



Analyzing Co-Occurrence of Non-Suicidal Self-Injury With Suicidal Ideation and Related Factors Among Adolescents in Jeju Island

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Objectives: Non-suicidal self-injury (NSSI) and suicidal behavior, including suicidal ideation (SI) and suicide attempts, are important predictors of suicide in adolescents. This study aimed to investigate the associations between NSSI, SI, NSSI+SI, mental health problems, and family factors in Korean adolescents in Jeju Island, with an emphasis on key findings.

Methods: A total of 561 adolescents completed self-report questionnaires regarding demographics, NSSI, SI, suicidal behavior, perceived family functioning, and mental health problems, which were assessed using Center for Epidemiological Studies Depression Scale for Children, Screen for Children Anxiety-Related Disorders (SCARED), and Youth Self-Report (YSR). Data were analyzed using descriptive statistics, one-way analysis of variance, chi-square test, post-hoc analyses, and multivariate logistic regression.

Results: In this study, 22.3% of adolescents reported either NSSI or SI, with 5.5% reporting NSSI and 20.7% reporting SI. Combined (NSSI+SI) group showed a significantly higher SCARED score, anxiety/depression, thought problems, attention problem, and rule breaking on YSR than did the SI only group. Higher level of depression and anxiety were significantly associated with NSSI and SI. Female sex and perceived family dissatisfaction were significantly associated factors for SI, but not for NSSI in multivariate logistic regression.

Conclusion: This study provides insights into the clinical characteristics and associated factors among adolescents with NSSI, SI, and NSSI+SI in Jeju Island. Identifying these results can inform the development of targeted prevention and intervention strategies to mitigate the negative consequences of these behaviors and contribute to a better understanding of the role of family in this context.

Keywords: Non-suicidal self-injury; Suicidal ideation; Family relations; Adolescents.

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INTRODUCTION

Suicide is a major public health concern in Korea, which has the highest suicide rate among Organization for Economic Co-operation and Development (OECD) countries and is the leading cause of death among adolescents [1,2]. According to the 2021 statistics on Korean adolescent suicidal behavior, 12.0% (n=5498) reported having seriously considered suicide in the past 12 months, 3.6% (n=1647) reported making a suicide plan, and 1.9% (n=896) reported a suicide attempt. These results show an increasing trend compared to the data from 2020 [3].

Non-suicidal self-injury (NSSI) and suicidal behavior, in-

cluding suicidal ideation (SI) and suicide attempts, are important predictors of suicide in adolescents [4-6]. According to a systematic review, the prevalence of NSSI in nonclinical samples is estimated to be 17.2% among adolescents, which is higher than the rates observed in young adults (13.4%) and adults (5.5%) [7].

Self-harm behaviors, including NSSI and suicidal behavior, are prevalent among adolescents and are associated with a range of negative mental health outcomes, including depression, anxiety, and other mental health problems [8-12]. Although NSSI is defined as self-harm without suicidal intent, numerous studies have found a direct association between NSSI and suicide attempts. It has been reported that 70% of adolescents participating in NSSI had reported a suicide attempt, and 55% reported multiple suicide attempts [13], while another study found that over 90% of adolescents reporting

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suicide attempts also engaged in deliberate self-harm [14]. Adolescents showing both NSSI and SI or suicidal behavior have become increasingly common in clinical practice. Recent meta-analysis reported that combined incidence of NSSI and suicide attempt co-occurrence was 9.6% [15]. Suicidal behavior and self-harm in children and adolescents were increased significantly during the COVID-19 pandemic [16]. This highlights the importance of understanding clinical characteristics and risk factors for adolescents showing both NSSI and SI behaviors.

Research has shown that family environmental factors, such as family cohesion, communication, and support, are associated with self-harm behaviors and mental health problems. Moreover, high family conflict and low parental monitoring are associated with suicidality and self-injury in children [17]. Although recent studies have illuminated the relationships between self-harm behaviors and mental health problems in Korean adolescents, few investigations have examined the associations between NSSI, suicidal behaviors, a comprehensive range of mental health problems, and family environment simultaneously in this population.

Therefore, this study aimed to investigate the associations between NSSI, SI, various mental health problems, and family factors in Korean adolescents in Jeju Island. The primary objectives were as follows: 1) to investigate prevalence of self-harm behaviors and the differences in clinical characteristics and family factors among NSSI, SI, and co-occurring NSSI and SI groups and 2) to investigate the impact of perceived family factors on NSSI and SI among adolescents in Jeju Island.

METHODS

Participants and procedures

This cross-sectional study included adolescents aged 13 to 18 years, attending school in Jeju Island, Korea for at least six continuous months. Jeju Island is known for its unique socio-cultural environment, which is distinct from mainland Korea. This environment has the potential to influence the mental health and behavior of adolescents. In collaboration with the Jeju Island Office of Education, we selected two middle schools and two high schools from both urban and rural areas. A guideline including the study background and informed consent to participate in the study was distributed. Data were collected through a paper and pencil survey, which was distributed and collected by mental health professionals. These professionals received education on the background of the study and the contents of the survey to ensure accurate data collection. Written informed consent was obtained from participants. Of the 718 participants who consented to the study, a total of 561 participants who responded

to assessment measures were included in this study (middle school students: $n=111$, 19.8%; high school students: $n=450$, 80.2%), and data were collected between September 2017 and December 2017. The original study was approved by the Institutional Review Board (IRB) in 2017 as “prevalence and risk factors of psychiatric disorders in child and adolescent population -school based research-,” and for further research about NSSI and SI, a separate IRB approval for the present study was obtained in 2020 (Grant No. 2020-11-011).

Assessment tools

Suicidal ideation and behavior questionnaire

Suicidal ideation and behavior questionnaire, developed for the study “prevalence and risk factors of psychiatric disorders in child and adolescent population -school based research-” (Ministry of Health and Welfare, HMI6C1994), consists of five items and is a self-administered questionnaire that asks participants to respond with a “Yes” or “No” answer based on their experiences, feelings, and thoughts about suicide over the past year. The five items include 1) SI, 2) suicidal planning, 3) suicidal intent, 4) suicide attempts, and 5) NSSI. This study aimed to explore the prevalence of each item, with a particular focus on exploring the mental health problems and factors associated with NSSI and SI. Those who experienced only NSSI or SI, respectively, were defined as the NSSI only and SI only groups. Furthermore, subjects that responded to both NSSI and SI were defined as the combined (NSSI+SI) group.

Center for Epidemiological Studies Depression Scale for Children

The Center for Epidemiological Studies Depression Scale for Children (CES-DC) is a scale developed by the National Institute of Mental Health (NIMH) to assess the degree of depressive symptoms in children and adolescents aged 6–17 years [18]. We used the standardized CES-DC [19], with higher scores indicating the presence of severe depressive symptoms.

Screen for Children Anxiety-Related Disorders

The Screen for Children Anxiety-Related Disorders (SCARED) is a self-report scale consisting of 41 items, developed to assess adolescent anxiety [20]. The items are scored on a 3-point Likert scale (0=not at all, 1=sometimes, and 2=often). Higher scores indicate a higher level of anxiety. The scale has been adapted and revised for use with Korean adolescents [21].

Youth Self-Report

The Youth Self-Report (YSR), developed by Achenbach

and Edelbrock [22], was used to assess mental health problems in adolescents. In this study, the Korean Youth Self-Report (K-YSR) was used [23]. The scale includes competence and syndrome subscales. The syndrome subscale consists of eight empirically based symptoms (anxiety/depression, withdrawal/depression, somatic complaint, social problem, thought problem, attention problem, rule breaking, and aggressive behavior).

Demographics and psychosocial variables

Demographic data included age, sex, and perceived socioeconomic status (SES: 1-very poor, 2-poor, 3-average, 4-good, 5-very good). Participants completed items assessing their perceived academic achievement (1-doing very poorly, 2-doing poorly, 3-average, 4-doing well, 5-doing very well), perceived family satisfaction (1-very unsatisfied, 2-slightly unsatisfied, 3-neutral, 4-slightly satisfied, 5-very satisfied), and perceived family emotional support (1-never receive, 2-sometimes receive, 3-almost always receive, 4-no family).

Statistical analysis

For statistical analysis, we used the SPSS software version 18.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to summarize the demographic characteristics of the study participants, and the chi-square test was also used to analyze the differences in categorical variables, such as sex, perceived academic achievement, perceived family satisfaction, and perceived family emotional support among the four groups (no NSSI+no SI, NSSI only, SI only, and both NSSI+SI). One-way analysis of variance (ANOVA) was used to compare the mean scores of CES-DC, SCARED, and K-YSR. Post-hoc analyses were conducted using Bonferroni's multiple comparison tests to identify significant group differences. Multivariate logistic regression analyses were conducted to examine SI and NSSI with other variables (sex, age, academic achievement, family factors, and mental health symptoms) while controlling for potential confounding factors.

RESULTS

Demographics and prevalence of NSSI and SI

The study included 561 adolescents from Jeju Island. The mean age of participants was 16.58 ± 1.47 years, and 57.6% were female. The majority of participants had middle SES (63.8%) and middle perceived academic achievement (41.4%). Most participants reported satisfaction with their family (72.2%) and less than half of participants (45.8%) reported always receiving emotional support from their family. Of these, 116 (20.7%) reporting experiencing SI over the past year. NSSI was reported by 31 (5.5%), and co-occurrence of NSSI and SI

was found in 22 (3.9%) participants. Furthermore, 17 (3.0%) reported suicidal intent, 27 (4.8%) reported having a suicide plan, and 16 (2.9%) reported a history of suicide attempts. In total, 125 (22.3%) participants reported either NSSI, SI, or both (Table 1).

Difference in psychosocial variables and mental health problems among NSSI and SI groups

Table 2 shows the distribution of sex, perceived SES, perceived academic achievement, perceived family satisfaction, and perceived family emotional support significantly differed among the four groups (control, SI only, NSSI only, and combined [NSSI+SI]). Notably, the combined (NSSI+SI) and SI only groups had high proportions of females (86.4% and 72.3%, respectively), contributing to the overall difference among the groups. SES distribution varied across groups without a clear correlation to NSSI or SI presence ($p=0.089$). The SI only and combined (NSSI+SI) groups had lower perceived academic achievement ($p=0.017$), perceived family satisfaction ($p<0.001$), and perceived family emotional support ($p=0.019$) (Table 2).

Table 1. Demographic characteristics of study sample

Characteristics	Value (n=561)
Sex	
Male	238 (42.4)
Female	323 (57.6)
Age (yr)	16.58 ± 1.47
Perceived socioeconomic status	
High	139 (24.8)
Middle	358 (63.8)
Low	64 (11.4)
Perceived academic achievement	
High	113 (20.1)
Middle	232 (41.4)
Low	216 (38.5)
Perceived family satisfaction	
Satisfaction	405 (72.2)
Fair	106 (18.9)
Dissatisfaction	50 (8.9)
Perceived family emotional support	
Always	257 (45.8)
Occasionally	235 (41.9)
Never	69 (12.3)
Suicidal ideation and behavior	
NSSI	31 (5.5)
SI	116 (20.7)
Suicide intent	17 (3.0)
Suicide plan	27 (4.8)
Suicide attempt	16 (2.9)

Values are presented as mean \pm standard deviation or number (%). NSSI, non-suicidal self-injury; SI, suicide ideation

The ANOVA and post-hoc analysis revealed significant differences in CES-DC, SCARED, and K-YSR scores across the four groups. The combined (NSSI+SI) group had the highest scores on all mental health problems among the four groups. The NSSI only group exhibited significantly higher levels of depression and somatic symptoms compared to the

control group. The combined (NSSI+SI) group showed significantly higher SCARED, anxiety/depression, thought problem, attention problems, and rule breaking than did the SI only group (Table 3).

Table 2. Demographic, academic, and family factors differences among non-suicidal self-injury and suicidal ideation groups

	Control (no NSSI+no SI) (n=436)	NSSI only (n=9)	SI only (n=94)	Combined (NSSI+SI) (n=22)	p
Age (yr)	16.98±1.34	17.44±0.88	16.97±1.37	17.14±1.42	0.715
Sex					<0.001**
Male	205 (47.0)	4 (44.4)	26 (27.7)	3 (13.6)	
Female	231 (53.0)	5 (55.6)	68 (72.3)	19 (86.4)	
Perceived SES					0.089
High	111 (25.5)	2 (22.2)	23 (24.5)	3 (13.6)	
Middle	282 (64.7)	5 (55.6)	53 (56.4)	18 (81.8)	
Low	43 (9.9)	2 (22.2)	18 (19.1)	1 (4.5)	
Perceived academic achievement					0.017*
High	96 (22.0)	0 (0)	16 (17.0)	1 (4.5)	
Middle	188 (43.1)	5 (55.6)	31 (33.0)	8 (36.4)	
Low	152 (34.9)	4 (44.4)	47 (50.0)	13 (59.1)	
Perceived family satisfaction					<0.001**
Satisfaction	336 (77.1)	8 (88.9)	48 (51.1)	13 (59.1)	
Fair	77 (17.7)	1 (11.1)	23 (24.5)	5 (22.7)	
Dissatisfaction	23 (5.3)	0 (0)	23 (24.5)	4 (18.2)	
Perceived family emotional support					0.019*
Always	215 (49.3)	3 (33.3)	30 (31.9)	9 (40.9)	
Occasionally	177 (40.6)	5 (55.6)	44 (46.8)	9 (40.9)	
Never	44 (10.1)	1 (11.1)	20 (21.3)	4 (18.2)	

Values are presented as mean±standard deviation or number (%). *p<0.05; **p<0.001. NSSI, non-suicidal self-injury; SES, socioeconomic status; SI, suicide ideation

Table 3. Comparison of mental health problems by non-suicidal self-injury and suicidal ideation groups

	No NSSI+no SI ^a (n=436)	NSSI only ^b (n=9)	SI only ^c (n=94)	NSSI+SI ^d (n=22)	Comparison	p
CES-DC	13.60±7.75	21.56±7.20	23.43±11.47	27.00±10.41	b, c, d>a	<0.001**
SCARED	13.30±10.54	18.33±12.17	24.02±13.70	33.32±15.68	d>c>a; d>b	<0.001**
K-YSR						
Internalizing problem	44.53±11.43	54.44±6.11	57.54±11.55	62.50±13.13	c, d>a	<0.001**
Externalizing problem	43.27±11.68	50.56±16.70	54.26±10.88	58.09±13.25	c, d>a	<0.001**
Anxiety/depression	51.81±4.08	53.11±3.66	57.79±8.79	61.73±12.12	d>c>a; d>b	<0.001**
Withdrawing/depression	53.37±6.00	53.44±4.28	59.72±9.66	62.59±12.43	c, d>a; d>b	<0.001**
Somatic complaints	53.03±5.85	59.00±7.31	56.91±8.74	60.05±8.79	b, c, d>a	<0.001**
Social problem	52.04±4.63	52.78±4.76	56.47±7.07	60.82±10.22	c, d>a	<0.001**
Thought problem	52.61±4.94	54.78±6.16	57.40±7.87	62.95±8.61	d>c>a; d>b	<0.001**
Attention problem	51.55±4.14	52.11±3.41	54.90±8.17	63.45±16.50	d>c>a; d>b	<0.001**
Rule breaking	53.25±5.64	55.67±7.14	57.31±8.25	61.73±7.25	d>c>a	<0.001**
Aggressive behavior	51.75±4.27	54.89±10.49	55.01±6.01	57.50±8.50	c, d>a	<0.001**

Values are presented as mean±standard deviation. Adjustment for multiple comparisons: Bonferroni. **p<0.001. CES-DC, Center for Epidemiological Studies Depression Scale for Children; K-YSR, Korean Youth Self-Report; NSSI, non-suicidal self-injury; SCARED, Screen for Children Anxiety-Related Disorders; SI, suicide ideation

Table 4. Multivariable logistic regression for the non-suicidal self-injury and suicide ideation

	Non-suicidal self-injury				Suicide ideation			
	B	SE	OR (95% CI)	p	B	SE	OR (95% CI)	p
Sex (Ref.: male)	0.765	0.475	2.129 (0.839–5.403)	0.112	0.825	0.276	2.283 (1.329–3.923)	0.003*
Age	0.138	0.168	1.148 (0.827–1.594)	0.410	-0.045	0.099	0.956 (0.787–1.161)	0.651
Perceived SES	0.086	0.351	1.089 (0.548–2.167)	0.807	-0.111	0.228	0.895 (0.572–1.399)	0.625
Perceived academic achievement (Ref.: high)								
Middle	1.592	1.061	4.914 (0.614–39.299)	0.133	-0.198	0.371	0.820 (0.396–1.697)	0.593
low	1.721	1.062	5.588 (0.697–44.807)	0.105	0.198	0.365	1.219 (0.596–2.492)	0.587
Perceived family satisfaction (Ref.: satisfaction)								
Fair	-0.374	0.525	0.688 (0.246–1.926)	0.476	0.241	0.313	1.272 (0.689–2.349)	0.442
Dissatisfaction	-0.836	0.710	0.434 (0.108–1.744)	0.239	1.069	0.406	2.912 (1.315–6.453)	0.008*
Perceived family emotional support (Ref.: always)								
Occasionally	0.102	0.459	1.107 (0.450–2.722)	1.107	0.209	0.293	1.232 (0.694–2.188)	0.476
Never	-0.137	0.681	0.872 (0.229–3.311)	0.872	0.661	0.404	1.937 (0.877–4.279)	0.102
CES-DC	0.053	0.023	1.054 (1.007–1.103)	0.023*	0.075	0.015	1.078 (1.046–1.111)	<0.001**
SCARED	0.045	0.018	1.046 (1.009–1.083)	0.014*	0.049	0.011	1.050 (1.026–1.073)	<0.001**

*p<0.05; **p<0.001. CES-DC, Center for Epidemiological Studies Depression Scale for Children; CI, confidence interval; SCARED, Screen for Children Anxiety-Related Disorders; SE, standard error; SES, socioeconomic status; OR, odds ratio

Factors affecting the NSSI and SI

Table 4 presents the multivariate logistic regression results for SI and NSSI separately. NSSI and SI were significantly associated with higher CES-DC and SCARED scores. SI was uniquely associated with female sex (adjusted odds ratio [AOR]=2.283, p=0.003) and perceived family dissatisfaction (AOR=2.912, p=0.008), while NSSI showed no significant associations with these factors. Age, perceived SES, perceived academic achievement, and perceived family emotional support were not significantly associated with either outcome (Table 4).

DISCUSSION

In the present study, we found differences in sex, perceived academic achievement, level of perceived family satisfaction, and family emotional support depending on the characteristics of self-harm behavior and SI. The adolescents with NSSI and SI had significantly higher levels of anxiety, thought problems, attention problems, and rule breaking behavior than those with SI. In addition, depression and anxiety were significantly associated with NSSI and SI, and female and perceived family dissatisfaction were significantly associated with SI.

Our study revealed that 22.3% of Korean adolescents in Jeju Island engaged in NSSI or had SI, with NSSI reported by 5.5% and SI by 20.7% of respondents. These rates bear similarities to previous studies. However, our NSSI rate is slightly lower (previous range: 8.0%–28.3%) and our SI rate is notably higher (previous range: 8%–18.8%) [24–26]. The SI rate

observed in our study is significantly higher than the 12% national average for Korean adolescents reported in 2021 [3]. Our findings are particularly significant given the unique psychosocial landscape of Jeju. Jeju has higher than average rates of several factors detrimental to adolescent mental health, including high divorce and adult high-risk alcohol consumption rate, high prevalence of school bullying and posttraumatic stress disorder among adolescents, as indicated in a comprehensive study [27].

While some studies found lower SES to be associated with self-harm in adolescence, particularly among girls [28], and with an increased risk of NSSI in young Korean adults [29], others did not observe a significant association [30]. Our study aligns with the latter finding, as we did not observe a significant relationship between SES and NSSI or SI. It is worth considering that differences in study populations, measures used to assess SES, or cultural contexts may contribute to the variability in findings across studies.

Previous research has identified various risk factors associated with self-harm behaviors and SI, such as depression, anxiety, substance misuse, and interpersonal difficulties [5–7,11,12]. Our study supports these findings and indicates that emotional problems, including depression and anxiety, are associated with both SI and self-injurious behavior. This emphasizes the need for comprehensive mental health interventions that address a range of emotional problems, rather than focusing solely on SI or self-injury [14]. Depression scores were notably elevated among adolescents with experiences of NSSI and SI, corroborating previous studies that singled out depression as a major risk factor for both behaviors [31].

Suicide and NSSI both involve self-harm behaviors, but these are phenomenologically distinct. Suicide attempts are generally associated with thoughts of death, while NSSI is generally associated with an intent to alleviate distress. There are some explanations of the link between NSSI and suicide. One hypothesis states that NSSI tends to have an earlier age of onset than suicidal behavior and NSSI predicts suicidal behavior (Gate theory) [32]. Another hypothesis states that NSSI and suicide may have similar risk factors. NSSI and suicidal behaviors are both markers of psychological distress and may also share biological factors (third variable theory) [33]. Recent research has suggested a reciprocal relationship between NSSI and SI, and emotion dysregulation mediates the relationship between NSSI and SI [34]. In the present study, it was difficult to suggest a mechanism underlying the relationship between NSSI and SI; therefore, long-term follow-up studies on adolescent NSSI and suicide behaviors are needed. However, in the present study, adolescents with co-occurring NSSI and SI displayed more extensive mental health problems, such as anxiety, depression, thought problems, attention problems, and rule breaking behavior, than those reporting SI alone. These results are consistent with previous research that individuals with a history of both NSSI and suicide attempts present with more severe psychological and behavioral problems [35]. It is essential for clinicians to assess these clinical characteristics in adolescents presenting with NSSI and SI, which may be instrumental in preventing future suicides.

We found that SI, but not NSSI, was uniquely associated with female sex and family dissatisfaction, aligning with previous studies that have reported a higher prevalence of SI among females [5,32]. Potential gender-specific factors, including early pubertal timing, different socialization processes, and coping strategies, might play a part in the higher observed risk of SI among adolescent girls [36]. Furthermore, previous research indicates that predictors for suicide attempts vary by gender, with depression and conduct problems having more impact on boys, while family satisfaction and academic grades play a significant role for girls [37]. These findings collectively emphasize the need for gender-specific considerations in the clinical assessment of suicide risk and in the design of targeted interventions and prevention strategies.

Our study reinforces the pivotal role of perceived family satisfaction in relation to SI among adolescents. The OR for family dissatisfaction was higher than that of female sex, indicating the importance of a thorough assessment of an adolescent's family satisfaction in both the prevention and treatment of SI. While prior research has focused on the impacts of family conflict, poor communication, and low levels of family cohesion and support on suicidal behaviors [16,17],

our findings suggest that the subjective perception of family satisfaction could be more strongly associated with SI than the mere presence or absence of emotional support within the family. Therefore, intervention strategies for SI should aim to not only treat psychopathology but also to holistically improve the quality of family relationships, including aspects such as communication, parental support, and family cohesion [38,39].

Our study had several limitations. First, the cross-sectional design limits our capacity to infer causality, underscoring the need for future longitudinal research. Second, we relied on self-report measures, which might introduce bias or social desirability effects. Future research would benefit from multiple informants or objective measures to enhance the validity of the results. Third, we did not thoroughly evaluate comorbid psychiatric disorders or specific suicidal planning and attempts, both of which could influence the relationship between self-harm behaviors and mental health outcomes. Fourth, our study was conducted in a specific region, namely, Jeju Island of Korea, and although schools in urban and rural areas were selected through collaboration with the Jeju Island Office of Education, it may be difficult to represent the entire population of Jeju Island. While we believe our findings contribute to a broader understanding of Korean adolescents, they may not be fully generalizable to other populations or cultural contexts. Additionally, the relatively small sample size of the NSSI only group may limit the generalizability of this subgroup. Despite these limitations, our study leveraged a large sample size and validated measures, thus making a significant contribution to the literature on self-harm behaviors and mental health outcomes in Korean adolescents.

CONCLUSION

In conclusion, our study provides valuable insights into the prevalence and risk factors associated with NSSI and SI among Korean adolescents in Jeju Island. The findings highlight the importance of timely detection and targeted interventions focusing on sex, family satisfaction, and mental health problems. Clinicians should proactively assess broad psychopathologies including anxiety, depression, attention problems, and rule breaking behaviors for adolescents with NSSI or SI. Particularly for female adolescents with depression or anxiety, family dissatisfaction should prompt a thorough evaluation of SI. Further research is needed to investigate the underlying mechanisms and assess the efficacy of tailored interventions for this population.

Availability of Data and Material

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

Conflicts of Interest

Duk-Soo Moon, a contributing editor of the *Journal of the Korean Academy of Child and Adolescent Psychiatry*, was not involved in the editorial evaluation or decision to publish this article. All remaining authors have declared no conflicts of interest.

Author Contributions

Conceptualization: Duk-Soo Moon, Na Ri Kang. Data curation: Na Ri Kang. Formal analysis: Na Ri Kang, Un-Sun Chung. Investigation: all authors. Methodology: Na Ri Kang, Young Sook Kwack, Bung-Nyun Kim. Project administration: Duk-Soo Moon, Na Ri Kang, Young Sook Kwack, Bung-Nyun Kim. Software: Na Ri Kang. Supervision: Un-Sun Chung, Young Sook Kwack, Bung-Nyun Kim. Validation: Na Ri Kang, Un-Sun Chung. Visualization: Duk-Soo Moon, Na Ri Kang, Un-Sun Chung. Writing—original draft: Duk-Soo Moon. Writing—review & editing: Duk-Soo Moon, Na Ri Kang, Un-Sun Chung.

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