

Computer/gaming station use in youth: Correlations among use, addiction and functional impairment

Susan Baer MD PhD¹, Kelly Saran MD¹, David A Green PhD²

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OBJECTIVE: Computer/gaming station use is ubiquitous in the lives of youth today. Overuse is a concern, but it remains unclear whether problems arise from addictive patterns of use or simply excessive time spent on use. The goal of the present study was to evaluate computer/gaming station use in youth and to examine the relationship between amounts of use, addictive features of use and functional impairment.

METHOD: A total of 110 subjects (11 to 17 years of age) from local schools participated. Time spent on television, video gaming and non-gaming recreational computer activities was measured. Addictive features of computer/gaming station use were ascertained, along with emotional/behavioural functioning. Multiple linear regressions were used to understand how youth functioning varied with time of use and addictive features of use.

RESULTS: Mean (\pm SD) total screen time was 4.5 ± 2.4 h/day. Addictive features of use were consistently correlated with functional impairment across multiple measures and informants, whereas time of use, after controlling for addiction, was not.

CONCLUSIONS: Youth are spending many hours each day in front of screens. In the absence of addictive features of computer/gaming station use, time spent is not correlated with problems; however, youth with addictive features of use show evidence of poor emotional/behavioural functioning.

Key Words: *Adolescence; Computer addiction; Internet addiction; Video games*

Over the past 20 years, youth engagement with media has greatly increased. Youth consider media activities, such as social messaging and video games, integral to daily life (1,2). The impact of these computer/gaming station activities on youth development and functioning is unclear. Some Internet activities are associated with intellectual and social stimulation (3) and some video games may improve visual/spatial skills (4). However, as highlighted in a recent Public Broadcasting Service documentary (5), "every hour of life on the screen is an hour spent not in the rest of life ... if we're there, where aren't we?"

In addition to quantity of use, concerns have been raised about addictive use (alternatively described as problematic use or pathological use), which focuses on qualitative features including difficulty controlling use, distress when not using and ongoing use despite knowledge of it causing problems (6-8). Many studies have investigated Internet addiction and found correlations with mental health problems including harm avoidance, low self-esteem, social phobia and depressive symptoms (9-16). Results from longitudinal studies suggest that mental health problems predispose to developing Internet addiction, and that Internet addiction worsens mental health problems (17-19).

L'utilisation de l'ordinateur et des consoles de jeu chez les adolescents : les corrélations entre l'utilisation, la dépendance et l'atteinte fonctionnelle

OBJECTIF : L'utilisation de l'ordinateur et des consoles de jeu est intégrée à la vie des jeunes d'aujourd'hui. La surutilisation demeure une préoccupation, mais on ne sait pas si des problèmes découlent de schèmes d'utilisation dépendants ou simplement d'une durée d'utilisation excessive. La présente étude visait à évaluer l'utilisation de l'ordinateur et des consoles de jeu chez les adolescents ainsi qu'à examiner la relation entre la quantité d'utilisation, les caractéristiques de dépendance et l'atteinte fonctionnelle.

MÉTHODOLOGIE : Les chercheurs ont obtenu la participation de 110 sujets de 11 à 17 ans provenant d'écoles locales. Ils ont mesuré le temps consacré à la télévision, aux jeux vidéo et aux activités informatiques récréatives non liées au jeu. Ils ont vérifié les caractéristiques de dépendance d'utilisation de l'ordinateur et de la console de jeu, de même que le fonctionnement affectif et comportemental. Ils ont fait appel à la régression linéaire multivariée pour comprendre la variation du fonctionnement des adolescents selon la durée d'utilisation et les caractéristiques de dépendance d'utilisation.

RÉSULTATS : Le temps d'écran total moyen s'élevait à $4,5 \pm 2,4$ heures/jour. Les caractéristiques de dépendance d'utilisation étaient constamment corrélées avec une atteinte fonctionnelle démontrée par des mesures multiples et par les informateurs, tandis que la durée d'utilisation, abstraction faite de la dépendance, ne l'était pas.

CONCLUSIONS : Chaque jour, les adolescents passent de nombreuses heures devant un écran. En l'absence de caractéristiques de dépendance à l'égard de l'utilisation de l'ordinateur et des consoles de jeu, le temps consacré n'est pas corrélé avec des problèmes, mais les adolescents qui présentent des caractéristiques de dépendance d'utilisation ont des manifestations de mauvais fonctionnement affectif et comportemental.

While many studies have examined the relationship between computer/gaming station use and mental health problems, the relationship between use and functional impairment is less well understood. Children with pathological gaming habits have been shown to have poorer grades (18), and Internet addiction has been associated with interpersonal problems (20,21), and poor academic and job performance (22). Concern has also been raised about the relationship between exposure to violent video games and aggressive behaviour (23). It remains unclear whether functional impairment is associated primarily with the amount of use (eg, through the displacement of other activities) or whether it is the qualitative 'addictive' features of use that are most associated with impairment.

In the present study, we examined patterns of computer/gaming station use in a general school population, along with measures of emotional and behavioural functioning. We assessed the amounts of use and features of addictive use. The primary hypothesis was that addictive use would be correlated with poorer functioning and that the correlation would be unique to addiction and not simply an effect of time of use. Evidence supporting this hypothesis is found in an earlier study involving a psychiatric clinic population, in which

¹University of British Columbia, British Columbia Children's Hospital; ²University of British Columbia, Vancouver, British Columbia
Correspondence: Dr Susan Baer, British Columbia Children's Hospital, Box 141, 4500 Oak Street, Vancouver, British Columbia V6H 3N1.

Telephone 604-875-2345 ext 7396, fax 604-875-2099, e-mail sbaer@cw.bc.ca
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we found that addictive features of use were correlated with increased psychopathology and functional impairment, whereas time of use, after controlling for addiction, was not (24). Further objectives were to compare previously validated scales of computer/gaming station addiction, including a parental report of addictive use.

METHOD

Participants

Youth were recruited through elementary and secondary public schools in Vancouver (British Columbia) over an eight-month period in 2010. Recruitment was achieved through the use of information flyers for students to take home (elementary schools) and recruitment booths with questionnaire packages for students to take home (secondary schools). The research assistant contacted all parents by telephone to explain the study, and all subjects signed consent or assent forms. The University of British Columbia Research Ethics Board (Vancouver, British Columbia) and the Vancouver School Board approved the study. Inclusion criteria included being between 11 and 17 years of age, and the ability to read English for both youth and parent.

Demographics

Youth and parents completed questionnaires containing demographic information. Information regarding family income and postal code were collected from parents as markers of socioeconomic status (SES). Parents selected among a choice of five income ranges, and a mean imputed family income was calculated using the midpoints of the ranges. Postal code was used to assess for neighborhood effects using the postal code index (ratio of median income within the postal code to Canadian median income) (25). The amount of time youth spent on video gaming, recreational nongaming computer activities and television for weekdays and weekends was estimated by both youth and parent. A weighted average of daily use was calculated. The questionnaire did not distinguish between off- and online gaming.

Measures

Several validated measures assessing the presence of emotional symptoms and the youth's level of functioning were completed. Youth also completed two validated questionnaires assessing addictive features of computer/gaming station use: one focused exclusively on the Internet and one included all types of computer/gaming station use. Measures are described below. No current validated measures examining addictive features of computer/gaming station use based on parent report exist and, thus, proposed questions around addictive use were asked separately of parents to determine whether these correlated with the youth reports.

Strengths and Difficulties Questionnaire (SDQ): Youth and parent completed the self-report SDQ and parent SDQ for youth 11 to 17 years of age. The SDQ is a 25-item validated scale of psychopathology (www.sdqinfo.org) and is used extensively for research and clinical purposes with excellent psychometrics (26). It is composed of five subscales: emotional problems; conduct problems; hyperactivity; peer problems; and prosocial behaviour.

Weiss Functional Impairment Rating Scale-parent (WFIRS-P): Parents completed the WFIRS-P, a validated self-report questionnaire assessing functional impairment in children (www.caddra.ca). The WFIRS-P consists of 50 Likert-style questions about the child's level of functioning in six domains: family; learning and school; life skills; self-concept; social activity; and risky activity (27). Higher scores reflect higher levels of functional impairment. The WFIRS-P has excellent psychometric properties, with Cronbach's alpha >0.9 (27). The life skills section includes a question on excessive computer and television use, which was excluded from the statistical analysis.

Computer/Gaming station Addiction Scale (CGAS): Youth completed the CGAS, a validated self-report questionnaire assessing addictive features of computer/gaming station use (24), based on proposed criteria for Internet addiction for adolescents (28). The CGAS has good psychometric properties with excellent internal consistency (Cronbach's alpha = 0.89) (24). The CGAS consists of eight Likert-style questions, graded on a scale from 1 to 5, assessing preoccupation with computer/gaming station activities; failure to resist the impulse to use; tolerance (increased use needed to feel satisfied); withdrawal (distress when not using, resolving with use); longer than intended use; unsuccessful efforts to cut down; excessive efforts put into trying to use; and continued use despite knowledge of it causing problems. Questions about addictive features are embedded within 16 other questions about the youth's perceptions of positive and negative aspects of computer/gaming station use to minimize the negative halo effect of the scale. Items are summed to create an addiction score.

Internet Addiction Test (IAT): Youth completed the IAT, a validated measure of Internet addiction (29,30), consisting of 20 Likert-style questions (www.netaddiction.com). Items are summed to create a total score. The IAT is possibly the most widely used English language scale of Internet addiction, although it has been validated primarily in adults (31,32) and includes some questions that are inappropriate for children (eg, "How often do you prefer the Internet to intimacy with your partner?"). (One validation study included some youth, but the mean age of the sample was older than 25 years [32].) The IAT has been used previously in children and adolescents in translated versions (33,34). For the present study, the language in five questions was slightly modified to make the questions appropriate for the younger sample. (In question 3, "intimacy with partner" was changed to "spending time with friends in person." In question 7, "Facebook, MSN, etc" was added after "email." In question 8, "job performance and productivity" was changed to "extracurricular activities." In question 11, "anticipating" was changed to "thinking about." In question 14, "late night log-ins" was changed to "staying up late on the Internet.")

Proposed parent computer/gaming station addiction questions: Most proposed criteria for computer/gaming station addiction are based on an individual's subjective experience of use, similar to the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition, text revision* criteria for substance dependence. While many parents report concerns about their child's computer/gaming station use, it is unclear whether their observations about problematic use correlate well with the youth's experience. Therefore, parents were asked to complete eight trial questions that reflected common parental concerns about use, with the goal of comparing these with the two validated self-report measures described above. Parents responded to eight Likert-style questions about their child's use including: child only seems happy when using; child keeps using despite use causing problems; child gets angry when told to stop using; child has neglected other interests since starting to use; child puts a lot of effort into getting to use; child needs to spend more time using now in order to feel satisfied; child tries to hide amount of use; and child is preoccupied with use.

Statistical analysis

Descriptive statistics were calculated for all variables. Multiple linear regressions were performed with total and subscale scores of the WFIRS-P, self-report SDQ and parent SDQ as the dependent variables. Predictor variables included sex, age, gaming time, nongaming computer time, television time and CGAS addiction score. Regression coefficients were calculated showing the associations between predictor variables and youth functioning as shown by the SDQs and WFIRS-P. IAT score was subsequently substituted for the

CGAS score in the regressions to check for concurrence between the two scales. Missing values on the SDQ were imputed as per the SDQ scoring protocol (www.sdqinfo.org). Missing WFIRS-P, IAT and CGAS items were handled the same way. Subjects were dropped for a specific regression if they were missing >2 subscale items, except for the WFIRS-P 'self' subscale which contained only three items and, therefore, all responses were required. This protocol resulted in dropping one subject for the self-report SDQ and parent SDQ regressions, and four subjects for the WFIRS-P regressions. STATA version 9.1 (Statacorp, USA) was used for the statistical analysis. Statistical significance was set at $P < 0.05$.

RESULTS

Sample characteristics are shown in Table 1. The sample size was 110 with a mean (\pm SD) age of 13.8 ± 1.9 years, including 54 females (49.1%) and 56 males (50.9%). All households had at least one computer and Internet access. The mean postal code index was 1.03 ± 0.34 , and the sample showed a broad range of annual family income with approximately 20% in each of the five categories: <\$40,000; \$40,000 to \$60,000; \$60,000 to \$80,000; \$80,000 to \$120,000; and >\$120,000.

Mean youth-reported screen time was 4.5 ± 2.4 h/day, divided up into 1.6 ± 1.7 h/day on gaming, 1.7 ± 1.5 h/day on nongaming recreational computer activities and 1.4 ± 1.1 h/day watching television. Boys reported significantly more gaming time than girls (2.1 ± 2.1 h/day versus 1.0 ± 0.89 h/day, $P < 0.001$). Parent and youth reports of time were similar and no clinically or statistically significant differences were found. SES was not found to have any significant effects. For the regressions, youth estimates of time were used.

The mean value of the CGAS addiction score was 15.4 ± 5.7 and the mean value of the IAT score was 34.3 ± 10.7 . There was excellent correlation between the CGAS score and the IAT score ($r = 0.88$, $P < 0.001$). The proposed parent-observed markers for addiction were also summed for a mean score of 15.1 ± 7.3 . Parent-observed markers showed only moderate correlation with the CGAS score ($r = 0.44$, $P < 0.001$) and the IAT score ($r = 0.44$, $P < 0.001$). Addiction score did not vary significantly according to sex or SES, and did not depend on whether time was spent on gaming or nongaming activities (ie, children who were predominantly gamers were equally likely to show addictive features of use to those predominantly engaged in other activities, such as social networking).

Regression results

Multiple linear regressions showing how self-report SDQ scores are associated with sex, age, gaming time, nongaming time, television time and CGAS addiction scores are shown in Table 2. The CGAS addiction score was significantly correlated with the total SDQ score as well as most subscale scores (ie, subjects with high addiction scores reported higher levels of difficulties. In contrast, neither gaming time nor nongaming time was correlated with any

TABLE 1
Demographics of participants

Participants, n	110
Age, years	13.82 ± 1.93
Female sex, %	49
Postal code index	1.03 ± 0.34
Internet access, %	100

Data presented as mean \pm SD unless otherwise indicated

SDQ subscale, implying no relationship between the two, (ie, for a youth with a given addiction score, the amount of time they spend on the computer/gaming station has no correlation with their functioning).

Multiple linear regressions showing how parent SDQ scores are associated with sex, age, gaming time, nongaming time, television time and CGAS addiction scores are shown in Table 3. Similar to the result for the self-report SDQ, the CGAS addiction score was significantly correlated with the total parent SDQ score as well as all subscale scores (ie, subjects with high addiction scores reported higher levels of difficulties in all domains). Time spent on screens was generally not correlated with impairment based on the parent SDQ, with the exception of a positive correlation between video gaming time and the hyperactivity subscale, implying that parents reported more hyperactivity symptoms in youth who spent more time video gaming.

Multiple linear regressions showing how WFIRS-P scores are associated with sex, age, gaming time, nongaming time, television time and CGAS addiction scores are presented in Table 4. Similar to the result seen with both SDQ scales, the CGAS addiction score was significantly correlated with the total WFIRS-P score as well as most subscale scores (ie, subjects with a high addiction score have greater functional impairment). Time spent on screens was generally not correlated with functional impairment based on the WFIRS-P, with the exception of negative correlations between both poor self-concept and social functioning and nongaming time. This result implies that youth who spent a lot of time on nongaming activities showed better self-concept and better social functioning.

Regressions were rerun for the total scores of the self-report SDQ, parent SDQ and WFIRS-P, substituting the different addiction measures – IAT score and the parent-addiction score – for the CGAS addiction score to check for concurrence between measures. Results for the IAT regressions showed the same pattern as the CGAS regressions, with addiction score being correlated with self-report SDQ ($\beta = 0.31$, $P = 0.003$), parent SDQ ($\beta = 0.39$, $P < 0.001$) and WFIRS-P ($\beta = 0.28$, $P = 0.01$), and no correlations with time of use. Similarly, regressions with parent markers of addiction showed that only the addiction score was correlated with self-report SDQ ($\beta = 0.28$, $P = 0.008$), parent SDQ ($\beta = 0.49$, $P < 0.001$) and WFIRS-P ($\beta = 0.44$, $P < 0.001$), and no correlations with time of use.

TABLE 2

Multiple regression coefficients* showing the associations between predictor variables and adolescent functioning, as measured by the self-report Strengths and Difficulties Questionnaire (SDQ) subscale and total scores (n=109)

Child SDQ	Emotional problems	Conduct problems	Hyperactivity	Peer problems	Prosocial behaviour	Total score
Female sex	0.72 ± 0.38	0.30 ± 0.28	0.45 ± 0.48	-0.083 ± 0.33	0.59 ± 0.37	1.39 ± 0.98
Age	0.13 ± 0.11	0.10 ± 0.11	-0.004 ± 0.10	0.11 ± 0.12	-0.12 ± 0.11	0.11 ± 0.11
Gaming time	-0.13 ± 0.096	-0.058 ± 0.098	-0.028 ± 0.10	0.10 ± 0.10	-0.036 ± 0.10	-0.047 ± 0.096
Nongaming time	0.052 ± 0.11	-0.016 ± 0.11	-0.019 ± 0.11	-0.025 ± 0.12	0.046 ± 0.11	-0.0017 ± 0.085
Television time	0.082 ± 0.092	-0.039 ± 0.095	0.038 ± 0.095	0.081 ± 0.099	0.067 ± 0.097	0.063 ± 0.090
Addiction score (CGAS)	0.24 ± 0.10	0.34 ± 0.10	0.35 ± 0.10	0.11 ± 0.10	-0.021 ± 0.10	0.38 ± 0.096

Data presented as standardized regression coefficients \pm standard error, except female sex, which are nonstandardized, with statistically significant associations shown in bold. *Standardized regression coefficients can be interpreted as the number of SDs the SDQ score would increase, given a 1 SD increase in the predictor variable. CGAS Computer/Gaming station Addiction Scale

TABLE 3
Multiple regression coefficients* showing the associations between predictor variables and adolescent functioning, as measured by the parent-report Strengths and Difficulties Questionnaire (SDQ) subscale and total scores (n=109)

Parent SDQ	Emotional problems	Conduct problems	Hyperactivity	Peer problems	Prosocial behaviour	Total score
Female sex	0.74±0.39	0.18±0.30	-0.27±0.46	-0.50±0.34	0.25±0.39	0.15±1.08
Age	0.16±0.11	0.062±0.11	-0.13±0.11	0.080±0.11	-0.13±0.11	0.041±0.11
Gaming time	0.085±0.10	-0.061±0.10	0.20±0.097	0.098±0.10	0.097±0.098	0.13±0.098
Nongaming time	-0.23±0.12	-0.14±0.11	0.040±0.11	-0.16±0.12	-0.040±0.11	-0.15±0.11
Television time	-0.093±0.096	-0.17±0.094	-0.031±0.091	-0.061±0.095	0.10±0.089	-0.11±0.092
Addiction score (CGAS)	0.26±0.10	0.35±0.10	0.34±0.099	0.21±0.10	-0.33±0.10	0.39±0.098

Data presented as standardized regression coefficients ± standard error, except female sex, which are nonstandardized, with statistically significant associations shown in bold. *Standardized regression coefficients can be interpreted as the number of SDs the SDQ score would increase, given a 1 SD increase in the predictor variable. CGAS Computer/Gaming station Addiction Scale

TABLE 4
Multiple regression coefficients* showing the associations between predictor variables and adolescent functioning, as measured by the Weiss Functional Impairment Rating Scale-parent (WFIRS-P) total and subscale scores (n=106)

WFIRS-P	Family	Learning/school	Life skills	Self-concept	Social activity	Risky activity	Total WFIRS-P
Female sex	1.88±1.01	-0.53±0.70	0.15±0.82	0.58±0.36	0.15±0.54	-0.056±0.41	2.07±2.97
Age	0.0085±0.12	0.16±0.11	0.067±0.11	0.024±0.11	0.051±0.11	0.0032±0.11	0.069±0.11
Gaming time	0.020±0.10	0.059±0.10	-0.018±0.10	0.19±0.096	0.047±0.10	0.020±0.11	0.051±0.10
Nongaming time	-0.18±0.12	-0.0089±0.11	0.00039±0.10	-0.34±0.11	-0.28±0.12	0.038±0.12	-0.15±0.12
Television time	-0.037±0.10	0.16±0.095	0.10±0.092	0.11±0.094	0.070±0.099	0.057±0.097	0.091±0.096
Addiction score (CGAS)	0.29±0.10	0.22±0.10	0.30±0.10	0.36±0.10	0.17±0.10	0.30±0.10	0.35±0.10

Data presented as standardized regression coefficients ± standard error, except female sex, which are nonstandardized, with statistically significant associations shown in bold. *Standardized regression coefficients can be interpreted as the number of SDs the WFIRS-P score would increase, given a 1 SD increase in the predictor variable. CGAS Computer/Gaming station Addiction Scale

DISCUSSION

In the present study, youth reported an average of 4.5 h of screen time per day. This result is similar to findings from other general population studies (35-37) and is significantly less than the approximately 7 h of screen time per day found in youth presenting to psychiatric clinics (24,38). However, it is more than double the 2 h/day limit suggested by American and Canadian guidelines (39,40). Although there are positives associated with media use, high screen time has been associated with a number of problems including obesity, metabolic syndrome, musculoskeletal pain and sleep disruption (36,41-45).

To our knowledge, the present study was the first to directly compare two self-report scales of addictive features of computer/gaming station use. The scales have some differences. The IAT assesses Internet use only while the CGAS also includes 'off-line' computer/gaming station use; all IAT questions contribute to the total score, whereas CGAS scoring questions are embedded within other questions addressing positives and negatives of use. Despite these differences, these two scales showed excellent correlation ($r=0.88$) suggesting that both tap into distinct qualitative features of addictive use.

A unique feature of the present study was the inclusion of parent observations of amount of use and addictive features of use, in contrast to previous studies that relied primarily on self-report. Although child and parent estimates of screen time were similar, proposed parent addiction scores showed only moderate correlation with the youth addiction scores (CGAS and IAT). Youth report relies on a subjective sense of loss of control and some insight into use being problematic (eg, "I'm trying to cut down but I can't"), whereas parent report relies more on observations about the effects of addictive use (eg, "My child gets angry when told to stop using"), thus tapping into different aspects of problematic use. Youth and parent perspectives are thus different but overlapping, and the significant association seen between both parent and youth addiction scores with functional and emotional impairment suggests that both have meaningful perspectives on addictive features of use.

A key finding of the present study was that computer/gaming station addiction is consistently correlated with emotional and functional problems in youth across multiple measures of addiction and impairment as well as multiple informants. Increased computer/gaming station use in the absence of addictive features was generally not correlated with problems, which implies a difference between youth who choose to spend a large amount of their free time on the computer and youth who are unable to control their use. These findings, similar to those previously observed in a psychiatric population (24), suggest that the impairment arises from the qualitative features of addictive use, not simply from displacement of other recreational activities, lending weight to the growing evidence that Internet addiction is a distinct entity associated with both psychiatric and functional problems.

Increased nongaming recreational computer use was associated with better self-concept and social functioning based on the WFIRS-P. Much of nongaming computer time is spent on social networking activities such as 'Facebook' and e-mail, and participation in these activities may help improve social confidence and connectedness. Our data are only correlational and, thus, this may simply reflect that youth with better social functioning use more social networking.

In conclusion, the present study found that youth in a general school population spend far more time on computer/gaming station use than guidelines recommend. Addictive patterns of use were consistently shown to be associated with emotional/behavioural impairment, whereas time, after controlling for addiction, was not, lending weight to the concept of 'Internet addiction' as a distinct entity. This result implies that clinical assessment of youth should include questions about qualitative subjective features of use (eg, "I'm trying to cut down, but I can't"), along with amount of use. Further implications are that interventions that simply restrict the amount of use may be insufficient to address addictive use. Parents and youth had overlapping but distinct perspectives on addiction, and concerns from either parents or youths warrant clinical concern and further investigation.

The present study has several limitations. Because it was cross-sectional, determining causality is not possible. Although we did include handheld gaming devices, the growing importance of smartphone use and texting were not considered in the definition of screen time. Our study relied on parent and self-report of computer/gaming station addictive features, which may be influenced by an individual's insight and beliefs about use. Currently, no gold standard clinician-administered diagnostic tool for assessing

computer/gaming station use exists and further research is recommended to develop such a clinically relevant tool.

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