

The impact of the COVID-19 pandemic on outpatients of internal medicine and pediatrics

A descriptive study

Hayoung Byun, MD^{a,ib}, Dawon Kang, MD^b, Se-Il Go, MD^c, Hye In Kim, MD^d, Jong Ryeal Hahm, MD^e, Rock Bum Kim, MD^{f,*}

Abstract

This study analyzed the changes in the number of outpatients and disease presentation during the entirety of 2020, the period of COVID-19 pandemic.

The average annual number of outpatient visits between 2017 and 2019 (before COVID-19) and the total number of outpatient visits in 2020 (COVID-19 period) were compared. Diagnostic codes were identified during 2 periods to analyze changes in the number of outpatient visits according to disease and month.

The average annual number of outpatient visits was 47,105 before, and 40,786 during the COVID-19 pandemic, with a decrease of 13.4%. The number of outpatient visits in internal medicine decreased by 10.2% during the COVID-19 pandemic and tended to rebound during the second half of the year. However, the number of outpatient visits in the pediatric department decreased by 37.5% overall throughout the COVID-19 period and continued to decline in the second half of the year. The number of outpatients with infectious diseases decreased significantly (35.9%) compared to noninfectious diseases (cancer, 5.0%; circulatory disease, 4.1%). In addition, the number of outpatient visits due to viral diseases continued to decline, while the incidence of bacterial diseases increased rapidly in the second half of the year.

This study confirmed that the number of outpatient visits due to bacterial or viral infections decreased throughout the COVID-19 crisis. Therefore, expanding public health and telemedicine services is necessary to prevent secondary health problems caused by essential medical use restrictions.

Abbreviations: COVID-19 = Coronavirus 2019, NRF = National Research Foundation, SD = standard deviation.

Keywords: COVID-19, infectious disease, internal medicine, number of outpatient visits, pediatrics

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The datasets generated during and/or analyzed during the current study are publicly available.

^a Department of Rehabilitation Medicine, Gyeongsang National University College of Medicine and Gyeongsang National University Hospital, Jinju, Republic of Korea,

^b Department of Physiology and Institute of Health Sciences, College of Medicine, Gyeongsang National University, Jinju, Republic of Korea, ^c College of Medicine, Gyeongsang National University, Institute of Health Sciences and Department of Internal Medicine, Gyeongsang National University Changwon Hospital, Changwon, Republic of Korea, ^d Division of Endocrinology and Metabolism, Department of Medicine, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Republic of Korea, ^e College of Medicine, Gyeongsang National University, Institute of Health Sciences and Department of Internal Medicine, Gyeongsang National University Hospital, Jinju, Republic of Korea, ^f Regional Cardiocerebrovascular Disease Center, Gyeongsang National University Hospital, Jinju, Republic of Korea.

* Correspondence: Rock Bum Kim, Gyeongsang National University Hospital, Jinju, Gyeongsangnam-do 52727, Republic of Korea (e-mail: krb747@gmail.com).

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1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has been an ongoing global issue since the first case was observed in December 2019. The first case in South Korea occurred on 20 January 2020 and 60,740 cases were observed in 2020.^[1] As of May 2021, the pandemic is still ongoing.

The COVID-19 pandemic has also affected the use of medical services, which has decreased due to lockdown of hospitals to prevent the spread of COVID-19, patients' fear of secondary hospital acquired infection and stigma on confirmed cases of COVID-19 (social accusations and ostracization), and the expansion of telemedicine. The decrease in the use of medical services mainly occurred between March and April 2020. The number of patients with acute coronary syndrome in the United Kingdom decreased by 40% compared to the same period in 2019,^[2] and hospitalizations for acute stroke have decreased by 50% to 80% in some countries.^[3] In addition, the number of newly diagnosed cancer patients had decreased by 46.5% in the United States and 40% in the Netherlands at the peak of the COVID-19 outbreak.^[4] In addition, the outpatient volume for all diseases has decreased by approximately 60% across the United States.^[5] The number of patients with infectious diseases also declined. The number of outpatient visits for bronchitis decreased by 76.79%, pneumonia by 71.03%, and acute upper respiratory infection by 56.87% in 2020, compared to the numbers observed in 2019.^[6] The number of pediatric outpatients (under the age of 18) diagnosed with infectious disease also decreased by 62.6%.^[7] Additionally, the number of antibiotic prescriptions in the United States also declined by 51.2% during the COVID-19 pandemic period.^[8]

The Korean government has also implemented social distancing policies, such as entry restrictions or conditional entry allowance on foreign entrants from each country, bans on large gatherings and restrictions on multi-use facilities to prevent the spread of COVID-19 in 2020. In addition, it was recommended to promote and practice hand hygiene and wearing masks at the individual level. These policies and preventive habits are expected to effectively prevent the spread of other infectious diseases besides COVID-19, thereby reducing the incidence of infectious diseases.^[9] However, there is some claim that such restrictions may have unclear effects to the COVID-19 pandemic.^[10] To find out the role of human mobility networks in spread of epidemics, Hancean et al analyzed country-to-country global spread of COVID-19 by using exponential random graph models, and they reported that spread of COVID-19 was patterned by the migration and tourism.^[11] For the first case of COVID-19 importations, the dominant mode of transportation was the air flight, and main carriers were male and returning travellers.^[11] Therefore, policies regarding these network may have positive effects on COVID-19 spread prevention.

Since the COVID-19 outbreak began, many researchers have been trying to develop COVID-19 vaccines, and there were 27 vaccine candidates for clinical evaluation and 139 candidates for preclinical development of COVID-19 in 2020.^[12] Along with the development of vaccine, its strategy is also important. Due to the heterogeneity of the society, frequency of interactions involving spread of COVID-19 pandemic, and clinical and immunological manifestations of COVID-19 infected individuals would be different.^[13] According to the study by Markovic et al, heterogeneity in health status along with spatial distribution patterns within the population may affect the result of vaccination by socioeconomic, cultural as well as immunological

and other biological factors.^[13] Therefore, it is important to know the change in pattern of hospital visit during the COVID-19 pandemic, to figure out the change in health factors that can affect the COVID-19 infection.

This study aimed to compare the number of outpatient visits in internal medicine and pediatric departments in 2020, which was defined as the COVID-19 pandemic period, to that of the years 2017 to 2019, which was defined as the pre-COVID-19 period. In addition, changes in the number of outpatient visits were analyzed by separating non-infectious and infectious diseases.

2. Methods

2.1. Subjects for Study

The subjects were patients who visited the outpatient clinic at a tertiary general hospital's internal medicine and pediatric departments during the 5 years between January 1, 2016 and December 31, 2020. The total number of outpatient visits we observed was 1,308,822, and we obtained the date of visit, age, and sex information at the time of the visit, along with the diagnosis code based on the International Classification of Diseases 10th revision diagnostic criteria.

Among these cases, we excluded 207,620 cases that did not have a diagnosis code. In the case of revisit with the same diagnosis code within 1 year after the first visit, only data from the first visit were analyzed. However, cases of revisiting >1 year after the first visit were included in the analysis. Cases in 2016 were excluded from the analysis because it was not possible to confirm their first visit or obtain sufficient data. Data from visits in 2016 were only used for analysis when the 2016 visit precluded a revisit in 2017. Therefore, the final data for analysis consisted of 182,100 first visit cases from 2017 to 2020 (Fig. 1).

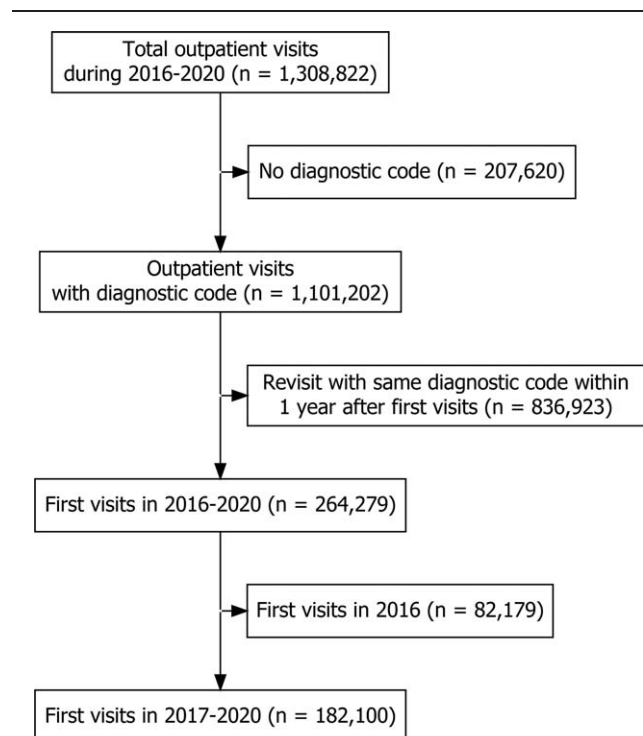


Figure 1. Flowchart for data analyzed in this study. This study included 182,100 first visit cases from 2017 to 2020.

2.2. Type of diseases for analysis

We analyzed the number of first-visit outpatients per year for each disease for 4 years between 2017 and 2020, and compared the change in outpatient visits during 2017 to 2019 (pre-COVID-19 period) and 2020 (COVID-19 period). The diseases were classified as infectious or noninfectious, identified, and analyzed. Infectious diseases were defined according to the following diagnostic codes: all infectious diseases (A00-B99, J00-J22), bacterial infectious diseases (A00-A79), viral infectious diseases (A80-A99, B00-B34, J00-J22), or fungal and other infectious diseases (B35-B99). Noninfectious diseases were defined as follows according to diagnostic codes: all cancers (C00-D48) and circulatory diseases (I00-I99).

In the analysis, the number of outpatient visits in each department and the sex and age groups of the actual number of patients were compared for each year. The number of outpatient visits and the actual number of patients were also compared between the pre-COVID-19 and COVID-19 periods based on department, sex, age group, and disease presentation. The monthly numbers of outpatient visits were then compared based on the total number of outpatients, department, and disease presentation.

2.3. Statistical analysis

The number of outpatient visits to internal medicine and pediatric departments during each year were analyzed, and the number and proportions were analyzed by calculating the actual number of patients in each year to determine distribution by sex and age group.

To compare the difference between the average number of outpatient visits in 2017 to 2019 (pre-COVID-19 period) and the number of outpatient visits in 2020 (COVID-19 period), a chi-square goodness-of-fit test was performed under the hypothesis that the expected numbers are equal. In addition, the local polynomial regression curve was plotted for the average number of monthly outpatient visits in the pre-COVID-19 and COVID-19 periods, respectively, and a χ^2 goodness-of-fit test was performed to analyze the monthly differences. The statistical significance level for the difference was set to 0.001 to avoid multiple testing problems.

To determine the 2020 COVID-19 outbreak status in South Korea, we analyzed and plotted the epidemic curve based on the

data of daily COVID-19 cases from the Korea Disease Control and Prevention Agency (<http://ncov.mohw.go.kr/>). In addition, the change trends and change points of cases were observed with segmented regression analysis based on the data. Thereafter, we determined the outbreak period from the change point at which the number of cases significantly increased up to the change point at which the change was reduced to the previous level. A supplementary figure shows this in more detail (see Supplementary Figure 1, <http://links.lww.com/MD2/A900>). All analyses were performed using R software (version 4.0; R Core Team, 2020) (R: Language and Environment for Statistical Computing, R Foundation for Statistical Computing, Vienna, Austria).

2.4. Ethics statement

This study was an analysis data from the electronic medical records, retrospectively. The data set did not include any personal information such as patient name, social security number, address, or phone number. So the data set was openly available for public research purposes and informed consent could not be obtained. The present study protocol was reviewed and approved by the Institutional Review Board of Gyeongsang National University Hospital (approval No. GNUH 2021-04-018).

3. Results

The total number of outpatient visits between 2017 and 2019 was 182,100. Among them, the rates of internal medicine and pediatric patients were 88.9% and 11.1%, respectively. The actual number of patients was 99,237, with an average age of 51.3 ± 24.2 years, and the male-to-female ratio was 52.4:47.6. Patients in their 60s made up the largest age group (20.6%). Table 1 shows the characteristics of the number of outpatient visits and the actual number of patients by year and age group.

According to the analysis of the pre-COVID-19 period and COVID-19 periods, the total number of outpatient visits was 47,105 in the pre-COVID-19 period and 40,786 in the COVID-19 period, with an overall decrease of 13.4% ($P < .001$). The number of outpatient visits in internal medicine decreased by 10.2% during the COVID-19 period ($P < .001$), but it decreased by 37.5% in pediatric patients ($P < .001$). The decrease in the number of outpatient visits for males ($-14.2%$, $P < .001$) was

Table 1
Department and demographic characteristics of the study participants by years.

	2017	2018	2019	2020	Total
No. of outpatient visits, n	49,128	45,686	46,500	40,786	182,100
Internal medicine, n (%)	43,134 (87.8)	39,896 (87.3)	41,524 (89.3)	37,295 (91.4)	161,849 (88.9)
Pediatrics, n (%)	5994 (12.2)	5790 (12.7)	4976 (10.7)	3491 (8.6)	20,251 (11.1)
Actual no. of patients, n	28,766	25,181	24,111	21,179	99,237
Male, n (%)	14,912 (51.8)	13,284 (52.8)	12,795 (53.1)	10,966 (51.8)	51,957 (52.4)
Age, y, mean (\pm SD)	50.2 (\pm 24.2)	50.5 (\pm 24.5)	51.9 (\pm 24.3)	53.1 (\pm 23.5)	51.3 (\pm 24.2)
<19, n (%)	4647 (16.2)	4175 (16.6)	3624 (15.0)	2615 (12.3)	15,061 (15.2)
20–29, n (%)	1336 (4.6)	1127 (4.5)	1093 (4.5)	1276 (6.0)	4832 (4.9)
30–39, n (%)	1805 (6.3)	1,436 (5.7)	1358 (5.6)	1268 (6.0)	5867 (5.9)
40–49, n (%)	3202 (11.1)	2609 (10.4)	2347 (9.7)	2081 (9.8)	10,239 (10.3)
50–59, n (%)	5561 (19.3)	4718 (18.7)	4484 (18.6)	3649 (17.2)	18,412 (18.6)
60–69, n (%)	5736 (19.9)	5143 (20.4)	4929 (20.4)	4644 (21.9)	20,452 (20.6)
70–79, n (%)	4559 (15.8)	4150 (16.5)	4227 (17.5)	3691 (17.4)	16,627 (16.8)
>80, n (%)	1920 (6.7)	1823 (7.2)	2048 (8.5)	1955 (9.2)	7746 (7.8)

SD = standard deviation.

Table 2
Comparison between the pre-COVID-19 period and the COVID-19 period by department, demography and diseases.

	Mean no. of Pre-COVID19 period (2017–2019)	No. of COVID-19 period (2020)	Percentage change (%)	P
Total	47,105	40,786	−13.4	<.001
Internal medicine	41,518	37,295	−10.2	<.001
Pediatrics	5587	3491	−37.5	<.001
Sex				
Female	12,356	10,213	−17.3	<.001
Male	13,664	10,966	−19.7	<.001
Age group				
<19	4149	2615	−37.0	<.001
20–29	1186	1276	+7.6	.070
30–39	1533	1268	−17.3	<.001
40–49	2719	2081	−23.5	<.001
50–59	4921	3649	−25.8	<.001
60–69	5269	4644	−11.9	<.001
70–79	4312	3691	−14.4	<.001
>80	1930	1955	+1.3	.688

COVID-19 = coronavirus 2019.

greater than that of females (−12.5%, $P < .001$) during the COVID-19 period. Besides those under 19 years old (−37.6%, $P < .001$), the greatest decrease in the number of outpatient visits was that of the 50 to 59 age group at −19.2% ($P < .001$, Table 2).

In the comparison of the number of outpatient visits by disease type, the decrease of visits due to infectious diseases during the COVID-19 period (−35.9%, Fig. 2A) was greater than that due to non-infectious diseases such as cancer (−5.0%, $P = .014$, Fig. 2B) and circulatory disease (−4.1%, $P = .038$, Fig. 2C). Among the infectious diseases, the number of outpatient visits due to viral diseases decreased by 48.8%, whereas the number of outpatient visits due to bacterial (11.8%, $P = .003$) and fungal infections or other infectious diseases (14.3%, $P = .299$) did not decrease as much (Fig. 2D).

Figure 3 shows a comparison between the number of monthly outpatient visits during the pre-COVID-19 and COVID-19 periods. During the COVID-19 period, the number of outpatient visits decreased during March–April, then a similar number of outpatient visits compared to that of the pre-COVID-19 period was observed in September–October, which later decreased again in December (Fig. 3A). The number of outpatient visits at internal medicine departments during the second half of 2020 did not differ significantly from that of the pre-COVID-19 period (Fig. 3B). However, it was lower than that of the pre-COVID-19 period in pediatric patients in every single month (Fig. 3C).

The number of outpatient visits for infectious diseases was lower in all months (Figure 3D), but the number of bacterial infections in September–December was greater than that of the same pre-COVID-19 period (Fig. 3E). However, the number of outpatient visits for viral infections decreased throughout the COVID-19 period compared to that of the pre-COVID-19 period (Fig. 3F). The number of outpatient visits for fungal and other infectious diseases decreased in March–June and December of the COVID-19 period (Fig. 3G). Cancer (Fig. 3H) and circulatory disease (Fig. 3I) showed no significant difference in most months except for a decrease in March and April, as they are noninfectious.

4. Discussion

This study showed a 13.4% decrease in internal medicine and pediatric outpatient medical service use during the COVID-19

period. The decrease in the number of outpatient visits during the period from March to April 2020, when the number of COVID-19 patients began to increase rapidly in South Korea, was particularly significant. This period was the first outbreak period, and the number of new COVID-19 patients in South Korea averaged 177.0/day (25 February to 20 April) and a maximum of 909 cases were observed as of February 29 (Supplementary Figure 1, <http://links.lww.com/MD2/A900>). Around the same time, the World Health Organization declared the COVID-19 crisis a pandemic,^[14] and the infectious disease crisis stage was upgraded to the highest stage (red level) in South Korea, with some areas being restricted.^[15] As a result, the public's social activities and medical service use were restricted, and the importance of wearing a mask and personal hygiene was emphasized. Therefore, there was a significant decrease in the number of outpatient visits in the early months of 2020, the first outbreak period of COVID-19. This decrease in patients also occurred in other countries, some reporting steeper declines in the number of patients than in the present study.^[4–6,16,17]

After the first outbreak period in South Korea, there was a second (August 12 to September 20) with an average number of 207.9 confirmed patients per day (up to 441, August 27). A third outbreak period with an average of 648.5 confirmed patients per day (up to 1240 as of December 25) occurred between November 11 and December 31 (Supplementary Figure 1, <http://links.lww.com/MD2/A900>). However, the number of outpatient visits did not decrease significantly during these periods compared to the first outbreak period. Rather, at the time of the second outbreak period, outpatient visits to internal medicine departments were at a similar level to that of the pre-COVID-19 period. This might be due to the greater fear caused by limited scientific understanding, rapid increase in mortality rates, growing social concerns, and stricter public regulations during the initial spread of COVID-19. However, the public may start to fear the disease less due to more accurate information about the disease, a gradual decrease in mortality rates, and fatigue from social constraints. Other countries also showed a large decrease in the number of outpatient visits in February–March 2020, which returned to the pre-COVID-19 level, although the number of COVID-19 patients increased after March.^[15]

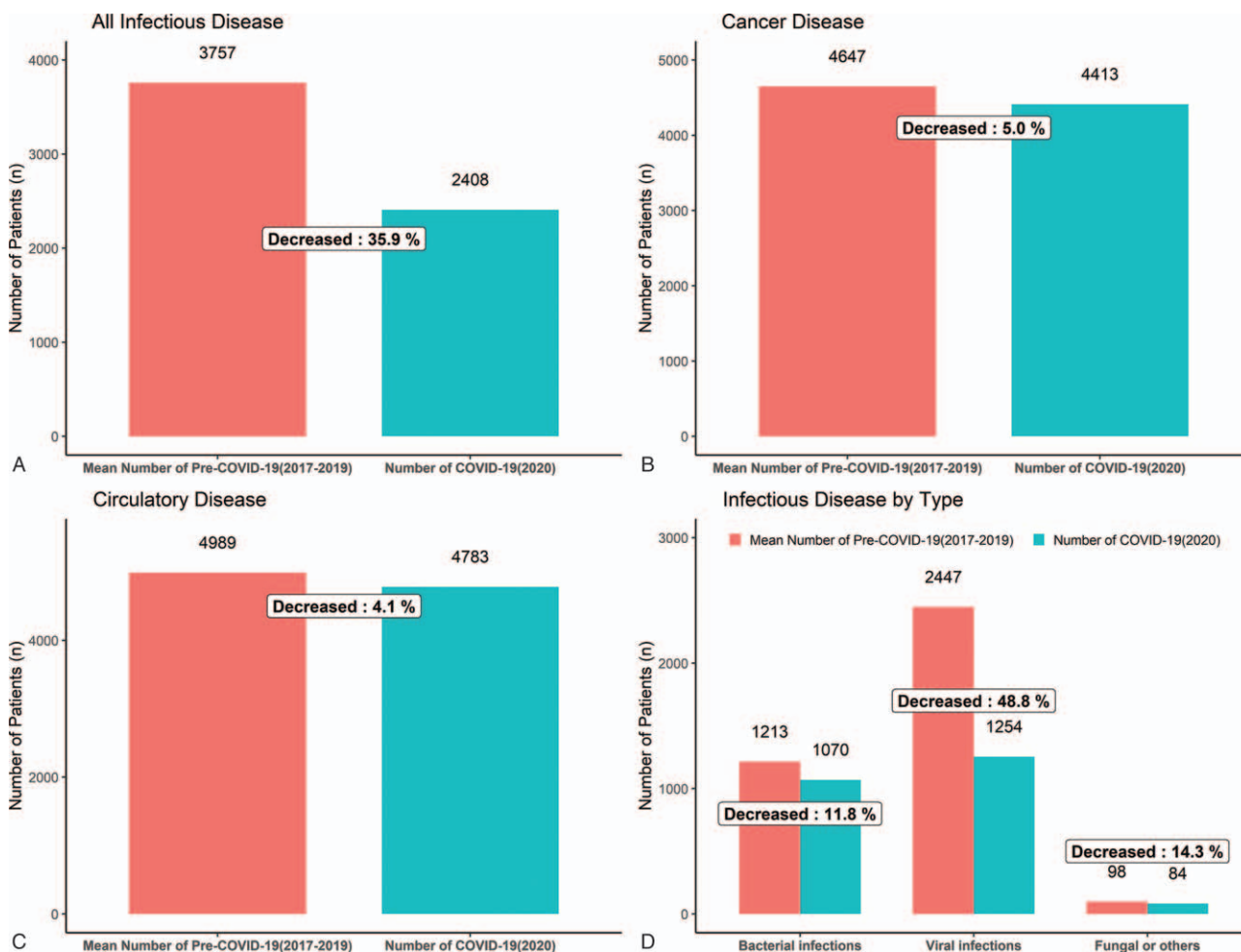


Figure 2. Comparison of the number of outpatient visits by disease type. A) Number of outpatient visits for infectious diseases. B) Number of outpatient visits for cancer. C) Number of outpatient visits for circulatory diseases. D) Number of outpatient visits for bacterial, viral, and fungal or other infections. The figure shows that the decrease of outpatient visits due to infectious diseases during the COVID-19 period was greater than that due to non-infectious diseases, and the decrease was greatest when viral infection was the reason of visit.

In this study, the decrease in the number of outpatient visits was greater among pediatric patients (−37.5%) compared to internal medicine patients (−10.2%). In children, infectious and noninfectious diseases, such as trauma, occur through activities and contact in preschools or schools. Almost all schools in South Korea conducted online classes instead of in person classes in 2020, which may have caused a greater decline in the number of outpatient visits in pediatrics compared to internal medicine departments. In addition, pediatric patients and their parents prefer to improve their personal hygiene and maintain social restrictions by limiting outdoor activities and eating out. This can lead to a tendency to watch and wait instead of going to the hospital immediately when children are sick. Other studies reported similar results, showing a decrease in the number of hospital visits in children compared to adults.^[16] In a study by Hartnett et al, the number of hospital visits decreased by 42% for all age groups, except for pediatric patients under the age of 14, among whom it decreased by 71% to 72% when comparing numbers before and after the COVID-19 period.^[16] The rebound in the number of outpatient visits was also lower in children than in adults. In our study, the number of internal medicine

outpatient visits returned to almost pre-COVID-19 levels in the second half of 2020, while the number of pediatric outpatient visits decreased during the second and third outbreak periods in 2020 and did not rebound to the number observed during the pre-COVID-19 period. The decrease in the number of pediatric patient visits was greater than that of adults, and the rebound was not as great as that of adults, and this was consistent with the results of studies conducted in other countries.^[5,18]

The decrease in the number of outpatient visits by disease type was as follows: the decrease in infectious diseases (−35.9%) was greater than the decrease in the number of outpatients with noninfectious diseases (−5.0% and −4.1% for cancer and circulatory disease patients, respectively). Among infectious diseases, there was a greater decrease in the number of outpatient visits for viral diseases compared to bacterial diseases. In addition, the number of outpatients with bacterial diseases rebounded to numbers similar to those of the pre-COVID-19 period, whereas the incidence of viral diseases did not rebound during the COVID-19 period and continued to decrease compared to the numbers observed during the pre-COVID-19 period during the second and third outbreak periods. Since viral

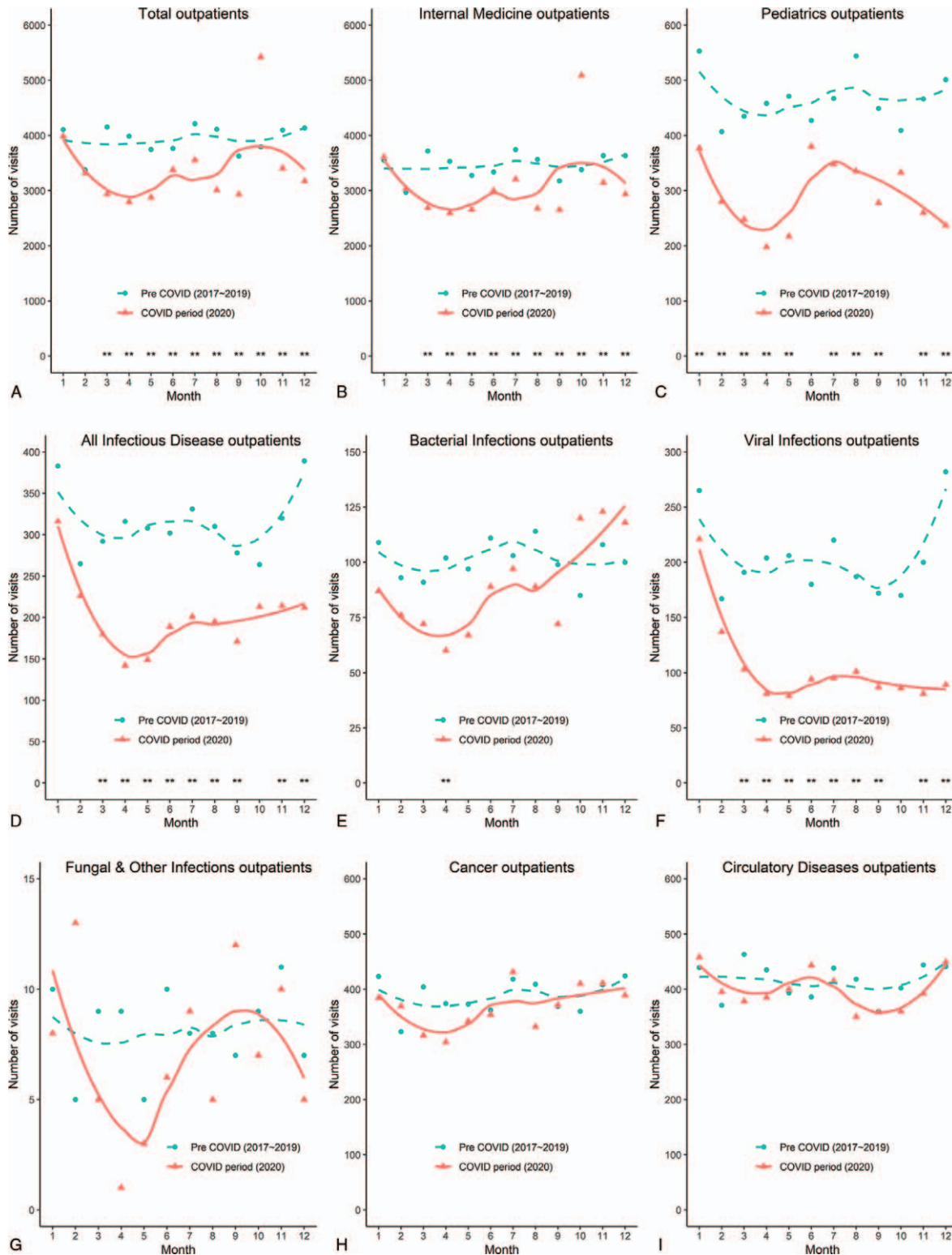


Figure 3. Monthly comparison in the number of outpatient visits between the pre-COVID-19 period and COVID-19 period. (A) Total number of outpatient visits. (B) Number of outpatient visits in internal medicine department. (C) Number of outpatient visits in pediatric department. (D) Number of outpatient visits for all infectious diseases. (E) Number of outpatient visits for bacterial infectious diseases. (F) Number of outpatient visits for viral infectious diseases. (G) Number of outpatient visits for fungal or other infectious diseases. (H) Number of outpatient visits for cancer. (I) Number of outpatient visits for circulatory diseases. The figure shows that the number of outpatient visits decreased or was not differ during the COVID-19 period compared to pre-COVID-19 period, except patients with bacterial infection in September-December, which showed greater number of outpatient visits than pre-COVID-19 period. The number of pre-COVID-19 period is the average value for 3 years from 2017 to 2019. The curves of lined and dotted are Local Polynomial Regression curve. ** $P < .001$ for differences between pre-COVID-19 and COVID-19 period.

diseases are more contagious between people, they may have been prevented by wearing a mask, improving personal hygiene and practising social distancing. In fact, studies have shown that the hospitalization rate of influenza was 11.9 to 26.9 times lower than that of the previous season because seasonal influenza activity decreased during the COVID-19 outbreak period.^[19,20] In addition, more patients with viral diseases tend to adopt the watch and wait approach because their symptoms are relatively mild, whereas the symptoms of bacterial diseases are more severe.^[21] Another study with children also showed that the occurrence of nonviral diseases such as urinary tract infection decreased by 16.4%, whereas the incidence of viral diseases such as common cold and bronchiolitis decreased by 70%.^[22] Another possible reason for the reduction in the number of outpatient visits with viral diseases is that other viral infections may have symptoms similar to those of COVID-19. Patients may be hesitant to visit the hospital due to concerns about COVID-19 infection, compulsory quarantine treatment, and social stigma after having COVID-19. In addition, hand washing and personal hygiene management is more important than respiratory transmission through contact with other people for bacterial urinary tract infection, food poisoning, or pneumonia.^[23] The bacterial disease rebound might be due to people returning to previous habits and being less careful as the COVID-19 crisis continued for a long time.

This study has some limitations. First, this study analyzed only outpatient visits in internal medicine and pediatrics, and inpatients and patients in other departments were not included. Therefore, interpretations regarding the generalizability of this must be approached with caution, and future studies with detailed analysis are required. In addition, only diagnostic codes were used to categorize the outpatients by disease without using the results of physical examinations, blood tests, or imaging tests. The use of these results would help attain a more accurate diagnosis and better categorized analysis. However, it is necessary to focus on the overall trend in the results of this study, since the primary purpose of the study was to determine whether the total number of outpatient visits has changed. The data of this study were mainly obtained from outpatient data of severely ill patients from tertiary general hospitals. Therefore, the decrease in the number of outpatient visits in the primary clinic may be different. However, primary clinics may also have experienced similar or greater changes in the number of outpatient visits due to the overall social environment during the COVID-19 period. Further studies might be required to gauge the total number of outpatient visits in South Korea since the number of COVID-19 patients in each region is different.

Nevertheless, this study differs from the others since it compared data from the entirety of 2020 with data from previous years. Most studies with similar purposes published thus far have only analyzed data up to the first half of 2020, when the rules regarding COVID-19 were the strictest. This study determined whether the number of outpatient visits decreased and rebounded during and after the first outbreak period in February–March 2020, and during the second and third outbreak periods in the second half of 2020.

In conclusion, this study confirmed that the number of outpatient visits decreased during the COVID-19 crisis in 2020, especially in pediatric patients and those with infectious diseases. The decrease may be due to external factors such as lockdown of medical institutions, social distancing, bans on large gatherings,

and fear of stigma due to the confirmation of COVID-19 infection. In addition, personal factors such as mask wearing, hand hygiene, and the watch and wait approach to mild symptoms should also be considered. Furthermore, the reduction of actual infectious diseases, especially viral diseases, is thought to be the cause of the reduction in the number of outpatients. Lastly, there may be concerns regarding secondary health damage due to COVID-19, such as the possibility that the treatment time may be missed or that it may not be treated properly due to a decrease in essential medical service use stemming from social and personal factors. To solve these problems, contact-free medical services, such as telemedicine, as well as effective and efficient vaccine dissemination must be expanded. Noninfectious diseases among children, such as growth and obesity often have self-limiting conditions, whereas internal medicine patients usually have chronic diseases such as hypertension and diabetes that need to be managed chronically. Therefore, the management of chronic diseases through contact-free medical services would improve social healthcare.

Author contributions

Conceptualization: Jong Ryeal Hahm, Rock Bum Kim.

Data curation: Rock Bum Kim.

Formal analysis: Jong Ryeal Hahm, Rock Bum Kim.

Investigation: Dawon Kang, Rock Bum Kim.

Methodology: Jong Ryeal Hahm, Rock Bum Kim.

Software: Dawon Kang.

Validation: Se-Il Go, Hye In Kim.

Writing – original draft: Hayoung Byun, Rock Bum Kim.

Writing – review & editing: Hayoung Byun, Dawon Kang, Jong Ryeal Hahm, Rock Bum Kim.

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