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A Comparison of Risk and Protective Factors for Excessive Internet Game Play between Koreans in Korea and Immigrant Koreans in the United States

Ji Sun Hong ,¹ Sun Mi Kim ,¹ Jae-Woo Jung ,² So Young Kim ,¹ Un-Sun Chung ,³ and Doug Hyun Han ¹

¹Department of Psychiatry, Chung Ang University Hospital, Seoul, Korea

²Department of Internal Medicine, Chung Ang University Hospital, Seoul, Korea

³Department of Psychiatry, School of Medicine, Kyungpook National University, Daegu, Korea



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Address for Correspondence:

Doug Hyun Han, MD, PhD

Department of Psychiatry, Chung Ang University Hospital, 102 Heukseok-ro, Dongjak-gu, Seoul 06973, Korea.
E-mail: hduk70@gmail.com

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ORCID iDs

Ji Sun Hong

<https://orcid.org/0000-0002-3898-8427>

Sun Mi Kim

<https://orcid.org/0000-0003-4131-0542>

Jae-Woo Jung

<https://orcid.org/0000-0002-3411-735X>

So Young Kim

<https://orcid.org/0000-0003-3457-9455>

Un-Sun Chung

<https://orcid.org/0000-0003-3871-1425>

Doug Hyun Han

<https://orcid.org/0000-0001-5888-0686>

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ABSTRACT

Background: Studying immigrants may have the potential to explore how cultural and environmental changes affect the internet game play patterns of individuals in the two countries. We planned to compare risk and preventive factors for Internet Gaming Disorder (IGD) between Korean adolescents in Korea and immigrant Koreans in the US.

Methods: Ninety-four Koreans and 133 immigrant Koreans were recruited. Independent factors consisted of five domains including demographic data, physical activity, academic, art, and music activities, psychological factors, and game and media play. The dependent variable in the current study was the high-risk group of IGD, which was assessed with Young's Internet Addiction Scale scores. To determine the protective and risk factors for IGD, we performed a multiple logistic regression analysis using the high-risk group as the dependent variable.

Results: Five domains affected the risk for IGD in Korean and immigrant Korean groups. Vigorous physical activity was the strongest protective factor for IGD in the Korean group, while media activity was the strongest protective factor for IGD in immigrant Koreans in the US.

Conclusion: The results indicate that internet gaming problems might be affected by environmental factors and it is recommended that gaming activity is substituted with physical activity, extracurricular classes, books, and music.

Keywords: Internet Gaming Disorder; Immigrant Koreans; Physical Activity; Reading Books

INTRODUCTION

For several decades, internet use and internet game play have been discussed as a disease category due to their harmful effects such as impaired daily life, academic performance, and family relationships, particularly among adolescents.¹ The American Psychiatric Association's Substance Use and Related Disorders Workgroup for the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5) suggested that Internet Gaming Disorder (IGD) would be a condition for future research with a formal diagnosis.² Recently, the World Health Organization (WHO) International Classification of Disease (ICD)-11 proposed a new category of "Gaming Disorder."³ However, there were debates on IGD as

Disclosure

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Author Contributions

Conceptualization: Hong JS, Jung JW, Han DH. Data curation: Jung JW, Kim SY, Chung USS, Han DH. Formal analysis: Kim SM, Han DH. Writing - original draft: Hong JS, Kim SM. Writing - review & editing: Hong JS, Han DH.

a formal diagnosis due to a lack of scientific evidence and weak causality of gaming on functional impairment.⁴

Immigrant studies may have the potential to shed light on how changes in culture and environments influence habits and behaviors of individuals between two countries.^{5,6} In a survey of 2,334 Mexican Americans and 2,460 Mexicans in Mexico, Borges et al.⁵ reported that immigrant Mexicans have an increased prevalence of substance use in response to cumulative exposure to US society.⁵ Latino immigrants are less likely to cause problems such as operating a vehicle under the influence of alcohol, get into fights while drinking, and taking part in risky behaviors, compared to US-born Latinos.⁶ With the evidence of different cancer incidence profiles between African-born Blacks and US-born Blacks, immigrant studies were thought to stimulate etiologic research and help inform targeted interventions.⁷

For exploring the causes or aggravating factors that lead to IGD, many studies have suggested that demographic factors, psychological conditions, activity factors, physical activity, and media use patterns could be preventive or risk factors for IGD.⁸⁻¹¹ In individual demographic factors related to IGD, being male could be a risk factor 2–3 times higher, when compared to being female.^{12,13} In addition, older age can also be a risk factor for IGD, as compared to younger age among adolescents.¹⁴ Activity factors may consist of academic achievement, activity in leisure time, and social activity.^{15,16} In a survey of US students in 27 universities, sadness and depressive mood, boredom, and stress could be associated with intensive internet use.¹⁶ In addition, the failure of academic achievement or exercise, failure to engage in face-to-face social activities, negative affective states, and concentration difficulties could also induce excessive internet use.¹⁶ In a survey with 1,168 Korean adolescents regarding problematic internet use, Lee et al.¹⁵ reported that academic stress was significantly associated with problematic internet use. In a survey of 509 adolescents aged 10–18 years, social networking site (SNS) addiction and IGD could augment each other and simultaneously contribute to aggravating clinical symptoms.¹⁰ Compared to US students, Korean students may spend more time to achieve academic success in school and extracurricular classes. In addition, academic stress would aggravate the severity of internet addiction in Korean adolescents.¹⁷

With the five domains of 1) demographic data, 2) physical activity, 3) academic, art, and music activities, 4) psychological factors, and 5) game and media play, we planned to compare risk and preventive factors for internet game play between Korean adolescents in Korea and immigrant Koreans in the US. Through our approach of studying immigrant Koreans, we would be able to suggest etiological and causal factors of IGD, as well as develop a targeted intervention for adolescents in each country.

METHODS

Participants

In Korea and the United States, Korean and immigrant Korean adolescents who play internet games for more than 3 hours/week were recruited from September to December, 2017. From five high schools in Seoul, three high schools in Gyeonggi and two high schools in Incheon, Korea, 120 Korean students responded to our questions. From five high schools in New Jersey, five high schools in California and two high schools in Utah, 144 immigrant Korean students, who could speak Korean, responded to our questions. Of 120 Korean students, 26

did not complete questionnaires and scales. Of 144 immigrant Korean students, 11 did not complete questionnaires and scales. Finally, 94 Korean students and 133 immigrant Korean students were recruited in the analysis of the current study.

Independent factors

Independent factors consisted of five domains, including demographic data, physical activity, academic, art, and music activities, psychological factors, and game and media play.

Demographic factors included residence, age, education year, and sex.

For assessment of physical activity, the International Physical Activity Questionnaire (IPAQ) short form was used.¹⁸ Participants were asked to report light, moderate, and vigorous physical activity performed during the last seven days. This 7-item inventory utilizes a series of yes or no and fill-in-the-blank questions to assess the time spent per week engaged in various types and intensities of physical activity (PA). A higher score indicates a greater PA level, and the Cronbach's α and test-retest reliability of the IPAQ after translation into Korean were previously reported as 0.65.¹⁸ The physical activity included physical education class in school and physical activities after school.

The questions on academic, art, and music activities included mean hours/day of study on a weekday and weekend, mean hours of school stay on a weekday and weekend, mean hours/day of extracurricular classes for study on a weekday and weekend, and mean total hours/week on a weekday (mean total hours/month on a weekend) of art and music. "School stay" means the hours of regular school time for academic performance.

Psychological status was assessed with the Center for Epidemiologic Studies Depression scale (CES-D)¹⁹ and Dupaul's Attention Deficit Hyperactivity Disorder (ADHD) scale–Korean version (K-ARS).²⁰ The CES-D was designed specifically to screen for depressive symptoms in the general population.^{21–23} The CES-D consists of 20 items which ask how participants felt during the previous week. The Korean version of the CES-D had adequate test-retest reliability (0.68 over several weeks) and internal consistency (0.89–0.93).¹⁹ The scores range from 0 (lowest) to 60 (highest), and total scores indicate the following: 1) not depressed (0–9 points), 2) mildly depressed (10–15 points), 3) moderately depressed (16–24 points), or 4) severely depressed (more than 25 points). The standard cutoff point of 16 or more was used to classify patients with depressive symptoms.²⁴ The internal consistency of the CES-D score in this study was 0.87. The K-ARS is an ADHD symptom severity scale composed of 18 items (9 items for assessing inattention and 9 items for assessing hyperactivity), designed by Dupaul.²⁵ The Korean version of the ARS has been validated by So et al.²⁰ The internal consistency of the K-ARS has been reported to range from 0.77 to 0.89.²⁰ The internal consistency of the K-ARS score in this study was 0.88.

The questions in the domain of game and media play included mean hours/day of game playing, mean hours/day of smart phone use, mean hours of SNS use/day, mean hours of watching television/day, mean hours of reading a book/day, mean hours of reading a newspaper/day, and mean hours of listening to music/day.

The dependent variable of the current study was the high-risk group of IGD, assessed using Young's Internet Addiction Scale scores (YIAS). The YIAS was developed by Kimberly Young and has been used for assessing problematic internet use.²⁶ It consists of 20 questions with a

5-point Likert type scale. The Korean version of YIAS scale was reported to have high internal consistency with a Cronbach's alpha coefficient of 0.921 and proper validity.²⁷ In the current study, the Cronbach's alpha coefficient was 0.91. A score of 50 points or higher on the YIAS was regarded as comprising the high-risk group for problematic internet use or the IGD group.^{12,28}

Statistical analysis

The demographic characteristics, physical activity, activities apart from physical activity, psychological status, and game and media activity of Koreans and immigrant Korean adolescents were analyzed with independent t-tests and χ^2 tests.

To determine the protective and risk factors for internet gaming disorder, we performed a multiple logistic regression analysis using the high-risk group as the dependent variable. Using multiple regressions with the entire sample of Koreans in Korea and US, the current study added a discrete set of hierarchical variables. In the first stage, demographic factors were entered into Model 1, to be correlated with the high-risk group of internet gaming disorder. Physical activity was entered in the second stage. In the third stage, academic, art, and music activities were added. In the fourth stage, two psychological factors were added. Finally, game and media play were added. In the group of Korean participants as well as immigrant Korean participants, a hierarchical logistic regression was applied in the same manner. Statistical significance was set a priori at $\alpha = 0.05$ (two-sided), to limit type-I error. We conducted all analyses using the complex samples module of the PASW statistics software package, version 19 (SPSS Inc., Chicago, IL, USA).

Ethics statement

The research protocol for the current study was approved by the Chung Ang University Hospital Institutional Review Board (reference No. C2014149). Written informed consent for data to be used in the research was provided by parents and adolescents.

RESULTS

Comparison of five domains between Koreans and immigrant Korean adolescents

There were no significant differences in age, sex, and education years between Korean adolescents and immigrant Korean adolescents (**Table 1**).

In all degrees of physical activities, except the frequency of light activity, immigrant Korean adolescents showed increased physical activity in terms of frequency and duration, as compared to Korean adolescents (**Table 1**).

Korean adolescents showed increased hours of study on a weekday and weekend, school stay on a weekday and weekend, extracurricular classes on a weekday and weekend, and art and music lessons on a weekend, as compared to immigrant Koreans. There was no significant difference in art and music lesson hours on a weekday between the two groups.

There were no significant differences in the scores of CES-D and K-ARS between two groups.

Korean adolescents showed increased scores on the YIAS, compared to immigrant Koreans. In addition, the number of high-risk participants for IGD in the Korean group was higher

Table 1. The comparison of demographic data between Koreans in Korea and Immigrant Koreans in the United States

Variables	Koreans in Korea (n = 94)	Koreans in the US (n = 133)	Statistics
Demographic characteristics			
Age, yr	15.2 ± 1.2	15.1 ± 1.2	t = 0.8, P = 0.43
Sex, male/female	47/47	77/56	$\chi^2 = 1.4, P = 0.24$
Education year	10.6 ± 0.8	10.7 ± 1.0	t = -0.4, P = 0.67
US stay, yr	-	7.3 ± 4.0	-
Physical activity			
Vigorous activity frequency, day/wk ^a	1.9 ± 1.7	3.8 ± 2.3	t = -6.5, P < 0.01
Vigorous activity duration, hr/day ^b	0.9 ± 1.4	1.5 ± 1.1	t = -3.2, P = 0.01
Moderate activity frequency, day/wk ^a	2.3 ± 2.2	4.0 ± 2.2	t = -5.9, P < 0.01
Moderate activity duration, hr/day ^b	0.9 ± 1.0	1.2 ± 1.0	t = -2.5, P = 0.01
Light activity frequency, day/wk	6.1 ± 1.5	5.7 ± 2.2	t = 1.6, P = 0.11
Light activity duration, hr/day ^b	1.5 ± 1.1	2.2 ± 2.3	t = -2.7, P = 0.01
Academic, art, and music activities			
Study, hr/day			
Weekday ^a	9.5 ± 2.9	4.3 ± 3.9	t = 10.9, P < 0.01
Weekend ^a	6.2 ± 2.1	2.6 ± 2.6	t = 10.9, P < 0.01
School stay, hr/day			
Weekday ^a	9.5 ± 2.8	7.1 ± 2.3	t = 7.1, P < 0.01
Weekend ^a	5.4 ± 1.3	1.0 ± 1.7	t = 20.1, P < 0.01
Extracurricular classes, hr/day			
Weekday ^a	2.1 ± 2.3	1.1 ± 1.9	t = 3.5, P < 0.01
Weekend ^a	2.1 ± 2.3	0.7 ± 1.2	t = 6.1, P < 0.01
Art and music			
Weekday, hr/wk	2.3 ± 2.0	2.6 ± 3.0	t = -0.88, P = 0.38
Weekend, hr/mon ^a	3.4 ± 3.2	2.1 ± 2.6	t = 3.2, P < 0.01
Psychological status			
CES-D	15.6 ± 8.1	17.4 ± 9.9	t = -1.4, P = 0.17
K-ARS	8.4 ± 7.8	8.8 ± 6.9	t = -0.39, P = 0.69
Games and media play			
Young's Internet Addiction Scale ^a	54.4 ± 16.4	39.6 ± 13.2	t = 6.5, P < 0.01
High risk group/control group ^b	36/58	31/102	$\chi^2 = 5.9, P = 0.01$
Game use time, hr/day ^a	1.9 ± 1.4	1.4 ± 1.3	t = 2.9, P < 0.01
Smartphone use time, hr/day ^b	2.4 ± 1.5	2.9 ± 1.9	t = -2.3, P = 0.02
SNS use time, hr/day	0.9 ± 0.8	1.5 ± 2.7	t = -1.8, P = 0.07
Other media, hr/day			
Watching TV	0.9 ± 0.9	1.5 ± 3.1	t = -1.8, P = 0.07
Reading a book ^a	0.7 ± 0.7	2.6 ± 2.4	t = -2.9, P < 0.01
Reading a newspaper	0.1 ± 0.3	0.3 ± 0.2	t = -1.1, P = 0.28
Listening to music ^a	1.9 ± 1.5	2.6 ± 1.6	t = -3.5, P < 0.01

Data are presented as mean ± standard deviation. Vigorous intensity activities include jogging, running, and rope jumping. Moderate intensity activities include bicycling and leisure. Light intensity activities include walking, level ground, and strolling. Extracurricular classes for tutoring and academic help. Art and music mean music and art activity after school or free time.

CES-D = the Center for Epidemiologic Studies Depression Scale, K-ARS = Attention Deficit Hyperactivity Disorder Rating scale-Korean version, SNS = social networking service, TV = television.

^aP < 0.01; ^bP < 0.05.

than that in the immigrant Korean group (**Table 1**). With a sex ratio of high-risk participants for IGD of 23 (male) to 13 (female) in the Korean group, the number of male students was higher than that of female students. However, there was no statistical significance ($\chi^2 = 4.5, P = 0.06$). With a sex ratio of high-risk participants for IGD of 21 (male) to 10 (female) in the immigrant Koreans group, the number of male students was higher than that of female students. However, there was no statistical significance ($\chi^2 = 1.5, P = 0.29$). Compared to Korean adolescents, immigrant Koreans used smartphones more. In addition, immigrant Koreans read books for more hours and listened to music for more hours, as compared to Korean adolescents.

Hierarchical logistic regression analysis with the dependent factors of YIAS

In all adolescents (Koreans and immigrant Koreans), all five models were significantly associated with the high-risk group of IGD. With the highest step chi-square value, psychological factors were the strongest risk factors for the high-risk group of IGD in comparison to the four other sets of factors. Demographic factors, tested in Model 1, significantly enhanced the predictability of the variance to 70.5% in the high-risk group of IGD. Physical activity, tested in Model 2, explained an additional 1.2% of the variance in the high-risk group of IGD, beyond the effects of demographic factors. Academic, art, and music activities, tested in Model 3, explained an additional 0.9% of the variance in the high-risk group of IGD, beyond the effects of demographic factors and physical activity. Psychological factors, tested in Model 4, explained an additional 7.5% of the variance in the high-risk group of IGD, beyond the effects of demographic factors, physical activity, and academic, art, and music activities. Game and media play, tested in Model 5, explained an additional 0.8% of the variance the high-risk group of IGD, beyond the effects of demographic factors, physical activity, academic, art, and music activities, and psychological factors. According to the Wald statistics for all independent variables, the variables of residence in Korea, lower frequency and duration of vigorous activity, higher scores on K-ARS, and less book-reading hours significantly predicted the high-risk group of IGD (Table 2).

In Korean adolescents, four models (Models 2, 3, 4, and 5) were significantly associated with the high-risk group of IGD. With the highest step chi-square value, physical activity was the strongest risk factor for the high-risk group of IGD in comparison to the four other sets of factors. Physical activity, tested in Model 2, explained an additional 13.8% of the variance in the high-risk group of IGD, beyond the effects of demographic factors. Academic, art, and music activities, tested in Model 3, explained an additional 4.3% of the variance in the high-risk group of IGD, beyond the effects of demographic factors and physical activity. Psychological factors, tested in Model 4, explained an additional 5.3% of the variance in the high-risk group of IGD, beyond the effects of demographic factors, physical activity, and academic, art, and music activities. Game and media play, tested in Model 5, explained an additional 4.3% of the variance the high-risk group of IGD, beyond the effects of demographic factors, physical activity, academic, art, and music activities, and psychological factors. According to the Wald statistics for all independent variables, the variables of lower frequency of vigorous activity, higher scores on K-ARS, more extracurricular classes on a weekday, and fewer hours listening to music significantly predicted the high-risk group of IGD (Table 3).

In immigrant Korean adolescents, four models (Models 2, 3, 4, and 5) were significantly associated with the high-risk group of IGD. With the highest step chi-square value, game and media use was the strongest risk factor for the high-risk group of IGD in comparison to the four other sets of factors. Physical activity, tested in Model 2, explained an additional 11.1% of the variance in the high-risk group of IGD, beyond the effects of demographic factors. Activities apart from physical activity, tested in Model 3, explained an additional 3.5% of the variance in the high-risk group of IGD, beyond the effects of demographic factors and physical activity. Psychological factors, tested in Model 4, explained an additional 6.2% of the variance in the high-risk group of IGD, beyond the effects of demographic factors, physical activity, and academic, art, and music activities. Game and media play, tested in Model 5, explained an additional 2.2% of the variance in the high-risk group of IGD, beyond the effects of demographic factors, physical activity, academic, art, and music activities, and psychological factors. According to the Wald statistics for all independent variables, the

Table 2. Hierarchical linear regression analysis with Young's Internet Addiction Scale Score as the dependent variable, for all participants

Independent variables	Model	Model 1			Model 2			Model 3			Model 4			Model 5		
	0	B	Wald	OR	B	Wald	OR	B	Wald	OR	B	Wald	OR	B	Wald	OR
Demographic factors																
Residence		-1.693	31.486	0.184 ^a	-1.379	15.994	0.252 ^a	-1.522	5.279	0.218 ^b	-2.738	12.062	0.065 ^a	-2.327	6.224	0.098 ^b
Age, yr		-0.087	0.398	0.917	-0.073	0.242	0.930	0.049	0.097	1.050	0.052	0.088	1.054	0.018	0.008	1.018
Sex		0.441	2.164	1.554	0.337	1.058	1.401	0.327	0.873	1.387	0.362	0.798	1.436	0.445	0.876	1.561
Education year		0.245	1.844	1.278	0.241	1.596	1.273	0.250	1.537	1.284	0.266	1.366	1.304	0.286	1.390	1.331
Physical activity																
Vigorous																
Frequency					-0.201	4.224	0.818 ^b	-0.233	4.806	0.792 ^a	-0.252	4.311	0.777 ^b	-0.382	7.142	0.683 ^a
Duration					-0.159	1.057	0.853	-0.275	2.437	0.760	-0.369	3.550	0.691	-0.446	3.856	0.640 ^b
Moderate																
Frequency					-0.092	0.979	0.912	-0.109	1.214	0.897	-0.073	0.412	0.930	0.017	0.016	1.017
Duration					0.148	0.505	1.159	0.184	0.754	1.201	0.370	2.202	1.448	0.493	2.938	1.638
Light																
Frequency					-0.088	1.055	0.916	-0.063	0.497	0.939	-0.067	0.465	0.935	-0.101	0.796	0.904
Duration					0.051	0.383	1.052	0.093	1.023	1.097	0.148	2.192	1.159	0.111	0.811	1.118
Academic, art, and music activities																
Study																
Weekday								-0.124	3.299	0.884	-0.103	1.871	0.902	-0.059	0.467	0.942
Weekend								-0.116	1.620	0.891	-0.143	1.865	0.867	-0.049	0.166	0.953
School																
Weekday								0.040	0.330	1.041	0.121	2.384	1.129	0.129	2.094	1.138
Weekend								0.168	2.046	1.183	0.042	0.105	1.043	-0.037	0.061	0.964
Extracurricular classes																
Weekday								0.170	2.674	1.185	0.140	1.471	1.150	0.177	1.724	1.194
Weekend								-0.061	0.261	0.941	-0.009	0.005	0.991	-0.079	0.300	0.924
Art & music																
Weekday								-0.134	2.410	0.875	-0.189	3.178	0.827	-0.113	0.877	0.893
Weekend								-0.021	0.093	0.979	-0.080	0.846	0.923	-0.126	1.488	0.881
Psychological factors																
CES-D											0.070	7.318	1.073 ^a	0.058	3.821	1.060
K-ARS											0.123	12.546	1.131 ^a	0.152	14.587	1.164 ^b
Game and media play																
Game time														0.186	0.998	1.205
Smart phone														0.159	1.355	1.172
SNS time														0.048	0.083	1.049
TV														0.186	1.758	1.204
Book														-0.972	9.088	0.378 ^a
Newspaper														0.522	0.403	1.686
Music														-0.193	2.452	0.825
Indices	Model 0	Model 1			Model 2			Model 3			Model 4			Model 5		
-2LL		265.3			248.1			233.4			192.9			163.9		
Model χ^2/P		38.8/< 0.01			17.2/< 0.01			14.7/< 0.01			40.4/< 0.01			29.1/< 0.01		
Nag R ²		0.213			0.296			0.362			0.524			0.624		
Class accuracy	60.8	70.5			72.7			73.6			81.1			81.9		

Light intensity activities include walking, level ground, and strolling. Moderate intensity activities include bicycling and leisure. Vigorous intensity activities include jogging, running, and rope jumping. Extracurricular classes for tutoring and academic help. Art and music after school or free time. B = beta, OR = odds ratio, -2LL = -2 log likelihood, Nag R² = Nagelkerke's R², CES-D = the Center for Epidemiologic Studies Depression Scale, K-ARS = Attention Deficit Hyperactivity Disorder Rating scale-Korean version, SNS = social networking service, TV = television.

^aP < 0.01; ^bP < 0.05.

variables of lower frequency of vigorous activity, fewer art and music hours on a weekday, higher scores on K-ARS, more hours watching TV, and less book-reading hours significantly predicted the high risk group of IGD (Table 4).

Table 3. Hierarchical linear regression analysis with Young's Internet Addiction Scale Score as the dependent variable, in Korean participants

Independent variables	Model	Model 1			Model 2			Model 3			Model 4			Model 5		
	0	B	Wald	OR	B	Wald	OR	B	Wald	OR	B	Wald	OR	B	Wald	OR
Demographic factors																
Age, yr		0.024	0.013	1.024	0.224	0.739	1.250	0.343	1.124	1.409	0.436	1.125	1.547	-0.218	0.080	0.804
Sex		0.302	0.479	1.353	-0.244	0.187	0.783	0.156	0.045	1.168	-0.229	0.063	0.796	-0.485	0.128	0.616
Education year		0.390	1.269	1.476	0.577	1.767	1.780	0.694	1.981	2.002	1.286	4.768	3.619 ^a	1.011	0.952	2.749
Physical activity																
Vigorous																
Frequency					-0.635	9.033	0.530 ^a	-0.742	8.414	0.476 ^b	-0.596	4.232	0.551 ^a	-1.236	4.772	0.290 ^a
Duration					-0.310	2.588	0.733	-0.546	4.842	0.579 ^a	-0.634	4.065	0.530 ^a	-0.737	1.833	0.478
Moderate																
Frequency					-0.123	0.640	0.884	-0.142	0.697	0.868	-0.030	0.024	0.970	-0.272	0.732	0.762
Duration					0.309	0.859	1.363	0.494	1.613	1.639	0.356	0.702	1.428	0.415	0.353	1.514
Light																
Frequency					-0.324	1.427	0.723	-0.369	1.264	0.691	-0.323	0.715	0.724	-0.804	1.061	0.448
Duration					-0.103	0.143	0.902	-0.334	1.074	0.716	-0.185	0.250	0.831	-0.430	0.334	0.650
Academic, art, and music activities																
Study																
Weekday								-0.248	4.058	0.780 ^a	-0.162	1.330	0.851	0.138	0.417	1.147
Weekend								0.004	0.001	1.004	-0.118	0.431	0.889	0.032	0.013	1.032
School																
Weekday								0.176	1.772	1.192	0.271	2.957	1.311	0.667	2.653	1.948
Weekend								-0.042	0.026	0.959	-0.087	0.086	0.916	-0.932	1.641	0.394
Extracurricular classes																
Weekday								0.486	4.247	1.626 ^a	0.478	3.868	1.613 ^a	0.685	5.331	1.984 ^a
Weekend								0.125	0.481	1.133	0.109	0.234	1.115	-0.501	1.749	0.606
Art & music																
Weekday								0.517	3.401	1.677	0.220	0.414	1.247	1.475	2.515	4.370
Weekend								-0.215	2.377	0.806	-0.299	2.777	0.741	-0.722	3.808	0.486
Psychological factors																
CES-D											0.083	1.508	1.086	-0.047	0.117	0.954
K-ARS											0.203	5.140	1.225 ^a	0.517	4.523	1.677 ^a
Game and media play																
Game time														0.455	0.425	1.576
Smart phone														0.901	3.323	2.461
SNS time														-0.058	0.003	0.944
TV														-1.078	1.925	0.340
Book														-1.592	0.553	0.204
Newspaper														4.609	1.181	10.429
Music														-2.319	6.070	0.098 ^a
Indices	Model 0	Model 1			Model 2			Model 3			Model 4			Model 5		
-2LL		122.5			95.8			84.5			67.0			41.0		
Model χ^2/P		2.6/0.45			26.7/< 0.01			11.3/< 0.01			17.5/< 0.01			26.0/< 0.01		
Nag R ²		0.038			0.364			0.477			0.626			0.803		
Class accuracy	61.7	61.7			75.5			79.8			85.1			89.4		

Class accuracy: classification accuracy, light intensity activities include walking, level ground, and strolling; moderate intensity activities include bicycling and leisure; vigorous intensity activities include jogging, running, and rope jumping.

B = beta, OR = odds ratio, -2LL = -2 log likelihood, Nag R² = Nagelkerke's R², CES-D = the Center for Epidemiologic Studies Depression Scale, K-ARS = Attention Deficit Hyperactivity Disorder Rating scale-Korean version, SNS = social networking service, TV = television.

^aP < 0.05; ^bP < 0.01.

Table 4. Hierarchical linear regression analysis with Young's Internet Addiction Scale Score as the dependent variable, in Korean immigrants in the US

Independent variables	Model	Model 1			Model 2			Model 3			Model 4			Model 5		
	0	B	Wald	OR	B	Wald	OR	B	Wald	OR	B	Wald	OR	B	Wald	OR
Demographic factors																
Age, yr		-0.208	1.213	0.812	-0.199	1.018	0.819	0.085	0.126	1.089	0.116	0.192	1.123	0.265	0.452	1.303
Sex		0.532	1.629	1.703	0.567	1.492	1.763	0.756	2.100	2.131	0.689	1.366	1.992	1.264	2.457	3.540
Education year		0.173	0.658	1.189	0.150	0.449	1.162	0.114	0.215	1.121	0.028	0.010	1.028	-0.039	0.013	0.962
Physical activity																
Vigorous																
Frequency					-0.154	1.107	0.858	-0.116	0.439	0.891	-0.202	1.020	0.817	-0.647	4.570	0.524 ^a
Duration					0.013	0.002	1.013	-0.202	0.272	0.817	-0.444	1.015	0.642	-0.808	1.832	0.446
Moderate																
Frequency					0.053	0.154	1.055	-0.005	0.001	0.995	0.021	0.013	1.021	0.290	1.085	1.336
Duration					0.004	0.000	1.004	0.155	0.206	1.168	0.567	2.028	1.763	0.256	4.834	3.512
Light																
Frequency					-0.115	1.297	0.892	-0.022	0.035	0.978	-0.021	0.027	0.979	-0.107	0.403	0.898
Duration					0.053	0.383	1.054	0.156	1.808	1.169	0.142	1.268	1.153	-0.003	0.000	0.997
Academic, art, and music activities																
Study																
Weekday								-0.020	0.037	0.980	-0.027	0.055	0.973	0.005	0.001	1.005
Weekend								-0.296	2.603	0.744	-0.323	2.350	0.724	-0.212	0.551	0.809
School																
Weekday								-0.134	1.543	0.874	-0.033	0.078	0.968	-0.084	0.242	0.919
Weekend								0.238	1.608	1.269	0.208	0.976	1.231	0.144	0.288	1.155
Extracurricular classes																
Weekday								-0.077	0.148	0.926	0.072	0.074	1.074	0.763	1.849	2.144
Weekend								-0.335	1.089	0.715	-0.463	1.671	0.630	-0.643	1.847	0.525
Art & music																
Weekday								-0.431	6.413	0.650 ^a	-0.552	6.494	0.576 ^a	-0.913	7.140	0.401 ^b
Weekend								0.182	1.965	1.200	0.231	2.120	1.260	0.498	4.701	1.645 ^a
Psychological factors																
CES-D											0.072	4.299	1.074 ^a	0.083	3.084	1.086
K-ARS											0.105	5.160	1.111 ^a	0.194	8.500	1.214 ^b
Game and media play																
Game time														0.208	0.393	1.231
Smart phone														0.161	0.682	1.175
SNS time														-0.126	0.509	0.882
TV														0.500	5.083	1.648 ^a
Book														-1.697	9.516	0.183 ^b
Newspaper														-0.005	0.000	0.995
Music														0.080	0.227	1.083
Indices																
-2LL	Model 0	Model 1			Model 2			Model 3			Model 4			Model 5		
		299.5			264.8			238.9			206.2			170.5		
Model χ^2/P		2.6/0.21			34.7/< 0.01			25.9/< 0.01			32.7/< 0.01			35.6/< 0.01		
Nag R ²		0.027			0.215			0.338			0.475			0.603		
Class accuracy	60.8	58.1			69.2			72.7			78.9			81.1		

Class accuracy: classification accuracy, light intensity activities include walking, level ground, and strolling; moderate intensity activities include bicycling and leisure; vigorous intensity activities include jogging, running, and rope jumping.

B = beta, OR = odds ratio, -2LL = -2 log likelihood, Nag R² = Nagelkerke's R², CES-D = the Center for Epidemiologic Studies Depression Scale, K-ARS = Attention Deficit Hyperactivity Disorder Rating scale-Korean version, SNS = social networking service, TV = television.

^aP < 0.05; ^bP < 0.01.

DISCUSSION

Current results showed that the five domains, including demographic data, physical activity, academic, art, and music activities, psychological factors, and game and media play, affected the risk for IGD in Koreans and immigrant Korean groups. Interestingly, vigorous physical activity could be the strongest protective factor for IGD in the Korean adolescent group, while

media activity, especially reading a book, could be a protective factor for IGD in immigrant Koreans in US.

Of the five domains, psychological factors were the highest risk factor for IGD in all adolescent groups. This was similar to past findings in IGD with adolescents.^{11,29-31} Both depression and ADHD may lead to, and/or stem from, gaming problems,^{11,29,30} and greater symptom severity at the time of initiating treatment appears to be related to the need for more extensive care. Moreover, IGD with comorbid depression, was associated with serious psychiatric phenomenology and burden in adolescents with IGD.³¹

Residence in the US as a demographic factor was a protective factor for higher risk for IGD. The prevalence of IGD in Korea was higher than that observed in the US.³²⁻³⁴ The prevalence of IGD in Korean adolescents was reported as 5.9% and high risk for IGD group was 8%.³⁴ The prevalence of IGD in US adolescents was reported between 3.6%–4.9%.^{32,33} Different environmental factors between US and Korea may play an important role in preventing IGD. Actually, vigorous physical activity was the strongest protective factor for IGD in the hierarchical logistic regression analysis of the Korean group, while reading books (within the game and media factor) was the strongest protective factor in the immigrant Korean group. Physical activity in the current study was an important protective factor for IGD in all adolescents (both in Korea and the US). In a comparison of 8,912 US adolescents and 5,309 Korean adolescents, Korean students spent 30% of out-of-school hours on playing PC games, while US students spent 27% of out-of-school hours on playing sports.³⁵ Playing sports as well as reading books were common positive predictors of school achievement in both countries.³⁵

Different environmental factors between Korea and the US in the current study were also observed in other activities, except the physical activities domain. In the current results, more extracurricular classes on a weekday were associated with greater risk for IGD in Korea, while fewer art and music hours on a weekday was associated with greater risk for IGD in the US. The stress in response to school achievement of German adolescents was reported to be associated with IGD.³⁶ In Korea, several reports have suggested that art, music, and physical therapy may be worth applying to clinical practice for IGD treatment, as a substitute for gaming and for emotional stability.³⁷ We cautiously suggest that extracurricular classes might be a risk factor for IGD while art and music activity might be a protective factor, as a substitute for IGD. In Korean adolescents, listening to music can be another substitute activity instead of gameplay in the current results. Music therapy programs, including listening to music, were reported to increase self-efficacy in adolescents with IGD.³⁸

There were several limitations in the current study. First, the current study recruited adolescents within a limited age range (15–18 years) and used only self-report instruments in a relatively small number of participants. Due to the limitation of self-report instruments, the comorbidities of IGD were not medically assessed. Attention deficit hyperactivity disorder and major depressive disorder are well known comorbidities of IGD. In addition, due to the small number of participants, the male sex, one of risk factors for IGD, was not identified in the current study. Readers should be cautious for generalizing and interpreting the results. Second, because the present study was cross-sectional, we cannot clarify the causality in these associations.

Finally, the current results did not consider the characteristics of immigrant people including adaptation, language problems, and economic factors. Future studies should include the characteristics of immigrant status.

With the results of this study, we think that internet gaming problems might be affected by environmental factors and it is recommended to substitute gaming activity with others, such as physical activity, extracurricular classes, reading books, and listening to music.

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