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ORIGINAL ARTICLE

Screen time and physical violence in 10 to 16-year-old Canadian youth

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Abstract
Objectives To examine the independent associations between television, computer, and video game use with physical violence in youth.
Methods The study population consisted of a representative cross-sectional sample of 9,672 Canadian youth in grades 6–10 and a 1-year longitudinal sample of 1,861 youth in grades 9–10. The number of weekly hours watching television, playing video games, and using a computer was determined. Violence was defined as engagement in ≥2 physical fights in the previous year and/or perpetration of ≥2–3 monthly episodes of physical bullying. Logistic regression was used to examine associations.
Results In the cross-sectional sample, computer use was associated with violence independent of television and video game use. Video game use was associated with violence in girls but not boys. Television use was not associated with violence after controlling for the other screen time measures. In the longitudinal sample, video game use was a significant predictor of violence after controlling for the other screen time measures.
Conclusions Computer and video game use were the screen time measures most strongly related to violence in this large sample of youth.

Keywords Adolescent · Violence · Television · Video games · Computer · HBSC

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Introduction

In 2002 the World Health Organization released the first global report on violence and health (World Health Organization 2002). The report highlighted that violence by young people is one of the most visible forms of violence in society. The consequences of youth violence include death, disability, illness, and a reduced quality of life. Youth violence adds greatly to the costs of several essential services such as health care, welfare, and police. One of the recommendations within the report is that more scientific research should be conducted on the patterns and causes of youth violence to assist in the development of more effective responses to the problem (World Health Organization 2002).

The influence of screen time behaviors such as television viewing and video games use on violent behaviors within youth has been extensively studied over the past few decades. The study results have been summarized in a series of narrative literature reviews (Bushman and Anderson 2001; Olson 2004; Browne and Hamilton-Giachritsis 2005; Huesmann 2007) and meta-analyses (Ferguson 2007; Ferguson and Kilburn 2009), a sample of which are referenced here. While some of these reviews have concluded that excessive exposure to violence during

screen time may alter real-life behaviors, others have argued that methodological issues (e.g., use of unreliable measures) in many of the published studies have led to false conclusions about these associations.

One methodological issue that has been poorly addressed in previous studies is the consideration of different screen time measures. First, while computer use outside of video games represents a significant and growing screen time component (Mark et al. 2006), the effects of this screen time component on violence has not been well studied. Second, we are aware of only two studies that have simultaneously examined the effect of more than one screen time measure on violence (Kuntsche 2004; Ferguson et al. 2009). The results from these studies suggest that television does not influence violent behaviors after control for video games. Further research is needed to clarify the role of different screen time measures on violence within young people.

The purpose of this study was to examine the independent effects of television, computer, and video game use on physical violence in youth. We had the opportunity to explore these relationships using existing population health data obtained on a large and representative sample of Canadian youth in grades 6–10.

Methods

Study population

Results are based on the Canadian records from the 2005/06 World Health Organization Health Behaviour in School-Aged Children Survey (HBSC). The HBSC is a cross-sectional survey from 41 countries (Currie et al. 2008). The survey consisted of a classroom-based questionnaire. The sample was designed according to the international HBSC protocol in which a cluster design was used with the school class being the basic cluster, the distribution of the students reflected the distribution of Canadians in grades 6–10, and the sample was self-weighted. Samples were selected to represent distributions of schools by size, location, language, and religion. Approximately 74% of the students selected consented to participate and completed the questionnaire. The total sample consisted of 9,672 youth from 188 schools across the country. Students who did not respond to the measures of interest were excluded, leaving a total of 8,881.

In addition to the nationally representative cross-sectional survey, a 1 year prospective cohort study was conducted in a non-representative subsample of 2,031 grade 9 and 10 youth from 15 high schools in the province of Ontario. The students in the prospective cohort study were also part of the national cross-sectional survey, and the 15 schools that were selected were done so based on convenience. Only 1,861 of these 2,031 students completed both the baseline and follow-up questionnaires (which were identical), and had complete information on the necessary study variables to be included in this study.

The Canadian HBSC was approved by the Queen's University General Research Ethics Board. Consent was obtained from the participating school boards, individual schools, parents, and students.

Screen time

The amount of time spent watching television, playing video games, and using the computer was determined using the following questions: "About how many hours a day do you usually watch television (including videos and DVDs) in your free time?", "About how many hours a day do you usually play video games on a computer or games console (Playstation, Xbox, GameCube, etc.) in your free time?" and "About how many hours a day do you usually use a computer for chatting on-line, internet, emailing, homework, etc., in your free time?". For each questions the response options were "none at all", "about half an hour a day", "about 1 h a day", "about 2 h a day", "about 3 h a day", "about 4 h a day", "about 5 h a day", "about 6 h a day", or "about 7 or more hours a day". Questions were asked for both weekday and weekend use, and weighted means were used to calculate the total hours per week of each screen time measure. For these calculations, students who responded "not at all" were assigned value of 0 and students who responded "about 7 or more hours a day" were assigned value of 7 h. A previous validation study reported that television time in youth is only underestimated by 0.09 h/week week (Schmitz et al. 2004). Furthermore, simple questionnaire measures of television use, such as those obtained in the HBSC, are correlated ($r = 0.47$) with television time measured by a detailed log (Schmitz et al. 2004).

Violence

Participants reported two measures of physical violence: (1) frequency of physical fighting in the previous 12 months, and (2) frequency of physical bullying of another student(s) in the past couple of months. The fighting measure was originally developed for the Youth Risk Behavior Survey, whose authors reported a high test–retest reliability for this item (Kappa 68.2%) (Brener et al. 1995). The physical bullying measure was conceived by Olweus who reported high internal consistency reliabilities at the classroom level (0.80–0.90) during developmental analyses (Olweus 1992). A composite measure of physical violence, defined as engagement in at least two episodes of

physical fighting in the previous 12 months and/or reporting the perpetration of at least 2–3 episodes per month of physical bullying, comprised the primary outcome for this study (Pickett et al. 2009).

Covariates

Participants were divided into grades 6–8 (primary school) and grades 9–10 (high school) categories to denote age differences. Gender differences were also explored. The Family Affluence Scale is used as the measure of socio-economic status in the HBSC. The three groups (low, medium, or high) were developed based on four indicators of family wealth (car ownership, bedroom sharing, holiday travel, and computer ownership) (Currie et al. 2001, 2008). Participants were asked a question about who they lived with most of the time, and their responses were used to create a family structure variable (both parents, single parent, parent + step parent, other). Finally, a continuous parent trust/communication variable was created based on answers to six questions, each of which had a 5-point response scale (ease of talking to mother, ease of talking to father, parents understand me, have happy home life, parents trust me, what parents think of me is important).

Statistical analysis

Analyses were completed using SAS version 9.1 (SAS Institute Inc., Cary, NC). For the longitudinal sample the screen time measures were based on the baseline survey and the violence outcome was based on the follow-up survey. Relations between screen time measures were examined using Spearman correlations. Differences in the proportion of youth engaging in violence according to quartiles of the screen time measures were examined using χ^2 and multivariate logistic regression. The logistic models were adjusted for the family affluence scale, family structure, parent trust/communication; gender and grade were also controlled for in the non-stratified models. To account for clustering by school classes, the SURVEYLOGISTIC procedure was used to estimate sampling errors. Strengths of association were estimated by the odds ratio (OR) and 95% confidence intervals (CI). All p values <0.05 were considered to be statistically significant.

Results

Descriptive characteristics of the cross-sectional and longitudinal samples are shown in Table 1. For both samples,

Table 1 Descriptive characteristics of the 2005/06 Canadian health behaviour in school-aged children survey

Variable	Cross-sectional sample (n = 8,881)		Longitudinal sample (n = 1,861)	
	N	Percent	N	Percent
Sex				
Male	4,116	46.4	809	43.8
Female	4,765	53.7	1,040	56.3
Grade				
6	1,491	16.8	–	–
7	1,621	18.3	–	–
8	1,778	20.0	–	–
9	2,131	24.0	1,016	55.0
10	1,860	20.9	833	45.1
Family affluence scale				
Low	806	9.1	133	7.2
Moderate	3,494	39.3	763	41.3
High	4,581	51.6	953	51.5
Family Structure				
Both parents	6,061	68.3	1,354	73.2
Parent + step parent	911	10.3	173	9.4
Single parent	1,604	18.1	296	16.0
Other	305	3.4	26	1.4
Violent and aggressive behaviors				
Frequent physical bullying	321	3.6	57	3.1
Frequent physical fighting	1,216	13.7	132	7.1
Physical bullying or fighting	1,366	15.4	174	9.4

Table 2 Descriptive information on screen time behaviours in the 2005/06 Canadian health behaviour in school-aged children survey

Variable	25th percentile	50th percentile	75th percentile
Cross-sectional sample (n = 8,881)			
Television (h/wk)	9	17	26
Computer (h/wk)	3.5	9	21
Video games (h/wk)	1	7	16
Longitudinal sample (n = 1,861)			
Television (h/wk)	9	16	25
Computer (h/wk)	6.5	14	23
Video games (h/wk)	0	4.5	14

slightly more than half of the participants were girls. 15.4% of the grade 6–10 cross-sectional sample and 9.4% of the grade 9–10 longitudinal sample were frequently engaged in violence (physical bullying or fighting). As shown in Table 2, the median weekly screen time values were 17 h for television, 9 h for computer, and 7 h for video games in the cross-sectional sample. The corresponding values were 16 h, 14 h, and 4.5 h for the longitudinal sample.

Within the cross-sectional sample, the three screen time measures were modestly but significantly ($p < 0.01$) correlated with each other in a positive manner ($r = 0.21$ for television versus computer, $r = 0.31$ for television versus video games, $r = 0.21$ for computer versus video games). Similar observations were made in the longitudinal sample ($r = 0.20$, 0.25, and 0.13).

As shown in Table 3, the prevalence of girls attending elementary schools (grades 6–8) who regularly engaged in violence increased across television viewing quartiles. No associations between television and violence were observed in high school youth (grades 9–10) or boys attending elementary school. Conversely, high computer use was associated with a higher prevalence of violence within all gender and grade subgroups (Table 3). For instance, 12.4% of high school girls who were in the highest computer use quartile engaged in violence compared to 6.7% of high school girls who were in the lowest computer use quartile. Finally, for girls and elementary school boys, video game use was associated with engagement in violence (Table 3).

In the next analyses, the three screen time behaviors were included within the same regression models to determine their independent associations with violence (Table 4). The general pattern of results within each of the gender and grade subgroups suggested that high computer use was associated with an increased relative odds of engagement in violence independent of television and video games. Conversely, television use was not associated with violence after controlling for the other two screen time measures. Video game use was only associated with violence in girls.

To confirm the cross-sectional observations, the analyses were repeated in the longitudinal sample of grade 9 and 10 youth (Table 5). Due to the smaller sample size, the longitudinal analyses were not performed separately within

Table 3 Prevalence (%) of violence according to screen time in the cross-sectional 2005/06 Canadian health behaviour in school-aged children survey

Screen time behavior	Elementary school youth (grades 6–8)		High school youth (grades 9–10)	
	Males (n = 2,282)	Females (n = 2,608)	Males (n = 1,834)	Females (n = 2,157)
Television				
Quartile 1	26.1	10.6	17.9	8.8
Quartile 2	21.0	9.7	16.1	7.9
Quartile 3	24.2	11.3	13.6	9.0
Quartile 4	24.5	16.6	20.0	10.7
	$p_{trend} = 0.42$	$p_{trend} < 0.01$	$p_{trend} = 0.32$	$p_{trend} = 0.10$
Computer				
Quartile 1	23.3	9.4	14.5	6.7
Quartile 2	17.6	8.7	17.1	6.6
Quartile 3	25.3	13.8	13.5	10.6
Quartile 4	29.2	16.7	22.2	12.4
	$p_{trend} < 0.01$	$p_{trend} < 0.01$	$p_{trend} < 0.01$	$p_{trend} < 0.01$
Video games				
Quartile 1	22.3	10.6	18.6	7.8
Quartile 2	23.5	9.4	13.9	4.3
Quartile 3	22.7	11.9	17.3	9.0
Quartile 4	27.5	16.2	17.8	12.5
	$p_{trend} = 0.03$	$p_{trend} < 0.01$	$p_{trend} = 0.45$	$p_{trend} < 0.01$

Table 4 Multivariate associations between screen time behaviors and violence in the cross-sectional 2005/06 Canadian health behaviour in school-aged children survey

Screen time behavior	Elementary school youth [OR (95% CI)]		High school youth [OR (95% CI)]	
	Males (n = 2,282)	Females (n = 2,608)	Males (n = 1,834)	Females (n = 2,157)
Television				
Quartile 1	1.00	1.00	1.00	1.00
Quartile 2	0.74 (0.58–0.96)	0.84 (0.59–1.20)	0.90 (0.63–1.28)	0.88 (0.59–1.31)
Quartile 3	0.82 (0.63–1.06)	0.93 (0.66–1.32)	0.69 (0.48–0.98)	1.02 (0.68–1.54)
Quartile 4	0.77 (0.58–1.03)	1.33 (0.95–1.87)	1.03 (0.72–1.47)	1.09 (0.75–1.58)
	$p_{trend} = 0.21$	$p_{trend} = 0.07$	$p_{trend} = 0.99$	$p_{trend} = 0.76$
Computer				
Quartile 1	1.00	1.00	1.00	1.00
Quartile 2	0.68 (0.50–0.92)	0.84 (0.57–1.24)	1.22 (0.83–1.80)	1.05 (0.69–1.60)
Quartile 3	1.05 (0.80–1.38)	1.25 (0.83–1.88)	0.89 (0.58–1.38)	1.59 (1.03–2.47)
Quartile 4	1.21 (0.93–1.57)	1.32 (0.87–1.99)	1.63 (1.08–2.45)	1.51 (1.16–2.76)
	$p_{trend} = 0.03$	$p_{trend} = 0.06$	$p_{trend} = 0.07$	$p_{trend} < 0.01$
Video games				
Quartile 1	1.00	1.00	1.00	1.00
Quartile 2	1.15 (0.86–1.53)	1.07 (0.72–1.57)	0.72 (0.50–1.04)	0.61 (0.23–1.66)
Quartile 3	1.06 (0.81–1.39)	1.34 (0.95–1.88)	0.89 (0.60–1.33)	1.41 (0.90–2.20)
Quartile 4	1.27 (0.98–1.65)	1.44 (1.02–2.04)	0.77 (0.53–1.13)	1.49 (1.01–2.21)
	$p_{trend} = 0.10$	$p_{trend} = 0.02$	$p_{trend} = 0.48$	$p_{trend} = 0.03$

All odds ratios were adjusted for the family affluence scale, family structure, parent trust/communication, and the other screen time behaviors

OR (*95% CI*) odds ratio (95% confidence interval)

males and females. In the multivariate analysis, video game use remained a statistically significant predictor of violence after controlling for the other screen time measures.

Discussion

Main findings

The purpose of this study was to examine the independent relations between different screen time measures and physical violence in youth. Computer and video game use were independently related to increased engagement in violence in most of the age and gender groups examined; however, the magnitude of effect for these relations was relatively small. Regardless of age and gender, television viewing was not related to violence after consideration of time spent on the computer and watching video games.

What is already known

The vast majority of previous studies examining the relation between screen time and violence in youth have limited their analyses to television alone or video games alone (refer to recent literature reviews (Bushman and Anderson 2001; Olson 2004; Browne and Hamilton-Giachritsis 2005; Huesmann 2007)). The results from many (but not all) of these studies have suggested that excessive exposure to violence during television may alter real-life behaviors. However, the methodological rigor of this literature has been questioned by some experts in the field (Olson 2004; Ferguson and Kilburn 2009) who do not support the conclusion that exposure to media violence leads to aggressive behavior.

We are aware of two previous studies that have examined the independent relations between different screen time measures and violence in youth (Kuntsche 2004; Ferguson et al. 2009). One of these studies was based on the 1998 HBSC conducted in Switzerland (Kuntsche 2004). Because the 1998 HBSC questionnaire did not assess computer use, this screen time measure was not considered. Within that study, high television viewing and video game use were each associated, in univariate analyses, with an increased odds that the participants had hit another student(s) in recent months. However, in the multivariate analysis, video games use but not television use was associated with hitting other students in girls; neither screen time measure was independently associated with hitting other students in boys. A second study, conducted in a sample of 603 predominately Hispanic children (aged 10–14 years) from the state of Texas, measured exposure to television and video game violence as they related to an array of child and parental reported violent and aggressive behaviors (Ferguson et al. 2009). This cross-sectional study reported that television violence was not independently related to any of the seven outcome variables measured. Video game use was related to the bullying behavior outcome only, and the effect size for this

Table 5 Associations between screen time behaviors and violence in the longitudinal 2005/06 Canadian health behaviour in school-aged children survey

Screen time behavior	Prevalence (%)	OR (95% CI)[a]
Television		
Quartile 1	9.1	1.00
Quartile 2	7.8	0.84 (0.53–1.34)
Quartile 3	8.2	0.80 (0.49–1.30)
Quartile 4	12.4	1.13 (0.73–1.76)
	$p_{trend} = 0.04$	$p_{trend} = 0.44$
Computer		
Quartile 1	8.6	1.00
Quartile 2	6.7	0.72 (0.43–1.20)
Quartile 3	8.8	0.89 (0.57–1.40)
Quartile 4	13.8	1.31 (0.83–2.07)
	$p_{trend} < 0.01$	$p_{trend} = 0.13$
Video Games		
Quartile 1	7.4	1.00
Quartile 2	7.4	1.10 (0.65–1.85)
Quartile 3	8.7	1.34 (0.84–2.13)
Quartile 4	13.7	1.93 (1.27–2.93)
	$p_{trend} < 0.01$	$p_{trend} < 0.01$

OR (*95% CI*) odds ratio (95% confidence interval)

[a] Multivariate odds ratios were adjusted for grade, gender, family affluence scale, family structure, parent trust/communication, and the other screen time behaviors

relationship was fairly small. Thus, relatively consistent findings were made in the 1998 Swiss HBSC, the study of Hispanic children from Texas, and the 2006 Canadian HBSC that are reported here. The similarity of observations made in these different samples implies that our study findings may be generalizable to other countries and cultures.

What this study adds

To our knowledge, this is the first study to simultaneously consider the influence of the three primary screen time behaviors—television, video games, and computers—on engagement in physical violence in youth. We found that the modest associations that existed between television viewing and engagement in violence within the longitudinal sample and the grade 6–8 female cross-sectional sample, were no longer statistically or clinically meaningful after control for computer and video game use. This is an important observation for two reasons. First, while the time youth spend watching television has remained stable in recent years (Marshall et al. 2006), video game and computer use are increasing (Janssen 2008). Thus, the two screen time components that were independently related to violence in most of the age and gender subgroups examined in this study are accounting for an increasingly greater percentage of total screen time. Second, the findings suggest that recent studies examining the influence of television on engagement in violence were methodologically flawed. Other screen time measures should have been used as covariates in these studies. While computer and video game use were independently related to violence in this study, it is important to note that these effects (e.g., odds ratios of 1.21–1.93 in most extreme screen time categories) would be considered small to modest in magnitude by epidemiological standards (Oleckno 2002).

An interesting question to ask, given the main findings of this study, is why computer and video game use independently predicted engagement in physical violence in most of the age and gender groups examined while television use did not. Although speculative, we suggest there may be greater parental control over television viewing relative to computer and video game use. Additional research is needed to address this question. Future research should also explore whether the implementation of more stringent policies and laws around the violent content that can be provided to young people in these entertainment media have a resultant change in their violent and aggressive behaviors.

The results from this study provided some insight into the dose–response relation between screen time and violence. Current guidelines from the American Academy of Pediatrics (American Academy of Pediatrics 2001) and the Canadian Paediatrics Society (Canadian Paediatric Society 2003) are that youth be exposed to no more than 2 h/day of screen time, which equates to 14 h per week. This volume of screen time was around the 20th percentile in the sample studied here, implying that quartiles 2 through 4 exceeded the screen time guidelines. In the majority of instances, we did not observe statistical or clinically significant increased odds of violence in the second or third quartiles for the different screen time measures. This suggests, at least in relation to the impact that screen time may have on violence, that current screen time guidelines may be overly restrictive. Future studies need to more closely examine the dose–response relation between screen time and a variety of health measures. These types of results would provide the evidence base that could be used to inform revisions to the current screen time guidelines.

Strengths and limitations

The strengths of this study include the use of a large and representative study sample, the confirmation of the cross-sectional findings in the longitudinal subsample, and the consideration of the three primary screen time behaviors. As with any study, this study was not without its

limitations. Although the HBSC questionnaire items have been validated, the study measures were based on self-report and this may have biased the observed associations. There were a number of potential covariates (e.g., family violence, peer influence, depression) that we were not able to control for in the analyses given their unavailability in the HBSC dataset. Finally, the HBSC questions only inquired about the volume of screen time. There was no assessment of the violent content that the participants were exposed to, and it is not certain that a higher screen time volume was associated with a higher exposure to screen time violence.

Conclusions

The findings from this large and representative sample of Canadian youth suggest that excessive computer and video game use have a weak to modest impact on increasing physical violence in youth. Television use was not independently related to physical violence. These findings underscore the importance of considering different forms of screen time.

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Conflict of interest The authors declare that they have no competing interests.

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