

The effects of Internet addiction on the lifestyle and dietary behavior of Korean adolescents

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Abstract

We performed this study to examine lifestyle patterns and dietary behavior based on the level of Internet addiction of Korean adolescents. Data were collected from 853 Korean junior high school students. The level of Internet addiction was determined based on the Korean Internet addiction self-scale short form for youth, and students were classified as high-risk Internet users, potential-risk Internet users, and no risk Internet users. The associations between the students' levels of Internet addiction and lifestyle patterns and dietary behavior were analyzed using a chi-square test. Irregular bedtimes and the use of alcohol and tobacco were higher in high-risk Internet users than no risk Internet users. Moreover, in high-risk Internet users, irregular dietary behavior due to the loss of appetite, a high frequency of skipping meals, and snacking might cause imbalances in nutritional intake. Diet quality in high-risk Internet users was also worse than in potential-risk Internet users and no risk Internet users. We demonstrated in this study that high-risk Internet users have inappropriate dietary behavior and poor diet quality, which could result in stunted growth and development. Therefore, nutrition education targeting high-risk Internet users should be conducted to ensure proper growth and development.

Key Words: Internet addiction, dietary behavior, diet quality, adolescents

Introduction

The Internet has become an important tool for social interaction, information, and entertainment [1]. However, as the Internet has moved into homes, schools, Internet cafes, and businesses, the prevalence of Internet addiction has been increasing rapidly. Internet addiction is characterized as poorly controlled Internet use, and can lead to impulse-control disorders [2]. Recently, Internet addiction, especially among adolescents, has been recognized as an important social issue in various countries because of the high prevalence of depression, aggressive behavior, psychiatric symptoms, and interpersonal problems associated with this addiction [3,4]. The incidence of Internet addiction in adolescents was estimated to be approximately 11% in China [2], 8% in Greece [5], and 18.4% in Korea [1].

Adolescents are more vulnerable to Internet addiction than adults, and the social performance, psychology, and lifestyle habits of Internet addicts can be affected by this addiction [6]. Numerous cross-sectional studies have shown that Internet addiction has an adverse effect on several lifestyle-related factors

in adolescents; it can result in irregular dietary habits, extended periods of time spent on the Internet [7], physical inactivity, short duration of sleep [2], and increased use of alcohol and tobacco [2,8,9]. Some studies have reported that the change in lifestyle-related factors caused by heavy Internet use could have an adverse impact on the growth and development of Internet addicts [2,7].

Nutritional status also plays a crucial role in growth and development during adolescence. Several studies have shown that malnutrition or unbalanced nutritional intake can reduce weight gain and decrease leg length in adolescents [9,10]. Optimal nutrition is therefore important for adolescents to grow and develop properly. Moreover, once dietary habits are formed during childhood, they tend to be carried on throughout adulthood, thus teaching adolescents to develop healthy eating habits is of critical importance [11].

Numerous studies have showed associations between Internet addiction and mental health problems, such as depression and psychiatric symptoms, among adolescents. However, information on the effects of Internet addiction on the dietary behavior of

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adolescents is limited. Therefore, in this study, we examined the dietary behavior of Korean adolescents according to their level of Internet addiction.

Subjects and Methods

Subjects

This cross-sectional study included 1,000 adolescents from grades 7 through 9 living in Seoul, Korea. Of 1,000 participants, 800 students were recruited from eight junior high schools. The remaining 200 subjects were recruited from the Korean Youth Counseling Institute (KYCI), where they had been diagnosed and were being treated as Internet addicts. The study was conducted from October 2008 to November 2008. The Institutional Review Board of Chung-Ang University (Seoul, Korea) deemed this study exempt from the requirement for informed consent. Of the 1,000 surveys administered and collected, 147 were excluded due to incomplete responses and difficulty in assessing the level of Internet addiction, thus a total of 853 samples were analyzed in this study.

Korean Internet addiction test (KS scale)

Internet addiction was evaluated using the Korean version of the Internet addiction self-scale short form (KS scale) for youth, which was developed by the Korea Agency for Digital Opportunity and Promotion [12]. In brief, the KS scale for adolescents is a 20-item self-report questionnaire, consisting of six core components: disturbance of daily routines, self-esteem, withdrawal, virtual interpersonal relationship, deviant behavior, and tolerance. Response to each question is on 4-point Likert scale where 1 corresponds to "not at all", 2 corresponds to "sometimes", 3 corresponds to "frequently", and 4 corresponds to "always". The level of Internet addiction was categorized as either high-risk, potential-risk, or no risk based on the total score and the score for the three components of disturbance of daily routines, withdrawal, and tolerance. Subjects were classified as high-risk Internet users if their total score was the same or greater than 52, and/or if the score for disturbance of daily routine, withdrawal, and tolerance was greater than 16, 10, and 12, respectively. Subjects were classified as potential-risk Internet users if their total score was greater than or equal to 48 and less than 52 and/or if their score for disturbance of daily routine, withdrawal, and tolerance was greater than 14, 9, and 11, respectively. Subjects were classified as no risk Internet users if their total score was less than 48.

Subject characteristics and lifestyle patterns

The following socio-demographic characteristics of subjects were used in this analysis: age at the time of recruitment, family

income per month, and the education level of the parents. A lifestyle habit questionnaire assessed the regularity of bedtime, sleep disturbance, and the use of alcohol and tobacco.

Dietary behaviors and diet quality

The dietary behavior questionnaire assessed recent changes in meal size, appetite, eating speed, frequency and reasons for skipping meals, and the frequency, type, and reasons for snacking. Diet quality was assessed by a 10-item mini-dietary assessment index. The mini-dietary assessment index was used to assess overall dietary quality based on the 2005 Dietary Guidelines and Food Tower for Koreans [13]. This index includes four food groups that should be consumed, four food groups that limited amounts of should be consumed, and two items regarding varied and regular diet. Responses to food items of which sufficient amounts should be consumed were reported using a 5-point Likert scale where 1=seldom, 3=sometimes, and 5=always. Responses to food items of which limited quantities should be consumed were also reported using a 5-point Likert scale where 1=always, 3=sometimes, and 5=seldom. The maximum possible score for diet quality is 50. In this study, diet quality was defined as "good" if the total score was greater than or equal to 30 [14].

Statistical analyses

All analyses were performed with a significance level of $\alpha = 0.05$ using the SPSS software package version 12.0 (SPSS Inc, Chicago, IL, USA). Relationships between levels of Internet addiction and socio-demographic characteristics, lifestyle patterns, and dietary behavior were analyzed using the chi-square test. The relationship between dietary quality and level of Internet addiction based on the self-scale rating system were analyzed using one-way ANOVA followed by Duncan's multiple range test for multiple comparisons.

Results

General characteristics of subjects

The general characteristics of the participants and the relationships between the level of Internet addiction and general characteristics are provided in Table 1. Subjects were between the ages of 13 and 15 years with a mean age of 14.0 years. More boys were high-risk Internet users than girls (31.4% vs.14.0%), and more girls were no risk Internet users than boys (74.7% vs. 58.9%). Younger adolescents were significantly more likely to be high-risk Internet users than older adolescents ($P < 0.001$). Household monthly income was significantly related to the level of Internet addiction; adolescents from households with a low monthly income (< 1,000 K won and 1,000 K-1,999 K won) were more likely to be high-risk Internet users (57.5% and 31.7%, respectively)

Table 1. Subject characteristics based on level of Internet addiction

	High risk (n=186)	Potential risk (n=90)	No risk (n=577)	Total (n=853)	P-value
Gender					
Boys	120 (31.4) ¹⁾	37 (9.7)	225 (58.9)	382 (100.0)	< 0.001
Girls	66 (14.0)	53 (11.3)	352 (74.7)	471 (100.0)	
Age (years)					
13	72 (33.8)	15 (7.0)	126 (59.2)	213 (100.0)	< 0.001
14	58 (18.3)	46 (14.5)	213 (67.2)	317 (100.0)	
15	56 (17.3)	29 (9.0)	238 (73.7)	323 (100.0)	
Monthly income (Korean Won)²⁾					
< 1,000K	23 (57.5)	3 (7.5)	14 (35.0)	40 (100.0)	< 0.001
1,000K-1,999K	38 (31.7)	15 (12.5)	67 (55.8)	120 (100.0)	
2,000K-2,999K	35 (22.2)	25 (15.8)	98 (62.0)	158 (100.0)	
3,000K-3,999K	29 (15.9)	14 (7.7)	139 (76.4)	182 (100.0)	
≥4,000K	43 (15.6)	28 (10.1)	205 (74.3)	276 (100.0)	
Father's education					
High school graduate & under	79 (27.2)	28 (9.7)	183 (63.1)	290 (100.0)	< 0.001
College graduate	61 (17.3)	37 (10.5)	254 (72.2)	352 (100.0)	
Graduate school graduate	17 (15.2)	17 (15.2)	78 (69.6)	112 (100.0)	
Others	12 (57.1)	1 (4.8)	8 (30.1)	21 (100.0)	
Mother's education					
High school graduate & under	92 (22.4)	41 (10.4)	261 (66.2)	394 (100.0)	0.008
College graduate	55 (18.0)	31 (10.1)	220 (71.9)	306 (100.0)	
Graduate school graduate	7 (13.5)	9 (17.3)	36 (69.2)	52 (100.0)	
Others	11 (47.8)	3 (13.1)	9 (39.1)	23 (100.0)	

¹⁾ N (%)²⁾ 1,250 Korean won = 1US dollar**Table 2.** KS-scale scores based on the level of Internet addiction

Components	Maximum score	High risk (n=186)	Potential risk (n=90)	No risk (n=577)	Total (n=853)
Disturbance of daily routine	24	14.97 ± 3.21 ^{1)a2)}	13.90 ± 3.25 ^b	9.32 ± 2.21 ^c	11.04 ± 3.59
Self-esteem	4	2.41 ± 0.94 ^a	1.69 ± 0.84 ^b	1.32 ± 0.61 ^c	1.60 ± 0.85
Withdrawal	16	10.56 ± 2.59 ^a	5.22 ± 2.21 ^c	5.49 ± 1.50 ^b	6.88 ± 2.82
Virtual interpersonal relationship	12	7.23 ± 2.54 ^a	4.56 ± 1.89 ^b	3.78 ± 1.41 ^c	4.62 ± 2.58
Deviant behavior	8	5.16 ± 1.53 ^a	3.93 ± 1.46 ^b	2.87 ± 1.07 ^c	3.48 ± 1.55
Tolerance	16	10.61 ± 2.97 ^a	8.76 ± 2.64 ^b	5.90 ± 2.04 ^c	7.23 ± 3.07
Total	80	50.95 ± 8.41 ^a	41.06 ± 5.29 ^b	28.69 ± 6.36 ^c	34.90 ± 11.48

¹⁾ Mean ± S.D²⁾ Values with different superscript letters within a row are significantly different after Duncan's multiple range test ($P < 0.05$).

than adolescents from households with a higher monthly income. Adolescents from households with high monthly incomes (3,000K-3,999K won and ≥4,000K won) were more likely to be no risk Internet users (76.4% and 74.3%, respectively). Parents' educational status also affected the level of Internet addiction. High-risk Internet users had parents whose highest level of education was high school graduation or less (27.2% in father and 22.4% in mother, respectively). In contrast, a high proportion of no risk Internet users had parents who were college graduates (72.2% in father and 71.9% in mother, respectively).

KS-scale score

The total KS-scale score and the scores of the six components of the KS-scale are presented in Table 2. High-risk Internet users

had significantly higher total KS-scale scores and scores for the six main components than potential-risk Internet users and no risk Internet users ($P < 0.05$).

Lifestyle patterns

Lifestyle patterns, including bedtime, sleep disturbance, alcohol use, and tobacco use according to the level of Internet addiction are shown in Table 3. No risk Internet users had regular bedtime patterns (10.4% always had a regular bedtime and 41.8% often had a regular bedtime) while high-risk Internet users complained of irregular bedtime patterns (13.6% reported often irregular bedtimes and 11.4% reported always irregular bedtimes). Both high- and potential-risk Internet users suffered from sleep disturbances (81.1% and 76.7%, respectively). Similarly, 66% of

Table 3. Lifestyle patterns based on the level of Internet addiction

	High risk (n=186)	Potential risk (n=90)	No risk (n=577)	Total (n=853)	P-value
Bedtime					
Always regular	20 (10.9) ¹⁾	15 (16.7)	60 (10.4)	95 (11.2)	< 0.001
Often regular	49 (26.6)	25 (27.8)	241 (41.8)	315 (37.0)	
Neither regular or irregular	69 (37.5)	30 (33.3)	229 (39.7)	328 (38.5)	
Often irregular	25 (13.6)	14 (15.6)	32 (5.5)	71 (8.3)	
Always irregular	21 (11.4)	6 (6.7)	15 (2.6)	42 (4.9)	
Sleep disturbance					
Yes	150 (81.1)	69 (76.7)	278 (48.3)	497 (58.4)	< 0.001
No	35 (18.9)	21 (23.3)	298 (51.7)	354 (41.6)	
Alcohol use					
Yes	123 (66.5)	58 (64.4)	252 (43.7)	433 (50.8)	< 0.001
No	62 (33.5)	32 (35.6)	325 (56.3)	419 (49.2)	
Tobacco use					
Yes	97 (52.4)	28 (31.1)	90 (15.6)	215 (25.2)	< 0.001
No	88 (47.6)	62 (68.9)	897 (84.4)	637 (74.8)	

¹⁾ N (%)**Table 4.** Recent changes in dietary habits based on the level of Internet addiction

	High risk (n=186)	Potential risk (n=90)	No risk (n=577)	Total (n=853)	P-value
Changes in meal size					
Increased	54 (29.0) ¹⁾	29 (32.2)	164 (28.6)	247 (29.1)	0.019
Decreased	62 (33.3)	20 (22.2)	127 (22.2)	209 (24.6)	
No change	70 (37.6)	41 (45.6)	282 (49.2)	393 (46.3)	
Changes in appetite					
Worse	25 (13.4)	7 (7.8)	21 (3.7)	53 (6.2)	0.001
Bad	30 (16.1)	11 (12.2)	80 (13.9)	121 (14.2)	
No change	72 (38.7)	43 (47.8)	254 (44.2)	369 (43.4)	
Better	17 (9.1)	8 (8.9)	78 (13.6)	103 (12.1)	
Do not know	42 (22.6)	21 (23.3)	142 (24.7)	205 (24.1)	
Changes in eating speed					
Fast	64 (34.4)	37 (41.1)	173 (30.0)	274 (32.2)	0.002
Average	71 (38.2)	33 (36.7)	271 (47.0)	375 (44.0)	
Slow	32 (17.2)	11 (12.2)	109 (18.9)	152 (17.8)	
Irregular	19 (10.2)	9 (10.0)	23 (4.0)	51 (6.0)	

¹⁾ N (%)

high-risk Internet users and 64% of potential-risk Internet users had used alcohol. Fifty-two percent of high-risk Internet users had used tobacco while only 15.6% of no risk Internet users had used tobacco.

Dietary behavior and diet quality

Recent changes in eating habits among adolescents are provided in Table 4. More of high-risk Internet users answered that their dietary habits had been changed to have small meal sizes, a poor appetite, and irregular eating speeds than no risk Internet users ($P=0.019$, 0.001 , and 0.002 , respectively). High-risk Internet

Table 5. Snacking patterns based on the level of Internet addiction

	High risk (n=186)	Potential risk (n=90)	No risk (n=577)	Total (n=853)	P-value
Skipping breakfast					
Yes	88 (47.3) ¹⁾	43 (48.3)	228 (40.1)	359 (42.6)	0.683
No	98 (52.7)	46 (51.7)	340 (59.9)	484 (57.4)	
Skipping Lunch					
Yes	16 (8.6)	6 (6.8)	34 (6.0)	56 (6.7)	0.177
No	170 (91.4)	82 (93.2)	531 (94.0)	783 (93.3)	
Skipping Dinner					
Yes	38 (20.4)	15 (17.1)	80 (14.1)	133 (17.0)	0.049
No	148 (79.6)	73 (82.9)	486 (85.9)	707 (82.8)	
Reasons for meal skipping					
Oversleep	49 (28.3)	22 (26.2)	112 (21.3)	183 (23.4)	0.026
No appetite	34 (19.7)	20 (23.8)	122 (23.2)	176 (22.5)	
Indigestion	6 (3.5)	6 (7.1)	29 (5.5)	41 (5.2)	
Snacking before a meal	8 (4.6)	5 (6.0)	21 (4.0)	34 (4.3)	
Weight loss	10 (5.6)	8 (9.5)	38 (7.2)	56 (7.2)	
Saving money	2 (2.9)	0 (0.0)	2 (0.4)	7 (0.9)	
Lack of time	25 (14.5)	10 (11.9)	118 (22.4)	153 (19.5)	
Habit	18 (10.4)	6 (7.1)	40 (7.6)	64 (8.2)	
Others	18 (10.4)	7 (8.3)	44 (8.4)	69 (8.8)	
Frequency of snacking					
≥ 3 times/day	29 (15.8)	13 (14.4)	55 (9.7)	97 (11.5)	0.004
1-2/day	104 (56.5)	65 (72.2)	396 (69.8)	565 (67.2)	
None	51 (27.7)	12 (13.3)	116 (20.5)	179 (21.3)	
Snack items					
Confectionery	86 (55.5)	50 (60.2)	239 (47.2)	375 (50.4)	0.245
Soda	4 (2.6)	4 (4.8)	38 (7.5)	46 (6.2)	
Ttokbokki, rameon, fried foods	21 (13.5)	8 (9.6)	73 (14.4)	102 (13.7)	
Fast foods	12 (7.7)	3 (3.6)	26 (5.1)	41 (5.5)	
Fruits	14 (9.0)	9 (10.8)	61 (12.1)	84 (11.3)	
Milk	15 (9.7)	8 (9.6)	55 (10.9)	78 (10.5)	
Others	3 (1.9)	1 (1.2)	14 (2.8)	18 (2.4)	
Reasons for snacking					
Hunger	86 (46.7)	46 (51.1)	319 (55.6)	451 (53.2)	0.057
Lack of time for a meal	10 (5.4)	1 (1.1)	30 (5.2)	41 (4.8)	
Habit	28 (15.2)	22 (24.4)	79 (13.8)	129 (15.2)	
Boredom	33 (17.9)	14 (15.6)	98 (17.1)	145 (17.1)	
Social event	17 (9.2)	5 (5.6)	34 (5.9)	56 (6.6)	
Others	10 (5.4)	2 (2.2)	14 (2.4)	26 (3.1)	

¹⁾ N (%)

users had a high prevalence of skipping dinner (Table 5). High-risk Internet users snacked frequently, often snacking more than three times per day (15.8% vs. 9.7 % for no risk Internet users). Favorite snacks and reasons for snacking were not significantly different among adolescents based on levels of Internet addiction.

Diet quality based on levels of Internet addiction is shown

Table 6. Diet quality¹⁾ based on the level of Internet addiction

	High risk (n=186)	Potential risk (n=90)	No risk (n=577)	Total (n=853)
I eat more than one serving of milk or dairy products every day.	2.72 ± 1.72 ^{2)ab3)}	3.36 ± 1.36 ^b	3.40 ± 1.52 ^b	3.25 ± 1.58
I eat several servings of meat, fish, egg, bean, or tofu every day.	2.86 ± 1.50 ^a	3.04 ± 1.48 ^a	3.35 ± 1.41 ^b	3.21 ± 1.44
I eat vegetables and Kimchi every meal.	2.83 ± 1.63 ^a	3.11 ± 1.48 ^{ab}	3.43 ± 1.45 ^b	3.26 ± 1.51
I eat one serving of fruit or fruit juice every day.	2.91 ± 1.69 ^a	3.38 ± 1.49 ^b	3.45 ± 1.55 ^b	3.32 ± 1.59
I eat three meals a day on a regular basis.	2.58 ± 1.56 ^a	2.98 ± 1.63 ^b	3.32 ± 1.59 ^c	3.12 ± 1.62
I eat a variety of foods every day.	2.86 ± 1.60 ^a	2.98 ± 1.48 ^a	3.38 ± 1.45 ^b	3.16 ± 1.42
I eat fried or stir-fried foods most of the time.	2.85 ± 1.57 ^a	2.78 ± 1.42 ^a	3.35 ± 1.45 ^b	3.18 ± 1.49
I eat fatty meat most of the time.	2.72 ± 1.50 ^a	2.73 ± 1.50 ^a	3.28 ± 1.56 ^b	3.10 ± 1.58
I add table salt or soy sauce to foods most of the time.	3.26 ± 1.67 ^a	3.07 ± 1.59 ^a	3.53 ± 1.52 ^b	3.42 ± 1.57
I eat ice cream, cake, and/or drink soda between meals.	2.80 ± 1.72 ^a	2.80 ± 1.50 ^a	3.29 ± 1.54 ^b	3.13 ± 1.59
Total	28.38 ± 6.34 ^a	30.22 ± 6.79 ^b	33.75 ± 6.01 ^c	32.20 ± 6.57

¹⁾ Diet quality was assessed by using 10-item mini-dietary assessment index developed by Kim [14].

²⁾ Mean ± SD

³⁾ Values with different superscript letters within a row are significantly different ($P < 0.05$) after Duncan's multiple range test.

in Table 6. The diet quality of high-risk Internet users was significantly lower than that of potential-risk Internet users and no risk Internet users, respectively ($P < 0.05$).

Discussion

In this study, we demonstrated that high-risk Internet users eat smaller meals, have less of an appetite, skip meals, and snack more than their potential-risk and normal-risk Internet user counterparts. Moreover, the diet quality of high-risk Internet users is poorer than that of potential-risk Internet users and no risk Internet users.

The frequency of skipping dinner in high-risk Internet users was significantly higher than that in no risk Internet users. This finding is consistent with a study by Kim and Chun that reported a high incidence of meal skipping in Internet addicts [7]. The high frequency of skipping dinner could be related to snacking; more frequent snacking was observed in high-risk Internet users than no risk Internet users. Savage *et al.* also reported that adolescent heavy snackers skipped dinner more frequently than

their non- or light-snacker adolescent counterparts [15]. Moreover, the favorite snacks of our participants were confectionery and fast food, which are nutritionally poor foods with high calories provided by fats and simple sugars but with few other nutrients such as vitamins and minerals. Thus high-risk Internet users have improper dietary behaviors that could impact their growth and development.

The quality of the diet of high-risk Internet users as measured using a mini-dietary assessment index was poor. The mini-dietary assessment index that we used is a Korean version of the Healthy Eating Index in which scores over 30 indicate a good quality diet. In high-risk Internet users, the average total score was 28.38, which indicates an “inappropriate” diet quality. High-risk Internet users had the lowest meal regularity score, reflected by a higher rate of skipping dinner in high-risk Internet users than no risk Internet users. Moreover, high-risk Internet users did not consume enough milk and dairy products, meat and fish, and fruits and vegetables compared with no risk Internet users. Proper intake of milk and dairy products as major sources of calcium during childhood is crucial for achieving optimal peak bone mass and maintaining and repairing bone tissue [16]. In addition, low consumption of fruits and vegetables in high-risk Internet users suggests low intake of vitamins, minerals, and fiber in these individuals. Vitamins and minerals play a crucial role in energy production, maintenance of bone health, adequate immune function, and protection against oxidative stress [17,18]. Several studies have shown that proper fruit and vegetable intake can prevent health problems such as obesity and cardiovascular diseases [19-21].

High-risk Internet users not only consumed too little of the recommended food groups; they consumed more than the recommended daily quantities of fatty foods, fried foods, salt, and foods high in simple sugars. High fat and simple sugar intake increase the chance of being overweight or obese. Obese children and adolescents can have various adverse health outcomes, including diabetes, hypertension, dyslipidemia, and metabolic syndrome [22-24]. Furthermore, obese children have a higher risk of cardiovascular mortality when they reach adulthood [22,23]. The diet of high-risk Internet users, though it may meet their energy requirements, is lacking in nutritional value, and may therefore not support the growth spurt during adolescence and may cause nutrition-related health problems.

High-risk Internet users drank and smoked more and had a poorer quality diet and higher frequency of meal skipping than no risk Internet users. Results from two cross-sectional studies on Korean high school students [8] and Taiwanese high school students [2] found a strong association between Internet addiction and high use of alcohol and tobacco. Alcohol and tobacco companies use the Internet to promote and advertise their products by using themes and icons of youth popular culture, games and contests, and commercially-sponsored websites and homepages [25]. Therefore, because high-risk Internet users are more likely to be exposed to tobacco and alcohol advertisements,

they are more likely to drink and smoke than other Internet users. Furthermore, high frequency of use of tobacco and alcohol can exacerbate diet-related problems, because smoking and drinking are negatively associated with diet quality and dietary behaviors such as meal regularity [26,27].

High-risk Internet users reported more irregular sleep patterns and more episodes of sleep disturbance than no risk Internet users. This is consistent with a previous study of Korean adolescents that showed that Internet addiction was associated with insomnia, apnea, and nightmare [8]. In addition, sleep disturbance could increase the risk of mental health problems as well as substance abuse [6,28,29,30]. Hence, high-risk Internet users are more likely to experience physical and mental health problems.

This study has some limitations. First, this study was a cross-sectional study, therefore we could not confirm causal associations between Internet addiction and dietary behavior. Second, the questionnaire was self-reported. It is therefore possible that some of the adolescents may not have admitted to using alcohol and tobacco due to social restrictions, even though this study was anonymous.

High-risk Korean adolescent Internet users had improper dietary behavior and a poorer diet quality than their no risk Internet counterparts. To ensure that the growth and development of high-risk Internet users is not adversely impacted, their diets should be supplemented with the nutrients that they are lacking. Interventions to improve both dietary behavior and treat Internet addiction may have synergistic health benefits.

In conclusion, the results of this study suggest that children should be educated as to what a balanced diet and optimum physical activity routine is to remain healthy and grow. Furthermore, the government should take an active role in designing and evaluating Internet addiction-related health intervention strategies. Given the likely adverse effects of Internet addiction on adolescents' development because of poor dietary behavior, it is critical to raise awareness about Internet addiction. Close attention should be paid to students at risk of Internet addiction, as well as students at low risk to prevent them from becoming addicted to the Internet.

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