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.

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Have changes in Internet use during the COVID-19 pandemic affected older adults' self-rated health? A cross-sectional study of young-old and old-old populations in Korea

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ABSTRACT

Disparities in Internet access are barriers to older populations' well-being. This study examined the association between changes in older adults' Internet usage during the coronavirus disease 2019 (COVID-19) pandemic and their self-rated health. Participants were adults aged 65 years and above, selected from the 2020 Digital Divide Survey conducted in Korea (n = 1150). Changes in Internet use among younger (aged 65–74 years) and older (aged 75 years and above) groups and the association between these changes and participants' self-rated health were examined. Internet usage remained similar or increased during the COVID-19 pandemic, particularly among the younger group. Increased Internet use was associated with better self-rated health of the participants. Other characteristics, including age, income, and education level, were also positively associated with their health. This study highlights the need for increasing older adults' access to online activities to enhance health equity in the digital era.

Introduction

The ever-increasing use of the Internet has changed the lifestyles of individuals around the world. This trend accelerated as a result of the coronavirus disease 2019 (COVID-19) pandemic as many countries implemented social distancing measures. In this context, disparities in access to information and communication technologies (ICT) are considered barriers to the social inclusion of people without the required knowledge and skills.[1] Although the Internet usage among older adults is constantly increasing, they show lower rates of Internet adoption as compared to younger adults.[2] The Organization for Economic Cooperation and Development (OECD) defines the "digital divide" as the gaps between individuals, households, businesses, and regions in terms of their access to and use of ICT for various activities.[3] Considering that older people, particularly those with lower levels of education and economic resources, are less likely to use the Internet,[4] the digital divide between older and younger populations can widen social inequality during the COVID-19 pandemic.

Online activities, including using email and social media, can lower the social isolation and loneliness of older adults by increasing social contact.[5,6] During the COVID-19 pandemic, many older adults have learned to use the Internet to communicate with family and for everyday services such as grocery shopping and remote healthcare services.[7] Internet usage also has helped people gain health information and use prevention services related to COVID-19. For example, information regarding real-time confirmed COVID-19 cases and clinics that provided vaccinations or COVID-19 testing were provided online by both the government and private developers in South Korea.[8]

Previous studies have reported the positive impact of Internet usage on older adults' health and well-being.[9,10] However, the current evidence on the association between Internet use and self-rated health among the older population is inconsistent. Self-rated health is a comprehensive measure of an individual's health, which is a strong predictor of well-being.[11] Recent studies have demonstrated the association between Internet usage and better self-rated health in older adults.[12-15] Further, Fjell et al.[14] suggested that Internet usage can enhance older adults' self-rated health by improving social support, social contact, and access to health information. However, some studies reported no significant association between Internet usage and self-rated health[16] or negative associations.[17] These inconsistent findings highlight the need to examine the link between Internet usage and self-rated health among older adults.

Moreover, it is unclear whether older adults' Internet usage and its impact on health differ between young-old and old-old populations. Contrary to common belief, many older adults remain healthy and are capable of engaging in work or social activities beyond retirement age (65 years).[18] It has also been suggested that older adults

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have satisfying social relationships because they prioritize meaningful social experiences and gain interpersonal skills as they age.[19] Considering the limited physical contact during the pandemic, Internet usage can facilitate meaningful virtual social activities, which may be beneficial for older adults' health. This would be particularly relevant for the old-old group, given that their physical function declines as they age. A previous study showed that while the old-old group is less likely to use ICT, they may have better psychological well-being when they are able to use it.[20] However, we have limited knowledge of the extent of changes in older adults' involvement in various Internet activities during the COVID-19 pandemic and its association with their health.

In this study, we aimed to examine the association between changes in Internet usage during the COVID-19 pandemic and the self-rated health of older adults in South Korea. We also examined differences between the young-old group (65–74 years) and the old-old group (75 years and above). We predicted that older adults' involvement in Internet activities increased during the COVID-19 pandemic and that the health effects of increased Internet usage would differ between the young-old and old-old groups. We hypothesized that (1) the increase in Internet usage during the COVID-19 pandemic would be associated with better self-rated health and (2) the old-old group would report a stronger association between increased Internet usage and self-rated health than the young-old group.

Material and methods

Study design and participants

We conducted a secondary analysis of nationwide cross-sectional data from the 2020 Digital Divide Survey in the Republic of Korea. The inclusion criteria were (1) community-dwelling older adults aged 65 years and over and (2) using the Internet through personal computers or wireless digital devices such as smartphones and tablets. Individuals who resided in facilities (e.g., dormitories, nursing homes, prisons) were excluded. The 2020 Digital Divide Survey was conducted on 15,000 people nationwide, including citizens (aged seven years and above), people with disabilities, low-income populations, rural residents (farmers and fishermen), people from North Korea, and international migrant women. Based on the inclusion criteria, we selected older adults aged 65 years and above from the datasets. The final study sample included a total of 1,150 adults who were 65 years and above.

Ethical considerations

The National Statistical Office approved the 2020 Digital Divide Survey (approval no. 120017). Our study was approved as exempt from review by the University's Institutional Review Board (IRB; IRB no. 1041078-202203-HR-145) because it analyzed publicly-available anonymized data (https://www.data.go.kr/data/15038422/fileData.do).

Data

The 2020 Digital Divide Survey was conducted between September and December 2020 by the Ministry of Science and ICT in the Republic of Korea. The survey has been conducted annually since 2002 to measure the digital information gap in Korea. Trained personnel conducted face-to-face interviews at participants' residences based on a structured survey instrument. After the interviewers explained the survey purpose and principles of protecting personal privacy, those who agreed to participate were enrolled in the study.

Measures

The survey consists of structured questionnaires on 19 domains regarding digital use and participants' attitudes in relation. Questions regarding changes in respondents' Internet usage during the COVID-19 pandemic were newly added in 2020. The dependent variable in this study was the participants' self-rated health. The outcome was based on one question asking the level of participants' satisfaction with their physical and mental health. Their responses were included in the analysis as continuous variables, ranging from 1 (not satisfied at all) to 4 (very satisfied).

Changes in the use of four types of online services during the COVID-19 pandemic between the younger and older age groups were compared. The responses for each service use were based on a 5-point Likert scale: 1 (significantly decreased), 2 (somewhat decreased), 3 (remained similar), 4 (somewhat increased), and 5 (significantly increased). Social networking and information-sharing services included social networking sites (SNS), messenger, personal blogs, and online communities. Social participation services included expressing opinions on social issues online, proposing policies or filing complaints to the government or public agencies, and participating in online donations, volunteer activities, surveys, or voting. Daily services included information services (e.g., weather forecast and public transportation), online shopping, online financial transaction services, and public services (e.g., issuance of civil complaint documents, tax payment, information for public welfare information services). Search, email, and content services included searching for information or news, using email, media content (movies, music, books, etc.), and educational content.

Participants' socioeconomic status and health conditions were included as covariates in the analyses, based on previous research. Previous studies have shown that age, gender, and health status are relevant factors indicating Internet usage in old age.[21] Studies showed that socioeconomic status, including income and education, are crucial factors affecting the use of technology, including the Internet.[22,23] Income and educational level were controlled for in the analyses to consider the possible relationship between these socioeconomic inequalities and self-rated health.[16] Research also showed that people with disabilities had less access to the Internet as compared to the general population,[24] suggesting the disability digital divide.

Data analysis

Descriptive statistics were used to examine participants' characteristics according to age group, with the proportions calculated for categorical variables and means for continuous variables. Comparisons between the two age groups were assessed using independent t-tests or χ^2 tests as appropriate. A series of multiple regressions was performed to examine the association between changes in Internet usage during the COVID-19 pandemic and self-rated health among the young-old and the old-old groups, adjusting for covariates. Each of the four types of service uses was examined by performing separate regression models. The standardized coefficients and *P*-values were analyzed to show the association between study variables. We included age, gender, level of education (i.e., less than middle school graduation and more), household income, household arrangements, and disability (i.e., yes vs no) as covariates in all models. We used IBM SPSS Statistics for Windows, Version 25.0. (IBM Corp, Armonk, NY, USA). Missing values were excluded from analyses. A *P*-value of <0.05 was considered statistically significant.

Results

Characteristics of the participants

The average score of participants' self-rated health was higher (Mean = 2.61, SD = 0.8) in the younger group (aged 65–74 years)

than that (Mean = 2.44, SD = 0.7) in the older group (aged 75 years and above) (Table 1). The average age of the young-old was 69.18 (SD = 2.8), while that of the old-old was 79.93 (SD = 3.6). In both groups, the proportion of women was higher than that of men. In the younger participants, the proportion with educational levels above high school was higher (76.6%) than that of older participants (55.2%). The young-old group had an average higher income level compared to the old-old group. As for household arrangements, 91.2% of the younger group and 82.1% of the older group lived with others. The proportions of participants who had disabilities were 2.2% in the younger group and 4.0% in the older group.

Changes in Internet usage during the COVID-19 pandemic

Table 2 presents the changes in Internet usage by age group (aged 65–74 and 75+). The average scores for the changes in the use of four types of Internet services during the COVID-19 pandemic were calculated. For social networking and information-sharing services, the younger group had a higher score (3.24) than the older group (2.98). Regarding the use of social participation services, the score of the younger group was slightly higher (2.89) than that of the older group (2.87), but the difference between the two groups was not significant. The younger group showed higher increases (3.20) in the use of daily services than the older group (2.98). The younger group also showed higher increases (3.26) in the use of search, email, and content services than the older group (3.01).

Association between changes in Internet usage and self-rated health

The results from multiple regression analysis on the associations between Internet usage and self-rated health are presented in Table 3. We found a positive association between self-rated health and social network and information-sharing services in the young-old (β = 0.12, $p < 0.01$) and the old-old groups (β = 0.21, $p < 0.001$). The use of online daily services was also positively associated with self-rated health in the young-old (β = 0.09, $p < 0.05$) and the old-old (β = 0.14, $p < 0.01$) groups. Use of social participation services (β = 0.11, $p< 0.05$) and search, email, and content services (β = 0.15, $p < 0.001$) were positively associated with self-rated health only among the old-old groups.

Regarding other variables, older age was negatively associated with self-rated health in both age groups. A higher income level was positively associated with the outcome in both age groups for social network and information-sharing services and daily services. For the other two services (social participation and search, email, and content services), only the young-old group demonstrated significant positive associations between higher income and the outcome. Higher educational level was positively associated with self-rated health only among the young-old groups for all types of services.

Table 1
Background characteristics of the study participants (n = 1,150).

Variable	65–74 years (n = 670) N (%) or Mean± SD	75 years and above (n = 480) N (%) or Mean± SD	X^2 or T
Self-rated health	2.61± 0.8	2.44± 0.7	3.76***
Age, years	69.18± 2.8	79.93± 3.6	54.83***
Gender			
Male	318 (47.5)	178 (37.1)	12.83***
Female	352 (52.5)	302 (62.9)	
Educational level			
Less than middle school	157 (23.4)	215 (44.8)	58.30***
Higher than high school	513 (76.6)	265 (55.2)	
Household income group	6.91± 2.4	5.89± 2.9	6.35***
Household arrangements			
Living alone	59 (8.8)	86 (17.9)	21.07***
Living with others	611 (91.2)	394 (82.1)	
Disability			
Yes	15 (2.2)	19 (4.0)	2.88
No	655 (97.8)	461 (96.0)	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
SD: standard deviation.

Table 2
Changes in Internet use during the COVID-19 pandemic according to age group.

Types of Internet services (range: 1-5)	65–74 years (n = 670)		75 years and above (n = 480)		T
	Mean	SD	Mean	SD	
Social networking and information-sharing services	3.24	0.58	2.98	0.44	8.88***
Social participation	2.89	0.58	2.87	0.51	0.65
Daily services	3.20	0.59	2.98	0.42	7.51***
Search, email, and content services	3.26	0.57	3.01	0.42	8.56***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
SD: standard deviation.

Discussion

This study examined changes in Internet usage during the COVID-19 pandemic and its association with self-rated health among Korean older adults using nationwide survey data. This research is the first attempt to analyze these associations according to the types of Internet services and age groups among this population. Overall, Internet usage in both age groups either remained similar or increased during the COVID-19 pandemic, especially among the younger group. A significant association was found between increased Internet use and better self-rated health of older adults.

The findings also demonstrated that older adults' self-rated health was affected by their age and the types of Internet services they used. A positive association was found between increased use of social networking services and self-rated health. A recent study in Japan showed that older adults who had non-face-to-face social interactions during the COVID-19 pandemic reported better self-rated health.[25] Considering that previous research has demonstrated that greater Internet use is associated with declines in social interaction and increases in loneliness,[26] these results could potentially reflect the context of the COVID-19 pandemic. While offline contacts decreased during the pandemic, SNS facilitated a connection with family and friends and enabled older adults to have leisure time.[27]

Interestingly, differences were found between the results of the young-old and the old-old groups. Associations between greater Internet use and better health were significant only among the old-old group in information-seeking and social participation activities. This finding aligns with a study that revealed the beneficial effects of ICT use on well-being only for the oldest population (75+) with frail health.[28] Internet usage might benefit the health of older adults by enhancing their knowledge related to health or social care services. Hone et al.[29] suggested that people with worse health or those who failed to find services that meet their needs might search for online information related to diseases. Although it was not possible to identify the types of information older adults accessed, the old-old population could potentially benefit more from searching for information related to health care or daily services because of higher care needs.

Moreover, the positive results of online social participation suggest that Internet usage might strengthen the beneficial impact of social activities and political engagement on older adults health.[30] It has been previously reported that Internet usage can increase users' political participation by enhancing knowledge and efficacy.[31] Particularly, online volunteering provided leisure opportunities for older adults during the COVID-19 pandemic, despite geographical

Table 3
Associations between changes in use of different Internet services and self-related health among older adults.

	Social network and information sharing		Social participation		Daily services		Search, email, and content services	
Variables	65-74	75+	65-74	75+	65-74	75+	65-74	75+
Changes in Internet use	0.12**	0.21***	-0.01	0.11*	0.09*	0.14**	0.04	0.15***
Gender (male = 1, female = 2)	-0.03	0.05	-0.03	0.06	-0.03	0.05	-0.03	0.06
Age	-0.09*	-0.10*	-0.11**	-0.12**	-0.10**	-0.10*	-0.10**	-0.10*
Education								
Less than middle school (ref.)								
Higher than high school	0.15***	0.06	0.16***	0.07	0.16***	0.06	0.16***	0.08
Income	0.10*	0.13*	0.12**	0.11	0.11*	0.13*	0.11*	0.12
Household Arrangement								
Living alone (ref.)								
Living with others	0.04	-0.03	0.04	-0.03	0.04	-0.03	0.04	-0.02
Disability	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01
R^2	0.09	0.10	0.07	0.07	0.08	0.08	0.08	0.08

* $p < .05$, ** $p < .01$, *** $p < .001$.

restrictions or disabilities.[32] Thus, older adults who had limited chances for social participation might have a greater sense of social integration and satisfaction through online activities, which could benefit their health. The positive impact of Internet usage on self-rated health might also be related to widespread use and preference for Internet services in Korea. The South Korean government has promoted the development of ICT technology, services, and infrastructure since the 1990s. The country now has one of the world's highest levels of broadband infrastructure and Internet connection speeds, along with the launch of the first nationwide fifth-generation (5G) services in 2019.[33] Although there is a gap in Internet usage between younger and older populations, many older adults are using Internet services increasingly, especially during the COVID-19 pandemic.

Further, the results reflect the fact that self-rated health is a subjective and multifaceted concept. Gracia and Herrero[16] suggested that the existing socioeconomic inequalities in health might affect the relationship between the digital divide and health among older adults. The present study demonstrated that older adults with higher levels of education and income were more likely to report better health. Older adults with better socioeconomic conditions may have better access to online activities or services that could protect their health, even during the COVID-19 pandemic. It is also possible that older adults with better health statuses had more access to various online activities and services. Despite the causal complexity, our findings suggest that not only technology but also socioeconomic conditions affect individuals' access to Internet services and the self-rated health of the users.

In this regard, measures are needed to increase access to quality online services and information among older populations to decrease health inequalities. While the Internet has become a necessity during the COVID-19 pandemic, older adults with low digital literacy and fewer resources require more attention. Measures to support vulnerable older adults' participation in meaningful online activities and social networking would be helpful to enhance both their access to the Internet and their health. Education programs for older adults are also required to aid them in learning how to access and evaluate online information and services. Older adults might feel overwhelmed by too much information online, which is one of the main barriers to using the Internet to search for health information.[34] This is particularly relevant during the COVID-19 pandemic because the circulation of fake news and misinformation online affected public opinion about accepting the COVID-19 vaccine, especially among those who use social media.[35,36] It is crucial for health professionals and researchers to consider the possible benefits and harm of Internet usage when developing interventions and services for older adults. More research on the needs for and barriers to use of various Internet services among older adults and their associations with self-rated health is needed, and might require cooperation between researchers from the healthcare and technology fields.

This study has several limitations. First, since it used a cross-sectional design, the causality was not examined. It is not clear whether Internet use predicted better self-rated health, or whether better socioeconomic conditions and health conditions of older adults predicted higher levels of Internet use. This highlights the need for longitudinal and experimental studies to examine the association between Internet use and the health of older adults. Second, only older adults who could complete the survey participated in the study, and they might be healthier than the average older adult. This might affect our results, especially among the oldest-old. Third, the results should be interpreted with caution because previous studies have used varying definitions of Internet usage. The frequency of usage and types of online activities might affect health outcomes. Additionally, unhealthy patterns of Internet use might lead to negative health outcomes, including addiction.[37] It would be beneficial to carefully measure the level of Internet use that is appropriate for research.

Conclusions

This study demonstrated that increases in Internet usage during the COVID-19 pandemic were associated with better self-rated health of older adults. The results suggest the need for support to access quality online activities and services among older populations. It would be particularly useful to support socioeconomically-vulnerable older adults to decrease the digital divide and enhance equity in health. More research on the needs for and barriers to the use of various Internet services among older adults and their associations with self-rated health is required.

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Declarations of interest

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