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Public interest in the digital transformation accelerated by the COVID-19 pandemic and perception of its future impact

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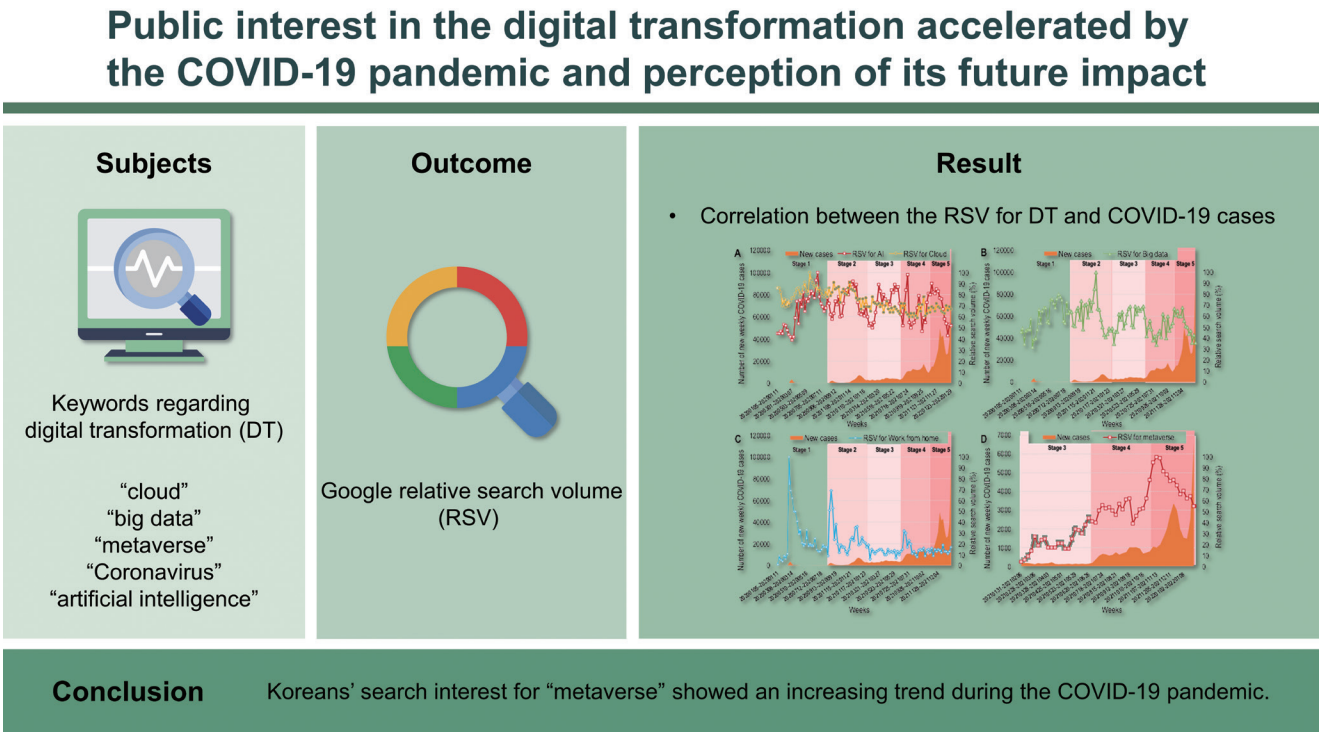

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Background/Aims: The coronavirus disease 2019 (COVID-19) pandemic has accelerated digital transformation (DT). We investigated the trend of the public interest in technologies regarding the DT and Koreans' experiences and their perceptions of the future impact of these technologies.
Methods: Using Google Trends, the relative search volume (RSV) for topics including "coronavirus," "artificial intelligence," "cloud," "big data," and "metaverse" were retrieved for the period from January 2020 to January 2022. A survey was conducted to assess the population's knowledge, experience, and perceptions regarding the DT.
Results: The RSV for "metaverse" showed an increasing trend, in contrast to those for "cloud," "big data," and "coronavirus." The RSVs for DT-related keywords had a negative correlation with the number of new weekly COVID-19 cases. In our survey, 78.1% responded that the positive impact of the DT on future lives would outweigh the negative impact. The predictors for this positive perception included experiences with the metaverse (4.0-fold) and virtual reality (VR)/augmented reality (AR) education (3.8-fold). Respondents predicted that the biggest change would occur in the healthcare sector after transportation/communication.
Conclusions: Koreans' search interest for "metaverse" showed an increasing trend during the COVID-19 pandemic. Koreans believe that DT will bring about big changes in the healthcare sector. Most of the survey respondents have a positive outlook about the impact of DT on future life, and the predictors for this positive perception include the experiences with the metaverse or VR/AR education. Healthcare professionals need to accelerate the adoption of DT in clinical practice, education and training.

Keywords: Coronavirus; Metaverse; Virtual reality; Augmented reality; Delivery of health care

INTRODUCTION

The coronavirus disease 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has caused enormous damage to human society, including morbidity and mortality in many people and huge economic loss [1]. However, the COVID-19 pandemic has led to advances in vaccine technology and accelerated digital transformation. As a means to overcome this pandemic, digital technologies, such as artificial intelligence (AI), the Internet of things (IoT), big data, virtual reality (VR), augmented reality (AR), metaverse, telemedicine, 5G cellular technology and smart applications, geographical information systems, and robots, have been usefully utilized for various purposes, including the detection of suspected COVID-19 cases, contact tracing, real-time access to COVID-19 data for research and decision making, remote monitoring of COVID-19 suspects and patients in self-isolation and quarantine facilities, the tracking of home-quarantined individuals using GPS and mobile phones, remote consultations between healthcare professionals and COVID-19 patients, automatic gate control systems that check body temperature and whether a mask is worn, the training of healthcare professionals, the spatial mapping of COVID-19 hotspots, controlling social distancing in crowded places, and disinfection/sterilization of COVID-19 contaminated areas, etc. [2-6].

In addition, under the global lock-down implemented to prevent the spread of COVID-19, many activities have been converted to non-face-to-face interactions due to social distancing policies, and as meetings between people and travel are restricted, increasing individual leisure time led to advances in related industries and technologies. For on-line education, academic conferences, meetings, and telemedicine, various novel technologies, such as smart video conferencing platforms, VR/AR, and the metaverse have been widely utilized. Personal leisure, which has become more important during the pandemic, has led to the rapid growth of online video streaming platforms, such as YouTube, Netflix, and online game industries.

All of these changes due to the pandemic have contributed to accelerating the digital transformation [7,8]. However, the general public's interest and knowledge about the key technologies of the digital transformation that are increasingly affecting public health and our lives due to the COVID-19 pandemic, and the perception of their impact on the future, have not been investigated. In this study, the trend of Koreans' interest in key technologies of the digital transformation, as well as their interest in the coronavirus

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and related topics, was investigated via the weekly changes in relative search volumes (RSVs) in Google Trends (GT), and the correlations between these RSVs and the number of new weekly COVID-19 cases in Korea were studied. In addition, Koreans' knowledge and experiences regarding the latest digital technologies, and their perception of the impact of these technologies on human lives in the future were investigated through a telephone questionnaire survey.

METHODS

Estimation of the interest in the topics related to COVID-19 and the digital transformation using Google Trends

GT was used to investigate the temporal trends in web searches of topics related to COVID-19 and key technologies of the digital transformation. The RSV value reflects the people's interest in the selected keywords. The highest and lowest rates of search interest are represented by 100 and 0 respectively. The keywords for searches in GT included "coronavirus," "mask," "social distancing," "vaccine effectiveness," "vaccine side effects," "fourth industrial revolution," "digital transformation," "artificial intelligence," "cloud," "big data," "metaverse," and "work from home." Translations of these keywords into Korean were used. In the query, as a default option, "all categories" and "all types of web search" were used, and as the option for the region, Korea was selected. We retrieved weekly GT data on the selected keywords for the period from January 5, 2020 to January 29, 2022. For some searches, monthly GT data were retrieved for the period from January 2016 to January 2022.

In order to estimate the search interest in the specific topics in each region in Korea, first, we obtained the weekly RSV value for the search topic for the entire period of 2 years, and, subsequently, we performed a search for each 1-week period again and retrieved the RSV values by sub-region. The weekly RSV of the sub-region was determined by multiplying the weekly RSV value of Korea retrieved from the entire period by the RSV value of the sub-region retrieved from the indicated 1-week period search.

Number of new weekly COVID-19 cases in Korea

The numbers of new weekly COVID-19 cases in Korea and each region were extracted from the daily press releases of the Korea Disease Control and Prevention Agency (KDCA) [9]. This count includes only cases diagnosed with a confirmatory test. The COVID-19 outbreak in Korea was arbitrarily classified into five stages by the researcher considering the trend of the number of confirmed cases and the availability of vaccines.

Questionnaire survey

We conducted a telephone interview survey using a struc-

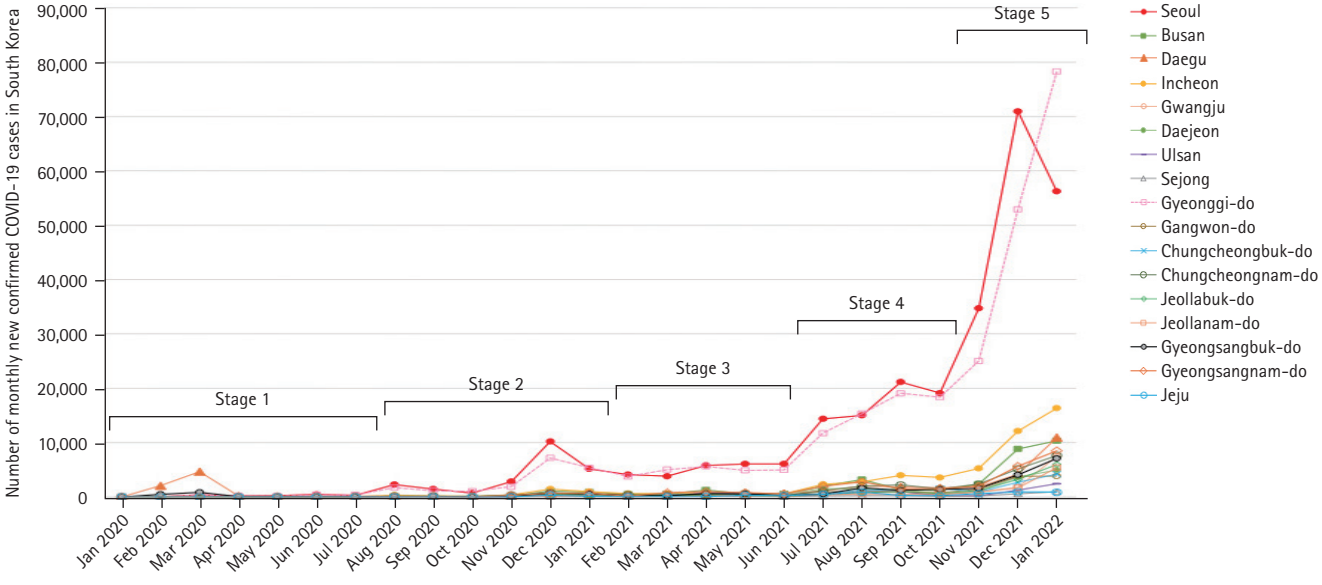

Figure 1. Trend of the number of monthly coronavirus disease 2019 (COVID-19) cases by region in Korea.

tured questionnaire through Korea Research International Inc. (Seoul, Korea) from February 15, 2022 to February 18, 2022. The study population was set to 1,000 adults aged 18 or older, and the final number of respondents was 1,011. The study population was stratified by gender, age, and geographic location. The quota of each stratified group was decided based on the population structure from the National Resident Registration Statistics. Respondents were contacted by random number dialing, and trained interviewers conducted computer-aided interviews with respondents who agreed to participate. The questionnaire was developed to assess the knowledge, experience, and perception about the fourth industrial revolution and digital transformation.

Statistical analyses

All statistical analyses were conducted using Stata version 11.2 (StataCorp., College Station, TX, USA). The Kruskal-Wallis test was used for the comparison of the median between groups. Multilevel mixed-effects linear regression was used to analyze trends over time and to determine the correlation between the number of new weekly COVID-19 cases and RSVs for specific keywords. A multinomial logistic regression model was used to determine the predictors of positive expectations of the survey respondents for the positive impact of digital transformation on their daily lives in the future. All tests were two-tailed and $p < 0.05$ was considered statistically significant.

Ethical statement

This study protocol was reviewed by the Institutional Review Board of Samsung Medical Center and was exempted from review (SMC 2022-08-141).

RESULTS

Stages of COVID-19 outbreak in Korea during the pandemic

The COVID-19 outbreak in Korea was divided into five stages (Fig. 1). In stage 1 (from January 2020 to July 2020), following the first wave centered in Daegu and Gyeongsangbuk-do in February-March 2020, the incidence decreased through contact tracing with quarantining and social distancing. Stage 2 (from August 2020 to January 2021) features a larger second wave centered around the Seoul

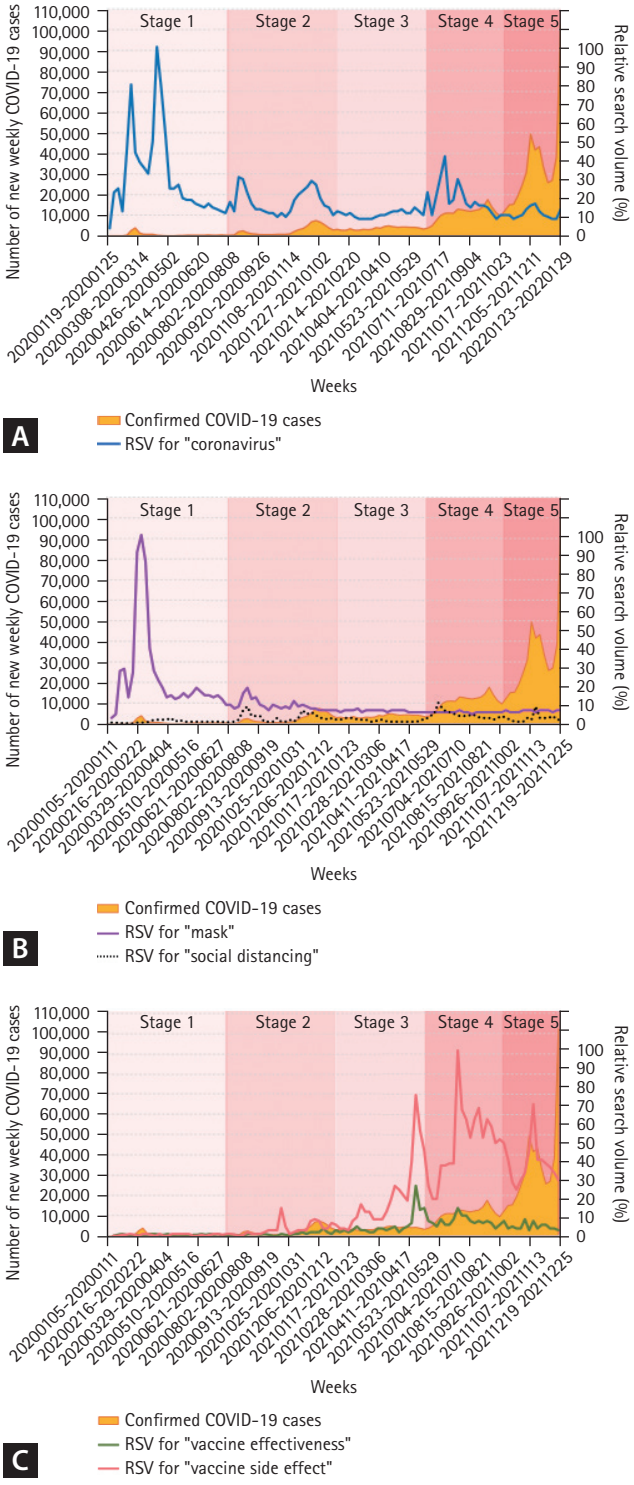

Figure 2. Trends of the relative search volumes (RSVs) in Google Trends for "coronavirus" and related topics. (A) Trend of the RSVs for coronavirus. (B) Trend of the RSVs for mask and social distancing. (C) Trend of the RSVs for vaccine effectiveness and side effect. COVID-19, coronavirus disease 2019.

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metropolitan area (Seoul, Gyeonggi-do, and Incheon) due to the easing of policies that promoted social distancing. Stage 3 (from February 2021 to June 2021) is the period during which the number of new infections did not increase because of mass vaccination, and stage 4 (from July 2021 to October 2021) is a period in which the number of new cases increased again, mainly in the Seoul metropolitan area, due to the spread of the Delta variant of SARS-CoV-2 and waning vaccine immunity. Stage 5 (from November 2021 to January 2022) is a period in which the number of new cases surged with the spread of the Omicron variant virus in all regions of the country, despite booster vaccinations.

Time trends of the RSVs for "coronavirus" and related topics

The RSV for "coronavirus" through GT was highest in stage 1, followed by stages 2 and 4 (Fig. 2A), and there was a significant difference in its RSV between stages ($p < 0.001$) (Supplementary Table 1). This difference was observed similarly in all regions in Korea (Supplementary Table 2). After the peak at the beginning of stage 1, a decreasing trend was observed throughout the period (coefficient, –0.1661; $p < 0.001$). While the RSV for "mask" reached a peak at the time of the first wave in stage 1 and then decreased and gently maintained its level, the RSV for "social distancing" was relatively small, although a slight increase in its RSV was observed for every wave (Fig. 2B). After the vaccine against SARS-CoV-2 became available, the RSV for "vaccine effectiveness" increased gradually and peaked in stage 3, whereas the RSV for "vaccine side effects" was relatively greater and peaked in stage 4 (Fig. 2C).

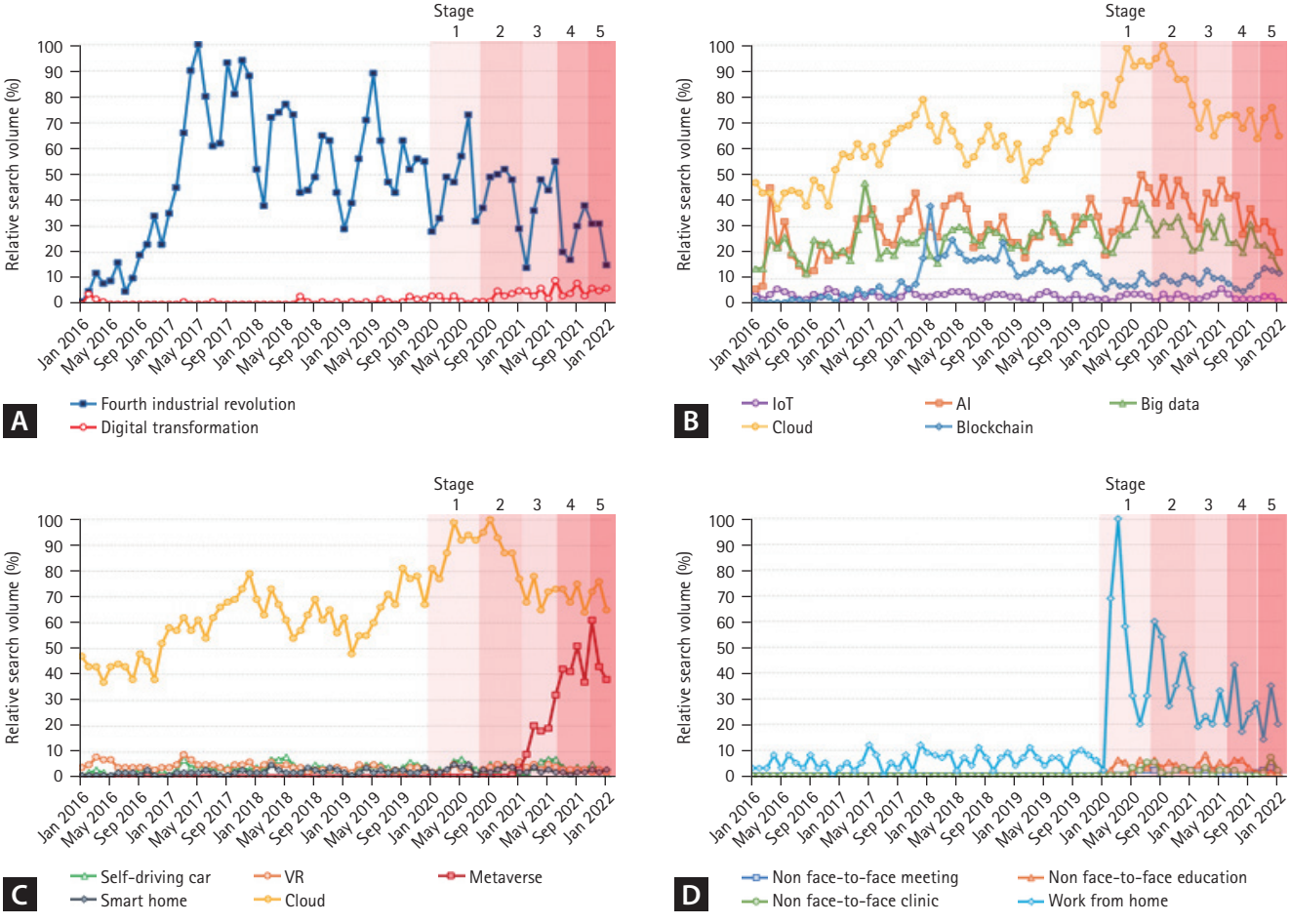

Figure 3. Trends of the relative search volumes (RSVs) in Google Trends for key technologies in digital transformation from 2016 to 2021. (A) Trend of the RSVs for fourth industrial revolution and digital transformation. (B) Trend of the RSVs for Internet of thing (IoT), artificial intelligence (AI), big data, cloud, and blockchain. (C) Trend of the RSVs for self-driving car, virtual reality (VR), metaverse, and smart home. (D) Trend of the RSVs for non-face-to-face activities.

Time trends of the RSVs for key technologies in digital transformation

While the RSV for the "fourth industrial revolution" reached its peak in 2017 and has gradually decreased, the RSV for "digital transformation" was relatively small, but an increasing trend has been observed over the past 2 years of the COVID-19 pandemic (Fig. 3A). Among the key technologies characterizing the digital transformation, "cloud" showed the highest RSV, followed by "artificial intelligence," "big data," and "metaverse," but it was the RSV of "metaverse" that has significantly increased during the pandemic (Fig. 3B and 3C). Among the non-face-to-face activities implemented for social distancing during the pandemic, the RSV for "working from home" was very high at the beginning of the pandemic, followed by "non-face-to-face education" and "non-face-to-face clinic" (Fig. 3D).

The RSV for "AI" showed a significant difference between stages (p = 0.003) (Supplementary Table 1), however, no significant time trend was observed (Fig. 4A). The RSV for "cloud" showed a significant difference between stages (p < 0.001), and this difference was similarly observed in all regions except Jeju-do (Supplementary Table 3). A statistically significant decreasing time trend was observed for cloud (Fig. 4A) (coefficient, –0.1880; p < 0.001). The RSV for "big data" showed a significant difference between stages (p < 0.001), but in the detailed analysis by region, this difference was observed only in Seoul, Gyeonggi-do, and Daejeon (Supplementary Table 4). A significant decreasing

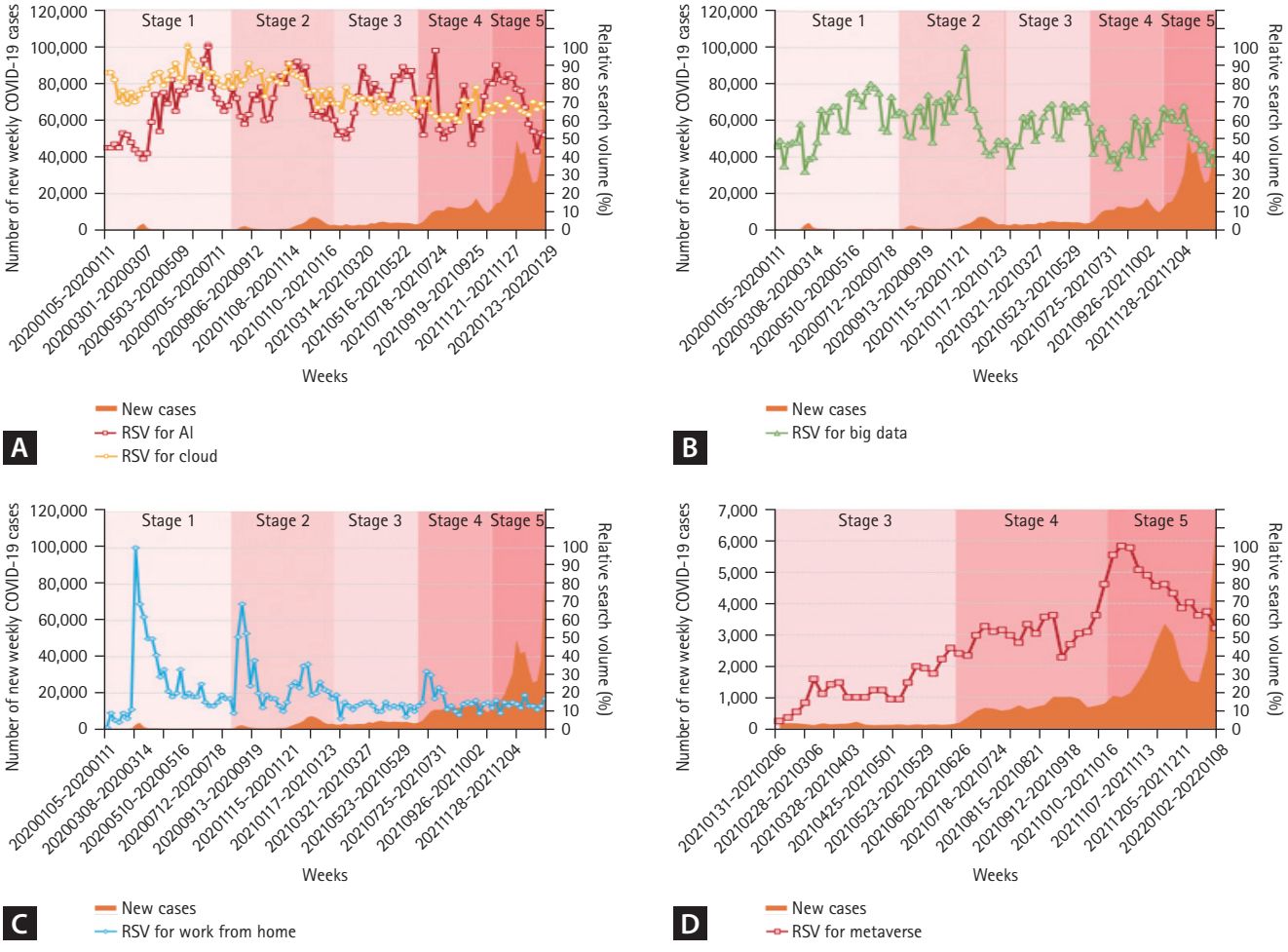

Figure 4. Correlation between the relative search volumes (RSVs) for key technologies of the digital transformation in Google Trends and the number of new weekly coronavirus disease 2019 (COVID-19) cases. For the metaverse, the RSV values were very low in stages 1–2, so only stages 3 to 5 were analyzed. (A) Number of new weekly COVID-19 cases versus RSV for artificial intelligence (AI) and cloud. (B) Number of new weekly COVID-19 cases versus RSV for big data. (C) Number of new weekly COVID-19 cases versus RSV for work from home. (D) Number of new weekly COVID-19 cases versus RSV for metaverse.

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trend over time was also observed (coefficient, –0.0471; $p < 0.001$) (Fig. 4B). The RSV for "metaverse" also showed a significant difference between stages ($p < 0.001$), and this difference was similarly observed in all regions. In contrast to other variables, the RSV for "metaverse" showed a significantly increasing trend (coefficient, 0.9333; $p < 0.001$) (Fig. 4D). The RSV for "work from home" showed a significant difference between stages ($p < 0.001$), but this difference was observed only in Seoul, Gyeonggi-do, and Busan. Following the two peaks for "work from home" observed at the beginning of stages 1 and 2, which were seen at the same time as the waves with sudden increasing numbers of COVID-19 cases, a decreasing trend was observed during the entire period (coefficient, –0.0704; $p < 0.001$) (Fig. 4C). Thus, an increasing time trend was observed only in the RSV for "metaverse" among digital technologies included in this study.

Correlation between the number of new weekly COVID-19 cases and the RSVs for "coronavirus" and key technologies of the digital transformation

Unlike the RSVs for "coronavirus" and "work from home," which showed a positive correlation with the number of new weekly COVID-19 cases, the RSVs for "AI," "big data," and "metaverse" showed a negative correlation (Table 1).

Questionnaire survey

Acquisition of information and knowledge about digital transformation

Among 1,011 respondents, 667 (66.0%) answered that they had first heard about the fourth industrial revolution or the digital transformation before the start of the COVID-19 pandemic, 175 (17.3%) had first heard about it after the pandemic began, and 169 (16.7%) had never heard of it. The age group with the most respondents hearing about the digital transformation after the pandemic began was in the 60 to 74-year range ($p = 0.003$) (Table 2). The lower their education level, the less they had heard of it prior to the pandemic or hadn't heard of it ($p < 0.001$). The media most frequently heard by respondents about the digital transformation were TV and Internet portals such as Google and Naver, accounting for 27.8% and 24.3% of the responses, respectively, followed by YouTube (17.6%), social networking services, including Facebook and Instagram (8.3%), books or magazines (8.3%), newspapers (8.2%), and radio (5.4%).

AI (28.0%) ranked first in the survey on the most core technology that characterizes the fourth industrial revolution, followed by VR/AR and the metaverse (20.0%), big data (16.7%), self-driving car technology (16.3%), IoT (7.1%), blockchain (7.1%), and cloud computing (4.9%).

Experiences

Among the respondents, 35.2% answered that they had experience using products that used IoT or AI technology, which included smart home products, such as refrigerators, washing machines, and air conditioners (31.3%), smart home control systems applied to electricity, water, and heating (15.9%), self-driving cars (13.6%), smart door locks (12.2%), healthcare products such as blood sugar monitoring (8.7%), home security cameras (7.4%), and pet care products, such as automatic feeders (4.3%). Twenty percent of respondents answered that they had experienced a product or service with VR/AR or metaverse technology

Table 1. Correlation between the number of new weekly COVID-19 cases and RSVs for "coronavirus" and key technologies for digital transformation

Dependent variable	Coefficient	Standard error	*z*	*p* value
RSV for "coronavirus"	2.6580	0.2584	10.29	< 0.001
RSV for "artificial intelligence"	–2.3294	0.4720	–4.94	< 0.001
RSV for "cloud"	–0.2252	0.3437	–0.66	0.512
RSV for "big data"	–1.2523	0.3946	–3.17	0.002
RSV for "metaverse"	–3.0254	0.7488	–4.04	< 0.001
RSV for "work from home"	2.0471	0.1806	11.33	< 0.001

The independent variable was the number of new weekly COVID-19 cases (log).
COVID-19, coronavirus disease 2019; RSV, relative search volume.

Table 2. Demographic characteristics of the survey respondents and the answers to the survey question "When did you first hear about the fourth industrial revolution or digital transformation?"

	Number (%)			*p* value
	I heard it before the start of the pandemic	I heard it after the pandemic began	I never heard of it	
Place of residence				0.157
Seoul (n = 200)	137 (68.5)	38 (19.0)	25 (12.5)	
Busan (n = 63)	45 (71.4)	13 (20.6)	5 (7.9)	
Daegu (n = 43)	24 (55.8)	7 (16.3)	12 (27.9)	
Incheon (n = 67)	41 (61.2)	14 (20.9)	12 (17.9)	
Gwangju (n = 33)	18 (54.6)	8 (24.2)	7 (21.2)	
Daejeon (n = 29)	15 (51.7)	5 (17.2)	9 (31.0)	
Ulsan (n = 28)	24 (85.7)	3 (10.7)	1 (3.6)	
Gyeonggi-do (n = 250)	177 (70.8)	39 (15.6)	34 (13.6)	
Gangwon-do (n = 30)	18 (60.0)	5 (16.7)	7 (23.3)	
Chungcheong-do (n = 72)	41 (56.9)	10 (13.9)	21 (29.2)	
Sejong (n = 8)	6 (75.0)	0 (0)	2 (25.0)	
Jeolla-do (n = 64)	40 (62.5)	10 (15.6)	14 (21.9)	
Gyeongsang-do (n = 110)	74 (67.3)	18 (16.4)	18 (16.4)	
Jeju-do (n = 14)	7 (50.0)	5 (35.7)	2 (14.3)	
Age in years				0.003
18–19 (n = 28)	21 (75.0)	1 (3.6)	6 (21.4)	
20–29 (n = 143)	102 (71.3)	6 (4.2)	35 (24.5)	
30–39 (n = 163)	108 (66.3)	21 (12.9)	34 (20.9)	
40–49 (n = 196)	145 (74.0)	27 (13.8)	24 (12.2)	
50–59 (n = 214)	152 (71.0)	39 (18.2)	23 (108)	
60–74 (n = 267)	139 (52.1)	81 (30.3)	47 (17.6)	
Gender				0.767
Male (n = 570)	380 (66.7)	93 (16.3)	97 (17.0)	
Female (n = 441)	287 (65.1)	82 (18.6)	72 (16.3)	
Education				< 0.001
Middle school graduation or lower (n = 62)	18 (29.0)	23 (37.1)	21 (33.9)	
High school graduation (n = 289)	160 (55.4)	70 (24.2)	59 (20.4)	
Attending or graduating from university (n = 578)	419 (72.5)	72 (12.5)	87 (15.1)	
Graduate school or higher (n = 82)	70 (85.4)	10 (12.2)	2 (2.4)	
Occupation				0.004
Management/office/finance/insurance (n = 205)	152 (74.2)	25 (12.2)	28 (13.7)	
Research and engineering (n = 56)	50 (89.3)	1 (1.8)	5 (8.9)	
Education/law/social work/police/firefighters/military (n = 70)	54 (77.1)	8 (11.4)	8 (11.4)	
Healthcare (n = 29)	21 (72.4)	4 (13.8)	4 (13.8)	
Art/design/broadcasting/sports (n = 39)	24 (61.5)	7 (18.0)	8 (20.5)	
Beauty/travel/accommodation/food/security/cleaning (n = 47)	25 (53.2)	18 (38.3)	4 (8.5)	
Marketing/sales/driving/transport (n = 94)	60 (63.8)	18 (19.2)	16 (17.0)	
Construction/miner (n = 47)	26 (55.3)	8 (17.0)	13 (27.7)	
Installation/maintenance/production (n = 49)	31 (63.3)	8 (16.3)	10 (20.4)	
Agriculture/forestry/fishing (n = 29)	7 (36.8)	6 (31.6)	6 (31.6)	
Other (n = 356)	217 (61.0)	72 (20.2)	67 (18.8)	

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applied. VR/AR games (49.1%) were the most frequent, followed by education and training programs (19.1%), metaverse services (14.9%), medical services (7.1%), and virtual shopping malls (7.1%). The experience of using VR/AR or metaverse products/services was 49% higher in the Seoul metropolitan areas than in non-metropolitan areas ($p = 0.001$), 34% higher in men than women ($p = 0.029$), 75% higher in younger age groups ($p < 0.001$), and 81% higher in those with a higher education level ($p < 0.001$). In the case of non-face-to-face activities, 54.4% of the respondents experienced non-face-to-face education or meetings, and 90.1% of them responded that they would use it even after the pandemic is over. On the other hand, 32.2% experienced work from home, and only 4.5% experienced telemedicine.

Perceptions of how digital transformation will affect daily lives in the future and predictors of positive expectations

The largest number of respondents answered that transportation and communication (35.8%) are the areas where the fourth industrial revolution or digital transformation will bring the biggest change in the future, followed by healthcare (21.6%), education (14.4%), shopping and consumption (12.3%), home life, such as laundry or cooking (9.5%), and arts, culture, and sports (6.4%). When asked about the future impact of the fourth industrial revolution or digital transformation on daily lives, 78.1% responded that the positive impact would outweigh the negative impact. Multinomial logistic regression analysis revealed that women were 33.5% less likely than men to think that the positive impact would be greater than the negative impact (Table 3). The respondents who had used metaverse products or services were 4.0 times more likely to think that the positive impact would outweigh the negative impact, compared with those who had not ($p = 0.036$). Similarly, respondents who had used VR/AR education programs were 3.8 times more likely to think that there would be a positive impact ($p = 0.021$).

DISCUSSION

Our study showed that Koreans' search interest regarding key technologies of the digital transformation had a negative correlation with the number of new weekly COVID-19 cases with a decreasing trend over time for most selected keywords except "metaverse," which showed an increasing time trend. Search interest for "coronavirus" and "mask" remained low for most of the study period after peaking, in line with the first wave of the COVID-19 outbreak, although the RSV for "vaccine side effects" soared as the vaccine became available in the midst of the pandemic. It seems very natural that search interest for "coronavirus," "mask," and "work from home" have increased temporarily due to the surge in the number of COVID-19 cases in the early phase of the pandemic and the lock-down policy. On the other hand, RSVs for key technologies of the digital transformation showed fluctuations throughout the period. These results suggest a high level of interest in digital technologies, which Koreans have frequently encountered under quarantine measures for public health and daily life.

Table 3. Predictors of respondents who think that the positive impact of the fourth industrial revolution or digital transformation on daily lives in the future will outweigh the negative impact

Variable	Relative risk ratios	Standard error	*z*	$p > \|z\|$	95% Confidence interval
Positive impact will be greater					
Female	0.665	0.113	–2.40	0.017	0.477–0.928
Higher education level	1.156	0.140	1.20	0.231	0.912–1.467
Experience with smart home products	1.361	0.330	1.27	0.204	0.846–2.191
Experience with self-driving car	1.397	0.527	0.89	0.376	0.667–2.928
Experience with VR or AR games	1.995	0.817	1.69	0.092	0.894–4.452
Experience with metaverse	4.005	2.649	2.10	0.036	1.096–14.642
Experience with VR/AR education programs	3.784	2.189	2.30	0.021	1.218–11.760
Negative impact will be greater (base outcome)					

VR, virtual reality; AR, augmented reality.

The COVID-19 pandemic has given the general public many opportunities to experience these new technologies, and in particular, metaverse technology began to become deeply involved in our lives [10]. Various application cases using VR or metaverse technology have been reported during the pandemic, which include virtual rehabilitation for COVID-19 patients [11] or patients with cognitive disorders [12]; VR-based physical activity interventions for older adults [13]; intensive care unit (ICU)-specific VR for psychological well-being and quality of life after COVID-19 ICU treatment [14]; VR intervention for increasing COVID-19 vaccination intention [15]; VR simulation as a training or education tool for healthcare professionals or medical students [16-19].

It is very interesting to see that the results of our survey showed that Koreans predict that digital transformation will bring about very big changes in the healthcare sector. The results of our survey also support the growing interest and experience of the general public about the metaverse. The survey has shown that more than three-fourths of respondents have a positive outlook about the impact of the fourth industrial revolution or digital transformation on our lives in the future. Interestingly, respondents who have used metaverse products/services or VR/AR education programs are more likely to think that the positive impact of the fourth industrial revolution or digital transformation on our lives in the future will outweigh the negative impact, compared to those who have not used these technologies. Furthermore, VR/AR and the metaverse ranked second after AI in the survey on the most core technologies that characterize the fourth industrial revolution, giving a glimpse into Koreans' perception of these technologies. The products or services they experienced included education and training programs, metaverse services, medical services, and virtual shopping malls, as well as games. The increase in search interest for "metaverse" in stages 3–5 of the pandemic observed in our GT analysis is consistent with the survey results. These results also coincide with the finding that the number of published articles on the four technology types corresponding to the metaverse in the PubMed search soared in 2021 and the term "metaverse" began to appear in biomedical articles in 2020 and 2021 [20].

This study has some limitations. First, since the subject of the GT analysis and the questionnaire survey was limited to Korea and the trend of COVID-19 outbreaks varies from country to country, the results of this study cannot be generalized. Second, the study period was until the end of January 2022, the beginning of the period when COVID-19 caused by the Omicron variant widely spread in Korea, and the situation after that was not reflected.

In conclusion, analysis of GT data showed Koreans' search interest regarding key technologies of the digital transformation had a negative correlation with the number of new weekly COVID-19 cases, with a decreasing trend over time in most selected keywords except "metaverse," which showed an increasing trend. The survey showed that Koreans predict that digital transformation will bring about big changes in the healthcare sector. Most of the respondents have a positive outlook about the impact of the digital transformation on future life, and the predictors for this positive perception include previous experiences with the metaverse or VR/AR. Koreans appear to be prepared to positively face the changes brought about by the digital transformation, which has been accelerated due to the COVID-19 pandemic. Healthcare professionals also need to accelerate the adoption of digital transformation in areas of clinical practice, education and training.

KEY MESSAGE

1. Analysis of Google Trends data showed Koreans' search interest regarding key technologies of the digital transformation had a negative correlation with the number of new weekly coronavirus disease 2019 (COVID-19) cases, with a decreasing trend over time in most selected keywords except "metaverse," which showed an increasing trend.
2. The questionnaire survey showed that Koreans predict that digital transformation will bring about big changes in the healthcare sector.
3. Most of the respondents have a positive outlook about the impact of the digital transformation on future life, and the predictors for this positive perception include previous experiences with the metaverse or virtual reality/augmented reality.
4. Koreans appear to be prepared to positively face the changes about by the digital transformation, which has been accelerated due to the COVID-19 pandemic. Healthcare professionals also need to accelerate the adoption of digital transformation in areas of clinical practice, education, and training.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

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Supplementary Table 1. Comparison of the mean RSV for "coronavirus" and key technologies of digital transformation in Google Trends in Korea between different stages of the COVID-19 pandemic

Variable	Median (range) of RSV					*p* value
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	
Coronavirus	16.2 (0–100)	11.6 (1.2–31.0)	7.6 (1.4–23.0)	11.6 (3.4–42.0)	8.2 (2.0–17.0)	< 0.001
Artificial intelligence	33.3 (0–100)	36.9 (0–92.0)	37.4 (0–89.0)	33.0 (0–98.0)	29.7 (0–90.0)	0.003
Cloud	52.3 (0–100)	51.5 (16.5–91.0)	38.9 (0–78.0)	36.0 (0–78.0)	39.7 (12.2–72.0)	< 0.001
Big data	25.9 (0–80.0)	28.6 (0–100)	25.2 (0–69.0)	21.7 (0–67.0)	21.4 (0–68.0)	< 0.001
Metaverse[a]	-	-	7.4 (0–44.0)	26.8 (0–79.0)	43.6 (0–100)	< 0.001
Work from home	3.7 (0–100)	5.0 (4.8–69.0)	0 (0–19.0)	0 (0–32.0)	1.6 (0–73.7)	< 0.001

RSV, relative search volume; COVID-19, coronavirus disease 2019.
[a]In stages 1–2, RSV values were very low, so only stages 3 to 5 were analyzed.

Supplementary Table 2. Comparison of the mean RSV for "coronavirus" in Google Trends in Korea between different stages of the COVID-19 pandemic

Variable	Median (range) of RSV					*p* value
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	
Seoul	18.3 (1.5–90.0)	12.2 (5.6–23.8)	7.9 (4.3–17.0)	13.2 (6.9–27.7)	9.9 (6.1–17.0)	< 0.001
Busan	15.4 (1.1–100)	13 (4.6–25.2)	7.7 (3.6–17.3)	12.4 (5.0–31.1)	9.2 (4.2–14.8)	< 0.001
Daegu	16.1 (1.9–83.0)	10.2 (5.0–26.4)	7.0 (2.5–17)	11.1 (2.0–29.1)	7.4 (4.7–15.6)	< 0.001
Incheon	17.8 (1.5–91.0)	10.6 (4.0–18.9)	6.8 (3.2–15.2)	11.0 (7.0–34.0)	9.1 (4.7–16.0)	< 0.001
Gwangju	17.6 (1.8–92.0)	10.2 (3.4–18.4)	8.2 (3.2–15.9)	10.0 (3.4–31.0)	6.4 (4.4–10.5)	< 0.001
Daejeon	16.0 (1.4–75)	12.1 (4.8–24.6)	9.4 (4.1–23.0)	14.7 (5.2–42.0)	8.5 (4.7–14.6)	< 0.001
Ulsan	17.1 (1.2–81.0)	11.9 (2.9–26.0)	8.2 (2.5–15.4)	12.0 (5.7–33.6)	7.7 (3.3–15.6)	< 0.001
Gyeonggi-do	16.3 (1.4–81.0)	11.5 (4.4–20.0)	7.3 (2.9–14.0)	10.9 (7.0–26.9)	8.7 (5.6–14.3)	< 0.001
Gangwon-do	15.2 (0.4–93.0)	13.0 (7.3–31.0)	7.9 (3.5–18.6)	11.6 (5.2–29.8)	10.0 (5.3–15.0)	< 0.001
Chungcheongbuk-do	18.1 (2.5–89)	10.7 (3.9–27.0)	7.1 (2.1–20.0)	12.0 (6.8–31.1)	8.1 (5.5–16.8)	< 0.001
Chungcheongnam-do	16.3 (1.9–80.0)	11.2 (4.3–17.1)	6.6 (3.6–16.3)	11.5 (6.5–28.8)	7.9 (4.4–11.7)	0.0001
Jeollabuk-do	16.7 (2.4–94)	10.3 (3.3–24.4)	8.7 (1.4–14.3)	11.0 (4.6–26.4)	8.7 (4.0–14.5)	< 0.001
Jeollanam-do	15.5 (1.9–78.0)	10.1 (3.5–30.0)	6.2 (1.8–12.2)	11.8 (5.9–24.4)	8.1 (3.6–15.3)	< 0.001
Gyeongsanbuk-do	13.9 (2.4–85.0)	12.6 (3.5–27.0)	7.7 (2.5–14.3)	10.8 (6.7–26.0)	8.7 (5.4–16.7)	0.001
Gyeongsangnam-do	14.2 (1.1–82.0)	10.9 (4.9–18.4)	6.8 (4.1–13.8)	11.1 (4.4–27.6)	7.3 (5.2–14.8)	0.002
Jeju-do	16.1 (0–54.0)	11.0 (1.2–29.0)	7.8 (1.9–22.5)	11.1 (5.9–27.0)	7.2 (2.0–11.9)	0.004

RSV, relative search volume; COVID-19, coronavirus disease 2019.

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Supplementary Table 3. Comparison of the mean RSV for "big data" in Google Trends in Korea between different stages of the COVID-19 pandemic

Variable	Median (range) of RSV					*p* value
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	
Seoul	52.7 (25.6–71.5)	50.7 (31.4–90.0)	49.7 (15.4–69.0)	37.2 (15.2–51.0)	39.0 (19.4–68.0)	< 0.001
Busan	24.8 (7.3–59.3)	23.5 (10.0–63.0)	25.0 (6.7–68.3)	22.7 (11.4–40.8)	27.7 (8.6–51.0)	0.884
Daegu	28.6 (0–80.0)	33.2 (0–62.7)	25.4 (0–65.6)	21.9 (10.3–57.0)	23.4 (12.2–56.4)	0.465
Incheon	26.1 (5.3–60.0)	26.8 (14.4–73.0)	22.1 (0–48.5)	24.1 (10.6–37.5)	28.8 (13.2–57.1)	0.283
Gwangju	35.2 (0–76.0)	26.1 (0–74.0)	32.4 (6.0–54.0)	21.1 (0–43.1)	17.5 (5.2–60.5)	0.061
Daejeon	41.8 (9.1–76.0)	46.0 (8.6–87.0)	59.0 (8.3–68.0)	35.1 (11.5–62.0)	23.8 (0–55.4)	0.003
Ulsan	14.5 (0–67.2)	24.7 (0–100)	13.7 (0–43.5)	21.6 (0–50.0)	26.0 (0–60.0)	0.402
Gyeonggi-do	30.0 (9.0–61.2)	31.1 (10.8–52.0)	28.1 (9.8–54.5)	24.0 (12.0–34.2)	22.4 (11.2–60.5)	0.031
Gangwon-do	22.5 (0–75.0)	23.8 (7.7–80.0)	21.8 (8.0–55.2)	20.8 (0–60.0)	11.5 (0–42.6)	0.340
Chungcheongbuk-do	28.6 (0–73.0)	26.9 (7.3–75.0)	29.0 (8.6–62.0)	23.4 (9.2–67.0)	16.5 (0–48.1)	0.356
Chungcheongnam-do	28.5 (6.6–78.0)	36.8 (13.0–85.0)	39.9 (7.4–60.0)	27.8 (3.2–50.2)	29.1 (12.6–60.0)	0.237
Jeollabuk-do	19.7 (0–44.2)	24.4 (5.9–75.0)	19.3 (0–43.7)	20.4 (0–40.9)	13.8 (0–65.0)	0.249
Jeollanam-do	24.2 (0–68.0)	31.2 (0–67.0)	24.5 (9.7–69.0)	18.5 (0–49.7)	10.8 (0–39.4)	0.108
Gyeongsanbuk-do	19.2 (0–53.0)	20.1 (0–53.3)	19.2 (0–42.8)	11.2 (0–35.3)	14.8 (6.5–61.0)	0.700
Gyeongsangnam-do	19.7 (0–42.9)	22.3 (4.4–73.5)	17.0 (2.8–33.1)	13.8 (3.8–50.4)	14.0 (5.8–39.3)	0.601
Jeju-do	0 (0–0)	0 (0–60.5)	0 (0–0)	0 (0–0)	0 (0–0)	0.999

RSV, relative search volume; COVID-19, coronavirus disease 2019.

Supplementary Table 4. Comparison of the mean RSV for "cloud" in Google Trends in Korea between different stages of the COVID-19 pandemic

Variable	Median (range) of RSV					*p* value
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	
Seoul	77.5 (51.8–96.0)	79.1 (59.6–91.0)	67.0 (40.3–74.0)	62.5 (50.6–72.0)	66.0 (49.8–69.0)	<0.001
Busan	48.0 (16.1–77.4)	51.7 (33.8–77.1)	42.8 (14.7–56.9)	37.8 (17.8–56.1)	41.5 (32.2–53.3)	<0.001
Daegu	58.3 (32.4–87.4)	54.2 (31.7–83.3)	47.5 (0–63.0)	41.8 (20.2–61.0)	35.9 (12.7–45.5)	<0.001
Incheon	54.2 (37.1–83.7)	56.2 (38.5–74.6)	38.4 (18.6–69.8)	35.9 (18.9–54.0)	38.4 (16.6–48.8)	<0.001
Gwangju	53.5 (21.7–88.0)	54.6 (16.5–77.0)	37.4 (0–67.3)	37.5 (14.3–68.0)	44.9 (26.6–67.0)	0.002
Daejeon	54.0 (30.0–91.0)	60.7 (30.4–85.1)	45.6 (0–74.1)	35.2 (24.6–78.0)	41.0 (23.1–57.6)	<0.001
Ulsan	49.3 (21.9–87.0)	43.6 (21.9–69.7)	33.8 (5.0–70.2)	31.9 (8.8–67.9)	35.9 (17.3–65.0)	0.005
Gyeonggi-do	57.9 (37.8–76.5)	61.9 (46.2–83.7)	48.2 (19.2–67.7)	42.8 (35.8–55.3)	48.3 (36.0–55.1)	<0.001
Gangwon-do	46.5 (18.9–100)	58.0 (19.5–82.0)	42.9 (0–78.0)	33.1 (16.9–57.6)	39.1 (12.2–64.9)	0.002
Chungcheongbuk-do	46.5 (14.6–69.9)	41.5 (31.1–61.9)	33.9 (22.0–61.2)	36.0 (18.6–58.0)	36.0 (15.2–70.0)	0.003
Chungcheongnam-do	50.8 (28.7–71.3)	47.1 (27.0–75.7)	36.6 (16.9–72.0)	32.7 (17.7–63.9)	32.5 (21.8–50.9)	<0.001
Jeollabuk-do	42.5 (16.1–76.4)	39.6 (18.6–64.6)	33.8 (23.7–64.0)	28.6 (14.8–58.9)	29.9 (17.7–46.9)	0.001
Jeollanam-do	46.8 (18.9–83.0)	46.8 (23.2–80.4)	33.9 (0–50.4)	32.5 (9.8–56.1)	41.0 (17.9–72.0)	0.003
Gyeongsanbuk-do	39.9 (0–86.0)	39.6 (21.0–69.7)	32.2 (18.7–48.2)	27.5 (11.5–44.1)	36.0 (18.6–46.2)	<0.001
Gyeongsangnam-do	45.6 (22.4–75.6)	41.1 (19.3–60.0)	28.4 (17.0–59.0)	28.4 (16.4–54.7)	30.2 (18.7–50.4)	<0.001
Jeju-do	46.6 (0–86.0)	48.2 (18.6–84.0)	36.7 (0–67.2)	33.7 (0–70.3)	44.2 (26.1–63.0)	0.075

RSV, relative search volume; COVID-19, coronavirus disease 2019.

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