The general public’s perspectives on telemedicine during the COVID-19 pandemic in Korea: analysis of a nationwide survey

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**OBJECTIVES:** We investigated the awareness, experience, approval, intention to use, and the desired type of telemedicine among Korean general public.

**METHODS:** From November to December 2020, we conducted an online self-reported survey on awareness, experience, approval, and intent to use telemedicine services among Korean residents aged 20 years or older. A total of 2,097 participants completed the survey.

**RESULTS:** Of the 2,097 participants, 1,558 (74.3%) were aware of, 1,198 (57.1%) approved of, and 1,474 (70.3%) had the intention to use telemedicine. Participants from regions other than the Seoul metropolitan area and Daegu–Gyeongbuk Province (adjusted odds ratio [aOR], 1.29; 95% confidence interval [CI], 1.02 to 1.63), households with a monthly household income of US$6,000 or more (aOR, 1.44; 95% CI, 1.01 to 2.08), participants who had a college/university or associate’s degree (aOR, 1.35; 95% CI, 1.04 to 1.75) or a master’s degree or above (aOR, 1.73; 95% CI, 1.20 to 2.50), and housewives (aOR, 1.30; 95% CI, 1.03 to 1.64) had higher odds of approval. Elderly participants, those with a chronic disease (aOR, 1.26; 95% CI, 1.04 to 1.54), those who had experienced delays of healthcare services (aOR, 1.94; 95% CI, 1.27 to 2.96), and those who had experience with telemedicine (aOR, 4.28; 95% CI, 1.69 to 10.82) were more likely to intend to use telemedicine services. Regarding types of telemedicine, teleconsultation between doctors showed the highest approval rate (73.1%).

**CONCLUSIONS:** In the context of the coronavirus disease 2019 pandemic, more than 70% of participants had already used or intended to use telemedicine at some point. Groups with a substantial need for telemedicine were more in favor of telemedicine.

**KEY WORDS:** COVID-19, Telemedicine, Awareness, Participation, Intention
INTRODUCTION

Following the World Health Organization's pandemic declaration in March 2020, the coronavirus disease 2019 (COVID-19) outbreak has resulted in an unprecedented global health crisis [1-3]. Social distancing became the global norm in order to prevent the spread of this novel disease. In addition, as a suboptimal substitute for in-person care, telemedicine has been recommended for patients with both chronic and acute diseases to prevent the transmission of the virus [4]. In Korea, telemedicine first emerged in Daegu and Gyeongsangbuk Province, which were most strongly affected by COVID-19 in the early stages of the outbreak.

Globally, telemedicine services have emerged as an alternative to in-person care that does not interfere with the continuity or quality of care. Before the pandemic, telemedicine improved access to care for those in underserved areas who experienced difficulty accessing healthcare [5,6]. Previous studies have reported that telemedicine positively affected the prevention, evaluation, management, and monitoring of disease [7] and reduced healthcare costs due to a decrease in emergency room visits and hospitalizations [8]. Patients who received telemedicine services reported satisfaction with the overall services, most specifically in regards to communication with healthcare professionals, cost-effectiveness, and time savings [9]. Healthcare professionals have also reported that telemedicine is advantageous for communicating with patients, as it is cost-effective and time-effective. However, despite these benefits for expanding healthcare access, there are concerns about health inequities among vulnerable populations who are in a lower socioeconomic status and less likely to have access to the necessary technology and knowledge of how to use it [10,11].

It has been argued that the telemedicine system, which was efficiently built during the COVID-19 pandemic, should be actively utilized even after COVID-19 [12,13]. Telemedicine, from the doctor's perspective, has desirable outcomes, such as efficiency and cost-effectiveness of care. However, there has been limited research from patients' and the general population's perspectives towards telemedicine; thus, demands for telemedicine, attitudes towards it, and the desired type of telemedicine are not fully understood. In Korea, changes in perspectives towards telemedicine may occur, since telemedicine has been temporarily allowed during the pandemic. The aim of this study is to investigate the awareness, experience, approval, and intention to use telemedicine, as well as the perceived reasonable cost range and the desired type of telemedicine, in a nationwide sample.

MEASUREMENTS AND METHODS

Data collection and recruitment

We performed a cross-sectional study using survey data (n = 2,097) from November 10 to December 4, 2020. The survey candidates were selected using stratified sampling by age, sex, and geographical region. Those who were informed of the purpose of the study and consented to participate were enrolled in the study.

Measurements

The online survey consisted of a set of questions on basic demographics, self-reported changes in health status during the COVID-19 pandemic, chronic disease management, awareness of telemedicine, and attitudes toward telemedicine. In the survey, telemedicine was defined as "the remote consultation and prescription to patients over a wired/wireless phone and video without a direct visit to healthcare providers when doing so is deemed to be safe according to the physician's judgment." The demographic variables included age, sex, area of residence, household income, education level, supplementary private insurance, marital status, and occupation. Participants were categorized into 5 age groups (20-29, 30-39, 40-49, 50-59, and 60 and older), and 3 groups in terms of the area of residence (Seoul metropolitan area, Daegu-Gyeongsangbuk Province, and others), which were categorized according to the magnitude of the COVID-19 outbreak. Monthly household income (US$) was divided into 4 groups (≤ 2,000, 2,000-3,999, 4,000-5,999, ≥ 6,000), and education level was divided into 3 groups (high school graduate and under, college/university graduate or associate's degree, and master's degree or above). Marital status was categorized into 3 groups (single, married, and divorced or widowed), and occupations were divided into 4 groups (office workers, manual workers, self-employed, and housewife/student/unemployed). Self-reported health status before and after the COVID-19 pandemic was measured on a 5-point Likert scale, and then divided into 3 groups (unchanged, improved, or worsened) [14,15]. The questions regarding chronic disease management asked whether participants currently had a chronic disease (yes/no); then, those who did were further asked whether they have experienced delays in healthcare services after the COVID-19 outbreak, for either chronic disease management ("Have you ever experienced delays in consultation or had problems while you needed a prescription refill or consultation resulting from an uncontrolled chronic disease?") or any other conditions ("Have you ever experienced delays or disruptions in healthcare services, such as consultations, tests, and treatment?").

Lastly, participants were asked about their awareness, experience, approval, and intent to use telemedicine services. They were asked to identify a reasonable range of cost as well as other factors important for telemedicine use. Regarding awareness, participants were asked to indicate whether they had heard of telemedicine. Those who indicated that they were aware of telemedicine were further asked whether they had experience with telemedicine. Then, a yes-or-no question inquired about participants' feeling of approval of telemedicine after the COVID-19 pandemic. Participants were also asked to indicate whether they had a very low, low, high, or very high degree of intention to use telemedicine services. Additionally, participants were asked to choose their level of approval for each of the 6 types of telemedicine, which included (1) tele-consultations between doctors, (2) telemedicine between a doctor and a patient, (3) telemedicine between a doctor and a patient's caregiver, (4) telemedicine for diagnosis or consultation (e.g. telepathology, teleradiology), (5) remote care in a ward or in-
tensive care unit (e.g., a tele-intensive care unit), and (6) telemedicine in which a doctor continuously monitors a patient’s condition. Regarding the reasonable cost of telemedicine, participants were asked an open-ended question and answered with a specific amount. Lastly, regarding the factors to be considered for telemedicine, participants were asked, among a choice of 5, to select the factor with the highest priority. The choices included (1) the possibility of connecting to face-to-face treatment, if necessary, (2) availability whenever the patient needs, (3) management tailored to each patient’s situation and characteristics, (4) accessibility for use independent of disease type, and (5) availability without economic burden.

Statistical analysis
We performed descriptive statistics and the chi-square test on demographics, awareness, experience, approval, intention to use, approval rate by type of telemedicine, and factors to be considered for telemedicine. We then performed multivariate logistic regression on factors associated with approval and intention to use telemedicine and the t-test or analysis of variance on the average reasonable copay amounts for telemedicine. Statistical significance was defined as a two-tailed p-value < 0.05. All statistical analyses were performed using Stata version 23 (StataCorp., College Station, TX, USA).

Ethics statement
This study protocol was approved by the Seoul National University Hospital Institutional Review Board (IRB approval No. E-2011-102-1173).

RESULTS
Baseline characteristics of participants and people who had experience with telemedicine
Table 1 shows the basic demographics and awareness of telemedicine among the study participants. The study participants were evenly distributed by sex and across all age groups. Of the 2,097 participants, 401 (19.1%) lived in the Seoul metropolitan area, 196 (9.4%) lived in Daegu-Gyeongbuk Province, and 1,500 (71.5%) lived in other areas. The lowest household income group (below US$2,000) was the least frequent, with 192 (9.2%) participants. The majority of participants were college/university graduates or had associate's degrees (n = 1,498, 71.4%), and 1,718 (81.9%) held supplementary private health insurance. Married participants (n = 1,251, 59.7%) and office workers comprised majorities (n = 1,110, 52.9%). There were 1,081 (51.6%) participants with more than one pre-existing chronic condition. The majority of participants were college/university graduates or had associate's degrees (n = 1,498, 71.4%), and 1,718 (81.9%) held supplementary private health insurance. Married participants (n = 1,251, 59.7%) and office workers comprised majorities (n = 1,110, 52.9%). There were 1,081 (51.6%) participants with more than one pre-existing chronic condition. The majority of participants were college/university graduates or had associate's degrees (n = 1,498, 71.4%), and 1,718 (81.9%) held supplementary private health insurance. Married participants (n = 1,251, 59.7%) and office workers comprised majorities (n = 1,110, 52.9%). There were 1,081 (51.6%) participants with more than one pre-existing chronic condition. The majority of participants were college/university graduates or had associate's degrees (n = 1,498, 71.4%), and 1,718 (81.9%) held supplementary private health insurance. Married participants (n = 1,251, 59.7%) and office workers comprised majorities (n = 1,110, 52.9%). There were 1,081 (51.6%) participants with more than one pre-existing chronic condition.

Table 1. Baseline characteristics of the study participants

| Characteristics | Total | Experienced | p-value |
|-----------------|-------|-------------|---------|
| Total           | 2,097 (100) | 67 (4.3) |         |
| Sex             |       |             |         |
| Male            | 1,058 (50.5) | 37 (4.7) |         |
| Female          | 1,039 (49.6) | 30 (3.9) | 0.450   |
| Age (yr)        |       |             |         |
| 20-29           | 377 (18.0) | 10 (4.4) |         |
| 30-39           | 411 (19.6) | 14 (5.0) | 0.720   |
| 40-49           | 485 (23.1) | 18 (5.0) | 0.710   |
| 50-59           | 479 (22.8) | 13 (3.2) | 0.470   |
| ≥60             | 345 (16.5) | 12 (4.2) | 0.920   |
| Region          |       |             |         |
| Seoul metropolitan area | 401 (19.1) | 23 (7.9) | 0.240   |
| Daegu-Gyeongbuk Province | 196 (9.4) | 7 (4.8) | 0.001   |
| Others          | 1,500 (71.5) | 37 (3.3) |         |
| Household income (US$) |       |             |         |
| <2,000          | 192 (9.2) | 4 (3.2) |         |
| 2,000-3,999     | 684 (32.8) | 26 (5.3) | 0.340   |
| 4,000-5,999     | 610 (29.2) | 16 (3.5) | 0.890   |
| ≥6,000          | 600 (28.8) | 21 (4.4) | 0.550   |
| Educational status |       |             |         |
| High school graduate and under | 359 (17.1) | 7 (2.7) |         |
| College/university graduate | 1,498 (71.4) | 51 (4.6) | 0.190   |
| Master’s degree or above | 240 (11.4) | 9 (5.0) | 0.220   |
| Private insurance |       |             |         |
| Yes             | 1,718 (81.9) | 63 (4.8) |         |
| No              | 379 (18.1) | 4 (1.6) | 0.030   |
| Marital status  |       |             |         |
| Single          | 755 (36.0) | 17 (3.3) |         |
| Married         | 1,251 (59.7) | 48 (4.9) | 0.160   |
| Widowed/divorced | 91 (4.3) | 2 (2.9) | 0.830   |
| Job             |       |             |         |
| Office worker   | 1,110 (52.9) | 40 (4.8) |         |
| Manual worker   | 212 (10.1) | 8 (5.4) | 0.760   |
| Own business    | 193 (9.2) | 7 (4.5) | 0.860   |
| Housewife/Student/Unemployed | 582 (27.8) | 12 (2.9) | 0.110   |
| Having a chronic illness |       |             |         |
| No              | 1,016 (48.5) | 13 (1.8) | <0.001  |
| Yes             | 1,081 (51.6) | 54 (6.3) |         |
| Subjective change in health status |       |             |         |
| No change       | 1,478 (70.5) | 32 (3.0) | 0.001   |
| Improved        | 199 (9.5) | 13 (8.3) |         |
| Worsened        | 420 (20.0) | 22 (6.9) | 0.002   |
| Delayed treatment for chronic conditions |       |             |         |
| No              | 973 (90.0) | 22 (2.9) | <0.001  |
| Yes             | 108 (10.0) | 32 (34.4) |         |
| Delayed elective treatment and treatment for non-chronic conditions |       |             |         |
| No              | 1,938 (92.4) | 33 (2.3) |         |
| Yes             | 159 (7.6) | 34 (25.0) | <0.001  |

Values are presented as number (%).
Awareness, approval, and intention to use telemedicine

Of the 2,097 participants, 1,558 (74.3%) responded that they were aware of telemedicine. Older participants were more likely to be aware of telemedicine. All age groups showed a higher awareness rate than those 20-29 years old (p<0.05). Participants with higher monthly household income, corresponding to US$4,000-$5,999 (75.6 vs. 64.6%, p = 0.003) and ≥ US$6,000 (78.8 vs. 64.6%, p<0.001), participants who had supplementary health insurance (75.7 vs. 67.8%, p = 0.001), participants who were married (78.2 vs. 67.6%, p<0.001), and participants with underlying chronic diseases (78.9 vs. 69.4%, p<0.001) were more likely to be aware of telemedicine than their counterparts. Participants who had experienced delays in healthcare services for reasons other than chronic diseases were more likely to be aware of telemedicine than those who had not (85.5 vs. 73.4%, p = 0.001). With regard to approval, 1,198 (57.1%) of the total study population approved of telemedicine services. Females had a lower rate of approval than males (53.4 vs. 60.8%, p = 0.001). All age groups showed a higher approval rate than those 20-29 years old (p = 0.02). Participants with a monthly income of more than US$6,000 (60.3 vs. 50.0%, p = 0.010), participants with a master’s degree or above (63.8 vs. 54.0%, p = 0.020), married participants (61.7 vs. 49.3%, p<0.001), self-employed participants (65.8 vs. 55.7%, p = 0.009) had higher rates of approval of telemedicine. Participants with chronic diseases (60.8 vs. 53.3%, p = 0.001), and participants who experienced delays in healthcare for conditions other than chronic diseases (66.0 vs. 56.4%, p = 0.020) were more likely to approve telemedicine than their counterparts. Among all participants, 1,474 (70.3%) intended to use telemedicine. Compared to those in their 20s, all other age groups were significantly more likely to use telemedicine (p<0.03). Those without supplementary health insurance were less likely to use telemedicine treatment (62.5 vs. 72.0%, p<0.001). Married participants, (74.3 vs. 63.7%, p<0.001), those with chronic diseases (66.6 vs. 73.7%, p<0.001). Additionally, those who experienced delays in healthcare for a chronic disease after the COVID-19 outbreak (72.6 vs. 84.3%, p = 0.010) or for any other conditions (69.4 vs. 81.8%, p = 0.001), as well as those who had previously received telemedicine (72.6 vs. 92.5%, p = 0.001) had more intent to use telemedicine (Table 2).
## Table 2. Awareness, approval, and intention to use telemedicine

| Variables                                    | Awareness | p-value | Approval | p-value | Intention to use | p-value |
|----------------------------------------------|-----------|---------|----------|---------|------------------|---------|
| **Total**                                    | 1,558 (74.3) |         | 1,198 (57.1) |         | 1,474 (70.3) |         |
| **Sex**                                      |           |         |          |         |                  |         |
| Male                                         | 790 (74.7) |         | 643 (60.8) |         | 757 (71.6) |         |
| Female                                       | 768 (73.9) | 0.690   | 555 (53.4) | 0.001   | 717 (69.0) | 0.200   |
| **Age (yr)**                                 |           |         |          |         |                  |         |
| 20-29                                        | 230 (61.0) |         | 169 (44.8) |         | 226 (60.0) |         |
| 30-39                                        | 278 (67.6) | 0.050   | 219 (53.3) | 0.020   | 278 (67.6) | 0.030   |
| 40-49                                        | 359 (74.0) | <0.001  | 263 (54.2) | 0.006   | 342 (70.5) | 0.001   |
| 50-59                                        | 403 (84.1) | <0.001  | 312 (65.1) | <0.001  | 348 (72.7) | <0.001  |
| ≥60                                          | 288 (83.5) | <0.001  | 235 (68.1) | <0.001  | 280 (81.2) | <0.001  |
| **Region**                                   |           |         |          |         |                  |         |
| Seoul metropolitan area                      | 291 (72.6) |         | 214 (53.4) |         | 279 (69.6) |         |
| Daegu-Gyeongbuk Province                     | 145 (74.0) | 0.720   | 109 (55.6) | 0.610   | 137 (69.9) | 0.940   |
| Others                                       | 1,122 (74.8) | 0.360  | 875 (58.3) | 0.070   | 1,058 (70.5) | 0.710   |
| **Household income (US$)**                   |           |         |          |         |                  |         |
| <2,000                                       | 124 (64.6) |         | 96 (50.0)  |         | 126 (65.6) |         |
| 2,000-3,999                                  | 491 (71.8) | 0.060   | 386 (56.4) | 0.110   | 483 (70.6) | 0.190   |
| 4,000-5,999                                  | 461 (75.6) | 0.003   | 352 (57.7) | 0.060   | 428 (70.2) | 0.240   |
| ≥6,000                                       | 473 (78.8) | <0.001  | 362 (60.3) | 0.010   | 432 (72.0) | 0.090   |
| **Educational status**                       |           |         |          |         |                  |         |
| High school graduate and under               | 257 (71.6) |         | 194 (54.0) |         | 249 (69.4) |         |
| College/university graduate                 | 1,121 (74.8) | 0.210  | 851 (56.8) | 0.340   | 1,052 (70.2) | 0.750   |
| Master's degree or above                     | 180 (75.0) | 0.360   | 153 (63.8) | 0.020   | 173 (72.1) | 0.470   |
| **Private insurance**                        |           |         |          |         |                  |         |
| Yes                                          | 1,301 (75.7) |         | 998 (58.1) |         | 1,237 (72.0) |         |
| No                                           | 257 (67.8) | 0.001   | 200 (52.8) | 0.060   | 237 (62.5) | <0.001  |
| **Marital status**                           |           |         |          |         |                  |         |
| Single                                       | 510 (67.6) |         | 372 (49.3) |         | 481 (63.7) |         |
| Married                                      | 978 (78.2) | <0.001  | 772 (61.7) | <0.001  | 929 (74.3) | <0.001  |
| Widowed/divorced                             | 70 (76.9)  | 0.070   | 54 (59.3)  | 0.070   | 64 (70.3)  | 0.210   |
| **Job**                                      |           |         |          |         |                  |         |
| Office worker                                | 835 (75.2) |         | 618 (55.7) |         | 781 (70.4) |         |
| Manual worker                                | 149 (70.3) | 0.130   | 125 (59.0) | 0.380   | 158 (74.5) | 0.220   |
| Own business                                 | 157 (81.4) | 0.070   | 127 (65.8) | 0.009   | 144 (74.6) | 0.230   |
| Housewife/Student/Unemployed                 | 417 (71.7) | 0.110   | 328 (56.4) | 0.790   | 391 (67.2) | 0.180   |
| **Having a chronic illness**                 |           |         |          |         |                  |         |
| No                                           | 705 (69.4) | <0.001  | 541 (53.3) | 0.001   | 677 (66.6) | <0.001  |
| Yes                                          | 853 (78.9) |         | 657 (60.8) | 0.001   | 797 (73.7) | <0.001  |
| **Subjective change in health status**       |           |         |          |         |                  |         |
| No change                                    | 1,084 (73.3) |         | 843 (57.0) |         | 1,042 (70.5) |         |
| Improved                                     | 156 (78.4) | 0.130   | 117 (58.8) | 0.640   | 144 (72.4) | 0.590   |
| Worsened                                     | 318 (75.7) | 0.330   | 238 (56.7) | 0.890   | 288 (68.6) | 0.470   |
| **Delayed treatment for chronic conditions** |           |         |          |         |                  |         |
| No                                           | 760 (78.1) |         | 592 (60.8) |         | 706 (72.6) |         |
| Yes                                          | 93 (86.1)  | 0.060   | 65 (60.2)  | 0.890   | 91 (84.3)  | 0.010   |
| **Delayed elective treatment and treatment for non-chronic conditions** |           |         |          |         |                  |         |
| No                                           | 1,422 (73.4) |         | 1,093 (56.4) |         | 1,344 (69.4) |         |
| Yes                                          | 136 (85.5) | 0.001   | 105 (66.0) | 0.020   | 130 (81.8) | 0.001   |
| **Experience with telemedicine**              |           |         |          |         |                  |         |
| No                                           | -         | 965 (64.7) |         | 0.360   | 1,083 (72.6) |         |
| Yes                                          | -         | 47 (70.2)  |         | 0.360   | 62 (92.5)  | 0.001   |

Values are presented as number (%).
| Variables | Total | 1,386 (66.1) | 1,345 (64.8) | 1,476 (70.4) |
|-----------|-------|---------------|---------------|---------------|
| Sex       |       |               |               |               |
| Male      | 763 (72.1) | 0.030 | 770 (74.1) | 0.020 | 759 (71.7) | 0.020 | 736 (70.8) | 0.050 |
| Female    | 623 (60.8) | 0.280 | 658 (63.3) | 0.230 | 627 (60.7) | 0.220 | 600 (58.6) | 0.250 |
| Age (yr)  |       |               |               |               |
| 20-29     | 214 (56.8) | 0.040 | 238 (57.9) | 0.020 | 251 (61.4) | <0.001 | 223 (62.4) | 0.020 |
| 30-39     | 275 (66.9) | 0.001 | 314 (64.7) | 0.001 | 364 (75.1) | <0.001 | 318 (70.3) | 0.009 |
| 40-49     | 381 (69.5) | 0.001 | 322 (72.5) | <0.001 | 378 (75.9) | <0.001 | 374 (70.3) | <0.001 |
| ≥60       | 71 (54.3) | 0.001 | 84 (53.9) | <0.001 | 120 (51.1) | 0.001 | 124 (51.1) | 0.001 |
| Region    |       |               |               |               |
| Seoul-Gangnam area | 310 (77.3) | 0.070 | 269 (67.1) | 0.020 | 259 (63.8) | 0.060 | 298 (74.3) | 0.380 |
| Daegu-Gyeongbuk Province | 138 (70.4) | 0.050 | 129 (65.9) | 0.020 | 131 (69.2) | 0.060 | 123 (69.0) | 0.590 |
| Others    | 1,085 (72.3) | 0.050 | 988 (65.9) | 0.050 | 926 (61.7) | 0.080 | 974 (64.9) | 0.080 |
| Household income (US$) |       |               |               |               |
| <2,000    | 135 (70.3) | 0.070 | 111 (57.8) | 0.030 | 100 (52.1) | 0.020 | 124 (64.6) | 0.120 |
| 2,000-3,999 | 472 (69.1) | 0.050 | 396 (66.4) | 0.050 | 471 (68.9) | 0.050 | 406 (64.6) | 0.110 |
| 4,000-5,999 | 469 (66.4) | 0.050 | 421 (66.9) | 0.050 | 450 (71.3) | 0.050 | 416 (64.4) | 0.380 |
| 6,000-9,999 | 453 (66.3) | 0.050 | 417 (66.9) | 0.050 | 430 (71.2) | 0.050 | 414 (71.2) | 0.380 |
| Educational status |       |               |               |               |
| High school graduate and under | 251 (69.4) | 0.010 | 226 (63.0) | 0.010 | 224 (64.4) | 0.010 | 231 (64.5) | 0.010 |
| College/university graduate | 1,109 (70.4) | 0.010 | 988 (66.6) | 0.010 | 930 (62.1) | 0.010 | 965 (64.2) | 0.070 |
| Master’s degree or above | 1,157 (72.3) | 0.010 | 1,022 (67.5) | 0.010 | 1,093 (67.1) | 0.010 | 1,065 (69.2) | 0.070 |
| Private insurance |       |               |               |               |
| Yes       | 1,276 (74.3) | 0.010 | 1,199 (68.5) | 0.010 | 1,256 (72.5) | 0.010 | 1,217 (70.8) | 0.440 |
| No        | 257 (67.8) | 0.010 | 227 (59.9) | 0.010 | 219 (59.9) | 0.010 | 228 (58.2) | 0.010 |
| Marital status |       |               |               |               |
| Married   | 594 (66.8) | 0.001 | 438 (58.0) | <0.001 | 409 (64.1) | <0.001 | 481 (65.1) | <0.001 |
| Widowed/divorced | 71 (78.0) | 0.030 | 61 (67.5) | 0.001 | 59 (74.4) | 0.050 | 70 (76.9) | 0.050 |
| Educational status |       |               |               |               |
| Private insurance |       |               |               |               |
| Yes       | 1,276 (74.3) | 0.010 | 1,199 (68.5) | 0.010 | 1,256 (72.5) | 0.010 | 1,217 (70.8) | 0.440 |
| No        | 257 (67.8) | 0.010 | 227 (59.9) | 0.010 | 219 (59.9) | 0.010 | 228 (58.2) | 0.010 |
| Job       |       |               |               |               |
| Office worker | 803 (72.3) | 0.030 | 698 (62.1) | 0.020 | 790 (71.1) | 0.010 | 785 (70.7) | 0.020 |
| Manual worker | 154 (72.6) | 0.030 | 134 (65.9) | 0.020 | 153 (72.2) | 0.030 | 148 (75.2) | 0.040 |
| Household | 147 (67.6) | 0.020 | 131 (67.9) | 0.020 | 147 (70.3) | 0.050 | 134 (70.4) | 0.350 |
| Student/Unemployed | 425 (72.7) | 0.050 | 385 (66.2) | 0.050 | 430 (71.1) | 0.050 | 381 (71.1) | 0.050 |
| Have a chronic illness |       |               |               |               |
| Yes       | 707 (66.8) | 0.010 | 691 (66.8) | 0.010 | 706 (69.5) | 0.010 | 706 (69.5) | 0.010 |
| No        | 826 (76.4) | 0.010 | 754 (69.8) | <0.001 | 785 (70.9) | 0.010 | 785 (70.9) | 0.010 |
Table 3. Continued

| Variables                                      | Tele-consultations between doctors | p-value | Telemedicine between a doctor and a patient | p-value | Telemedicine between a doctor and a patient’s caregiver | p-value | Telemedicine for diagnosis or consultation | p-value | Remote care in a ward or ICU | p-value | Telemedicine in which the doctor continuously monitors the patient’s condition | p-value |
|------------------------------------------------|-----------------------------------|---------|-------------------------------------------|---------|----------------------------------------------------------|---------|-------------------------------------------|---------|------------------------------------------|---------|----------------------------------------------------------|---------|
| Subjective change in health status            |                                   |         |                                           |         |                                                          |         |                                           |         |                                           |         |                                                          |         |
| No change                                     | 1,067 (72.2)                      | 0.810   | 973 (65.8)                                | 0.160   | 1,058 (71.6)                                             | 0.220   | 945 (63.9)                                | 0.510   | 130 (65.3)                               | 0.100   | 1,049 (71.0)                                             | 0.920   |
| Improved                                      | 142 (71.4)                        |         | 121 (60.8)                                |         | 134 (67.3)                                              |         | 132 (66.3)                                |         | 130 (65.3)                               |         | 130 (65.3)                                             |         |
| Worsened                                      | 324 (77.1)                        | 0.040   | 292 (69.5)                                | 0.160   | 305 (72.6)                                              | 0.680   | 282 (67.1)                                | 0.230   | 297 (70.7)                               | 0.920   | 1,124 (75.4)                                             | 0.130   |

Delayed treatment for chronic conditions

| No                                           | 1,170 (78.5)                      | 0.680   | 1,059 (71.0)                              | 0.250   | 1,008 (67.6)                                            | 0.860   | 654 (67.2)                                | 0.780   | 714 (73.4)                               |         | 1,124 (75.4)                                             |         |
| Yes                                          | 54 (80.6)                         |         | 47 (70.2)                                 |         | 52 (77.6)                                              |         | 46 (68.7)                                 |         | 45 (67.2)                               |         | 1,124 (75.4)                                             |         |

Delayed elective treatment and treatment for non-chronic conditions

| No                                           | 748 (76.9)                        | 0.280   | 682 (70.1)                                | 0.460   | 718 (73.8)                                              | 0.170   | 74 (68.5)                                 | 0.780   | 71 (65.7)                               | 0.090   | 1,363 (70.3)                                             |         |
| Yes                                          | 78 (72.2)                         |         | 72 (66.7)                                 |         | 65 (60.2)                                              |         | 74 (68.5)                                 |         | 71 (65.7)                               |         | 1,363 (70.3)                                             |         |

Experience with telemedicine

| No                                           | 1,409 (72.7)                      | 0.150   | 1,268 (65.4)                              | 0.030   | 1,371 (70.7)                                            | 0.020   | 1,254 (64.7)                              | 0.740   | 113 (71.1)                               | 0.840   | 1,363 (70.3)                                             |         |
| Yes                                          | 124 (78.0)                        |         | 118 (74.2)                                |         | 109 (68.6)                                              |         | 105 (66.0)                                |         | 113 (71.1)                               |         | 1,363 (70.3)                                             |         |

Values are presented as number (%).

Table 4. Factors affecting approval and intention to use telemedicine

| Variables                                      | Approval of telemedicine | Intention to use telemedicine |
|------------------------------------------------|--------------------------|-----------------------------|
| Sex                                            |                          |                             |
| Male                                          | 1.00 (reference)         | 1.00 (reference)            |
| Female                                         | 0.73 (0.61, 0.88)        | 0.93 (0.76, 1.13)           |
| Age (yr)                                       |                          |                             |
| <20                                           | 1.00 (reference)         | 1.00 (reference)            |
| ≥20                                           | 1.00 (reference)         | 1.00 (reference)            |
| Region                                         |                          |                             |
| Seoul metropolitan area                        | 1.00 (reference)         | 1.00 (reference)            |
| Daegu–Gyeongbuk Province                       | 1.00 (reference)         | 1.00 (reference)            |
| Others                                         | 1.00 (reference)         | 1.00 (reference)            |
| Household income (US$)                         |                          |                             |
| <2,000                                        | 1.00 (reference)         | 1.00 (reference)            |
| 2,000–3,999                                   | 1.00 (reference)         | 1.00 (reference)            |
| 4,000–5,999                                   | 1.00 (reference)         | 1.00 (reference)            |
| ≥6,000                                        | 1.00 (reference)         | 1.00 (reference)            |
| Educational status                             |                          |                             |
| High school graduate and under                 | 1.00 (reference)         | 1.00 (reference)            |
| College/university graduate                   | 1.00 (reference)         | 1.00 (reference)            |
| Master’s degree or above                      | 1.00 (reference)         | 1.00 (reference)            |
| Private insurance                              | 1.00 (reference)         | 1.00 (reference)            |
| Having a chronic illness                       | 1.00 (reference)         | 1.00 (reference)            |
| Delayed elective treatment and treatment for non-chronic conditions | 1.00 (reference)         | 1.00 (reference)            |

(Continued to the next page)
Table 4. Continued

| Variables                        | Approval of telemedicine | Intention to use telemedicine |
|----------------------------------|--------------------------|-----------------------------|
| Experience with telemedicine³    |                          |                             |
| No                               | 1.00 (reference)         | 1.00 (reference)            |
| Yes                              | 1.16 (1.01, 1.32)        | 4.28 (1.69, 10.82)         |

Values are presented as adjusted odds ratio (95% confidence interval).
¹Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, and having a chronic illness.
²Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, having a chronic illness, and experience with telemedicine.
³Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, and change in health status.
⁴Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, having a chronic illness, change in health status, and experience with telemedicine.
⁵Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, having a chronic illness, change in health status, and experience with telemedicine.

Table 4. Continued

Experience with telemedicine

Values are presented as adjusted odds ratio (95% confidence interval).
¹Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, and having a chronic illness.
²Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, having a chronic illness, and experience with telemedicine.
³Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, and change in health status.
⁴Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, having a chronic illness, change in health status, and experience with telemedicine.
⁵Adjustment for sex, age, region, household income, educational status, private insurance, marital status, job status, having a chronic illness, change in health status, and experience with telemedicine.

face treatment if necessary (23.6%). Socio-demographic factors, including sex, monthly household income, education level, supplementary private insurance, and occupation, were associated with the prioritization of factors considered to be important for telemedicine (Supplementary Material 2).

DISCUSSION

Telemedicine has contributed to the ability to continue delivering healthcare services under emergency circumstances in order to prevent the collapse of the health system [16]. The use of telemedicine to contain the spread of COVID-19 has become a global phenomenon [17,18]. Correspondingly, the Korean government has temporarily allowed teleconsultations starting on March 2, 2020 [19]. In this study, we investigated public opinion on telemedicine through a representative sample of the Korean population. We found that more than half of the total study population agreed with the implementation of telemedicine. Although telemedicine has been useful during emergency circumstances such as COVID-19 [20], several concerns remain that it is difficult to conduct direct consultations and complete lab tests. The main reported barriers to the implementation of telemedicine are insufficient understanding and access among users [21]. Furthermore, the sustainability of telemedicine in Korea is still controversial due to legal and ethical issues, as well as safety and responsibility among healthcare providers [22]. We explored these questions through the perspective of the public, as healthcare consumers, towards telemedicine, which will affect whether telemedicine will be implemented in the long term.

In this study, more than 70% of participants intended to use telemedicine, and this intention was associated with older age. Considering that the usage rate of telemedicine was higher among the younger age group [23], our study result suggests that older people have a high awareness of telemedicine and intention to use it, but there are barriers to actual use. Having additional private health insurance and a pre-existing chronic disease also showed a positive association with intention to use telemedicine. These findings aligned with previous studies that people with higher household income and chronic diseases were more likely to receive telemedicine services during the COVID-19 pandemic [23]. Similar to previous findings that people who received guidance on how to use the telemedicine platform and who had previously experienced telemedicine were more likely to approve of telemedicine, we found that those who previously used telemedicine were more in favor of the long-term use of telemedicine. In addition, participants who experienced delays in healthcare due to the COVID-19 outbreak were more likely to approve of telemedicine, which may reflect the need for remote care [24]. The main advantage felt by patients who have actually experienced telemedicine was convenience, and non-delayed care delivery and the benefits of receiving care in their own home were important factors for patients [25].

In regard to types of telemedicine services, teleconsultations between doctors had the highest approval rate, followed by teleradiology or telepathology. These results were different from those of previous studies, according to which patients agreed most with routine doctor visits, followed by post-surgery visits, expert consultations, and surgical remote mentoring in previous studies [26]. Teleconsultation between doctors was occasionally used in practice prior to the pandemic because it promoted access to healthcare in rural areas and increased the capacity of primary healthcare physicians [27,28], and a report found that medical staff working at private hospitals experienced fewer restrictions or barriers to telemedicine than medical staff working at university hospitals [29]. Thus, there was already a certain level of social acceptance for teleconsultation prior to its widespread use during the pandemic. Telemedicine between a doctor and a patient’s caregiver had the lowest approval rate, which may reflect the anxiety of the public regarding non-face-to-face care through a patient’s caregiver without direct patient contact.

In this study, the factor considered to be most important among study participants was management tailored to each patient’s situation and characteristics. According to Loeb et al. [30], selecting appropriate patients for telemedicine should be included in the task checklist for telemedicine launch. Likewise, it is remarkably important not only that appropriate patients should be selected for telemedicine services, but that the type of telemedicine should be tailored to each individual [31]. Previous studies that dealt with the advantages and disadvantages of telemedicine found that the main advantage was a reduction in travel and associated costs. Next, tailored care should be considered important, considering that physical examinations are limited in telemedicine. The possibility of connecting to face-to-face treatment if necessary is also an important factor related to previously reported limitations. The factor rated important by the fewest participants was accessibility for use independent of disease type, reflecting that patient-specific
characteristics were considered more significant than disease-specific characteristics in telemedicine.

There are several limitations of this study. First, since the study population was limited to those speaking Korean and residing in Korea, our results may have limited generalizability to other populations. Second, although the study participants were recruited by stratifying the Korean population by age, sex, and region, selection bias may have occurred because they were given the option to participate in this study.

In conclusion, the COVID-19 pandemic has marked a turning point for not only healthcare providers, but patients and society. When we analyzed the survey results, it was found that the majority of the public was in favor of the use of telemedicine even after COVID-19. Interestingly, the approval of telemedicine had a positive correlation with age, indicating that technology use may not be a barrier to using telemedicine. Individuals with healthcare needs, such as those with chronic diseases and experiences of delays in healthcare services due to COVID-19, had a higher approval rate of telemedicine. Additionally, the financial status of patients (e.g., having supplementary health insurance) may potentially affect the approval of telemedicine. The general population considered individually tailored management to be important. Aspects for ensuring safety in care should be also considered while building infrastructure for telemedicine services after the COVID-19 pandemic. Telemedicine has demonstrated advantages in delivering timely care while minimizing exposure to COVID-19 and protecting healthcare providers and patients amid the COVID-19 pandemic, and it may be widely utilized after the pandemic.

SUPPLEMENTARY MATERIALS
Supplementary materials are available at http://www.e-epih.org/.

CONFLICT OF INTEREST
The authors have no conflicts of interest to declare for this study.

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