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Suicide and Non-Suicidal Self-Injury From Internet Addiction Among Korean Adolescents

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Objectives: This study examined the associations between Internet addiction and suicide and non-suicidal self-injury (NSSI) among South Korean adolescents.
Methods: We conducted a cross-sectional study of 1694 Korean adolescents. The suicidal Ideation Questionnaire and Deliberate Self-Harm Inventories were used to identify high-risk suicide and NSSI groups, respectively. Internet addiction was assessed using the Internet Addiction Scale. Other questionnaires included sociodemographic data, perceived academic stress, and daily life-related factors. We also performed a logistic regression analysis using the high suicide risk and NSSI groups as dependent variables.
Results: The high suicide risk and NSSI prevalence rates among participants were 11.8% and 28.3%, respectively. A multivariable logistic regression analysis revealed that Internet addiction is associated with higher suicide risk and NSSI. Additionally, being female and academic stress were significant suicide risk factors, while male participants had a higher NSSI prevalence.
Conclusion: Our results suggest that monitoring adolescents' Internet use and providing education to prevent Internet addiction would lower high suicide and NSSI risk. Moreover, suicide and NSSI risk screening in adolescents with Internet addiction and providing suitable interventions will be essential for the preventing suicide and NSSI.

Keywords: Adolescents; Suicide; Non-suicidal self-injury; Internet addiction.

INTRODUCTION

Suicide and self-injury are severe social and medical problems for adolescents. Adolescence is a critical period for child development and suicide and self-injury prevention. Statistics from the Ministry of Gender Equality and Family 2022 determined suicide as the highest cause of adolescent death in the past ten years [1]. There is a strong correlation between suicidal ideation and the high risk of suicide [2]; therefore, identifying and predicting the degree of suicidal ideation is crucial for preventing it. Compared to suicide, non-suicidal self-injury (NSSI) is more prevalent and frequent in adolescents [3]. NSSI entails self-inflicting injury to the body intentionally without suicidal intent [4]. Although there is a clear distinction between suicide and NSSI, the two behaviors are profoundly related. Previous studies have established NSSI as a prominent risk factor for later adolescent suicidal behav-

ior [4]. NSSI increases suicide risk by reducing fear of death and increasing pain tolerance [5]. NSSI has various facets, such as emotion regulation and communication attempts, but psychological stress ultimately escalates future suicide risk [5,6]. Given the significant impact suicide has on our society, it is imperative that discussions on adolescent mental health prioritize these crucial topics [4-6].

Internet use is essential in our daily lives and activities. The internet facilitates information-sharing, social interactions, and a myriad of educational and entertainment functions. Despite its numerous advantages, excessive usage can lead to several harmful effects. As their cognitive functions are still in development, adolescents are particularly vulnerable to excessive Internet usage, also called Internet addiction [7]. Internet addiction can be defined as the inability to control Internet usage, which results in marked psychological distress and daily functional impairment [8]. Clinical features of Internet addiction include excessive use, preoccupation, withdrawal, tolerance, and loss of control [8]. Adolescents are more susceptible to Internet addiction than other age groups

because they quickly adapt to new technologies and accept them without consideration [7]. Previous studies report adolescent Internet addiction incidence from 0.8% to 26.7% [7,8]. Emotional and behavioral problems associated with adolescent Internet addiction include anxiety, depression, sleep disorders, social isolation, school refusals, substance abuse, and suicide ideation and attempts [9,10]. Recent studies have indicated that adolescents with Internet addiction have higher self-harm and suicide risks. A prospective cohort study in Taiwan reported that adolescent Internet addiction was notably associated with self-harm and suicidal behavior [9]. In a cross-sectional survey of Chinese adolescents, deliberate self-harm and Internet addiction corroborated a significant correlation [11]. Furthermore, in a cross-sectional study on Korean adolescents, Internet addiction correlated considerably with suicidal ideation [10].

Although Internet addiction's potential association with suicide and NSSI risk recently attracted attention as research topics, no research has yet been conducted on Korean teenagers to examine this relationship. This study is the first to investigate the relationship between suicide and NSSI risk and Internet addiction, including sociodemographic and daily life-related variables in Korean adolescents. We aimed to estimate the prevalence of high-risk suicide and NSSI in large school-based adolescent samples. Additionally, we explored factors that affect suicide and NSSI risk, particularly those concerning Internet addiction.

METHODS

Study design and participants

This cross-sectional study surveyed 1694 high school students (63.5% male; 36.5% female) aged 16−18 years old living in Gwangju Metropolitan City from July to September 2016. After removing participant data from the incomplete questionnaire responses, this analysis included 1674 participants (40.7% 10th grade; 59.3% 11th grade). Among the participants, 38.2% and 61.8% answered that they either had or did not have a religion, respectively. Regarding academic achievement levels, 35.5%, 31.4%, and 33.1% were in the good, average, and poor levels, respectively. Informed consent was obtained from all participants before starting the survey. This study was approved by the Chonnam National University Hospital Institutional Review Board (CNUH-2016-181).

Outcome measures

Sociodemographic characteristics

Sociodemographic data included age, sex, high school grade (10th or 11th), religious status (yes or no), and academic achievement level (poor, average, or good). Participants were divided into two groups by the presence or absence of religion. Academic achievement levels were classified into three groups according to participants' perceptions: good, average, and poor.

Perceived academic stress and daily life-related characteristics

Participants were divided into academic stress presence or absence groups to assess their perceived academic stress. Daily life-related factors were eating breakfast (yes or no), and hours of sleep (<7 h/day or ≥7 h/day).

Internet addiction

The duration of internet use on a school day was classified into three groups (<1 h/day, ≥1 h/day and <2 h/day, or ≥2 h/day). Internet addiction levels were evaluated using the Internet Addiction Scale for Adolescents (KS-II) [12]. The KS-II reflects internet users' tendencies in Korea and secured validity through scale standardization [12]. The 15 KS-II items were scored based on intensity using a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree), with higher scores indicating a higher Internet addiction severity [12]. The total item scores classified users into three risk groups: high (44 points or more), potential (41 points or more), and general (40 points or less) [12]. This study's internal KS-II consistency was acceptable (Cronbach's α=0.86).

High suicide risk

Reynold's Suicidal Ideation Questionnaire (SIQ) assesses the severity and frequency of suicidal ideation [13]. We implemented SIQ standardization in a sizeable normal group, indicating high sensitivity and specificity compared to those who attempted suicide [14], with a moderate- to high-sensitivity marker of subsequent suicide attempts [14]. The translation of the questionnaire was revised according to the situation in Korea while faithfully utilizing the meaning of the existing items through discussion by the authors. SIQ items were scored based on suicidal ideation frequency using a 7-point Likert scale ranging from 0 (never thought) to 6 (thought almost every day), with higher scores indicating a higher suicide risk [14]. A cutoff score ≥41 indicated clinically high suicide risk [13]. The total score was used in our analysis, and this study's internal consistency was favorable (Cronbach's α=0.97).

NSSI experience

The Deliberate Self-Harm Inventory (DSHI) consists of 17 items and measures deliberate self-harm behaviors [15]. Items on this scale were configured to a yes or no answer, depending on the presence or absence of 17 self-harm types.

The sample was divided into two groups based on the presence or absence of self-harm history on the DSHI scale. We used a translated scale from a previous study conducted in Korea [16]. The internal consistency of the DSHI in this sample was acceptable (Cronbach's α=0.74).

Statistical analysis

We analyzed the data by dividing subjects into presence or absence groups of high suicide risk and NSSI experience. The groups' sociodemographic and clinical factors were analyzed using the chi-square test for categorical variables and the independent t-test for continuous variables. For independent variables divided into three categories, we used the linear-by-linear association chi-square test to evaluate each variable's linear trend. Binary logistic regression analysis identified factors affecting high suicide risk and NSSI experience among study participants. Factors estimated to affect high suicide risk and NSSI experience presence or absence, which are dependent variables, were analyzed using univariate analysis. Finally, a multivariate analysis assessed these significant variables to control each influence and calculate corrected adjusted odds ratio and confidence intervals. SPSS for Windows ver. 21.0 (IBM Corp., Armonk, NY, USA) was used to perform the statistical tests. All statistical tests were two-tailed; $p<0.05$ was taken to indicate statistical significance.

RESULTS

There were 1694 participants in this study; 1075 male (63.5%) and 599 female (36.5%) adolescents between 16 and

Table 1. Sociodemographic and clinical factors by high suicide risk and NSSI presence

Variables	Total	High suicide risk (+)			NSSI (+)		
		Value	χ^2	p	Value	χ^2	p
Age (yr)	16.6±0.5	16.6±0.5	-1.001†	0.317	16.5±0.5	-1.457†	0.145
Sex			23.304	<0.001*		6.933	0.008*
Male	1075 (63.5)	96 (8.9)			327 (30.4)		
Female	599 (36.5)	101 (16.9)			146 (24.4)		
High school grade			0.250	0.617		0.914	0.339
10th	681 (40.7)	77 (11.3)			184 (27.0)		
11th	991 (59.3)	120 (12.1)			289 (29.2)		
Religion			1.095	0.578		5.838	0.054
Yes	635 (38.2)	78 (12.3)			201 (31.7)		
No	1023 (61.8)	116 (11.3)			268 (26.2)		
Academic achievement level			0.544	0.909		7.048	0.029*
Good	594 (35.5)	71 (12.0)			156 (26.3)		
Average	526 (31.4)	58 (11.0)			139 (26.4)		
Poor	543 (33.1)	67 (12.3)			177 (32.6)		
Academic stress			4.506	0.034*		2.941	0.086
Yes	1508 (90.2)	186 (12.3)			436 (28.9)		
No	164 (9.8)	11 (6.7)			37 (22.6)		
Eating breakfast			3.088	0.079		2.367	0.124
Yes	488 (29.3)	68 (13.9)			151 (30.9)		
No	1176 (70.7)	128 (10.9)			320 (27.2)		
Hours of sleep			2.515	0.113		0.191	0.662
<7 h/d	1315 (79.3)	163 (12.4)			375 (28.5)		
≥7 h/d	344 (20.7)	32 (9.3)			94 (27.3)		
Internet use			8.522	0.014*		5.174	0.075
<1 h/d	1020 (60.9)	109 (10.7)			280 (27.5)		
≥1 h/d, <2 h/d	369 (22.0)	40 (10.8)			97 (26.3)		
≥2 h/d	285 (17.1)	48 (16.8)			96 (33.7)		
Internet addiction			71.602	<0.001*		12.293	0.002*
General	1638 (97.8)	177 (10.8)			455 (27.8)		
Potential-risk	23 (1.4)	11 (47.8)			9 (39.1)		
High-risk	13 (0.8)	9 (69.2)			9 (69.2)		

Values are presented as mean±standard deviation or number (%). *$p<0.05$; †independent t-test. NSSI, non-suicidal self-injury

18 years (mean±standard deviation age=16.6±0.5 years). The high suicide risk and NSSI prevalence rates were 11.8% and 28.3%, respectively. Table 1 indicates the sociodemographic and clinical factors of the cohort and their high suicide risk and NSSI associations. Suicide risk prevalence was higher among female adolescents than among male adolescents (p<0.001), but the opposite was true for NSSI (p=0.008). Groups with academic stress (p=0.034) or more than two hours of daily Internet use (p=0.014) were significantly associated with high suicide risk. The poor academic achievement group expressed a considerably higher NSSI ratio than other groups (p=0.029). Furthermore, the Internet addiction risk group was statistically related to increased suicide risk (p<0.001) and NSSI (p=0.002). There were no significant high suicide risk and NSSI differences in age, high school grade, religious status, eating breakfast status, and sleep duration (Table 1).

Table 2 shows the univariate logistic regression analysis results that detected high suicide risk-associated factors. Female sex, academic stress, and Internet addiction (potential-risk user group, high-risk user group) were significantly associated with increased suicide risk (Table 2). Table 3 shows the univariate logistic regression analysis results that de-

Table 2. Univariate logistic regression analysis results in detecting high suicide risk factors

Variables	Wald	OR	95% CI	p
Sociodemographic characteristics				
Sex, female	19.673	2.085	1.507−2.885	<0.001*
Academic achievement level				
Average	0.003	0.989	0.672−1.455	0.954
Poor	1.575	1.280	0.871−1.880	0.209
Perceived academic stress				
Academic stress, yes	7.306	2.624	1.304−5.283	0.007*
Daily life-related factors				
Eating breakfast, no	0.781	0.858	0.612−1.204	0.377
Sleeping more than 7 h, no	2.904	1.434	0.947−2.171	0.088
Internet use				
≥1 h/d, <2 h/d	0.023	1.031	0.694−1.531	0.880
≥2 h/d	1.938	1.333	0.889−1.997	0.164
Internet addiction				
Potential-risk	18.061	6.485	2.738−15.358	<0.001*
High-risk	18.070	15.148	4.326−53.038	<0.001*

*p<0.05. OR, odds ratio; CI, confidence interval

Table 3. Univariate logistic regression analysis results in detecting NSSI-associated factors

Variables	Wald	OR	95% CI	p
Sociodemographic characteristics				
Sex, male	7.618	1.403	1.103−1.785	0.006*
Academic achievement level				
Average	0.263	0.931	0.707−1.225	0.608
Poor	3.277	1.282	0.980−1.679	0.070
Perceived academic stress				
Academic stress, yes	3.705	1.479	0.993−2.203	0.054
Daily life-related factors				
Eating breakfast, no	3.715	0.788	0.618−1.004	0.054
Sleeping more than 7 h, no	0.027	1.023	0.776−1.349	0.870
Internet use				
≥1 h/d, <2 h/d	0.225	0.935	0.710−1.233	0.635
≥2 h/d	2.056	1.242	0.924−1.670	0.152
Internet addiction				
Potential-risk	1.190	1.611	0.684−3.793	0.275
High-risk	8.824	6.107	1.851−20.152	0.003*

*p<0.05. NSSI, non-suicidal self-injury; OR, odds ratio; CI, confidence interval

Table 4. Multiple logistic regression analysis results in detecting high suicide risk and NSSI factors

Variables	Wald	OR	95% CI	p
High suicide risk				
Sex, female	20.923	2.047	1.506−2.782	<0.001*
Academic stress, yes	5.624	2.214	1.148−4.271	0.018*
Internet addiction				
Potential-risk	21.227	7.308	3.136−17.031	<0.001*
High-risk	22.264	18.838	5.564−63.776	<0.001*
NSSI				
Sex, male	7.761	1.385	1.101−1.741	0.005*
Internet addiction				
High-risk	9.192	6.276	1.914−20.577	0.002*

*p<0.05. NSSI, non-suicidal self-injury; OR, odds ratio; CI, confidence interval

tected NSSI-associated factors. Male sex and Internet addiction (high-risk user group) were significantly related to NSSI (Table 3).

The multivariable logistic regression analysis results of high suicide risk and NSSI are illustrated in Table 4. Female sex, academic stress, and Internet addiction (potential-risk user group, high-risk user group) were significantly associated with high suicide risk. Conversely, male sex and Internet addiction (high-risk user group) were NSSI-risk factors (Table 4).

DISCUSSION

This study investigated the prevalence of high suicide risk and NSSI among adolescent students. Furthermore, the effects of sociodemographic and clinical variables (especially Internet addiction) on high suicide risk and NSSI were considered. Our results indicated that high suicide risk and NSSI experience groups had 11.8% and 28.3% prevalence rates, respectively. These prevalence rates among Korean adolescents corroborated those in prior studies (10.5%−12.1% and 24.0%−29.2%, respectively) [17,18]. For example, a meta-analysis of 1989 to 2018 published articles reported that the 12-month suicidal ideation and NSSI prevalence rates vary due to several factors, such as cultural background (Western vs. non-Western: suicidal ideation 13.0% vs. 15.2%; NSSI 19.7% vs. 19.1%, respectively), socioeconomic status (developed vs. low- and middle-income countries: suicidal ideation 11.9% vs. 15.9%; NSSI 19.7% vs. 19.1%, respectively), geographical location (Asia vs. North America: suicidal ideation 13.3% vs. 12.8%; NSSI 25.7% vs. 18.7%, respectively), and methodological study differences [19]. Therefore, further research is necessary to fully understand how these factors affect suicidal ideation and NSSI prevalence in adolescents.

Our study substantiates that Internet addiction is a risk factor for suicidal ideation and NSSI in Korean adolescents. In several previous studies, Internet addiction was significantly correlated with suicidal behavior and self-harm [9,10]. Individuals struggling with Internet addiction have higher depression, anxiety, and other mental health concern rates, increasing their suicidal ideation and NSSI risk [9]. Additionally, those with Internet addiction exhibit low frustration resistance and are likelier to use evasive and inflexible coping methods [20]. People with Internet addiction also frequently tend to make more risky decisions than healthy controls, which may be related to brain region-specific functioning changes associated with conflict monitoring, compensation, and cognitive control [21]. In a previous study that reviewed Internet contagion effects, online platforms were a potential suicide-related information source linked to escalated suicidal ideation [22]. The neuropsychological problems described above may explain the increased risk of suicidal ideation and NSSI in adolescents with Internet addiction [9,10,20-22]. Considering these points, evaluating whether adolescents with Internet addiction have neuropsychological problems and providing appropriate interventions can help lower suicide and NSSI risk. Further research is required to understand the nature of these relationships and develop effective interventions to reduce suicidal ideation and NSSI risk among adolescents with Internet addiction.

In this study, women tended to have a greater risk of suicide, and men had a greater risk of NSSI. The results of previous studies on suicide risk by sex are inconsistent [23,24]. The risk of suicide measured in this study was based on the frequency of suicidal ideation. Women are more likely to experience internalizing disorders (mood or anxiety disorders), stressful life events (sexual or physical abuse), and social barriers (discrimination, stigma, and gender-based violence), which are associated with higher suicidal ideation risk [23,24]. Further, women may be more likely to seek help for mental health concerns, resulting in a higher reported prevalence of suicidal ideation. In studies before 2000, self-injurious behaviors were showed as "feminine behavior," which is more prevalent in women than men [25]. After 2000, previous studies comparing men's and women's NSSI proportions reported inconsistent results [25,26]. In this study, men had a higher prevalence of NSSI. NSSI characteristics differ by sex (method, frequency, duration of use, and purpose) [25,26], which may explain the difference in men's and women's NSSI statistics in this study. Additionally, gender role conflict appears to increase the risk of mental health risk behaviors, including NSSI, in men by undermining the protective factors of help-seeking and social support (intimacy, self-expression, and connection with others) [25,27]. It is important to note that

NSSI is a complex behavior with multiple contributing factors, and more research is needed to understand why it varies between genders. The government and health authorities should provide early intervention by identifying associated risk groups through further studies on gender-based suicidal ideation and NSSI variation.

Academic stress was also significantly correlated with high suicide risk. According to previous studies, suicidal ideation was frequently apparent in academic stress groups, consistent with our results [28]. Excessive academic stress is strongly associated with decreased academic performance, physical illness, depression, anxiety, and suicide risk [28,29]. Specifically, East Asia's sociocultural characteristics, including Korea's, are expected to contribute to this (e.g., the tendency to regard academic achievement as a means of fulfilling family obligations, parents' high expectations for children's academic achievement, and the school's academic emphasis climate) [28,30]. Therefore, to lower Korean adolescents' suicide risk in high academic-pressure environments, it is necessary to check whether they experience academic stress and adequately help them. Further research on the relationship between academic stress and suicidal ideation is essential for a detailed intervention plan.

This study had several limitations. First, in this study, we did not investigate mental health issues that could comorbid with Internet addiction and be associated with suicidal behavior and NSSI. Second, the data used in this study consisted only of self-rating scales and not face-to-face assessments by experts. Third, this study was conducted on teenagers in one city, so the results may not be generalizable to other populations. Forth, the cross-sectional design precludes inferences regarding causality. Finally, this study enrolled only volunteer adolescents. Some adolescents with suicidal ideation or NSSI experience may have been unable to participate due to psychological symptoms or stigma severity surrounding mental health issues, leading to under-reporting. Despite these limitations, this study provides data that could help predict and prevent suicidal behaviors and self-injury in Korean adolescents by shedding light on suicide and NSSI risk factors. Further research is needed to determine the variables mediating risk factors in this study and suicide or NSSI.

CONCLUSION

Our results show that Internet addiction is significant associated with suicide and NSSI risks among Korean adolescent students. These findings suggest that government should pay more attention to psychological health among adolescents with Internet addiction. In the future, researchers should aim to identify the mechanism and mediating factors of sui-

cide and NSSI vulnerability among adolescents with Internet addiction and develop effective interventions based on their findings. Moreover, it is necessary to check whether adolescents experience academic stress and provide appropriate help. The results of this study will help develop interventions and policies to prevent suicide and self-injury among Korean adolescents.

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