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Association between Smoking and Problematic Internet Use among Japanese Adolescents: Large-Scale Nationwide Epidemiological Study

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Cover Page

Association between Smoking and Problematic Internet Use among Japanese Adolescents: Large-Scale Nationwide Epidemiological Study

Hisayoshi Morioka, MD, PhD[1], Osamu Itani, MD, PhD[2], Yoneatsu Osaki, MD, PhD[3], Susumu Higuchi, MD, PhD[4], Maki Jike, PhD[1], Yoshitaka Kaneita, MD, PhD[2], Hideyuki Kanda, MD, PhD[5], Sachi Nakagome, MD, PhD[1], and Takashi Ohida, MD, PhD[1]

[1]Division of Public Health, Department of Social Medicine, Nihon University School of Medicine, Itabashi-ku, Tokyo, Japan.

[2]Department of Public Health and Epidemiology, Faculty of Medicine, Oita University, Yufu-shi, Oita, Japan.

[3]Division of Environmental and Preventive Medicine, Department of Social Medicine, Faculty of Medicine, Tottori University, Yonago-shi, Tottori, Japan.

[4]National Hospital Organization Kurihama Medical and Addiction Center, Yokosuka-shi, Kanagawa, Japan.

[5]Department of Public Health, Faculty of Medicine, Shimane University, Izumo-shi,

Cover Page

Shimane, Japan.

Running Title: Association Smoking and Problematic Internet Use

Address correspondence to:

Dr. Osamu Itani, Department of Public Health and Epidemiology

Faculty of Medicine, Oita University, 1-1 idaigaoka, Yufu-shi, Oita 879-5593, Japan

Tel.: +81-97-586-5735, fax: +81-97-586-5739, E-mail: itaniosamu@oita-u.ac.jp

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Abstract

The aim of this study was to clarify the association between smoking and problematic

internet use (PIU), such as internet addiction (IA) and excessive internet use (EIU),

among Japanese adolescents. A self-administered questionnaire was administered to

students enrolled in randomly selected junior and senior high schools throughout Japan.

Responses were obtained from 100,050 students (0.94:1 ratio of boys to girls). The

prevalence of IA (as indicated by a Young Diagnostic Questionnaire for Internet

Addiction score ≥5) in all participants, boys, and girls was 8.1%, 6.4%, and 9.9%,

respectively. The prevalence of EIU (≥5 hours/day) in all participants, boys, and girls

was 12.6%, 12.3%, and 13.0%, respectively. The results of multiple logistic regression

analyses indicated that the adjusted odds ratios (AORs) for IA and EIU were

significantly higher among students who smoked (including those who previously

smoked) than among those who never smoked ($P<0.01$ for all comparisons). In

addition, the AORs were highest for students who smoked ≥21 cigarettes per day. The

prevalence and AORs of IA and EIU tended to increase with smoking frequency and

number of cigarettes smoked per day, indicating a dose-dependent relationship. Thus, IA

and EIU have strong associations with smoking. This study revealed that adolescents

p. 1

Easy to read version

ORIGINAL RESEARCH ARTICLE

who routinely smoked, or those who smoked more cigarettes per day had a higher risk

of PIU than adolescents who did not. These findings suggest that there is a close

association between smoking and PIU among Japanese adolescents.

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ORIGINAL RESEARCH ARTICLE

Main Text

Introduction

With the rapid growth in internet use among youth worldwide in recent years,

issues related to problematic internet use (PIU), such as internet addiction (IA) and

excessive internet use (EIU), have arisen among adolescents. Recent studies have

reported that PIU in adolescents is associated not only with health problems such as

depression, anxiety, [1-4] and sleep disorders,[5] but also with risky behaviors such as

substance use [3] and aggression.[3] Smoking, in particular, has been reported to be

associated with PIU.[2, 3]

However, some studies [5, 6] have reported no association between smoking and

PIU in adolescents. In addition, studies that did report an association between smoking

and PIU did not investigate the characteristics of smoking behavior, such as the

presence of a smoking habit and the number of cigarettes smoked per day. We

hypothesized that addressing the limitations of the previous studies by investigating the

association between smoking status and PIU in adolescents would elucidate specific

characteristics of smoking behavior that are associated with PIU. This knowledge

would be highly beneficial for public health, as it will not only clarify how smoking and

PIU are associated, but will also improve healthcare guidance for adolescents who

suffer from PIU by addressing their smoking behavior. The present study investigated

p. 3

Easy to read version

Main Text

the association of IA and EIU with smoking behavior, including the number of

cigarettes smoked per day. This study is one in a series of nationwide surveys about the

lifestyle characteristics (such as alcohol use, smoking, eating, and sleeping) of Japanese

junior and senior high school students.

Methods

Participants

A single-stage cluster sampling method was employed. In total, 10,018 junior

high schools and 4,603 senior high schools (14,621 schools overall) in Japan were

included in this study in May 2011. Among these schools, 140 junior high schools

(selection rate: 1.4%) and 124 senior high schools (selection rate: 2.7%) were randomly

selected. In the Japanese education system, children are in primary school for six years,

starting at age six. They then enter junior high school for three years, followed by three

years of senior high school.

Procedure

We used the same survey methods that were used in a previous nationwide

survey of lifestyle characteristics of Japanese junior and senior high school students.[7-9]

p. 4

Easy to read version

Main Text

Self-administered anonymous questionnaires for all students were sent to the selected

schools. At participating schools, the questionnaires were distributed to students by

homeroom teachers. The students read the questionnaire and then responded to the

questions. Each completed questionnaire was placed in an envelope and sealed with an

adhesive flap by the student. The questionnaires were collected by the teachers, and

each school returned the completed questionnaires to us. The survey was conducted

between October 2012 and March 2013. The following ethical considerations were

taken account: we requested that the teachers not look at the questionnaires over

students' shoulders while the students were completing the questionnaires, and we

assured anonymity of the questionnaires. This study was approved by the Ethics

Committee of the Nihon University School of Medicine.

Response rates

Of the selected junior and senior high schools, 94 and 85 returned responses,

respectively (school cooperation rate: 67.1% and 68.5%, respectively). A total of 179

out of 264 junior and senior high schools returned responses (overall school cooperation

rate: 67.8%). Of the 109,847 eligible students, 101,134 responded to the questionnaire

(38,871 [92.6%] junior high and 62,263 [91.7%] senior high school students), yielding

p. 5

Easy to read version

Main Text

an overall response rate of 92.1%. The eventual response rates were 59.8% and 61.3%

for junior and senior high schools, respectively (60.7% overall). Responses to 1,084

questionnaires were excluded because the student's sex or grade was not specified, or

because the responses were inconsistent. Data from the remaining 100,050

questionnaires (38,494 junior and 61,556 senior high school students, including 51,587

boys and 48,463 girls) were analyzed.

Measures

The survey questions were developed based on questionnaires used in similar

previous studies. To assess internet use, all questions on the 8-item version of the Young

Diagnostic Questionnaire for Internet Addiction (YDQ) [10] were translated into Japanese.

Similar to previous studies of adolescents,[1, 6, 11] IA was defined as affirmative answers to

≥ 5 of the questions on the YDQ. We also included a question about the average number

of hours spent using the internet per weekday during the previous 30 days. EIU was

defined as ≥ 5 hours per day, similar to a previous study of adolescents.[4]

Students were asked about their current smoking behavior. The possible

responses were I have never smoked; I smoked in the past, but do not smoke currently; I

sometimes smoke; and I regularly smoke. A question about the average number of

p. 6

Easy to read version

Main Text

cigarettes smoked per day in the previous 30 days was also included (possible responses: I don't smoke, ≤ 10, ≥ 11 but ≤ 20, and ≥ 21).

Mental health status was assessed by selected items from the 12-item General Health Questionnaire (GHQ-12). [12, 13] The GHQ-12 is a self-administered questionnaire that was designed as a screening tool for mental illness. [12, 13] In this study, we used the assessments for "depression and anxiety" and "decrease in positive feeling" from the GHQ-12. One question from each of the two factors was selected for this study. Students who answered affirmatively to either question were classified as having poor mental health (GHQ score ≥ 1). In addition, the questionnaire also assessed basic characteristics (sex and grade), lifestyle habits (eating breakfast, bedtime, and drinking alcohol), and school life (intention to study at a university and participation in extracurricular activities).

Data analysis

First, we performed a factor analysis (using the maximum likelihood method) of all the questions in the Japanese 8-item version of the YDQ to extract factors and calculate their contribution rates. We also calculated the reliability coefficient (Cronbach's coefficient α).

p. 7

Easy to read version

ORIGINAL RESEARCH ARTICLE

Main Text

The sex-specific prevalences of IA and EIU were then calculated. The prevalence of IA, stratified by current smoking habit and average number of cigarettes smoked per day (in the previous 30 days), was calculated. The associations of current smoking habit and average number of cigarettes smoked per day with IA were examined using Mantel–Haenszel tests for trends. EIU calculations and analyses were performed using the same approach.

We performed multiple logistic regression analyses using the forced entry method to examine the associations between IA or EIU as the dependent variables and current smoking habit and mental health status as the explanatory variables. The following seven covariates were used to minimize confounding: sex, age, eating breakfast, bedtime, alcohol consumption, intention to study at a university, and participation in extracurricular activities. Analyses with the average number of cigarettes smoked per day as the explanatory variable were performed using the same approach. All analyses were performed using IBM SPSS Statistics, version 20 J for Windows (IBM Corp., Somers, NY, USA).

Results

Factor analysis of the Japanese 8-item version of the YDQ with the eigenvalue

p. 8

Easy to read version

Main Text

set at ≥1.0 extracted one factor, with a contribution rate of 66.0%. The reliability

coefficient (Cronbach's coefficient α) was 0.94, and a high degree of internal

consistency was observed.

The prevalence of IA in all participants, boys, and girls was 8.1% (95%

confidence interval (CI) [7.9-8.3]), 6.4% (95% CI [6.2-6.6]), and 9.9% (95% CI

[9.6-10.2]), respectively. The prevalence of EIU in all participants, boys, and girls was

12.6% (95% CI [12.4-12.8]), 12.3% (95% CI [12.0-12.6]), and 13.0% (95% CI

[12.7-13.3]), respectively.

The prevalence of IA and EIU, stratified by current smoking habit and the

average number of cigarettes smoked per day, is shown in Table 1. Significant trends

were observed in the prevalence of IA and EIU related to current smoking habits

($P<0.01$): as the current smoking habit increased, the prevalence of IA and EIU also

increased. Similar relationships were observed between the prevalence of IA and EIU

and the average number of cigarettes smoked per day ($P< 0.01$): the prevalence of IA

and EIU increased as the average number of cigarettes smoked increased.

The results of the multiple regression analyses are shown in Table 2. Model 1

includes IA or EIU as dependent variables, and current smoking habit and mental health

status as covariates. The adjusted odds ratio (AOR) for IA was significantly highest for

p. 9

Easy to read version

Main Text

students who sometimes smoked (AOR: 1.59, 95% CI [1.33–1.90], *P*<0.01), and the

AOR for IA was significantly higher for students with poor mental health status (AOR:

3.23, 95% CI [3.07–3.40], *P*<0.01). The AOR for EIU (≥5hours) was highest for

students who habitually smoked (AOR: 1.79, 95% CI [1.59–2.03], *P*<0.01), and the

AOR for EIU was significantly higher for students with poor mental health status

(AOR: 1.35, 95% CI [1.30–1.41], *P*<0.01).

Model 2 includes IA ~~and~~ or EIU as dependent variables, and the average

number of cigarettes smoked per day and mental health status as covariates. The AOR

for IA was highest for students who smoked ≥21 cigarettes per day (AOR: 1.78, 95% CI

[1.29–2.44], *P*<0.01), and the AOR for IA was significantly higher for students with

poor mental health status (AOR: 3.23, 95% CI [3.06–3.40], *P*<0.01). The AOR for EIU

was also highest for students who smoked ≥21 cigarettes per day (AOR: 2.53, 95% CI

[1.93–3.31], *P*<0.01), and AOR for EIU was significantly higher for students with poor

mental health status (AOR: 1.36, 95% CI [1.30–1.42], *P*<0.01)

Discussion

In this study, we performed two set of statistical analyses to assess the strength

of the epidemiological associations between smoking and PIU (IA or EIU). First, we

p. 10

Easy to read version

Main Text

examined the associations between current smoking habits or the number of cigarettes

smoked per day and the prevalence of PIU. The results indicated that the prevalence of

PIU significantly increased with current smoking or as the number of cigarettes smoked

increased. Next, we examined the association between smoking and PIU via

multivariate analysis after adjusting for covariates (sex, age, lifestyle, and other

variables). The AORs for PIU tended to increase for current smoking or as the number

of cigarettes smoked per day increased. There was a dose-dependent relationship

between smoking and PIU, as measured by prevalence and AORs. Therefore, the

epidemiological association between smoking and PIU was considered to be strong.

This result is consistent with a previous finding of an association between

smoking and PIU. [14] However, two other studies reported no association between

smoking and PIU. [5,6] One of these studies did find an association of PIU with alcohol

consumption, [5] but not with smoking. However, the smoking prevalence among the

adolescents in this previous study was lower than the prevalence of alcohol

consumption, which may have contributed to these results. The second study reported

very weak correlations between Internet addiction and daily alcohol consumption and

between IA and tobacco use. [6] However, a detailed description of the methods,

including the questions used was not reported in this study.

p. 11

Easy to read version

Main Text

One possible reason for the association between smoking and PIU is that PIU

and substance use (such as smoking) may be different symptoms of a single underlying

disorder or disease. PIU is considered a type of behavioral addiction. [15, 16] Gambling

addiction, which is another type of behavioral addiction, is associated with substance

use. [17, 18] An experimental study [19] reported that PIU and smoking both involve

activation of the same brain sites. Moreover, PIU and substance dependency are similar

from a phenomenological standpoint. [20] In addition, a longitudinal study reported

female adolescents who simultaneously developed compulsive internet use and

substance dependence. [21] These individuals were unable to control their emotions and

coped with this disability by spending time on the internet or through substance use.

There is disagreement about whether IA is an addiction to the internet or to content

mediated by the internet. [22] Moreover, a consensus has not been reached on the

definition of PIU itself. Further studies of PIU are needed. The second possible

explanation for our findings is the existence of certain disorders or diseases that are

associated with both smoking and PIU. For instance, associations have been reported

between insomnia and smoking, [5] and between insomnia and PIU, [23] in adolescents. The

association between smoking and PIU—should be investigated in future studies,

considering the effects of more potential confounders. The third possibility is the

p. 12

Easy to read version

Main Text

existence of a causal relationship between smoking and PIU. However, we were unable

to assess causality because our study was cross-sectional. To the best of our knowledge,

no studies have found that nicotine causes internet dependency.

An explanatory model, in which IA is a type of impulse-control disorder was

proposed. [24-26] Impulse-control disorders are reportedly associated with smoking, even

among adolescents. [27-30] Brand et al. hypothesized that subjects who displayed social

risk factors that triggered IA, such as previous or current lack of social support and

social isolation, [31, 32] developed IA through maladaptive coping (such as turning to the

internet) with daily problems and then maintained their addictive behavior. [33] Based on

this theory, Brand et al. performed covariance structure analyses as part of an

epidemiological study to test the goodness of fit of their model. They demonstrated that

most of the variance in the observed factors could be explained by the model. For their

analyses, they used the brief COPE [34] to assess coping style and included substance use

as one of the subscales. They reported that substance use (as a maladaptive coping

mechanism) significantly affected IA. Thus, potential psychological or

pathophysiological mechanisms mediating IA and substance use have gradually been

revealed. However, since our present study was cross-sectional, it could not provide

p. 13

Easy to read version

Main Text

useful information on the mechanisms mediating IA and smoking. This issue should be

addressed in future studies.

Our study had some limitations. Non-response bias might have occurred,

because certain schools and students chose not to participate. Moreover, data from

long-term absentees would not have been reflected in the current analyses. It is possible

that the use of a self-administered questionnaire induced reporting bias. In conclusion,

this study revealed a consistent association between smoking and PIU among Japanese

adolescents. PIU should be considered to help guide healthcare for adolescents who

smoke.

Acknowledgment

Author Disclosure Statement

No competing financial interests exist.

p. 14

Easy to read version

ORIGINAL RESEARCH ARTICLE

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p. 15

Easy to read version

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p. 16

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p. 17

Easy to read version

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p. 18

Easy to read version

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p. 19

Easy to read version

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p. 20

Easy to read version

ORIGINAL RESEARCH ARTICLE

Table Legends

TABLE 1.

Title: PREVALENCE OF INERNET ADDICTION OR EXESSIVE INTERNET USE

AMONG JAPANESE ADOLESCENTS, BASED ON CURRENT SMOKING

AND THE AVERAGE NUMBER OF CIGARETTES SMOKED

Footnote: Studens with missing data were excluded from the analysis.

CI, confidence interval

Internet addiction: affirmative responses to ≥ 5 of 8 questions from the

Japanese version of the Young Diagnostic Questionnaire for Internet

addiction

Excessive Internet use: average of ≥ 5 hours of internet use per weekday

during the previous 30 days

P for trend was calculated by Mantel–Haenszel test.

Easy to read version

ORIGINAL RESEARCH ARTICLE

TABLE 2.

Title: ASSOCIATIONS BETWEEN CURRENT SMOKING AND THE AVERAGE

NUMBER OF CIGARETTES SMOKED, AND INTERNET ADDICTION OR

EXCESSIVE INTERNET USE

Footnote: Students with missing data were excluded from the analysis.

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval

Internet addiction was defined as affirmative responses to ≥ 5 or 8 questions

from the Japanese version of the Young Diagnostic Questionnaire for

Internet addiction.

Excessive internet use was defined as an average of ≥ 5 hours of internet use

per weekday during the previous 30 days.

Poor mental health status was defined as a 12-item General Health

Questionnaire score of ≥ 1.

P values were calculated by logistic regression analysis (forced entry

method).

Covariate values: Sex, grade, having breakfast, bedtimes, intention to study

at a university, participation in extracarricular activities,

and alcohol consumption.

p. 22

TABLE 1. PREVALENCE OF INERNET ADDICTION OR EXESSIVE INTERNET USE AMONG JAPANESE ADOLESCENTS, BASED ON CURRENT SMOKING AND THE AVERAGE NUMBER OF CIGARETTES SMOKED

	internet addiction				excessive internet use (≥5 hours)			
	N	Prevalence (%)	95%CI	P for trend	N	Prevalence (%)	95%CI	P for trend
current smoking habit				<0.01				<0.01
I have never smoked.	89,909	7.7	7.5 - 7.9		90,158	11.2	11.0 - 11.4	
I smoked in the past, but do not smoke currently.	5,226	12.5	11.6 - 13.4		5,326	25.3	24.1 - 26.5	
I sometimes smoke.	1,012	16.9	14.6 - 19.2		1,031	30.9	28.1 - 33.7	
I regularly smoke.	1,381	14.9	13.0 - 16.8		1,421	40.9	38.3 - 43.5	
average number of cigarettes smoked per day (in the previous 30 days)				<0.01				<0.01
I don't smoke.	93,745	7.9	7.7 - 8.1		93,855	12.0	11.8 - 12.2	
≤10	2,090	14.8	13.3 - 16.3		2,094	33.2	31.2 - 35.2	
≥11 but ≤20	373	16.1	12.4 - 19.8		376	37.0	32.1 - 41.9	
≥21	258	22.9	17.8 - 28.0		257	51.4	45.3 - 57.5	

Studens with missing data were excluded from the analysis.

CI, confidence interval.

Internet addiction: affirmative responses to ≥5 of 8 questions from the Japanese version of the Young Diagnostic Questionnaire for Internet addiction.

Excessive Internet use: average of ≥5 hours of internet use per weekday during the previous 30 days.

P for trend was calculated by Mantel–Haenszel test.

TABLE 2. ASSOCIATIONS BETWEEN CURRENT SMOKING AND THE AVERAGE NUMBER OF CIGARETTES SMOKED, AND INTERNET ADDICTION OR EXCESSIVE INTERNET USE

Model 1

	internet addiction			excessive internet use (≥5 hours)		
	AOR	95%CI	*P*	AOR	95%CI	*P*
current smoking habit			<0.01			<0.01
I have never smoked.	1.00			1.00		
I smoked in the past, but do not smoke currently.	1.30	1.19 - 1.43		1.63	1.52 - 1.75	
I sometimes smoke.	1.59	1.33 - 1.90		1.57	1.35 - 1.81	
I regularly smoke.	1.21	1.03 - 1.43		1.79	1.59 - 2.03	
mental health status			<0.01			<0.01
Good	1.00			1.00		
Poor	3.23	3.07 - 3.40		1.35	1.30 - 1.41	

Model 2

	internet addiction			excessive internet use (≥5 hours)		
	AOR	95%CI	*P*	AOR	95%CI	*P*
average number of cigarettes smoked per day **(in the previous 30 days)**			<0.01			<0.01
I don't smoke.	1.00			1.00		
≤10	1.28	1.12 - 1.47		1.46	1.32 - 1.62	
≥11 but ≤20	1.25	0.93 - 1.69		1.23	0.98 - 1.55	
≥21	1.78	1.29 - 2.44		2.53	1.93 - 3.31	
mental health status			<0.01			<0.01
Good	1.00			1.00		
Poor	3.23	3.06 - 3.40		1.36	1.30 - 1.42	

Students with missing data were excluded from the analysis.

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

Internet addiction was defined as affirmative responses to ≥5 or 8 questions from the Japanese version of the Young Diagnostic Questionnaire for Internet addiction.

Excessive internet use was defined as an average of ≥5 hours of internet use per weekday during the previous 30 days.

Poor mental health status was defined as a 12-item General Health Questionnaire score of ≥1.

P was calculated by logistic regression analysis (forced entry method).

Covariate values: Sex, grade, having breakfast, bedtimes, intention to study at a university, participation in extracarricular activities, and alcohol consumption.