Even if those who have private health insurance typically use more healthcare services than those who have not, it suggests that they respond strongly to health risk by reducing their use of healthcare services to prevent contagion from hospital. Regarding outpatient status, they are not statistically significant.

The number of outpatient visits has the same pattern as outpatient visits status. Columns (3) and (4) show the incidence rate ratio of each variable. Those who have private health insurance utilized the number of outpatient services more than those without insurance by approximately 4 %–11 % points, which are all statistically significant at the 1 % level. In addition, all individuals are less likely to use outpatient visit during the MERS pandemic by approximately 7 % points. In addition, during the MERS pandemic, insured individuals are less likely to increase the number of outpatient visits by approximately 8 %. During MERS, all individuals decreased the number of outpatient visits by about 7 %. So insured individuals responded to the MERS pandemic by decreasing outpatient visits more than uninsured.

Using the Hausman test to verify the endogeneity of the model, I compared the coefficients of the random effect model and the fixed effect model to test for correlations between the error term and the explanatory variables. According to the Hausman test statistics, all models used in this study have endogeneity, and thus the preferred model is the fixed effect model.

Table 3 shows the different effects on inpatient care between two groups: those who have private health insurance and those who do not. Similar to outpatient care, I examined the effect on whether or not an individual used inpatient services and the number of days they were hospitalized. Based on the IRR of the fixed effect model, column (2) in Table 3 indicates that those who have private health insurance have a higher probability of inpatient than those who have not by 25.9 % or 34.0 % points. In addition, days of inpatient

[3] Coefficients in tables are calculated by odd ratio or incidence rate ratio. Therefore, they measure the ratio of odds or incidence rate.

Table 2
The effect of COVID-19 on health care services: Number of outpatients.

	Logit: Outpatient Status		Poisson: Number of Outpatient	
	Random Effect (1)	Fixed Effect (2)	Random Effect (3)	Fixed Effect (4)
Health Insurance	1.0396	1.1975***	1.0437***	1.1111***
	[.0388]	[.0637]	[.0125]	[.0155]
Merce	.7904***	.8105***	.9310***	.9315***
	[.0294]	[.0316]	[.0066]	[.0066]
Health Insurance * MERS	.9748	.9689	.9215***	.9156***
	[.0581]	[.0582]	[.0141]	[.0141]
Age Group	Base: Age 30–39			
40- 49	1.3772***	1.1674**	1.2776***	1.1553***
	[.0669]	[.0781]	[.0259]	[.0295]
50 – 59	2.9128***	1.5385***	1.8094***	1.3894***
	[.1686]	[.1479]	[.0424]	[.0447]
60 - 69	8.4976***	2.4879***	2.3432***	1.5589***
	[.5755]	[.3081]	[.0587]	[.0557]
70 - 79	18.0581***	4.1858***	2.8320***	1.7584***
	[1.4513]	[.6794]	[.0749]	[.0667]
80 or above	11.8400***	3.5938***	2.7704***	1.7152***
	[.1.2012]	[.7626]	[.0812]	[.0698]
Married	1.6714***	1.0179	1.0385***	.9735
	[.0779]	[.1030]	[.0150]	[.0175]
***Sex:** Male*	2.2714***	–	1.3589***	–
	[.0961]	–	[.0265]	–
Education	Base: No Education			
Middle School	.9881	1.1900	.9964	1.2781***
	[.0759]	[.3677]	[.0266]	[.0587]
High School	.5913***	1.1218	.7319***	1.0781
	[.0406]	[.3775]	[.0183]	[.0588]
College	.4640***	1.3904	.5787***	.9362
	[.0354]	[.5283]	[.0168]	[.0772]
Above	.4545***	1.7816	.6096***	1.3396*
	[.0570]	[.9852]	[.0347]	[.0085]
Household Income	Base: 1st Quintile			
*2*nd *Quintile*	.8107***	.9914	.9709***	.9867
	[.0409]	[.0613]	[.0085]	[.0088]
*3*rd *Quintile*	.7636***	.9826	.9534***	.9840
	[.0411]	[.0670]	[.0104]	[.0112]
*4*th *Quintile*	.7810***	1.0060	.9413***	.9828
	[.0439]	[.0731]	[.0116]	[.0127]
5th Quintile	.8195***	1.0456	.9661**	1.0134
	[.0488]	[.0815]	[.0136]	[.0153]
Economic Status	Base: Excellent			
Not Working	1.1288***	.9866	1.0410***	1.0020
	[.0399]	[.0436]	[.0084]	[.0085]
Chronic Disease (No)	2.3602***	1.6306***	1.5120***	1.4112***
	[.1042]	[.0742]	[.0274]	[.0263]
Year Fixed Effect	●	●	●	●
Region Fixed Effect	●	●	●	●
Hausman Test	15339.58***		1383.15***	
Observation	73,090	38,467	73,090	62,766
Number of Groups	14,229	7029	14,229	11,791

Note: All coefficients in columns (1) and (2) are the odd ratio of corresponding variables. All coefficients in columns (3) and (4) are the incidence rate ratio which measure the rate of occurrence of corresponding variables. Standard errors are in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01.

increased by about 20 % or 33.5 % points, which are statistically significant. Turning to the effect of MERS, during the MERS pandemic, probability of inpatient and days of inpatient increased by 6–11 % and 2 %–5 % points, respectively, compared to periods outside of MERS. This result is not consistent with the effect on outpatient services. Coefficients on Health Insurance * MERS are less than 1 and are not statistically significant (see Table 4).

Results on emergency department visits have the same pattern as inpatient utilization. Although having private health insurance has increased the use of emergency rooms, results are not statistically significant. During the MERS period, the use of emergency rooms, like inpatient medical use, decreased by approximately 12 %–8 % points, and the frequency of emergency room visits increased by 14 %–13 % points. And during the MERS period, although people with private health insurance reduced their emergency room visits more than those without insurance, it is statistically insignificant.

So far, I have compared the MERS period with the period outside of MERS. An Event Study compares the effects over time. By considering the cross-term of insurance coverage and year, we examined the impact of private health insurance on outpatient medical utilization over time. In the first panel of Fig. 1, the coefficient value of the cross term was obtained from the random effect model, and

Table 3
The effect of COVID-19 on health care services: Number of Overnight hospitalized.

	Logit: Inpatient Status		Poisson: Days of Inpatient	
	Random Effect (1)	Fixed Effect (2)	Random Effect (3)	Fixed Effect (4)
Health Insurance	1.2587***	1.3395**	1.2002***	1.3352**
	[.0837]	[.1915]	[.0759]	[.1731]
MERS	1.0689	1.1101	1.0198	1.0537
	[.0757]	[.0815]	[.0624]	[.0660]
Health Insurance * MERS	.8456	.8650	.8763	.8833
	[.1188]	[.1250]	[.1096]	[.1138]
Age Group	Base: Age 30–39			
40- 49	.8303*	.6201**	.8336*	.6557**
	[.0864]	[.1376]	[.0827]	[.1304]
50 – 59	1.0879	.7410	1.1563	.8613
	[.1158]	[.2174]	[.1177]	[.2256]
60 - 69	1.5737***	.9469	1.6822***	1.0709
	[.1735]	[.3148]	[.1781]	[.3161]
70 - 79	2.0246***	1.2119	2.1360***	1.3042
	[.2380]	[.4433]	[.2418]	[.4200]
80 or above	2.2122***	1.2853	2.3628***	1.4281
	[.2980]	[.5148]	[.3048]	[.5018]
Married	1.0915	1.0350	1.0735	1.0883
	[.0685]	[.2160]	[.0657]	[.1975]
***Sex:** Male*	.9023*	–	.9315	–
	[.0506]	–	[.0515]	–
Education	Base: No Education			
Middle School	.9084	.5727	.9110	.7140
	[.0749]	[.3150]	[.0756]	[.3615]
High School	.7100***	1.1255	.8110***	1.4178
	[.0574]	[.7210]	[.0641]	[.8195]
College	.5856***	.4394	.6355***	.6692
	[.0583]	[.4113]	[.0617]	[.5544]
Above	.6103***	.3413	.6394**	.6281
	[.1169]	[.5841]	[.1204]	[.9324]
Household Income	Base: 1st Quintile			
*2*nd *Quintile*	1.1585**	1.2600**	1.1515**	1.2065**
	[.0837]	[.1258]	[.0749]	[.1004]
*3*rd *Quintile*	1.1278	1.3043**	1.1059	1.1836*
	[.0914]	[.1589]	[.0825]	[.1203]
*4*th *Quintile*	1.2281**	1.4476***	1.2169**	1.3154**
	[.1052]	[.1976]	[.0967]	[.1508]
5th Quintile	1.1629	1.3965**	1.1087	1.1711
	[.1087]	[.2134]	[.0965]	[.1509]
Economic Status	Base: Excellent			
Not Working	1.5182***	1.0641	1.4661***	1.0293
	[.0864]	[.0937]	[.0777]	[.0785]
Chronic Disease (No)	1.8037***	1.3590**	1.8132***	1.4609***
	[.2413]	[.2121]	[.2269]	[.2080]
Year Fixed Effect	●	●	●	●
Region Fixed Effect	●	●	●	●
Hausman Test	28.32		31.06	
Observation	73,090	10,208	73,090	10,245
Number of Groups	14,229	1843	14,229	1858

Note: All coefficients in columns (1) and (2) are the odd ratio of corresponding variables. All coefficients in columns (3) and (4) are the incidence rate ratio which measure the rate of occurrence of corresponding variables. Standard errors are in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01.

the post-estimation value was drawn into two groups according to whether they had health insurance over time. The second panel was drawn using the fixed effect model. In both figures, during the MERS period, the group that owned private health insurance used medical services less than the group without insurance, and the amount of decrease was also greater. After MERS in 2015, outpatient utilization increased, and those who owned private health insurance had more outpatient medical utilization than those who did not.

Results in Table 5, which is consistent with Fig. 1, are noticeable that here is a significant decrease in medical utilization in 2015. The values of 0.9290 and 0.9568 are the smallest IRR values among all years, indicating that the group with health insurance received less outpatient treatment in 2015 than the group without it. According to the random effect model, .9568 implies a decrease in outpatient medical utilization by 4.3 % points compared to the group without health insurance in 2012, while the random effect model shows a decrease of 7.1 % points (0.9290).

Table 4
The effect of MERS on health care services: Number of emergency.

	Logit: Emergency Status		Poisson: Number of Emergency visit	
	Random Effect (1)	Fixed Effect (2)	Random Effect (3)	Fixed Effect (4)
Health Insurance	1.0507	1.0414	1.0293	1,0433
	[.0881]	[.1861]	[.0849]	[.1732]
Merce	.8815	.9247	.8571*	.8717
	[.0872]	[.0950]	[.0764]	[.0798]
Health Insurance * MERS	.8891	.8827	.9573	.9667
	[.1740]	[.1785]	[.1707]	[.1772]
Age Group	Base: Age 30–39			
40- 49	.8514	1.5799	.8948	1.6033*
	[.1069]	[.4672]	[.1108]	[.4474]
50 – 59	1.0689	2.0560*	1.1574	1.8739*
	[.1385]	[.7856]	[.1483]	[.6732]
60 - 69	1.1815	2.8929**	1.3133**	2.3668**
	[.1632]	[1.2746]	[.1793]	[.9598]
70 - 79	1.3563	3.9606***	1.5138***	3.0349**
	[.2002]	[.1.9344]	[.2207]	[1.3528]
80 or above	1.8324***	5.0626***	2.0694***	4.0262***
	[.3071]	[2.7717]	[.3409]	[1.9905]
Married	1.1035	1.1291	1.0879	1.0829
	[.0884]	[.3230]	[.0875]	[.2945]
***Sex:** Male*	.8392**	–	.8438**	–
	[.0591]	–	[.0602]	–
Education	Base: No Education			
Middle School	1.1202	2.2094	1.1173	3.3410
	[.1165]	[1.7672]	[.1188]	[2.4771]
High School	.7470***	.6468	.7522***	1.8752
	[.0782]	[.5990]	[.0782]	[1.3541]
College	.6714***	.4960	.6801***	.7765
	[.0844]	[.5997]	[.0850]	[.8374]
Above	.3927***	.0790	.4222***	.1300
	[.1140]	[.1396]	[.1176]	[.2171]
Household Income	Base: 1st Quintile			
2nd *Quintile*	.9796	1.0038	.9977	1.0101
	[.0933]	[.1348]	[.0894]	[.1199]
3rd *Quintile*	.9763	1.0426	.9876	1.1139
	[.1026]	[.1698]	[.0996]	[.1629]
*4*th *Quintile*	.9987	1.1728	1.0609	1.3508*
	[.1111]	[.2090]	[.1130]	[.2157]
5th Quintile	1.0245	1.3172	1.0344	1.4498**
	[.1220]	[.2628]	[.1206]	[.2585]
Economic Status	Base: Excellent			
Not Working	1.3251***	1.0556	1.3068***	1.0262
	[.0982]	[.1248]	[.0931]	[.1087]
Chronic Disease (No)	1.4133**	.9765	1.4142**	1.0499
	[.2094]	[.1731]	[.2001]	[.1745]
Year Fixed Effect	●	●	●	●
Region Fixed Effect	●	●	●	●
Hausman Test	19.38		19.31	
Observation	73,090	6034	73,090	6041
Number of Groups	14,229	1094	14,229	1096

Note: All coefficients in columns (1) and (2) are the odd ratio of corresponding variables. All coefficients in columns (3) and (4) are the incidence rate ratio which measure the rate of occurrence of corresponding variables. Standard errors are in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01.

5. Discussion

This study examines the impact of private health insurance, indemnity insurance (which compensates actual medical expense out of coverage by public health insurance), on healthcare utilization. The findings indicate that those who are covered by the indemnity insurance show a higher propensity to use healthcare services than those without, which is consistent with many previous studies in Korea [39–41]. The increased healthcare utilization by private health insurance could be attributed to both moral hazard and adverse selection. However, given that people with poor health cannot enroll in private health insurance due to the insurance company's screening process [42–44], moral hazard leads to increase healthcare utilization rather than adverse selection.

During the MERS outbreak in June and July 2015, outpatient visits decreased due to concerns about infection, but emergency room visits, and hospitalization were not significantly affected, irrespective of being covered by insurance or not. However, healthcare utilization by indemnity insurance policyholders decreased more than that of non-policyholders during the outbreak, with a greater decrease in outpatient visits. This suggests that a large proportion of healthcare utilization was due to moral hazard during the periods

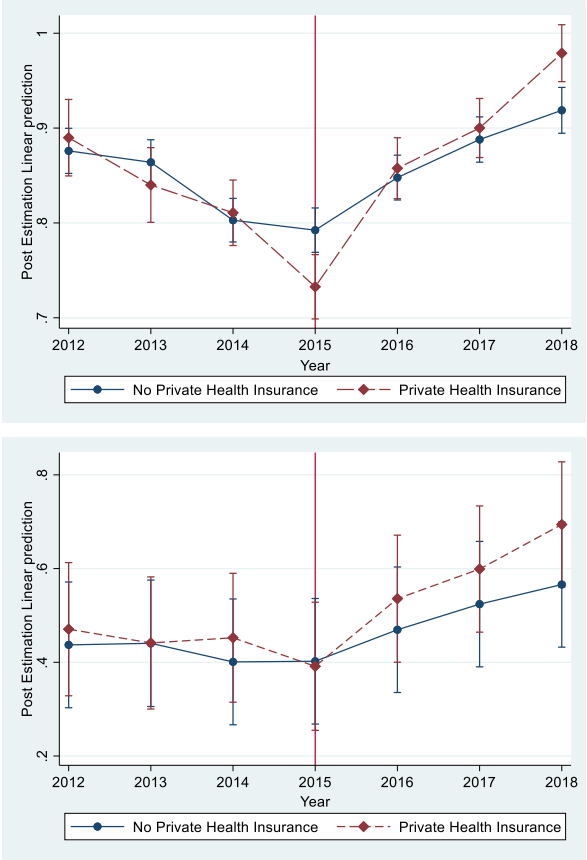

Fig. 1. Trend for Outpatient Visits before, during and after the MERS pandemic
(KHP 2012–2018)
Note: All coefficients in the first panel are obtained from the Panel Random Effect and those in the second panel are obtained from the Fixed Effect models.

outside of the MERS pandemic. Since those with private health insurance are generally younger, more educated, have higher incomes, and are healthier than those without, advantageous selection occurs, which in turn leads to decreased healthcare utilization.

Although this study examines the impact of private health insurance on health care utilization during the MERS pandemic, the results of this study can serve as evidence for the impact of health insurance during other pandemics including the COVID-19. Additionally, this study uses diff-in-diff estimation strategy to control for endogeneity issues, which have been a concern in previous researches.

This study has some limitations: First is methodological. It does not explicitly address adverse selection and related endogeneity. However, since the private health insurance market in Korea creates an advantageous selection, rather than an adverse selection, it is significant to find evidence of overutilization in a situation where insured individuals are healthier. The decline in healthcare utilization during the MERS pandemic was larger for the insured individuals than the uninsured ones. Another limitation is the data used in this study. Even though the Korean Medical Panel Survey provides information on healthcare utilization and private health insurance, a higher quality dataset could be created when combined with administrative data on insurance claims of the National Health Insurance, a public health insurance. This combined dataset could determine whether a medical procedure performed by a patient is essential or not. This remains the future study.

6. Conclusion

This study found that first, those who have private health insurance, the indemnity insurance, tend to use healthcare services more than those who have not. Second, during the period of the MERS outbreak, utilizations of healthcare services decreased regardless of whether individuals have private health insurance or not. Third, the decrease in utilizations of healthcare services during the MERS outbreak was more pronounced among those who have private health insurance. This study contributes to provide further evidence of moral hazard caused by overuse of medical services among private health insurance in the context of South Korea's health insurance system. The existence of private health insurance in Korea has resulted in an increase in overall healthcare costs and has also impacted medical expenses that the public health insurance covers. Therefore, it is important to identify and measure the extent of overuse.

Table 5
The effect of MERS on number of outpatient: Event study.

	Poisson: Number of Outpatient Visits	
	Random Effect (1)	Fixed Effect (2)
Health Insurance	1.0140	1.0340
	[.0215]	[.0231]
Year		
2013	.9881	1.0034
	[.0098]	[.0100]
2014	.9295***	.9643***
	[.0092]	[.0096]
2015	.9198***	.9656***
	[.0093]	[.0100]
2016	.9722***	1.0328***
	[.0100]	[.0110]
2017	1.0120	1.0908***
	[.0106]	[.0119]
2018	1.0437***	1.1374***
	[.0112]	[.0129]
Health Insurance * Year		
Health Insurance*2013	.9629	.9678
	[.0238]	[.0240]
Health Insurance*2014	.9939	1.0181
	[.0233]	[.0240]
Health Insurance*2015	.9290***	.9568*
	[.0219]	[.0228]
Health Insurance*2016	.9960	1.0334
	[.0231]	[.0242]
Health Insurance*2017	.9983	1.0423*
	[.0230]	[.0243]
Health Insurance*2018	1.0474**	1.0993***
	[.0239]	[.0254]
Year Fixed Effect	●	●
Region Fixed Effect	●	●
Hausman Test	2146.74***	
Observation	73,090	62,766
Number of Groups	14,229	11,791

Note: All coefficients in columns (1) and (2) are the incidence rate ratio which measure the rate of occurrence of corresponding variables. Standard errors are in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01.

Data availability statement

The data used in this study, from the Korean Health Panel Study, is available for public use via the following link, along with the 'Korean Health Paney Survey Data User Agreement' form: https://www.khp.re.kr:444.

CRediT authorship contribution statement

Jugntaek Lee: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Jungtaek Lee reports financial support was provided by The National Research Foundation of Korea.

Appendix

Table 1
Outcome Variables and Control Variables

Variable	Definition
Outcome Variables	
Outpatient	a dummy variable that is equal to 1 if an individual used outpatient service at least once and otherwise it is 0

(*continued on next page*)

Table 1 (*continued*)

Variable	Definition
Number of Outpatient Visits	Number of outpatient
Inpatient	a dummy variable that is equal to 1 if an individual used inpatient service at least once and otherwise it is 0
Number of Inpatient Visits	Number of inpatient
Emergency Dep	a dummy variable that is equal to 1 if an individual used ER service at least once and otherwise it is 0
Number of Emergency Dep Visits	Number of ER visits
Control Variables	
Health Insurance	an indicator variable that is equal to 1 if the individual (i) has private health insurance in year (t)
MERS	an indicator variable that takes the value of 1 if the observation is included in June and July 2015
Age Group	Aged 30–39, 40–49, 50–59, 60–69, 70–79, 80 and above
Married	An indicator variable that is coded as 1 if married and 0 if not.
Sex	An indicator variable that is coded as 0 for females and 1 for males.
Education	A categorical variable that divides educational attainment into five groups Educational as follows: No education, Middle School grad, High School Grad, College Grad, and Above college grad
Household Income	A categorical variable that divides household income into five quintiles
Economic Status	An indicator variable coded as 1 if employed and 0 if not.
Chronic Disease	An indicator variable that is coded as 1 if there is one or more chronic conditions, and 0 if not.

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