



Impact of COVID-19 on healthcare utilization among chronic disease patients in South Korea

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ABSTRACT

Background: From 2020 to 2022, South Korea has experienced significant direct and indirect damage because of the coronavirus pandemic. Preventive measures aimed at controlling the spread of the virus have inadvertently limited healthcare accessibility for patients without COVID-19, leading to detrimental consequences, particularly for patients with chronic diseases. Hence, there is a growing need to comprehensively examine the changes in healthcare utilization among patients with chronic diseases owing to the COVID-19 pandemic, along with the associated factors and health outcomes.

Methods: To examine changes in healthcare utilization among patients with chronic diseases and their impact on health outcomes, we used the NHIS database. Logistic regression analysis was used to investigate changes in healthcare utilization, and a two-part model was applied to explore the effects of reduced healthcare utilization on hospitalization status and length of hospital stay.

Results: Since the onset of the pandemic, the likelihood of hospitalization has been 1.10 times higher than that during pre-pandemic times in the population groups with a 20 % decrease in outpatient healthcare utilization. Notably, individuals belonging to the low-income group exhibited a 1.77-fold higher likelihood of hospitalization than those in the high-income group. Furthermore, in cases where hospitalization could have been avoided, low-income individuals had an extended hospital stay of 16.7 days compared with high-income individuals.

Conclusion: There is a need for a more proactive approach for classifying patients with chronic diseases based on various vulnerability factors to effectively respond to future novel infectious diseases and reduce the long-term burden on the nation.

1. Introduction

From January 2020, when the first case of coronavirus disease 2019 (COVID-19) was reported in South Korea, to May 2023, when the pandemic was declared endemic, South Korea experienced 3 years of social and economic damage caused by the COVID-19 pandemic. During the early stages of the COVID-19 outbreak, the country gained international attention because of its proactive governmental response to contain the spread of the virus. South Korea sought to minimize the spread of COVID-19 by implementing social distancing measures in cooperation with its citizens. While these rigorous government-led containment measures were effective in suppressing the spread of

COVID-19, they also led to an increase in public anxiety about the disease, resulting in limited access to healthcare for those without COVID-19 and an escalation in unmet healthcare needs (Roy et al., 2021; Chen and McGeorge, 2020; Moynihan et al., 2021; Chou et al., 2020; Kang et al., 2022; Lee and You, 2021). Limited healthcare accessibility is particularly detrimental for patients with chronic diseases requiring ongoing medical management and treatment. Adequate access to healthcare services and adherence to treatment plans are critical for managing chronic diseases (Kendzerska et al., 2021; Chandrasekaran and Ganesan, 2021). Therefore, a decrease in healthcare utilization can lead to delays or interruptions in treatment plans, resulting in disease progression, worsening of patients' conditions, and an increased risk of

Abbreviations: COVID-19, Coronavirus disease 2019; NHIS, National Health Insurance Service.

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Table 1

Characteristics of individuals undergoing continuous treatment for hypertension and diabetes prior to the occurrence of COVID-19 in 2020.

Characteristics	Hypertension (A)		Diabetes (B)		Chronic disease (C = A + B)		
	number	(%)	number	(%)	number	(%)	
Sex	Male	1,576,647	(46.8)	732,781	(54.0)	2,309,428	(48.9)
	Female	1,791,658	(53.2)	623,180	(46.0)	2,414,838	(51.1)
Age	under 40 s	20,945	(0.6)	26,927	(2.0)	47,872	(1.0)
	40 s	188,116	(5.6)	97,782	(7.2)	285,898	(6.1)
	50 s	701,883	(20.8)	298,679	(22.0)	1,000,562	(21.2)
	60 s	1,100,640	(32.7)	456,305	(33.7)	1,556,945	(33.0)
	over 70 s	1,356,721	(40.3)	476,268	(35.1)	1,832,989	(38.8)
Insurance level	Medicaid	145,967	(4.3)	88,008	(6.5)	233,975	(5.0)
	Q1 (low)	550,627	(16.3)	217,788	(16.1)	768,415	(16.5)
	Q2	419,784	(12.5)	164,427	(12.1)	584,211	(12.5)
	Q3	527,379	(15.7)	207,722	(15.3)	735,101	(15.8)
	Q4	654,418	(19.4)	258,451	(19.1)	912,869	(19.6)
Disability	Q5 (high)	1,024,796	(30.4)	401,720	(29.6)	1,426,516	(30.6)
	No	3,009,454	(89.3)	1,182,536	(87.2)	4,191,990	(88.7)
Region	Yes	358,851	(10.7)	173,425	(12.8)	532,276	(11.3)
	Seoul	594,450	(17.6)	230,053	(17.0)	824,503	(17.5)
Region	Busan	224,680	(6.7)	95,293	(7.0)	319,973	(6.8)
	Daegu	154,461	(4.6)	67,279	(5.0)	221,740	(4.7)
	Incheon	192,186	(5.7)	79,089	(5.8)	271,275	(5.7)
	Gwangju	74,991	(2.2)	33,807	(2.5)	108,798	(2.3)
	Deajeon	91,498	(2.7)	40,115	(3.0)	131,613	(2.8)
	Ulsan	64,875	(1.9)	27,764	(2.0)	92,639	(2.0)
	Sejong	15,337	(0.5)	5,726	(0.4)	21,063	(0.4)
	Gyeonggi	789,769	(23.4)	318,325	(23.5)	1,108,094	(23.5)
	Gangwon	138,069	(4.1)	49,120	(3.6)	187,189	(4.0)
	Chungbuk	122,831	(3.6)	47,082	(3.5)	169,913	(3.6)
	Chungnam	162,068	(4.8)	62,256	(4.6)	224,324	(4.7)
	Jeonbuk	137,758	(4.1)	56,977	(4.2)	194,735	(4.1)
	Jeonnam	147,810	(4.4)	60,329	(4.4)	208,139	(4.4)
	Gyeongbuk	203,292	(6.0)	82,176	(6.1)	285,468	(6.0)
	Gyeongnam	211,793	(6.3)	85,710	(6.3)	297,503	(6.3)
	Jeju	42,422	(1.3)	14,852	(1.1)	57,274	(1.2)
	Changes inhealthcare utilization	Decrease	1,585,962	(47.1)	675,872	(49.8)	2,261,834
None		469,889	(14.0)	151,063	(11.1)	620,952	(13.1)
Increase		1,312,454	(39.0)	529,026	(39.0)	1,841,480	(39.0)

Note: South Korea is divided into a total of 17 administrative regions.

complications (Higgins et al., 2021; Cho, 2022). Moreover, changes in patient behavioral patterns due to reduced healthcare utilization can lead to long-term adverse health effects (Higgins et al., 2021; Cho, 2022). Therefore, it is essential to assess the changes in healthcare utilization among patients with chronic diseases, identify the factors influencing such reductions, and further investigate the impact of decreased healthcare utilization on the health outcomes of patients with chronic diseases. Such research is crucial for understanding the implications of reduced healthcare utilization on the well-being of individuals with chronic illnesses. As of 2021, chronic diseases accounted for 79.6 % of deaths in South Korea, and healthcare expenditures related to chronic diseases amounted to \$ 55 billion, representing 85.0 % of the total healthcare costs (Baek, 2022 2022.10.). Considering these figures, management of chronic diseases is a major challenge. Furthermore, considering the rapidly aging population, the burden of chronic diseases is expected to increase markedly owing to the growing elderly population (Baek, 2022 2022.10.). Therefore, systematic management of chronic diseases can be considered a priority among health policy tasks, given the anticipated exacerbation of the burden caused by population aging. In examining the changes in healthcare utilization and health impacts resulting from COVID-19, several studies have focused on short-term healthcare changes before and after the onset of COVID-19 by using methods such as interrupted time series analysis (Kang et al., 2022; Park et al., 2022; Morishita et al., 2022; Davies et al., 2021; Greenberg et al., 2021). However, research specifically addressing changes in healthcare utilization among patients with chronic diseases due to COVID-19 remains limited (Park et al., 2022). This could be attributed to research findings suggesting that COVID-19 has had a minimal impact on the health of patients with chronic diseases. For example, Park et al. (2022) indicated that while there was a marked decrease of 20.4 % in

healthcare utilization among elderly patients with acute conditions before and after COVID-19, no significant changes were observed among elderly patients with chronic diseases. Additionally, a survey conducted by the Korea Institute for Health and Social Affairs (Ej, 2022 2022.4.11.) through telephone interviews revealed that only 8.1 % and 5.4 % of patients with hypertension and diabetes, respectively, reported not receiving or delaying outpatient visits during the COVID-19 pandemic. These findings may have led to a decrease in research and policy interest regarding the health of patients with chronic diseases. However, it is important to note that previous studies have limitations in terms of the definition of chronic disease and the utilization of limited sample data. Because patients with chronic diseases require systematic management and treatment, inadequate management, even through telemedicine, may result in adverse health outcomes.

Therefore, this study was aimed at providing evidence for ensuring healthcare accessibility for patients with chronic diseases and delivering continuous medical services and treatment to them even during infectious disease outbreaks, considering the potential occurrence of future novel infectious disease outbreaks. Through an analysis of the National Health Insurance Service (NHIS) database, which enables the identification of changes in healthcare utilization among the general population, this study focused on major chronic diseases, such as hypertension and diabetes. This study sought to understand the patterns of healthcare utilization changes among patients with chronic diseases due to the COVID-19 pandemic and identify the characteristics of patient groups exhibiting decreased healthcare utilization behaviors. Furthermore, this study aimed to comprehensively examine the health outcomes resulting from reduced healthcare utilization. The ultimate objective of this study was to generate evidence that can facilitate the provision of more systematic and meticulous medical services to patients with chronic

Table 2
Comparison of socioeconomic characteristics among individuals with chronic conditions receiving ongoing treatment, who experienced a 20 or more reduction in healthcare utilization from 2018 to 2019 to 2020–2021.

Characteristics		Change in healthcare utilization			
		Not decreased number (%)		Decreased number (%)	
Sex	Male	1,273,115	(55.1)	1,036,313	(44.9)
	Female	1,299,322	(53.8)	1,115,516	(46.2)
Age	under 40 s	25,695	(53.7)	22,177	(46.3)
	40 s	156,503	(54.7)	129,395	(45.3)
	50 s	551,129	(55.1)	449,433	(44.9)
	60 s	868,620	(55.8)	688,325	(44.2)
	over 70 s	970,490	(52.9)	862,499	(47.1)
Insurance level	Medicaid	119,796	(51.2)	114,179	(48.8)
	Q1 (low)	421,946	(54.9)	346,469	(45.1)
	Q2	320,965	(54.9)	263,246	(45.1)
	Q3	402,176	(54.7)	332,925	(45.3)
	Q4	499,158	(54.7)	413,711	(45.3)
Region	Q5 (high)	774,562	(54.3)	651,954	(45.7)
	Seoul	459,806	(55.8)	364,697	(44.2)
	Busan	605,894	(54.7)	502,200	(45.3)
	Daegu	176,494	(55.2)	143,479	(44.8)
	Incheon	147,257	(54.3)	124,018	(45.7)
	Gwangju	120,483	(54.3)	101,257	(45.7)
	Deajeon	61,754	(56.8)	47,044	(43.2)
	Ulsan	70,642	(53.7)	60,971	(46.3)
	Sejong	50,286	(54.3)	42,353	(45.7)
	Gyeonggi	11,097	(52.7)	9,966	(47.3)
	Gangwon	97,895	(52.3)	89,294	(47.7)
	Chungbuk	90,233	(53.1)	79,680	(46.9)
	Chungnam	119,207	(53.1)	105,117	(46.9)
	Jeonbuk	104,610	(53.7)	90,125	(46.3)
	Jeonnam	112,449	(54.0)	95,690	(46.0)
Gyeongbuk	151,433	(53.0)	134,035	(47.0)	
Gyeongnam	161,280	(54.2)	136,223	(45.8)	
CCI	Jeju	31,604	(55.2)	25,670	(44.8)
	1	637,183	(51.7)	594,692	(48.3)
	2	81,295	(50.1)	81,082	(49.9)
Number of family members	3	10,878	(48.0)	11,772	(52.0)
	1	670,553	(54.5)	559,860	(45.5)
	2	690,390	(54.6)	573,551	(45.4)
Total	3–4	796,082	(54.4)	666,124	(45.6)
	Over 5	415,404	(54.1)	352,289	(45.9)
Total		2,572,437	(54.5)	2,151,829	(45.5)

diseases during prolonged infectious disease disasters, which can occur at any time in the future, compared with other types of disasters.

2. Materials and methods

2.1. Data source and study populations

This study used data from the NHIS database, which represents the entire Korean population. This study focused on the population diagnosed with diabetes (E10–E14) and hypertension (I10–I15), based on the International Classification of Diseases system. To limit the study population to patients who had been receiving continuous management before the occurrence of COVID-19, individuals with at least one instance of healthcare utilization related to diabetes or hypertension each year from 2017 to 2019 were defined as patients with chronic diabetes or hypertension. This study was approved by the Institutional Review Board (IRB No. E04-2022–030).

2.2. Outcome measures and variables

2.2.1. Dependent variable

In the first study that examined the factors influencing reduced healthcare utilization, the dependent variable was reduced healthcare utilization. Using individual-level outpatient healthcare utilization data from 2018 to 2021, a reduction in outpatient healthcare utilization was

defined as a decrease of 20 % or more in outpatient visits from 2020 to 2021 compared with the average number of visits in 2018 and 2019. The second study that investigated the relationship between reduced healthcare utilization and avoidable hospitalization employed a two-part model. The dependent variable in the Part 1 model was the occurrence of hospitalization due to chronic conditions. The Part 2 model focused only on hospitalized patients, and the dependent variable was the length of hospital stay.

2.2.2. Independent variable

To examine the factors influencing reduced healthcare utilization due to COVID-19, the following variables were considered: sex, age, region (to be chosen from among 17 administrative regions), health insurance quintile (Separated into six groups: one comprising medical aid beneficiaries with incomes below 40 % of the median, and the others classified based on quintiles of insurance premiums), disability status (without considering disability grade), household size (classified as single-person household, two-person household, three- to four-person household, and household of five or more persons), and the Charlson Comorbidity Index calculated based on medical records from 2019. To investigate the impact of reduced healthcare utilization on health outcomes, an additional variable was included: outpatient healthcare utilization reduction categories (no reduction, less than 5 % reduction, 5–10 % reduction, 10–20 % reduction, and > 20 % reduction). These variables were added to the existing independent variables in the analysis.

2.3. Statistical analysis

To examine the factors influencing reduced healthcare utilization due to COVID-19, a logistic regression analysis was performed, considering the binary nature of the dependent variable representing the occurrence of reduced healthcare utilization. A two-part model was employed to analyze the health outcomes related to reduced healthcare utilization. In Part 1, a logistic regression analysis was conducted to examine the occurrence of hospitalization due to chronic conditions. In Part 2, a linear regression analysis was performed using the length of hospital stay as the dependent variable, focusing only on patients hospitalized due to chronic conditions. All analyses were conducted using the SAS 9.4 statistical package.

3. Results

Descriptive statistics for the patients with chronic diseases are presented in [Table 1](#). The sex distribution among patients with chronic disease showed a slightly higher proportion of females (51.1 %) than males. Among all patients with chronic disease, the highest proportion (38.8 %) was found among those aged ≥ 70 years, followed by those in their 60 s (33.0 %) and 50 s (21.2 %). In terms of income quintiles, the highest proportion (30.6 %) of patients with chronic disease was observed in the fifth quintile (high-income group), whereas individuals eligible for medical aid accounted for the lowest proportion (5.0 %). The prevalence of disability among patients with chronic diseases was 11.3 %. Among the study population, 47.9 % had a reduction in their healthcare utilization, whereas 52.1 % exhibited no change or increase in healthcare utilization. These characteristics remained similar when patients with chronic diseases were further categorized as having hypertension or diabetes. However, in terms of sex, a slightly higher proportion of female patients than of male patients was observed among patients with hypertension.

3.1. Factors influencing reduced healthcare utilization

In this study, a reduction of 20 % or more in individual healthcare utilization from 2020 to 2021 compared with that in 2018–2019 was defined as reduced healthcare utilization. The sociodemographic

Table 3

Analysis of factors influencing the reduction in healthcare utilization among individuals with chronic conditions receiving ongoing treatment from 2018 to 2019 to 2020–2021.

Variables (reference)		Point Estimate			p-value	Point Estimate			p-value
		(Model 1)				(Model 2)			
Sex (Male)	Female	1.04	1.03	1.04	<0.0001	1.04	1.04	1.05	<0.0001
Age (under 40 s)	40 s	0.96	0.94	0.98	0.0593	0.95	0.93	0.98	<0.0001
	50 s	0.94	0.93	0.96	<0.0001	0.96	0.94	0.99	<0.0001
	60 s	0.91	0.90	0.93	<0.0001	0.95	0.93	0.98	<0.0001
Region (Gyeonggi)	over 70 s	1.01	1.00	1.03	<0.0001	1.06	1.03	1.09	<0.0001
	Seoul	0.95	0.95	0.96	<0.0001	0.94	0.93	0.95	<0.0001
	Busan	0.98	0.97	0.98	<0.0001	0.96	0.95	0.97	<0.0001
	Daegu	1.02	1.01	1.02	0.5956	1.01	0.99	1.02	0.1139
	Incheon	1.01	1.00	1.02	0.0353	1.02	1.00	1.04	0.8731
	Gwangju	0.91	0.90	0.92	<0.0001	0.91	0.89	0.94	<0.0001
	Deajeon	1.04	1.03	1.05	0.0002	1.05	1.02	1.07	0.0145
	Ulsan	1.02	1.01	1.04	0.4147	1.04	1.01	1.06	0.1707
	Sejong	1.08	1.05	1.11	<0.0001	1.09	1.03	1.15	0.0085
	Gangwon	1.09	1.08	1.10	<0.0001	1.09	1.07	1.11	<0.0001
	Chungbuk	1.06	1.05	1.07	<0.0001	1.08	1.06	1.10	<0.0001
	Chungnam	1.06	1.05	1.07	<0.0001	1.08	1.06	1.10	<0.0001
	Jeonbuk	1.03	1.02	1.04	0.0134	1.03	1.02	1.05	0.1062
	Jeonnam	1.01	1.00	1.02	0.4759	1.01	0.99	1.03	0.1432
	Insurance Level (Q5)	Gyeongbuk	1.06	1.05	1.07	<0.0001	1.06	1.04	1.07
Gyeongnam		1.01	1.01	1.02	0.3824	1.01	1.00	1.03	0.428
Jeju		0.98	0.96	0.99	<0.0001	0.98	0.95	1.01	0.004
Medicaid		1.13	1.12	1.14	<0.0001	1.08	1.06	1.09	<0.0001
Q1		0.99	0.98	0.99	<0.0001	0.97	0.96	0.98	<0.0001
Q2		0.99	0.99	1.00	<0.0001	0.98	0.97	0.99	<0.0001
Disability (none)	Q3	1.00	0.99	1.00	<0.0001	0.99	0.98	1.00	0.006
	Q4	1.00	0.99	1.00	<0.0001	0.99	0.98	1.00	0.0513
	Yes					1.069	1.058	1.08	1.07
	CCI(1)					1.056	1.045	1.067	1.06
Number of family members (1)	2					1.147	1.117	1.178	1.15
	3–4					1.001	0.992	1.011	1.00
	Over 5					1.007	0.998	1.017	1.01
						0.999	0.987	1.011	1.00

characteristics of the patients with chronic diseases who experienced reduced healthcare utilization are presented in Table 2. Among all the patients with chronic diseases, approximately 45.5 % (2,151,829 individuals) experienced a reduction of 20 % or more in healthcare utilization.

The likelihood of experiencing reduced healthcare utilization was higher among female patients, individuals aged ≥ 70 years, medical aid recipients, and those with a higher Charlson Comorbidity Index. The results of the logistic regression analysis examining the factors influencing reduced healthcare utilization among patients with chronic diseases are shown in Table 3. The analysis revealed that the probability of reduced healthcare utilization was 1.04 times higher for female patients than for male patients. Additionally, individuals aged ≥ 70 years were 1.06 times more likely to experience reduced healthcare utilization compared with those aged < 40 years of age. Furthermore, relative to individuals in the highest income quintile (5th quintile), medical aid recipients had a 1.07 times higher probability of experiencing reduced healthcare utilization and individuals with disabilities had a 1.06 times higher probability of experiencing reduced healthcare utilization.

3.2. Analysis of health outcomes associated with reduced healthcare utilization

In this study, the health outcome variable examined was hospitalization owing to chronic conditions. Using a two-part model, a logistic regression analysis was initially conducted to determine the likelihood of hospitalization owing to chronic conditions. Subsequently, among those hospitalized owing to chronic conditions, factors influencing the length of hospital stay were analyzed. First, we examined the distribution of hospitalizations owing to chronic conditions following the onset of COVID-19. It was observed that the proportion of hospitalizations was relatively higher among individuals aged ≥ 70 years. Additionally,

medical aid recipients and individuals with disabilities had higher hospitalization rates (see Supplementary Table 1).

3.2.1. Analysis of factors influencing hospitalization for chronic conditions after COVID-19

Analysis of the factors influencing hospitalization for chronic conditions revealed that individuals with a ≥ 20 % reduction in outpatient healthcare utilization had a 1.10 times higher probability of hospitalization (see Table 4). The probability of hospitalization was 1.06 times higher in female patients than in male patients, and individuals aged ≥ 70 years had a 1.04 times higher probability of hospitalization than those aged < 40 years. One important point to note is the need to distinguish between healthcare utilization and health outcomes. In this study, it was observed that healthcare utilization decreased for females compared to males after the occurrence of COVID-19. However, in previous studies analyzing health outcomes such as mortality and complications, it has been reported that males experienced negative health impacts compared to females due to COVID-19 (Jin et al., 2020; GEBHARD, Catherine, , 2020; BABU, Naresh, , 2020). In terms of income quintiles, medical aid recipients had a 1.77 times higher probability of hospitalization than individuals in the highest income quintile (5th quintile). Additionally, individuals with disabilities had a 1.29 times higher probability of hospitalization than those without disabilities.

3.2.2. Analysis of factors influencing the length of hospital stay for patients with chronic diseases

The analysis of factors influencing the length of hospital stay for patients hospitalized for chronic diseases revealed that the patient group with a ≥ 20 % reduction in outpatient healthcare utilization had an average hospital stay that was 30.4 days longer than that of the group without such a reduction (see Table 5). Female patients had a hospital stay that was 1.9 days longer than that for male patients. Medical aid

Table 4
Analysis of factors affecting hospital admissions for hypertension and diabetes in 2020–2021 after COVID-19.

Variables (reference)		Point Estimate			p-value	Point Estimate			p-value
		95 Wald	Confidence	Limits		95 Wald	Confidence	Limits	
		modell			model2				
Decreased in Outpatient Healthcare utilization (Not decreased)	Under 5	0.71	0.69	0.72	<0.0001	0.75	0.72	0.78	<0.0001
	5–10	0.77	0.76	0.79	<0.0001	0.80	0.78	0.83	<0.0001
	10–20	0.89	0.87	0.91	0.0793	0.92	0.89	0.95	0.3255
	Over 20	1.05	1.03	1.07	<0.0001	1.10	1.07	1.13	<0.0001
Sex (Male)	Male	0.94	0.93	0.95	<0.0001	1.05	1.02	1.07	<0.0001
Age (under 40 s)	40 s	0.53	0.50	0.57	<0.0001	0.47	0.44	0.52	<0.0001
	50 s	0.63	0.60	0.67	<0.0001	0.49	0.46	0.53	<0.0001
	60 s	0.85	0.80	0.90	0.0041	0.64	0.59	0.69	<0.0001
	over 70 s	1.38	1.31	1.46	<0.0001	1.04	0.97	1.12	<0.0001
Region (Gyeonggi)	Seoul	0.93	0.91	0.95	<0.0001	0.93	0.90	0.96	<0.0001
	Busan	1.20	1.17	1.23	<0.0001	1.17	1.12	1.21	0.3169
	Daegu	0.99	0.96	1.02	<0.0001	1.02	0.97	1.07	<0.0001
	Incheon	1.03	1.00	1.06	<0.0001	1.02	0.97	1.08	<0.0001
	Gwangju	1.21	1.17	1.26	<0.0001	1.31	1.24	1.40	<0.0001
	Deajeon	0.95	0.92	0.99	<0.0001	0.90	0.84	0.96	<0.0001
	Ulsan	1.22	1.17	1.27	<0.0001	1.23	1.15	1.32	0.0262
	Sejong	1.20	1.10	1.30	0.1037	1.21	1.04	1.40	0.4446
	Gangwon	1.01	0.98	1.05	<0.0001	1.06	1.00	1.12	0.0019
	Chungbuk	1.22	1.18	1.25	<0.0001	1.22	1.16	1.28	0.0117
	Chungnam	1.07	1.04	1.10	<0.0001	1.12	1.06	1.17	0.2684
	Jeonbuk	1.28	1.25	1.32	<0.0001	1.32	1.25	1.38	<0.0001
	Jeonnam	1.44	1.40	1.47	<0.0001	1.57	1.50	1.63	<0.0001
	Geyongbuk	1.18	1.15	1.21	<0.0001	1.19	1.14	1.24	0.065
	Gyeongnam	1.23	1.20	1.26	<0.0001	1.30	1.25	1.35	<0.0001
Insurance Level (Q5)	Jeju	1.06	1.01	1.12	0.0212	1.12	1.02	1.22	0.5312
	Medicaid	1.69	1.65	1.73	<0.0001	1.77	1.70	1.84	<0.0001
	Q1	1.05	1.03	1.06	<0.0001	1.11	1.08	1.15	0.0071
	Q2	1.01	0.99	1.03	<0.0001	1.06	1.02	1.10	<0.0001
	Q3	1.01	0.99	1.03	<0.0001	1.07	1.04	1.10	<0.0001
Disability (none)	Q4	0.99	0.98	1.01	<0.0001	1.02	0.99	1.05	<0.0001
	Yes					0.76	0.79	<0.0001	1.30
	CCI(1)					0.87	0.91	0.0793	1.17
						1.03	1.07	<0.0001	1.30
Number of family (1)	2					0.93	0.95	<0.0001	0.97
	3–4					0.50	0.57	<0.0001	0.99
	Over 5					0.60	0.67	<0.0001	1.00

recipients had a hospital stay that was 16.7 days longer than that of individuals in the highest income quintile (5th quintile). Additionally, individuals with disabilities had a hospital stay that was 8.5 days longer than that for those without disabilities.

4. Discussion

This study aimed to examine whether there were significant differences in healthcare utilization and health effects owing to the COVID-19 pandemic among individuals with chronic diseases based on socioeconomic status, by using comprehensive data from the NHIS database. It focused on major chronic diseases, such as hypertension and diabetes, and investigated the changes in healthcare utilization before and after the COVID-19 pandemic as well as the factors influencing these changes. Health outcomes were examined using hospitalization as a surrogate indicator of chronic disease. The analysis revealed that various factors such as sex (female), age (≥ 70 years), medical aid recipients, and disabilities had an impact on the decrease in healthcare service utilization among patients with chronic diseases after COVID-19. Furthermore, this decrease in healthcare service utilization increases the likelihood of hospitalization for chronic diseases by 1.1 times.

The groups (women, older adults, medical aid recipients, and individuals with disabilities) found to have decreased healthcare utilization and negative health outcomes in the study are generally recognized as vulnerable populations. In addition to the direct health consequences of COVID-19, it was confirmed that the indirect health consequences resulting from COVID-19 also disproportionately affected vulnerable populations, exacerbating health inequalities. Specifically, in this study,

the group with lower income levels showed a greater decrease in outpatient utilization than the high-income group. The likelihood of hospitalization due to chronic diseases, which can be considered an avoidable hospitalization, was higher in the low-income group than in the high-income group, and the length of hospital stay was longer. This can be interpreted as a result of the lack of systematic management despite the need for medical management in the low-income group. Generally, patients with chronic diseases are known to have poorer outcomes after COVID-19, because they are classified as individuals with underlying conditions (Williamson et al., 2020; Imam et al., 2020; van Gerwen et al., 2021).

According to the “Disaster and Safety Management Basic Act” of South Korea, infectious diseases are classified as social disasters. The law classifies vulnerable populations as children (11.7 % of the total population), the elderly (17.5 %), individuals with disabilities (5.2 %), and low-income individuals (3.6 %). Although many groups not explicitly mentioned in the law are likely to be vulnerable to infectious diseases, the vulnerable populations specified in the law already account for approximately 40 % of the total population, considering the rapidly increasing number of elderly individuals. Moreover, considering limited budgets and resources, as the number of vulnerable groups increases, it is necessary to identify vulnerable populations based on multiple vulnerability factors rather than a single criterion to provide appropriate assistance and support to those who need it.

This study has several limitations. First, it was limited to patients with hypertension and diabetes, which may restrict the generalizability of the findings. However, considering the proportion of patients with hypertension and diabetes among the total population of patients with

Table 5

Analysis of factors affecting length of hospital stay in patients hospitalized for hypertension and diabetes in 2020–2021 after COVID-19.

Parameter		Estimate	(S. E)	Pr > t
intercept		2.62	2.30	0.25
Decreased in Outpatient Healthcare Utilization (Not decreased)	Under 5	-1.85	1.10	0.09
	5–10	1.51	1.03	0.14
	10–20	3.40	1.09	0.00
	Over 20	30.40	0.75	<0.0001
Sex (Male)	Female	1.94	0.60	0.00
Age (under 40 s)	40 s	4.72	2.51	0.06
	50 s	4.90	2.17	0.02
	60 s	4.84	2.09	0.02
	over 70 s	13.44	2.06	<0.0001
Region (Gyeonggi)	Seoul	-2.13	1.02	0.04
	Busan	9.41	1.19	<0.0001
	Daegu	-0.23	1.46	0.87
	Incheon	9.25	1.60	<0.0001
	Gwangju	2.04	1.83	0.27
	Deajeon	4.86	2.07	0.02
	Ulsan	3.63	2.04	0.08
	Sejong	1.72	4.44	0.70
	Gangwon	2.79	1.65	0.09
	Chungbuk	-0.77	1.60	0.63
	Chungnam	3.87	1.50	0.01
	Jeonbuk	5.70	1.46	<0.0001
	Jeonnam	5.76	1.25	<0.0001
	Gyeongbuk	4.02	1.33	0.00
	Gyeongnam	8.61	1.23	<0.0001
	Jeju	0.29	2.71	0.91
Insurance Level (Q5)	Medicaid	16.71	1.14	<0.0001
	Q1	1.85	1.00	0.06
	Q2	1.59	1.09	0.15
	Q3	-0.29	0.98	0.77
	Q4	0.08	0.90	0.93
Disability (none)	Yes	8.45	0.75	<0.0001

chronic diseases in South Korea, these two diseases are considered representative chronic diseases. Second, owing to limitations in administrative data, detailed research on the pathways through which decreased healthcare utilization leads to health outcomes could not be conducted. Thirdly, in this study, although a higher reduction in healthcare utilization among women compared to men was observed, it is critical to conduct a detailed analysis by distinguishing between men and women, considering gender-specific diseases. This is necessary to accurately ascertain whether this decline is attributable to the COVID-19 pandemic, a decrease in the absolute quantity of healthcare utilization, or other factors. Fourth, in this study, the adverse health effects of COVID-19 were investigated by considering an increase in the number of hospitalization days as the outcome variable. However, a limitation arises as this approach does not fully consider the pre-existing healthcare utilization characteristics of the subjects under analysis. For example, in Korea, females typically exhibit higher healthcare utilization than males, and individuals receiving medical aid generally have higher healthcare usage compared to those covered by health insurance. Hence, further research is warranted to ascertain whether the observed rise in hospitalization days for these subjects is indicative of health deterioration or unmet healthcare needs.

5. Conclusions

Patients with chronic diseases have inherent vulnerabilities to COVID-19 compared with the general population. They require meticulous attention and care, and it is essential to pay special attention to a minority of patients with chronic diseases who may not be able to access proper healthcare, even if the majority are utilizing healthcare services appropriately after COVID-19. Considering the number of patients with chronic diseases in Korea, the influence of this minority cannot be underestimated. In examining the impact of COVID-19 on chronic

disease patients, this study is significant in that it identifies characteristics of subgroups within the population with chronic diseases with larger decreases in healthcare utilization and investigates the impact of such utilization reductions on health outcomes.

In anticipation of future novel infectious diseases that may manifest in uncertain forms and timelines, drawing lessons from over 3 years of experience with COVID-19, it is expected that by establishing a systematic chronic disease management system and proactively responding to the management of patients with chronic diseases in the event of infectious disease disasters, better policies can be implemented to protect the health of numerous patients with chronic diseases in the long term and reduce the burden of disease. Moreover, it is crucial not to disregard the possibility of an increased burden of new types of chronic diseases among COVID-19 survivors. Therefore, beyond restoring previous efforts in chronic disease management, a more proactive response is necessary, expanding the scope of chronic disease patient management beyond pre-COVID-19 levels and enhancing the capacity for early management and response.

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CRediT authorship contribution statement

Taeuk Kang: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Yoonkyoung Lee:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Conceptualization. **Minku Kang:** Visualization, Methodology, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2024.102680>.

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