

Electronic screen use and mental well-being of 10–12-year-old children

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Background: Today's children spend a great deal of time viewing electronic screen material, but the consequences of such behaviors, if any, are unknown. This study sought to identify (i) the magnitude of total daily electronic screen time and (ii) the relations between electronic screen use and mental well-being indicators, in a sample of 10–12-year-old children. **Methods:** We analysed cross-sectional, population-based data of 10–12-year-old children from the 2007 *Youth in Iceland* school survey ($n = 10\,829$, response rate: 81.7%, boys: 50.5%). Logistic regression models with odds ratios and 95% confidence intervals were conducted to assess the odds of each selected mental well-being indicator, depending on the number of daily hours spent on each electronic screen-based activity. All analyses were conducted separately for boys and girls and adjusted for family structure. **Results:** The prevalence of self-reported screen use of 4 hours per day or more ranges from 2.8% to 6.6% among boys and from 1.0% to 3.8% among girls. All five screen-based activities were significantly associated with all seven well-being indicators ($P < 0.001$) with symptoms being more common with increased time spent on screen use. **Conclusions:** This study is the first of its kind to demonstrate a dose-response relationship between electronic screen use and mental well-being in 10–12-year-old children. Further research is needed to assess the validity and potential implications of these findings.

Introduction

In recent years, electronic screen media use has increased greatly among children in developed countries.^{1–4} Some studies have shown that increased screen use among children is related to more time spent at home and sedentary behaviour, but decreased communal or family activities.^{5–9} Computer game playing and television viewing have been found to be the most popular screen media activities among children.^{3,4} A study conducted by the Kaiser Family Foundation in the USA found that children aged >8 years spend an average of 6.43 hours per day on electronic media.¹⁰ Another study showed that nearly one-half (47%) of American children spend >2 hours per day on various types of sedentary screen viewing.¹¹

Some studies have demonstrated a positive effect of computer and Internet usage on children's self-conceptualization and socialization through increased opportunities for playing, communicating and learning.^{6,12} In addition, positive benefits of video game playing have been suggested, including improvements in reaction time, self-esteem and socialization in children.¹³ Such outcomes are contrary to the negative aspects more commonly associated with video game playing, such as aggression, arousal and aggressive cognition in children who excessively play violent video games.^{14–17} Desjarlais and Willoughby claimed that using computers for online communication among adolescents in grades 9, 11 and 12 could support and improve the quality of their friendships, which can be viewed as compensating for social anxiety.¹⁸ Another study has shown that about 62% of boys claim that playing video games helps them relax, 50% say that video games help them forget problems and around 46% say that it releases anger.¹⁹

Nonetheless, there are growing concerns worldwide that electronic screen viewing may be related to multiple problems in children. Some studies demonstrate that computer games may negatively

affect the self-esteem and sociability of children, especially among boys.^{8,20} The causality of increasing exposure to screen media, health risk behaviours and other correlated problems among children is continuously under debate,^{19,21} but much remains to be understood in this regard. Most of the current literature is concerned with what causes the suggested problems. Non-educational or non-violent media screen viewing by children before age 3 years has been associated with their subsequent attention problems.²² A prospective longitudinal study also supported the stance that childhood television viewing was associated with attention problems in adolescence, regardless of the contents of the television program,²³ and extensive television viewing has been shown to negatively affect attention and long-term educational outcomes.^{24,25}

Other studies have shown that reducing screen viewing by children is positively associated with decrease in their aggressive behaviours,²⁶ but a recent review questions this assertion.²⁷ To date, both positive and negative outcomes in children related to their electronic screen use have been found. Another branch of research has considered children's screen viewing and psychological problems.²⁸ However, no study has specifically studied the relationship between several types of electronic screen use activities and specific mental well-being symptoms in children. Therefore, the purpose of the current study was to investigate the relationship between seven mental well-being indicators and the amount of time spent on five possible electronic screen viewing activities in 10–12-year-old children.

Methods

Sample

The present study used population-wide cross-sectional data from the 2007 *Youth in Iceland* study, which is a population-based survey

that monitors trends in a wide range of demographic and health-related variables in 10–12-year-old children in all primary schools in Iceland.²⁹ The survey was conducted by the Icelandic Center for Social Research and Analysis (ICSRA) in collaboration with the Icelandic Ministry of Education, Science and Culture. A total of 10 829 students completed the questionnaire (response rate: 81.7% of the national Icelandic population, boys: 50.5%). An estimated 90% of the approximately 320 000 inhabitants of Iceland are of Norse-Celtic descent, with 80% of the population belonging to the Lutheran State Church and no other religious institution having >3.0% of the population registered in its services;³⁰ consequently, exogenous variables, such as race and religion, which are often used in research in other countries, were not included in the present analyses.

Participants

Participants reported in this study were 5th, 6th and 7th graders who were 10, 11 and 12 years of age. Under ICSRA oversight, teachers at each school supervised questionnaire completion on-site. All students who attended school on the day of the survey were asked to participate in the survey. The questionnaire was to be completed within their regular classrooms. No identifying information was obtained. All aspects of data collection, including participant involvement based on passive parental consent, were in compliance with Icelandic law on the protection of human subjects.

Measures

Mental well-being indicators

As a part of the Symptom Check List 90 (SCL-90), respondents were asked whether they had experienced any of the following seven symptoms during the week before the study: little interest in doing things, little appetite, loneliness, that they cried easily or wanted to cry, had difficulties falling asleep or staying asleep, feeling sad or blue or felt the future seemed hopeless. Response options were 1 = 'never', 2 = 'almost never', 3 = 'seldom', 4 = 'sometimes' and 5 = 'often'.³¹ For the purpose of this analysis, the responses were dichotomized into 0 = 'Never, almost never or seldom', and 1 = 'sometimes or often'.

Electronic screen use

Screen use was assessed with the following five questions about the average time respondents usually spent each day on the following activities: watching TV/DVD/VCR, playing Internet computer games, playing computer games not on the Internet, using Internet communication or 'chatting' channels and 'other' computer use. Response options were 1 = 'No time', 2 = '1/2–1 hour', 3 = 'about 1 hour', 4 = 'about 2 hours', 5 = 'about 3 hours' and 6 = '4 hours or more'. For the purpose of the present analysis, all variables were re-coded into three groups with 1 = '0–1 hour per day', 2 = '2–3 hours per day' and 3 = '4 hours or more per day'.

Family structure

Participants were asked who of the following live in their home: father, step- or foster father, mother, step- or foster mother, siblings (if any), grandfather, grandmother and other relatives. For the purpose of this analysis, these variables serve as control subjects in all predictive models.

Statistical analysis

First, we reported frequencies and percentages of grade, time spent on different types of electronic screen use and prevalence of mental well-being symptoms. Then, we used logistic regression with adjusted odds ratios and 95% confidence intervals in our

predictive analyses. All models were run separately for boys and girls with the reference category set to 0/1 hour per day on each respective screen use activity. The software IBM SPSS Statistics, version 19.0, was used to analyse the data.

Results

Table 1 shows the prevalence of the five categories of electronic screen use among girls and boys in the study. Excessive use (4 hours or more) is generally more common among boys with the greatest difference found in the question about Internet computer games (5.9% of boys and 1.4% of girls), but the least on the use of Internet chatting channels (4.0% boys and 2.9% girls, respectively). The same trend was observed for daily use of 2–3 hours. Boys are more prevalent than girls on all occasions except one; more girls than boys claim to use Internet chatting channels for 2–3 hours per day (15.2% girls and 12.1% boys). Overall, the use of TV/VCR/DVD is the most common screen use observed with almost 43% of boys and 34% of girls reporting such use for 2 hours or more every day.

Table 2 shows the prevalence of the seven mental well-being indicators in the SCL-90 check list that are examined in the study. Sleeping problems are the most common with >21% of boys and almost 25% of girls reporting occurrence sometimes or often during the past 7 days.

Tables 3–9 show the relative relationship between time spent on the five different screen use behaviours and the seven mental well-being indicators assessed from the SCL-90 checklist. The seven well-being variables and five screen use measures result in 35 separate analyses for boys and girls, or 70 in total. On all occasions, a screen use of 4 hours per day or more is associated with a significant increase in odds of having experienced subsequent negative indicators sometimes or often during past 7 days. This holds for both boys and girls. A linear dose-response relationship is observed for both boys and girls in all categories of screen use and its relations to feeling sad or having little interest in doing things (table 3). Generally, the relationship between screen use and mental well-being follows a similar path for the other indicators with a few notable exceptions between screen use of 0/1 hours and 2/3 hours per day. The relationship between time spent on non-

Table 1 Participants by gender and grade and their frequency of various forms of electronic screen use

Characteristics	Boys % (n/N)	Girls % (n/N)
Participant (n = 10 829)	50.5 (5282/10467)	49.5 (5185/10467)
Grade		
5th (10–11 years old) (n = 3439)	32.6 (1707/5239)	33.0 (1700/5150)
6th (11–12 years old) (n = 3461)	33.2 (1738/5239)	32.5 (1675/5150)
7th (12–13 years old) (n = 3600)	34.2 (1794/5239)	34.5 (1775/5150)
Hours per day watching TV/VCR/DVD		
0–1 hour per day	57.3 (2877/5024)	65.9 (3322/5039)
2–3 hours per day	36.1 (1813/5024)	30.2 (1523/5039)
4 hours or more per day	6.6 (334/5024)	3.8 (194/5039)
Hours per day playing computer games on the Internet		
0–1 hour per day	76.7 (3805/4961)	89.8 (4431/4934)
2–3 hours per day	17.4 (865/4961)	8.8 (434/4934)
4 hours or more per day	5.9 (291/4961)	1.4 (69/4934)
Hours per day playing non-Internet computer games		
0–1 hour per day	78.3 (3846/4914)	94.5 (4646/4919)
2–3 hours per day	16.6 (818/4914)	4.3 (212/4919)
4 hours or more per day	5.1 (250/4914)	1.2 (61/4919)
Hours per day using Internet chatting channels		
0–1 hour per day	84.0 (4185/4984)	81.9 (4098/5004)
2–3 hours per day	12.1 (602/4984)	15.2 (761/5004)
4 hours or more per day	4.0 (197/4984)	2.9 (145/5004)
Hours per day on other computer use		
0–1 hour per day	90.6 (4471/4933)	94.5 (4701/4976)
2–3 hours per day	6.6 (325/4933)	4.5 (225/4976)
4 hours or more per day	2.8 (137/4933)	1.0 (50/4976)

Internet computer games and having had little appetite during the past 7 days is not significantly stronger for boys spending 0/1 hours per day and those spending 2/3 hours per day (table 4). This is also true for the relationship between time watching TV/VCR/DVD and feeling lonely during the past week for both girls and boys, as well as for time on Internet chatting and feeling lonely among boys (table 5). The odds of crying easily or wanting to cry is not significantly greater among boys who watch TV/VCR/DVD 0/1 hours per day and 2/3 hours per day, and neither is the same symptom for boys who spent 0/1 or 2/3 hours per day on non-Internet computer games or boys who spend 0/1 hours or 2/3 hours per day on Internet chatting channels (table 6). Further, the odds of reporting difficulties falling asleep or staying asleep are not more common

among boys who spend 0/1 hours per day or 2/3 hours per day on TV/VCR/DVD, and neither is more common for boys who spent 0/1 hour per day or 2/3 hours per day on Internet games (table 7). This pattern is also observed for boys who watch TV/VCR/DVD 0/1 or 2/3 hours per day, spent 0/1 hour or 2/3 hours per day on Internet games or those who report spending 0/1 hour or 2/3 hours per day on Internet chatting channels and odds of feeling sad or blue sometimes or often during the past 7 days (table 8). Finally, the odds of feeling the future to be hopeless are not greater in boys who watch TV/VCR/DVD 0/1 hour per day or 2/3 hours per day nor in boys who spent 0/1 hours per day or 2/3 hours per day on Internet chatting channels (table 9).

Table 2 Prevalence of mental well-being indicators in the study population (all items refer to the past 7 days)

Characteristic	Boys % (n/N)	Girls % (n/N)
How often felt sad or with little interest in doing things?		
Never, almost never or seldom	85.5 (4369/5109)	84.7 (4302/5080)
Sometimes or often	14.5 (740/5109)	15.3 (778/5080)
How often had little appetite?		
Never, almost never or seldom	84.7 (4292/5069)	80.9 (4098/5065)
Sometimes or often	15.3 (777/5069)	19.1 (967/5065)
How often felt lonely?		
Never, almost never or seldom	90.2 (4555/5052)	84.3 (4264/5057)
Sometimes or often	9.8 (497/5052)	15.7 (793/5057)
How often cried easily or wanted to cry?		
Never, almost never or seldom	93.2 (4742/5088)	79.7 (4048/5077)
Sometimes or often	6.8 (346/5088)	20.3 (1029/5077)
How often had sleeping problems?		
Never, almost never or seldom	78.8 (4028/5111)	75.2 (3819/5081)
Sometimes or often	21.2 (1083/5111)	24.8 (1262/5081)
How often felt sad or blue?		
Never, almost never or seldom	92.9 (4729/5093)	86.5 (4383/5069)
Sometimes or often	7.1 (364/5093)	13.5 (686/5069)
How often felt the future was hopeless?		
Never, almost never or seldom	92.5 (4711/5092)	91.5 (4658/5089)
Sometimes or often	7.5 (381/5092)	8.5 (431/5089)

Discussion

The current study investigated the relationship between five measures of electronic screen use and seven mental well-being indicators among 10–12-year-old school children. Findings consistently show that the odds of having experienced any of the negative symptoms sometime or often during the past 7 days increase with greater amount of time spent in front of electronic screens among both girls and boys. This relationship is especially evident for those spending ≥ 4 hours every day on any kind of screen activity.

In recent years, the potential effects of excessive computer use have been studied among children. Nevertheless, much remains to be understood about the potential influences of electronic screen use and child well-being. The majority of recent studies have focused on exposure to violence in electronic media, predominantly from computer game playing. Our findings are in harmony with many of them. For example, Nelson and Gordon-Larsen³² found an association between time spent in front of electronic screens and sleeping problems in adolescents. This relationship was particularly evident in those who reported ≥ 4 hours per day of electronic screen-based activities. Dworak *et al.*³³ also reported that excessive television viewing and computer game playing significantly reduce sleep efficiency among school-aged children, subsequently causing a higher risk for attention-deficit/hyperactivity disorder and also

Table 3 Prevalence of children reporting feeling sad or with little interest on doing things sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you felt sad or had little interest in doing things?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	12.5% (353/2828)	1.0	12.9% (424/3275)	1.0
2–3 hours per day	15.7% (281/1786)	1.31 (1.10–1.55)	18.0% (271/1507)	1.46 (1.23–1.72)
4 hours or more per day	23.5% (77/327)	2.13 (1.61–2.82)	35.6% (69/194)	3.54 (2.59–4.85)
Time spent on Internet games				
0–1 hour per day	12.8% (481/3747)	1.0	14.0% (616/4385)	1.0
2–3 hours per day	17.5% (150/855)	1.44 (1.18–1.77)	24.9% (107/429)	1.99 (1.57–2.51)
4 hours or more per day	25.4% (72/284)	2.20 (1.65–2.93)	33.8% (23/68)	2.85 (1.70–4.78)
Time spent on non-Internet games				
0–1 hour per day	13.0% (492/3783)	1.0	14.7% (674/4596)	1.0
2–3 hours per day	18.4% (148/804)	1.48 (1.20–1.81)	25.2% (53/210)	1.99 (1.44–2.76)
4 hours or more per day	22.5% (55/244)	1.87 (1.36–2.58)	29.5% (18/61)	2.25 (1.28–3.97)
Time on Internet chatting				
0–1 hour per day	13.2% (546/4131)	1.0	13.3% (540/4055)	1.0
2–3 hours per day	18.5% (109/588)	1.50 (1.19–1.88)	23.3% (176/755)	1.93 (1.59–2.34)
4 hours or more per day	24.1% (46/191)	2.00 (1.42–2.84)	31.9% (45/141)	2.88 (1.99–4.16)
Time on other computer use				
0–1 hour per day	13.3% (588/4416)	1.0	14.7% (685/4651)	1.0
2–3 hours per day	23.0% (73/317)	1.93 (1.47–2.55)	25.6% (57/223)	1.95 (1.42–2.66)
4 hours or more per day	23.1% (31/134)	1.85 (1.22–2.81)	32.0% (16/50)	2.63 (1.44–4.82)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

Table 4 Prevalence of children reporting having little appetite sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you had little appetite?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	13.5% (379/2804)	1.0	17.2% (560/3264)	1.0
2–3 hours per day	16.4% (291/1776)	1.25 (1.06–1.47)	20.9% (314/1502)	1.27 (1.09–1.48)
4 hours or more per day	23.6% (76/322)	1.93 (1.46–2.56)	38.1% (74/194)	2.89 (2.13–3.92)
Time spent on Internet games				
0–1 hour per day	14.1% (525/3719)	1.0	18.1% (790/4369)	1.0
2–3 hours per day	16.8% (143/850)	1.23 (1.01–1.51)	28.2% (121/429)	1.76 (1.40–2.20)
4 hours or more per day	25.4% (71/280)	1.97 (1.47–2.62)	39.7% (27/68)	2.81 (1.71–4.62)
Time spent on non-Internet games				
0–1 hour per day	14.2% (535/3756)	1.0	18.7% (857/4583)	1.0
2–3 hours per day	16.7% (134/803)	1.18 (0.96–1.45)	27.8% (58/209)	1.69 (1.24–2.31)
4 hours or more per day	27.9% (67/240)	2.25 (1.67–3.04)	27.9% (17/61)	1.55 (0.87–2.75)
Time on Internet chatting				
0–1 hour per day	14.0% (575/4107)	1.0	16.3% (658/4041)	1.0
2–3 hours per day	19.3% (112/579)	1.47 (1.17–1.84)	30.4% (229/753)	2.21 (1.85–2.64)
4 hours or more per day	29.8% (57/191)	2.45 (1.76–3.39)	42.9% (60/140)	3.73 (2.63–5.27)
Time on other computer use				
0–1 hour per day	14.6% (638/4384)	1.0	18.6% (861/4638)	1.0
2–3 hours per day	21.1% (67/317)	1.55 (1.17–2.06)	28.4% (63/222)	1.72 (1.27–2.33)
4 hours or more per day	25.6% (34/133)	1.85 (1.23–2.77)	44.0% (22/50)	3.32 (1.88–5.85)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

Table 5 Prevalence of children reporting feeling lonely sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you felt lonely?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	8.6% (240/2801)	1.0	14.6% (476/3265)	1.0
2–3 hours per day	9.9% (175/1771)	1.15 (0.94–1.41)	16.2% (242/1495)	1.11 (0.94–1.32)
4 hours or more per day	21.2% (68/321)	2.80 (2.07–3.79)	28.0% (54/193)	2.10 (1.51–2.93)
Time spent on Internet games				
0–1 hour per day	8.8% (327/3709)	1.0	14.6% (639/4367)	1.0
2–3 hours per day	11.0% (94/852)	1.28 (1.01–1.64)	23.1% (98/425)	1.70 (1.33–2.16)
4 hours or more per day	19.8% (55/278)	2.37 (1.72–3.27)	28.4% (19/67)	2.11 (1.22–3.65)
Time spent on non-Internet games				
0–1 hour per day	8.7% (325/3746)	1.0	15.0% (687/4574)	1.0
2–3 hours per day	12.9% (103/799)	1.52 (1.20–1.93)	24.3% (51/210)	1.85 (1.34–2.58)
4 hours or more per day	20.4% (49/240)	2.59 (1.85–3.64)	39.3% (24/61)	3.55 (2.08–6.04)
Time on Internet chatting				
0–1 hour per day	9.4% (385/4097)	1.0	14.4% (579/4033)	1.0
2–3 hours per day	9.7% (57/586)	1.04 (0.78–1.40)	21.1% (159/753)	1.55 (1.27–1.88)
4 hours or more per day	19.7% (37/188)	2.22 (1.52–3.25)	29.3% (41/140)	2.29 (1.57–3.35)
Time on other computer use				
0–1 hour per day	9.0% (395/4384)	1.0	15.1% (700/4630)	1.0
2–3 hours per day	17.0% (53/312)	2.05 (1.49–2.80)	25.0% (55/220)	1.83 (1.33–2.52)
4 hours or more per day	24.4% (32/131)	2.97 (1.96–4.52)	34.0% (17/50)	2.74 (1.51–5.00)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

negatively relating to the children's cognitive performance. A prospective study recently published by Hume *et al*³⁴ also partly supports our findings that there is an association between depressive symptoms and TV viewing among adolescent girls. Their results implied that negative symptoms predicted increased TV viewing over time in girls. They concluded that the findings were probably because of withdrawal from social activities. Furthermore, Jolin and Weller³⁵ reviewed a large amount of contemporary literature on the topic and presented an overview of the

relationship between television viewing and sleep, attention and interpersonal relationships in children and adolescents. However, only one recent study on the association between media use including television-viewing and the risk of depression was mentioned in their review. That particular study was conducted by Primack *et al*³⁶ and included participants from grades 7 to 12. They underwent depressive symptom assessment 7 years later in their young adulthood. The results revealed greater odds of depression in adulthood for each additional hour spent in front of the television

Table 6 Prevalence of children reporting crying easily or wanted to cry sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you cried easily or wanted to cry?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	5.8% (164/2817)	1.0	18.0% (589/3279)	1.0
2–3 hours per day	7.1% (126/1776)	1.22 (0.96–1.55)	23.2% (347/1498)	1.37 (1.18–1.59)
4 hours or more per day	13.2% (43/326)	2.37 (1.66–3.40)	34.5% (67/194)	2.29 (1.68–3.13)
Time spent on Internet games				
0–1 hour per day	6.2% (233/3734)	1.0	18.9% (829/4386)	1.0
2–3 hours per day	7.4% (63/855)	1.20 (0.90–1.60)	30.0% (127/424)	1.80 (1.45–2.25)
4 hours or more per day	11.4% (32/280)	1.79 (1.20–2.65)	44.1% (30/68)	3.16 (1.94–5.15)
Time spent on non-Internet games				
0–1 hour per day	6.2% (233/3772)	1.0	19.6% (900/4595)	1.0
2–3 hours per day	8.2% (66/801)	1.33 (1.00–1.77)	31.8% (67/211)	1.93 (1.43–2.60)
4 hours or more per day	11.1% (27/243)	1.82 (1.19–2.79)	36.7% (22/60)	2.19 (1.27–3.75)
Time on Internet chatting				
0–1 hour per day	6.5% (268/4116)	1.0	18.4% (745/4052)	1.0
2–3 hours per day	6.8% (40/587)	1.05 (0.75–1.49)	27.4% (206/752)	1.64 (1.37–1.97)
4 hours or more per day	13.5% (26/192)	2.05 (1.32–3.17)	38.3% (54/141)	2.60 (1.83–3.69)
Time on other computer use				
0–1 hour per day	6.0% (263/4406)	1.0	19.6% (910/4647)	1.0
2–3 hours per day	13.7% (43/314)	2.49 (1.76–3.52)	31.4% (70/223)	1.84 (1.37–2.47)
4 hours or more per day	15.8% (21/133)	2.67 (1.64–4.36)	42.9% (21/49)	2.91 (1.63–5.17)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

Table 7 Prevalence of children reporting sleeping difficulties sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you had difficulties falling asleep or staying sleeping?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	19.9% (562/2828)	1.0	22.7% (746/3286)	1.0
2–3 hours per day	20.6% (366/1780)	1.04 (0.90–1.21)	26.8% (402/1499)	1.24 (1.07–1.42)
4 hours or more per day	33.3% (109/327)	1.98 (1.55–2.54)	42.1% (80/190)	2.37 (1.76–3.21)
Time spent on Internet games				
0–1 hour per day	20.1% (754/3745)	1.0	23.6% (1036/4384)	1.0
2–3 hours per day	22.5% (193/856)	1.16 (0.97–1.38)	34.0% (145/426)	1.63 (1.32–2.02)
4 hours or more per day	29.6% (83/280)	1.62 (1.23–2.12)	53.0% (35/66)	3.39 (2.07–5.55)
Time spent on non-Internet games				
0–1 hour per day	19.5% (738/3780)	1.0	24.1% (1110/4599)	1.0
2–3 hours per day	24.9% (201/806)	1.35 (1.13–1.62)	36.4% (76/209)	1.82 (1.36–2.43)
4 hours or more per day	32.8% (79/241)	1.96 (1.48–2.60)	50.0% (29/58)	2.86 (1.69–4.85)
Time on Internet chatting				
0–1 hour per day	19.8% (819/4130)	1.0	22.8% (925/4054)	1.0
2–3 hours per day	23.5% (138/587)	1.24 (1.01–1.53)	32.2% (242/752)	1.57 (1.32–1.86)
4 hours or more per day	35.1% (67/191)	2.09 (1.54–2.85)	46.1% (65/141)	2.75 (1.95–3.87)
Time on other computer use				
0–1 hour per day	19.7% (868/4412)	1.0	24.1% (1122/4650)	1.0
2–3 hours per day	32.1% (102/318)	1.92 (1.50–2.46)	37.2% (83/223)	1.84 (1.39–2.43)
4 hours or more per day	37.1% (49/132)	2.32 (1.61–3.33)	51.0% (25/49)	3.12 (1.76–5.50)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

in childhood. The same relationship was observed for total media exposure.

This study has some limitations. First, findings are based on cross-sectional data, so temporal order of cause and effect is not possible to assess. One therefore needs to keep in mind that the findings of the study reveal the co-occurrence of increased screen use and prevalence of negative mental well-being symptoms in the

population among 10–12-year-old children. We are unable to conclude whether screen use causes depression or negative mental health in general, or whether children who spend much time every day in front of electronic screens do so because they are lonely or sad. However, in a group of almost 11 000 children, one may expect to find a mixture of causal order. Second, findings are entirely based on self-reports. We are therefore unable to rule out responses

Table 8 Prevalence of children reporting feeling sad or blue sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you felt sad or blue?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	6.2% (175/2820)	1.0	11.8% (387/3277)	1.0
2–3 hours per day	7.2% (129/1782)	1.17 (0.92–1.48)	15.3% (228/1494)	1.34 (1.12–1.60)
4 hours or more per day	15.1% (49/325)	2.61 (1.85–3.68)	26.2% (50/191)	2.52 (1.79–3.55)
Time spent on Internet games				
0–1 hour per day	6.4% (240/3741)	1.0	12.6% (551/4380)	1.0
2–3 hours per day	7.8% (67/854)	1.24 (0.94–1.65)	19.8% (84/424)	1.70 (1.31–2.19)
4 hours or more per day	14.3% (40/280)	2.23 (1.55–3.22)	30.9% (21/68)	2.76 (1.62–4.68)
Time spent on non-Internet games				
0–1 hour per day	6.3% (238/3772)	1.0	13.1% (600/4589)	1.0
2–3 hours per day	9.5% (77/807)	1.53 (1.17–2.00)	19.7% (41/208)	1.67 (1.17–2.38)
4 hours or more per day	12.2% (29/238)	1.97 (1.30–2.98)	30.5% (18/59)	2.70 (1.52–4.78)
Time on Internet chatting				
0–1 hour per day	6.6% (273/4126)	1.0	11.7% (474/4041)	1.0
≥2–3 hours per day	8.0% (47/589)	1.24 (0.90–1.71)	20.7% (156/753)	1.93 (1.57–2.36)
4 hours or more per day	14.7% (28/191)	2.26 (1.48–3.46)	31.9% (45/141)	3.31 (2.29–4.80)
Time on other computer use				
0–1 hour per day	6.3% (277/4409)	1.0	12.8% (592/4636)	1.0
2–3 hours per day	13.5% (43/319)	2.28 (1.61–3.22)	25.0% (56/224)	2.25 (1.64–2.09)
4 hours or more per day	16.5 (22/133)	2.64 (1.63–4.27)	38.0% (19/50)	3.88 (2.16–6.97)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

Table 9 Prevalence of children reporting feeling the future was hopeless sometimes or often during past 7 days in relation to their screen use^a

Variables	How often during past 7 days have you felt the future was hopeless?			
	Boys		Girls	
	% (n/N)	OR (95% CI)	% (n/N)	OR (95% CI)
Time watching TV/VCR/DVD				
0–1 hour per day	6.3% (176/2815)	1.0	7.2% (236/3286)	1.0
2–3 hours per day	7.5% (133/1783)	1.20 (0.95–1.52)	9.4% (141/1503)	1.31 (1.05–1.64)
4 hours or more per day	16.9% (55/326)	2.91 (2.09–4.06)	20.2% (39/193)	3.06 (2.09–4.47)
Time spent on Internet games				
0–1 hour per day	6.2% (232/3737)	1.0	7.4% (327/4393)	1.0
2–3 hours per day	9.9% (85/855)	1.68 (1.29–2.18)	14.7% (63/428)	2.08 (1.55–2.78)
4 hours or more per day	16.4% (46/280)	2.70 (1.90–3.83)	28.4% (19/67)	4.48 (2.57–7.79)
Time spent on non-Internet games				
0–1 hour per day	6.2% (234/3769)	1.0	7.9% (364/4602)	1.0
2–3 hours per day	10.6% (86/810)	1.71 (1.32–2.22)	15.2% (32/210)	2.16 (1.45–3.20)
4 hours or more per day	18.2% (44/242)	3.13 (2.18–4.47)	24.6% (15/61)	3.57 (1.94–6.56)
Time on Internet chatting				
0–1 hour per day	6.8% (282/4123)	1.0	7.0% (283/4057)	1.0
2–3 hours per day	7.7% (45/588)	1.11 (0.80–1.55)	12.4% (94/757)	1.82 (1.42–2.34)
4 hours or more per day	19.9% (38/191)	3.01 (2.05–4.41)	30.0% (42/140)	5.41 (3.68–7.96)
Time on other computer use				
0–1 hour per day	6.5% (288/4409)	1.0	7.9% (368/4656)	1.0
2–3 hours per day	15.4% (49/318)	2.57 (1.85–3.58)	16.0% (36/225)	2.17 (1.49–3.15)
4 hours or more per day	18.8% (25/133)	2.92 (1.84–4.63)	30.0% (15/50)	4.89 (2.62–9.12)

Adjusted odds ratios (OR) with 95% confidence intervals (CI).

a: Denominators vary from N as a result of differences in missing information.

without foundation, but the large sample size minimizes this limitation. Third, we decided to operate with odds ratios rather than relative risks in our calculations. This is because of convenience with the software operations and inclusion of the control variable, but we appreciate that odds ratios tend to exaggerate the relative difference between groups in comparison with relative risks.³⁷ Fourth, with fast-paced technology advancement and use, measuring 'screen use' has become increasingly difficult in recent

times. For example, cell phones are now small computers that can be connected to the Internet, and tablet computers, such as iPods, are now owned by many young children. Despite these limitations, the study has several strengths. First, the analysis is based on a large sample with a high response rate. Second, our sample is large enough to detect exposure in groups that spend ≥ 4 hours on all selected screen use activities, and separately for girls and boys. Third, we use a standardized, validated measuring tool for our assessment

of mental well-being.³¹ Fourth, the ICSRA has conducted school-based studies among adolescents for almost 2 decades. These questionnaires have all been carefully pilot tested and validated over time.

Conclusions

Even though the nature and temporal order of the observed relationship between electronic screen use and mental well-being in 10–12-year-old children remains unexplained after this study, it has been established. The consistency of the findings across all categories of screen use and successive well-being symptoms is by far too clear to be considered a coincidence. Screen use and mental health among 10–12-year-old children go hand in hand. Future studies should focus on explaining why this observed association exists.

Key points

- Between 1.3% and 4.3% of 10–12-year-old girls and 2.8% and 6.6% of 10–12-year-old boys in Iceland watch electronic screen material ≥ 4 hours every day.
- A clear dose-response relationship between electronic screen use and negative mental well-being was observed.
- Excessive screen use of 4 hours per day or more was observed to be strongly related to negative well-being symptoms for all five types of screen use and all seven mental well-being indicators.

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