



# The Difference in the Quality of Life of Korean Children With Attention-Deficit/Hyperactivity Disorder Between Before and After COVID-19

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**Objectives:** This study aimed to compare the quality of life (QoL) of children with attention-deficit/hyperactivity disorder (ADHD) before and during coronavirus disease-2019 (COVID-19) and to examine how their QoL is affected by emotional and environmental factors during COVID-19.

**Methods:** Participants in the pre-COVID-19 (n=43) and COVID-19 (n=36) groups were recruited from the same university hospital. The Pediatric Quality of Life Inventory (PedsQL) 4.0 Child Self-report, the Children's Depression Inventory (CDI), the Revised Children's Manifest Anxiety Scale (RCMAS), the PedsQL 4.0 Parent Proxy Report, and the Conners' Parent Rating Scale (CPRS) were employed. Independent t-tests, Pearson's correlation analysis, and multiple regression analysis were conducted.

**Results:** Caregivers assessed the children's QoL more negatively than the children themselves in both groups. Children with ADHD evaluated their physical function more negatively and anxiety was significantly higher in the COVID-19 group. In the COVID-19 group, the PedsQL child self-report was significantly predicted by the CPRS, the CDI, and environmental factors (i.e., relation to child and monthly household income).

**Conclusion:** Children with ADHD in the COVID-19 group had a numerically lower QoL and significantly higher anxiety. To improve QoL, it is important to deal with not only depression but also ADHD symptoms and environmental factors.

**Keywords:** COVID-19; Attention-deficit/hyperactivity disorder; Quality of life; Depression; Anxiety.

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## INTRODUCTION

As the coronavirus disease-2019 (COVID-19) pandemic stretches on, many are concerned about its effects on mental health. During previous viral outbreaks, such as severe acute respiratory syndrome and swine flu (H1N1), quarantine to prevent the spread of infectious diseases has affected individuals' mental health and quality of life (QoL) [1]. While many studies have focused on adults, research on children's mental health during pandemics is limited [2].

Worldwide quarantine and school closures have been enforced to prevent COVID-19 infection. After these measures were implemented, everyday life changed. Instead of attending school, children remained at home, many of whom were accompanied by their parents who worked from home or were

laid off. During the quarantine period, children in the general population were affected by various stressors, including the quarantine itself, fear of infection, boredom, inadequate information, lack of social interaction, and family financial loss [3]. Especially, children younger than 18 years have suffered from more severe psychiatric symptoms during school closures [4]. Moreover, statistics indicate that negative emotions such as depression and anxiety, increased [5].

Children with attention-deficit/hyperactivity disorder (ADHD) are more susceptible to environmental changes and have difficulty adapting to the complexity of the situation. They also have lower levels of tolerance towards the uncertainties arising from COVID-19. Furthermore, ADHD symptoms have context-dependent characteristics and can be aggravated by exposure to stress [6]. Therefore, children with ADHD were affected more than others, and their symptoms were more severe than during the pre-COVID-19 period [7,8]. During this the pandemic, anxiety and behavioral problems

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were exacerbated. These changes and aggravation of ADHD symptoms can contribute to the development of major depression, substance use disorders, and interfamilial conflicts [9]. For children with ADHD, both the symptoms and QoL have worsened during COVID-19 [10].

QoL is a multidimensional construct that consists of psychological, social, emotional, and physical functions [11]. In the previous study on the QoL of Korean children with ADHD conducted before COVID-19, school function had the greatest impact on children's QoL and was influenced by conflicts between peers [12]. As school life can affect their QoL, children with ADHD in Korea may have experienced a significant environmental shift during the COVID-19 pandemic.

Some studies have evaluated children's QoL during the COVID-19 pandemic. However, most studies conducted during COVID-19 regarding children's QoL only involved caregiver evaluations and were executed by indirect methods such as social network service research forms or text messages [13]. Considering the QoL reported by children was investigated from the caregiver's perspective, a self-study of children's QoL is needed [12].

In this study, we hypothesized that the QoL of children with ADHD is lower during COVID-19 than in the pre-COVID-19 period. Second, the QoL of children with ADHD was evaluated as lower by caregivers than by the children themselves, as in the previous study [12]. To confirm the hypotheses, we selected data from a previous study conducted at an identical university hospital as the pre-COVID-19 group [12]. Primarily, we compared the QoL of children with ADHD before and during COVID-19. Furthermore, we investigated the differences in the perspectives of children and caregivers regarding QoL. Lastly, we examined how the severity of ADHD symptoms, emotional factors such as depression and anxiety, and environmental factors could affect children's QoL during the COVID-19 pandemic.

## METHODS

The COVID-19 pandemic group was recruited from November 1, 2020 to May 31, 2021 when they visited the outpatient department of psychiatry at Inha University Hospital, located in Incheon, South Korea. The recruited participants were diagnosed with ADHD based on criteria stipulated in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders. Participants included both the patients and their caregivers. The inclusion criteria were patients with ADHD aged between 7 and 12 years who had attended elementary school. Patients with comorbid mental disorders, seizure disorders, organic brain syndrome, or hospitalization for other internal diseases in the four weeks prior to the study

were excluded. Patients or caregivers who did not want to participate were also excluded. Caregivers were defined as family members who spent most of their time with the patient or who supported the patient economically.

Patients who met the inclusion criteria and their caregivers received information regarding the research purpose during the recruitment period. If both the patient and caregiver agreed to participate in the study, the researchers obtained their written consent. Subsequently, the patient and caregiver filled out questionnaires individually in separate areas with the assistance of a psychiatry resident. If they had trouble understanding the questionnaire, the attending psychiatrist clarified the unclear items. This study was approved by the Institutional Review Board of Inha University Hospital (IRB No. 2020-09-010).

The COVID-19 pre-pandemic group subjects were selected from the previous study on the QoL of children with ADHD conducted by the same university hospital's Department of Psychiatry. The inclusion and exclusion criteria were the same as those used for the during COVID-19 group (hereafter, the COVID-19 group) [12]. COVID-19 infection of caregivers and children was irrelevant to this study and not a consideration for either the pre-COVID-19 or COVID-19 group.

## Measures

We collected caregivers' demographic characteristics, including sex, age, education, employment status, marital status, relationship to child, cohabitation, and monthly household income. The patient demographics included sex, age, and school grade. Regarding employment status, housewives were included in the unemployed group. Marital status consisted of single, married, and other (i.e., divorced, bereaved). Monthly household income was divided into under and above 2000000 won, which was based on the average income for a three-person (1935289 won) and four-person (2374587 won) household announced in 2020 for lower-income families in South Korea [14]. The definition of a "lower-income family" is a family in which the total income is low but insufficient to qualify for government assistance. The evaluation scales for children's QoL and emotional factors were the same as those used in previous studies [12].

## Korean version of the Pediatric Quality of Life Inventory 4.0

### PedsQL 4.0 Child Self-Report

A Korean version of the Pediatric Quality of Life Inventory version 4.0 (PedsQL 4.0), generic core scale, was used to evaluate QoL. Children reported their QoL using the self-report (version 4.0) for those aged 8 and 12 years. Varni et al. [15] created the PedsQL version 4.0 generic core scale, and Kook

and Varni [16] translated it into Korean and validated it. It consists of 23 items and is divided into four subscales consisting of eight physical functioning items, five emotional functioning items, five social functioning items, and five school functioning items. Each questionnaire was scored on a 4-point Likert scale ranging from 0 to 4 (0=never a problem, 1=barely a problem, 2=sometimes a problem, 3=frequently a problem, and 4=almost always a problem). Each item was reverse-scored and linearly transformed into a 0–100 scale: 0 score was converted to 100, 1 to 75, 2 to 50, 3 to 25, and 4 to 0. The converted scores were summed and divided by the total number of questionnaires. A higher score indicates a higher QoL reported by the child. Based on Kook and Varni [16], Cronbach's  $\alpha$  was between 0.72 and 0.87 for each subscale, and the total internal consistency was 0.90.

#### PedsQL 4.0 Parent Proxy Report

The child's QoL from the caregiver's perspective was evaluated using the PedsQL 4.0, a generic core scale parent version. Similar to the children's version, Varni et al. [15] created the PedsQL 4.0 generic version, and Kook and Varni [16] translated it into Korean and validated it. It consists of 23 items and is divided into four subscales comprised of eight physical functioning items, five emotional functioning items, five social functioning items, and five school functioning items. Kook and Varni's [16] research indicates that Cronbach's  $\alpha$  ranged from 0.75 to 0.88 for each subscale, and the total internal consistency coefficient was 0.90.

#### Conners' Parent Rating Scale

The Korean version of the Conners' Parent Rating Scale (CPRS) [17] was used to evaluate the severity of ADHD symptoms in children. Caregivers of children with ADHD have reported it. Park et al. [18] translated and validated the scale into Korean. The scale has been used in various studies and proven to be reliable. This study used a simple version to evaluate ADHD and problematic behavior-related symptoms. It consists of 48 items and, each scored on a 3-point Likert scale points based on the severity of the children's behavior. The parental version consists of five subscales: attitude, learning, psychophysical, impulsivity/hyperactivity, and anxiety problems. Based on Park et al. [18], Cronbach's  $\alpha$  ranged from 0.53 to 0.82 for each subscale. Cronbach's  $\alpha$  of subscales for psychophysical and anxiety problems were 0.63 and 0.53 respectively. If these subscales are excluded, Cronbach's  $\alpha$  of the remaining subscales ranges from 0.75 to 0.82.

#### Children's Depression Inventory

The Children's Depression Inventory (CDI) is used to evaluate depression in children. It was created by Kovacs [19] and

translated into Korean by Cho and Lee [20]. It can be used in children aged 7–17 years. The questionnaire is a self-report consisting of 27 items. Children score each item from 0 to 2 points based on the severity of their depression. Total scores range from 0 to 54 points with higher scores indicating more severe depression. Based on Cho and Lee [20], Cronbach's  $\alpha$  was 0.88.

#### Revised Children's Manifest Anxiety Scale

The revised Child Manifest Anxiety Scale (RCMAS) evaluates children's anxiety. It was created by Reynolds and Richmond [21] and translated into Korean by Choi and Cho [22], and is a self-report with 37 items (nine false items and 28 anxiety items). Children can answer "yes" or "no" on a 2-point scale. Total scores range from 0 to 28 points, with higher scores indicating higher anxiety in children. Based on the research by Cho and Lee [20], its Cronbach's  $\alpha$  was 0.81.

#### Statistical analysis

Chi-square tests were conducted to compare the demographic characteristics between the pre-COVID-19 and COVID-19 groups. Age did not meet the normality test because younger children participated more. For this reason, the Mann-Whitney U test was used to compare the age of children in both groups. Fisher's exact test was conducted if more than 20% of the cells had lower than five expected frequencies. QoL and other factors (severity of symptoms, depression, and anxiety) were compared between the pre-COVID-19 and COVID-19 groups using an independent t-test.

Pearson's correlation analysis was used to analyze the correlation between QoL and other factors between the two groups. Multiple regression analysis was conducted to analyze the influence of each factor on the QoL. Nominal variables were converted to dummy variables for the regression analysis. The dummy variables were a series of dichotomous variables, and these created variables were entered into the regression. SPSS version 19 for Windows (IBM Corp., Armonk, NY, USA) was used, and statistical significance was set at  $p < 0.05$ .

## RESULTS

#### Demographic characteristics

The pre-COVID-19 and COVID-19 groups consisted of a total of 43 and 36 children and their caregivers, respectively. The groups were mutually exclusive, and there were no overlapping participants between children and caregivers. There were also no significant differences in the children's age, sex, and grade between the two groups (Table 1). In addition, there were no significant differences in the caregivers' age, education, employment status, marital status, cohabitation, or monthly

household income between the two groups. Monthly household income did not differ significantly between the two groups. Most caregivers' incomes were higher than KRW 2000000. However, caregivers' relationships with their children showed significant differences between the two groups. Those whose relationships with children were fathers were included only in the COVID-19 group, not in the pre-COVID 19 group. Other relationships (e.g., grandparents or aunt) were more prevalent in the COVID-19 group than in the pre-COVID-19 group (Table 2).

**Comparison of QoL reported by children vs. a caregiver**

In the PedsQL 4.0 parent proxy report, there were no significant differences between the pre-COVID-19 and COVID-19

**Table 1.** Demographic characteristics for children

	Pre COVID-19 (n=43)	COVID-19 (n=36)	U or $\chi^2$	p
Child				
Age, yr	9.17 ± 1.68	8.87 ± 1.58	698.500	0.457
Sex			2.247	0.134
Male	34 (79.1)	23 (63.9)		
Female	9 (20.9)	13 (36.1)		
Grade			6.361	0.265
1st grade	11 (25.6)	7 (19.4)		
2nd grade	8 (18.6)	8 (22.2)		
3rd grade	6 (14.0)	11 (30.6)		
4th grade	11 (25.6)	3 (8.3)		
5th grade	3 (7.0)	3 (8.3)		
6th grade	4 (9.3)	4 (11.1)		

Data are presented as mean ± standard deviation or n (%)

**Table 2.** Demographic characteristics for care-givers

	Pre COVID-19 (n=43)	COVID-19 (n=36)	U or $\chi^2$	p
Age			2.475	0.398
< 30	0 (0.0)	2 (5.6)		
31–40	21 (48.8)	16 (44.4)		
> 40	22 (51.2)	18 (50.0)		
Education			0.336	0.924
< high school	2 (4.7)	1 (2.8)		
High school	17 (39.5)	13 (36.1)		
> high school	24 (55.8)	22 (61.1)		
Employment status			0.020	0.886
Yes	21 (48.8)	17 (47.2)		
No*	22 (51.2)	19 (52.8)		
Marital status			0.464	0.895
Single	2 (4.7)	2 (5.6)		
Married	37 (86.0)	29 (80.6)		
Other (divorced/ bereaved)	4 (9.3)	5 (13.9)		

Data are presented as n (%). \*no includes housewife

groups' total scores (66.658±11.835 vs. 63.980±11.427, p=0.312). When the subscale scores were compared, there were no significant differences between the pre-COVID-19 and COVID-19 groups.

In the PedsQL 4.0, there were no significant differences between the pre-COVID-19 and COVID-19 groups when the total scores were compared (77.427±13.545 vs. 71.709±13.517, p=0.065). The physical functioning subscale score was significantly higher in the pre-COVID-19 group than that in the COVID-19 group (81.613±14.581 vs. 68.750±15.346, p<0.001). No significant differences were found in any of the other subscales (Table 3).

When comparing the PedsQL 4.0 parent proxy report and child self-report, the parent proxy report had significantly lower scores than the child self-report in both the pre-COVID-19 and COVID-19 groups (pre-COVID-19 group, 66.658±11.835 vs. 77.427±13.545, p<0.001; COVID-19 group, 63.980±11.427 vs. 71.709±13.517, p=0.013).

When analyzed by subscales, emotional, social, psychosocial functioning scores were significantly lower in the PedsQL 4.0 parent proxy report than in the PedsQL 4.0 child self-report in both the pre-COVID-19 and COVID-19 groups. School functioning scores were significantly lower in the pre-COVID-19 group (Supplementary Table 1 in the online-only Data Supplement).

**Comparison of the severity of symptoms and emotional factors (depression, anxiety) between the pre-COVID-19 and COVID-19 groups**

A comparison of the severity of symptoms measured using the CPRS showed no significant differences between the two groups (p=0.200). However, there was a significant difference in the anxiety subscale scores between the pre-COVID-19 and COVID-19 groups (8.700±2.891 vs. 6.806±3.905, p=0.016).

The emotional factors reported by the children were compared. Depression, as measured by the CDI, was not significantly different between the two groups (p=0.986); however, anxiety, as measured by the RCMAS, was significantly lower in the pre-COVID-19 than COVID-19 group (11.140±5.955 vs. 15.222±6.821, p=0.006) (Table 4). In terms of anxiety, caregivers reported their children had lower anxiety, but the children themselves reported higher anxiety during COVID-19 than before the pandemic.

**Correlation of each PedsQL parent and child self with CPRS, CDI, and RCMAS in the pre-COVID-19 and COVID-19 periods**

In the pre-COVID-19 group from the previous study, the PedsQL parent total score was correlated with the CPRS and

**Table 3.** Comparison between the PedsQL parent proxy report and PedsQL self-report scores between the pre-COVID-19 and COVID-19 groups

PedsQL scale	Pre COVID-19 (n=43)	COVID-19 (n=36)	t	p
PedsQL-parent				
PedsQL total	66.658 ± 11.835	63.980 ± 11.427	1.018	0.312
PedsQL physical	75.727 ± 19.346	69.965 ± 17.267	1.384	0.170
PedsQL emotional	59.883 ± 17.745	58.611 ± 15.147	0.339	0.735
PedsQL social	61.163 ± 17.622	58.750 ± 16.052	0.631	0.530
PedsQL school	64.419 ± 13.853	65.500 ± 12.189	-0.196	0.849
PedsQL psychosocial	61.822 ± 11.338	60.787 ± 11.461	0.402	0.689
PedsQL-child self				
PedsQL total	77.427 ± 13.545	71.709 ± 13.517	1.870	0.065
PedsQL physical	81.613 ± 14.581	68.750 ± 15.346	3.813	<0.001*
PedsQL emotional	74.767 ± 19.668	69.167 ± 24.480	1.128	0.263
PedsQL social	74.651 ± 23.462	77.222 ± 20.991	-0.509	0.612
PedsQL school	76.163 ± 17.038	71.806 ± 18.790	1.080	0.283
PedsQL psychosocial	75.194 ± 15.695	72.732 ± 15.114	0.706	0.482

Data are presented as mean ± standard deviation. \*p < 0.01. PedsQL, Pediatric Quality of Life Inventory version 4.0 generic core scale

**Table 4.** Comparison of CPRS, CDI, and RCMAS between the pre-COVID-19 and COVID-19 groups

	Pre COVID-19 (n=43)	COVID-19 (n=36)	t	p
CPRS	41.116 ± 15.520	36.389 ± 16.979	1.292	0.200
Impulsive-hyperactive	14.023 ± 6.933	12.444 ± 6.336	1.048	0.298
Conduct problem 1	8.465 ± 4.516	7.694 ± 4.187	0.781	0.437
Anxiety	8.700 ± 2.891	6.806 ± 3.905	2.471	0.016†
Psychosomatic	1.628 ± 1.604	1.389 ± 1.691	0.649	0.518
Conduct problem 2	0.465 ± 0.631	0.528 ± 0.941	-0.353	0.725
CDI	11.721 ± 6.981	11.694 ± 6.013	0.018	0.986
RCMAS	11.140 ± 5.955	15.222 ± 6.821	-2.840	0.006*

Data are presented as mean ± standard deviation. \*p < 0.01; †p < 0.05. CPRS, Conners' Parent Rating Scale; CDI, Children's Depression Inventory; RCMAS, Revised Child Manifest Anxiety Scale

**Table 5.** Correlation of each PedsQL parent and child self with CPRS, CDI, and RCMAS in pre-COVID-19 and COVID-19 periods

	Pre COVID-19			COVID-19		
	CPRS total	CDI	RCMAS	CPRS total	CDI	RCMAS
PedsQL parent total	-0.466*	-0.331†	-0.223	-0.541*	-0.235	-0.276
PedsQL child self total	-0.165	-0.566*	-0.509*	0.159	-0.577*	-0.403†

\*p < 0.01; †p < 0.05. PedsQL, Pediatric Quality of Life Inventory version 4.0 generic core scale; CPRS, Conners' Parent Rating Scale; CDI, Children's Depression Inventory; RCMAS, Revised Child Manifest Anxiety Scale

the CDI scores. However, the PedsQL child self-total score was correlated with the CDI and the RCMAS scores. Similarly, the PedsQL child self-total score was correlated with the CDI and RCMAS scores in the COVID-19 group, whereas the PedsQL parent total score was correlated only with the CPRS total score (Table 5). In both the pre-COVID-19 and COVID-19 groups, the PedsQL parent subscales tended to correlate with the CPRS subscales. In contrast, the PedsQL child self-subscales tended to correlate with the CDI and RCMAS (Supplementary Tables 2 and 3 in the online-only Data Supplement).

### Effects of factors (symptom severity, depression and anxiety) on the QoL reported by caregivers and children

Multiple regression analysis was used to evaluate the effects of ADHD symptom severity, depression, and anxiety on the QoL. Caregivers' relationship to their child and monthly household income were nominal variables, so they were converted to a series of dichotomous variables for regression analysis.

In the pre-COVID-19 group, the child's age, sex, and caregiver's relationship with the child were adjusted. As a result, the total PedsQL 4.0 parent proxy report was significantly pre-

**Table 6.** Associations between the PedsQL parent proxy report and child self-report with other variables by multiple linear regression analyses

Dependent variable	R <sup>2</sup>	F	p	Independent variables	β	t	p
Pre COVID 19							
PedsQL parent	0.366	2.448	0.033†	CPRS	-0.453	-2.623	0.013†
PedsQL child self	0.432	3.239	0.008*	CDI	-0.505	-2.308	0.027†
COVID 19							
PedsQL parent	0.461	2.138	0.060	CPRS	-0.476	-2.593	0.016†
PedsQL child self	0.706	5.237	<0.001*	CPRS	0.346	2.424	0.023†
				CDI	-0.545	-3.763	<0.001*
				Relation (father)	-0.395	-2.109	0.046†
				Monthly income (>2000 K)	0.470	3.290	0.003*

\*p < 0.01; †p < 0.05. PedsQL, Pediatric Quality of Life Inventory version 4.0 generic core scale; CPRS, Conners' Parent Rating Scale; CDI, Children's Depression Inventory; reference group: relation (mother), monthly income (< 2000 K)

dicted by the total CPRS score. CDI significantly predicted the total PedsQL 4.0 child self-report score.

In the COVID-19 group, the child's age, sex, and caregiver's relation to the child was adjusted and total score of the PedsQL 4.0 child self-report was additionally adjusted by monthly household income. The total PedsQL 4.0, the parent proxy report score, was predicted by the CPRS, but was not significant. The total score of the PedsQL 4.0, i.e., the child self-report, was predicted by the total score of the CPRS, the CDI, relation to child, and monthly household income. When the caregiver was the father, the total score of PedsQL 4.0 child self-report was predicted negatively. When monthly household income was higher than KRW 20000000, the total score of the PedsQL 4.0, child self-report, was predicted positively (Table 6).

## DISCUSSION

In this study, we hypothesized that the QoL of children with ADHD would be lower in the COVID-19 group than in the pre-COVID-19 group. To compare the two time periods, the previous study—originally designed to compare the QoL of children with ADHD as reported by themselves and their caregivers—conducted by an identical hospital was used as the control group (the pre-COVID-19 group) [12].

Additionally, we evaluated whether different perspectives on the QoL of children with ADHD between the children themselves and their caregivers persisted during the COVID-19 period. We also analyzed the severity of ADHD symptoms and the emotional factors that can affect the QoL of children with ADHD. The results of the previous study showed differences in perceptions regarding the QoL of children with ADHD between patients and their caregivers. The CDI scale significantly predicted self-reported QoL in ADHD children. In contrast, the CPRS scores for the severity of ADHD symptoms significantly predicted the QoL of children with ADHD,

as reported by caregivers [12].

In terms of demographic characteristics, the children in both the groups showed no significant differences. However, caregivers' relationships with their children were significantly different between the two groups. Unlike the pre-COVID-19 group, the COVID-19 group comprised fathers as caregivers.

## QoL

When comparing the QoL of children with ADHD between the two groups, the total QoL score measured by both caregivers and children was lower in the COVID-19 group than in the pre-COVID-19 group, but the difference was not significant. This study's hypothesis that the QoL of children would be lower in COVID-19 patients was shown only in numerical terms. Although there was no difference in the total score for QoL reported by the children, the Physical Functioning subscale score of the PedsQL child self-report was significantly lower in the COVID-19 group than in the pre-COVID-19 group. The Physical Functioning subscale contains questions on the level of difficulty in performing physical activities and pain in daily life. Through these questions, it can be interpreted that the quarantine situation of being restricted to a limited area affected physical function and QoL. Furthermore, children with ADHD and comorbid depression or anxiety are significantly associated with somatic complaints [23,24]. In this study, anxiety, as measured by the RCMAS, showed significantly higher scores in the COVID-19 group than pre-COVID-19 group. Therefore, these results could be interpreted as indicating that children with ADHD experienced higher anxiety expressed through somatic complaints during COVID-19, which was reflected in the lower PedsQL Physical Functioning subscale. However, a more detailed study should be conducted to determine how physical function affects QoL.

The Social Functioning subscale self-reported by children was higher in the COVID-19 group than in the pre-COVID-19

group, although the difference was not statistically significant. This discrepancy was due to a decrease in social activities during the COVID-19 social distancing campaign. Decreased social activity could positively affect ADHD children. A prior study of children in the general population also reported slightly favorable attitudes towards COVID-19 restrictions [25].

When comparing the QoL subscales reported by caregivers and children, caregivers evaluated children's QoL as lower than what the children reported themselves in both groups. In the COVID-19 group, unlike the pre-COVID-19 group, there was no significant difference in school functioning between the caregivers and children's reports. This indicates that the quarantine environment protected some children who had experienced problems, such as fewer friendships, bullying, victimization, and rejection by their peers [26]. This may be due to the fact that the symptoms of hyperactivity and impulsivity can deteriorate relationships with peers [27]. According to the previous study, as domestic children with ADHD are most affected by school functioning, school closures might positively affect children with ADHD [12].

### Severity of ADHD symptoms

The severity of ADHD symptoms was reported by caregivers using the CPRS, and total severity score was not significantly different between the two groups. This was different from the results of previous studies, in which ADHD symptoms worsened during the COVID-19 outbreak [7]. In this study, only the anxiety subscale of the CPRS showed a significant difference and was much lower in the COVID-19 group than in the pre-COVID-19 group. However, anxiety in children with ADHD, which was evaluated using the RCMAS, was significantly higher in the COVID-19 group than in the pre-COVID-19 group. Children with ADHD experience anxiety during COVID-19 [5]. This discordance in anxiety between children and their caregivers was consistent with the findings of a previous study [28]. Furthermore, the type of questionnaire used to assess anxiety could have affected this discordance. The CPRS has only seven questions on anxiety, but the RCMAS consists of 37 questions.

Depression self-measured by children using the CDI did not show a score difference between the two groups. This was different from other studies in which negative emotions, such as depression and anxiety, were higher during the COVID-19 outbreak [5]. The different results may be a consequence of age-related differences in recruitment as this study only included elementary school-aged children. Elementary school children were concerned about their life and health being associated with anxiety but not with depression [29].

Most of the QoL reported by the children was correlated with the CDI and RCMAS scores, but the QoL reported by

the caregivers did not. In addition, most of the symptom severities reported by caregivers did not correlate with the QoL reported by children. These results indicate that the QoL of children with ADHD reported by caregivers was insufficient to reflect their emotional factors. However, QoL reported by the children did not correlate with symptom severity. Thus, children with ADHD—especially elementary school-aged children—experienced anxiety but expressed it physically and not verbally during the COVID-19 pandemic. For these reasons, caregivers perceived that their symptoms had worsened, but they did not recognize a correlation with anxiety.

In the multiple regression results, in the pre-COVID-19 group, the QoL of children with ADHD reported by the caregiver was predicted to be most affected by the severity of symptoms. The QoL of children with ADHD, self-reported by the children, was predicted to be the most affected by depression. This was identical to the previous study when we extracted elementary school-aged children from the original group [12].

In the COVID-19 group, the QoL of children with ADHD reported by caregivers was predicted to be most affected by the severity of symptoms. This result was identical to that of the pre-COVID-19 group, but the difference was not statistically significant. The QoL of children with ADHD, self-reported by the children, was predicted the most by the severity of symptoms, depression, caregiver's relationship with the child, and monthly household income. Caregivers' characteristics can influence both ADHD symptoms and QoL and the association between them [11]. If the reporting caregiver was the father, the QoL of the patient with ADHD was expected to be negative. This indicates that all caregivers should be educated about their children's symptoms to close the gap in understanding between caregivers and children. Monthly household income positively predicted QoL in children with ADHD; thus its effect on QoL of children with ADHD needs to be studied. Contrary to the result of the pre-COVID-19 group, a higher CPRS (more severe symptoms) reported by caregivers predicted a higher QoL in children with ADHD. This result can be inferred from the differences between the caregivers and children. Domestic children with ADHD are greatly distressed by school functioning, as identified in the previous study [12]. However, during the COVID-19 outbreak, children could be freer in their homes and not distressed at school. Owing to school closures, caregivers had to take care of their children with ADHD most of the day. These changes distressed the caregivers [30]. From this, we concluded that the children with ADHD felt that their QoL improved, but their caregivers felt that their child's symptoms worsened.

Among the emotional factors, depressive symptoms were not significantly different between the two groups; however, anxiety symptoms were higher in the COVID-19 group than

in the pre-COVID-19 group. That said, only depressive symptoms significantly predicted QoL in children with ADHD in the multiple regression analysis. Children with ADHD experienced anxiety and expressed it physically during the COVID-19 outbreak period, but a major component in improving QoL was depressive symptoms in both the pre-COVID-19 and COVID-19 groups. Accordingly, further long-term research is needed to determine whether anxiety affects QoL in children with ADHD.

This study has several strengths. First, QoL was reported directly by the children themselves. During the COVID-19 period, most studies on children with ADHD were conducted by their caregivers only or through indirect methods, such as online surveys. Furthermore, as suggested above, children can present differently from their caregivers, so self-reported scores can contribute to a more appropriate understanding the multidimensional aspects of children with ADHD. Second, we employed a comparative study between the pre-COVID-19 and COVID-19 groups, not a cross-sectional study, as most studies have only been conducted during the COVID-19 outbreak. Third, children with ADHD were compared to those who had identical psychiatric disorders, not the general population, to determine how the COVID-19 outbreak affected children with ADHD. Finally, the control group, i.e., the pre-COVID-19 group extracted from the previous study, showed results similar to those of the original group. Based on this result, further research could be conducted on older children included in the previous study [12].

This study has some limitations. First, the sample size was small, and recruitment was conducted in a single-hospital outpatient setting. Second, school management was not identical for each school during the COVID-19 pandemic and depended on the study time and grade. Because of these limitations, further research, including multiple centers and more subjects, is needed. Third, selection bias may have occurred. Caregivers who accepted the study might have paid more attention to their children's status. Fourth, this study did not consider whether children took prescription medications. In this study, participants visited the clinic for the first time. Therefore, we did not consider whether the patients took medication. However, as taking medication can clearly affect children's QoL, further studies are needed. Fifth, some children with ADHD, particularly those aged 7–12 years, were too young to understand the report. However, the attending psychiatrist helped them understand the questions, not their caregivers. Lastly, the COVID-19 and pre-COVID-19 groups were not identical and participated separately. Therefore, other extraneous factors could have contributed to the results. However, we found that there were no significant differences in demographics, especially among the children. In addition,

this study was conducted in an identical hospital clinic and protocol setting with an identical disorder group. That said, as the COVID-19 outbreak or its termination cannot be predicted, further studies are needed. Thus, the COVID-19 group that participated in this study could be re-evaluated after the pandemic ends or tapers off.

## CONCLUSION

The total PedsQL score was lower in the COVID-19 group than in the pre-COVID-19 group. As in the previous study, children with ADHD reported lower QoL than their caregivers. Discrepancies in QoL between children and caregivers remain, even though they have spent more time during the COVID-19 period. Children with ADHD also had lower physical function and higher anxiety than pre-COVID-19 children. Children with ADHD, especially those of elementary school age, could express their anxiety physically. To increase the QoL of children with ADHD, treatments for not only the accompanying depression but also ADHD symptoms itself and improvement of environmental factors (i.e., who takes care of the child, household income) are needed. Further studies are required to evaluate how the COVID-19 outbreak affected children with ADHD after the pandemic.

### Supplementary Materials

The online-only Data Supplement is available with this article at <https://doi.org/10.5765/jkacap.220019>.

### Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author upon reasonable request.

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

### Author Contributions

Conceptualization: all authors. Data curation: Jung-Hoon Lee, Seri Maeng, Jeong-Seop Lee. Formal analysis: all authors. Investigation: Jung-Hoon Lee, Seri Maeng, Jeong-Seop Lee. Methodology: all authors. Project administration: Jung-Hoon Lee, Seri Maeng, Jeong-Seop Lee. Resources: Jung-Hoon Lee, Seri Maeng, Jeong-Seop Lee. Software: Jung-Hoon Lee. Supervision: all authors. Validation: Jung-Hoon Lee, Seri Maeng, Jeong-Seop Lee. Visualization: Jung-Hoon Lee. Writing—original draft: Jung-Hoon Lee. Writing—review & editing: Jung-Hoon Lee, Seri Maeng, Jeong-Seop Lee.

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