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Screen time and risk behaviors in 10- to 16-year-old Canadian youth

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ABSTRACT

Objective. To examine television, computer, and video game use as possible determinants of multiple risk behaviors (MRB) among Canadian youth.

Methods. Results are based on the Canadian 2005/06 Health Behaviour in School-Aged Children Survey. This survey included a representative cross-sectional sample of 8215 youth in grades 6–10, and a 1-year longitudinal sample of 1424 youth in grades 9–10. Total hours per week of television, video games, and computer use were calculated and participants were grouped into quartiles. Six risk behavior variables (smoking, drunkenness, non-use of seatbelts, cannabis use, illicit drug use, non-use of condoms) were combined to form a MRB score. Ordinal and repeated measure logistic regression models were used to examine associations between screen time and MRB variables.

Results. High computer use (top quartile) was associated with approximately a 50% increased engagement of MRB in both samples. High television use was also associated with modestly increased engagement in MRB in the cross-sectional sample.

Conclusions. High computer use was the screen time behavior that was mostly strongly and consistently associated with engagement in MRB. Future research is needed to understand the relationship between specific screen time behaviors and adolescent health to help strengthen current screen time guidelines for youth.

Introduction

A large percentage of youth engage in risk taking behaviors (Brener and Collins, 1998). For example, within Canadian youth; 28% of males and 30% of females smoke; 52% of males and 35% of females participate in binge drinking; 38% of males and 39% of females have tried cannabis; 4% of males and females use illicit drugs; and 21% of sexually active males and 51% of sexually active females have had sex without a condom in the past year (Galambos and Tilton-Weaver, 1998; Public Health Agency of Canada, 2008). This is concerning as engagement in risk behaviors may have immediate and long-term consequences on adolescent health such as increased occurrence of psychosomatic health symptoms (Simpson et al., 2006), injury (Pickett et al., 2006), and risk factors for chronic diseases (Jessor, 1991).

Jessor developed a conceptual framework to explain the causes and consequences of risk taking behaviors in adolescents (Jessor, 1991). According to this framework, risk behaviors are not considered separately, rather they occur in clusters of multiple risk behaviors (MRB). The framework conceptualizes the determinants of MRB in order to increase understanding of adolescent risk behaviors and to facilitate the development of prevention and intervention strategies (Jessor, 1991). Screen time (i.e., television, video games, computer) is one potential determinant of adolescent risk taking behavior that fits within Jessor's framework. Bandura's social cognitive theory (Escobar-Chaves et al., 2005) helps to further explain how screen time media can influence adolescents' risk taking behavior within the context of Jessor's framework. A key construct in Bandura's theory is observational learning, which implies that people learn behaviors by observing other people perform them as well as reinforcements they receive for them (Baranowski et al., 2002). Therefore, screen time exposure to violent, sexual, drug or alcohol content may impact adolescents' behavior, particularly given the volume of exposure. For example, the median screen time in 11- to 15-year-old boys and girls in Canada are 4.4 h/day and 3.7 h/day, respectively (Mark et al., 2006).

The widely held, but not uniform conclusion among literature reviews on screen time and risk behaviors is that excessive screen time exposure increases engagement in risk behaviors in youth (Brown and Witherspoon, 2002; Escobar-Chaves et al., 2005; Hogan, 2000; Strasburger and Donnerstein, 1999; Thompson, 2005; Villani, 2001). However, the reviews also highlight important gaps in the literature. One gap is that the majority of research has focused on the impact of television. As the internet and video games have become major components in adolescents' lives, more research is needed to understand the impact of these screen time measures on risk behaviors. Therefore, the purpose of this study was to examine the effects of television, computer, and video game

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use on MRB in youth. We had the opportunity to do so in a representative sample of Canadian youth.

Methods

Participants

The study is based on Canadian records from the 2005/06 *Health Behaviour in School-aged Children Survey* (HBSC). The HBSC is a World Health Organization sponsored cross-sectional survey that consists of a classroom based questionnaire about health behaviors, lifestyle factors, and demographics (Currie et al., 2001). The Canadian sample was designed according to the international HBSC protocol in that a cluster design was used with school class being the basic cluster, the distribution reflected the distribution of Canadians in grades 6–10, and the sample was self-weighted. Approximately 74% of the students selected consented to participate. The total sample consisted of 9672 students from across Canada. We excluded participants who did not respond to the measures of interest, leaving 8215.

In addition to the nationally representative cross-sectional survey, a one year prospective cohort was conducted in a non-representative sub-sample of 3300 grades 9–10 youth from the province of Ontario. Baseline measures were collected between January 2006 and May 2006, with identical follow-up questionnaires being answered 12 months after baseline. A total of 2031 students were successfully linked between the two time points and 1424 students had complete information on the measures of interest.

Ethics approval was obtained from the Queen's University General Research Ethics Board. Consent was obtained from the participating school boards, individual schools, parents, and students. Participation was voluntary.

MRB (Outcome)

Common risk behaviors assessed were current smoking (4 categories: "every day," "at least once a week, but not every day," "less than once a week," and "do not smoke"), lifetime drunkenness (5 categories: "never," "once," "2–3times," "4–10 times," and "$>$10 times"), current use of seatbelts (6 categories: "never travel by car," "usually there is no seat belt where I sit," "always," "often," "sometimes," and "never"), lifetime cannabis use (7 categories: "never," "1–2 times," "3–5 times," "6–9 times," "10–19 times," "20–39 times," and "40 or more times"), lifetime illicit drug use (7 categories: "never," "1–2 times," "3–5 times," "6–9 times," "10–19 times," "20–39 times," and "40 or more times"), and non-use of condoms during most recent sexual intercourse (3 categories: "I have never had sexual intercourse," "yes," and "no") (Currie et al., 2001). Cannabis use, illicit drug use, and condom use were only assessed in grades 9–10 students.

Responses for each item were given a point score based on meaningful cut-points that corresponded with frequency of engagement ("never" = 0, "occasional" = 1, "frequent" = 2). The points were summed for the various items to create a MRB score and this score was grouped into 3 categories: "never" (0 points in all grades), "occasional" (1–3 points in grades 6–8, 1–6 points in grades 9–10), and "frequent "(4–6 points in grades 6–8, 7–12 points in grades 9–10).

We validated the overall fit of the MRB scale in the sample by conducting a confirmatory factor analysis for categorical indicators using M-Plus (version 5, Los Angeles, CA). The comparative fit index (CFI) and the Tucker–Lewis index (TLI) were used to assess the total variance accounted for by the model, where values higher than 0.90 were sought (Klien, 2005). The root mean square error of approximation (RMSEA) was used to assess the residual variance, where values lower than .10 were sought (Klien, 2005). For the MRB scale: CFI = 0.991; TLI = 0.989; and RMSEA = 0.038 indicating excellent properties of fit for the scale.

Screen time (exposure)

The amount of hours spent watching television, playing video games, and using the computer per weekday and weekend were determined using 6 questions (Currie et al., 2001). For each question there were 9 response options: "none at all," "30 min/day," "1 h," "2 h," "3 h," "4 h," "5 h," "6 h," and "7 or more hours a day." Weighted means for weekday and weekend use were used to calculate the total hours per week. Each screen time measure was then split into quartiles. A previous validation study reported that a brief questionnaire used to measure television viewing time, similar to that used in HBSC, was significantly correlated ($r = 0.47$) with television viewing time measured by a weekly detailed log among 11–15 year olds (Schmitz et al., 2004).

Covariates

Demographics

Participants were subdivided into grades 6–8 (primary school) and grades 9–10 (high school). Gender differences were explored.

Physical activity

After being given a definition and common examples of physical activities, participants were asked two questions regarding the number of days they were active for at least 60 min in the past week and a typical week. The responses from the two questions were averaged (Prochaska et al., 2001).

Socioeconomic status (SES)

The family affluence scale was used to assess SES. Participants were divided into 3 categories (low, medium, high) based on 4 indicators of family wealth (car ownership, bedroom sharing, holiday travel, and computer ownership) (Currie et al., 2001).

Family structure

Participants were asked a question about who they lived with most of the time and the following groups were created: both parents, single parent, parent and step parent, and other (Griesbach et al., 2003).

Parent trust and communication

Participants were asked questions on the following domains: ease of talking to mother, ease of talking to father, parents understand me, have happy home life, parents trust me, and what parents think of me is important. There was a 5-point response scale for each question and participants were divided into 3 categories (low, medium, high) based on a summary score (Currie et al., 2001).

Statistical analysis

Analyses were completing using SAS version 9.2 (SAS Institute Inc., Cary, NC). For the cross-sectional sample, ordinal multiple logistic regression models were used to estimate the relative odds of engagement in MRB (occasional or frequent vs. never). Analyses were run separately for grades 6–8 and 9–10 students. For the longitudinal sample, a repeated measure multiple logistic regression model was conducted based on the pre- and post-test measures to calculate the cumulative odds ratios (ORs). Based on assumptions of confounding (Rothman et al., 2008) as well as previous literature on risk behaviors (Galambos and Tilton-Weaver, 1998; Janssen et al., 2007; Pickett et al., 2006; Simpson et al., 2006); grade, gender, physical activity, SES, family structure, and parent trust/communication were considered as potential confounders for the regression models. A backwards deletion procedure was used to select the confounders. Gender and grade were forced into the models as they are known confounders. Physical activity, SES, family structure, parent trust/communication were also entered; and physical activity, SES, family structure were removed based on changes of less than 10% in the main effects (Rothman et al., 2008). Error estimates and 95% confidence intervals (CI) were adjusted for using the SURVEYLOGISTIC (cross-sectional analysis) and GENMOD (longitudinal analysis) procedures to account for the clustering by school class. Because the MRB were not rare outcomes, the ORs obtained from logistic regression do not approximate relative risk. Therefore, rate ratios (RRs) were derived by adjusting the ORs for the proportion of the outcome in the referent groups (P_0) as follows: $RR = OR/((1-P_0)+(P_0 \times OR))$ (Zhang and Yu, 1998).

Results

Participant characteristics are in Tables 1 to 3. The average age of the participants was 12.9 (1.0 SD) years within the grades 6–8 cross-sectional sample, 15.3 (0.6 SD) years within the grades 9–10 cross-sectional sample, and 15.2 (0.6 SD) years within the grades 9–10 longitudinal sample. The median weekly hours of television, computer, and video games were 18, 7, and 7 within the grades 6–8 cross-sectional sample; 16, 14, and 4.5 within the grades 9–10 cross-sectional

Table 1
Participant characteristics for the Canadian 2005/06 Health Behaviour in School-Aged Children Survey.

Variable	Cross-sectional sample Grades 6–8 ($n=4671$)		Cross-sectional sample Grades 9–10 ($n=3544$)		Longitudinal sample Grades 9–10 ($n=1424$)	
	n	Percent	n	Percent	n	Percent
Sex						
Male	2177	46.6	1630	46.0	618	43.4
Female	2494	53.4	1914	54.0	806	56.6
Grade						
6	1429	30.6	–	–	–	–
7	1546	33.1	–	–	–	–
8	1696	36.3	–	–	–	–
9	–	–	1896	53.5	772	54.2
10	–	–	1648	46.5	652	45.8
Parent trust and communication						
Low	1630	34.9	1201	33.9	403	28.3
Medium	1523	32.6	1216	34.3	495	34.8
High	1518	32.5	1127	31.8	526	36.9
Family structure						
Both parents	2966	63.5	2336	65.9	953	66.9
Single parent	817	17.5	588	16.6	222	15.6
Parent and step parent	430	9.2	383	10.8	124	8.7
Other	458	9.8	237	6.7	125	8.8
Socioeconomic status						
Low	439	9.4	305	8.6	103	7.2
Medium	1817	38.9	1414	39.9	588	41.3
High	2415	51.7	1825	51.5	733	51.5
Physical activity						
0–1 h/week	187	4.0	249	7.0	182	12.8
1.5–3 h	930	19.9	829	23.4	355	24.9
3.5–5 h	1569	33.6	1233	34.8	471	33.1
5.5–7 h	1985	42.5	1233	34.8	416	29.2

Table 2
Descriptive information on screen time behaviours for the Canadian 2005/06 Health Behaviour in School-Aged Children Survey.

Variable	25th percentile	50th percentile	75th percentile
Cross-sectional sample: grades 6–8 ($n=4671$)			
Television (h/week)	9.0	18.0	27.0
Computer (h/week)	3.5	7.0	18.0
Video games (h/week)	2.5	7.0	17.0
Cross-sectional sample: grades 9–10 ($n=3544$)			
Television (h/week)	9.0	16.0	25.0
Computer (h/week)	5.0	14.0	23.0
Video games (h/week)	0	4.5	16.0
Longitudinal sample: grades 9–10 ($n=1424$)			
Television (h/week)	13.1	21.0	29.0
Computer (h/week)	9.0	18.0	28.0
Video games (h/week)	1.0	6.5	17.0

sample; and 21, 18, and 6.5 within the grades 9–10 longitudinal sample (Table 2). Within the cross-sectional sample, the prevalence of grades 9–10 youth who occasionally or frequently engaged in MRB was significantly higher than in grades 6–8 youth (Table 3).

The associations between screen time and MRB in the cross-sectional sample are shown in Table 4. For grades 6–8 students, the prevalence of participants who occasionally and frequently engaged in MRB increased across television, computer, and video game quartiles ($P_{trend} \leq 0.01$). For the logistic regression analyses adjusted for confounders, grades 6–8 youth in the highest television (RR = 1.15, 95% CI: 1.09–1.20), computer (RR = 1.29, 95% CI: 1.24–1.34), and video game (RR = 1.09, 95% CI: 1.01–1.56) quartiles were significantly more likely to be occasional multiple risk engagers than youth in the lowest quartiles. Similar observations were made for frequent engagement in MRB, with the exception of video game use.

For the cross-sectional sample of grades 9–10 youth, the prevalence of participants who occasionally and frequently engaged in MRB increased across television and computer quartiles ($P_{trend} \leq 0.02$). There were similar findings for logistic regression analyses that were adjusted for confounders. For example, grades 9–10 youth in the highest television quartile were 30% (95% CI: 9–53%) more likely to frequently engage in MRB and grades 9–10 youth in the highest computer use quartile were 53% (95% CI: 29–77%) more likely to frequently engage in MRB than youth in the lowest quartiles. There was no relationship between video game use and MRB in this age group ($P_{trend} > 0.8$, Table 4).

To confirm the cross-sectional observations, a repeated measures analysis was performed in the longitudinal sub-sample of grades 9–10 youth (Table 5). Youth in the highest computer quartile were 56% (95% CI: 35–76%) more likely to be occasional/frequent multiple risk engagers than youth in the lowest computer quartile.

Discussion

This study examined the effects of television, computer, and video game use on MRB in large cross-sectional and longitudinal samples of youth. High computer use was associated with approximately a 50% increased risk of engagement in MRB both samples. High television use was also associated with modestly increased engagement in MRB in the cross-sectional sample. Video game was not related to MRB in either sample.

Our findings are consistent with literature reviews on screen time and risk behaviors in youth which have concluded that screen time exposure to advertising, violent, sexual, drug or alcohol related content influences behaviors (Brown and Witherspoon, 2002; Escobar-Chaves et al., 2005; Hogan, 2000; Strasburger and Donnerstein, 1999; Thompson, 2005; Villani, 2001). This conclusion is consistent with the concept of observational learning in Bandura's social cognitive theory (Baranowski et al., 2002).

The majority of previous research on the impact of screen time exposure on MRB has focused on television. By examining the impact of videogame and computer use, the present study addresses a meaningful gap. Interestingly, we found that high computer use was the screen time behavior that was mostly strongly and consistently associated with engagement in MRB. This finding may be explained by more established censorship protocols (i.e., rating systems, warnings, etc.) for television, movies, and video games than for internet use on the computer (Brown and Witherspoon, 2002). Although parents can place controls on internet usage in their homes, most youth are more computer savvy then their parents (Villani, 2001). The internet provides access to pornography and other sexual content (Brown and Witherspoon, 2002) as well as advertising for alcohol and tobacco (Brown and Witherspoon, 2002; Escobar-Chaves et al., 2005). In addition, the internet can serve as an information source for various health behaviors, and the information that is provided is not always accurate (Brown and Witherspoon, 2002).

This study provides information on the dose–response relationship between screen time and MRB, which has implications on screen time guidelines. Both American and Canadian pediatric associations recommend a maximum of 2 h of screen time per day for children and adolescents (American Academy of Pediatrics, 2001; Nieman, 2003). Although participants within the 2nd to 4th quartiles of screen time in our sample exceeded these guidelines, in most cases clinically and statistically significant increased risks of MRB were only observed in the last quartiles. This suggests that the current screen time guidelines do not accurately coincide with significant increases in MRB. It should also be noted that the current guidelines focus on overall screen time; they are not specific to different types of screen time behaviors. The

Table 3
Prevalence (%) of engagement in MRB for the Canadian 2005/06 Health Behaviour in School-Aged Children Survey.

Variable	Cross-sectional			Cross-sectional			Longitudinal [a]		
	Grades 6–8 ($n=4671$)			Grades 9–10 ($n=3544$)			Grades 9–10 ($n=1424$)		
	Never	Occasional	Frequent	Never	Occasional	Frequent	Never	Occasional	Frequent
MRB scale	62.1	33.2	4.7	35.6	54.0	10.4[b]	30.6	57.7	11.7
Smoking	93.7	4.6	1.7	85.2	9.7	5.1[b]	86.0	9.0	5.0
Drunkenness	83.2	8.4	8.4	52.7	14.7	32.6[b]	41.2	13.7	45.1 [c]
Non-use of seatbelts	70.6	17.7	11.7	66.4	20.8	12.8[b]	71.6	19.1	9.3 [c]
Cannabis use	–	–	–	66.6	9.7	23.7	57.9	9.1	33.0 [c]
Other drug use	–	–	–	83.8	9.8	6.4	83.5	8.6	7.9
Non-use of condoms	–	–	–	78.6	16.2	5.2	72.2	20.4	7.4

[a] Based on the measures obtained in the follow-up survey.
[b] Significant differences in MRB between the cross-sectional grades 6–8 sample and the cross-sectional grades 9–10 sample ($p<0.05$).
[c] Significant differences in MRB between the cross-sectional grades 9–10 sample and the longitudinal grades 9–10 samples ($p<0.05$).

present study indicates that different types of screen time behaviors have different implications for health in adolescents. Therefore, future research should examine specific screen time behaviors and adolescent health in an effort to strengthen the evidence informing screen time guidelines.

Study limitations and strengths

In addition to examining different screen time behaviors, strengths of this study include the large population-based sample that is representative of Canadian adolescents and the use of a confirmatory longitudinal analysis. Limitations of the study include the use of self-report data on both the screen time and MRB measures. The responses may have been biased to provide socially desirable responses, which may have resulted in over or under estimates of the true associations. Finally, the HBSC survey did not assess the specific content that participants were exposed to during their screen time engagement.

Conclusion

Excessive screen time use, especially computer use, was a determinant of engagement in MRB in youth. These findings suggest that consideration should be given to limiting excessive computer use. Also, further research is needed to understand the impact of specific screen time behaviors on the health of adolescents to help strengthen current screen time guidelines.

Conflict of interest statement
The authors declare that there are no conflicts of interest.

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Table 4
Prevalence (%) and rate ratios (95% CI) for engagement in MRB in the cross-sectional sample according to television, computer, and video game use within the Canadian 2005/06 Health Behaviour in School-Aged Children Survey.

Screen time measure	Grades 6–8				Grades 9–10			
	Occasional ($n=1549$)		Frequent ($n=218$)		Occasional ($n=1910$)		Frequent ($n=369$)	
	Prevalence	RR (95% CI)	Prevalence	RR (95% CI)	Prevalence	RR (95% CI)	Prevalence	RR (95% CI)
Television								
Quartile 1	22.2	1.00	24.8	1.00	26.1	1.00	25.2	1.00
Quartile 2	20.7	1.01 (0.95–1.08)	16.5	0.86 (0.69–1.03)	22.4	1.06 (0.91–1.21)	23.6	1.14 (0.91––1.38)
Quartile 3	27.2	1.10 (1.04–1.16)	22.5	0.96 (0.81–1.10)	28.2	1.13 (1.01–1.26)	24.7	1.09 (0.89–1.31)
Quartile 4	29.9	1.15 (1.09–1.20)	36.2	1.15 (1.02–1.26)	23.3	1.17 (1.03–1.32)	26.5	1.30 (1.09–1.53)
	$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}=0.02$	$P_{trend}=0.02$	$P_{trend}=0.01$	$P_{trend}<0.01$	$P_{trend}=0.01$
Computer								
Quartile 1	24.4	1.00	19.3	1.00	16.9	1.00	17.6	1.00
Quartile 2	21.9	1.07 (1.00–1.13)	18.8	1.08 (0.90–1.23)	22.0	1.16 (1.01–1.30)	21.9	1.11 (0.89–1.37)
Quartile 3	26.6	1.19 (1.13–1.24)	22.5	1.18 (1.00–1.29)	28.7	1.26 (1.11–1.40)	23.6	1.07 (0.84–1.30)
Quartile 4	27.1	1.29 (1.24–1.34)	39.4	1.39 (1.30–1.46)	32.4	1.52 (1.37–1.67)	36.9	1.53 (1.29–1.77)
	$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}=0.01$	$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}<0.01$
Video games								
Quartile 1	20.4	1.00	19.7	1.00	32.9	1.00	31.7	1.00
Quartile 2	22.7	1.01 (0.93–1.08)	21.1	1.03 (0.86–1.18)	20.5	0.91 (0.79–1.04)	23.3	1.08 (0.89–1.29)
Quartile 3	27.6	1.01 (0.93–1.08)	26.2	1.02 (0.81–1.17)	21.8	0.89 (0.77–1.03)	22.8	1.01 (0.79–1.23)
Quartile 4	29.3	1.09 (1.01–1.56)	33.0	1.14 (0.99- 1.27)	24.8	1.01 (0.87–1.14)	22.2	1.01 (0.79–1.25)
	$P_{trend}<0.01$	$P_{trend}=0.02$	$P_{trend}=0.01$	$P_{trend}=0.67$	$P_{trend}=0.55$	$P_{trend}=0.88$	$P_{trend}=0.97$	$P_{trend}=0.97$

RR (95% CI) = rate ratio (95% confidence interval). Rate ratios were adjusted for sex, grade, and parent trust and communication.

Table 5
Prevalence and repeated measures cumulative rate ratios (95% confidence intervals) for engagement in MRB in the longitudinal sample according to television, computer, and video game use within the Canadian 2005/06 Health Behaviour in School-Aged Children Survey.

Screen time measure		Prevalence [a]	Prevalence [a]	Cumulative
		Occasional	Frequent	RR (95% CI)
		($n=818$)	($n=164$)	($n=982$)
Television	Quartile 1	23.5	24.4	1.00
	Quartile 2	25.8	26.8	1.07 (0.92–1.24)
	Quartile 3	26.5	24.4	1.14 (0.97–1.32)
	Quartile 4	24.2	24.4	1.11 (0.93–1.30)
		$P_{trend}=0.55$	$P_{trend}=0.36$	$P_{trend}=0.19$
Computer	Quartile 1	25.3	22.7	1.00
	Quartile 2	20.8	22.1	1.18 (1.01–1.35)
	Quartile 3	26.3	20.1	1.31 (1.14–1.49)
	Quartile 4	27.6	35.1	1.56 (1.35–1.76)
		$P_{trend}<0.01$	$P_{trend}<0.01$	$P_{trend}<0.01$
Video Games	Quartile 1	28.0	24.4	1.00
	Quartile 2	24.1	22.5	0.92 (0.80–1.11)
	Quartile 3	24.4	29.3	0.94 (0.80–1.13)
	Quartile 4	23.5	23.8	0.98 (0.81–1.17)
		$P_{trend}=0.04$	$P_{trend}=0.66$	$P_{trend}=0.88$

[a] Based on the follow-up survey RR (95% CI) = rate ratio (95% confidence interval). Cumulative rate ratios were adjusted for sex, grade, and parent trust and communication.

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