



## Relationship between Internet Addiction and Poor Mental Health among Japanese Adolescents

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(Received 13 Mar 2019; accepted 17 May 2019)

### Abstract

**Background:** Internet addiction and poor mental health are two pervasive problems during adolescence. This study aimed to determine whether Internet addiction and poor mental health status exhibited a bidirectional relationship in which either variable could become a risk factor for the onset of the other.

**Methods:** Longitudinal school-based survey with a baseline sample of 1547 students among 8 schools (10th graders) in Japan surveyed in 2015 and followed up 1 year later. The schools are located in the middle city. We assessed internet addiction using the Japanese version of the Diagnostic Questionnaire developed by Young and mental health status using the 12-item General Health Questionnaire. Regression analyses including the covariates tested whether Internet addiction was related to the onset of poor mental health among youth who had never internet addiction, and poor mental health was related to the onset of internet addiction.

**Results:** The incidence for Internet addiction and poor mental health during one year were 22.0% and 8.8%, respectively. Multiple regression analyses showed that poor mental health (adjusted odds ratio: 2.17 [95%CI: 1.45–3.25]) promoted new onset of Internet addiction and Internet addiction (adjusted odds ratio: 2.39 [95%CI: 1.36–4.20]) also promoted new onset of poor mental health.

**Conclusion:** Internet addiction and poor mental health status each increased the risk of onset of the other. Adolescents, their parents and schools need to take policies to use properly Internet.

**Keywords:** Internet addiction; Adolescents; Japan; General health questionnaire; Cohort study

### Introduction

In modern society, the Internet is an indispensable tool in daily life; however, several studies have reported negative effects of Internet addiction (IA) on schoolwork, the home environment, and physical and mental health (1-5). IA has become a serious public health issue observed in all age groups; however, its effects are particularly detrimental to young people, who are in the process of growing both mentally and socially (6).

Epidemiological surveys examining IA have been conducted in various regions, and a meta-analysis

showed that the worldwide IA prevalence was 6.0%, 95% CI [5.1–6.9]. Specifically, the highest (10.9%; 95% CI [5.4–16.3]) and lowest (2.6%; 95% CI [1.0–4.1]) prevalence were observed in the Middle East and Northern and Western Europe, respectively (7). In addition, the prevalence of IA observed in East Asian adolescents were 10.4% in China (8), 17.4% in Taiwan (9), from 17% to 26.8% in Hong Kong (10), and 10.7% in South Korea (4). Japanese adolescents, which used Young's diagnostic questionnaire, reported



that 6.4% of boys and 9.9% of girls exhibited suspected Internet dependence (11). Differences in prevalence are thought to result from differences in sample sizes, screening tests, and research designs. However, the overall results indicate that IA is common in adolescents.

Moreover, in a systematic review, IA risk factors were categorized according to individual psychological characteristics, parental and family issues, Internet usage status/individual awareness, and other elements such as schoolwork (12). Psychological characteristics included mental health conditions such as depression, attention deficit hyperactivity disorder, social anxiety, and suicide attempts (4, 13). As most research regarding IA have involved cross-sectional studies, it has been difficult to ascertain causal relationships. Accordingly, longitudinal studies conducted to calculate incidence rates are of greater academic value relative to that of cross-sectional studies. Although longitudinal research examining IA in high school students is scarce, several studies have explored the mutual relationship between IA and poor mental health (14-17). For example, Cho et al. compared individuals with and without anxiety or depression at baseline and reported that the risk of IA in those with anxiety or depression was 1.07 times higher than that observed for those without either condition (16). In addition, the relative risk of depression in people who used the Internet pathologically was approximately 2.5 times higher than that observed for people not demonstrated pathological Internet use (17). These longitudinal studies demonstrated a bidirectional relationship between IA and mental health, in which either could be the cause or result of the other, in adolescents. This bidirectional relationship indicates that IA increases the incidence of poor mental health, and poor mental health increases the possibility of the onset of IA, creating a vicious cycle. Therefore, the establishment of an understanding of this relationship is extremely important. However, no studies have been conducted to examine the bidirectional relationship between IA and poor mental health to date.

Therefore, we used epidemiological tools that had demonstrated validity and reliability, to conduct a 1-year longitudinal survey examining IA in adolescents. The main purpose of the study was to determine whether IA and poor mental health status exhibited a bidirectional relationship in which either variable could become a risk factor for the onset of the other.

## Methods

### *Participants and data collection*

We invited students from 8 high schools in a middle city to participate in the study. The study sample included 1,547 students who entered high schools in 2015. Two surveys were conducted with the same population, using self-administered questionnaires: 1) a baseline survey and 2) a follow-up survey. The baseline survey was conducted from Apr to Jul of 2015, and the follow-up survey was conducted from Apr to Jul of 2016. We sent a letter to the principal of each school, with sufficient questionnaires and envelopes for all the students enrolled at the school. Class teachers at the schools that agreed to participate the survey distributed the questionnaires to the students. To protect the privacy of respondents and obtain candid responses, the questionnaire contained a statement confirming that completed questionnaires would not be seen by the teachers. Upon completion of the questionnaires, the students were asked to seal them in envelopes with adhesive flaps. Collection and delivery of the questionnaires were entrusted to the teachers, instructed to follow the guidelines for conducting the survey. The teachers collected the sealed envelopes and sent them back to the Department of Public Health and Epidemiology, Faculty of Medicine, Oita University without opening them. Written informed consent was obtained from all participants. The study was approved by the local ethics committee and registered at ClinicalTrials.gov (identifier: UMIN000027587).

### *Questionnaires*

The main questions in the study pertained to the following: (i) sex, (ii) Internet usage, (iii) mental

health status, (iv) lifestyle behaviors, and (v) sleep status. We used the Japanese version of the Diagnostic Questionnaire developed by Young to assess problematic Internet use (18). We followed Young's proposal of dichotomized distinction of IA via a cutoff point of 5 (18). The reliability and validity of the scale have been examined (19). In this study, Cronbach's alpha is from 0.710 to 0.726.

The Japanese version of the 12-item General Health Questionnaire was used to evaluate mental health status (20, 21). Participants with total scores of  $\geq 4$  were considered to have poor mental health; this cutoff point was deemed valid in previous studies (22, 23). The reliability and validity of the scale have ranged from 0.78 to 0.95 and from 0.83 to 0.95 (20, 24). In this study, Cronbach's alpha is from 0.808 to 0.820. In addition, we asked about interpersonal relationships (i.e., problems with friends and whether the participants had people who understood them).

The lifestyle factors assessed included daily breakfast consumption, snacking, skipping meals, exercise habits, grooming and appearance, and study hours. Concerning skipping breakfast, those who did not eat breakfast every day were defined as having a "skipping breakfast habit." Concerning snacking habits, those who ate more than 1 snack per day were defined as having a "snacking habit." Regarding the habit of skipping meals, those who missed more than 1 meal per day were defined as having "a habit of skipping meals." Concerning exercise habits, those who exercised on more than 10 d per month were defined as having an "exercise habit." Concerning grooming and appearance, those who were often or always careful about their appearance were considered to care about their "grooming and appearance." With respect to study hours, those who studied for more than 2 h per day were considered to "study for long hours."

Sleep status was assessed in terms of sleep duration, subjective sleep quality, insomnia symptoms, and excessive daytime sleepiness. Subjective sleep quality was assessed using the question "How would you assess the quality of your sleep?" (Responses included "very good,"

"good," "bad," and "very bad"); participants whose responses were "bad" or "very bad" were considered to have poor subjective sleep quality. Insomnia symptoms experienced during the preceding month were assessed using 3 questions: 1) "Do you have difficulty initiating sleep?" 2) "Do you have difficulty remaining asleep?" 3) "Do you experience early morning awakening?" The responses for each included the following: "never," "seldom," "sometimes," "often," and "always." "Often" and "always" were considered affirmative responses to the item, and an affirmative response to any of the items indicated the presence of insomnia symptoms. Excessive daytime sleepiness was assessed using the Japanese version of the Epworth Sleepiness Scale (25). Responses are provided using a scale ranging from 1 to 4. The presence of excessive daytime sleepiness was determined using a cutoff point of 11.

#### ***Statistical analyses***

First, the incidence of IA at the time of the follow-up survey was calculated using a chi-squared test. In this analysis, only participants who did not exhibit IA at baseline assessment were selected. Second, logistic regression analysis was used to identify the factors that predicted IA. We performed multiple logistic regression modeling with backward stepwise variable selection to identify factors associated with IA. Independent variables introduced gender, poor mental health, grooming appearance, skipping breakfast, snacking, skipping meals, insomnia, sleep quality, excessive daytime sleepiness, studying hour, and exercise habit in the baseline survey. Variables with *P*-values of  $>0.10$  were eliminated from the model. Only participants who did not exhibit IA at baseline assessment were included in this analysis selected. Third, the incidence of poor mental health in the follow-up survey was calculated using a chi-squared test. Only participants who did not exhibit mental health in the baseline assessment were included in this analysis. Fourth, logistic regression analysis was performed to identify the factors that predicted poor mental health. Only participants who did not display poor mental health in the baseline assessment were included

in this analysis. We used multiple logistic regression modeling with backward stepwise variable selection to identify factors associated with poor mental health. Variables with  $P$ -values of  $>0.10$  were eliminated from the model. Independent variables introduced gender, internet addiction, grooming appearance, skipping breakfast, snacking, skipping meals, insomnia, sleep quality, excessive daytime sleepiness, studying hour, and exercise habit in the baseline survey. The levels of statistical significance were set at  $P<0.05$ . The SPSS 17.0 software package (Chicago, IL, USA) was used for all analyses.

## Results

Overall, 1,522 of the 1,547 students invited to participate in the baseline survey agreed to do so. The number of students whose baseline and follow-up survey data could be linked to the names provided in the questionnaires was 1,440. Of these students, 1,434 agreed to participate in the follow-up survey. Data for 92.7% of the participants were ultimately analyzed.

Table 1 shows the participants' baseline characteristics. The proportion of girls who participated in the study (54%) was higher relative to that of boys (46%). The prevalence of IA was 12.3%. The prevalence of poor mental health was 41.7%.

**Table 1:** Characteristics of the analyzed participants at the time of the baseline survey

<i>Variable</i>		<i>N</i>	<i>%</i>
Gender	Boys	711	46.0
Internet addiction		190	12.3
Poor Mental health status		645	41.7
Insomnia		147	9.5
Poor Sleep quality		204	13.2
Excessive daytime sleepiness		692	44.7
Grooming appearance		1121	72.5
Skipping breakfast		142	9.2
Snacking habit		587	37.9
Habit of skipping meals		132	8.5
Study 2 hours over/ everyday		453	29.3
Exercise habit		885	57.2

Table 2 shows the incidence of IA in the follow-up survey according to participants' characteristics. The new IA incidence rate for all participants was 8.8%. The IA incidence rate increased significantly according to mental health status, gender, and snacking habits. In addition, the incidence rate observed in participants with poor mental health was significantly higher relative to that of participants with good mental health.

Table 3 shows the predictors of new-onset IA. Poor mental health (adjusted odds ratio: 2.17 [95%CI: 1.45–3.25]) was identified as factor that promoted new incidence of IA. Table 4 shows the incidence of poor mental health at baseline and follow-up assessment. The incidence rate for poor mental health for all participants was 22.0%, and that observed for participants who exhibited IA and snacking habits were significantly higher relative to that of the reference group.

**Table 2:** The incidence of internet addiction between the baseline and follow-up surveys

<i>Variable</i>	<i>N</i>	<i>Total</i>	<i>Incidence rate (%)</i>	<i>P-value</i>	
Total	108	1229	8.8		
Mental health	Good	49	775	6.3	<0.001
	Poor	59	454	13.0	
Gender	Boy	38	580	6.6	0.009
	Girl	70	649	10.8	
Insomnia	No	99	1126	8.8	0.985
	Yes	9	103	8.7	
Sleep quality	Good	89	1084	8.2	0.071
	Poor	18	141	12.8	
Grooming appearance	No	35	314	11.1	0.089
	Yes	73	913	8.0	
Snacking habits	Yes	52	480	10.8	0.043
	No	56	748	7.5	
Habit of skipping meals	Yes	13	96	13.5	0.088
	No	95	1130	8.4	
Exercise habit	No	54	507	10.7	0.053
	Yes	54	722	7.5	

*P*-values were calculated with the chi-squared test.  
In each section, missing data have been excluded from the statistical analyses.

**Table 3:** The predictive factors of internet addiction

<i>Variable</i>	<i>N</i>	<i>AOR</i>	<i>95%CI</i>		<i>P-value</i>
Gender	Boy	567	1.00		0.011
	Girl	641	1.73	1.13 – 2.65	
Poor mental health	No	756	1.00		< 0.001
	Yes	452	2.17	1.45 – 3.25	

AOR: adjusted odds ratio, CI: confidence interval. Participants with missing data were excluded from the analysis. Logistic regression analyses were conducted on participants who did not have internet addiction at the baseline survey. Adjusted for gender, mental health status, snacking habit, and grooming appearance by multiple logistic regression using stepwise method.

**Table 4:** The incidence of poor mental health between the baseline and follow-up surveys

<i>Variable</i>	<i>N</i>	<i>Total</i>	<i>Incidence (%)</i>	<i>P-value</i>	
Total		198	900	22.0	
Internet addiction	No	164	787	20.8	<0.001
	Yes	23	56	41.1	
Gender	Boy	91	449	20.3	0.211
	Girl	107	451	23.7	
Insomnia	No	182	850	21.4	0.079
	Yes	16	50	32.0	
Sleep quality	Good	179	834	21.5	0.165
	Poor	18	62	29.0	
Grooming appearance	No	46	236	19.5	0.270
	Yes	152	662	23.0	
Snacking habits	No	58	356	16.3	0.001
	Yes	140	543	25.8	
Habit of skipping meals	No	16	62	25.8	0.463
	Yes	182	835	21.8	
Exercise habit	No	90	370	24.3	0.160
	Yes	108	530	20.4	

*P*-values were calculated with the chi-squared test.  
In each section, missing data have been excluded from the statistical analyses.

Table 5 shows the predictors of new-onset of poor mental health. IA (adjusted odds ratio: 2.39

[95%CI: 1.36–4.20]) was identified as factor that promoted new onset of poor mental health.

**Table 5:** The predictive factors of poor mental health

<i>Variable</i>		<i>N</i>	<i>AOR</i>	<i>95%CI</i>	<i>P-value</i>
Internet addiction	No	768	1.00		0.003
	Yes	56	2.39	1.36 – 4.20	
Insomnia	No	779	1.00		0.039
	Yes	45	1.97	1.03 – 3.75	

Participants with missing data were excluded from the analysis. Logistic regression analyses were conducted on participants who did not have poor mental health at the baseline survey. Adjusted for internet addiction, insomnia, and snacking habit by multiple logistic regression.

## Discussion

This was the first longitudinal study to examine IA in high school students in Japan. The response rate for the survey was unusually high. In addition, the results demonstrated a relationship between the IA and poor mental health. Therefore, the findings could serve as an important resource in the development of future IA prevention strategies.

Moreover, participants with poor mental health at baseline assessment developed IA easily. Regarding psychological factors, a high correlation between Internet dependence and mental health problems, such as depression, has been reported in numerous cross-sectional (3, 5, 26-28) and longitudinal studies (14-16, 29, 30). Therefore, anxiety disorders and depression are risk factors for the future onset of IA. Conversely, IA is known to increase the risk of depression. For example, relative to those without IA, participants with IA were approximately 2.5 times more likely to develop depression (17). Many studies have reported IA in East Asia; in addition, in the European Union, previous IA and emotional problems were important predictors of IA 2 years later, and both factors were associated with the development of IA over the long term (31). IA and mental health problems could occur in any country. Compensatory Internet use to escape from psychosocial problems explained Internet dependence (32). In addition, a survey involving

Japanese high school students showed that the process of escaping psychological pain by browsing the Internet increased the tendency toward latent Internet dependence and exerted a negative effect on daily life (33). In recent years, high school students have begun to use the Internet almost entirely via their smartphones. This provides various types of diversion at a low cost regardless of time or location. The Internet is an optimum tool via which to escape from reality, and its use as a coping strategy for stress is understandable, particularly in high school students whose time tends to be limited because they attend lessons at school, participate in after-school club activities, and cram school learning. Moreover, a meta-analysis reported a relationship between IA and mental health conditions such as depression, anxiety disorder, and alcohol dependence (34). These results suggested a bidirectional relationship between IA and mental health, in which both variables could be either a risk factor or an outcome. However, none of the previous studies that reported this bidirectional relationship included the same target population. Therefore, the current study provide novel information regarding the relationship between IA and poor mental health.

Aside from poor mental health, the factors that predicted IA onset in the current study included gender, grooming appearance, and snacking habits. With regard to gender, previous research showed that male was a risk factor for online

game addiction (28, 35, 36). In contrast, there was no difference in IA between genders (37). In a survey conducted by the Japanese Ministry of Internal Affairs and Communications, the proportion of high school students with a strong tendency toward Internet dependence was highest in girls, at 5.2%, with proportions of 3.9% and 4.6% for boys and the overall sample. With respect to sex, the effects of sex could have been influenced by factors such as race, region of residence, or the device used to access the Internet. Future research should examine these factors.

This study had several limitations. For example, the study period was limited to 1 year, which might have been an insufficient period within which to record actual IA rates; future studies should measure IA rates for longer periods. In addition, the sample included only first- and second-year students from high schools in a single provincial city in Japan, which could have led to sampling bias. Future research should examine whether similar results are obtained with students in different grades and districts. Furthermore, both nonresponse bias and reporting bias could have occurred. Moreover, the study did not examine some factors associated with IA, such as self-efficacy and home environment, identified in previous research (38, 39).

## Conclusion

A 1-year longitudinal study of Japanese high school students demonstrated a relationship between IA and poor mental health, in which IA and poor mental health could be the cause or result of the other. We hope that future endeavors to improve mental health and increase self-management skills in adolescents will lead to the prevention of IA. Adolescents, their parents and educational institutions need to take policies to use properly the Internet.

## Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or fal-

sification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

## Acknowledgements

This study was supported by a grant from the Japan Society for the Promotion of Science (KAKENHI Grant Number 26507009).

## Conflict of interest

The authors declare that there is no conflict of interests.

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