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## Original Article

## The association between alcohol use and problematic internet use: A large-scale nationwide cross-sectional study of adolescents in Japan

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## ABSTRACT

**Background:** This study aimed to clarify the associations between the frequency and amount of alcohol consumption and problematic Internet use, such as Internet addiction and excessive Internet use.**Methods:** A self-administered questionnaire survey was administered to students enrolled in randomly selected junior and senior high schools throughout Japan, and responses from 100,050 students (51,587 males and 48,463 females) were obtained. Multiple logistic regression analyses were performed in order to examine the associations between alcohol use and problematic Internet use such as Internet addiction (Young Diagnostic Questionnaire for Internet Addiction  $\geq 5$ ) and excessive Internet use ( $\geq 5$  h/day).**Results:** The results of multiple logistic regression analyses indicated that the adjusted odds ratios for Internet addiction (YDQ  $\geq 5$ ) and excessive Internet use ( $\geq 5$  h/day) became higher as the number of days in which alcohol had been consumed during the previous 30 days increased. In addition, the adjusted odds ratio for excessive Internet use ( $\geq 5$  h/day) indicated a dose-dependent association with the amount of alcohol consumed per session.**Conclusions:** This study revealed that adolescents showing problematic Internet use consumed alcohol more frequently and consumed a greater amount of alcohol than those without problematic Internet use. These findings suggest a close association between drinking and problematic Internet use among Japanese adolescents.© 2016 The Authors. Publishing services by Elsevier B.V. on behalf of The Japan Epidemiological Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

In recent years, use of the Internet has increased worldwide, and a large proportion of users are adolescents. In Japan, the internet utilization rate of Japanese adolescents increased from 72.8% in 2001<sup>1</sup> to 96.3% in 2009.<sup>2</sup> With the rapid global popularization of the Internet in recent years, issues related to problematic Internet use (PIU) among adolescents have arisen,<sup>3–11</sup> potentially affecting adolescents' health<sup>3–9,11</sup> and social activities,<sup>3,8–10</sup> including school performance. Recent studies have found that 6.7% of adolescents

(aged 15–19 years) in Hong Kong,<sup>5</sup> 4.04% of students (aged 14–18 years) in the United States,<sup>8</sup> and 3.1% of students (mean age, 16.16 years) in Greece<sup>10</sup> were evaluated as Internet addicts. In addition, 17.1% of adolescents (ages 12–18 years) in Singapore reported using the Internet more than 5 h per day.<sup>9</sup>

However, to date, a standard definition of PIU has not been established. Spada et al. argued that there were no officially or broadly accepted diagnostic criteria for PIU, even in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders.<sup>12</sup> Rial et al. reported that previous studies have referred to PIU as Internet addiction (IA), compulsive Internet use, pathological Internet use, excessive Internet use (EIU), or Internet dependence.<sup>13</sup>

Recent studies have reported that PIU is associated with depression and anxiety,<sup>3,5–9,11</sup> sleep disorders (e.g., excessive daytime sleepiness),<sup>4</sup> and substance use (e.g., tobacco).<sup>7,8</sup> PIU among

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adolescents is a public health problem that has recently emerged and requires corrective action.

Another public health issue is alcohol use among adolescents. Previous studies have indicated that heavy alcohol consumption during adolescence has long-lasting adverse social and physical effects (e.g., antisocial behavior, such as violence<sup>14</sup>; mental disorders<sup>15</sup>; and a decline in cognitive function<sup>16,17</sup>). Some epidemiological studies have also examined and reported the effects of alcohol use on Internet addiction among adolescents in recent years.<sup>4,18,19</sup> Ko et al. conducted a cross-sectional study of 2114 high school students using a self-administered questionnaire and reported that problematic alcohol use was associated with Internet addiction.<sup>18</sup> Sung et al. performed a nationwide, web-based epidemiological study of adolescents and concluded that alcohol use was significantly associated with Internet addiction only among girls.<sup>19</sup> They postulated two hypotheses to explain the association between alcohol use and Internet addiction. One hypothesis attempted to explain this association from a psychological perspective. Based on Jessor's Problem-Behavior Theory<sup>20</sup> (psychosocial proneness), they viewed problematic forms of behavior, such as alcohol drinking, as a symptom of specific psychosocial factors that are common to many behavioral problems. They inferred that alcohol drinking caused other types of problematic behavior, such as Internet addiction, through such common psychosocial factors. The other hypothesis was based on a neurophysiological perspective: neurotransmitter systems (e.g., serotonergic and dopaminergic) have pathophysiological associations with both alcohol use and behavioral addictions.<sup>21</sup>

The results of these previous epidemiological studies have not contradicted these hypotheses. However, these studies had some important limitations: they were poorly representative national samples, with comparatively small sample sizes of a few thousand subjects<sup>4,18</sup>; they had unknown or extremely low (less than 50%) response rates<sup>4,18</sup>; there was a possibility of substantially large selection bias due to the adoption of a web-based survey method<sup>19</sup>; and they failed to adjust for some potential confounding factors (e.g., lifestyle habits, such as smoking and exercise, as well as mental health status).<sup>4,18</sup> In addition, as none of these studies considered the amount and frequency of alcohol consumption, the existence of a dose-response relationship between alcohol use and Internet addiction was unknown. Therefore, we designed the present study to address these shortcomings and yield more epidemiologically accurate evidence. If the association between drinking and PIU status in adolescents is investigated using a design that compensates for the limitations of the previous studies, the key factors of this association may be elucidated. This knowledge is highly beneficial for public health, not only because it will clarify how drinking and PIU are associated, but also because it will improve healthcare guidance for adolescents who suffer from PIU by addressing their drinking status. Therefore, in the present study, we conducted a survey on alcohol use and PIU (e.g., IA) among junior and senior high school students in Japan.

## 2. Methods

In the Japanese education system, a child enters junior high school at the age of 12 years. Junior high school is compulsory 3-year education, and those who wish to further their education may go to senior high school for another 3 years. In this report, the grades in junior high school are described as the 7th to 9th grades, and those in senior high school as the 10th to 12th grades.

The number of all registered high schools as of May 2011 in Japan was 14,621 (10,018 junior and 4603 senior high schools). Among them, 140 junior (enrollment: 65,053) and 124 senior high schools (enrollment: 101,591) were randomly selected using a

single-stage cluster sampling method with probability proportional to size. We requested the selected schools to participate on a whole-school basis.

The same number of self-administered anonymous questionnaires as the number of students enrolled in a school were sent to all selected schools. Upon arrival of the questionnaires, the responsible person at a given school determined whether the school would participate in the survey on a whole-school basis. At participating schools, the questionnaires were distributed to students by homeroom teachers. Each completed questionnaire was placed in an envelope, and then it was sealed with an adhesive flap by each student. All questionnaires were collected by teachers before being returned to us on a whole-school basis. The survey was conducted between October 2012 and March 2013. The following ethical considerations were taken account: we requested the teachers not to peer at questionnaires over students' shoulders while students were filling out the questionnaires, and we assured anonymity of the questionnaires. This study was approved by the Ethics Committee of the Nihon University School of Medicine.

The questionnaire items used in this study were developed from questionnaires used in similar previous studies. To assess Internet use, all questions of the 8-item version of the Young Diagnostic Questionnaire for Internet Addiction (YDQ)<sup>22</sup> were translated into Japanese and added to the current questionnaire. Reliability and validity of the YDQ were verified in previous studies.<sup>23,24</sup> According to a meta-analysis by Frangos et al., the overall Cronbach's alpha of the YDQ is 0.889.<sup>23</sup> Cronbach's alpha of the YDQ in this study was 0.937. Similar to previous studies involving adolescents,<sup>5,10,25</sup> IA was defined as an affirmative answer to at least 5 of the 8 YDQ questions. We also included a question on the average number of hours spent using the Internet per weekday during the previous 30 days. EIU was defined as 5 or more hours of use per day, based on a previous study with adolescents. As IA and EIU were reported as PIU in a previous study,<sup>13</sup> we referred to both IA and EIU as PIU in the present study. With regard to alcohol consumption, we included questions on the number of days during the past 30 days on which the respondent had consumed alcohol and on the amount of alcohol consumed per session.

As a mental health indicator, the Japanese version of the 12-item General Health Questionnaire (GHQ-12)<sup>26,27</sup> was used. Doi et al. investigated its reliability and validity and reported that the Cronbach's alpha coefficients were 0.83 for men and 0.85 for women. We used the questions from the "depression and anxiety" and "decrease in positive feeling" factors of the GHQ-12.<sup>27</sup> One question from each of the two factors was selected for the present study, and subjects who answered affirmatively to either question were defined as having poor mental health (GHQ score  $\geq 1$ ). Previous studies have shown that evaluation of mental health status using depression symptoms with the GHQ-12 and with this cutoff point had a sensitivity of 87.0% and a specificity of 85.1%.<sup>28</sup> The Cronbach's alpha in this study was 0.816.

First, the prevalence of IA based on sex and grade was calculated. Then, the association between sex and IA was examined using a chi-square test. Calculations and analyses of EIU were performed using the same approach.

Next, the prevalence of IA based on the number of days on which alcohol was consumed was calculated. Then, an association between the number of days of alcohol use and IA was examined using a Mantel-Haenszel test for trend. Furthermore, the prevalence of IA based on the amount of alcohol consumed per drinking session was calculated. Then, an association between the amount of alcohol and IA was examined using a Mantel-Haenszel test for trend. Calculations and analyses of EIU were performed using the same approach.

Next, we performed multiple logistic regression analyses to calculate the adjusted odds ratios (aORs) for adolescents who were addicted to the Internet or who had EIU ( $\geq 5$  h/day) for both the number of days alcohol was consumed and the amount of alcohol consumed per session during the previous 30 days. Regarding the covariates, besides basic attributes (sex and age), eating habits (eating breakfast), and school life (intention to study at university and participating in extracurricular activities), the following items, which are known to have significant associations with IA or EIU, were used: sleep<sup>4</sup> (bedtimes), smoking,<sup>7,8</sup> and mental health.<sup>3,5–9,11</sup> All analyses were performed using SPSS 20.0 for Windows (IBM Corp, Armonk, NY, USA).

### 3. Results

Of the 140 junior and 124 senior high schools that were selected, 94 (67.1%) and 85 (68.5%) participated, respectively. The total number of enrolled students in the participating junior and senior high schools was 109,847. Of those, 38,871 junior and 62,263 senior high school students responded. The eventual response rate was 60.7% (101,134 responses out of 166,644 eligible students across all initially selected junior and senior high schools). From the collected questionnaires, 1084 were excluded because the respondent's sex or grade was not specified or the responses were inconsistent. Data from the remaining 100,050 questionnaires (51,587 males and 48,463 females) were analyzed.

IA and EIU prevalence with regard to sex is shown in Table 1. The prevalence of IA was 8.1% (95% confidence interval [CI], 7.9%–8.3%) in all participants, 6.4% (95% CI, 6.2%–6.6%) in boys, and 9.9% (95% CI, 9.6%–10.2%) in girls. The result of a chi-square test indicated a significant sex-based difference in the prevalence of IA ( $P < 0.001$ ). The prevalence of EIU was 12.6% (95% CI, 12.4%–12.8%) in all participants, 12.3% (95% CI, 12.0%–12.6%) in boys, and 13.0% (95% CI, 12.7%–13.3%) in girls. The result of a chi-square test indicated a significant sex-based difference in the prevalence of EIU ( $P < 0.001$ ).

IA and EIU prevalence with regard to the number of days on which alcohol had been consumed and the amount of alcohol consumed per drinking session is shown in Table 2. Significant associations were observed between the prevalence of IA and EIU and the number of days on which alcohol had been consumed ( $P < 0.001$ ): with an increase in the number of days of alcohol use, the prevalence of IA and EIU also increased. Similar associations were observed between the prevalence of IA and EIU and the amount of alcohol consumed per drinking session ( $P < 0.001$ ).

Table 3 shows the results of multiple logistic regression analyses using IA and EIU as objective variables, and the number of days on which alcohol was consumed and mental health status as covariates. Significant associations were observed between both the number of days of alcohol use and mental health status and IA. In

particular, the aOR odds ratio for IA significantly increased as the number of days of alcohol use increased. Significant associations were also observed between both the number of days on which alcohol was consumed and mental health status and EIU. Similar to IA, the aOR for EIU significantly increased as the number of days of alcohol use increased.

Table 4 shows the results of multiple logistic regression analyses using IA and EIU as objective variables and the amount of alcohol consumed per drinking session and mental health status as covariates. Significant associations were observed between both the amount of alcohol and mental health status and IA. In particular, the aOR for IA significantly increased as the amount of alcohol increased. Significant associations were also observed between both the amount of alcohol consumed per drinking session and mental health status and EIU. Similar to IA, the aOR for EIU significantly increased as the amount of alcohol increased.

### 4. Discussion

The present study provides evidence of a strong association between alcohol use (amount and frequency) and PIU, with a dose-response relationship. We have inferred some reasons for the observed association of alcohol use with Internet use among adolescents. One possibility is that alcohol consumption and PIU may be different symptoms of a single underlying disorder or disease. PIU is considered a type of behavioral addiction.<sup>29,30</sup> Gambling addiction, another type of behavioral addiction, has been found to be associated with substance use.<sup>31,32</sup> An experimental study<sup>33</sup> has shown that PIU and substance dependency involve activation of the same sites in the brain. Moreover, it has been reported that PIU and substance dependency are phenomenologically linked.<sup>34</sup> In addition, a longitudinal study reported on cases of female adolescents who simultaneously developed compulsive Internet use and substance use.<sup>35</sup> The present results also suggest that alcohol use and PIU are symptoms of a single disorder or disease. Adolescents who had impaired emotional control may have dealt with this disability by going on the Internet or using substances. Meanwhile, there is an argument about whether Internet addiction is an addiction to the Internet or to content mediated by the Internet.<sup>36</sup> Moreover, a consensus has not been reached on the definition of PIU itself. Further studies on PIU are required.

Another possibility is the existence of certain disorders or diseases that may be associated with both drinking and PIU, such as insomnia. The prevalence of insomnia symptoms (i.e., difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening) has been reported to be higher among adolescents who are addicted to the Internet than among adolescents who are not addicted.<sup>4</sup> Moreover, insomnia in adolescents has been associated with alcohol use.<sup>37,38</sup> In addition to insomnia, aggressive behavior

**Table 1**  
Prevalence of Internet addiction and excessive Internet use among Japanese adolescents, based on sex.

	Internet addiction <sup>a</sup>			Excessive Internet use ( $\geq 5$ h/day) <sup>b</sup>		
	Prevalence (%)	95% CI (%)	<i>P</i>	Prevalence (%)	95% CI (%)	<i>P</i>
Boys	6.4	6.2–6.6	<0.001 <sup>c</sup>	12.3	12.0–12.6	<0.001 <sup>d</sup>
Girls	9.9	9.6–10.2		13.0	12.7–13.3	
Total	8.1	7.9–8.3		12.6	12.4–12.8	

CI, confidence interval.

Subject with missing data were excluded from the analysis.

<sup>a</sup> Internet addiction: affirmative response to at least 5 or 8 questions from Young Diagnostic Questionnaire for Internet addiction.

<sup>b</sup> Excessive Internet use ( $\geq 5$  h/day): average of  $\geq 5$  h of Internet use per weekday during the previous 30 days.

<sup>c</sup> *P* was calculated by  $\chi^2$  test, Internet addiction  $\times$  Sex.

<sup>d</sup> *P* was calculated by  $\chi^2$  test, Excessive Internet use  $\times$  Sex.

**Table 2**  
Prevalence of Internet addiction and excessive Internet use among Japanese adolescents, based on the number of days on which alcohol had been consumed and amount of alcohol consumed per drinking session.

	Internet addiction <sup>a</sup>			Excessive Internet use ( $\geq 5$ h/day) <sup>b</sup>		
	Prevalence (%)	95% CI (%)	<i>P</i> for trend	Prevalence (%)	95% CI (%)	<i>P</i> for trend
<b>Number of days on which alcohol had been consumed</b>			<0.001 <sup>c</sup>			<0.001 <sup>e</sup>
None	7.3	7.1–7.5		10.8	10.6–11.0	
1–5 days	13.2	12.5–13.9		24.4	23.6–25.2	
6–19 days	15.6	13.7–17.5		34.8	32.3–37.3	
$\geq 20$ days	25.1	20.5–29.7		41.9	36.6–47.2	
<b>Amount of alcohol consumed per drinking session</b>			<0.001 <sup>d</sup>			<0.001 <sup>f</sup>
Not drinking	6.5	6.3–6.7		9.4	9.2–9.6	
Less than a glass	9.4	9.0–9.8		11.5	11.0–12.0	
1 or 2 glasses	11.8	11.2–12.4		21.1	20.3–21.9	
3–5 glasses	12.8	11.8–13.8		30.9	29.5–32.3	
$\geq 6$ glasses	16.3	14.7–17.9		38.4	36.2–40.6	

CI, confidence interval.

Subject with missing data were excluded from the analysis.

<sup>a</sup> Internet addiction: affirmative response to at least 5 or 8 questions from Young Diagnostic Questionnaire for Internet addiction.

<sup>b</sup> Excessive Internet use ( $\geq 5$  h/day): average of  $\geq 5$  h of Internet use per weekday during the previous 30 days.

<sup>c</sup> *P* was calculated by Mantel-Haenszel test for trend, Internet addiction  $\times$  Number of days on which alcohol had been consumed.

<sup>d</sup> *P* was calculated by Mantel-Haenszel test for trend, Internet addiction  $\times$  Amount of alcohol consumed per drinking session.

<sup>e</sup> *P* was calculated by Mantel-Haenszel test for trend, Excessive Internet use ( $\geq 5$  h)  $\times$  Number of days on which alcohol had been consumed.

<sup>f</sup> *P* was calculated by Mantel-Haenszel test for trend, Excessive Internet use ( $\geq 5$  h)  $\times$  Amount of alcohol consumed per drinking session.

**Table 3**  
Multiple logistic regression analyses regarding associations between number of days on which alcohol had been consumed and Internet addiction or excessive Internet use.

	Internet addiction <sup>a</sup>			Excessive Internet use ( $\geq 5$ h/day) <sup>b</sup>		
	AOR	95% CI	<i>P</i> value	AOR	95% CI	<i>P</i> value
<b>Number of days on which alcohol had been consumed</b>			<0.001			<0.001
None	1.00			1.00		
1–5 days	1.49	1.39–1.60		1.85	1.75–1.95	
6–19 days	1.62	1.38–1.90		2.42	2.13–2.74	
$\geq 20$ days	3.36	2.57–4.41		3.55	2.79–4.51	
<b>Mental health status</b>			<0.001			<0.001
Good	1.00			1.00		
Poor	3.25	3.09–3.42		1.36	1.31–1.42	

AOR, adjusted odds ratio; CI, confidence interval.

Adjusted for Sex, Grade, Having breakfast, Bedtimes, Intending to study at university, Participating in extracurricular activities, Smoking.

<sup>a</sup> Internet addiction: affirmative response to at least 5 or 8 questions from Young Diagnostic Questionnaire for Internet addiction.

<sup>b</sup> Excessive Internet use ( $\geq 5$  h/day): average of  $\geq 5$  h of Internet use per weekday during the previous 30 days.

**Table 4**  
Multiple logistic regression analyses regarding associations between amount of alcohol consumed per drinking session and Internet addiction or excessive Internet use.

	Internet addiction <sup>a</sup>			Excessive Internet use ( $\geq 5$ h/day) <sup>b</sup>		
	AOR	95% CI	<i>P</i>	AOR	95% CI	<i>P</i>
<b>Amount of alcohol consumed per drinking session</b>			<0.001			<0.001
Not drinking	1.00			1.00		
Less than a glass	1.33	1.25–1.42		1.19	1.12–1.25	
1 or 2 glasses	1.46	1.36–1.57		1.91	1.81–2.02	
3–5 glasses	1.44	1.30–1.60		2.62	2.42–2.83	
$\geq 6$ glasses	1.74	1.51–2.01		3.25	2.92–3.63	
<b>Mental health status</b>			<0.001			<0.001
Good	1.00			1.00		
Poor	3.22	3.06–3.39		1.34	1.29–1.40	

AOR, adjusted odds ratio; CI, confidence interval.

Adjusted for Sex, Grade, Having breakfast, Bedtimes, Intending to study at university, Participating in extracurricular activities, Smoking.

<sup>a</sup> Internet addiction: affirmative response to at least 5 or 8 questions from Young Diagnostic Questionnaire for Internet addiction.

<sup>b</sup> Excessive Internet use ( $\geq 5$  h/day): average of  $\geq 5$  h of Internet use per weekday during the previous 30 days.

(e.g., serious fights and carrying weapons) have been associated with PIU<sup>8</sup> and alcohol use<sup>39</sup> among adolescents. Therefore, future research should consider the effects of these confounding factors when examining the association between Internet and alcohol use among adolescents.

The present study had three main strengths. First, the survey used a nationally representative random sample of over 100,000

students. Second, as both the amount and frequency of alcohol consumption were assessed, analyses of the effects of drinking on PIU, including the dose-response relationship, could be performed. Third, in analyses of the associations of alcohol use and Internet addiction, multivariate analyses were used and covariate factors other than alcohol use and Internet addiction were taken into account and appropriately adjusted.



The present study had some limitations. First, because a cross-sectional design was used, a causal relationship could not be determined. For example, this study found associations between alcohol drinking and PIU, such that alcohol drinking may induce PIU. However, the possibility that PIU may induce alcohol drinking cannot be refuted. The latter possibility was suggested in a study by Sun et al. of 1761 high school students in China and 1182 counterparts in the USA.<sup>35</sup> This longitudinal study, with a follow-up survey conducted 1 year later, investigated the association between compulsive Internet use and binge drinking. The authors reported that baseline compulsive Internet use was a significant factor for a change in binge drinking, but they did not find an inverse association. To obtain accurate evidence of causal relationships between alcohol use and Internet addiction, more longitudinal studies with better measures of Internet addiction are needed. Second, a non-response bias may have occurred, as certain schools and students chose not to participate. Moreover, data from long-term absentees are not reflected in the current analyses. Third, the use of a self-administered questionnaire may have resulted in a reporting bias. For instance, data on the number of days alcohol had been consumed and the amount consumed may have been subject to recall bias. Moreover, because underage drinking is illegal in Japan, the respondents may have tended to under-report their alcohol consumption. Fourth, as residential area data of participants were not available, we could not analyze geographical differences.

In conclusion, this study suggests a close association between alcohol drinking and PIU among Japanese adolescents. When addressing the issue of PIU among adolescents, the existence of other forms of problematic behavior, including alcohol drinking, must be considered.

### Conflicts of interest

None declared.

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