



Deterioration of Mental Health in Children and Adolescents During the COVID-19 Pandemic

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This paper reviews the global effect of the coronavirus disease 2019 (COVID-19) pandemic on the mental health of children and adolescents in South Korea, the U.S., Japan, and China. We reviewed research on deteriorated mental health, including increased suicide, suicidal thoughts, and self-harm. Various studies have shown that students' mental health issues, such as depression and anxiety, have worsened during the COVID-19 pandemic. Furthermore, the number of students who committed suicide has significantly increased in the U.S. and Japan. Factors such as prior mental health status, change in daily routine, reduced physical activity, excessive screen time, overuse of electronic devices, and reduced social support have been reported to have a significant effect. The chain of deteriorating mental health among the youth began at the onset of COVID-19, social distancing, and school closure. As youths began to stay at home instead of going to school, they lost opportunities to connect with their friends or teachers, who could provide support outside of their homes. Young people spent less time on physical activity and more time online, which damaged their sleeping schedule and daily routine. In preparing for the post-pandemic phase, we should thoroughly analyze the long-term effects of the pandemic on youth mental health, while simultaneously tackling current imminent issues.

Keywords: COVID-19; Mental health; Children; Adolescent; Suicide.

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INTRODUCTION

As the coronavirus disease 2019 (COVID-19) has spread worldwide, mental health issues are gaining increasing attention. In January 2020, the first COVID-19 case was confirmed in Korea and the government established policies to prevent its spread. Social distancing, school closures, and remote working systems helped control new cases. However, they were insufficient to control the spreading mental health issues called "Corona blue." The most recent report published by the Korean Society for Traumatic Stress Studies and the Ministry of Health and Welfare (August 2022) stated that 16.9% of the Korean population is at high risk of depression [1]. Although the percentage of people at risk has consistently decreased throughout the pandemic, it is still five times higher than before the pandemic, which was approximately 3.2%

[1]. Furthermore, in June 2022, 12.7% of Korean adults had suicidal thoughts, which is an elevated figure from 9.7% in the early pandemic phase (March 2020) [1]. Considering that approximately 4.6% of adults had suicidal thoughts before the pandemic, we can see the severity of COVID-19-related mental health issues among Korean adults [1]. Matsumoto et al. [2] examined the effect of COVID-19 infection among 763 adults from Japan and Sweden. They compared three groups: non-infected, without the post-COVID-19 condition, and with the post-COVID-19 condition. Post-COVID-19 refers to physical impairment, e.g., dyspnea, ageusia, anosmia, three to four months after recovery [3]. People with post-COVID-19 symptoms had significantly higher levels in all measured categories: fear of COVID-19, anxiety, depression, and post-traumatic stress disorder (PTSD) [2].

While the examination of an adult in Korea was conducted every four months from the onset of the pandemic, commensurate research on children and adolescents is scarce. In Korea, only a small number of studies on youth mental health

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have been conducted, yet most have examined college students. Therefore, we briefly review studies on COVID-19-related mental health issues among children and adolescents worldwide. We will first review the studies on the effect of COVID-19 on mental health and suicide, and what factors are reported to cause them. We will then discuss the special concerns for COVID-19-related mental issues that should be considered in socio-cultural aspect. Finally, we provide some ideas on navigating a solution to prevent, handle pandemic situations.

DETERIORATED MENTAL HEALTH AND INCREASED SUICIDE DURING THE COVID-19 PANDEMIC ACROSS THE WORLD

Suicide, suicidal thoughts, and self-harm

As the deteriorating mental health issue has increased worldwide, suicide among adolescents and children has also been analyzed. Possibly because of the nature of suicide and the difficulty of accessing data, comparatively fewer studies have been conducted on adolescent and child suicides. In a recent study in the U.S., Charpignon et al. [4] analyzed data from the state department of public health of 14 U.S. states from 2015 to 2020. They found that suicide cases among adolescents increased after the pandemic [4]. A total of 5 out of 14 states had an increased number of suicide cases among adolescents after the pandemic, while the number of general suicide cases increased only in Oklahoma [4]. In Georgia, for example, the mean number of adolescent suicide cases from 2015 to 2019 increased from 87.8 to 106 in 2020. Indiana also had 62.8 cases of adolescent suicide cases from 2015 to 2019, but it leaped to 83 cases in 2020. New Jersey (32.4 to 37), Oklahoma (54.8 to 67), and Virginia (67.6 to 85) also showed a statistically significant increase in suicide cases among adolescents. In Japan, a study using data from the Ministry of Health, Labor, and Welfare (November 2016 to October 2020) showed a significant increase in the suicide rate during the second wave (July–October 2020) [5].

The percentage of self-harm and suicidal thoughts also increased significantly. In the U.S., about 20% of teenagers (n=7705) who were surveyed by the Centers for Disease Control and Prevention answered that they seriously considered suicide, and 9.0% of participants attempted suicide in January 2020–January 2021 [6]. Zhang et al. [7] asserted that approximately 31.8% of children and adolescents reported that they harmed themselves during the first wave (November 2019) and 42.0% of students harmed themselves in the successive wave (May 2020). The percentage of students who had suicidal thoughts increased as well, from 22.5% during first wave

(November 2019) to 29.7% in the successive wave (May 2020) [7]. Similarly, in John et al. [8], the number of students (18–24 years old) who had suicidal thoughts and experienced self-harm significantly increased during the pandemic (March 2020–May 2020). The risk ratio of the youngest group (18–24 years old) was 1.7 for suicidal thoughts and 5.7 for self-harm, after adjusting for other significant factors such as wave, loneliness, sex, age, social grade, etc [8]. Increase in suicidal ideation was also observed in Polish college students; 18% of participants (n=753) reported that they had suicidal thoughts after they started online learning [9]. Even though comparatively fewer studies report actual suicide cases and most studies are about mental health problems and suicidal ideation or plans, existing studies offer scope for the crisis of mental health and suicide issues among children and adolescents during the pandemic.

Deteriorated mental health

Although each study was conducted in a different context, since the onset of the COVID-19 pandemic, many studies across several countries reported deteriorated mental health in adolescents and children [10]. In the U.S., Jones et al. [6] analyzed the Adolescent Behaviors and Experiences Survey data from the Central Disease Center. They found that 37.1% of adolescents (n=7705) thought their mental health was bad during the pandemic, and 44.2% of participants experienced persistent negative feelings such as sadness or hopelessness [6]. Adolescents also felt that they lost support from their family and friends and experienced negative moods more often during the pandemic [11,12]. Depression, anxiety, and loneliness levels also soared during the pandemic [11,12]. A high percentage of Japanese children and adolescents experienced depression, anxiety, and loneliness because of the pandemic [2,13-16]. Elementary and junior high school students (n=191) showed worse mental health conditions during the school closure period (March–May 2020) compared to when the school was reopened [17]. During the school closure period, students surveyed felt significantly less active and vigorous and felt harder to find things interesting [17].

As children experience more negative feelings about the pandemic, they tend to be more maladaptive and show internalizing and externalizing behaviors [12,18]. O’Sullivan et al. [12] interviewed 48 families to investigate the impact of the lockdown using Interpretative Phenomenological Analysis. They found that 36% of families referred to negative behavioral changes in children, including bedwetting, frustration, and clinginess toward their parents [12]. In another study of 680 children aged 7–15 years who were examined by the Impact of Events Scale-Revised test, 21% of them were even found to be experiencing PTSD [19].

Other studies have reported the prevalence of mental health issues among college students. Deng et al. [20], who meta-analyzed 89 studies examining college students' mental health, found that the average prevalence of depression symptoms was approximately 34%, and anxiety symptoms were approximately 32%. Tahara et al. [15] investigated college students aged 20–24 (n=223), and 70.9% of participants were classified as a “severe mental health problem group” by the General Health Questionnaire-12 (GHQ-12). Students reported less communication with their family and friends than before, leading them to suffer from mental health issues [15]. Another study of Polish college students also indicated that 56.4% of the participants (n=753) had depressive symptoms, and 86.8% of the students experienced nervousness and irritability after online learning started [9].

RELEVANT FACTORS ON MENTAL HEALTH AND SUICIDE

Individual factors

Sex and age

Although most studies include sex and age as research variables, it is difficult to determine whether female or male students and younger or older students were more negatively influenced by the pandemic due to inconsistencies between the various reports. Regarding age, some studies that focused on depression or anxiety reported that older students tended to report worse mental health after the onset of a pandemic [10,21-23]. However, other studies reported that older adolescents were less likely to have mental health issues [24,25]. In a study using the Korea Youth Risk Behavior Web-based Survey (KYRBS) that covers around 800 school units, Jang [26] analyzed data from Korean middle school students (n=1977) to test the differences in physical activity, stress, and mental status. All variables except physical activity had different levels by sex, and male students had a higher level of COVID-19-related stress, loneliness, anxiety, and depression than female students [26]. However, in another cross-sectional study analyzing KYRBS data, Lee et al. [27] found that the female sex was a risk factor for depressive mood. Lopez-Serrano et al. [28] surveyed 441 children (under 18 years old) and examined 23 questions about clinical symptoms, including somatic complaints and oppositional defiant and aggressive behaviors. Children under 12 years old had significantly increased oppositional defiant behavior, irritability, dependence on adults, and repetitive body movements [28]. Furthermore, while the more dominant issue among girls was body dissatisfaction, boys reported a drastic decrease in social contact [28].

Prior mental health status

Prior mental health issues are one of the most significant factors predicting COVID-19-related mental health issues. Scholars have reported that adolescents and children with a history of mental health issues suffered a greater impact on their mental health during the pandemic. Students who experience psychological issues are at a higher risk of anxiety, depression, PTSD, stress, suicidal thoughts [18,29-31]. Graell et al. [32] examined adolescents with eating disorders and found that their disorders worsened, and they had an increased risk of comorbidity compared to before the COVID-19 pandemic. In addition, the impact of the pandemic hit harshly on children with autism spectrum disorders (ASD) and their parents. Colizzi et al. [33] indicated that children with ASD (n=527) suffered from family issues as well as in managing and structuring their activities.

Daily routine, physical activity, and screen time

Daily routine

Domestic lockdown, social distancing, and school closure considerably changed people's lifestyles and worsened mental health [18,34-37]. Before the pandemic, even though it was stressful for children and adolescents, going to school offered them a structured schedule, so it was an important coping mechanism [34]. However, during school closure, students lost their structured lifestyle, leading to a disruption in daily routine. Liu et al. [38] surveyed 1594 children and adolescents in China (9–16 years old). They indicated that the disrupted daily routine strongly predicts psychological maladjustment, such as depressive symptoms, family loneliness, and peer-related loneliness [38]. A study of Korean university students (n=318) also showed a positive correlation between structured routine and mental well-being [36]. At the same time, structured routine was negatively correlated with the level of depression, COVID-19-related stress, and intolerance of uncertainty [36]. The importance of structured routines was verified in numerous previous studies examining mental health of children and adolescent during the pandemic [18,35,37,39].

Physical activity

Adolescents and children spent less time in physical activity during the pandemic [27,40-44]. Ng et al. [41] surveyed 1214 students who were 12–18 years old to figure out the change in physical activity during the pandemic. Half of the participants answered that they spend less time in physical activity because most sports activities were canceled [41]. Similarly, much younger Japanese children aged 3–5 years old (n=504) spent less time doing physical exercise than be-

fore the pandemic [42]. Participants reported that their sedentary time increased significantly while their physical activity was considerably reduced [42]. Even students who actively spent time on physical activity before the pandemic showed a decrease in the amount of time spent on such activity [43]. More than 52% of participants (135 of 261) stopped exercising as they used to [43]. According to studies using KYRBS data [27,44], Korean middle and high school students also showed decreased physical activity in 2020 than in 2019, but it was significant only in male students because the female student did not have enough physical activity before the pandemic [27].

Lack of physical activity successively led to deteriorated mental health [27,42,44,45]. Chinese children and adolescents (6–15 years old) who spent more time on physical activity had less depression and anxiety than those who spent lesser time [45]. Lower physical activity levels were negatively correlated with anxiety and loneliness [44]. Interestingly, for Korean students, the level of physical activity was not correlated with depression, and students who performed high-intensity exercise reported a higher level of depression [44]. This observation is opposite to traditional findings on the relationship between physical activity and depressive mood [27,42,44,45]. Thus, further investigation into the relationship between physical exercise and depressive mood in Korean students is necessary.

Use of an electronic device and increased screen time

As the time adolescents and children spend at home increases, so does the use of phones and computers. In Japan, the proportion of children who meet the recommended screen time by the World Health Organization, which provides a guideline for preschool-aged children, significantly decreased from 27.2% to 19.9% [42]. In Spain, Lopez-Serrano et al. [28] asked 23 questions to explore clinical symptoms in different age groups (infants, prepubescents, adolescents). Parents and caregivers answered that the screen time of children and adolescents soared during the pandemic across all age groups [28]. Most of the respondents reported that their children are using their electronic devices “much more than before” (58%) or “little more than before” (28.3%) [28].

Several studies assert that increase in screen time have a strong relationship with deteriorated mental health [18,46–50]. Rosen et al. [18] asserted that passive screen time, which refers to passive scrolling down to watch videos or on social media, is highly related to externalizing psychopathology among children aged 7–15 years old. The more time children spend passively scrolling down, the more they show externalizing behaviors [18]. In contrast, other scholars tested the effect of stress on smartphone overuse and suggested that

coping strategies, mindfulness, and self-regulation may help reduce addiction [49,50].

Sleeping issues

The pandemic also frustrated children and adolescents with maintaining their normal sleeping patterns. Approximately 41.8% of parents or caregivers (n=441) reported that their children had difficulty sleeping during the pandemic [28]. In general, sleep duration increases in all ages of children and adolescents, except for the youngest children [44,51–53]. Moreover, some studies found a change in the sleeping pattern [51–53]. Zhao et al. [52] analyzed 2427 Chinese students (6–17 years old) in January 2020 to determine their mental health status and sleep patterns after quarantine. A significant change in the sleeping pattern was found; during weekdays, more students went to bed late and woke-up late than before [52]. Similarly, a study on 4314 Italian children and adolescents (1–18 years old) reported delayed bedtime and wake-up time across all age groups [51].

On the contrary, Korean students seemed more satisfied with sleeping than before [40,44]. Around 64.6% of Korean students (n=112251) were satisfied and felt recovered with sleep in 2020, while 53.5% of students did so in 2019 [44]. Nevertheless, students who were unsatisfied with their sleeping still showed a higher level of perceived stress, students who were satisfied with their sleeping perceived their stress level as comparatively low [44]. In addition, students who reported depression, anxiety, and stress slept significantly fewer hours than students who did not have those issues [44].

Support from family and friends

Children and adolescents are especially vulnerable to crises as they rely more on their parents and friends than adults. After the pandemic, many children and adolescents felt a lack of connectedness to their families and friends [9,10,54,55]. Numerous studies have shown that a low-income family and an adverse parental relationship with children are significant risk factors that deteriorate children’s mental health during the pandemic [21,31,56–59]. Similarly, although support from friends was a proper coping strategy for children and adolescents before the pandemic, school closure, and e-learning have frustrated students’ desire for the peer support they used to have [9,10,54]. Tahara et al. [15] explored the effect of peer support during the pandemic on 223 college students who are 20–24 years old. The study found that 70.9% of students scored higher than four on GHQ-12, which indicates a severe mental health problem [15]. Students with poor mental health status reported that they communicate much less with their friends than before (91.1%), while 73.8% of students without mental health issues answered so [15]. The few-

er students communicate with their friends, the more they are likely to have mental health issues [15]. In another study, Yamazaki et al. [16] found that suicidal thoughts were more prevalent among college students with fewer friends. Adolescents who were alone and had a negative relationship with family and friends tend to have more depressive and anxiety symptoms [45,60].

SPECIAL CONSIDERATIONS IN COVID-19-RELATED ISSUES FOR CHILDREN AND ADOLESCENTS' MENTAL HEALTH

School closure

Although students commonly report academic stress and related mental issues, the regular schedule and curriculum provided by the school system yield far-reaching psychological benefits. In that sense, a radical lifestyle change followed by school closure deprived them of such benefits [11,12,61]. In Japan, Kishida et al. [13] compared the mental health status of 1984 students (6–15 years old) who were under full school closure, partial closure, and full school. They used the Strengths and Difficulties Questionnaire to measure mental health symptoms: emotional symptoms, conduct problems, and hyperactivity/inattention [13]. Other symptoms such as anxiety, depression, oppositional defiant behavior, and irritability were measured using the Spence Children's Anxiety Scale, the Depression Parent-Rating Scale for Children, and so on [13]. During November 27 and December 1, 2020, students with complete school closure showed significantly worse mental health status than those with partial school closure and full school conditions [13].

Another Japanese study reported similar results. A significantly higher percentage of students under school closure from March 1 to May 31, 2020 (n=78) reported decreased or no time spent with their friends than those in reopening time in October 2020 (n=113) [17]. Children under school closure felt less active and vigorous, less fresh, or rested when they woke up, and their lives were filled with interesting things [17]. Even though the time they spent with their family increased in general, participants who reported that the time spent with friends had decreased or had no contact with their friends was also higher in the school closure group [17]. Zhang et al. [7] reported that Chinese students (n=1241) had a significantly higher incidence rate of self-injury, suicidal ideation, suicide plans, and suicide attempts after they experienced school closure (mid-May 2020) compared to before the onset of the pandemic (early November 2019).

A Korean study that examined teenage students who visited the attention deficit/hyperactivity disorder clinic at Seoul

National University Hospital (n=136) showed that 65% of the patients showed increased levels of depression, anxiety, aggression, and conflict with their parents after school restriction, while there was no difference in treatment [62]. They showed increased levels of depression, anxiety, aggression, conflicts with parents or family, and violation and tension. Decreased sleep duration, daily routine changes, and delayed treatment follow up were also observed [62].

Furthermore, closing schools and changing learning styles directly affected students' academic performance. Both students and teachers had to adapt to the new teaching methods and tools for online classes. In Austria, a considerable number of respondents among 1281 teachers (class teachers=456, teachers=772, principals=53) from 5th to 13th-grade students reported their experience on students after the pandemic started: 77% of teachers reported that more than five students from the class had problems with concentration and 80% of teachers reported that 80% of the class was lack of learning motivation. 78% of teachers also reported that the level of knowledge compared to pre-COVID-19 decreased [63]. König and Frey [25] suggested that academic performance was worse during the first lockdown (spring of 2020), especially among younger children due to their poor adaptation to remote learning while adjusting to a new school system. According to a systematic review of 42 papers on academic performance, parents, caregivers, and teachers reported that students struggled more with their academic performance compared to the pre-pandemic period [64].

Duration of the pandemic and wave

Longitudinal studies hint that the adverse effects resulting from the crises may not necessarily be observed right after the onset of the crisis, but rather the effects may manifest itself slowly and steadily [8,56,65,66]. An earlier Japanese study by Isumi et al. [56] utilized public data from the Ministry of Health, Labor and Welfare and reported that there was no significant increase in the suicide rate among adolescents and children after the pandemic: suicide rate after the pandemic (March–May of 2020) showed no significant difference from suicide rate reported the pre-pandemic (2018, 2019). The incidence rate ratio (IRR) of suicide after school closure because of COVID-19 was 1.15 (95% confidence interval [CI]: 0.81–1.64) in reference to suicide incidence before school closure. Another study utilizing data from the Ministry of Health, Labor, and Welfare, revealed that the tendency of a slight decrease in suicide during the first wave (February 2020–June 2020; IRR=0.98, 95% CI: 0.75–1.27) in reference to the suicide incidence pre-pandemic period; however, suicide incidence drastically increased during the second wave of COVID-19 (July 2020–October 2020), sur-

passing the suicide rate of the pre-pandemic period (IRR=1.49, 95% CI: 1.12–1.98) [5].

It is noteworthy that Japanese scholars compared COVID-19 and the Great Japan Earthquake cases and found similar temporal trends in suicide mortality rates [67]. In both cases, the suicide mortality rate significantly decreased immediately after the incident happened [67]. The suicide mortality rate after the earthquake in March 2011 was 18% lower than suicide mortality rate in the previous three years [67]. However, suicide mortality rate hiking back up in May and June, before stabilizing in October 2011 [67]. The mortality rate after COVID-19 showed a similar temporal trend [5,56,67]. Decreasing suicide mortality was observed from February to June 2020; however, suicide mortality rate hiking back up starting July of 2020 [67]. This trend was robust among the female population [67]. This suggests that COVID-19 and similar disastrous situations may have long-term effects on suicide.

Chinese studies have compared the prevalence of mental issues in children and adolescents and detected increased mental health crises over time [7,68,69]. Zhang et al. [68] asserted that the number of students who had depression and anxiety symptoms increased compared to before the pandemic. In the research conducted in April 2020, consisting of 493 junior high school students and 532 high school students, approximately 25% had depressive symptoms, and around 27% of high school students had anxiety symptoms, while depressive symptoms were reported for 17.2% of the student and anxiety symptoms were 16.4% before the pandemic [68]. In another study conducted from March 2020, the rates were even higher, indicating that 43.7% of adolescents had clinically significant depression and 37.4% had clinically significant anxiety [69].

Similar results have been observed in Germany and Australia. In Germany, Ravens-Sieberer et al. [24] surveyed 1586 families (n=1556) with children 7–17 years old. They compared it to cohort data (Behaviour and Well-being of Children and Adolescents in Germany) collected before the pandemic [24]. Participants' health-related quality of life was decreased after the pandemic from 50.2% to 15.3%, and they had more mental health issues [24]. The prevalence of significant mental health problems reported in the study was 17.8%, yet it was 9.9% before the pandemic [24]. Magson et al. [21] reported that depressive symptoms and anxiety increased two months after the social isolation, compared to 12 months before the outbreak.

In contrast, another KYRBS data analysis comparing reports from 57303 participants in June 2019 (before the outbreak) and 54948 participants from August to November 2020 (after the COVID-19 outbreak) showed that the num-

ber of students who experienced suicidal ideation decreased from 5979 (10.9%) in June 2019 (before the outbreak) to 7498 (13.1%) in August to November 2020 (after the COVID-19 outbreak), and suicidal planning also decreased from 2306 (4.0%) to 1953 (3.6%) [40]. The odds ratio of stress and depression between June 2019 and August to November 2020 was 0.77 and 0.85, respectively ($p < 0.001$) [40].

Lee and Hong [70] used the KYRBS with more recent data that were collected from August to November 2021 to check the long-term effect of COVID-19. In the data from 2021, a total of 54848 students participated from August to November 2021 [70]. The percentage of students who had suicidal ideation in 2020 was 10.7%, significantly decreasing from 12.7% in 2019. However, suicidal ideation in 2021 was 12.4%, returning to a similar level before the pandemic [70]. The studies presented above indicate that the suicide rate changes over time and may increase towards the end of the pandemic. Thus, we must stay alert to the long term state of mental health in children and adolescents and establish preemptive strategies to respond effectively to what may transpire in the future.

CONCLUSION

For four years, the world has suffered the prolonged effect of COVID-19, and enormous changes in our lives have occurred. Most studies focusing on children and adolescents assert that their mental health is in crisis, with regards to depression, anxiety, and behavioral symptoms. Scholars and mental health specialists have focused on these changes and have sifted through relevant factors. Moreover, we should not ignore that COVID-19 has also caused major changes in policies including social distancing, school closure, and the introduction of new offline schooling strategies. As discussed above, most factors in COVID-19-related issues are deeply intertwined with each other. The chain of deteriorating youth mental health started with the onset of COVID-19, which resulted in social distancing, and school closure. As youth began to stay at home instead of going to school, they lost opportunities to connect with their friends or teachers, who could provide support outside of their homes. Teachers deprived of face to face contact with the students lost chance to detect warning mental health signs in their students. Students spent less time on physical activity and more time online, which damaged their sleeping schedule and daily routine.

Scholars and specialists who tracked the mental health issues of adolescents and children warned that the aftereffect of COVID-19 may last for a long time [71]. In preparing for the post-pandemic phase, we should thoroughly analyze the long-term effects on youth mental health brought on by the

pandemic, simultaneously tackling current imminent issues. It is also necessary to pay extra attention to children and adolescents with prior mental health issues in rapidly changing disastrous situations. Since children and adolescents have comparatively fewer resources to deal with their stress or control their situation, they require special attention from their guardians. Helping them maintain a healthy daily routine, adhering to a sleeping schedule, and managing their screen time would be an easy but effective way to stay healthy. Lastly, not only the families and teachers but all members of society must sustain an effort to maintain connectedness with each other and our youths.

Availability of Data and Material

Data sharing not applicable to this article as no datasets were generated or analyzed during the study.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Yeni Kim. Data curation: all authors. Formal analysis: Eunkyung Jo. Funding acquisition: Aeju Kim. Investigation: all authors. Methodology: Eunkyung Jo, Yeni Kim. Project administration: Youngil Jeong, Aeju Kim. Resources: Youngil Jeong, Aeju Kim. Supervision: Youngil Jeong, Aeju Kim, Yeni Kim. Writing—original draft: Eunkyung Jo, Yeni Kim. Writing—review & editing: all authors.

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