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Clinical Research Article

Impact of coronavirus disease 2019 on patients with chronic pain: multicenter study in Korea

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Background: The coronavirus disease 2019 (COVID-19) pandemic has caused significant changes. This study aimed to investigate the impact of COVID-19 on patients with chronic pain.
Methods: Patients with chronic pain from 23 university hospitals in South Korea participated in this study. The anonymous survey questionnaire consisted of 25 questions regarding the following: demographic data, diagnosis, hospital visit frequency, exercise duration, time outside, sleep duration, weight change, nervousness and anxiety, depression, interest or pleasure, fatigue, daily life difficulties, and self-harm thoughts. Depression severity was evaluated using the Patient Health Questionnaire-9 (PHQ-9). Logistic regression analysis was used to investigate the relationship between increased pain and patient factors.
Results: A total of 914 patients completed the survey, 35.9% of whom had decreased their number of visits to the hospital, mostly due to COVID-19. The pain level of 200 patients has worsened since the COVID-19 outbreak, which was more prominent in complex regional pain syndrome (CRPS). Noticeable post-COVID-19 changes such as exercise duration, time spent outside, sleep patterns, mood, and weight affected patients with chronic pain. Depression severity was more significant in patients with CRPS. The total PHQ-9 average score of patients with CRPS was 15.5, corresponding to major depressive orders. The patients' decreased exercise duration, decreased sleep duration, and increased depression were significantly associated with increased pain.
Conclusions: COVID-19 has caused several changes in patients with chronic pain. During the pandemic, decreased exercise and sleep duration and increased depression were associated with patients' increasing pain.

Key Words: Chronic Pain; Complex Regional Pain Syndrome; Coronavirus; COVID-19; Depression; Fatigue; Pandemics; Physical Distancing; Sleep; Social Isolation; Surveys and Questionnaires.

INTRODUCTION

In the year 2020, our quality of life was affected by the sudden worldwide prevalence of coronavirus disease 2019 (COVID-19). The pandemic has had a profound effect on all aspects of society; it was a period that not only failed to provide a normal social life but also forced society to act cautiously towards everything [1,2]. Ordinary people around the world suffered from depression during the COVID-19 pandemic [3–6]. Moreover, this was a particularly difficult time for patients with chronic pain. Unfortunately, the COVID-19 pandemic has resulted in significant changes taking place worldwide. Some medical resources have been used for the hospitalization and isolation treatments of patients with COVID-19. In addition, more intensive care equipment and professional staff were needed, and more beds were used for COVID-19 patients [7]. Changes also occurred in the social conditions of most individuals worldwide, including those with chronic pain. Physical distancing is an effective way to reduce infection, which led to social distancing worldwide [8]. This change caused patients with chronic pain to struggle more than the general population. This is because pain can be controlled by social factors, including social connections [9]. There has also been a change in hospital usage patterns. Korean patients experienced hospital infections such as Middle East respiratory syndrome (MERS) in 2015 [10], which led them to visit hospitals less frequently.

Previous studies have suggested that social isolation can cause generally unhealthy outcomes, including the deterioration of mental and physical health [11]. Social interaction can also play an important role in controlling pain and coping with chronic pain [12]. Thus, individuals with chronic pain may increase their risk of physical and mental health deterioration when social distancing [8,9]. Aggravation of pain can lead patients with chronic pain to depend on negative strategies such as drug abuse and increased suicidal compulsion [13]. In patients with complex regional pain syndrome (CRPS), negative affective instability and high pain intensity are related to suicidal ideation [14]. Social distancing regulations can also limit or eliminate access to hospitals, as well as to many ancillary therapies such as massage, physical therapy, rehabilitation, and counseling services, which potentially contribute to relieving pain and stress [15]. Thus, this study aimed to identify the impact of hospital access, lifestyle, pain severity, and psychophysiological effects in patients with chronic pain during the COVID-19 pandemic.

MATERIALS AND METHODS

1. Participants

The Public Committee of the Korean Pain Society conducted a nationwide survey of patients from 23 university hospitals regarding the effects of COVID-19 on patients with chronic pain. All of the university hospitals were urban and had pain clinics that were staffed with professional pain physicians (professors). This anonymous survey focused on patients with chronic pain who visited the pain clinic for about 2 months from July to August 2020. Based on the results of this anonymous survey, this manuscript was drafted in 2021. Ethical approval for this study was waived by the Institutional Review Board of the Konkuk University Hospital (IRB no. KUMC 2021-04-045).

2. Inclusion and exclusion criteria

This was a multicenter, cross-sectional study. Patients diagnosed with chronic spinal pain (CSP), CRPS, or post-herpetic neuralgia (PHN) were included in this study. Chronic pain was defined as pain lasting for more than 6 months. This survey was conducted only for patients who agreed to participate in the survey; thus, those who did not agree were excluded from the study.

3. Questionnaires

The Public Relation Committee of the Korean Pain Society created all of the questionnaires that were employed in this survey, except for the Patient Health Questionnaire-9 (PHQ-9). Participants answered a series of questionnaires (**Appendix**) that consisted of 25 questions assessing the changes in the participants after the COVID-19 outbreak: hospital visit frequency, exercise duration, time outside, sleep duration, weight change, nervousness and anxiety, depression, interest or pleasure, fatigue, daily life difficulties, and thoughts of self-harm. The questionnaire was also comprised of the patients' demographic data, diagnosed diseases, current situations, and post-COVID-19 outbreak changes. The scores for the nine questions (Q16–24) were combined to evaluate depression severity using the PHQ-9. The PHQ-9 is based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria for major depression [16]. Participants were asked to answer each item on a scale of 0 to 3 based on how much the pain had bothered them in the past two weeks (0 = not at all; 1 = several days; 2 = more than half the days; 3 = nearly every day). The PHQ-9 score was calculated by adding the scores from each of the questions and creating a total score ranging from 0 to 27. A method based on

a cut-off score of 10 or more was used to screen for major depressive disorders. A 10th item was added to the diagnosis section of the PHQ-9 to ask the patient how difficult it was to manage their work, housework, and interpersonal relationships [16–21].

4. Statistical analysis

Data were analyzed using SPSS version 17 (SPSS Inc., Chicago, IL). Proportional differences were evaluated using the chi-squared test, while mean differences were analyzed using analysis of variance (ANOVA). To evaluate the factors that led to increased pain after the COVID-19 outbreak, the respondents were divided into two groups: the increased group and the non-increased group. The relationship between increased pain and patient factors (age, sex, diagnosis, and changes in hospital visit frequencies, exercise duration, time outside, sleep duration, weight, and depressive moods) was analyzed using a logistic regression analysis. Before logistic regression analysis, using the chi-squared test, Student's t-test, and ANOVA, we found that factors with $P < 0.1$ were related to increased pain. These factors were then analyzed using a logistic regression analysis. Statistical significance was set at $P < 0.05$.

RESULTS

1. Demographics

A total of 914 patients from 23 university hospitals completed the survey. There were 612 (66.9%) patients with CSP, 113 (12.4%) patients with PHN, 147 (16.1%) patients with CRPS, and 42 (4.6%) patients with more than two of these diseases. The mean age was highest in patients with PHN, followed by CSP patients, and lowest in CRPS patients. The ratio of male to female was different for each group, but there were a total of 457 male and 457 female (**Table 1**).

2. Hospital visits

Of the 914 patients, 718 responded to changes in hospital visits. The percentage of reduced hospital visits since the COVID-19 outbreak was 31.6% (227 patients), 4.7% (34 patients), and 3.8% (27 patients) in CSP, PHN, and CRPS patients, respectively. The percentage of total outpatient visits also decreased by 41.6%. In the disease group, 47.4% (227/479 respondents) of CSP patients, 40.0% (34/85 respondents) of PHN patients, and 22.0% (27/123 respondents) of CRPS patients reported reductions in hospital visits (**Fig. 1**). When asked about what changes were made in terms of frequency of hospital visits, 718 patients answered the question; 128 (17.8%) patients said that their

Table 1. Demographic data of the participants

Variable	CSP (n = 612)	PHN (n = 113)	CRPS (n = 147)	Two or more diagnoses (n = 42)	Total (n = 914)
Age (yr)	57.9 ± 15.0	65.5 ± 12.0	48.3 ± 12.1	53.0 ± 16.5	57.1 ± 15.0
Sex					
Female	331	50	47	29	457
Male	281	63	100	13	457

Values are presented as mean ± standard deviation or number only.
CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.
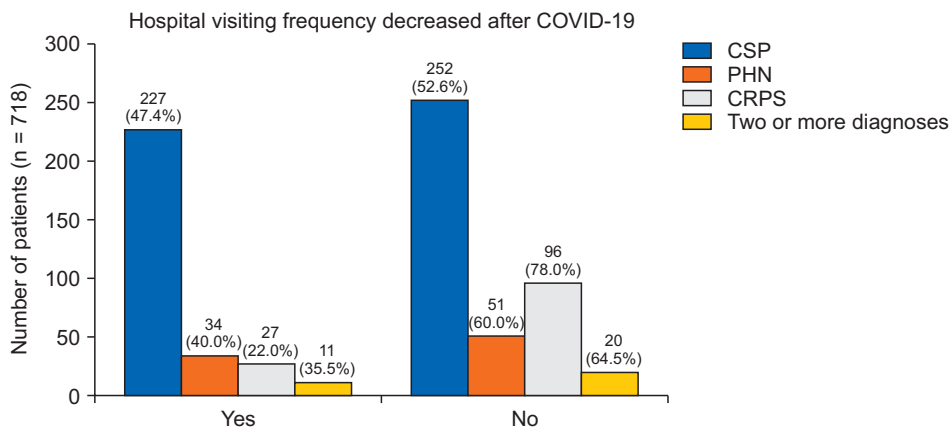

Fig. 1. Decrease in hospital visit frequency in patients after the COVID-19 outbreak. COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

visits decreased by more than 25% and less than or equal to 75%, which was the largest proportion of patients with change (**Table 2**). In all three disease groups, most patients reduced their visits due to COVID-19 (**Fig. 2A**). Of the 488 patients who clarified their reasons for the decrease in visits, 51.2% (250 patients) answered that it was due to COVID-19 (**Fig. 2B**). Multiple responses were available, and 486 patients answered the questions regarding their reduced hospital visits. A total of 128 (26.3%) patients reduced their visits due to family or friend recommendations, 221 (45.5%) made the decision voluntarily, 161 (33.1%) patients reduced their visits due to media influence, and 107 (22.0%) patients reduced their visits due to other reasons (**Table 3**).

3. Pain severity

One of the questions involved whether the participants' pain severity had changed since the COVID-19 outbreak. Of the 887 patients who answered, 200 (22.5%) patients reported that their pain level had worsened since the COVID-19 outbreak, 170 (19.2%) patients said it had decreased, and 517 (58.3%) patients said it had not changed. **Table 4** describes the pain scores of the patients before and after the COVID-19 outbreak. The pre-COVID-19 pain score was the highest in CRPS patients (numeric rating scale [NRS] 7.0), followed by PHN (NRS 6.2), and CSP (NRS 5.8) (*P* < 0.001) patients. After the COVID-19 outbreak, the pain

Table 2. Details of hospital visit changes

Hospital visit change	CSP	PHN	CRPS	Two or more diagnoses	Total
Decreased by < 25%	69	6	10	3	88 (12.3)
Decreased by 25%–75%	92	21	13	2	128 (17.8)
Decreased by > 75%	66	7	4	6	83 (11.5)
Increased	29	2	18	4	53 (7.4)
No change	223	49	78	16	366 (51.0)
Total	479	85	123	31	718

Values indicate the number of patients (%).
CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.
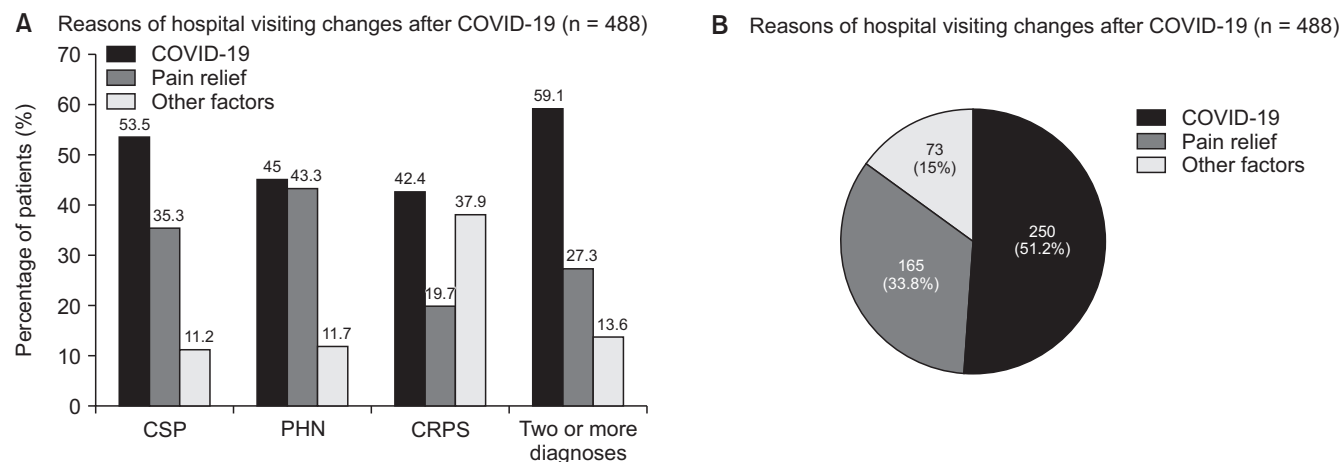

Fig. 2. Reasons of hospital visit changes after the COVID-19 outbreak (A) according to diseases and (B) in terms of the entire patient population. COVID-19: coronavirus disease 2019.

Table 3. Reasons for reducing hospital visits (multiple responses available)

Reason	CSP	PHN	CRPS	Two or more diagnoses	Total
Family's or friend's recommendation	94	17	13	4	128 (26.3)
Influenced by media	122	14	18	7	161 (33.1)
Voluntary decision	170	22	17	12	221 (45.5)
Others	62	20	21	4	107 (22.0)

Values indicate the number of patients (%).
CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

Table 4. Pain scores of the disease groups before and after the COVID-19 outbreak

Time		CSP (n = 394)	PHN (n = 74)	CRPS (n = 96)	Two or more diagnoses (n = 22)	P value
Before COVID-19	Mean	5.82	6.25	7.00	5.61	< 0.001
	SD	2.09	1.87	1.72	2.09	
	95% CI	5.61 to 6.03	5.81 to 6.68	6.65 to 7.35	5.61 to 6.03	
After COVID-19	Mean	5.18	5.29	7.26	5.33	< 0.001
	SD	2.07	2.31	2.03	2.71	
	95% CI	4.97 to 5.38	4.77 to 5.81	6.85 to 7.67	4.15 to 6.50	

COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome, SD: standard deviation, CI: confidence interval.
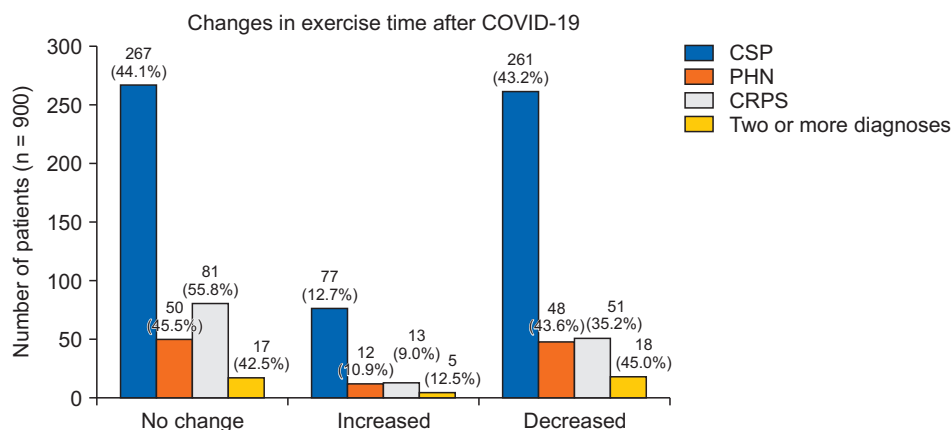

Fig. 3. Changes in exercise duration after the COVID-19 outbreak. COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

scores were highest in the CRPS patients (NRS 7.3). The pain scores of the CSP (NRS 5.2) and PHN (NRS 5.3) groups decreased slightly, but the scores of the CRPS group (NRS 7.3) increased (*P* < 0.001).

4. Daily lives

Questionnaires also examined the changes in patients' daily lives after the pandemic outbreak. Out of 914 patients, 900 patients answered that they exercised, and 42.0% (378 patients) said they exercised less than before the COVID-19 outbreak (**Fig. 3**). In the disease group, 43.2% (261/605 respondents) of CSP patients, 43.6% (48/110 respondents) of PHN patients, and 35.2% (51/145 respondents) of CRPS patients reported a decrease in their exercise duration. **Fig. 4** shows the changes in the time spent outside by patients with chronic pain after the COVID-19 outbreak. Of the 901 patients who answered the question, most of the respondents (79.4%, 715 patients) went out less after the COVID-19 outbreak. The percentage of patients in the disease group was 80.3% (485/604 respondents) for CSP patients, 80.9% (89/110 respondents) for PHN patients, and 74.8% (110/147 respondents) for CRPS patients.
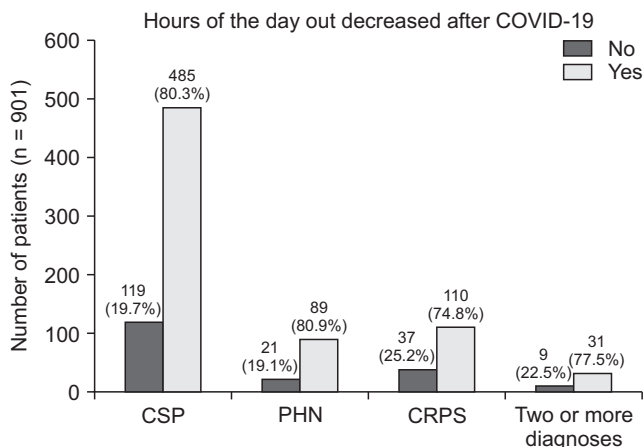
Fig. 4. Decrease in hours of day-out after the COVID-19 outbreak. COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

Among the participants, 14.5% reported that their sleep duration increased after the COVID-19 outbreak, 64.4% said it remained unchanged, and 21.1% reported decreases. When asked about weight gain, 29.4% gained weight after the COVID-19 outbreak, 52.0% remained unchanged, and 18.6% lost weight. Participants also answered a ques-

tionnaire regarding mood changes; 29.3% of them were more nervous or angry after the COVID-19 outbreak, 67.1% were unchanged, and 3.6% were less nervous or angry. Among the respondents, 52.1% experienced increasing worries since the COVID-19 outbreak, 45.6% remained unchanged, and 2.3% experienced decreasing worries. The number of patients with increased depression was 44.0%, 54.1% were unchanged, and 1.9% had decreased depression (**Fig. 5**). In the comparison of reduced exercise duration, increased depression, and decreased sleep duration among the three disease groups, there was no statistical difference in exercise duration, but there was a statistical difference between the three groups in terms of sleep duration and increased depression. In particular, CPRS patients had greater decreases in sleep compared to the other two groups, and the proportion of patients with increased depression was higher (**Table 5**).

5. PHQ-9

The scores for the nine questions (Q16–24) from the PHQ-9 were combined and used to classify depression severity. The PHQ-9 scores were divided into the following categories of increasing depression severity: 0–4, 5–9, 10–14, 15–19, and ≥ 20 representing minimal, mild, moderate, moderately severe, and severe depression, respectively [16]. Among respondents (877 patients), 39.9% (350 patients) rated their depression severity as minimal, 26.2% (230 patients) as mild, 14.6% (128 patients) as moderate, 7.8% (68 patients) as moderately severe, and 11.5% (101 patients) as severe (**Fig. 6**). In the disease group, 70.2% (101 patients) of CRPS subjects, 27.4% (29 patients) of PHN subjects, and 26.0% (153 patients) CSP subjects were found to have moderate or higher depression. Particularly, the frequency of severe depression was 41.0% (59 patients) for CRPS, 8.5% (9 patients) for PHN, and 5.6% (33 patients) for CSP patients. The depression severity of CRPS patients was higher than that of the other two groups (**Fig. 7**). CRPS patients also had statistically higher total PHQ-9 scores than CSP and PHN patients (**Table 6**). **Table 6** describes the difficulties of daily life for patients in connection with the PHQ-9 items. Of the respondents (858 patients), 55.7% (478 patients) said they had no difficulties, and 44.3% (380 patients) said they had difficulties (nearly every day, 14.1%; more than a week, 5.4%; and several days, 24.8% in two weeks) in their daily lives (**Table 7**).

Fig. 5. Changes in daily life after the COVID-19 outbreak. COVID-19: coronavirus disease 2019.
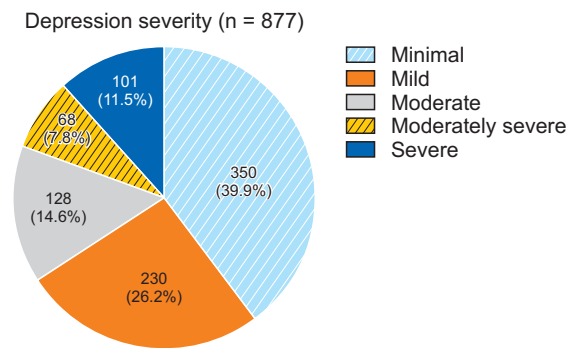
Fig. 6. Depression severity after the COVID-19 outbreak in connection with the Patient health Questionnaire-9. COVID-19: coronavirus disease 2019.

Table 5. Comparison of decreased exercise duration, decreased sleep duration, and increased depression among the three disease groups

Factor		CSP	PHN	CRPS	*P* value
Exercise duration	Decreased	381 (63.0)	77 (70.0)	83 (57.2)	0.113
	Increased or not changed	224 (37.0)	33 (30.0)	62 (42.8)	
Sleep duration	Decreased	102 (17.1)	20 (18.5)	54 (37.0)	< 0.001
	Increased or not changed	494 (82.9)	88 (81.5)	92 (63.0)	
Depression	Increased	249 (41.8)	32 (29.1)	92 (63.0)	< 0.001
	Decreased or not changed	346 (58.2)	78 (70.9)	54 (37.0)	

Values indicate the number of patients (%).
CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

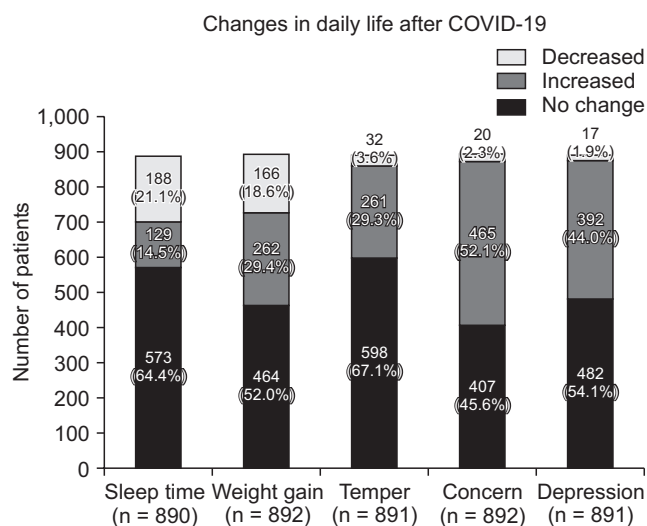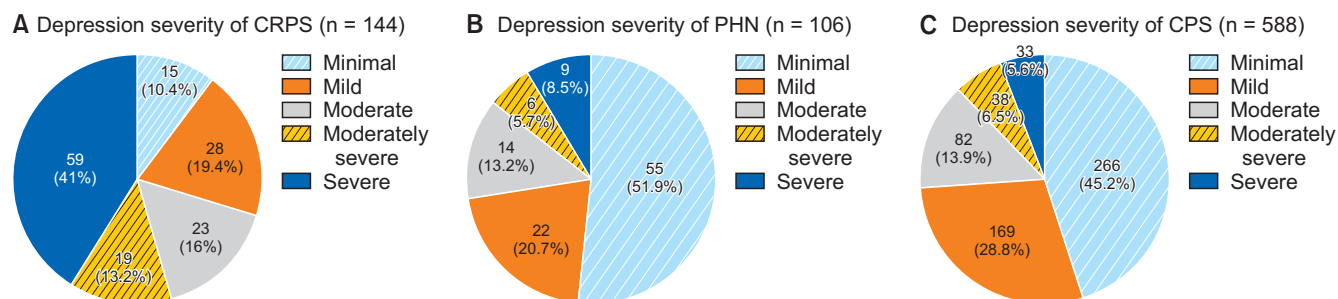**Fig. 7.** Depression severity after the COVID-19 outbreak in connection with the Patient Health Questionnaire-9 of patients with (A) CRPS, (B) PHN, and (C) CSP. COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

Table 6. Patient Health Questionnaire-9 total scores of the disease groups

Disease	Mean	SD
CSP (n = 588)	6.61	6.32
PHN (n = 106)	6.58	7.14
CRPS (n = 144)	15.5	8.2
Two or more diagnoses (n = 39)	7.49	5.24

CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome, SD: standard deviation.

6. Factors associated with increasing pain

The increased pain group after the outbreak included 200 patients, while the non-increased pain group included 687 patients. **Table 8** shows the correlation between increased pain and the other changes after the pandemic ($P < 0.1$). The logistic regression analysis revealed that a decrease in exercise duration, a decrease in sleep duration, and increased depression were statistically significant factors in increasing pain (**Table 9**).

DISCUSSION

In this study, we analyzed the impact of COVID-19 on patients with chronic pain and the changes caused by the pandemic.

According to this study, 41.6% of patients decreased their visits to the hospital during the pandemic, which was identified to be due to the direct influence from concerns of coronavirus infection rather than improved symptoms in all three disease groups. Most patients (45.5%) reduced their visits voluntarily to avoid virus infection, and others reduced their visits due to influence from the media or from family (33.1%) or due to friends' recommendations (26.3%), which is consistent with previous studies [10,22]. Statistically, the hospital visits of CRPS patients decreased less than those of PHN and CSP patients, possibly due to the severe pain experienced by CRPS patients, which made

it impossible to further reduce the number of hospital visits and treatments they had to receive [15,23]. In addition, the life patterns of patients with chronic pain changed significantly during the pandemic [24,25]. Of the patients, 42.0% exercised less, and 79.4% of patients went out less than before. This occurred more frequently in PHN patients than in CSP and CRPS patients. For each condition, the decrease in the frequency of hospital visits, time outside, and exercise duration was relatively less varied for those with CRPS. Conversely, a relatively large decrease was observed in patients with PHN. It can be inferred that due to the relatively severe level of pain and physical limitations in CRPS patients [23,26,27], the decrease was less prominent in them than in others, regardless of their COVID-19 concerns. CRPS patients also hesitate to exercise and rarely go out much due to their severe pain [28]; thus, their activity could not decrease significantly more. Meanwhile, patients with PHN tend to be relatively older, which suggests that social activity and exercise have been greatly affected by the coronavirus outbreak. It is thought that the tendency to avoid places where people gather, such as hospitals, is reflected by the high morbidity of COVID-19 in elderly patients [29,30].

Regarding changes in sleep duration, weight, and mood after the COVID-19 outbreak, it can be seen that many patients were affected by the pandemic. During the COVID-19 period, 21.1% of the patients reported reduced sleep duration. Approximately 29.4% of participants also gained weight. The frequency of nervousness, anxiety, and depression increased by 29.3%, 52.1%, and 44.0%, respectively. The changes in sleep duration, weight, and mood appear to be due to reduced time performing outdoor activities and an increased degree of pain, as mentioned in several other studies [31,32]. Furthermore, a lack of exercise increases depression and anxiety [5]. Sleep disorders are closely related to chronic pain and depression, which interact with each other to affect patient prognosis [33–35]. Sleep disorders also have a bidirectional relationship with pain [36]. Sleep disturbance, depression, anxiety, and pain intensity are correlated with each other [37]. Therefore,

Table 7. Degree of difficulty in daily life in connection with the Patient Health Questionnaire-9 in the last two weeks

Frequency in the last two weeks	CSP	PHN	CRPS	Two or more diagnoses	Total
None	369 (64.0)	62 (60.2)	30 (21.3)	17 (45.9)	478 (55.7)
Several days	140 (24.2)	27 (26.2)	34 (24.1)	12 (32.5)	213 (24.8)
More than a week	23 (4.0)	4 (3.9)	18 (12.8)	1 (2.7)	46 (5.4)
Nearly everyday	45 (7.8)	10 (9.7)	59 (41.8)	7 (18.9)	121 (14.1)
Total	577	103	141	37	858

Values indicate the number of patients (%).
CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

Table 8. Factors associated with increased pain score after the COVID-19 pandemic

Variable		No increased pain group (n = 687)	Increased pain group (n = 200)	P value
Age		57.5 ± 15.0	55.3 ± 14.8	0.069
Sex	Male	350 (79.2)	92 (20.8)	0.218
	Female	337 (75.7)	108 (24.3)	
Disease diagnosis	CSP	473 (79.4)	123 (20.6)	0.003
	PHN	90 (81.8)	20 (18.2)	
	CRPS	94 (65.7)	49 (34.3)	
Disease duration	< 1 yr	138 (83.6)	27 (16.4)	0.121
	≤ 1 yr, < 3 yrs	153 (75.7)	49 (24.3)	
	≤ 3 yrs, < 5 yrs	119 (79.3)	31 (20.7)	
	≤ 5 yrs	275 (74.7)	93 (25.3)	
Changes in hospital visit frequency	Decreased	226 (70.0)	97 (30.0)	0.198
	Not changed	457 (82.0)	100 (18.0)	
Changes in sleep duration	Decreased	113 (61.7)	70 (38.3)	< 0.001
	Not changed	560 (81.5)	127 (18.5)	
Changes in depressive mood	Not changed	426 (86.9)	64 (13.1)	< 0.001
	Increased	248 (65.1)	133 (34.9)	
Changes in exercise hours	Decreased	260 (69.3)	115 (30.7)	< 0.001
	Not changed	336 (83.0)	69 (17.0)	
	Increased	88 (84.6)	16 (15.4)	
Changes in time outside	Decreased	529 (75.6)	171 (24.4)	0.004
	Not changed	139 (84.2)	26 (15.8)	
	Increased	15 (93.8)	1 (6.2)	
Changes in weight	Decreased	109 (68.1)	51 (31.9)	< 0.001
	Not changed	380 (83.2)	77 (16.8)	
	Increased	186 (72.9)	69 (27.1)	

Values are mean ± standard deviation or represent the number of patients (%).
The numbers exclude patients that did not respond to each group or item's questionnaire.
COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome.

sleep evaluation is important in chronic pain management.

The PHQ-9 is a useful tool for diagnosing depressive disorders and consists of nine items [16,18]. Depression in patients with chronic pain has been increasing since the COVID-19 outbreak. The percentage of patients complaining of major depressive disorders was 70.2% in the CRPS group, which was higher than in the PHN (27.4%) and CSP (26.0%) groups. The proportion of patients suffering from severe depression was also the highest in the CRPS group compared to the other two groups, indicating that patients with CRPS experience particularly more depression than the other two groups. A previous study has already revealed the impact of COVID-19-related distress on patients with chronic pain, and patients with different diseases had distinct changes [25]. The prevalence of depression is also higher in patients with chronic pain than in the general population, and it was notably observed in patients with no psychiatric history [38]. It is necessary to understand that unrecognized depression is common in patients with

Table 9. Logistic-regression analysis for factors associated with increased pain score after the COVID-19 pandemic

Variable	95% CI	OR	P value
Disease diagnosis			
CSP	0.966 to 2.334	1.502	0.071
PHN	0.842 to 3.107	1.617	0.149
CRPS[a]			
Changes in exercise hours			
Increased	1.174 to 4.175	2.214	0.014
No change	1.172 to 2.657	1.765	0.007
Decreased[a]			
Changes in weight			
Increased	0.824 to 2.171	1.337	0.240
No change	0.954 to 2.423	1.520	0.078
Decreased[a]			
Changes in depressive moods			
No change	1.869 to 3.976	2.726	< 0.001
Increased[a]			
Changes in sleep duration			
No change	1.322 to 2.970	1.982	0.001
Decreased[a]			
Changes in time outside			
Increased	0.591 to 12.999	2.772	0.196
No change	0.653 to 1.563	1.010	0.965
Decreased[a]			

COVID-19: coronavirus disease 2019, CSP: chronic spinal pain, PHN: post-herpetic neuralgia, CRPS: complex regional pain syndrome, CI: confidence interval, OR: odds ratio.
[a]Reference category.

chronic pain. In addition, depression above moderate levels can affect the prognosis of the disease and treatment of chronic pain [39], thus requiring active treatment.

In this study, the post-COVID-19 outbreak pain score was the highest in CRPS patients. The pain scores in the CSP and PHN patients dropped slightly during the pandemic, while the score in the CRPS group increased. This is potentially related to several factors. As shown in **Fig. 2A**, the CRPS group had a smaller decrease in their number of hospital visits that was a result of pain improvement, as compared to other chronic pain patients. This is thought to be because of the intractable pain of CRPS patients compared to other chronic pain diseases. Therefore, even if treated, the proportion of patients who only control their symptoms and do not improve significantly is higher. In this study, increased pain was associated with decreased exercise duration, increased depression, and decreased sleep duration. However, in a comparison between the three disease groups, there was no statistical difference in exercise duration, but there were statistical differences in sleep duration and depression between the three groups. The proportion of patients in the CPRS group with decreased sleep duration and increased depression was higher than in the other groups. It is believed

that these factors were related to the increased pain of CRPS patients after the onset of the COVID-19 pandemic. Other studies have reported that the limited hospital visits due to risk of infection may have exacerbated the pain, which leads to a vicious cycle of increased depression due to worsening pain [38,40]. However, the analysis through logistic regression in this study found that the decrease in visit frequency is not associated with an increase in pain.

The total PHQ-9 scores were calculated. We evaluated major depressive disorders in patients with chronic pain, classified by their disease type, based on the commonly used cut-off of the PHQ-9 [21]. The total mean PHQ-9 score for CRPS patients was 15.5, which was above the cut-off score; in contrast, the mean scores for CSP and PHN patients were 6.61 and 6.58, respectively. Increased pain index score and depression were generally seen in all patients with chronic pain, but major depressive disorders were noticeable in CRPS patients. It is commonly known that patients with CRPS generally have high PHQ-9 scores [41]. Therefore, it is difficult to correlate these scores to COVID-19 due to the nature of CRPS itself. This should be considered in the management of pain in CRPS patients, and various methods, including consultation with psychiatrists, regular assessment of depression through visits, and appropriate medication and psychotherapy should be employed. A previous study has already discussed the importance of pain management during the pandemic while considering the risks and benefits [42].

According to another study, chronic pain disorders do not change significantly due to external factors such as COVID-19 [43]. In this study, lack of exercise, depression, and sleep disturbance were frequently observed in patients with chronic pain [44], and these have become more prominent since the COVID-19 outbreak [2]. Thus, factors related to increased pain were evaluated. In this study, decreased exercise duration, decreased sleep duration, and increased depression were significantly associated with increased pain in the patients. Therefore, in order to improve patients' pain, pain physicians should recommend regular exercise, sufficient sleep, and management of depression.

Severe acute respiratory syndrome (SARS) was a massive infectious disease outbreak. Studies have reported on patients with post-traumatic stress disorder and depression after contracting SARS [22,45]. Based on these results, COVID-19 is also more likely to lead to psychological aftereffects, especially in patients with chronic pain who are vulnerable to mental stress [46]. Based on the psychosocial and coping responses to past infectious disease cases in the community healthcare environment, alternative measures for this pandemic can be established in advance [47]. It is therefore necessary to strengthen the preparation and

capabilities of healthcare professionals to detect and manage these.

Although this study offers valuable information regarding the impact of COVID-19 on patients with chronic pain during the pandemic, some important limitations should be considered. One of the limitations of this study is the selection bias of the candidates. This survey was limited to patients at university hospitals where patients with severe pain were treated. Because the survey was conducted on patients visiting university hospitals, the symptoms of patients who were unable to visit the hospitals due to the risk of COVID-19 infection or the worsening of severe pain during the pandemic were overlooked. Second, the questions (except for the PHQ-9 questions) in this survey were not tested prior to the study. However, the Korean version of the PHQ-9 has been well evaluated [48]. Third, CO-VID-19 may change patients' work or school life. However, we did not investigate these topics. Further evaluations of these potential changes are required. Fourth, with regard to post-COVID-19 changes, we did not investigate whether patients actually contracted COVID-19, or whether someone in their immediate family contracted or died from CO-VID-19. We also did not investigate whether the patients were married, living alone, or had children, all of which can affect baseline depression or anxiety. Moreover, we only examined changes in exercise duration, but we did not investigate the types of exercise in detail; therefore, the range of exercise duration reported by patients was quite wide. However, the data obtained in this study does accurately reflect changes in lifestyle. Another limitation is that only CRPS, CSP, and PHN subjects were included in the study. The disease groups of CSP and PHN included in the study were centered on the patient group, which included the largest proportion of patients in the investigation. The CRPS group was not common but intractable and severe pain disease, we want to investigate how it was affected by COVID-19. It would have been more variable if chronic pain patients commonly found in outpatient clinics, including those with joint pain, neuropathic pain, and chronic musculoskeletal pain, were included. Further studies are needed to increase the generalizability of these results to broader populations. Finally, we asked patients with chronic pain to participate in the survey and only those who agreed were included. However, the number of patients who declined the survey was not confirmed. In the case of the authors' hospital, all patients who were requested to complete the survey participated, and no patients refused to participate.

In conclusion, a total of 41.6% of participants reduced their visits to hospitals during the pandemic. Concern for coronavirus infection was the major reason for their reduced visits in all three groups. Noticeable differences determined in the patients included changes in exercise duration, time outside, sleep patterns, mood, and weight. Moreover, CRPS patients had statistically higher total PHQ-9 scores than CSP and PHN patients. The total average PHQ-9 score of patients with CRPS was 15.5, corresponding to major depressive orders. According to the logistic regression analysis, decreased exercise duration, decreased sleep duration, and increased depression were significantly associated with increased pain in patients. Therefore, to reduce pain and improve daily life, pain physicians should recommend regular exercise, sufficient sleep, and depression management for patients with chronic pain.

CONFLICT OF INTEREST

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

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Appendix

Q1. What is your sex?
1. Male   2. Female

Q2. Please write down your age.
(_____ years)

Q3. What chronic pain disease do you have?
1. CRPS   2. Chronic spine pain   3. Post-herpetic neuralgia

Q4. How long have you been suffering from chronic pain?
1. Less than a year   2. 1 year ≤ period < 3 years
3. 3 years ≤ period < 5 years   4. ≥ 5 years

Q5. How frequently did you visit the hospital for treatment for your chronic pain disease in the six months before the COVID-19 outbreak (before January 2020)?
1. More than twice a week   2. Once a week   3. Once every two weeks
4. Once a month   5. Less than once a month

Q6. Have there been any changes in the frequency of your visits to hospitals for pain treatment during the COVID-19 pandemic since February 2020?
1. Yes   2. No

Q6-1. If there was a change in the frequency of your visits to the hospital, what was the change?
1. I barely visited the hospital (reduced number of visits by more than 76%)
2. I've reduced the visits to the hospital (reduced number of visits by more than 75%–26%)
3. I've slightly reduced the visits to the hospitals (reduced number of visits by less than 25%)
4. No change
5. It has increased

Q6-2. If the number of visits has decreased, what is the cause?
1. Impact of COVID-19   2. Decrease in pain   3. Others

Q7. If you reduced your visit to the hospital during the COVID-19 pandemic, why? (multiple responses available)
1. The media said it was dangerous (influence of the media)
2. Family members and acquaintances said it was dangerous (influence of family and acquaintances)
3. I thought I should cut back on my visits to the hospital
4. Economic reasons
5. Others

Q8. Is there any change in your degree of pain caused by your chronic pain disease compared to before the COVID-19 outbreak?
1. The pain worsened   2. There's been no change   3. The pain has decreased

Q8-1. If there is a change in the degree of pain, please indicate your pain degrees before and after the COVID-19 outbreak (0: no pain at all; 10: the most severe pain imaginable; 7 to 8 points: pain equivalent to childbirth).
Before COVID-19 _____ point → Current _____ point, pain degree changes

The following questions are about life patterns (Q9–Q15).
Q9. Is there any change in your weekly exercise duration after the COVID-19 outbreak?
1. It has increased   2. No change   3. It has decreased

Q9-1. If your exercise duration has reduced, how much has it decreased compared to before?
1. The time has decreased substantially (66% or more)
2. The time has decreased by about half (33–65%)
3. The time has decreased slightly (32% or less)

Q10. Has there been a change in the duration that you go out?
1. It has increased   2. No change   3. It has decreased

Q10-1. If you go out for less time, how much has the time you go out decreased compared to before?
1. The time has decreased substantially (66% or more)
2. The time has decreased by about half (33–65%)
3. The time has decreased slightly (32% or less)

Q11. Has there been a change in your sleeping duration?
1. It has increased   2. No change   3. It has decreased

Q12. Have you experienced any weight changes in the last 3 months?
1. I have gained more weight than before
2. No change
3. I have lost weight compared to before

Q13. Have you experienced a change in your frequency of nervousness or anger compared to before the COVID-19 outbreak?
1. It has increased   2. No change   3. It has decreased

Q14. Has there been a change in your frequency of anxiety compared to before the COVID-19 outbreak?
1. It has increased   2. No change   3. It has decreased

Q15. Has there been a change in your frequency of mood changes or depression compared to before the COVID-19 outbreak?
1. It has increased   2. No change   3. It has decreased

The following questions are found in the depression survey (Q16–Q25).
Please indicate how often you experienced the following problems in the last two weeks.

Q16. Have you ever felt that there was little interest or pleasure in everything?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q17. Have you ever felt down, depressed, or hopeless?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q18. Have you ever experienced difficulties in falling asleep, staying asleep, or have you been sleeping too much?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q19. Have you ever felt tired or had little energy?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q20. Have you ever lost your appetite or eaten too much?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q21. Have you ever felt bad about yourself, that you are a failure, or have let yourself or your family down?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q22. Have you ever found it difficult to focus on everyday tasks, such as reading newspapers or watching television?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q23. Have you ever moved or spoken so much slower than usual that other people could have noticed? Or the opposite -
been so fidgety or restless that you have been moving around a lot more than usual?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q24. Have you ever thought it would be better off dead or self-harmed in some way?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer

Q25. If any of the questions apply to you in questions 13–25, to what extent do you find your daily life difficult (work,
housework, interpersonal relationship)?
1. Not at all   2. Several days   3. More than a week   4. Nearly everyday   5. No answer