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Video game playing in high school students: health correlates, gender differences and problematic gaming

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Abstract

There is concern about the potential for negative impact of video games on youth. However the existing literature on gaming is inconsistent and has often focused on aggression. Health correlates of gaming and the prevalence and correlates of problematic gaming have not been systematically studied. We anonymously surveyed 4,028 adolescents about gaming, reported problems with gaming, and other health behaviors. 51.2% of the sample reported gaming (76.3% of boys and 29.2% of girls). There were no negative health correlates of gaming in boys, and lower odds of smoking regularly; however, girls who reported gaming were less likely to report depression, and more likely to report getting into serious fights and carrying a weapon to school. Among gamers, 4.9% reported problematic gaming, defined as reporting trying to cut back, experiencing an irresistible urge to play, and experiencing a growing tension that could only be relieved by playing. Boys were more likely to report these problems (5.8%) than girls (3.0%). Correlates of problematic gaming included regular cigarette smoking, drug use, depression, and serious fights. Results suggest that gaming is largely normative in boys and not associated with many health factors. In girls, however, gaming appears associated with more externalizing behaviors and fewer internalizing symptoms. The prevalence of problematic gaming is low but not insignificant, and problematic gaming may be contained within a larger spectrum of externalizing behaviors. More research is needed to define safe levels of gaming, refine the definition of problematic gaming, and evaluate effective prevention and intervention strategies.

Keywords

impulse control disorders; adolescents; video gaming; risk behaviors; gender

Introduction

The popularity of video, computer, online, and virtual reality games has raised concern in both the popular media¹ and research community regarding the potential for negative health effects of gaming, including the potential for addiction.²⁻¹⁰ Gaming has been associated with both positive and negative clinical correlates; however, the evidence for a negative impact of gaming has been inconsistent. Experienced gamers may exhibit superior visual, spatial and attention skills,^{11,12, 13} and video game formats have been successfully used to deliver health interventions to children and adolescents.¹⁴ Depending upon the specific game, high levels of motor skill and often problem solving are required to advance through levels of play.¹⁵ Survey research has indicated that children who play video games often do so in social groups, such as with friends or family members,^{16, 17} and that frequency of gaming is

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positively associated with more peer interaction outside of school,¹⁶ although there is not enough evidence to conclude that gaming is a positive contributor to social development in children.¹⁸ Research on the association between gaming and aggression, in both laboratory¹⁹⁻²¹ and survey²²⁻²⁵ settings, and several meta-analyses,^{26, 27} has generally indicated a lack of a strong association between playing games (even violent ones) and aggressive behavior,¹⁸ although some studies have found such an association.^{4, 24, 28-37}

While the research to support concern about gaming as a negative health behavior in general remains controversial, there is clear evidence that some individuals develop a pattern of gaming behavior that is problematic.^{1, 5, 6, 8, 38-42} As video gaming is a non-drug behavior with hedonic components, problematic gaming might be best conceptualized as a non-substance addiction or an impulse control disorder (ICD). The formal ICDs, such as pathological gambling, are characterized by appetitive urges or growing tension prior to participation, relief or pleasure following engagement in the behavior, and repeated behavioral engagement despite negative consequences.⁴³ Importantly, they are not defined by concern or complaints about the behavior from family, which is important when evaluating behaviors in adolescents who may be in conflict with parents around a wide variety of issues. Problematic gaming has typically been defined in the literature based on measures of pathological gambling;^{5, 6, 40, 44, 45} however, a variety of definitions and criteria have been used, leading to inconsistent estimates of the prevalence of problematic gaming.

Individuals with problematic gaming behavior have been shown to exhibit inattention, hyperactivity and poor self-control,^{46, 47} experience time distortion while playing,⁴⁸ and demonstrate increased aggression and diminished empathy if their games of choice contain aggressive content.^{28-30, 32, 37} Those with gaming problems who are engaged primarily in large online gaming communities often are shy,⁴⁹ have an external locus of control,⁴⁹ and use gaming to deal with negative emotions.⁵⁰

Multiple research gaps exist presently. First, not all adolescents play video games, and the health correlates of gaming (e.g. relationships with drug and alcohol use or depression) are incompletely understood, as much of the published research has focused on school performance, obesity, and aggression. Second, the likelihood of gaming, and the clinical correlates thereof, are likely to differ by gender, and sex differences in gaming and its health correlates are poorly understood. Third, much of the research on gaming has utilized online samples of gamers or small groups of individuals identified as having problematic gaming behaviors, presenting problems for generalizability. This study utilizes survey data from a large sample of adolescents and examines the prevalence and clinical correlates of gaming, reported problems associated with video games, and the prevalence and correlates of problematic gaming.

Methods

Sampling

Data are derived from a cross-sectional anonymous survey of students in public high schools as described previously.⁵¹ Schools were first recruited into the study, and then students at each enrolled school were invited to participate. Invitation letters were sent to all public 4-year and non-vocational or special education high schools in the State of Connecticut. After the initial round of letters were mailed, the response from schools was not yet sufficient to ensure that all geographic regions of the state were sufficiently represented. Therefore, targeted contacts were made to schools that were in areas that would ensure a more representative sample. The final sample was representative of 14- to 18-year-old adolescents in CT according to the most recent Census.⁵¹

Survey Procedures

In most cases, the entire student body was targeted for administration of the survey. Students were told that they could voluntarily refuse to complete the survey if they wished and were reminded to keep surveys anonymous. The survey took approximately 50 minutes to complete.

Measures

The measures used in this analysis included self-reported gender, race, ethnicity, grade, and family structure (living with one parent, two parents, or other family structure).

Health and functioning measures were categorized as presented in the tables and included: grade average; extracurricular activities; lifetime smoking history; lifetime marijuana use; lifetime history of a sip of alcohol; current alcohol use among those with a history of any alcohol consumption, categorized as none, light (1-2 days or drinking in the month), moderate (3-9 days of drinking in the month), and heavy (10 or more days of drinking in the month); lifetime use of other drugs; caffeine use; report of being sad or hopeless for two weeks or more in the previous year; getting into fights requiring medical attention in the previous year; carrying a weapon such as a knife, club, or gun to school in the past year; and body mass index (BMI) as calculated from self reported height and weight.

Respondents were asked to report how much time they spent playing video or computer games in a typical week. Respondents who reported “None” were classified as non-game players. For those who played games, the frequency of play was categorized as less than 7 hours per week, 7-14, 15-20, and 21 or more hours per week.

Those who played any video or computer games were asked: if they had ever tried to cut back on playing; whether a family member had expressed concern about the amount of time they spend playing games; whether they missed school, work, or an important social activity because they were playing video or computer games; whether they thought they had a problem with excessive video or computer game use; whether they experienced an irresistible urge or uncontrollable need to play video or computer games; and whether they experienced a growing tension or anxiety that could only be relieved by playing video or computer games. The three items of unsuccessfully trying to cut back, experiencing an irresistible urge to play, and experiencing growing tension only relieved by playing were modeled after the Minnesota Impulse Disorder Inventory⁵² and are considered the core features of an ICD. Students who endorsed all three items were categorized as ‘problematic video gamers.’ The coefficient alpha for these items was 0.76.

Data Analysis

First, demographic characteristics and health correlates were compared between respondents who played video or computer games and those who did not, stratified by gender, using Chi-square tests for categorical variables and t tests for continuous variables. Second, logistic regression models were fit to assess the association between each health correlate and playing video games, adjusting for demographic differences. Interaction terms between gender and health correlates determined whether the associations were significantly different in girls and boys.

Next, among the sub-sample of respondents who reported any game playing, those with problematic game playing were compared to those with non-problematic gaming, stratified by gender for bivariate analyses. Logistic regression models were fit to examine associations between health correlates and problematic gaming, adjusting for gender and race. There was insufficient statistical power to test gender interactions in multivariable models.

Results

Of the 4,028 respondents with data on video gaming, 2,064 (51.2%) reported playing at least one hour of video games per week. This proportion was higher in boys (76.3%) than in girls (29.2%, $p<0.0001$) (Table 1). In the total sample, gaming was significantly more prevalent in Asian students and lower grades. Among boys, playing video or computer games was associated with lower grade and with living in a two-parent household. Among girls, significant positive associations were found with Asian race and lower grade.

Among boys, gaming was associated with *higher* grade average, never smoking, never having used marijuana, and high caffeine consumption (Table 2) In girls, gaming was associated with occasional smoking, never having used marijuana, never having a sip of alcohol, high caffeine use, no history of depression, getting into serious fights, and carrying a weapon. Gaming was associated with slightly higher BMI in girls (mean(SD) BMI for gamers=22.35(4.44), for non-gamers=21.94(3.61); $p=0.03$), but not in boys.

Table 3 presents adjusted logistic regression analyses with interaction terms to identify significant differences across gender groups. Boys reporting gaming were less likely to be regular smokers, while there was no association between smoking and gaming in girls. Boys were also more likely to drink 1-2 servings of caffeinated drinks per day, while girls reporting gaming were more likely to drink 3 or more caffeine drinks per day. Girls reporting gaming were less likely to report depression, while there was no such association among boys. Similarly, girls were more likely to get into serious fights and carry a weapon, but no such association was seen among boys. Finally, girls reporting gaming had slightly higher average BMI measures (OR=1.03, $p=0.01$), while there was no association in boys (OR=1.0001, $p=0.98$).

Table 4 presents the frequency of gaming, along with reported problems associated with gaming, among the sample of 2,196 gamers. In the total sample, the majority of respondents reported playing less than 7 hours per week (61.1%); however, 10.9% reported playing 20 hours or more in a typical week. The most commonly endorsed items related to problems with gaming were family members expressing concern about gaming, trying to cut back on gaming, and experiencing an irresistible urge to play. While the majority of respondents endorsed none of the problematic symptoms, 4.9% endorsed all three of the items indicative of an ICD.

There were significant gender differences in patterns of gaming and problems with gaming as well. Girls as compared with boys more frequently reported playing fewer than 7 hours in a week, and 14% of boys reported playing 20 or more hours per week. Girls also reported problematic gaming less often than did boys. There were 84 boys (5.9%) who endorsed the three problem measures, while only 22 girls (3.0%) did so.

Table 5 compares demographic characteristics of those in the problematic gaming group, compared to all others who reported gaming, stratified by gender. Among boys, problematic gaming was associated with non-white and Asian race. There were no significant associations among girls.

Among health correlates (Table 6), problematic gaming was associated in boys with smoking regularly, depression, and getting into serious fights or carrying a weapon. Among girls, problematic gaming was associated with other drug use, depression and serious fights. There was no association with BMI in either boys ($p=0.20$) or in girls ($p=0.33$).

Logistic regression models presented in Table 7 indicated that, adjusted for race and gender, problematic gaming was associated with higher odds of smoking regularly, other drug use,

lower caffeine consumption, depression, serious fights and carrying a weapon to school. However, given effect sizes and the number of models, the most robust of these findings are for an increase in regular smoking (OR=2.12, $p=0.007$), depression (OR=3.62, $p<0.0001$) and serious fights (OR=2.97, $p<0.0001$).

Discussion

This study is among the first and largest to examine clinical correlates of video gaming and problematic gaming in a community sample of adolescents. We found that about half of the students reported gaming, concentrated among younger students and more common in boys.

There were no significant negative health correlates of gaming in boys, likely reflecting the popularity and normative nature of such games for this group. Additionally, boys who reported gaming were significantly less likely to report being a regular smoker. However, among girls gaming was associated with modestly lower risk of depression and moderate increases in serious fights (OR=1.7) and carrying a weapon (OR=2.1).

We also found that among boys reporting gaming, 5.9% endorsed problematic gaming, compared to 3.0% of girls reporting gaming, suggesting that male gamers may be at higher risk for developing a gaming problem, but that overall the risk of developing a problem is relatively low. Problematic gaming was associated with some important risk behaviors, with moderate effects sizes found for depression (OR=3.6) and fighting (OR=3.0), but was not associated with grade averages, extra-curricular activities, marijuana use, or alcohol use.

Gender differences in correlates of gaming

The gender differences observed between gamers and non-gamers, coupled with the contrast in frequencies of gaming across gender, is suggestive of a gender-specific self-selection process. That is, while gaming may be more appealing to boys in general, it may be particularly attractive to girls with particular characteristics. Although causality cannot be examined in these cross sectional data and competing hypotheses not eliminated, this finding may suggest not that gaming leads to aggression but that more aggressive girls are attracted to gaming as a recreational activity. The finding may also reflect cultural differences in socioeconomic conditions at home and in their communities: it is possible that girls who live in more violent neighborhoods, where they are more likely to experience fights and to carry a weapon for protection, are also more likely to be attracted to gaming, may be more likely to spend time with male peers who are themselves gaming, or may prefer to stay home and play games rather than be outside in dangerous communities.

The finding may also be reflective of personality characteristics that are more externalizing; girls reporting gaming are not only more likely to get into fights and carry weapons, behaviors generally considered to be externalizing, but also are somewhat less likely to report feelings of depression, which would reflect more internalizing patterns. An additional possibility is that gaming may exert a positive effect on mood in girls; however, this hypothesis and the precise nature of the relationship warrant additional study in longitudinal investigations.

Among boys, the finding that gaming is associated with more pro-social or beneficial behaviors, such as less cigarette use, may reflect a different peer group among gamers. As noted above, the general lack of associations between health behaviors and gaming in boys may also reflect the normative nature of gaming for boys in the current US culture.

Problematic Gaming

Although there are no uniformly agreed-upon thresholds for ‘excessive’ game playing, we found higher frequencies of playing among boys than girls, with about 14% of boys reporting playing on average 3 hours a day or more. This, coupled with the possibility that frequencies may be under-reported due to the known phenomenon of time lapse,⁴⁸ where gamers appear unaware of how much time has elapsed while playing, may reflect a strong appeal of these games, particularly to boys. However, it also suggests a need to further characterize the potential risks and benefits associated with high frequency play, and to balance such risks and benefits against those of other activities favored by adolescents, including watching TV or experimenting with substances.⁵³

Boys were significantly more likely than girls to report problems with gaming. When examining the three measures of an ICD, a relatively low but important proportion of both boys and girls have gaming problems. Further research is needed to examine the accuracy of self-reports of such problems, and whether these or other questions are the best way to assess impairment related to gaming. It is possible, for example, that some of the items may be endorsed as a “badge of honor” (e.g., claiming to have a problem or an irresistible urge to play as a sign of a ‘serious’ or very experienced player).

The results of this study suggest that adolescents with problematic gaming are more likely to also be engaging in other risk behaviors such as smoking, drug use and violence, and are more likely to report depression. It is not possible in these data to determine whether problematic gaming leads to experimentation, aggression, or depression, vice versa, or the factors develop in conjunction, perhaps related to common etiological factors such as the violence content in games, or other common underlying traits such as introversion/extraversion, impulsivity or sensation seeking. Future longitudinal research is needed to examine the onset of risk behaviors in temporal relation to gaming and their potential roles in the development of health problems.

Those reporting problems with gaming were also significantly more likely to report depression. Further research is needed to understand the role that video games play in brain function,⁵⁴⁻⁵⁶ including those pathways also associated with depression. However, some research has suggested that adolescents who play excessive amounts of video games in part do so to deal with negative affect.^{50, 57} Conversely, excessive playing may alter brain function in such a way as to increase depressed affect and the risk of depression.

Strengths and Limitations

This study is among the largest to examine gaming in high school students, and this sample size allowed for the examination of gender differences in health correlates. Data were examined using regression models in a manner consistent with prior work investigating youth impulse control behaviors, allowing for comparability across studies.⁵⁸ However, the data are cross-sectional, so that temporal associations cannot be elucidated, and this limits our ability to suggest causal pathways or theoretical models for problematic gaming. Also, the data were self-reported and the psychometric properties of the questions have not been directly evaluated, although they were based upon validated questions used to assess other impulsive behaviors in the Minnesota Impulse Disorder Inventory.⁵² Further research is needed to determine whether these questions are accurate, reliable, and appropriate for assessing problem gaming. We selected a relatively stringent threshold for defining problematic gaming, and further research is needed to determine the optimal threshold for this definition. Despite a substantial sample size, the low prevalence of problematic gaming did not allow us to fully investigate gender interactions in multivariable models. Given the suggestion of differences in bivariate analyses, future research should examine potential

gender differences in the correlates of problematic gaming. Additionally, other factors, such as depression, that are found in association with other impulse control behaviors may represent important variables of consequence (perhaps particularly for girls^{59, 60}) in the development of problematic video gaming, and future studies should investigate directly and systematically the relationships between gender, mood and problematic video gaming. Additional factors such as temperament warrant similar consideration as potential vulnerability factors.⁶¹ Such analyses could help identify how additional factors might be mediating the relationship between problem video game playing and negative measures of health and functioning. Finally, we were unable to distinguish between computer games, handheld video games, physically active games such as Wii, and online gaming. It is possible that each of these types of games may attract different types of players and correlate differentially with specific health measures, particularly since the types of games played may be directly associated with socio-economic status (SES), which we were unable to assess reliably.

In conclusion, we found no significant negative health correlates of video game use in boys; modest correlations with higher aggression and reduced depression in girls; a relatively low but important percentage of reported problems with gaming; and important associations between problematic gaming and smoking, drug use, aggressive behavior and depression, though no associations with grade averages, extra-curricular activities, marijuana use, or alcohol use. Additional research is needed to examine recreational and problematic levels of video gaming, to determine safe levels of gaming, and to identify risk factors and potential points of intervention and prevention. Additionally, more research is needed into beneficial uses of video games given their popularity amongst youth.⁶²

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Abbreviations

BMI	body mass index
ICD	impulse control disorder
OR	odds ratio
SD	standard deviation

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Table 1
Demographic characteristics of high school student sample and association with video game playing, by gender

Variable	Total Sample						Boys (n=1845)						Girls (n=2139)					
	N	%	% play video games ever	X2	p		N	%	% play video games ever	X2	p		N	%	% play video games ever	X2	p	
African-American	Yes	399	9.91	51.38	0.0033	0.954	186	10.08	74.19	0.51	0.4731	205	9.58	28.78	0.02	0.8845		
	No	3629	90.09	51.23			1659	89.92	76.55			1934	90.42	29.27				
White	Yes	3090	76.71	50.84	0.8493	0.3568	1399	75.83	76.05	0.22	0.6417	1666	77.89	29.47	0.23	0.6298		
	No	938	23.29	52.56			446	24.17	77.13			473	22.11	28.33				
Asian	Yes	159	3.95	65.41	13.3	0.0003	83	4.5	81.93	1.52	0.2184	67	3.13	43.28	6.62	0.0101		
	No	3869	96.05	50.66			1762	95.5	76.05			2072	96.87	28.76				
Other race	Yes	568	14.1	50.7	0.076	0.7823	250	13.55	79.2	1.33	0.2484	309	14.45	26.86	0.97	0.3243		
	No	3460	85.9	51.33			1595	86.45	75.86			1830	85.55	29.62				
Hispanic	Yes	519	13.43	52.41	0.31	0.5806	232	13.15	76.72	0.01	0.9232	273	13.23	30.4	0.14	0.7129		
	No	3346	86.57	51.11			1532	86.85	76.44			1791	86.77	29.31				
Grade	9th	1245	30.99	57.11	29.01	<0.0001	571	30.98	78.63	10.40	0.0155	654	30.65	37.92	35.23	<0.0001		
	10th	1108	27.58	50.9			505	27.4	79.01			592	27.74	26.35				
	11th	1055	26.26	47.39			477	25.88	74.42			571	26.76	24.69				
Family structure	12th	609	15.16	46.47			290	15.74	70.34			317	14.85	24.61				
	One parent	910	22.9	48.02	5.29	0.0711	386	21.15	70.98	10.33	0.0057	515	24.45	30.49	1.77	0.4133		
	Two parents	2865	72.09	52.32			1353	74.14	78.27			1484	70.47	28.17				
Other	199	5.01	49.75			86	4.71	70.93			107	5.08	32.71					

Table 2
Health and functioning measures and association with lifetime video game playing, by gender

Variable	Total Sample						Boys			Girls					
	N	%	% play video games ever	X ²	p	N	%	% play video games ever	X ²	p	N	%	% play video games ever	X ²	p
Grade average	2319	59.11	48.68	15.48	0.0004	941	52.05	78.21	6.7393	0.0344	1361	65.5	28.14	2.5883	0.2741
	1157	29.49	54.8			594	32.85	75.76			549	26.42	31.51		
	447	11.39	55.7			273	15.1	70.7			168	8.08	31.55		
Extra-curricular activities	3056	75.87	50.95	0.43	0.5104	1382	74.91	76.48	0.087	0.768	1642	76.76	29.05	0.098	0.7543
	972	24.13	52.16			463	25.09	75.81			497	23.24	29.78		
Smoking, lifetime															
Never	2441	62.41	54.4	34.34	<0.0001	1146	64.53	79.58	29.91	<0.0001	1268	60.53	31.39	12.42	0.002
Occasionally	949	24.26	43.73			397	22.35	71.54			546	26.06	23.26		
Regularly	521	13.32	47.22			233	13.12	66.52			281	13.41	30.25		
Marijuana, lifetime	1476	39.07	47.29	11.72	0.0006	689	40.39	70.68	16.85	<0.0001	772	25.78	25.78	7.11	0.0077
	2302	60.93	53			1017	59.61	79.35			1259	61.97	31.32		
Sip of alcohol, lifetime	3312	86.72	49.34	21.36	<0.0001	1444	84	75.48	1.49	0.2228	1833	89.07	28.31	7.87	0.005
	507	13.28	60.36			275	16	78.91			225	37.33	37.33		
Current alcohol frequency	756	31.01	48.81	2.81	0.4233	338	32.1	75.74	4.19	0.2419	412	30.18	26.46	5.74	0.1249
	704	28.88	48.15			295	28.02	72.54			402	29.45	30.35		
Light	697	28.59	44.76			286	27.16	75.17			406	29.74	22.91		
Moderate	281	11.53	46.26			134	12.73	67.16			145	10.62	26.9		
Heavy	305	9.17	54.43	1.33	0.2483	156	10.3	71.79	1.66	0.1971	144	8.09	34.03	1.28	0.2576
Other drug use, lifetime	3022	90.83	50.96			1359	89.7	76.45			1636	91.91	29.52		
	785	20.03	46.11	13.58	0.0011	390	21.87	66.41	26.74	<0.0001	381	18.2	24.67	8.83	0.0121
Caffeine use	2134	54.45	50.98			922	51.71	79.61			1195	57.1	28.79		
1-2 drinks per day	1000	25.52	54.9			471	26.42	77.28			517	24.7	33.66		
2+ drinks per day	835	21.78	47.19	6.27	0.0123	269	15.57	76.97	1.13	0.2874	556	26.9	27.66	7.85	0.0051
Sad or hopeless 2+weeks	2999	78.22	52.08			1459	84.43	73.98			1511	73.1	33.99		

Variable	Total Sample						Boys			Girls					
	N	%	% play video games ever	X ²	p	N	%	% play video games ever	X ²	p	N	%	% play video games ever	X ²	p
Serious fights	265	6.75	61.13	11.95	0.0005	166	9.33	71.69	2.02	0.1548	91	4.32	39.56	4.97	0.0258
	3660	93.25	50.14			1613	90.67	76.63			2014	95.68	28.7		
Carry a weapon	742	18.81	67.65	101.58	<0.0001	552	30.79	74.46	1.49	0.2217	176	8.35	44.32	21.51	<0.0001
	3202	81.19	47.13			1241	69.21	77.12			1933	91.65	27.73		

Table 3
Association between lifetime video game playing and other health factors, adjusting for grade and stratified by gender

Variable	Category	Total Sample		Boys		Girls		Gender interaction	
		OR	p	OR	p	OR	p	OR	p value
Grade average (Ref: A's and B's)	C's	0.66	0.8586	0.868	0.6483	1.14	0.458		0.0623
	D's and F's	0.84	0.1422	0.673	0.0278	1.08	0.9568		
Extra-curricular activities	Yes	0.97	0.6836	0.99	0.9351	0.961	0.7263		
Smoking, lifetime (Ref: Never)	Occasionally	0.76	0.0144	0.656	0.4695	0.71	0.003		0.1408
	Regularly	0.69	<0.0001	0.524	0.0046	1.07	0.1004		0.0028
Marijuana, lifetime	Yes	0.75	0.0002	0.653	0.0002	0.834	0.0854		0.1984
Sip of alcohol, lifetime	Yes	0.78	0.0239	0.856	0.3362	0.715	0.0245		0.3239
Current alcohol frequency (Ref: Never regular)	Light	1.05	0.7099	0.846	0.8659	1.243	0.1		
	Moderate	0.9	0.4022	0.978	0.3059	0.863	0.0716		
	Heavy	0.87	0.3964	0.671	0.0965	1.127	0.6305		
Other drug use, lifetime	Yes	1.04	0.7675	0.832	0.3376	1.292	0.1758		
Caffeine use (Ref: None)	1-2 drinks per day	1.51	<0.0001	1.929	0.0004	1.19	0.7481		0.0049
	2+ drinks per day	1.65	<0.0001	1.684	0.1366	1.51	0.0052		0.5075
Sad or hopeless 2+weeks	Yes	1.19	0.0549	1.154	0.3499	0.721	0.0024		0.0149
Serious fights	Yes	1.05	0.7501	0.778	0.1725	1.668	0.0218		0.008
Carry a weapon	Yes	1.17	0.1109	0.86	0.2056	2.095	<0.0001		<0.0001

† Interaction term tests whether the Odds Ratios for boys and girls are significantly different from each other

Table 4

Characteristics of video game playing, among those who have played video games

Characteristic	Level	Total Sample			Boys			Girls			p
		N	%	X2	N	%	X2	N	%	X2	
Frequency of game playing in a typical week	<7 hours	1262	61.14	739	52.49	511	81.76	160.22	<0.0001		
	7-14 hrs	385	18.65	314	22.3	65	10.4				
	15-20 hrs	192	9.3	160	11.36	28	4.48				
	20+ hrs	225	10.9	195	13.85	21	3.4				
Ever tried to cut back?		408	20.2	302	22.0	96	15.6	10.87	0.001		
Family expressed concern?		560	27.79	466	33.92	84	13.73	86.19	<0.0001		
Missed activities to play?		289	14.37	238	17.33	41	6.73	39.21	<0.0001		
Do you think you have a problem?		175	8.76	134	9.84	33	5.44	10.48	0.0012		
Experienced irresistible urge to play?		395	19.72	318	23.28	68	11.18	39.13	<0.0001		
Experienced growing tension only relieved by playing?		319	15.91	253	18.51	56	9.2	27.69	<0.0001		
Three key symptoms endorsed ¹		106	4.9	84	5.85	22	3.02	8.34	0.0039		
Total number of items endorsed	0	1094	53.92	650	47.03	429	69.53	97.3	<0.0001		
	1	366	18.04	269	19.46	95	15.4				
	2	243	11.98	197	14.25	42	6.81				
	3	131	6.46	106	7.67	24	3.89				
	4	109	5.37	94	6.8	13	2.11				
	5	51	2.51	42	3.04	9	1.46				
	6	35	1.72	24	1.74	5	0.81				

¹ Unsuccessfully tried to cut back, experience irresistible urge, experience growing tension only relieved by playing

Table 5

Demographic characteristics of those who report video game playing and association with problematic gaming

Variable	Total Sample					Boys					Girls				
	Number of gamers	%	% problematic gamers	X ²	p	Number of gamers	%	% problematic gamers	X ²	p	Number of gamers	%	% problematic gamers	X ²	p
African-American	219	9.97	7.76	3.56	0.0591	141	9.83	7.8	1.08	0.2995	71	9.74	2.82	0.0109	0.917
	1977	90.03	4.81			1294	90.17	5.64			658	90.26	3.04		
White	1656	75.41	4.47	5.55	0.0185	1079	75.19	4.91	6.99	0.0082	561	76.95	3.21	0.302	0.5823
	540	24.59	7.04			356	24.81	8.71			168	23.05	2.38		
Asian	109	4.96	7.34	1.19	0.2757	70	4.88	11.43	4.15	0.0416	31	4.25	0	1.01	0.3155
	2087	95.04	4.98			1365	95.12	5.57			698	95.75	3.15		
Other race	314	14.3	5.1	0.0001	0.9968	200	13.94	6.5	0.18	0.6747	107	14.68	2.8	0.02	0.8885
	1882	85.7	5.1			1235	86.06	5.75			622	85.32	3.05		
Hispanic	296	14.02	7.43	4.63	0.0315	184	13.37	8.7	3.64	0.0564	102	14.35	3.92	0.27	0.6021
	1816	85.98	4.52			1192	86.63	5.2			609	85.65	2.96		
Grade	743	33.97	4.31	3.18	0.3651	452	31.54	4.42	4.07	0.2538	277	38.15	2.89	0.47	0.9256
	601	27.48	5.16			400	27.91	6			192	26.45	3.13		
	525	24.01	4.95			364	25.4	5.77			157	21.63	2.55		
	318	14.54	6.92			217	15.14	8.29			100	13.77	4		
Family structure	478	22.12	5.02	0.84	0.6573	290	20.45	5.52	0.408	0.8154	183	25.74	3.83	0.502	0.7781
	1566	72.47	4.92			1061	74.82	5.66			483	67.93	2.9		
	117	5.41	6.84			67	4.72	7.46			45	6.33	2.22		

Table 6

Health and functioning measures and association with problematic gaming, by gender

Variable	Total Sample						Boys						Girls					
	Number of gamers	%	% problematic gamers	X2	p		Number of gamers	%	% problematic gamers	X2	p		Number of gamers	%	% problematic gamers	X2	p	
Grade average	1189	55.64	4.63	1.07	0.5847		748	53.24	5.61	0.2313	0.8908		431	61.05	2.78	0.569	0.7521	
	674	31.54	5.49			457	32.53	5.91			206	29.18	3.88					
	274	12.82	5.84			200	14.23	6.5			69	9.77	2.9					
Extra-curricular activities	1646	74.95	4.68	2.42	0.1198		1072	74.7	5.41	1.51	0.2191		552	75.72	2.54	1.81	0.1795	
	550	25.05	6.36			363	25.3	7.16			177	24.28	4.52					
Smoking, lifetime																		
	1363	64.35	3.96	10.28	0.0058		911	66.06	4.39	9.91	0.0071		434	61.13	2.76	2.08	0.353	
	467	22.05	5.57			302	21.9	6.62			161	22.68	2.48					
	288	13.6	8.33			166	12.04	10.24			115	16.2	5.22					
Marijuana, lifetime	776	37.91	6.19	2.86	0.0906		507	38.32	6.31	0.36	0.5472		256	36.99	4.69	3	0.0831	
	1271	62.09	4.48			816	61.68	5.51			436	63.01	2.29					
	1758	85.05	4.95	0.78	0.3778		1118	83.75	5.64	0.99	0.3207		614	87.59	3.26	0.23	0.6313	
	309	14.95	6.15			217	16.25	7.37			87	12.41	2.3					
Current alcohol frequency	396	31.5	5.3	2.44	0.4867		255	31.99	5.49	1.01	0.7984		138	30.8	5.07	6.91	0.0751	
	366	29.12	3.28			221	27.73	4.52			142	31.7	1.41					
	344	27.37	3.49			222	27.85	4.5			118	26.34	0.85					
	151	12.01	3.97			99	12.42	3.03			50	11.16	6.01					
Other drug use, lifetime	183	10.13	10.38	12.53	0.0004		120	10.17	9.17	3.03	0.0814		58	9.63	10.34	10.85	0.001	
	1623	89.87	1.37			1060	89.83	5.28			544	90.37	2.39					
	403	18.88	7.69	9.44	0.0089		279	20.04	7.89	4.18	0.1236		112	15.75	6.25	5.42	0.0666	
	1142	53.49	3.85			738	53.02	4.61			394	55.41	2.03					
Caffeine use	590	27.63	5.08			375	26.94	5.87			205	28.83	2.93					
	431	20.66	10.21	36.85	<0.0001		211	15.62	11.37	17.44	<0.0001		214	30.27	7.48	21.62	<0.0001	
	1655	79.34	3.26			1140	84.38	4.3			493	69.73	1.01					
Sad or hopeless 2+weeks	177	8.3	14.12	35.56	<0.0001		129	9.31	13.95	19.12	<0.0001		41	5.73	9.76	6.52	0.0106	
	1955	91.7	4.04			1257	90.69	4.69			675	94.27	2.67					

Variable	Total Sample						Boys			Girls			p		
	Number of gamers	%	% problematic gamers	X ²	p	Number of gamers	%	% problematic gamers	X ²	p	Number of gamers	%		% problematic gamers	X ²
Carry a weapon	530	24.75	7.74	12.63	0.0004	431	30.85	7.66	5.51	0.019	86	12.04	4.65	0.81	0.369
	1611	75.25	3.91			966	69.15	4.55			628	87.96	2.87		

Table 7

Adjusted odds of reporting problematic gaming, adjusted for race and gender, among video game players

Variable	Category	OR	95% CI	p
Grade average (Ref: A's and B's)	C's	1.08	(0.69, 1.71)	0.7383
	D's and F's	1.14	(0.62, 2.08)	0.6821
Extra-curricular activities	Yes	0.68	(0.44, 1.05)	0.0795
Smoking, lifetime (Ref: Never)	Occasionally	1.36	(0.82, 2.26)	0.2369
	Regularly	2.12	(1.23, 3.64)	0.0066
Marijuana, lifetime	Yes	1.26	(0.82, 1.92)	0.2905
Sip of alcohol, lifetime	Yes	0.93	(0.53, 1.63)	0.7945
Current alcohol frequency (Ref: Never regular)	Light	0.76	(0.36, 1.61)	0.4701
	Moderate	0.76	(0.35, 1.63)	0.4745
	Heavy	0.97	(0.37, 2.51)	0.9449
Other drug use, lifetime	Yes	2.25	(1.26, 4.02)	0.0064
Caffeine use (Ref: None)	1-2 drinks per day	0.51	(0.31, 0.85)	0.0094
	2+ drinks per day	0.7	(0.40, 1.21)	0.198
Sad or hopeless 2+weeks	Yes	3.62	(2.31, 5.65)	<0.0001
Serious fights	Yes	2.97	(1.74, 5.07)	<0.0001
Carry a weapon	Yes	1.65	(1.06, 2.58)	0.0262