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## Original Article

## Effect of digital divide on people with disabilities during the COVID-19 pandemic

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## ABSTRACT

**Background:** The COVID-19 pandemic has reinforced social inequality in marginalized groups. People with disabilities (PWD) are particularly restricted in their activities and lives due to the pandemic and experiencing more difficulties than the general population.

**Objective:** This study aims to explore the extent of the digital divide between PWD and people without disabilities (PWOD) during the COVID-19 pandemic in South Korea.

**Methods:** This study relied on the cross-sectional secondary data from the 2020 Digital Divide Survey conducted in Korea. We performed a series of bivariate analyses on the data of 5575 PWOD and 1781 PWD (18–69 years old) to compare Internet usage and various types of digital services related to the pandemic.

**Results:** We identified significant differences between PWOD and PWD in their Internet usage change during the pandemic. A higher number of PWD reported that their Internet usage with both computers and mobile devices remained similar to the pre-pandemic period while that of PWOD reported that their Internet usage via the same has increased. Significant gaps were found in the usage change of the five digital services with the largest gap in that of social networking services between PWOD and PWD. Further, PWOD were likelier to be aware of, utilize, and perceive the usefulness of digital services during the COVID-19 pandemic including application, information, delivery, and subscription services.

**Conclusion:** To ensure better post-pandemic outcomes for marginalized groups including PWD, the governments and authority agencies must facilitate digital access and services with appropriate accommodations needed by those populations.

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On March 11, 2020, the World Health Organization (WHO) officially declared the COVID-19 pandemic. The worldwide spread of the SARS-CoV-2 virus (hereafter, referred to as "virus") has brought about urgent changes in our society and human lives; the new term "social distancing" is used as the main policy of governments around the world as a recommended practice for people in the community or within a household to keep a safe space.<sup>1</sup> Central and regional governments in many countries around the world are closing all educational institutions, shopping malls, and restaurants besides shops selling necessities for survival, as well as banning various social gatherings to prevent the virus from

spreading further. In particular, governments have enforced quarantines and travel bans on an unprecedented scale to keep a person, who might have been exposed to the virus, away from others.

The COVID-19 pandemic has reinforced social inequality in marginalized groups who experience discrimination and social, political, and economic exclusion.<sup>2</sup> Notably, people with disabilities (PWD), who are particularly restricted in their activities and lives due to the pandemic, are experiencing more difficulties compared to people without disabilities (PWOD).<sup>3–7</sup> During the COVID-19 pandemic, concerns were expressed about PWD.<sup>8</sup> They are at a higher risk of contracting COVID-19 due to barriers to accessing preventive information and hygiene, reliance on physical contact for support, as well as respiratory conditions caused by certain impairments. Second, implementing social distancing, quarantines or similar restrictive programs may disrupt services vital for many PWD and undermine basic rights such as food, health care, sanitation, and communications, leading to abandonment, isolation

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and institutionalization. In addition to experiencing health and social inequalities and lack of care in isolation during the COVID-19 crisis, PWD face helplessness as well as stigma and prejudice attached to disabilities.<sup>9</sup> The "social isolation," as well as psychological and emotional instability, of PWD are evident under the COVID-19 pandemic.<sup>10</sup>

PWD are disproportionately represented among the COVID-19 patients. In South Korea, there was a total of 39,432 confirmed COVID-19 patients up to December 9, 2020.<sup>11</sup> Among the confirmed cases, 4% were PWD ( $n = 1562$ ). By the type of disabilities, 35.7% of the PWD had physical disabilities, followed by 17.2% with hearing impairments. Of the 556 COVID-19 deaths, 21% were PWD ( $n = 117$ ), which is disproportionate to their presence (5.1%) in the total population in South Korea. While the death rate was 1.2% among the 37,870 confirmed cases without disabilities ( $n = 439$ ), 7.5% of 1562 confirmed cases with disabilities died from COVID-19.<sup>11</sup> Confirmed cases by the age of PWD were 24.9% ( $n = 389$ ) in their 60s, 21.4% ( $n = 334$ ) in their 70s, 20.5% ( $n = 320$ ) in their 50s, 15% ( $n = 235$ ) in their 80s and older, 8% ( $n = 125$ ) in their 40s, 4.3% ( $n = 67$ ) in their 30s, 6% ( $n = 92$ ) under the age of 30. The risk of infection was high due to the age of PWD.<sup>12</sup>

The Korea National Rehabilitation Center conducted a survey of 2454 PWD and 999 PWOD from November to December 2020 on physical and mental health and life changes to understand the impact of COVID-19.<sup>10</sup> Although limited to descriptive analyses, the survey results imply that PWD face barriers to accessing medical services and necessary information about COVID-19 during the pandemic, resulting in social isolation and low life satisfaction. In particular, the number of PWD who reported new health problems or poor health after the COVID-19 outbreak was 14.7%, higher than that (9.9%) of PWOD. However, only 36.8% of the PWD received medical treatment due to health problems, lower than that (52.5%) of PWOD. Among the PWD who received care services, 18.2% experienced discontinuation of care due to COVID-19. In the case of information acquisition, 22.4% of the PWD reported that they had faced difficulty in obtaining necessary information in relation to COVID-19, whereas 18.2% of the PWOD reported the same. Nearly half of the PWD (46.1%) reported that they did not know how to find information related to COVID-19. Over a third of the PWD (35%) reported the lack of information services through easy-to-understand pictures and videos, and 23.2% reported the lack of sign language interpretation and screen commentary services. Understandably, 44.6% of the PWD felt lonely, which is 8.5% higher compared to 36.1% of the PWOD, and 44% of the PWD reported that their life satisfaction has decreased amidst the COVID-19 pandemic, which is 1.3 times higher than 34.6% of the PWOD.

As the technological dependence in all spheres of life during the COVID-19 crisis is deepening, digital inequalities have put the most digitally disadvantaged more at risk.<sup>13,14</sup> During the COVID-19 pandemic, accessing and understanding up-to-date online information about the virus is pivotal to protect oneself from it. Governments and official agencies, such as the WHO, have been working hard to disseminate reliable information about the virus and deliver services online.<sup>13</sup> However, some of the vulnerable social groups, including PWD, are difficult to reach if digital media serves as the main route of communication.<sup>15</sup> The South Korean government has stepped up innovative efforts to provide accurate and reliable Internet/mobile information services during the pandemic, such as daily confirmed case counts, confirmed mobility routes, pharmacies where face masks could be purchased, and the location of screening clinics in real-time. These kinds of services were very useful and safe as there was no direct personal contact. The South Korean government has also offered Internet/mobile application services through which individuals can apply for COVID-19 stimulus checks, emergency supports, and temporary

unemployment benefits to relieve economic distress. However, such innovative emergency services may be another barrier for people who cannot access the Internet or the devices or cannot use Internet/mobile technologies. Subsequently, the lack of digital access and digital literacy has exacerbated the vulnerability.

During the pandemic, most daily activities have switched from face-to-face to virtual environments such as e-learning, remote work, remote health checkup, live-streamed religious services, and online shopping. People who have chronic health conditions are disproportionately impacted by the abrupt shift to the virtual world due to serious disruptions to the services they rely on.<sup>16</sup> Access to virtual alternatives is limited by a restrained set of digital skills and economic constraints related to delivery fees.<sup>11</sup> People with chronic health conditions are not only at increased risk of exposure to the virus when they have to go to public places for Internet access but also are more likely to experience low social connectedness than other groups. In addition to social distancing measures and quarantines, digital deprivation is further linked to negative physical and mental health outcomes among already vulnerable populations, thus, amplifying existing social inequalities.<sup>17</sup>

In South Korea, for example, individuals with visual impairments encounter challenges with the use of quick response (QR) code entry logs at certain facilities.<sup>11</sup> The QR code checking is required to log visitors at entertainment and public facilities, restaurants, universities, churches to track COVID-19 cases and prevent further spread of the disease. However, those individuals are often denied access to public spaces because they cannot authenticate without help from others. Another example is a lack of accessibility in online shopping. Large grocery stores were supposed to provide screen readers for people with visual disabilities (PVD) to purchase food or necessities through their online portals as those people face more difficulty in using the physical stores due to the risk of infection. However, most online shopping malls have very low web accessibility, which has led to significant difficulties for PVD.<sup>12,18</sup> As the pandemic forced schools and universities to close on a national scale, teaching and learning activities were shifted to a full e-Education system. However, the right to education is not guaranteed for deaf students in the e-Education system without accommodations such as subtitles and sign language translation. Likewise, PVD have difficulty learning due to the lack of alternative texts.<sup>16</sup>

With the ongoing COVID-19 pandemic, little is known about differences in digital service usage and change in such usage between PWD and PWOD. This study aims to explore the extent of the digital divide between PWD and PWOD during the pandemic by addressing the following research questions: To what extent are PWD and PWOD different in changes in 1) Internet usage with computers and mobile devices, 2) the usage of digital services, 3) awareness, usage, and usefulness of digital services, and 4) the perception of the Internet/mobile technologies during the COVID-19 pandemic, respectively.

## Methods

### Data

This study relied on a cross-sectional dataset from the 2020 Digital Divide Survey conducted by the Korean Ministry of Science, ICT & Future Planning amidst the COVID-19 pandemic (September 2020 and December 2020).<sup>19</sup> The South Korean government has been conducting this survey since 2002 to measure digital usage and divide among diverse populations including general citizens, PWD, low-income people, farmers and fishermen, people from North Korea, and international migrant women. Using the square root proportional allocation method by sociodemographic

characteristics (e.g., gender, age, and residence), the survey created a nationally representative sample of each subgroup. In the original survey, PWD were selected from the national disability registry database using a proportionate quota by gender, age, and region. Thus, they were registered for disability benefits based on the disability rating scheme.

#### Sampling procedure

We selected 2 sets of samples including 7000 PWOD and 2200 PWD. First, we excluded 129 respondents from the PWOD group who self-reported having a disability. To make the age range consistent between the 2 groups, we excluded 1216 PWOD and 16 PWD aged under 18 or over 70 years, yielding 5655 PWOD and 2184 PWD, respectively. Moreover, we excluded 53 PWOD and 380 PWD ( $n = 433$ ) with no access to the Internet. After excluding 27 PWOD and 23 PWD ( $n = 50$ ) with no material access to the Internet (e.g., computer and smartphone), the final sample included 7356 respondents with 5575 PWOD and 1781 PWD aged between 18 and 69 years.

#### Measures

We examined differences in the demographic characteristics between PWOD and PWD. *Demographic information* in the study included gender and employment status measured as dichotomous variables, as well as age, education, and household income as continuous variables.

We compared Internet usage and various types of digital services related to the COVID-19 pandemic between PWOD and PWD. First, we measured *change in Internet usage* on a 5-point Likert scale ranging from 1 (very much decreased) to 5 (very much increased). Respondents were asked how their Internet usage has changed due to the COVID-19 pandemic. Considering most digital services and information related to the pandemic in South Korea were offered via mobile applications, we separately measured change in Internet usage with computers and mobile devices.

Second, we measured *changes in the usage of five digital services due to the COVID-19 pandemic* as a categorical variable: 1) Less: Internet usage decreased during the pandemic, 2) Similar: Internet usage remains similar to the pre-pandemic period, and 3) More: Internet usage increased. Respondents were asked about the usage change in five types of digital services during the COVID-19 pandemic: 1) search, email, and contents (e.g., information, news, media, and education) services, 2) social networking services (e.g., SNS, messenger, personal blog, and online community), 3) daily services (e.g., weather forecast, public transportations, navigation, E-commerce, internet banking, and E-government), 4) information creation and exchange (e.g., creating and editing online contents, uploading Internet contents, and sharing links), and 5) online social participation (e.g., online commenting on social issues, filing complaints, participating online survey for public policy, and online donation).

Third, we compared differences in awareness, actual usage, and usefulness of four digital services during the COVID-19 pandemic between PWOD and PWD. Awareness and actual usage were measured as dichotomous variables (=1 if aware of the services and if have used the services for actual usage, respectively). Usefulness was measured on a 4-point Likert scale ranging from 1 (Not useful at all) to 4 (Very useful). Respondents were asked about their awareness, actual usage, and usefulness of four types of digital services: 1) COVID-19 application services (e.g., COVID-19 stimulus check, emergency supports, and temporary unemployment benefits), 2) COVID-19 information services (e.g., daily confirmed case counts, quarantine process data, regular briefings by the government, and instructions for self-quarantine), 3) delivery services

(e.g., daily necessities and food), and 4) subscription services (e.g., video and music streaming and e-books).

Lastly, we measured change in the perception of the Internet and mobile technologies during the COVID-19 pandemic with three items. We coded respondents' answers into three groups as a categorical variable: 1) Disagree, 2) Neutral, and 3) Agree. The three items stated, "The Internet and mobile technologies have become more important than before in our lives," "Lacking the ability to use the Internet and mobile technologies will leave people behind in society," and "I hope for more opportunities to learn about the Internet and mobile technologies."

#### Statistical analysis

We performed descriptive and bivariate analyses to compare the sample characteristics between PWOD and PWD. Bivariate tests were also conducted to examine differences between the two groups in the Internet and digital service usage using chi-squared tests for dichotomous/trichotomous variables and independent *t*-test analyses for continuous variables. The software R version 4.0.3 was used to perform data management and analyses.

## Results

### Demographic characteristics

Table 1 shows descriptive statistics for the entire sample and comparisons of the demographic characteristics between PWD and PWOD. Results from bivariate analyses indicated statistically significant differences between PWD and PWOD on measures of all variables included in this study. The PWD group had a higher ratio of males to females (69.3%) than the PWOD group (51.6%). Respondents in their 50s comprised the largest percentage in the PWOD group (21.6%), while respondents in their 60s constituted the largest in the PWD group (37.2%). A greater percentage of the PWOD (42.4%) had college degrees or above compared to that of the PWD (9.8%). A large majority of the PWOD were employed (71%), while less than half of the PWD (43.8%) were employed at the time of the survey. In the PWOD group, the majority (63%) reported more than 4 million won (Korean currency) as their household income, while only 14.2% in the PWD group reported a household income of more than 4 million won.

### Change in the Internet usage during the COVID-19 pandemic

Table 2 shows significant differences between PWOD and PWD in their Internet usage change during the COVID-19 pandemic. In particular, on the one hand, a higher number of PWD, compared to PWOD, reported that their Internet usage with both computers and mobile devices remained similar to the usage during the pre-pandemic period. On the other hand, more respondents in the PWOD group, compared to PWD, reported that their Internet usage via both computers and mobile devices has increased. There were significant gaps between PWOD and PWD regarding their Internet usage change via computers ( $X^2(2, N = 7356) = 49.12, p < 0.001$ ) and mobile devices ( $X^2(2, N = 7356) = 33.89, p < 0.001$ ) during the COVID-19 pandemic.

### Change in the usage of digital services due to the COVID-19 pandemic

Table 3 presents significant gaps in the usage change in all five types of digital services between PWOD and PWD during the COVID-19 pandemic. The mean of the change in the digital services usage ranged from 3.72 (SD = 0.72) to 3.16 (SD = 0.73) for PWOD

**Table 1**  
Demographic characteristics.

		PWOD (N = 5575) N (%)	PWD (N = 1781) N (%)	Total (N = 7356) N (%)	$\chi^2$
Gender	Male	2875 (51.6)	1234 (69.3)	4109 (55.9)	171.13***
	Female	2700 (48.4)	547 (30.7)	3247 (44.1)	
Age	Under 20	386 (6.9)	34 (1.9)	420 (5.7)	810.96***
	20–29	981 (17.6)	47 (2.6)	1028 (14.0)	
	30–39	1012 (18.2)	120 (6.7)	1132 (15.4)	
	40–49	1166 (20.9)	316 (17.7)	1482 (20.1)	
	50–59	1202 (21.6)	602 (33.8)	1804 (24.5)	
	60–69	828 (14.9)	662 (37.2)	1490 (20.3)	
Mean (SD)		42.72 (14.6)	53.84 (11.4)	45.42 (14.7)	
Education level	Elementary school	10 (0.2)	236 (13.3)	246 (3.3)	1467.6***
	Middle school	375 (6.7)	423 (23.8)	798 (10.8)	
	High school	2824 (50.7)	947 (53.2)	3771 (51.3)	
	College and above	2366 (42.4)	175 (9.8)	2541 (34.5)	
Employment Status	Employed	3957 (71.0)	780 (43.8)	4737 (64.4)	433.8***
	Unemployed	1618 (29)	1001 (56.2)	2619 (35.6)	
Household Income (KRW: ₩)	Below 1,999,999	103 (1.8)	660 (37.100)	763 (10.4)	2528.5***
	2,000,000–2,999,999	511 (9.2)	459 (25.8)	970 (13.2)	
	3,000,000–3,999,999	1448 (26.0)	409 (23.0)	1857 (25.2)	
	Above 4,000,000	3513 (63.0)	253 (14.2)	3766 (51.2)	

Note. PWOD = people without disabilities; PWD = people with disabilities.  
\*\*\* $p < 0.001$ .

**Table 2**  
Frequencies of Change in Internet usage with Computer and Mobile during the COVID-19 pandemic.

	Computer			Mobile		
	Less	Similar	More	Less	Similar	More
PWOD (N = 5575)	343 (6.2)	3721 (66.7)	1511 (27.1)	27 (0.5)	1887 (33.8)	3661 (65.7)
PWD (N = 1781)	92 (5.2)	1344 (75.5)	345 (19.4)	8 (0.4)	738 (41.4)	1035 (58.1)
$\chi^2$	49.11***			33.89***		

Note. PWOD = people without disabilities; PWD = people with disabilities; Less = Internet usage decreased during; Similar = Internet usage remain similar to the pre-pandemic period; More = Internet usage increased.  
\*\*\* $p < 0.001$ .

**Table 3**  
Average scores on changes in the usage of digital services during the COVID-19 pandemic.

(range: 1–5)	PWOD (N = 5575)		PWD (N = 1781)		Gap <sup>b</sup>	T
	Mean	SD	Mean	SD		
Search, email, and contents services	3.72	0.72	3.48	0.66	0.24	13.332***
Social networking services	3.71	0.72	3.41	0.64	0.30	16.798***
Daily services <sup>a</sup>	3.58	0.73	3.38	0.69	0.20	10.037***
Information creation and exchange	3.32	0.73	3.13	0.59	0.19	11.061***
Social participation	3.16	0.73	3.09	0.68	0.07	3.928***

Note. PWOD = people without disabilities; PWD = people with disabilities.  
\*\*\* $p < 0.001$ .

<sup>a</sup> Daily services included weather forecast, maps, Internet banking, Government services, etc.  
<sup>b</sup> Gap was calculated by subtracting the mean of PWD from the mean of PWOD.

and from 3.48 (SD = 0.66) to 3.09 (SD = 0.68) for PWD, respectively. Of the digital services, the largest gap was found in the usage change of social networking services between PWOD and PWD during the COVID-19 pandemic ( $t(3380) = 16.8, p < 0.001$ ).

*Awareness, usage, and usefulness of digital services for the COVID-19 pandemic*

Results of the bivariate analyses are summarized in Table 4. There were statistically significant gaps in the awareness, usage, and perception of the usefulness of all four types of digital services. Overall, compared to PWD, PWOD were likelier to be aware of, utilize, and perceive the usefulness of digital services during the COVID-19 pandemic including application, information, delivery,

and subscription services. For the COVID-19 information, PWD were likelier to be aware of the relevant digital services while their usage and perception of those services were significantly lower than that of PWOD. PWD were least informed about and underutilized subscription services. The perception of usefulness on delivery services showed the largest gap ( $t(1580) = 4.97, p < 0.001$ ) followed by subscription services ( $t(740) = 3.67, p < 0.001$ ).

*Change in the perception of the Internet and mobile technologies during the COVID-19 pandemic*

Table 5 shows the perception change on the Internet and mobile technologies during the COVID-19 pandemic. Results of the bivariate analyses demonstrated significant differences between PWOD

**Table 4**  
Average Scores on Awareness, Usage, and Usefulness of Digital Services during the COVID-19 pandemic.

	N	Awareness <sup>a</sup>		Usage <sup>a</sup>		N <sup>b</sup>	Usefulness (range: 1–4)		
		N (%)	X <sup>d</sup>	N (%)	X <sup>d</sup>		Mean (SD)	Gap <sup>e</sup>	T
<b>COVID-19 Application Services<sup>c</sup></b>	PWOD (N = 5575)	5354 (96.0)	115.4***	4116 (76.9)	43.5***	PWOD (N = 4116)	3.39 (0.52)	0.08	4.532***
	PWD (N = 1781)	1590 (89.3)		1092 (68.7)		PWD (N = 1092)	3.31 (0.50)		
<b>COVID-19 Information Services<sup>d</sup></b>	PWOD (N = 5575)	4182 (75.0)	107.14***	3603 (86.2)	54.35***	PWOD (N = 3603)	3.36 (0.58)	0.07	4.082***
	PWD (N = 1781)	1545 (86.7)		1206 (78.1)		PWD (N = 1206)	3.29 (0.51)		
<b>Delivery Services</b>	PWOD (N = 5575)	5155 (92.5)	188.39***	4124 (80.0)	56.99***	PWOD (N = 4124)	3.37 (0.57)	0.1	4.972***
	PWD (N = 1781)	1444 (81.1)		1020 (70.6)		PWD (N = 1020)	3.27 (0.56)		
<b>Subscription Services</b>	PWOD (N = 5575)	4468 (80.1)	543.46***	3091 (69.2)	58.81***	PWOD (N = 3091)	3.27 (0.55)	0.09	3.667***
	PWD (N = 1781)	927 (52.0)		520 (56.1)		PWD (N = 520)	3.18 (0.51)		

Note. PWOD = people without disabilities; PWD = people with disabilities.

\*\*\*p < 0.001.

<sup>a</sup> For Awareness and Usage, the frequencies indicate participants who reported as being aware of and having used the service, respectively.

<sup>b</sup> The usefulness of the services was measured only by the respondents who reported as having used respective services.

<sup>c</sup> COVID-19 application services include stimulus check, emergency supports, and temporary unemployment benefits.

<sup>d</sup> COVID-19 information services include daily case counts, quarantine process data, regular briefings by the government, and instructions for self-quarantine.

<sup>e</sup> Gap was calculated by subtracting the mean of PWD from the mean of PWOD.

and PWD in their perception change. Compared to PWOD, on the one hand, PWD were likelier to state that the Internet and mobile technologies, as well as the ability to use said technologies, became less important or remained similar to the pre-pandemic period. On the other hand, a large majority of PWOD agreed that the Internet and mobile technologies ( $X^2(2, N = 7356) = 215.66, p < 0.001$ ), as well as the ability to use said technologies ( $X^2(2, N = 7356) = 151.55, p < 0.001$ ), had become more important. Compared to PWD, PWOD were likelier to hope for more opportunities to learn about the Internet and mobile technologies ( $X^2(2, N = 7356) = 288.74, p < 0.001$ ).

**Discussion**

We aimed to understand the digital divide affecting PWD during the COVID-19 pandemic in South Korea. First, there were significant differences between PWOD and PWD regarding their Internet usage change during the COVID-19 pandemic. Compared to PWOD, a higher number of PWD reported that their Internet usage with both computers and mobile devices remained similar to the usage during the pre-pandemic period. Second, significant gaps were found in the usage change of all five types of digital services between PWOD and PWD during the COVID-19 pandemic. Among the digital services, the largest gap was in the usage change of social networking services between PWOD and PWD during the COVID-19 pandemic. Third, compared to PWD, PWOD were likelier to be aware of, utilize, and perceive the usefulness of digital services during the COVID-19 pandemic including application, information, delivery, and subscription services. For the COVID-19 information, PWD were likelier to be aware of the relevant digital services while their usage and perception of those services were significantly lower than those of PWOD. PWD were least informed about and underutilized subscription services. The perception of usefulness on delivery services showed the largest gap. Fourth, compared to PWOD, PWD were likelier to perceive that the Internet and mobile technologies, as well as the ability to use technologies, became more important or remained similar to the pre-pandemic period.

Based on the findings from this study, we discussed seven issues as follows. First, due to the prolonged COVID-19 pandemic, PWD have been unhealthy, both physically and mentally.<sup>10</sup> With the ongoing COVID-19 pandemic, the physical health of PWD has deteriorated, and they are experiencing depression. It also affects the care and outdoor activities of PWD, and their life satisfaction has lowered significantly. The pandemic has changed the daily life of PWD to a greater degree than it changed the lives of PWOD. In

this context, a possible explanation for the usage rate of the Internet in PWD similar to before and after the COVID-19 pandemic could be, partly, because it was difficult for PWD to obtain the information regarding the pandemic through the Internet. This is consistent with the prior survey where PWD reported that being unaware of how to find information, a lack of information services through easy-to-read pictures and videos, and a lack of sign language interpretation and description video system were the barriers.<sup>10</sup> The previous studies have identified that the digital divide is caused by the lack of access, skills and confidence, and motivation and perceived benefit.<sup>14,21,23,25</sup> During the pandemic, the lack of accessibility to digital services, combined with the absence of individualized support for Internet use, may deter PWD from the latter, which, in turn, decreases their confidence and motivation to use digital services.

Second, the findings of this study highlighted the noticeable change in use of mobile phone for the digital services in both PWD and PWOD groups. This change was greater than the reported increase in the use of computer for the same purposes. There are two possible explanations for these results. In Korea under COVID 19, mobile services are used as a major method to deliver real-time information on the occurrence of confirmed cases in the community, the route of confirmed cases, the place of purchasing face masks in the early stages of COVID 19, and the location of screening inspections. In addition, Koreans tend to use their mobile phones much more than computer for entertainment services such as YouTube, dramas, cartoons, movie, etc.<sup>26</sup> This is also true for PWD based on the national initiatives that afford PWD more material access to the Internet than other countries by providing financial supports for them to buy smart phones, discount on Internet bills, and educational programs for Internet use.<sup>19</sup>

Third, the average scores on the perceived change in the usage of both social networking services and social participation were lower for PWD compared to PWOD in this study. Consistent with prior research,<sup>17</sup> relatively lower levels of social networking and participation may lead to high anxiety and depression among PWD during the COVID-19 pandemic. During the COVID-19 pandemic, digital networking is more important due to remote relationships with people. However, recent studies on PWD during the COVID-19 pandemic have shown that they are suffering from more psychological difficulties due to social isolation as they are unable to connect with people on the Internet.<sup>1,7,8,18</sup>

Fourth, none of the services used by PWD during the COVID-19 pandemic was rated more practically useful than rating of usefulness by PWOD. In the case of delivery and subscription services,

**Table 5**  
Frequencies change in the perception of internet/mobile technology during the COVID-19 pandemic.

	Internet and mobile technology have become more important than before in our lives.			A lack of the ability to use the Internet and mobile technology will leave people behind in society.			I hope for more opportunities to learn Internet and mobile technology.		
	Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree
PWOD (N = 5575)	140 (2.5)	1195 (21.4)	4240 (76.1)	312 (5.6)	1338 (24.0)	3925 (70.4)	151 (2.7)	1304 (23.4)	4120 (73.9)
PWD (N = 1781)	153 (8.6)	544 (30.5)	1084 (60.9)	213 (12.0)	570 (32.0)	998 (56.0)	165 (9.3)	642 (36.1)	974 (54.7)
$\chi^2$	215.66***			151.55***			288.74***		

Note. PWOD = people without disabilities; PWD = people with disabilities.  
\*\*\*p < 0.001.

those services are provided by the private sector, and the accommodations for the service applications are not disability sensitive. According to the 2020 Web Accessibility Survey, wholesale, retail, and food industries scored the lowest in disability accessibility and accommodations among 1000 websites in South Korea.<sup>19</sup> Even for government-developed support and information services related to COVID-19, their usage and usefulness were found to be lower for PWD compared with PWOD in this study.

Fifth, for information services directly related to health care during the COVID-19 pandemic, the results of this study indicate that awareness of those services among PWD was higher than that of PWOD; however, the actual usage and usefulness were lower. In the case of PWD with vulnerable health conditions, one possible explanation is that they were aware of information services but may not have a material device or Internet connection.<sup>19</sup>

Sixth, delivery and, especially, subscriptions services had lower awareness, usage, and rated usefulness for PWD compared to PWOD. This may be partly due to their inability to use the applications and pay for a subscriptions fee or delivery fee.<sup>20</sup> The subscription service contains commercial entertainment and educational content. PWD may not be familiar with those commercial contents that provide little to no accommodations for them.

Seventh, PWD's attitude toward the importance of the Internet and mobile technologies has not changed much before and during pandemic when compared to that of PWOD in this study. A previous study using data from the 2019 Digital Divide Survey found that there was a bigger gap in motivation in Internet usage (mean difference = 0.92) than Internet access (mean difference = 0.59) between PWOD and PWD before the pandemic.<sup>21</sup> PWOD tend to perceive that the Internet and mobile technologies have become very important due to the pandemic; therefore, they want to learn about more technologies. Attitudes toward the Internet have a profound impact on its use; the more positive experience, the more positive the user becomes, which leads to more use. PWD's neutral attitude on the Internet is unlikely to have a positive impact on future Internet use, which can further accelerate the digital gap between PWOD and PWD in the post-COVID-19 era. PWD may experience more digital alienation and not have the benefits from Internet use.

*Recommendations for increasing digital use in PWD*

Digital access, digital skills, and digital literacy are the most important tools to use the Internet better.<sup>23,24</sup> Thus, material access, as well as digital skills, needs to be catered for them. To increase digital use, we need one-to-one education for PWD, and we also need a way to integrate the personal assistants who take care of them in the education for Internet use.<sup>22</sup> In addition to Internet use education, economic support for data use needs to be guaranteed at the national level to increase Internet use among PWD.

Second, for a universal design of applications, the application

engineers need to be educated, and application certification systems must be introduced. This means that any future application should be created considering various types of disabilities. Disability-friendly applications need to be newly developed to ensure that PWD have a positive attitude towards using the Internet and mobile devices to enjoy digital equality. In addition, we can think of ways to support user fees when they use the delivery services and subscription services.

Maintaining social interactions through virtual spaces is critical for receiving the social support necessary to cope with uncertainties, fears, and anxiety that come with the consequences of the pandemic.<sup>17,24</sup> The importance of virtual communities, such as online groups or virtual forums, likely increase both for social support and information seeking purposes. In a context of imposed social isolation, however, PWD are at a greater risk for becoming further isolated. As one of the social support network factors, having assistance from more experienced Internet users when problems arise would increase knowledge and skills.<sup>25</sup> However, the isolation makes it harder to actualize the digital technical support. Digital exclusion is likely to exacerbate during and after the COVID-19 crisis.<sup>13</sup>

*Limitations of the study and directions for future research*

The following limitations are worth considering for future research. First, the current study provides a snapshot of changes in the usage of Internet and digital services, as well as the perception of the Internet/mobile technologies amidst the COVID-19 pandemic. It is important, however, to establish the baseline data of the Internet and digital service usage for each group before the COVID-19 pandemic to identify the actual changes in their usages between the two groups. Unfortunately, the survey for this study added the pandemic-related questions in 2020 and asked only about participants' perceived changes in internet and digital service usage, not their pre-pandemic usage rates nor current rates. It means that we do not know if PWOD started out with lower usage rates and so their larger gain may put them at an equivalent absolute usage rate now. The COVID-19 pandemic is still unfolding, and various Internet/mobile technologies and applications have been rapidly developed to tackle it. Given that changes in any outcomes of the Internet and digital services usage may not occur simultaneously, the long-term effects of the pandemic on the digital divide between PWOD and PWD may differ from the findings of this study.

Second, the survey used in this study does not include questions about online accommodations for PWD. In the massive rush to the virtual era due to the COVID-19 pandemic, most Internet/mobile technologies have failed to accommodate the needs of PWD. In addition to existing barriers with online materials, PWD are being unable to get up-to-date information about COVID-19 and are isolated from society. Online accommodations, such as enlarged texts, screen readers, and sign language interpreters, have a significant

impact on the usages of digital services among PWD and their perception of the Internet/mobile technologies. Future research is required to examine the extent to which accommodations and accessibility needs of PWD are met and to test the internal validity of this study when online accommodations are considered.

Third, the current study is limited to bivariate analyses to investigate differences in digital service usage and change in those usage between PWOD and PWD during the COVID-19 pandemic. However, previous studies have identified socioeconomic information (e.g., age, gender, education, and income) as determinants for gaps in digital outcomes between PWOD and PWD.<sup>27</sup> Although it is beyond the scope of this study to investigate the impacts of sociodemographic information on the difference and change in digital service usage, further study requires multivariate analyses to examine factors that impact the variability of the difference in digital service usage between PWOD and PWD.

Lastly, future research needs to investigate the patterns of the Internet and digital service usage pre-to-post COVID-19 pandemic by using longitudinal analyses of data to provide a more accurate understanding of the pandemic's impact on such usage between PWOD and PWD. In the same line, the Internet and digital service usage may widely vary across groups of people with different types of disabilities during the COVID-19 pandemic. For example, compared with PVD, written communication and online information are likely to be more accessible to individuals with hearing impairment even with a lack of accommodation. Further research is necessary to explore variations in the patterns of the Internet and digital service usage among people with different types of disabilities.

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