Association between Times Spent on the Internet and Weight Status in Korean Adolescents

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Abstract

Background: This study investigates whether the amount of time that Korean adolescents spend on the Internet per day is related to their weight status.

Methods: For this purpose, we analyzed data from the 2009 Korea Youth Risk Behavior Web-based Survey-V (KYRBWS-V), in which 72,399 students from the 7th to the 12th grade participated. We assessed the relationship between the amount of time spent on the Internet per day and body mass index (BMI) by using multivariate logistic regression analysis.

Results: For boys, the odds ratio (OR; confidence interval (CI): 95%) between becoming overweight and the amount of time spent on the Internet per day was 1.225 (1.042–1.441; P=0.014) for >4 hour. The ORs (CI: 95%) between becoming obese and time spent on the Internet per day were 1.238 (1.096–1.399; P=0.001) for >2–≤3 hours, 1.208 (1.021–1.428; P=0.027) for >3–≤4 hours, and 1.303 (1.109–1.532; P=0.001) for >4 hours. For girls, the ORs (CI: 95%) between becoming overweight and time spent on the Internet per day were 1.265 (1.089–1.469; P=0.002) for >2–≤3 hours and 1.338 (1.080–1.659; P=0.008) for >3–≤4 hours. The ORs (CI: 95%) between becoming obese and amount of time spent on the Internet per day were 1.239 (1.014–1.513; P=0.036) for >2–≤3 hours and 1.541 (1.182–2.010; P=0.001) for >3–≤4 hours.

Conclusion: Korean adolescents who spend more time on the Internet are predisposed to weight-related problems, regardless of age, time spent in physical exercise, mental stress, sleep duration, etc.

Keywords: Adolescent, Youth Risk Behavior, Web, Internet, Obesity, Korea

Introduction

Obesity has become a serious social and public health problem throughout the world. In 2011, the World Health Organization (WHO) reported that in 2008, 1.5 billion adults (aged 20 and older) were overweight. Of these, more than 200 million men and nearly 300 million women were classified as obese. About 65% of the world's population were said to live in countries where overweight and obesity kill more people than underweight. Finally, it was reported that in 2010, nearly 43 million children under the age of five were overweight (1).

Excessive weight is known to cause adverse health effects such as cardiac disease, musculoskeletal disorders, stroke, type II diabetes, and cancers (1). Given that approximately 80% of obese adolescents become obese adults, it is important to prevent obesity during adolescence (2-3).

Sedentary lifestyle has contributed to an increase in the prevalence of overweight and obesity (4-6), and television watching has been a major factor, particularly for children and adolescents (7). Over the past 20 years, many re-

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searchers have examined the relationship between television watching and obesity and found decreased time for physical activity, decreased resting metabolic rate (8-9), and increased energy intake (10). Recently, attention has shifted to the influence of food and beverage advertising that targets adolescent viewers as an important variable of weight status (11).

Aside from television, other components of sedentary lifestyle today include using the Internet, playing computer games, using the telephone, reading for fun, and listening to the radio (12). More investigative studies are needed to address the newer forms of sedentary behavior, particularly time spent on Internet use.

The Internet browser is a relatively new device, so early studies found a low prevalence of Internet use and no relationship to obesity (13). However, with computer use rising rapidly, more recent studies have reported controversial results—that there is no relationship (14) or that there may be a relationship (15-16).

In the Republic of Korea, the number of Internet users has grown dramatically. Internet penetration in Korea is the highest in Asia, reaching 81% of the population (17). As a result of increasing Internet use, there has been an increase in physical inactivity among teenagers. Only a few studies have examined the relationship between time spent on the Internet and obesity (18-19), and while there have been regional studies, no nationwide study has focused on this issue and its effects on Korean adolescents.

Therefore, the purpose of this study was to examine whether time on the Internet was related to obesity in Korean adolescents.

Materials and Methods

Subjects

The 5th Korea Youth Risk Behavior Web-based Survey (KYRBWS-V), a retrospective cohort study, was conducted using a complex sample design, involving stratification, clustering, and multistage sampling. This nationwide school-based survey was conducted by the Korea Centers for Disease Control and Prevention (KCDCP) to evaluate the prevalence of health-risk behavior among adolescent students in Korea (20). The present study drew on KYRBWS-V data for students from 400 middle schools and 400 high schools to evaluate the association of Internet use time with obesity, taking into account potential covariate variables.

Students participating in the survey were assigned unique identification numbers by classroom teachers. The students accessed the survey Web page using their ID numbers and responded to a question about their willingness to participate. Willing participants self-administered the questionnaire anonymously at the school, and those unwilling did not progress further. The KYRBWS-V was administered to a nationally representative group, and since it did not collect private information, ethical approval was not required. This survey has been shown to be valid and reliable (21-22).

The response rate was 97.6% (N = 75,066); students who were absent for long periods and students with dyslexia or dysgraphia were excluded from this study. Characteristics of the 72,399 participating students are shown in Table 1.

Independent variables

The participants were asked to self-record their heights and weights; BMI (kg/m^2) was calculated for each participant. In accordance with the World Health Organization (WHO) Asia-Pacific standard of obesity, individuals with BMIs of <23, ≥23–<25, and ≥25 kg/m^2 were classified into normal, overweight, and obese groups, respectively (23).

Dependent variables

Internet use times were evaluated for each participant by asking two questions: (Q1) "In the

last month, how much time, on average, did you spend per day on weekdays using the Internet, including games and Web surfing?" (Q2) "In the last month, how much time, on average, did you spend per day during weekends using the Internet, including games and Web surfing?" Responses were recorded in 30-minute increments. Average time using the Internet per day was calculated as follows:

{(Average hours using the Internet per day on weekdays × 5 days) + (average hours using the Internet per day on weekends × 2 days)} / 7 days = average time using the Internet per day.

Average times of Internet use per day were classified into six groups:
1) Never use the Internet
2) ≤1 hour
3) >1–≤2 hours
4) >2–≤3 hours
5) >3–≤4 hours
6) Over 4 hours

Covariate variables

① Ages: the students' ages defined by the KYRBWS were used without any modifications.

② Smoking frequency: the possible responses ranged from 1 (no) to 7(every day).

③ Drinking frequency: the possible responses ranged from 1 (no) to 7(every day).

④ Parents' education level: the possible responses ranged from 1 (middle school or lower) to 3 (college or higher).

⑤ Economic status: the possible responses ranged from 1 (very rich) to 5 (very poor).

⑥ Frequency of vigorous physical activities, such as digging, aerobics, heavy lifting, or fast cycling during the week: the possible responses ranged from 1 (no) to 6 (over 5 days).

⑦ Frequency of moderate physical activities, such as bicycling at a regular pace, carrying light loads, or playing doubles tennis during the week: the possible responses ranged from 1 (no) to 6 (over 5 days).

⑧ Frequency of muscular strength exercises, such as sit-ups, push-ups, and weight lifting, during the week: the possible responses ranged from 1 (no) to 6 (over 5 days).

⑨ Mental stress: the possible responses ranged from 1 (very high) to 5 (none).

⑩ Sleep duration: the possible responses ranged from 1 (≤4 hours/day) to 6 (≥8 hours/day).

Statistical analysis

All results from this study are shown as the average and standard deviation. Multivariate logistic regression analyses were conducted to determine whether Internet use time per day was related to weight status after adjusting for covariate variables. Statistical significance was set at $P < .05$, and all analyses were performed using SPSS ver. 12.0 (SPSS, Chicago, IL, USA).

Results

The multivariate logistic regression analyses

Multivariate logistic regression analyses of Internet use time per day for the overweight and normal-weight groups and for the obese and normal-weight groups of Korean adolescents are shown in Table 2 and 3, respectively. The data presented in the tables show the prevalence of overweight and obesity in Korean adolescents after adjusting for the following covariate variables; age, smoking frequency, drinking frequency, parents' education levels, economic status, frequency of vigorous and moderate physical activity, muscular strength training per week, mental stress, and sleep duration, and spanning a range of Internet use from "never" to "more than four hours per day".

For boys, the odds ratio (OR; confidence interval (CI): 95%) between becoming overweight and the amount of time spent on the Internet per day was 1.225 (1.042–1.441; $P = 0.014$) for >4 hour (Table 2). The ORs (CI: 95%) between becoming obese and time spent on the Internet

per day were 1.238 (1.096–1.399; $P = 0.001$) for >2–≤3 hours, 1.208 (1.021–1.428; $P = 0.027$) for >3–≤4 hours, and 1.303 (1.109–1.532; $P = 0.001$) for >4 hours (Table 3). For girls, the ORs (CI: 95%) between becoming overweight and time spent on the Internet per day were 1.265 (1.089–1.469; $P = 0.002$) for

>2–≤3 hours and 1.338 (1.080–1.659; $P = 0.008$) for >3–≤4 hours (Table 2). The ORs (CI: 95%) between becoming obese and amount of time spent on the Internet per day were 1.239 (1.014–1.513; $P = 0.036$) for >2–≤3 hours and 1.541 (1.182–2.010; $P = 0.001$) for >3–≤4 hours (Table 3).

Table 1: Characteristics of subjects (Mean ± SD)

	Variables	Boys (n = 38,152)	Girls (n = 34,247)	Total (n = 72,399)
	Age (years)	15.00 ± 1.73	15.12 ± 1.77	15.06 ± 1.75
	Height (cm)	169.58 ± 8.19	160.08 ± 5.39	165.09 ± 8.46
	Weight (kg)	60.14 ± 11.72	51.47 ± 7.67	56.04 ± 10.91
	Body mass index (kg/m^2)	20.80 ± 3.21	20.05 ± 2.58	20.45 ± 2.95
Weight state n (%)	Normal weight (BMI < 23)	29,404 (77.1)	29,674 (86.6)	59,078 (81.6)
	Over weight (23 ≤ BMI < 25)	4,385 (11.5)	2,961 (8.7)	7,346 (10.2)
	Obese (25 ≤ BMI)	4,363 (11.4)	1,612 (4.7)	5,975 (8.3)
Economic status n (%)	Very rich	2,691 (7.1)	1,337 (3.9)	4,028 (5.6)
	Rich	8,768 (23.0)	6,719 (19.6)	15,487 (21.4)
	Average	17,229 (45.2)	17,259 (50.4)	34,488 (47.6)
	Poor	6,890 (18.1)	6,825 (19.9)	13,715 (18.9)
	Very poor	2,574 (6.7)	2,107 (6.2)	4,681 (6.5)
City size n (%)	Large cities	20,252 (53.1)	17,708 (51.7)	37,960 (52.4)
	Middle-sized cities	13,303 (34.9)	12,153 (35.5)	25,456 (35.2)
	Small-sized cities	4,597 (12.0)	4,386 (12.8)	8,983 (12.4)
Grade n (%)	1st grade middle-school	6,711 (17.6)	5,615 (16.4)	12,326 (17.0)
	2nd grade middle-school	6,722 (17.6)	5,727 (16.7)	12,449 (17.2)
	3rd grade middle-school	6,767 (17.7)	5,615 (16.4)	12,382 (17.1)
	1st grade high-school	6,626 (17.4)	5,369 (15.7)	11,995 (16.6)
	2nd grade high-school	5,889 (15.4)	6,102 (17.8)	11,991 (16.6)
	3rd grade high-school	5,437 (14.3)	5,819 (17.0)	11,256 (15.5)

Table 2: The multivariate logistic regression analyses of time spent on the Internet for the overweight group compare normal weight group in Korean adolescents

Category	Boys					Girls				
	Beta	S. E.	OR	95% CI	*P*-value	Beta	S. E.	OR	95% CI	*P*-value
Never internet use	Ref					Ref				
≤ 1 hour per day	0.020	0.040	1.020	0.942-1.104	0.621	0.026	0.047	1.026	0.936-1.125	0.584
>1 - ≤2 hours per day	-0.018	0.048	0.982	0.893-1.080	0.708	0.052	0.057	1.054	0.941-1.179	0.363
>2 - ≤3 hours per day	-0.032	0.067	0.968	0.850-1.103	0.629	0.235	0.076	1.265	1.089-1.469	0.002**
>3 - ≤4 hours per day	-0.034	0.092	0.967	0.808-1.157	0.711	0.291	0.109	1.338	1.080-1.659	0.008**
> 4 hours per day	0.203	0.083	1.225	1.042-1.441	0.014*	-0.029	0.128	0.972	0.757-1.248	0.822

S.E; Standard Error, OR; Odd Ratio, CI; Confidence Interval
P<0.05 ***P*<0.01, tested by multivariate logistic regression analysis (adjusting for the following covariate variables; age, smoking frequency, drinking frequency, parents' education levels, economic status, frequency of vigorous and moderate physical activity, muscular strength training per week, mental stress, and sleep duration.)

Table 3: The multivariate logistic regression analyses of time spent on the Internet for the obese group comparing with normal weight group in Korean adolescents

Category	Boys					Girls				
	Beta	S. E.	OR	95% CI	*P*-value	Beta	S. E.	OR	95% CI	*P*-value
Never internet use	Ref					Ref				
≤ 1 hour per day	0.068	0.041	1.070	0.987-1.160	0.099	0.048	0.063	1.050	0.928-1.188	0.442
>1 - ≤2 hours per day	0.056	0.049	1.057	0.961-1.163	0.253	0.095	0.076	1.099	0.947-1.275	0.212
>2 - ≤3 hours per day	0.214	0.062	1.238	1.096-1.399	0.001**	0.214	0.102	1.239	1.014-1.513	0.036*
>3 - ≤4 hours per day	0.189	0.086	1.208	1.021-1.428	0.027*	0.432	0.136	1.541	1.182-2.010	0.001**
> 4 hours per day	0.265	0.082	1.303	1.109-1.532	0.001**	0.178	0.155	1.195	0.882-1.619	0.251

S.E; Standard Error, OR; Odd Ratio, CI; Confidence Interval
P<0.05 ***P*<0.01, tested by multivariate logistic regression analysis (adjusting for the following covariate variables; age, smoking frequency, drinking frequency, parents' education levels, economic status, frequency of vigorous and moderate physical activity, muscular strength training per week, mental stress, and sleep duration.)

Discussion

Television watching is the most common form of physical inactivity among adolescents and is a well-established risk factor for obesity (12, 24). Crespo et al. (2001) reported the lowest prevalence of weight gain among children aged 8 to 16 years watching television one hour per day or less and the highest weight gain among those watching television four or more hours per day (25). In addition, television expose

adolescents to advertisements for foods that are high in calories but offer little other nutritional value. Thirty-second commercials have been shown to increase consumption of advertised foods (26).
Internet use is comparable to watching television as a sedentary activity. Our results show that when Internet use time was over 2 hours, prevalence of overweight and obesity increased

in adolescents even after adjusting for covariate variables, including vigorous and moderate physical activities and muscular strength exercises, etc. These results mean that Internet use time, physical activities, exercises, and even television watching can each be independent factors relating to obesity.

On weekdays during afternoon and evening hours and throughout the weekend, Internet use competes with outdoor activities and other recreation. On the basis of our results, it is clear that parents or guardians have to limit Internet use time to less than two hours per day at home in order to prevent obesity in adolescents.

This study did not provide direct information on the magnitude of the association between Internet use and obesity, as compared to television watching. Therefore, further well-designed studies should be performed to determine the relative magnitude of these effects.

Our study has several limitations. First, it was conducted online, and the participants were asked to self-record their heights and weights. It is possible that obesity values were too low, because adolescents tend to over-report height and under-report weight (22). Second, information regarding the economic status was obtained from the adolescents, not from the parents, and their perceptions could have been inaccurate. Third, because this was a retrospective cohort study, it did not provide definitive evidence of causality or directionality but did provide their interrelationship. This study differs from previous regional case studies in that it investigated a nationwide population of adolescents. Therefore, our study is representative of the relationship between Internet use time and obesity in Korean adolescents.

In conclusion, Korean adolescents who spend more time on the Internet are predisposed to weight-related problems, regardless of age, time spent in physical exercise, mental stress, sleep duration, etc.

Ethical Considerations

Ethical issue principles including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

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