# Electronic Media Use and Adolescent Health and Well-Being: Cross-Sectional Community Study

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**Objective.**—To describe time adolescents spend using electronic media (television, computer, video games, and telephone); and to examine associations between self-reported health/well-being and daily time spent using electronic media overall and each type of electronic media.

**Methods.**—*Design*–Cross-sectional data from the third (2005) wave of the Health of Young Victorians Study, an Australian school-based population study. *Outcome Measures*–Global health, health-related quality of life (HRQoL; KIDSCREEN), health status (Pediatric Quality of Life Inventory 4.0; PedsQL), depression/anxiety (Kessler-10), and behavior problems (Strengths and Difficulties Questionnaire). *Exposure Measures*–Duration of electronic media use averaged over 1 to 4 days recalled with the Multimedia Activity Recall for Children and Adolescents (MARCA) computerized time-use diary. *Analysis*–Linear and logistic regression; adjusted for demographic variables and body mass index $z$ score.

**Results.**—A total of 925 adolescents (mean ± standard deviation age, 16.1 ± 1.2 years) spent, on average, 3 hours 16 minutes per day using electronic media (television, 128 minutes per day; video games, 35; computers, 19; telephone, 13). High overall electronic media use was associated with poorer behavior, health status, and HRQoL. Associations with duration of specific media exposures were mixed; there was a favorable association between computer use (typing/Internet) and psychological distress, whereas high video game use was associated with poorer health status, HRQoL, global health, and depression/anxiety. Television and telephone durations were not associated with any outcome measure.

**Conclusions.**—Despite television's associations with obesity, time spent in other forms of media use appear more strongly related to adolescent health and well-being. This study supports efforts to reduce high video game use and further exploration of the role of computers in health enhancement.

**KEY WORDS:** adolescent; health status; media; mental health; quality of life

*Academic Pediatrics* 2009;9:307–14

The Australian Government Department of Health and Aging national guidelines recommend young people spend no more than 2 hours per day using electronic media for entertainment, particularly during daylight hours.[1] The American Academy of Pediatrics recommends no more than 2 hours of quality television/videos daily.[2] However, many children exceed this. Australian children aged 10–13 years engage in nearly 4 hours of total media use per day.[3] Television is watched by at least 98% of 5–14-year-olds and is by far their most prevalent leisure activity.[4] Reports estimate children average 2–2.5 hours of television viewing,[4–6] 45 minutes playing video games, and 15 minutes using the computer for nongame activities (eg, Internet, chat, homework) each day.[3]

Many negative associations of electronic media use have been reported relating to reduced physical activity,[7] overweight,[8] and unhealthy dietary behavior.[9] Video games specifically have been related to aggressive affect and cognitions, anxiety, isolation, changes to emotional coping strategies, increased addiction potential, and difficulty distinguishing reality.[10] Aggression, violence, and behavior problems associated with video game use may result from the content based on social learning theory, which postulates that children, having observed a certain behavior, incorporate the modeled behavior as a construct into their own behavior.[11] Positive aspects of television use include "together time" for parents and children, an avenue to educate and instruct through high-quality educational programs,[12] and relaxation time. However, the impact of electronic media use on adolescents' overall quality of life and health (physical and mental) has been less thoroughly researched.

Further, no studies have incorporated the possible impacts of telephone use (mobile and/or landline) on adolescents' health. It is possible that this impact could be both positive (via interacting and socializing with peers/extended family) and/or negative (via alienation from the family).

There is substantial (although conflicting) research regarding associations between the Internet and depression. Studies examining adolescents who use the Internet more than others[13] or adolescents with high Internet use (>1 hour per day[14] or >2 hours per day[15]) show that this has

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Received for publication November 14, 2008; accepted April 4, 2009.

a positive relationship with depression,[13,14] and these adolescents have weakened family communication[13] and social ties.[14,15] One study[16] found that almost 30% of 10–17-year-olds reporting depressive symptomatology used the Internet for 3 or more hours a day, compared with 14% reporting minor symptomatology and 12% reporting mild or no symptoms of depression. However, other studies report that problems present with high Internet use had largely resolved 3 years later[13] and time spent online was not related to depression, anxiety, or social fearfulness.[17] Internet users' social networks may even be larger and more active than those of nonusers.[18] A review by Livingstone and colleagues[19] indicated that communication via the Internet is a healthy way for young people to socialize and may only be problematic for those already isolated.

Given the amount of time adolescents spend using electronic media, the lack of information about the associations between time spent in media use and their health/well-being is surprising. This study addresses this major evidence gap by drawing on a sizable Australian community cohort with comprehensive time-use data capturing all the main types of media use simultaneously, as well as a broad range of both positive and negative indicators of adolescent health/well-being. Electronic media was the focus of this study; listening to music or the radio was not included because electronic media are the dominant form of media.

This study aimed to explore the average daily time adolescents (age 13–19 years) spend using electronic media (television, computer, video games, and telephone, separately and overall), as well as the associations between adolescents' self-reported health/well-being and (1) duration of time spent using electronic media overall and (2) duration of time spent using each type of electronic media. "Electronic media" in this study does not refer to audio-based media, including listening to music/radio and iPods (MP3 players).

## METHODS

### Design

Data were drawn from the third wave of the population-based longitudinal Health of Young Victorians Study, whose design has been reported elsewhere.[20] Briefly, participants were selected for wave 1 in 1997 from across the state of Victoria, Australia, by means of a stratified 2-stage random sampling design based on school education sector (government, Catholic, or independent) and year level. The baseline response rate for prep (first school year) through third grade students was 83.2% (1943 of 2336 identified children) (age range, 5.0–10.7 years). These children were resurveyed in wave 2 (2000/1) (age range, 8.4–13.8 years; response rate 80.8%, or 1569 of 1943 children in wave 1). Consent was received and data collected for an additional 30 children who were not in the wave 1 sample. Wave 3 (2005/2006) mainly comprised students in 8th through 11th grade (mean age, 15.9 years; age range, 13.6–19.4 years), although a small number had already left school. Of the 1662 students invited to participate who could be located from those who took part in wave 1 and/or wave 2, 925 (55.7%) had both questionnaire and time-use data available; these subjects comprise the sample. On the 1997 baseline characteristics, the retained cohort was similar to those lost to follow-up in terms of gender (50.4% vs 51.1% male; $P = .79$). However, those retained were slightly younger (7.5 vs 7.7 years; $P = .003$) and were from areas of greater advantage (1027.8 vs 1021.8; $P = .04$).

The study was approved by the Ethics in Human Research Committee of the Royal Children's Hospital and school sectors. Written informed consent was provided both by a parent proxy and the student.

### Electronic Media Variables (Exposure Measures)

Use-of-time data were collected by a computerized activity recall diary, the Multimedia Activity Recall for Children and Adolescents (MARCA), a 24-hour activity recall linked to a compendium of energy expenditure.[21] The MARCA has intraclass coefficients for test-retest reliability for energy expenditure ranging from 0.88 to 0.94 and Spearman coefficients for convergent validity with accelerometry ranging from rho = 0.36 to 0.45.[22] For minutes of television viewing, the reliability (rho) was 0.80 to 0.84 for 3-hour retests.[3]

Adolescents were requested to complete 4 MARCA diaries (2 full school and 2 full non–school days, ie, weekend, holiday, or day off). Most adolescents completed their diaries on laptop computers, with the aid of a research assistant. Most adolescents completed these diaries at school, while those no longer attending school received a home visit. Individual recalls were classified as unusable and were excluded from analyses if they recorded 1) <10 activities per recall day (1% of recalls completed), 2) very high (>3.0 METs) energy expenditure (1% of recalls completed), or 3) very low (<1.1 METs) energy expenditure (0.64% of recalls completed). These were excluded because the adolescents did not appear to make a good effort at recall (based on few discrete activities being recalled), and activity patterns were improbably lazy or energetic. Those excluded were more likely to have been completed by a boy.

A total of 925 adolescents completed at least 1 recall that we could use, and they thus comprise the sample. Most of these adolescents completed 4 useable recalls (n = 767; 82.9%) (Table 1). Of these, most returned 2 useable school day recalls and 2 useable non–school day recalls (n = 528).

The MARCA's analytical software module was used to determine minutes (per recall) devoted to television viewing, using a computer (for typing/Internet), playing video games (computer/e-games ie, PlayStation), and telephone use (talking/texting). The category of computer use does not include the use of the computer for video game playing, which falls under the video games category. For each adolescent, average daily time spent in an activity subset was calculated by calculating the average across the useable school day recalls, calculating the average across the useable non–school day recalls, and calculating the average of the average school day and non–school day values. However, if no useable school day recalls were

**Table 1.** Number of Adolescents Who Returned 1, 2, 3, or 4 Useable Recalls, by Type of Recalls Returned

| Number of Useable Recalls Returned | Type of Recalls Returned: Mixture of School and Non–School Days | Only School Days | Only Non–School Days | Total |
|---|---|---|---|---|
| 1 | 0 | 11 | 9 | 20 |
| 2 | 21 | 12 | 16 | 49 |
| 3 | 77 | 0 | 12 | 89 |
| 4 | 720 | 0 | 47 | 767 |
| Total | 818 | 23 | 84 | 925 |

returned, then the average was equal to the non–school day average, and vice versa. No adjustments were made to account for the number of useable recalls returned.

## Outcome Measures

Self-report health and well-being (outcome) measures are shown in Table 2.

## Covariates

Covariates in the multivariate analyses were the adolescent's gender, age (years), and Victorian quintile of Socio-Economic Indexes for Areas (SEIFA) Disadvantage Index at the postal code of residence level.[23] SEIFA is a census-based measure of the socioeconomic status of Australian communities, standardized to have a national mean±standard deviation (SD) of 1000 ± 100, with higher values representing greater advantage. We also adjusted for body mass index (BMI) $z$ score because of the known cross-sectional associations between higher BMI and lower physical activity (and therefore potentially higher media use) and poorer physical and mental health. Height and weight measures were taken by trained field workers according to International Society for the Advancement of Kinanthropometry protocols. BMI (kg/m$^2$) was calculated and transformed to $z$ scores with the US 2000 Centers for Disease Control and Prevention growth charts.[24]

## Statistical Analysis

Analyses were cross-sectional as a result of media time-use data being available at wave 3 only.

Distributions for computer, video game, and telephone use were highly skewed to the right, with a large proportion of the sample having a daily average of 0 minutes. Hence, these were not included in the models as continuous variables. These variables were trichotomized into none (daily average equals 0 minutes), low (first half of distribution, excluding 0 minutes), and high (second half of distribution, excluding 0 minutes). Average daily media and television use were approximately normally distributed. However, these variables were categorized (divided into quartiles—low, medium, high, very high) for consistency.

**Table 2.** Self-Reported Health and Well-Being (Outcome) Measures

| Construct | Measure | Additional Information |
|---|---|---|
| Global health | From the Child Health Questionnaire (CHQ)[30] | Single item: "In general, would you say your health is? (Excellent; Very Good; Good; Fair; Poor)." Responses were dichotomized into Excellent/Very Good vs Good/Fair/Poor.[30] |
| Health status | Pediatric Quality of Life Inventory 4.0 (PedsQL 4.0),[31] version for 13–18-year-olds | Validated 23-item questionnaire assessing physical, emotional, social, and school functioning, from which Total, Physical Summary, and Psychosocial Summary scores are derived. The possible range of scores is 0–100, with 100 representing best possible health. Cronbach alpha = 0.89.[31] |
| Health-related quality of life (HRQoL) | KIDSCREEN | 10 items, Cronbach alpha = 0.82.[32] Assesses the HRQoL of healthy and chronically ill children and adolescents aged 8–18 years. Ten domains are measured: physical well-being, psychological well-being, moods and emotions, self-perception, autonomy, parents' relations and home life, peers and social support relations, school environment, bullying, and financial resources. Higher scores indicate higher HRQoL. |
| Psychological distress (anxiety/depression) | Kessler-10[33] | Kessler-10 (K-10) is a 10-item global measure of psychological distress based on questions about the level of anxiety and depressive symptoms in the most recent 4-week period. Scores range from 10–50, with a higher score indicating greater psychological distress. The K-10 has strong psychometric properties.[34] Scores are dichotomized into Low/Moderate distress vs High/Very High distress. |
| Behavior | Strengths and Difficulties Questionnaire (SDQ),[35] version for 12–18-year-olds | 25 items, excellent psychometric properties.[36] Behavioral screening—emotional symptoms, conduct problems, hyperactivity, peer problems, prosocial behavior. Generates Total Difficulties score (range 0–40), with higher scores representing greater problems; continuous variable. |

Analyses, adjusted for the above covariates, were carried out for average daily media use and each of the 4 media exposures separately, using linear regression methods for the continuous outcomes (health status [Pediatric Quality of Life Inventory 4.0; PedsQL], health-related quality of life [HRQoL] [KIDSCREEN], behavior [Strengths and Difficulties Questionnaire; SDQ]) and logistic regression for the binary outcomes (global health, anxiety/depression [Kessler-10]). Results present the effect estimates (mean differences for linear regression, odds ratios [ORs] for logistic regression) and 95% confidence intervals (95% CIs). Categorical independent measures were entered into the model using dummy variables to contrast the effect between the first category (reference) and each other category. Analyses were conducted by Stata release 10.0 (StataCorp, College Station, Tex).

## RESULTS

The sample comprised 925 adolescents (466 boys; mean ± SD age 16.1 ± 1.2 years), of whom 80 (8.7%) were in the first (most disadvantaged) SEIFA quartile, and of whom 239 (26.1%), 312 (34%), and 286 (31.2%) were in the second, third, and fourth (least disadvantaged) quartiles, respectively. The average PedsQL (health status) total mean score was 79.7 ± 10.8, the average SDQ (behavior) Total Difficulties score was 9.3 ± 5.0, and the mean KIDSCREEN (HRQoL) value was 47.5 ± 7.1. Although most participants reported being in excellent or very good health, 40.9% reported only good, fair, or poor global health, and 18.4% reported high/very high level of psychological distress on the Kessler-10.

### Levels of Media Use (Table 3)

On average, adolescents spent 3 hours 16 minutes per day using electronic media. Of this, the most time was spent watching television (2 hours 8 minutes), then playing video games (35 minutes), working on the computer (19 minutes), and using the telephone (13 minutes).

Just 1.8% of adolescents reported not watching television, but 53.7% reported not using a computer, 49.7% reported not playing video games, and 46.7% did not report any time using a telephone. Only 1 of the 925 adolescents did not spend any time using any electronic media.

Boys spent more time using electronic media than girls (3 hours 45 minutes vs 2 hours 48 minutes; $P < .001$). Boys watched more television (2 hours 25 minutes vs 1 hour 51 minutes; $P < .001$) and played video games more than girls (51 vs 20 minutes; <.0014). However, computer use was similar (20 minutes boys, 19 minutes girls; $P = .36$), and girls spent more time using the telephone than boys (18 vs 9 minutes; $P < .001$).

### Media Use and Health Outcomes

Relationships of media use with continuous outcomes (PedsQL, SDQ, and KIDSCREEN) are summarized in Table 4 and with categorical outcomes (global health and Kessler-10) in Table 5. Table 4 shows that adolescents who spent the most overall time using electronic media had poorer health status (coefficient −3.35; 95% CI, −5.47 to −1.23; $P = .002$), more behavior problems (coefficient 1.31; 95% CI, 0.34 to 2.28; $P = .008$), and poorer HRQoL (coefficient −1.43; 95% CI, −2.80 to −0.07; $P = .04$) than those who spent the least amount of time.

**Table 3.** Time Adolescents Spent Using Electronic Media*

| | Time (min/d) | | |
|---|---|---|---|
| Type of Media | Mean ± SD | Median (Interquartile Range) | Range |
| Total media | | | |
| All | 196.3 ± 104.9 | 178.8 (120.8–255.0) | 0–791.7 |
| Boys | 224.6 ± 114.1 | 210.0 (138.8–292.5) | 0–791.7 |
| Girls | 167.5 ± 85.6 | 156.3 (102.5–221.3) | 9.2–572.5 |
| Television | | | |
| All | 128.3 ± 80.9 | 115.0 (68.8–172.5) | 0–496.7 |
| Boys | 145.5 ± 89.8 | 133.5 (76.3–196.7) | 0–477.5 |
| Girls | 111.0 ± 66.4 | 105.0 (63.3–147.5) | 0–496.7 |
| Computer | | | |
| All | 19.3 ± 33.8 | 0 (0–25.0) | 0–222.5 |
| Boys | 19.8 ± 33.6 | 0 (0–27.5) | 0–222.5 |
| Girls | 18.7 ± 34.0 | 0 (0–22.5) | 0–210.0 |
| Video games | | | |
| All | 35.2 ± 65.0 | 2.5 (0–45.0) | 0–480.0 |
| Boys | 50.5 ± 79.0 | 16.9 (0–68.3) | 0–480.0 |
| Girls | 19.8 ± 41.4 | 0 (0–21.3) | 0–360.0 |
| Telephone | | | |
| All | 13.4 ± 23.2 | 1.7 (0–18.3) | 0–168.8 |
| Boys | 8.8 ± 20.3 | 0 (0–7.5) | 0–168.8 |
| Girls | 18.1 ± 25.0 | 9.2 (0–26.3) | 0–165.0 |

*For total media use and television viewing, $t$ test results suggest that there is strong evidence ($P < .001$) for a mean difference in time between boys and girls. For video game use and telephone use, Wilcoxon rank sum test results provide strong evidence to suggest that the distribution of time is different for boys and girls ($P < .001$). For computer use, Wilcoxon rank sum test results suggest that the distribution of time is the same for boys and girls ($P = .36$).

SD = standard deviation.

### Television Use

There was little evidence of associations with television use, except compared with low television use, high television use was associated with better KIDSCREEN HRQoL scores (coefficient 1.41; 95% CI, 0.10 to 2.72).

### Video Game Use

High levels of video game use were associated with poorer health status (coefficient −2.40; 95% CI, −4.20 to −0.60; $P = .009$) and HRQoL (coefficient −1.19; 95% CI, −2.35 to −0.03; $P = .04$) (Table 4). As Table 5 shows, adolescents who reported a high level of video game use were more likely to report good/fair/poor global health (OR 1.61, 95% CI, 1.13 to 2.29; $P = .009$) and high/very high levels of psychological distress (OR 1.79, 95% CI, 1.17 to 2.73; $P = .007$) than those who did not play video games. Further analyses found that video game use was driving the associations between higher total media use and poorer health status, more behavior problems, and poorer HRQoL. Without video game use included, total media use were no longer associated with health status (coefficient −1.12; 95% CI, −3.20 to 0.96; $P = .29$), behavior problems (coefficient 0.72; 95% CI, −0.22 to 1.67; $P = .13$), or HRQoL (coefficient −0.74; 95% CI, −2.07 to 0.60; $P = .28$).

**Table 4.** Adjusted Mean Difference for Continuous Health Outcomes by Average Daily Time Using Media*

| Independent Measures | Health Status (PedsQL) Total | | Behavior (SDQ) Total Difficulties | | Health-Related Quality of Life (KIDSCREEN) | |
|---|---|---|---|---|---|---|
| | Mean Difference† (95% CI) | *P* Value | Mean Difference† (95% CI) | *P* Value | Mean Difference† (95% CI) | *P* Value |
| Total media use | | | | | | |
| Low (<121 min) | Reference | | Reference | | Reference | |
| Medium (≥121 and <179 min) | −1.12 (−3.11, 0.88) | .27 | 0.22 (−0.70, 1.14) | .63 | −0.67 (−1.96, 0.63) | .31 |
| High (≥179 and <255 min) | −0.40 (−2.42, 1.63) | .70 | 0.20 (−0.73, 1.13) | .67 | 0.53 (−0.79, 1.84) | .43 |
| Very High (≥255 min) | −3.35 (−5.47, −1.23) | .002 | 1.31 (0.34, 2.28) | .008 | −1.43 (−2.80, −0.07) | .04 |
| Television | | | | | | |
| Low (<69 min) | Reference | | Reference | | Reference | |
| Medium (≥69 and <115 min) | 1.52 (−0.47, 3.52) | .14 | −0.11 (−1.02, 0.81) | .82 | 0.84 (−0.44, 2.13) | .20 |
| High (≥115 and <173 min) | 1.06 (−0.96, 3.09) | .30 | −0.42 (−1.35, 0.50) | .37 | 1.41 (0.10, 2.72) | .04 |
| Very high (≥173 min) | 0.20 (−1.90, 2.29) | .85 | 0.70 (−0.25, 1.66) | .15 | 0.60 (−0.75, 1.95) | .38 |
| Video game | | | | | | |
| None (0 min) | Reference | | Reference | | Reference | |
| Low (>0 and <45 min) | 0.63 (−1.10, 2.37) | .47 | −0.47 (−1.27, 0.33) | .25 | 0.97 (−0.15, 2.09) | .09 |
| High (≥45 min) | −2.40 (−4.20, −0.60) | .009 | 0.53 (−0.30, 1.35) | .21 | −1.19 (−2.35, −0.03) | .04 |
| Computer | | | | | | |
| None (0 min) | Reference | | Reference | | Reference | |
| Low (>0 and <28 min) | 1.25 (−0.52, 3.01) | .17 | −0.93 (−1.74, −0.12) | .02 | 0.74 (−0.40, 1.88) | .20 |
| High (≥28 min) | 0.36 (−1.40, 2.12) | .69 | −0.52 (−1.32, 0.29) | .21 | −0.23 (−1.36, 0.91) | .70 |
| Telephone | | | | | | |
| None (0 min) | Reference | | Reference | | Reference | |
| Low (>0 and <16 min) | −0.04 (−1.82 1.74) | .97 | −0.18 (−1.00, 0.64) | .66 | −0.33 (−1.48, 0.82) | .58 |
| High (≥16 min) | 0.24 (−1.54 2.02) | .79 | 0.10 (−0.62, 1.01) | .81 | −0.75 (−1.90, 0.40) | .20 |

*All outcomes adjusted for sex, average adolescent age at Multimedia Activity Recall for Children and Adolescents (MARCA) completion, Socio-Economic Indexes for Areas (SEIFA) Disadvantage Index quartile, and adolescent body mass index *z* score. Sample sizes ranged from 899 to 912. 95% CI = 95% confidence interval.

†Summarizes the effect (mean difference) of each category of the exposure measure (eg, telephone use) as a nominal variable against the reference category.

### Computer Use

Compared with no computer use, low (but not high) levels of computer use were associated with slightly lower (better) behavior problem scores (coefficient −0.93; 95% CI, −1.74 to −0.12; $P = .02$) (Table 4). For those reporting low levels of computer use, the odds of experiencing high/very high levels of psychological distress were 58% (95% CI, 37% to 91%) of the odds for those reporting no computer use (Table 5). Similarly, for those reporting high levels, the odds of experiencing high/very high levels of psychological distress were 61% (95% CI, 38% to 96%) of the odds for those reporting no computer use (Table 5).

### Telephone Use

There was little evidence of any associations between telephone use and health outcomes.

Finally, analyses were rerun with only the subset of adolescents who completed the desired 2 useable school day recalls plus 2 useable non–school day recalls (n = 528; full analyses available from the authors). Compared to the 397 adolescents who returned any other combination of recalls, these ideal recall completers were more likely to be boys (56.0% vs 44.0%) and slightly younger (mean 15.8 vs 16.2 years), but were similar in BMI *z* score (0.40 vs 0.39) and social disadvantage quintile. Point estimates varied only marginally throughout. The adverse associations between the range of health outcomes and very high total media and video game use remained evident, with a strengthened association between very high total media use and high psychological distress (OR 2.12, 95% CI, 1.04 to 4.30, $P = .04$ [was 0.08]). However, the associations between computer use and better health outcomes ceased to be significant, although the point estimates all remained in the protective direction. In Table 4, the unexpected association between high television use and better KIDSCREEN disappeared (coefficient 0.61, $P = .47$ [was .04]).

## DISCUSSION

This study confirmed high levels of electronic media use (averaging more than 3 hours per day), with television (just over 2 hours per day) followed by video games and computers, and the least time devoted to telephone use. High levels of video game use was associated with increased psychological distress and poorer physical and psychosocial well-being, HRQoL, and global health, while computer use was weakly associated with a lower risk of psychological distress. However, television was associated with neither physical nor psychological health/well-being.

This study's high daily television use, with levels above the American Academy of Pediatrics recommendations of no more than 1 to 2 hours of quality television/videos a day,[2] is in line with other Australian studies.[4,5] So too is the relative excess of video games over computers[3] and the fact that that boys use media,[3,8] television, and video game[3,25] more often than girls. However, it contrasts

**Table 5.** Adjusted Measures of Effect for Global Health and Psychological Distress Outcomes by Average Daily Time Using Media*

| | Poor/Fair/Good Global Health | | | High/Very High Psychological Distress (K-10) | | |
|---|---|---|---|---|---|---|
| Independent Measure | n (%) | OR (95% CI)† | *P* Value | n (%) | OR (95% CI)† | *P* Value |
| Total media use | | | | | | |
| Low (<121 min) | 94 (42.5) | 1.00 | ... | 40 (17.7) | 1.00 | ... |
| Medium (≥121 and <179 min) | 83 (37.2) | 0.86 (0.58, 1.27) | .44 | 44 (19.2) | 1.18 (0.72, 1.92) | .51 |
| High (≥179 and <255 min) | 87 (39.6) | 1.02 (0.69, 1.52) | .91 | 34 (15.0) | 0.93 (0.55, 1.56) | .78 |
| Very High (≥255 min) | 97 (44.3) | 1.42 (0.93, 2.15) | .10 | 49 (21.6) | 1.58 (0.95, 2.64) | .08 |
| Television viewing | | | | | | |
| Low (<69 min) | 89 (40.6) | 1.00 | ... | 44 (19.6) | 1.00 | ... |
| Medium (≥69 and <115 min) | 93 (41.7) | 1.06 (0.72, 1.57) | .75 | 40 (17.5) | 0.90 (0.56, 1.47) | .69 |
| High (≥115 and <173 min) | 94 (42.3) | 1.20 (0.81, 1.78) | .37 | 42 (18.4) | 1.03 (0.63, 1.67) | .92 |
| Very high (≥173 min) | 85 (38.8) | 1.07 (0.71, 1.62) | .75 | 41 (17.9) | 1.03 (0.62, 1.70) | .92 |
| Video game use | | | | | | |
| None (0 min) | 183 (41.9) | 1.00 | ... | 81 (17.9) | 1.00 | ... |
| Low (>0 and <45 min) | 73 (32.6) | 0.74 (0.52, 1.05) | .09 | 32 (14.0) | 0.75 (0.47, 1.19) | .22 |
| High (≥45 min) | 105 (47.3) | 1.61 (1.13, 2.29) | .009 | 54 (23.8) | 1.79 (1.17, 2.73) | .007 |
| Computer use | | | | | | |
| None (0 min) | 203 (43.0) | 1.00 | ... | 105 (21.6) | 1.00 | ... |
| Low (>0 and <28 min) | 77 (37.9) | 0.75 (0.53, 1.07) | .12 | 30 (14.2) | 0.58 (0.37, 0.91) | .02 |
| High (≥28 min) | 81 (38.9) | 0.88 (0.62, 1.24) | .47 | 32 (15.1) | 0.61 (0.38, 0.96) | .03 |
| Telephone use | | | | | | |
| None (0 min) | 164 (39.7) | 1.00 | ... | 70 (16.4) | 1.00 | ... |
| Low (>0 and <16 min) | 96 (42.7) | 0.96 (0.68, 1.37) | .84 | 46 (19.8) | 1.12 (0.72, 1.72) | .62 |
| High (≥16 min) | 101 (41.2) | 0.90 (0.64, 1.27) | .55 | 51 (20.4) | 1.13 (0.74, 1.74) | .58 |

*All outcomes adjusted for sex, average adolescent age at Multimedia Activity Recall for Children and Adolescents (MARCA) completion, Socio-Economic Indexes for Areas (SEIFA) Disadvantage Index quartile, and adolescent BMI *z* score. Sample sizes range from 872 to 897. K-10 = Kessler-10, a 10-item global measure of psychological distress; OR = odds ratio; 95% CI = 95% confidence interval.

†Summarizes the effect (OR) of each category of the exposure measure (eg, telephone use) as a nominal variable against the reference category.

with at least one major American study of 2000 young people aged 8–18 years[25] in which recreational computers were used for longer periods than video games and hand-held video games (62 minutes vs 49 minutes),[3] and mixed findings regarding boys' and girls' relative computer use—perhaps reflecting younger age groupings in some studies.[3]

Strengths of this study included its large-scale, community-based design, the recent nature of the data, and the fact that almost all participants completed 4 full days of the time-use diary (most population time-use studies collect only 2 full days of data). The 24-hour recall format for daily activities obliged adolescents to account for all waking hours of the day.

The associations between higher durations of video game use and poorer health/well-being are concerning. They could reflect content, which was beyond the focus of this study. Anderson and Bushman[26] reported that across a range of methodologically strong studies, violent video games amplify physiological arousal and aggression-related thoughts and feelings, and reduce prosocial behavior. Associations could also reflect a decline in social involvement and the psychological well-being that goes with social involvement. It might also be that people with antisocial traits are simply more attracted to antisocial media modalities, or there could be a bidirectional cause and effect where aggressively disposed or antisocial individuals select antisocial media, and antisocial media increases aggressive scripts.

Although the apparent favorable associations between computer use and psychological distress may seem surprising,[13,14,16] it is plausible that the Internet may encourage social networks and improve mental health.[18,19] E-mailing and instant messaging are an important means of communication and interaction, as are the social networking Web sites Facebook and MySpace. Indeed, Kraut and colleagues[13] reported that high use of the Internet was associated with mainly positive outcomes over a range of dependent variables measuring social involvement and psychological well-being (local and distant social circle, face-to-face communication, community involvement, trust in people, positive affect, and computer skill). Our positive findings may reflect exactly how an adolescent uses the computer; in one study, boys who spent more time surfing the Internet and doing homework reported a more active lifestyle and higher self-perceived social support, in contrast to those who used the computer for playing games.[27]

After adjusting for BMI, we found no strong associations with poorer health/well-being, despite the high levels of television viewing. Indeed, the relationship between television viewing and obesity has been contested with a meta-analysis by Marshall and colleagues[28] indicating that a small but statistically significant relationship exists among children and adolescents, although it is likely to be too small to be of real clinical relevance. Conversely, a review of the literature by DeMattia and colleagues[29] found that approaches to reduce sedentary behavior improved weight indices. Perhaps because television viewing can occur with the family, it allows social interaction—unlike video games, which are likely in this age group to be both more solitary and violent. Further, the nature of television viewing (how children watch, what

they watch, and with whom) may be as or more important than simply the number of hours watched. It could also be that the lack of a relationship between high television viewing and poorer health/well-being may reflect a wide range of program content viewed (which is beyond the scope of this study), where more neutral or family content would elicit better outcomes than more violent, provocative, or adult content.

This study also found that telephone use was not associated with any of the health outcomes. However, the measure of telephone use was potentially limited because the MARCA only allows for activities that are 5 minutes or more in duration. Therefore, although the study probably captured phone calls, it may not have adequately captured the extent of mobile phone text messaging.

Limitations include the cross-sectional nature of the analyses, so that causal directions of the relationships seen remain to be clarified. However, we could not use the longitudinal data set because we had media time-use at wave 3 only. Loss to follow-up may have biased the generalizability of our media time-use estimates to the whole population, although on the whole, our findings were congruent with estimates from other population-based cross-sectional studies with high recruitment rates. Further, this would be less likely to affect the internal relationships between media use and health/well-being—the primary focus of our study. Last, the MARCA does not allow for multitasking. Thus, secondary media exposures may have been missed. However, if participants were multitasking, they were instructed to report for the activity that was their main focus or estimate the time devoted to both activities. For future studies, novel methods such as ecological momentary assessment methods could be used to study moment-by-moment responsiveness of mood to direct media engagement. This involves the collection of real-time self-report data in the natural environment, frequently with the assistance of personal digital assistants (handhelds).

Although there is debate about television's associations with obesity, we showed that the duration of other forms of media use appear more strongly related to adolescent health/well-being. Future investigations into patterning of time use is warranted to better understand the influence of critical periods of media use across the day. This study supports development of interventions to reduce high video game use, as well as further exploration of the possible role of computers in health enhancement.

## ACKNOWLEDGMENTS

We thank the students and parents/guardians who participated in each of the 3 waves of the Health of Young Victorians Study (HOYVS). We also thank the many schools that allowed us to visit to survey the students. We acknowledge the work of all the field workers who conducted the data collection, as well as the full HOYVS investigator team.

The third wave of the Health of Young Victorians Study was funded by Australian National Health and Medical Research Council (NHMRC; project grant 334303). Dr Wake, the principal investigator, is supported by NHMRC Career Development Award 284556. Dr Hesketh is supported by an NHMRC/NHFA Postdoctoral Fellowship.

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