



Changes in walking practice and associated factors during the coronavirus disease 2019 pandemic

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ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic has induced many lifestyle changes, with reductions in healthy activities, including walking. The aim of this cross-sectional study was to identify strategies to maintain good health during a pandemic. Demographics, walking habits, health behaviors, health status, recognition of social capital, and changes in walking practice of 800 residents were evaluated using a structured questionnaire. Among the participants, 73.9%, 15.8%, and 10.4% reported no change, a decrease, and an increase in walking practice, respectively. Individuals in their 50 s and 60 s showed 6.388- and 5.054-times greater increases in walking, respectively, than did those aged 19–29 years. Walking increased more among high-income people than among low-income people. Additionally, walking practice increased in people participating in social gatherings, those with pets that needed walks, those with a COVID-19 history, those who considered walking as both a habitual and leisure activity, those with nearly no stress, and those satisfied with their safety, the natural environment, and public transportation; other health behaviors or conditions were not related to an increase in walking practice. To maintain good health during a pandemic, walking practice should be promoted in people in their 20 s and low-income groups. Moreover, people should be encouraged to attend meetings, including online interaction, and safe walking routes should be created within the community. Walking should be encouraged as a method of relieving stress, and the benefits of walking for recovery after an infectious disease should be emphasized. Furthermore, the direct effects of walking should be studied.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has brought about many restrictions and changes to lifestyles and health-promoting activities, and interest in whether this will turn into a health problem has been growing (Cortez et al., 2020). During the pandemic, most national health promotion workers were recruited to aid in the pandemic response and at quarantine facilities, resulting in the temporary discontinuation of national health-promotion projects (Cambon et al., 2021). Nevertheless, some people might have improved their health behaviors during the pandemic, and another such pandemic may occur in the future. Therefore, the factors that influence positive health behaviors need to be investigated; this may help to keep people healthy during future outbreaks.

Smoking cessation, abstinence from alcohol, physical activity, and healthy eating are known to promote health. Walking is a physical activity that can be performed easily and for a long time, providing

multiple health benefits with minimal negative effects (Morris and Hardman, 1997; Kelly et al., 2014; Mandini et al., 2018). A long-lasting walking habit significantly reduces body weight, body mass index, waist circumference, and blood pressure (Mandini et al., 2018). It is a means of transportation and helps in the enhancement of social bonds, maintenance of muscle strength, promotion of health, and prevention of activity restrictions in older adults (Morris and Hardman, 1997). Even after adjusting for other physical activities, walking was associated with an 11% reduction in all-cause mortality (Kelly et al., 2014).

In 2020, the South Korean Ministry of Health and Welfare and Korea Institute for Health Promotion developed guidelines for walking practice for adults aged 18–64 years to promote public health and prevent chronic diseases by promoting adequate walking. However, the rate of walking for at least 10 min at a time, at least 30 min a day, and at least 5 days a week in the past week among adults aged 19 years and older in Korea decreased from 41.7% in 2014 to 40.7% in 2018 (Ministry of Health and Welfare, Korea Health Promotion Institute, 2020). This rate

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decreased further to 39.6% in 2021, although this might have been influenced by the COVID-19 pandemic (Korea Disease Control and Prevention Agency, 2022).

Considering the decrease in walking during the COVID-19 pandemic, we sought to determine factors that could increase walking. This study aimed to identify the factors related to changes in walking practice during the COVID-19 pandemic. To do this, we first examined whether walking practice differed according to sociodemographic factors, walking habits, health behaviors, health status, and recognition of social capital. We then examined the influence of these factors on changes in walking practice.

2. Material and methods

This cross-sectional study included 800 people living in Busan City who were administered a structured questionnaire survey by trained surveyors between September 1st and 30th, 2022. Two districts in Busan city were targeted, and the size of the population (based on the population at the end of April 2022: 81,118 and 74,514; the total population was 155,632) to obtain the sample size required in the ANOVA was calculated considering a confidence level of 90% and a standard deviation of 6, and the maximum number was 390. Accounting for a potential non-response rate of approximately 3%, the total sample size was set at 800. Using the website of the Ministry of Public Administration and Security of the Republic of Korea (<https://jumin.mois.go.kr/#>) (Ministry of Public Administration and Security of the Republic of Korea, 2022), the population was categorized by sex and age, and the number of samples was accordingly allocated. One region where residents have a high walking practice rate and another where residents have a low walking practice rate (Korea Disease Control and Prevention Agency, 2022) were selected. The survey included items related to demographic characteristics, walking habits, health behaviors, health status, recognition of social capital, and changes in walking practice (decreased, no change, or increased). All variables were measured in a self-reported format. With regard to changes in walking practice, participants were asked to choose “reduced,” “no change,” or “increased” in response to the following question: “Evaluated by yourself, compared to before the COVID-19 pandemic, was there a change in your walking practice?”. The survey was conducted once, and a structured questionnaire was used.

The demographic characteristics assessed were sex, age group (19–29, 30–39, 40–49, 50–59, 60–69, and greater than 70 years), housing type (house, multi-complex house, apartment), period of residence in the current district, education level (middle school or lower, high school, college or higher), occupation (professional/office worker, sales/service worker, laborer, unemployed), household monthly income, marital status (married, single, divorced/separated), number of family members living together, participation in social gatherings (yes, no), presence of pets that need walks (yes, no), and COVID-19 history (yes, no).

Walking habits included days of walking per week, minutes of walking per week, reason for walking (daily life, leisure, daily life & leisure), ideal number of steps necessary for maintaining good health, and average number of steps per day. As for exercise-related contents, the days of exercise per week and minutes of exercise per week were investigated. Healthy behaviors and status included weight control efforts (trying to lose weight, trying to maintain weight, none), smoking (current smoker, never smoker, past smoker), high-risk drinking (yes, no), perceived body structure (thin, normal, obese), stress (considerable, a little, nearly none), depression (yes or no), hypertension (yes or no), and diabetes (yes or no). In addition, we assessed the recognition of social capital in terms of trust in neighbors (trust, distrust), safety level regarding natural disasters, traffic accidents, various accidents, crimes (satisfactory, unsatisfactory), natural environment (satisfactory, unsatisfactory), living environment (satisfactory, unsatisfactory), public transport (satisfactory, unsatisfactory), and medical services

(satisfactory, unsatisfactory). It has been shown that people who trust their neighbors are more likely to be active on a regular basis, and those who perceive their neighbors as active are more likely to take up a regular walking habit (Addy et al. 2004). High-risk drinking was defined as drinking more than twice a week, with greater than 7 drinks for men and greater than 5 drinks for women (Korea Disease Control and Prevention Agency, 2021).

A face-to-face questionnaire survey was conducted to confirm the change in walking practice during the COVID-19 pandemic. The data are presented as frequency with percentage or mean \pm standard deviation. The χ^2 test and F-test were used to determine whether the changes were significantly different depending on the demographic variables, walking habits, health behavior, and health status. Additionally, multiple logistic regression analysis was conducted using variables showing statistically significant differences in changes in walking practice to evaluate the effect of influencing variables. An increase in walking was denoted as “1,” and no change or a decrease in walking were denoted as “0.” Sex, age, education level, household income, and marital status were included in the regression analysis as controlling variables, and the influence of each variable on changes in walking practice was examined.

This study was approved by the ethics committee of Dongseo University (reference number 1041493-A-2022-006). Written informed consent was obtained from all participants, and all procedures were carried out in accordance with the relevant guidelines and regulations.

3. Results

Among the participants, 73.9% reported no change in walking practice, 15.8% reported a decrease in walking practice, and 10.4% reported an increase in walking practice (Table 1). Changes in walking practice during the COVID-19 pandemic significantly differed according to housing type, education level, occupation, household income, number of family members living together, participation in social gatherings, presence of pets, and history of COVID-19. However, there were no significant differences in walking practice according to sex, age, or marital status (Table 1). The group of participants with increased walking practice during the pandemic showed the highest proportions of participants living in apartments (80.7%), being college graduates (61.4%), and participation in social gatherings (80.7%) and the lowest proportion of participants being laborers (6.0%). Additionally, 67.5% of participants in this group had a high income (4 million won or more), and this group included a high proportion of pet owners. The number of family members living together and number of participants with a COVID-19 history (55.4%) were also higher in this group than in the groups of participants with no change or a decrease in walking during the pandemic (Table 1).

In terms of walking habits, there were significant differences among the three groups of participants (decreased, no change, increased) in the number of days and minutes of exercise per week, number of days and minutes of walking per week, types of walking, number of steps necessary for maintaining good health, and average number of steps per day (Table 2). The group with no change in walking practice showed the highest number of days of walking per week (5.64 ± 1.63 days), whereas the group with increased walking showed the highest minutes of walking per week (345.78 ± 234.34 min). The group of participants with increased walking showed the highest proportions of people who walked both as a habit and for leisure (69.9%), those who considered the number of steps necessary for maintaining health to be more than 10,000 (71.1%), and those with an average number of steps per day between 7,000 and 10,000 (63.8%) (Table 2).

The proportion of participants who considered their body structure to be normal was the highest in the group with no change in walking practice, whereas the proportion of participants who considered themselves to be obese was the highest in the group with decreased walking. In addition, the group with increased walking practice included the highest proportion of participants who had never tried to control their

Table 1
General characteristics of respondents by changes in walking practice during the COVID-19 pandemic, 2022 (unit: n (column %)).

		Changes in walking practice			Total (n = 800, 100.0%)	X ² / F(p-value)
		Decreased (n = 126, 15.8%)	No change (n = 591, 73.9%)	Increased (n = 83, 10.4%)		
Sex	Men	56 (44.4)	294 (49.7)	33 (39.8)	383 (47.9)	3.614 (p = 0.164)
	Women	70 (55.6)	297 (50.3)	50 (60.2)	417 (52.1)	
Age group	19–29	13 (10.3)	89 (15.1)	11 (13.3)	113 (14.1)	13.257 (p = 0.210)
	30–39	18 (14.3)	83 (14.0)	11 (13.3)	112 (14.0)	
	40–49	22 (17.5)	84 (14.2)	18 (21.7)	124 (15.5)	
	50–59	23 (18.3)	99 (16.8)	22 (26.5)	144 (18.0)	
	60–69	28 (22.2)	125 (21.2)	13 (15.7)	166 (20.8)	
	Over 70	22 (17.5)	111 (18.8)	8 (9.6)	141 (17.6)	
Housing type	House	24 (19.0)	82 (13.9)	7 (8.4)	113 (14.1)	11.841 (p < 0.019)
	Multi-complex house	24 (19.0)	129 (21.8)	9 (10.8)	162 (20.3)	
	Apartment	78 (61.9)	380 (64.3)	67 (80.7)	525 (65.6)	
Period of residence in the current district	Less than 5 years	20 (15.9)	62 (10.5)	3 (3.6)	85 (10.6)	16.963 (p < 0.030)
	5 to less than 10 years	21 (16.7)	88 (14.9)	17 (20.5)	126 (15.8)	
	10 to less than 15 years	25 (19.8)	91 (15.4)	16 (19.3)	132 (16.5)	
	15 to less than 20 years	16 (12.7)	53 (9.0)	8 (9.6)	77 (9.6)	
	More than 20 years	44 (34.9)	297 (50.3)	39 (47.0)	380 (47.5)	
Education level	Middle school or lower	22 (17.5)	108 (18.2)	8 (9.7)	138 (17.3)	16.963 (p < 0.001)
	High school	59 (46.8)	274 (46.4)	24 (28.9)	357 (44.6)	
	College or higher	45 (35.7)	209 (35.4)	51 (61.4)	305 (38.1)	
Occupation	Professional/office worker	18 (14.3)	115 (19.5)	24 (28.9)	157 (19.6)	13.688 (p < 0.033)
	Sales/service worker	37 (29.4)	160 (27.1)	23 (27.7)	220 (27.5)	
	Laborer	27 (21.4)	91 (15.4)	5 (6.0)	123 (15.4)	
	Unemployed	44 (34.9)	225 (38.1)	31 (37.3)	300 (37.5)	
Household monthly income (unit: million won)	Less than 200	19 (16.4)	141 (23.9)	9 (10.8)	179 (22.4)	11.883 (p < 0.000)
	200–400	56 (48.3)	246 (41.6)	18 (21.7)	320 (40.0)	
	400–600	31 (26.7)	157 (26.6)	44 (53.0)	232 (29.0)	
	Over 600	10 (7.9)	47 (8.0)	12 (14.5)	69 (8.6)	
Marital status	Married	89 (70.6)	390 (66.0)	57 (68.7)	536 (67.0)	3.981 (p = 0.409)
	Single	21 (16.7)	138 (23.4)	20 (24.1)	179 (22.4)	
	Divorced/separated	16 (12.7)	63 (10.7)	6 (7.2)	85 (10.6)	
Number of family members (mean ± SD)		2.65 ±1.127	2.62 ±1.071	2.94 ±0.967	2.66 ±1.073	3.202 (p < 0.041)
Attending meetings	Yes	75 (59.5)	368 (62.3)	67 (80.7)	510 (63.8)	11.883 (p < 0.003)
	No	51 (40.5)	223 (37.7)	16 (19.3)	290 (36.3)	
Presence of pets that need to be walked	Yes	28 (22.2)	84 (14.2)	25 (30.1)	137 (17.1)	15.714 (p < 0.000)
	No	98 (77.8)	507 (85.8)	58 (69.9)	663 (82.9)	
COVID-19 history	Yes	53 (42.1)	230 (38.9)	46 (55.4)	329 (41.1)	8.242 (p < 0.016)
	No	73 (57.9)	361 (61.1)	37 (44.6)	471 (58.9)	

COVID-19, coronavirus disease 2019.

weight, whereas the group with decreased walking practice included the highest proportion of participants who tried to maintain their weight (34.9%). In addition, the proportion of smokers was the highest in the group with decreased walking practice, and there was no significant difference in high-risk drinking among the three groups. The group with increased walking included the highest proportion of participants with nearly no stress. There were no significant differences in health status among the three groups. The group with increased walking showed the highest rates of trust in neighbors (88.0%), satisfaction with the safety level (88.0%), and satisfaction with the natural environment, living environment, and public transportation (Table 3).

Tables 4 and 5 show the results of the multiple regression analysis of the factors associated with changes in walking practice. Women showed a 1.680-times greater increase in walking practice than did men. Individuals in their 50 s and 60 s showed 6.388- and 5.054-times greater increases in walking practice, respectively, than did those aged 19–29 years. Those who earned 4 million won to less than 6 million won and those who earned more than 6 million won showed 4.455- and 3.871-times greater increases in walking practice, respectively, than did those who earned less than 2 million won. Those with a period of

residence of 5 to less than 10 years and those with a period of residence more than 20 years showed 4.269- and 3.991-times greater increases in walking practice, respectively, than did those with a period of residence less than 5 years. Furthermore, those who attended meetings showed a 2.012-times greater increase in walking practice than did those who did not participate in social gatherings. Those who had pets that needed to be walked showed a 1.866-times greater increase in walking practice than did those without pets that needed to be walked. Those with a COVID-19 history showed a 1.721-times greater increase in walking practice than did those who did not have a COVID-19 history. People who considered walking to be both a daily life and a leisure activity showed a 2.645-times greater increase in walking practice than did those who only considered walking to be a daily life. Participants with average step counts of 7,000–9,999 and 10,000 showed 4.151- and 3.299-times greater increases in walking practice, respectively, than did those with an average step count of less than 5,000 (Table 4).

In the regression analysis of the increase in walking practice according to health behaviors, health status, and recognition of social capital, only stress showed a significant association with walking practice. Participants with nearly no stress showed a 3.659-times greater

Table 2
Exercise and walking habits according to changes in walking practice during the COVID-19 pandemic, 2022 (unit: mean ± SD, column %).

		Changes in walking activity						Total (n = 800)	X ² /F (p-value)	
		Decreased (n = 126, 15.8%)		No change (n = 591, 73.9%)		Increased (n = 83, 10.4%)				
Days of exercise (/week)	(mean ± SD)	0.87	±1.43	1.00	±1.83	1.47	±1.76	1.03	±1.77	3.159 (p < 0.043)
Minutes of exercise (/week)	(mean ± SD)	59.72	±101.10	75.30	±159.98	133.98	±143.39	78.94	±151.63	6.745 (p < 0.001)
Days of walking (/week)	(mean ± SD)	4.79	±2.11	5.64	±1.63	4.93	±1.58	5.43	±1.74	17.003 (p < 0.000)
Minutes of walking (/week)	(mean ± SD)	270.79	±218.25	340.59	±245.28	345.78	±234.34	330.14	±241.20	4.584 (p < 0.010)
Reason for walking	Daily life	26	(20.6)	172	(29.1)	11	(13.3)	209	(26.1)	21.284 (p < 0.000)
	Leisure	27	(21.4)	61	(10.3)	14	(16.9)	102	(12.8)	
	Daily life & leisure	73	(57.9)	358	(60.6)	58	(69.9)	489	(61.1)	
Ideal number of steps necessary for maintaining good health (/day)	Less than 5,000 steps	14	(11.1)	46	(7.8)	4	(4.8)	64	(8.0)	17.353 (p < 0.008)
	5,000–6,999 steps	28	(22.2)	124	(21.0)	9	(10.8)	161	(20.1)	
	7,000–9,999 steps	30	(23.8)	107	(18.1)	11	(13.3)	148	(18.5)	
	More than 10,000 steps	54	(42.9)	314	(53.1)	59	(71.1)	427	(53.4)	
Average number of steps (/day)	Less than 5,000 steps	52	(41.3)	200	(33.8)	13	(15.7)	265	(33.1)	28.294 (p < 0.000)
	5,000–6,999 steps	37	(29.4)	159	(26.9)	17	(20.5)	213	(26.6)	
	7,000–9,999 steps	20	(15.9)	116	(19.6)	30	(36.1)	166	(20.8)	
	More than 10,000 steps	17	(13.5)	116	(19.6)	23	(27.7)	156	(19.5)	

COVID-19, coronavirus disease 2019; SD, standard deviation.

increase in walking than did those with high stress. In the analysis of walking practice according to recognition of social capital, those who were satisfied with their safety level, natural environment, and public transport showed 2.512-, 1.835-, and 2.174-times greater increases in walking practice, respectively, than did those who were not satisfied (Table 5).

4. Discussion

Among the study participants, 10.4% showed an increase in walking practice. The number of women, people in their 50 s and 60 s, high-income earners, people who participated in social gatherings, and people who had pets that needed to be walked was greater in the group with increased walking practice. In addition, people who spent more time exercising, spent more time walking, took more than 7,000 steps per day, and engaged in walking both habitually and for leisure than did others showed increased walking practice. Furthermore, people who felt nearly no stress during the COVID-19 pandemic showed a 3.66-times greater increase in walking practice than did those who were considerably stressed; this indicates a possibly that walking was adopted as a stress relief method, resulting in increased walking during the pandemic. People who were satisfied with their social capital showed increased walking practice from 1.835 times to 2.512 times; in particular, those who were satisfied with the safety level showed the highest increase in walking practice.

Regular walking is an effective therapy for mental health problems, such as depression and stress (Gusi et al., 2008; Robertson et al., 2012; Olafsdottir et al. 2020). Therefore, it is natural that people might have attempted to relieve their stress through walking during the COVID-19 pandemic; walking is assumed to have been very helpful in relieving their stress. In addition, people with a history of COVID-19 might have increased their walking to manage their health and help accelerate their recovery. There is little evidence that walking can help people recover from COVID-19; however, studies have shown that walking can significantly help people with stroke recover (Moore et al., 2022). Piva et al. (2023) reported that even during the COVID-19 pandemic, exercise

programs were effective for reducing depression and anxiety among adults including older people (Piva et al., 2023). Long-term research on methods to improve the recovery of people with COVID-19 is needed.

According to a previous study, women and older adults walked more for recreation than did men and young people, but there was no difference in the amount of walking for transportation (Ghani et al., 2016). In another study, it was reported that people with a high socioeconomic status were more likely to use local parks and rate the safety of parks and public transport more highly than did those with a low socioeconomic status (Leslie et al., 2010). In a study examining the physical activity levels and walking habits of urban residents in the United States, those in their 40 s and 50 s reported the highest rate of walking more than 20 times per month. In our study, those in their 50 s and 60 s walked the most, indicating a need to further study the relationship between age and regular walking (Berrigan and Troiano, 2002). Additionally, older adults do not drive as much as young individuals, making walking more important, resulting in parks and paths for safe walking becoming more important in their daily life (Bozovic et al., 2020).

The owners of dogs that need to be walked have been reported to be more active than are those who do not have dogs, and walking has been reported to benefit the emotional health of dog owners and their families (Cutt et al., 2008; Degeling and Rock, 2013). In addition, physical activity reportedly increases when parents and children live together and they all own a dog together, and it has been demonstrated that having a dog in the family can potentially increase walking (Salmon et al., 2010). Alidoust et al. (2018) explained that walking provides an opportunity for older adults to form social ties through conversations. Paid work and social activities increase walking in older adults (Julien et al., 2013). Stroope (2021) reported that walking and biking for transportation are significantly associated with social participation. In addition, a 3-year follow-up study revealed that many kinds of activities, such as volunteering, sports, hobbies, senior citizen club participation, neighborhood association participation, learning, health-promoting activities, and activities that teach skills also increased walking (Ihara et al., 2022).

For city dwellers, walking is an exercise that is considered an easy way to practice health promotion, an activity that provides an

Table 3
Health behaviors, health status, and satisfaction with the environment according to changes in walking practice during the COVID-19 pandemic, 2022
 (unit: n (column %)).

		Changes in walking practice						Total (n = 800)	X2/F (p-value)	
		Decreased (n = 126, 15.8%)		No change (n = 591, 73.9%)		Increased (n = 83, 10.4%)				
Weight control	Trying to lose weight	34	(27.0)	115	(19.5)	23	(27.7)	172	(21.5)	10.202 (p < 0.037)
	Trying to maintain weight	64	(50.8)	293	(49.6)	31	(37.3)	388	(48.5)	
	None	28	(22.2)	183	(31.0)	29	(34.9)	240	(30.0)	
Smoking	Current smoker	35	(27.8)	131	(22.2)	20	(24.1)	186	(23.3)	11.314 (p < 0.023)
	Never smoker	86	(68.3)	388	(65.7)	59	(71.1)	533	(66.6)	
	Past smoker	5	(4.0)	72	(12.2)	4	(4.8)	81	(10.1)	
High-risk drinking	Yes	8	(6.3)	38	(6.4)	3	(3.6)	49	(6.1)	1.016 (p = 0.602)
	No	118	(93.7)	553	(93.6)	80	(96.4)	751	(93.9)	
Body perception	Thin	16	(12.7)	99	(16.8)	9	(10.8)	124	(15.5)	18.829 (p < 0.001)
	Normal	71	(56.3)	399	(67.5)	53	(63.9)	523	(65.4)	
	Obese	39	(31.0)	93	(15.7)	21	(25.3)	153	(19.1)	
Stress	Considerable	25	(19.8)	61	(10.3)	5	(6.0)	91	(11.4)	17.163 (p < 0.002)
	A little	69	(54.8)	407	(68.9)	53	(63.9)	529	(66.1)	
	Nearly none	32	(25.4)	123	(20.8)	25	(30.1)	180	(22.5)	
Depression	Yes	3	(2.4)	18	(3.0)	-		21	(2.6)	2.676 (p = 0.262)
	No	123	(97.6)	573	(97.0)	83	(100.0)	779	(97.4)	
Hypertension	Yes	99	(78.6)	463	(78.3)	68	(81.9)	630	(78.8)	0.562 (p = 0.755)
	No	27	(21.4)	128	(21.7)	15	(18.1%)	170	(21.3)	
Diabetes	Yes	110	(87.3)	540	(91.4)	74	(89.2)	724	(90.5)	2.194 (p = 0.334)
	No	16	(12.7)	51	(8.6)	9	(10.8)	76	(9.5)	
Trust in neighbors	Trust	90	(71.4)	483	(81.7)	73	(88.0)	646	(80.8)	10.175 (p < 0.006)
	Distrust	36	(28.6)	108	(18.3)	10	(12.0)	154	(19.3)	
Safety level	Satisfied	86	(68.3)	436	(73.8)	73	(88.0)	595	(74.4)	10.617 (p < 0.005)
	Not satisfied	40	(31.7)	155	(26.2)	10	(12.0)	205	(25.6)	
Natural environment	Satisfied	66	(52.4)	428	(72.4)	68	(81.9)	562	(70.3)	25.997 (p < 0.000)
	Not satisfied	60	(47.6)	163	(27.6)	15	(18.1)	238	(29.8)	
Living environments	Satisfied	70	(55.6)	399	(67.5)	61	(73.5)	530	(66.3)	8.814 (p < 0.012)
	Not satisfied	56	(44.4)	192	(32.5)	22	(26.5)	270	(33.8)	
Public transport	Satisfaction	99	(78.6)	452	(76.5)	74	(89.2)	625	(78.1)	6.86 (p < 0.032)
	Not satisfied	27	(21.4)	139	(23.5)	9	(10.8)	175	(21.9)	
Medical services	Satisfied	81	(64.3)	409	(69.2)	54	(65.1)	544	(68.0)	1.523 (p = 0.467)
	Not satisfied	45	(35.7)	182	(30.8)	29	(34.9)	256	(32.0)	

COVID-19, coronavirus disease 2019.

opportunity for conversation and social interaction, and an activity during which people can look back on their day and calm down. Roads with interesting attractions, parks, pedestrian-friendly environments, and the presence of people walking together are factors that promote walking, and it is important to create a culture that considers pedestrians (Kim et al., 2011). Encouraging inactive people to walk can result in long-term health benefits; therefore, it is important to provide accurate health information to them (Segar and Richardson, 2014). The World Health Organization (2021) recommends that everyone perform at least 300 min of physical activity per week, and that it is better to do more than the recommended amount (WHO, 2021).

In one study, walking for transportation was found to be related to perceptions about the neighborhood across age groups, especially in the youngest age group, even though walking for leisure was not (Shigematsu et al., 2009). Environmental factors related to the neighborhood have been found to be associated with physical activity (Gebel et al., 2007; Transportation Research Board, Institute of Medicine, 2005). In addition, low individual social capital and safety have been reported to have a modest relationship with decreased walking (Caspi et al., 2013). Another study found that walking as a leisure activity is more likely to be performed when the levels of trust and networking among neighbors are high than when these levels are low (Kim and Yang, 2017).

A limitation of this study was that it was a cross-sectional study that only identified the associations, not the causal relationships, between the variables related to walking practice and did not objectively evaluate

the impact of increased walking on health. Future research should investigate these aspects. Nevertheless, in addition to confirming the changes in walking practice during the COVID-19 pandemic, we identified the characteristics of people who increased their regular walking, which could affect their health. In addition, this study could not directly measure natural environments that may highly influence walking habits; however, by identifying perceived social capital, it was indirectly confirmed that safety level, natural environment, and public transport were factors that affect walking. Previous studies have shown that the environment affects walking habits. When assessed using objective measures, the environment had no direct impact on walking; however, when assessed using perceived measures, it has been shown to be related to walking (McGinn et al., 2007). Moreover, another reported that pedestrian-friendly environments are important for promoting a walking habit (Kim et al., 2011). Future studies should also examine people who require a large amount of effort to maintain the increased walking. Since a decrease in walking, which was noted in men and in low-income groups, can negatively impact health, these populations should be encouraged to be active, and their social activities should be such that physical activities, such as walking, can be performed even during a pandemic. Moreover, education on the importance and maintenance of health is also necessary.

Table 4
Regression analysis of factors associated with an increase in walking practice by socio-demographic characteristics and walking preference.

		p-value	Odds ratio	95% CI	
				Lower	Upper
Sex (ref. men)	Women	0.041	1.680	1.020	2.766
Age group (ref. 19–29)	40–49	0.116	2.756	0.778	9.759
	50–59	0.005	6.388	1.755	23.250
	60–69	0.026	5.054	1.211	21.098
	Over 70	0.056	5.863	0.956	35.952
Education level (ref. middle school or lower)	High school	0.777	0.847	0.269	2.666
	Over university	0.111	2.832	0.787	10.190
Monthly family income (ref. less than 2 million won)	2-less than 4 million won	0.671	1.266	0.427	3.755
	4-less than 6 million won	0.007	4.455	1.518	13.075
	More than 6 million won	0.030	3.871	1.136	13.189
Marital status (ref. married)	Unmarried	0.315	1.687	0.609	4.674
	Divorced/separated	0.984	1.010	0.360	2.833
Housing type (ref. house)	Multi-complex house	0.875	0.919	0.318	2.650
	Apartments	0.139	1.890	0.813	4.391
Period of residence in the current district (ref. Less than 5 years)	5 to less than 10 years	0.028	4.269	1.166	15.621
	10 to less than 15 years	0.085	3.139	0.854	11.538
	15 to less than 20 years	0.101	3.287	0.793	13.632
	More than 20 years	0.031	3.991	1.136	14.019
Occupation (ref. professional/office worker)	Sales/service worker	0.991	0.996	0.509	1.950
	Laborer	0.396	0.618	0.203	1.878
	Unemployed	0.169	1.729	0.793	3.773
Number of family members		0.782	1.043	0.775	1.404
Attending meetings (ref. no)	Yes	0.028	2.012	1.079	3.750
Presence of pets that need to be walked (ref. no)	Yes	0.027	1.866	1.072	3.248
COVID-19 history (ref. no)	Yes	0.032	1.721	1.047	2.830
Days of exercise Days of walking		0.003	1.002	1.001	1.003
		0.423	1.000	0.999	1.001
Reason for walking (ref. daily life)	Leisure	0.075	2.241	0.922	5.444
	Daily life & leisure	0.006	2.645	1.320	5.303
Ideal number of steps necessary for maintaining good health (ref. Less than 5,000 steps)	5,000–6,999 steps	0.883	0.874	0.249	3.067
	7,000–9,999 steps	0.806	1.167	0.341	4.000
	More than 10,000 steps	0.565	1.913	0.631	5.794
Average number of steps per day (ref. Less than 5,000 steps)	5,000–6,999 steps	0.135	1.802	0.832	3.906
	7,000–9,999 steps	0.001	4.151	2.018	8.540
	More than 10,000 steps	0.002	3.299	1.542	7.057

CI, confidence interval; COVID-19, coronavirus disease 2019.

Table 5
Regression analysis of factors associated with an increase in walking practice according to health behavior, health status, and perception of social capital.

		p-value	OR	95% CI	
				Lower	Upper
Perceived body structure (ref. thin)	Normal	0.164	1.764	0.793	3.925
	Obese	0.222	1.744	0.714	4.260
Weight control (ref. trying to lose weight)	Trying to maintaining weight	0.706	0.886	0.470	1.667
	None	0.870	1.056	0.548	2.037
Smoking (ref. past smoker)	Current smoker	0.244	1.992	0.625	6.353
	Never smoker	0.308	1.843	0.568	5.981
Stress (ref. considerable)	Nearly none	0.017	3.659	1.264	10.591
	A little	0.097	2.296	0.860	6.129
Trust in neighbors (ref. distrust)	Trust	0.078	1.911	0.929	3.932
Safety level (ref. unsatisfactory)	Satisfactory	0.010	2.512	1.242	5.082
Natural environment (ref. unsatisfactory)	Satisfactory	0.049	1.835	1.003	3.359
Living environments (ref. unsatisfactory)	Satisfactory	0.181	1.441	0.844	2.460
Public transport (ref. unsatisfactory)	Satisfactory	0.039	2.174	1.040	4.544

OR, odds ratio; CI, confidence interval.

5. Conclusion

This study identified changes in walking practice and associated factors during the COVID-19 pandemic for formulating strategies to maintain good health during a pandemic. Among the participants, 10.4% reported an increase in walking practice, those in their 50 s and 60 s showed 6.388- and 5.054-times greater increases in walking, respectively, than did those aged 19–29 years. Walking increased more among high-income people than among low-income people. Additionally, walking practice increased in people participating in social gatherings, those with pets that needed walks, those with a COVID-19 history, those who considered walking as both a habitual and leisure activity, those with nearly no stress, and those satisfied with their safety, natural environment, and public transportation; other health behaviors or conditions were not related to an increase in walking practice. To maintain good health during a pandemic, walking practice should be promoted in people in their 20 s and low-income groups, and safe walking routes should be created within the community. Walking should be encouraged as a method of relieving stress, and the benefits of walking for recovery after an infectious disease should be emphasized.

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CRedit authorship contribution statement

Hyo Young Lee: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Supervision. **Hyuk Im:** Formal analysis, Writing – original draft, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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Data Statement

The data are available from the authors upon reasonable request and with permission from the Korea Disease Control and Prevention Agency.

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