



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Journal of Infection and Public Health

journal homepage: www.elsevier.com/locate/jiph

Original article

The impact of the COVID-19 pandemic in the healthcare utilization in Korea: Analysis of a nationwide survey

Eunkyo Kang^{a,b}, Jieun Yun^c, Soo-Hee Hwang^d, Hyejin Lee^{e,f,*}, Jin Yong Lee^{d,g,h,**}^a National Cancer Control Institute, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang-si Gyeonggi-do 10408, Republic of Korea^b Department of Family Medicine, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang-si Gyeonggi-do 10408, Republic of Korea^c Department of Pharmaceutical Engineering, Cheongju University, 298, Daeseong-ro, Cheongwon-gu, Cheongju-si, Chungcheongbuk-do, Republic of Korea^d HIRA Research Institute, Health Insurance Review & Assessment Service, 60 Hyeoksin-ro, Wonju-si, Gangwon-do, 26465, Republic of Korea^e Department of Family Medicine, Seoul National University Bundang Hospital, 82 Gumi-ro, 173 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do 13620, Republic of Korea^f Department of Family Medicine, Seoul National University College of Medicine, 101 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea^g Public Healthcare Center, Seoul National University Hospital, 101 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea^h Department of Health Policy and Management, Seoul National University College of Medicine, 101 Daehak-ro, Jongno-gu, Seoul 03080, Republic of Korea

ARTICLE INFO

Article history:

Received 30 March 2022

Received in revised form 29 June 2022

Accepted 4 July 2022

Keywords:

SARS-CoV-2

COVID-19

Healthcare utilization

Screening

Korea

ABSTRACT

Background: COVID-19 has brought changes in daily life and increased the medical burden. This study aims to evaluate the delays in healthcare services and related factors in the general population during the COVID-19 pandemic.

Methods: We took a nationally representative sample and conducted a mobile phone-based survey. The study was conducted anonymously. Of the 3377 subjects who consented to participate, a total of 2097 finished the survey. The primary outcome was respondents' experiences with delayed (1) health screenings, (2) non-urgent medical visits, (3) medical visits for chronic disease, and (4) emergency visits during the COVID-19 pandemic.

Results: Of 2097 respondents, females, residents of the Seoul metropolitan area, those with private insurance, those without chronic diseases, smokers, and drinkers had higher risk of delays in health screening and non-urgent medical visits after adjustment. Among chronic disease patients, those who were over 60 years old (adjusted odds ratio 0.36, 95% CI 0.14–0.92) showed lower risk of delayed medical visit. Residents of the Seoul metropolitan area, those with private insurance, smokers, and drinkers were all associated with experiencing delayed health screening and non-urgent medical visits had higher risk of delays in chronic disease visits and emergent medical visits.

Conclusions: Delayed access to healthcare services is associated with poor outcomes and may cause different complications. Efforts are needed to prevent delays in medical use due to infectious diseases such as COVID-19. Considering the possibility of the emergence of infectious diseases, various countermeasures are needed to prevent delays in medical visit.

© 2022 The Authors. Published by Elsevier Ltd on behalf of King Saud Bin Abdulaziz University for Health Sciences.

CC_BY_NC_ND_4.0

* Corresponding author at: Department of Family Medicine, Seoul National University Bundang Hospital, 82 Gumi-ro, 173 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, 13620, Republic of Korea.

** Corresponding author at: HIRA Research Institute, Health Insurance Review & Assessment Service, 60 Hyeoksin-ro, Wonju-si, Gangwon-do, 26465, Republic of Korea.

E-mail addresses: hjinlee@snu.ac.kr (H. Lee), jylee00@snu.ac.kr (J.Y. Lee).

¹ These authors contributed equally as corresponding author.

Introduction

COVID-19 has brought changes in daily life such as stay-at-home orders and social distancing, and changes in the method of providing healthcare services such as non-face-to-face treatment [1–3]. In addition, COVID-19 has increased the medical burden, preventing sufficient healthcare services from being provided [4,5]. Declines in health care services have been reported in a variety of areas, particularly during the COVID-19 pandemic as non-emergency care has been reported [6]. Health screening, including cancer screening [7],

and healthcare utilization for the chronic disease were decrease, and the number of cases in which patients choose to take over-the-counter drugs instead of visiting a hospital has increased [8].

This disruption in health care provision is thought to have had a major impact on the care of acute non-COVID-19 conditions, routine treatment of chronic diseases, and early diagnosis and treatment of life-threatening diseases [9,10]. The healthcare burden caused by COVID-19 can impair the functioning of all medical staff [11,12], and may limit the use of healthcare for the entire population [13]. However, although COVID-19 may have a significant impact on healthcare utilization in the general population, early studies focused on the impact of COVID-19 on the healthcare utilization of infected patients, such as hospitalizations or ICU admissions [14–16]. Most previous studies investigated only on restrictions on the healthcare utilization of specific population groups [17–19]. Although there were studies on general population, most of the studies are on specific situations such as specific screening or emergency care [20–22].

In the context of pandemic, it is important to understand healthcare resources and access for the general population. This study aims to evaluate the delays in healthcare services and related factors in the general population during the COVID-19 pandemic. Healthcare utilization was evaluated by dividing it into health screening, non-emergency care, chronic disease, and emergency care.

Materials and methods

Participants

The Korean National Statistical Office conducts a census every year. We calculated the representative sample size based on the 2020 National Statistical Office census results, the survey year. Assuming a 95% confidence interval, 2.2% error margin, and 0.5% standard deviation, the estimated sample size was 1984 people. Considering that some questions may not be answered, we collected more than 3000 participants. For the study subjects, sampling was conducted using quota samples by age, gender, and region for residents aged 19 years or older residing in Korea. For the sampling, in the first step according to the population structure of the 2015 Population census of the National Statistical Office, an appropriate number of samples was allocated according to the population distribution of 16 administrative districts. All 16 administrative districts were included in the sampling. The number of subjects by age and gender was earmarked for each organizational district unit in the second step.

An anonymous, voluntary web-based survey was accomplished by participants recruited from November 9 to December 4. Participants interested in the study were enrolled after confirming whether they met the inclusion criteria, and respondents who finally completed the survey were included in the study. The study inclusion criteria were those 19 years of age or older, physically healthy, and mentally stable enough to read, understand, and answer the questionnaire. Those who do not understand Korean proficiently may have limitations in understanding the consent form or reading and answering questions, so they were excluded from the study. The study protocol was approved by the Institutional Review Board (IRB no. E-2011–102–1173).

Survey design

This study was conducted in all regions of Korea with technical assistance from a social research company (Gallup Korea). The survey was pilot-tested with 100 respondents to identify unclear instructions or questions, ambiguous response expression, or other issues with the survey, and revised. Data from pilot tests were not

utilized in the analysis of the study. Based on the revised survey, the research subjects were informed of the purpose of the study, consented to participate, and then went to an encrypted website and filled out a questionnaire.

The study was conducted anonymously, but to prevent duplicate responses to the questionnaire, the study subjects were asked to use a mobile phone authentication system. When a respondent enters their mobile phone number, a password is sent to their mobile phone. The password is used to identify the mobile phone owner based on information from the mobile network provider, thereby preventing duplicate surveys. The questionnaire in this study was constructed in a multiple-choice format, and if a response is omitted, it is impossible to move to the next page. For this reason, there were no missing values in the case of respondents who completed the survey. When a study participant gave the same or similar answer to a question on one page (10 questions), a pop-up was set up to confirm the answer. Of the 3377 subjects who consented to participate, a total of 2097 finished the survey, and the dropout rate was 37.9%.

Outcome measure

The primary outcome was respondents' experiences with delayed (1) health screenings, (2) non-urgent medical visits, (3) medical visits for chronic disease, and (4) emergency visits during the COVID-19 pandemic. The questionnaire included questions about the demographic characteristics of the respondents, having chronic diseases, smoking and drinking habits, and the primary outcome. Demographic characteristics included gender, age, region of residence, marital status, occupation, education status, the poverty-income ratio, and private insurance status. In Korea, there were large-scale COVID-19 outbreaks in the Seoul metropolitan area and Daegu and Gyeongbuk areas, with fewer cases in other areas. Therefore, we divided the region of residence into three regions. To investigate whether they had a chronic disease, respondents were asked about their disease and duration of treatment.

Respondents with diseases such as heart disease, cancer, or diabetes that lasted more than 1 year and required continuous treatment or had limited activity were coded as chronic diseases. Smoking and alcohol consumption assessments included self-reported smoking and alcohol consumption.

Statistical analysis

We performed descriptive statistics on respondents' demographics. Numerical data were presented as numbers and percentages. Univariate and multivariate logistic regression were used to calculate the crude and adjusted odds ratio (aOR) with 95% confident interval (CI), and logistic regression was used to analyze the correlation between potential risk factors related to delay in healthcare utilization. A P value of < 0.05 indicates statistical significance. All statistical analyzes were conducted using R Statistical Software, version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Baseline characteristics of the respondents

A summary of the respondents' demographics and characteristics is represented in Table 1. Two thousand ninety-seven individuals who completed the survey were included in the analysis. The proportion of men and women who responded in the survey was similar (50.5% vs. 49.6%). As for the residential regions, 19.1% were in the metropolitan area and 9.4% were in Daegu and Gyeongbuk area. Among the respondents, 59.7% were married, 52.9% were office

Table 1
Baseline characteristics of the respondents and ratio of experienced delays for health screening and non-urgent medical visits.

Total	Delays in health screening (N = 2097)			Delays in non-urgent medical visits (Elective and non-chronic conditions) (N = 2097)			
	Yes, No (%)	No, No (%)	p-value	Yes, No (%)	No, No (%)	p-value	
	540 (25.8)	1557 (74.2)		159 (7.6)	1938 (92.4)		
Sex							
Male	1058 (50.5)	226 (21.4)	832 (78.6)	< 0.001	67 (6.3)	991 (93.7)	0.03
Female	1039 (49.6)	314 (30.2)	725 (69.8)		92 (8.9)	947 (91.2)	
Age							
19–29	377 (18.0)	71 (18.8)	306 (81.2)	0.07	29 (7.7)	348 (92.3)	0.07
30–39	411 (19.6)	104 (25.3)	307 (74.7)		41 (10.0)	370 (90.0)	
40–49	485 (23.1)	152 (31.3)	333 (68.7)		40 (8.3)	445 (91.8)	
50–59	479 (22.8)	130 (27.1)	349 (72.9)		28 (5.9)	451 (94.2)	
≥ 60	345 (16.5)	83 (24.1)	262 (75.9)		21 (6.1)	324 (93.9)	
Region							
Seoul metropolitan area	401 (19.1)	125 (31.2)	276 (68.8)	0.022	39 (9.7)	362 (90.3)	0.19
Daegu-Gyeongbuk area	196 (9.4)	48 (24.5)	148 (75.5)		13 (6.6)	183 (93.4)	
Others	1500 (71.5)	367 (24.5)	1133 (75.5)		107 (7.1)	1393 (92.9)	
Marital status							
Single	755 (36.0)	157 (20.8)	598 (79.2)	0.001	51 (6.8)	704 (93.3)	0.34
Married	1251 (59.7)	361 (28.9)	890 (71.1)		101 (8.1)	1150 (91.9)	
Widowed/divorced	91 (4.3)	22 (24.2)	69 (75.8)		7 (7.7)	84 (92.3)	
Job status							
Own business	193 (9.2)	36 (18.7)	157 (81.4)	0.03	14 (7.3)	179 (92.8)	0.46
Manual worker	212 (10.1)	44 (20.8)	168 (79.3)		16 (7.6)	196 (92.5)	
Office worker	1110 (52.9)	316 (28.5)	794 (71.5)		94 (8.5)	1016 (91.5)	
Housewife/Student/Unemployed	582 (27.8)	144 (24.7)	438 (75.3)		35 (6.0)	547 (94.0)	
Educational status							
High school graduate and under	359 (17.1)	67 (18.7)	292 (81.3)	< 0.001	21 (5.9)	338 (94.2)	0.38
College / university graduation or associate degree	1498 (71.4)	395 (26.4)	1103 (73.6)		124 (8.3)	1374 (91.7)	
Master's degree or above	240 (11.4)	78 (32.5)	162 (67.5)		14 (5.8)	226 (94.2)	
The poverty-income ratio							
0–1.0	863 (41.4)	196 (22.7)	667 (77.3)	0.001	69 (8.0)	794 (92.0)	0.63
1.0–2.0	955 (45.8)	255 (26.7)	700 (73.3)		69 (7.2)	886 (92.8)	
≥ 2.0	268 (12.9)	87 (32.5)	181 (67.5)		20 (7.5)	248 (92.5)	
Private insurance							
Yes	1718 (81.9)	482 (28.1)	1236 (71.9)	< 0.001	137 (8.0)	1581 (92.0)	0.15
No	379 (18.1)	58 (15.3)	321 (84.7)		22 (5.8)	357 (94.2)	
Chronic diseases							
Yes	1016 (48.5)	213 (21.0)	803 (79.0)	< 0.001	56 (5.5)	960 (94.5)	0.001
No	1081 (51.6)	327 (30.2)	754 (69.8)		103 (9.5)	978 (90.5)	
Smoking							
Yes	545 (26.0)	142 (26.1)	403 (73.9)	0.85	57 (10.5)	488 (89.5)	0.003
No	1552 (74.0)	398 (25.6)	1154 (74.4)		102 (6.6)	1450 (93.4)	
Alcohol drinking							
Yes	1603 (76.4)	447 (27.9)	1156 (72.1)	< 0.001	141 (8.8)	1462 (91.2)	< 0.001
No	494 (23.6)	93 (18.8)	401 (81.2)		18 (3.6)	476 (96.4)	

workers, and 71.4% had a college, university graduation, or associate degree. The poverty-income ratio of 1.0–2.0 was 45.8%, accounting for the majority. Of the total, 81.9% had private insurance, 48.5% reported having a chronic disease, 26.0% smoked, and 76.4% drank alcohol.

Factors associated with experiencing delayed health screening and non-urgent medical visits

Respondents with a significantly higher adjusted risk of experiencing delayed health screening were female (aOR 1.85, 95% CI 1.47–2.32), ages 40–49 (aOR 1.71, 95% CI 1.17–2.50), residents of the Seoul metropolitan area (aOR 1.34, 95% CI 1.06–1.69), married (aOR 1.35, 95% CI 1.02–1.79), those with a college/university degree (aOR 1.65, 95% CI 1.20–2.27) or higher (aOR 2.17, 95% CI 1.43–3.30), those with private insurance (aOR 1.82, 95% CI 1.33–2.49), those without chronic disease (aOR 1.62, 95% CI 1.31–2.00), smokers (aOR 1.85, 95% CI 1.47–2.32), and alcohol drinkers (aOR 1.71, 95% CI 1.31–2.24). [Tables 2,3,4.](#)

Respondents with a significantly higher adjusted risk of experiencing delayed health screening were female (aOR 2.17, 95% CI 1.49–3.16), residents of the Seoul metropolitan area (aOR 1.75, 95% CI

1.18–2.60), those with private insurance (aOR 1.49, 95% CI 1.06–2.09), those without chronic disease (aOR 1.88, 95% CI 1.32–2.68), smokers (aOR 2.20, 95% CI 1.31–3.72), and alcohol drinkers (aOR 1.71, 95% CI 1.15–2.54). For respondents in the age group of 50–59 years, aOR to experience delays in non-urgent medical visits was significantly lower (aOR 0.48, 95% CI 0.24–0.94).

Factors associated with experiencing delayed medical visits for chronic disease

Factors related to delay in medical visits due to chronic diseases were investigated for 1081 individuals who answered that they had chronic diseases. Among chronic disease patients, 10% of the respondents answered that they had experienced delays in medical visits due to chronic diseases, and the following factors showed a significant correlation; those who were over 60 years old (aOR 0.36, 95% CI 0.14–0.92), residents of the Seoul metropolitan area (aOR 1.64, 95% CI 1.02–2.69), those with a master's degree or above (aOR 0.46, 95% CI 0.19–0.87), those with private insurance (aOR 2.15, 95% CI 1.03–4.51), smokers (aOR 2.25, 95% CI 1.39–3.63), and alcohol drinkers (aOR 2.01, 95% CI 1.03–3.94).

Table 2
Crude and adjusted odds ratio from logistic regression analysis of factors associated with delays in health screening and non-urgent medical visits.

Sex	Delays in health screening (N = 2097)		Delays in non-urgent medical visits (Elective and non-chronic conditions) (N = 2097)	
	Crude OR	Adjusted OR	Crude OR	Adjusted OR
Male	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Female	1.59 (1.31–1.94)	1.85 (1.47–2.32)	1.44 (1.04–1.99)	2.17 (1.49–3.16)
Age				
19–29	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
30–39	1.46 (1.04–2.05)	1.31 (0.90–1.89)	1.33 (0.81–2.19)	0.98 (0.56–1.73)
40–49	1.97 (1.43–2.71)	1.71 (1.17–2.50)	1.08 (0.66–1.78)	0.70 (0.38–1.29)
50–59	1.61 (1.16–2.23)	1.47 (0.98–2.21)	0.75 (0.44–1.28)	0.48 (0.24–0.94)
≥ 60	1.37 (0.96–1.95)	1.23 (0.78–1.92)	0.78 (0.43–1.39)	0.50 (0.24–1.05)
Region				
Seoul metropolitan area	1.40 (1.10–1.78)	1.34 (1.06–1.69)	1.45 (0.98–2.14)	1.75 (1.18–2.60)
Daegu-Gyeongbuk area	1.00 (0.71–1.42)	1.00 (0.73–1.36)	0.93 (0.51–1.68)	0.91 (0.50–1.68)
Others	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Marital status				
Single	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Married	1.54 (1.25–1.91)	1.35 (1.02–1.79)	1.21 (0.85–1.72)	1.52 (0.96–2.42)
Widowed/divorced	1.21 (0.73–2.02)	1.26 (0.71–2.25)	1.15 (0.51–2.62)	1.53 (0.61–3.82)
Job status				
Own business	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Manual worker	1.14 (0.70–1.87)	1.24 (0.74–2.07)	1.04 (0.50–2.20)	0.89 (0.41–1.94)
Office worker	1.74 (1.18–2.55)	1.48 (0.98–2.22)	1.18 (0.66–2.12)	0.90 (0.48–1.68)
Housewife/Student/Unemployed	1.43 (0.95–2.16)	1.46 (0.95–2.25)	0.82 (0.43–1.56)	0.73 (0.37–1.44)
Educational status				
High school graduate and under	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
College / university graduation or associate degree	1.56 (1.17–2.08)	1.65 (1.20–2.27)	1.45 (0.90–2.34)	1.41 (0.84–2.37)
Master's degree or above	2.10 (1.44–3.06)	2.17 (1.43–3.30)	1.00 (0.50–2.00)	0.99 (0.47–2.10)
The poverty-income ratio				
0–1.0	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
1.0–2.0	1.24 (1.00–1.54)	1.03 (0.82–1.29)	0.90 (0.63–1.27)	0.76 (0.52–1.09)
≥ 2.0	1.64 (1.21–2.21)	1.24 (0.89–1.71)	0.93 (0.55–1.56)	0.72 (0.41–1.25)
Private insurance				
Yes	2.16 (1.60–2.91)	1.82 (1.33–2.49)	1.41 (0.88–2.24)	1.49 (1.06–2.09)
No	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Chronic diseases				
Yes	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
No	1.63 (1.34–2.00)	1.62 (1.31–2.00)	1.81 (1.29–2.53)	1.88 (1.32–2.68)
Smoking				
Yes	1.02 (0.82–1.28)	1.85 (1.47–2.32)	1.66 (1.18–2.33)	2.20 (1.31–3.72)
No	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Alcohol drinking				
Yes	1.67 (1.30–2.14)	1.71 (1.31–2.24)	2.55 (1.54–4.21)	1.71 (1.15–2.54)
No	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)

Factors associated with experiencing delayed emergent medical visits

One hundred thirty-nine patients visited the emergency room during the COVID-19 epidemic, accounting for about 6.6% of the total respondents. Of the 139 respondents, 55 (39.6%) answered that they experienced delay in emergent medical visits, and the following factors were related to the experience of delay; residents of the Seoul metropolitan area (aOR 2.76, 95% CI 1.37–4.65), those were housewife/student/unemployed (aOR 0.23, 95% CI 0.04–0.81), those with private insurance (aOR 0.13, 95% CI 0.03–0.62), smokers (aOR 3.08, 95% CI 1.36–6.96), and alcohol drinkers (aOR 5.35, 95% CI 2.07–26.70).

Discussion

Females, residents of the Seoul metropolitan region, one of the COVID-19 epidemic zones, those with private insurance, those without chronic diseases, smokers, and drinkers were all associated with experiencing delayed health screening and non-urgent medical visits. Among chronic disease patients, Age over 60 was negatively associated with delayed medical visits for chronic diseases. People who live in areas where COVID-19 is pandemic, such as Seoul metropolitan area, have been associated with delays in health screening, non-urgent medical visits, medical visits due to chronic

diseases and delays in emergent medical visits. In the case of highly educated people, there was a significantly negative correlation with the experience of delayed medical visits for chronic diseases. The respondents with private insurance were significantly associated with delayed visits for chronic diseases, and conversely, less risk of delays for emergency visits. Smoking and alcohol drinking also positively correlated with delays in health screening, non-urgent medical visits, medical visits for chronic diseases and emergency medical visits.

It has already been reported that restricting or avoiding access to medical care significantly impacts the occurrence and worsening of diseases and complications [23,24], timely provision and high access to medical care are essential for health outcomes, prognosis, well-being, avoidable hospitalization, and disease prevention [25,26]. Whatever the reasons for experiencing delayed medical visits during this pandemic, there is concern that these delays would result in increase in morbidity and mortality over the next following months or years [10,27–29]. Delays in screenings or non-urgent medical visits may reduce the rate of early disease detection, and patients with chronic diseases are more likely to experience severe complications if treatment is delayed or discontinued [29–31]. Several studies reported that reductions in cancer screening have a considerable impact on cancer incidence and prognosis [19,22,30]. A study that simulated the interruption of colorectal cancer screening

Table 3
Crude and adjusted odds ratio of factors associated with delays in medical visits for chronic diseases.

	Total, No (%)	Yes, No (%)	Crude OR	Adjusted OR
Total	1081	108 (10.0)		
Sex				
Male	585 (54.1)	60 (10.3)	1 (Ref)	1 (Ref)
Female	496 (45.9)	48 (9.7)	0.94 (0.63–1.40)	1.45 (0.91–2.33)
Age				
19–29	153 (14.2)	20 (13.1)	1 (Ref)	1 (Ref)
30–39	185 (17.1)	23 (12.4)	0.94 (0.50–1.79)	0.79 (0.38–1.65)
40–49	234 (21.7)	29 (12.4)	0.94 (0.51–1.73)	0.66 (0.31–1.42)
50–59	269 (24.9)	23 (8.6)	0.62 (0.33–1.17)	0.51 (0.22–1.16)
≥ 60	240 (22.2)	13 (5.4)	0.38 (0.18–0.79)	0.36 (0.14–0.92)
Region				
Seoul metropolitan area	232 (21.5)	31 (13.4)	1.57 (1.01–2.47)	1.64 (1.02–2.69)
Daegu-Gyeongbuk area	100 (9.3)	10 (10.0)	1.13 (0.56–2.28)	1.26 (0.61–2.61)
Others	749 (69.3)	67 (9.0)	1 (Ref)	1 (Ref)
Marital status				
Single	319 (29.5)	35 (11.0)	1 (Ref)	1 (Ref)
Married	704 (65.1)	72 (10.2)	0.92 (0.60–1.42)	1.27 (0.71–2.26)
Widowed/divorced	58 (5.4)	1 (1.7)	0.14 (0.02–1.06)	0.20 (0.03–1.62)
Job status				
Own business	105 (9.7)	7 (6.7)	1 (Ref)	1 (Ref)
Manual worker	120 (11.1)	18 (15.0)	2.47 (1.02–6.17)	2.01 (0.76–5.31)
Office worker	564 (52.2)	64 (11.4)	1.79 (0.80–4.03)	1.22 (0.51–2.91)
Housewife/Student/				
Unemployed	292 (27.0)	19 (6.5)	0.97 (0.40–2.39)	0.84 (0.32–2.20)
Educational status				
High school graduate and under	199 (18.4)	20 (10.1)	1 (Ref)	1 (Ref)
College / university graduation	737 (68.2)	79 (10.7)	1.07 (0.64–1.80)	0.81 (0.45–1.46)
Master's degree or above	145 (13.4)	9 (6.2)	0.59 (0.26–1.34)	0.46 (0.19–0.87)
The poverty-income ratio				
0–1.0	450 (41.9)	47 (10.4)	1 (Ref)	1 (Ref)
1.0–2.0	487 (45.3)	43 (8.8)	0.83 (0.54–1.28)	0.66 (0.41–1.06)
≥ 2.0	138 (12.8)	16 (11.6)	1.12 (0.62–2.05)	0.89 (0.46–1.72)
Private insurance				
Yes	890 (82.3)	99 (11.1)	2.53 (1.26–5.10)	2.15 (1.03–4.51)
No	191 (17.7)	9 (4.7)	1 (Ref)	1 (Ref)
Smoking				
Yes	329 (30.4)	53 (16.1)	2.43 (1.63–3.64)	2.25 (1.39–3.63)
No	752 (69.6)	55 (7.3)	1 (Ref)	1 (Ref)
Alcohol drinking				
Yes	834 (77.2)	97 (11.6)	2.82 (1.49–5.36)	2.01 (1.03–3.94)
No	247 (22.9)	11 (4.5)	1 (Ref)	1 (Ref)

programs worldwide during the COVID-19 pandemic found that even if screening is reduced or stopped for only six months, colorectal cancer deaths may increase by 0.4–1.0% for 30 years to 2050 [7]. In case of emergency or severe diseases, more critical problems may occur [32]. In previous studies, emergent medical visits for non-COVID-19 also decreased significantly [33,34]. According to Metzler et al. [35], due to the COVID-19 pandemic, approximately 40% of patients with acute coronary syndrome did not receive treatment, and 40% of those who did not receive treatment experienced severe complications or death.

This study found that the Seoul metropolitan area, a COVID-19 hotspots, was more likely to experience delays in all medical visits. This seems to be due to differences in social distancing policies and anxiety about COVID-19 infection by region. The Korean central government provided a guide to take customized actions for each region according to the scale and rate of transmission. When COVID-19 was prevalent only in some regions, the strength of social distancing has been determined by region [36]. Therefore, the COVID-19 hotspot was in a situation where a relatively strict social distancing policy was applied. Furthermore, there was an outbreak of Middle East respiratory syndrome coronavirus (MERS-CoV) in Korea in 2015, and most cases were hospital-acquired infection [37]. Therefore, it is presumed that Koreans were concerned about infection due to hospital use. Furthermore, in areas where COVID-19 was endemic, medical resources were focused on severe COVID-19 patients. [38]. As a result, it might affect the early

diagnosis rate, long-term morbidity, and survival of patients who missed screening or treatment during this period due to unintended consequences. In this study, it was confirmed that not only the medical utilization for specific purposes, but also several healthcare utilizations such as health screenings and non-emergency diseases could all decrease. Several studies also reported a decrease in medical use as in our study, but most of them were limited to specific services [21–23,25,28]. Our study has the advantage of being able to confirm changes in overall healthcare utilization.

In our study, delays in medical visits were higher for some types of medical visits and lower for others in highly educated or privately insured people. These are people with a high socioeconomic status (SES); the higher the SES, the more likely they are to have access to health care, even if health care resources are limited [39–41]. As a result, although the exact cause was not known, it is estimated that these results were contradictory depending on the type of medical service as a result of selective medical use.

Smokers and drinkers were also more likely to significantly delay or decrease the use of healthcare services during COVID-19, including health screenings [42]. Considering that these people have a higher risk of disease than other population groups, health care providers and policymakers should be careful not to delay the use of healthcare services, including health screening [43,44].

Delayed access to healthcare services is associated with poor outcomes and may cause different complications, especially in the

Table 4
Crude and adjusted odds ratio of factors associated with delays in emergent medical visits.

		Total, No (%)	Yes, No (%)	Crude OR	Adjusted OR
Total		139	55 (39.6)		
Sex					
	Male	68 (48.9)	31 (45.6)	1 (Ref)	1 (Ref)
	Female	71 (51.1)	24 (33.8)	0.61 (0.31–1.21)	1.00 (0.40–2.46)
Age					
	19–29	28 (20.1)	11 (39.3)	1 (Ref)	1 (Ref)
	30–39	32 (23.0)	17 (53.1)	1.75 (0.63–4.90)	1.18 (0.30–4.72)
	40–49	34 (24.5)	12 (35.3)	0.84 (0.30–2.37)	0.66 (0.14–3.09)
	50–59	24 (17.3)	5 (20.8)	0.41 (0.12–1.41)	0.43 (0.08–2.45)
	≥ 60	21 (15.1)	10 (47.6)	1.40 (0.45–4.41)	1.60 (0.28–9.22)
Region					
	Seoul metropolitan area	36 (25.9)	19 (52.8)	2.06 (0.94–4.51)	2.76 (1.37–4.65)
	Daegu-Gyeongbuk area	12 (8.6)	4 (33.3)	0.92 (0.26–3.30)	0.68 (0.15–3.01)
	Others	91 (65.5)	32 (35.2)	1 (Ref)	1 (Ref)
Marital status					
	Single	40 (28.8)	13 (32.5)	1 (Ref)	1 (Ref)
	Married	94 (67.6)	41 (43.6)	1.61 (0.74–3.49)	2.10 (0.74–5.98)
	Widowed/divorced	5 (3.6)	1 (20.0)	0.52 (0.05–5.12)	1.05 (0.06–17.81)
Job status					
	Own business	10 (7.2)	6 (60.0)	1 (Ref)	1 (Ref)
	Manual worker	16 (11.5)	6 (37.5)	0.40 (0.08–2.02)	0.21 (0.03–1.47)
	Office worker	82 (59.0)	36 (43.9)	0.52 (0.14–1.99)	0.30 (0.06–1.62)
	Housewife/Student/ Unemployed	31 (22.3)	7 (22.6)	0.19 (0.04–0.89)	0.23 (0.04–0.81)
Educational status					
	High school graduate and under	15 (10.8)	5 (33.3)	1 (Ref)	1 (Ref)
	College / university graduation	110 (79.1)	43 (39.1)	1.28 (0.41–4.01)	1.38 (0.39–4.96)
	Master's degree or above	14 (10.1)	7 (50.0)	2.00 (0.45–8.96)	2.27 (0.43–12.07)
The poverty-income ratio					
	0–1.0	51 (37.2)	22 (43.1)	1 (Ref)	1 (Ref)
	1.0–2.0	66 (48.2)	23 (34.9)	0.71 (0.33–1.49)	0.59 (0.24–1.44)
	≥ 2.0	20 (14.6)	9 (45.0)	1.08 (0.38–3.05)	0.99 (0.28–3.44)
Private insurance					
	Yes	123 (88.5)	51 (41.5)	0.47 (0.14–1.54)	0.13 (0.03–0.62)
	No	16 (11.5)	4 (25.0)	1 (Ref)	1 (Ref)
Smoking					
	Yes	55 (39.6)	32 (58.2)	3.69 (1.80–7.57)	3.08 (1.36–6.96)
	No	84 (60.4)	23 (27.4)	1 (Ref)	1 (Ref)
Alcohol drinking					
	Yes	119 (85.6)	53 (44.5)	7.23 (1.60–32.55)	5.35 (2.07–26.70)
	No	20 (14.4)	2 (10.0)	1 (Ref)	1 (Ref)

case of chronically ill patients. In our study, people with chronic diseases had a lower risk of delays in health screening, and non-urgent medical visits than those without chronic diseases. However, among those with chronic diseases, 213 (21.0%) experienced delays in health screening, and 56 (5.5%) experienced delays in non-urgent medical visits. Furthermore, 108 (10.0%) of those with chronic diseases experienced a delay in medical visits for chronic diseases. Thus, even if people with chronic diseases had lower risk of delays in health services, efforts are needed to prevent delays in medical use due to infectious diseases such as COVID-19, and some people with chronic diseases may experience health problems as a result of delayed medical services. Considering the possibility of the emergence of infectious diseases, various countermeasures including non-face-to-face treatment are needed to prevent delays in medical visit [3,45].

The lack of direct and valid measures of an individual's healthcare utilization is a limitation of the study. However, this study provided insight into factors related to delays in various healthcare services by surveying a representative population of a country.

In conclusion, COVID-19 has changed the general population's access to healthcare, and the degree of change varies with individual characteristics. The changes brought about by COVID-19 require new normal in our society, and it is important to maintain appropriate access to healthcare services even in new situations. The findings of this study will contribute to finding ways to prevent and respond to delay in medical service in epidemic that may occur in the future.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure

All authors have no potential conflicts of interest.

References

- [1] Doraiswamy S, Abraham A, Mamtani R, Cheema S. Use of telehealth during the COVID-19 pandemic: scoping review. *J Med Internet Res* 2020;22(12):e24087.
- [2] Ohannessian R, Duong TA, Odone A. Global telemedicine implementation and integration within health systems to fight the COVID-19 pandemic: a Call to Action. *JMIR Public Health Surveill* 2020;6(2):e18810.
- [3] Kim H, Lee H, Park CS, Kim S, Cho SA, Yoo SM, et al. Preliminary results of teleconsultations temporarily allowed during the COVID-19 pandemic. *Yonsei Med J* 2021;62(9):850–7.
- [4] Schrack JA, Wanigatunga AA, Juraschek SP. After the COVID-19 pandemic: the next wave of health challenges for older adults. *J Gerontol A Biol Sci Med Sci* 2020;75(9):e121–2.
- [5] Wright A, Salazar A, Mirica M, Volk LA, Schiff GD. The invisible epidemic: neglected chronic disease management during COVID-19. *J Gen Intern Med* 2020;35(9):2816–7.
- [6] Mehrotra A., Chernerew M., Linetsky D., Hatch H., Cutler D., Schneider E.: The impact of COVID-19 on outpatient visits in 2020: visits remained stable, despite a late surge in cases. *Commonwealth Fund*. February 2021. In.
- [7] de Jonge L, Worthington J, van Wifferen F, Iragorri N, Peterse EFP, Lew JB, et al. Impact of the COVID-19 pandemic on faecal immunochemical test-based colorectal cancer screening programmes in Australia, Canada, and the Netherlands: a comparative modelling study. *Lancet Gastroenterol Hepatol* 2021;6(4):304–14.

- [8] Lim MA, Huang I, Yonas E, Vania R, Pranata R. A wave of non-communicable diseases following the COVID-19 pandemic. *Diabetes Metab Syndr* 2020;14(5):979–80.
- [9] Rosenbaum L. The untold toll - the pandemic's effects on patients without covid-19. *N Engl J Med* 2020;382(24):2368–71.
- [10] Moynihan R, Sanders S, Michaleff ZA, Scott AM, Clark J, To EJ, et al. Impact of COVID-19 pandemic on utilisation of healthcare services: a systematic review. *BMJ Open* 2021;11(3):e045343.
- [11] Coster S, Watkins M, Norman IJ. What is the impact of professional nursing on patients' outcomes globally? An overview of research evidence. *Int J Nurs Stud* 2018;78:76–83.
- [12] Lee A, Cheung YSL, Joynt GM, Leung CCH, Wong WT, Gomersall CD. Are high nurse workload/staffing ratios associated with decreased survival in critically ill patients? A cohort study. *Ann Intensive Care* 2017;7(1):46.
- [13] Weissman GE, Crane-Droesch A, Chivers C, Luong T, Hanish A, Levy MZ, et al. Locally informed simulation to predict hospital capacity needs during the COVID-19 pandemic. *Ann Intern Med* 2020;173(1):21–8.
- [14] Elke B, Juliane W, Helene E, Ulrike N, Dimitra P, Christoph R, et al. A country-level analysis comparing hospital capacity and utilisation during the first COVID-19 wave across Europe. *Health Policy* 2021.
- [15] Gupta S, Hayek SS, Wang W, Chan L, Mathews KS, Melamed ML, et al. Factors associated with death in critically ill patients with coronavirus disease 2019 in the US. *JAMA Intern Med* 2020;180(11):1436–47.
- [16] Emanuel EJ, Persad G, Upshur R, Thome B, Parker M, Glickman A, et al. Fair allocation of scarce medical resources in the time of covid-19. *N Engl J Med* 2020;382(21):2049–55.
- [17] Antonucci M, Recupero SM, Marzio V, De Dominicis M, Pinto F, Foschi N, et al. The impact of COVID-19 outbreak on urolithiasis emergency department admissions, hospitalizations and clinical management in central Italy: a multicentric analysis. *Actas Urol Esp* 2020;44(9):611–6.
- [18] Nascimento BR, Brant LCC, Castro ACT, Froes LEV, Ribeiro ALP, Teixeira RA, et al. Reduction in hospital admissions associated with coronary events during the COVID-19 pandemic in the Brazilian private health system: data from the UNIMED-BH system. *Rev Soc Bras Med Trop* 2021;54. e01742021-e01742021.
- [19] Mafra da Costa A, Ribeiro AL, Ribeiro AG, Gini A, Cabasag C, Reis RM, et al. Impact of COVID-19 pandemic on cancer-related hospitalizations in Brazil. *Cancer Control J Moffitt Cancer Cent* 2021;28:10732748211038736.
- [20] Bergonti M. Emergency Room visits in the COVID-19 pandemic. *Eur Heart J* 2021;42(5):369–70.
- [21] Peng SM, Yang KC, Chan WP, Wang YW, Lin LJ, Yen AM, et al. Impact of the COVID-19 pandemic on a population-based breast cancer screening program. *Cancer* 2020;126(24):5202–5.
- [22] Bakouny Z, Paciotti M, Schmidt AL, Lipsitz SR, Choueiri TK, Trinh QD. Cancer screening tests and cancer diagnoses during the COVID-19 pandemic. *JAMA Oncol* 2021;7(3):458–60.
- [23] Lazzerini M, Barbi E, Apicella A, Marchetti F, Cardinale F, Trobia G. Delayed access or provision of care in Italy resulting from fear of COVID-19. *Lancet Child Adolesc Health* 2020;4(5):e10–1.
- [24] Huang YT, Lee YC, Hsiao CJ. Hospitalization for ambulatory-care-sensitive conditions in Taiwan following the SARS outbreak: a population-based interrupted time series study. *J Formos Med Assoc Taiwan yi zhi* 2009;108(5):386–94.
- [25] Teoh SE, Masuda Y, Tan DJH, Liu N, Morrison LJ, Ong MEH, et al. Impact of the COVID-19 pandemic on the epidemiology of out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Ann Intensive Care* 2021;11(1):169.
- [26] Ishimaru T, Tsuno K, Hori A, Okawara M, Yasuda Y, Fujino Y, et al. Disrupted care during the COVID-19 state of emergency and productivity loss attributed to presenteeism in workers: a nationwide cross-sectional study. *BMJ Open* 2021;11(12):e050068.
- [27] Moraliyage H, De Silva D, Ranasinghe W, Adikari A, Alahakoon D, Prasad R, et al. Cancer in lockdown: impact of the COVID-19 pandemic on patients with cancer. *oncologist* 2021;26(2):e342–4.
- [28] Kiss P, Carcel C, Hockham C, Peters SAE. The impact of the COVID-19 pandemic on the care and management of patients with acute cardiovascular disease: a systematic review. *Eur Heart J Qual Care Clin Outcomes* 2021;7(1):18–27.
- [29] Marzo-Castillejo M, Guiriguet Capdevila C, Coma, Redon E. The impact of COVID-19 on cancer diagnosis delay: possible consequences. *Atencion Prima* 2021;53(9):102142.
- [30] Vose JM. Delay in cancer screening and diagnosis during the COVID-19 pandemic: what is the cost? *Oncology* 2020;34(9):343.
- [31] Nadar SK, Tayebjee MH, Stowasser M, Byrd JB. Managing hypertension during the COVID-19 pandemic. *J Hum Hypertens* 2020;34(6):415–7.
- [32] Boukhris M, Hillani A, Moroni F, Annabi MS, Addad F, Ribeiro MH, et al. Cardiovascular implications of the COVID-19 pandemic: a global perspective. *Can J Cardiol* 2020;36(7):1068–80.
- [33] Friedman AB, Barfield D, David G, Diller T, Gunnarson C, Liu M, et al. Delayed emergencies: the composition and magnitude of non-respiratory emergency department visits during the COVID-19 pandemic. *J Am Coll Emerg Physicians Open* 2021;2(1):e12349.
- [34] Muselli M, Cofini V, Mammarella L, Carmignani C, Fabiani L, Desideri G, et al. The impact of covid-19 pandemic on emergency services. *Ann di Ig: Med Prev e di comunita* 2021.
- [35] Metzler B, Siostrzonek P, Binder RK, Bauer A, Reinstadler SJ. Decline of acute coronary syndrome admissions in Austria since the outbreak of COVID-19: the pandemic response causes cardiac collateral damage. *Eur Heart J* 2020;41(19):1852–3.
- [36] Kim W, Jung TY, Roth S, Um W, Kim C. Management of the COVID-19 pandemic in the republic of Korea from the perspective of governance and public-private partnership. *Yonsei Med J* 2021;62(9):777.
- [37] Kim KH, Tandl TE, Choi JW, Moon JM, Kim MS. Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak in South Korea, 2015: epidemiology, characteristics and public health implications. *J Hosp Infect* 2017;95(2):207–13.
- [38] Lee H, Lee JR, Jung H, Lee JY. Power of universal health coverage in the era of COVID-19: a nationwide observational study. *Lancet Reg Health West Pac* 2021;7:100088.
- [39] Webb Hooper M, Napoles AM, Perez-Stable EJ. COVID-19 and racial/ethnic disparities. *Jama* 2020.
- [40] Mongin D, Cullati S, Kelly-Irving M, Rosselet M, Regard S, Courvoisier D.S.: Neighbourhood socio-economic vulnerability and access to COVID-19 healthcare during the first two waves of the pandemic in Geneva, Switzerland: A gender perspective. *eClinicalMedicine* 2022, 46:101352.
- [41] Nguyen DL, Ambinder EB, Myers KS, Oluyemi E. Addressing disparities related to access of multimodality breast imaging services before and during the COVID-19 pandemic. *Acad Radiol* 2022.
- [42] Splinter MJ, Velek P, Ikram MK, Kieboom BCT, Peeters RP, Bindels PJE, et al. Prevalence and determinants of healthcare avoidance during the COVID-19 pandemic: a population-based cross-sectional study. *PLoS Med* 2021;18(11):e1003854.
- [43] Krueger PM, Chang VW. Being poor and coping with stress: health behaviors and the risk of death. *Am J Public Health* 2008;98(5):889–96.
- [44] Choi SH, Stommel M, Ling J, Noonan D, Chung J. The impact of smoking and multiple health behaviors on all-cause mortality. *Behav Med* 2020:1–8.
- [45] Alexander GC, Tajanlangit M, Heyward J, Mansour O, Qato DM, Stafford RS. Use and content of primary care office-based vs telemedicine care visits during the COVID-19 pandemic in the US. *JAMA Netw Open* 2020;3(10):e2021476.