United States Adolescents' Television, Computer, Videogame, Smartphone, and Tablet Use: Associations with Sugary Drinks, Sleep, Physical Activity, and Obesity

Erica L. Kenney, ScD, MPH, and Steven L. Gortmaker, PhD

Objective To quantify the relationships between youth use of television (TV) and other screen devices, including smartphones and tablets, and obesity risk factors.

Study design TV and other screen device use, including smartphones, tablets, computers, and/or videogames, was self-reported by a nationally representative, cross-sectional sample of 24 800 US high school students (2013-2015 Youth Risk Behavior Surveys). Students also reported on health behaviors including sugar-sweetened beverage (SSB) intake, physical activity, sleep, and weight and height. Sex-stratified logistic regression models, adjusting for the sampling design, estimated associations between TV and other screen device use and SSB intake, physical activity, sleep, and obesity.

Results Approximately 20% of participants used other screen devices for ≥5 hours daily. Watching TV ≥5 hours daily was associated with daily SSB consumption (aOR = 2.72, 95% CI: 2.23, 3.32) and obesity (aOR = 1.78, 95% CI: 1.40, 2.27). Using other screen devices ≥5 hours daily was associated with daily SSB consumption (aOR = 1.98, 95% CI: 1.69, 2.32), inadequate physical activity (aOR = 1.94, 95% CI: 1.69, 2.25), and inadequate sleep (aOR = 1.79, 95% CI: 1.54, 2.08).

Conclusions Using smartphones, tablets, computers, and videogames is associated with several obesity risk factors. Although further study is needed, families should be encouraged to limit both TV viewing and newer screen devices. *(J Pediatr 2017;182:144-9).*

Time spent with screen media devices, including televisions (TVs), computers, videogames, smartphones, and tablets, saturates the waking hours of most American youth. Teenagers (13-18 years old) spend over 6 hours daily engaged with screen devices,[1] well over the 2-hour limit recommended by the American Academy of Pediatrics.[2] The types of screens that youth use have changed rapidly. Smartphone use now makes up the majority of screen engagement among teens,[1] and most youth, even younger children, have their own device; a recent study found over one-half of 3 year olds had been given their own tablet.[3]

Excessive time spent watching TV has long been linked with heightened risk of childhood obesity, across both experimental and observational studies,[4-6] and longitudinal evidence suggests that this increased risk persists well into adulthood.[7] The Community Preventive Services Task Force, based on a comprehensive review of high quality evidence, recommends implementation of interventions to reduce screen time among children as a strategy to prevent obesity.[8] Increased intake of unhealthy foods and beverages is one pathway through which TV time raises obesity risk, largely because of exposure to marketing of unhealthy foods and beverages,[9-12] with higher levels of TV viewing associated with higher intake of total energy,[9,13] as well as sugar-sweetened beverages (SSBs), fast food, sweets, and salty snacks.[14] Increased TV viewing has also been associated with shorter and poorer quality sleep,[15,16] which is itself associated with excess energy intake and weight gain.[17,18]

Less is known about the health impacts of other screen devices, including computers, videogames, and newer media devices such as smartphones and tablets. Existing evidence suggests associations between smartphone and tablet use and inadequate sleep,[19,20] and food and beverage advertising is highly prevalent among social media and other websites directed toward children and youth.[21,22] Given the pervasiveness of TV and other screen devices in the lives of American youth, and given that the majority of adolescents' total screen time is now spent engaging with smartphones (about 2.75 hours per day, on average),[1] it is important to understand how evolving screen devices impact health. This study investigates the relationships between traditional TV use and combined use of smartphones, tablets, computers, and videogames (hereafter referred to as "other screen devices") and several behaviors that increase risk for obesity in a nationally representative survey of US adolescents. We hypothesized that both TV and other screen

BMI	Body mass index
CDC	Centers for Disease Control and Prevention
SSBs	Sugar-sweetened beverages
TV	Television
YRBSS	Youth Risk Behavior Surveillance System

From the Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA

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device use would be associated with significantly higher intake of SSBs, inadequate physical activity, less sleep, and a higher risk of obesity.

Methods

The Youth Risk Behavior Surveillance System (YRBSS) has been overseen by the Centers for Disease Control and Prevention (CDC) since 1991 to collect timely data on health behaviors among US youth.[23] The YRBSS monitors the prevalence of behaviors related to injuries and violence, risky sexual behaviors, tobacco use, alcohol and drug use, dietary intake, and physical activity, as well as the prevalence of obesity and asthma. As part of the YRBSS, national school-based surveys (the Youth Risk Behavior Survey) are conducted biennially by the CDC among a nationally representative sample of students in grades 9-12. The surveys use a 3-stage cluster sampling design, selecting first counties, then schools, then classrooms, with all students in a given classroom eligible to participate, resulting in a response rate of 71% overall since 1991. For this study, we used data from the 2013 and 2015 waves of the national survey, which were conducted among 29 207 students, because respondents were asked to report not only on TV, videogame, and computer use, but also on their use of smartphones, tablets, and time spent on social media. After excluding participants with missing data on any of the variables of interest, the final sample size was 24 800 (84.9% of original sample).

All data, including age, sex, race/ethnicity, and information on health behaviors, were collected from students via a self-administered questionnaire. For the primary exposure in this study (time spent on videogames, computers, smartphones, or tablets), students were asked, "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Count time spent on things such as Xbox, PlayStation, an iPod, an iPad or other tablet, a smartphone, YouTube, Facebook or other social networking tools, and the Internet.)" Similarly, for TV use, students were asked to report on how many hours they watch TV on an average school day. For both questions, response categories were never, <1 hour per day, 1 hour per day, 2 hours per day, 3 hours per day, 4 hours per day, or 5 or more hours per day.

The outcomes evaluated in this study included sleeping less than 8 hours nightly, consuming 1 or more SSBs per day, engaging in at least 60 minutes of physical activity per day for less than 7 days a week, and having obesity. Sleep was measured by asking students to report how many hours of sleep they got on an average school night. Sugar-sweetened beverage consumption was measured by asking how many times in the past 7 days they had drunk a can, bottle, or glass of soda or pop, not including diet drinks. For physical activity, students were asked how many of the past 7 days they had been physically active for at least 60 minutes over the course of the day. Body mass index (BMI) percentile was calculated by YRBSS study staff using student-reported height and weight and comparing with the CDC 2000 Reference Population.[24] YRBSS study staff set observations that appeared to be implausibly high or low values of weight, height, or BMI to missing. Obesity status was determined by calculating whether the respondent was at or above the 95th percentile for BMI.

Statistical Analyses

We estimated the distributions of population characteristics including age, race/ethnicity, sex, obesity, and TV and screen device viewing frequency using PROC SURVEYFREQ to account for the complex sampling design. Using PROC SURVEYLOGISTIC to account for the complex sampling design, we first estimated a set of crude logistic regression models to quantify the associations between TV or other screen device use and each outcome separately, without adjusting for covariates; each level of TV or other screen device viewing frequency was entered in as a categorical variable, with no reported screen viewing as the reference group in each model. We then calculated a second set of adjusted logistic regression models to estimate the associations between level of frequency of use of other screen devices (smartphone, tablet, computer, and videogame combined) and each outcome while simultaneously adjusting for TV viewing frequency and for a set of potentially confounding demographic variables, including age, race/ethnicity, and sex. We tested whether observed relationships between TV and other screen use frequency and the outcomes followed a dose-response pattern by calculating a model with TV and screen use frequencies entered as an ordinal variable rather than as categories. Because prior investigations of the relationships between screen use and weight have been stratified by sex, we also estimated sex-stratified models for all outcomes. Given the multiple models and outcomes in this study (resulting in 24 total adjusted models), we used a Bonferroni correction for setting the criteria for statistical significance, dividing an initial α of 0.05 by the 24 models to arrive at a corrected $\alpha = 0.002$.

Results

The study sample was representative of US youth (**Table I**), with about 57% of the sample identifying as White, 13% identifying as Black or African American, and 21% identifying as Hispanic or Latino. One-half of the sample was female. Most participants were between 15 and 17 years old, with 15% being 18 years or older. On average, respondents reported spending more time on other screen devices compared with TV (**Table II**); 19.5% spent more than 5 hours per day on other screen devices, compared with only 7.8% spending more than 5 hours per day watching TV. More than 25% of boys and approximately 20% of girls reported consuming at least 1 SSB per day, and approximately two-thirds of boys and three-quarters of girls reported not getting daily physical activity. More than two-thirds of adolescents also reported not getting 8 hours of sleep each night. Overall, 13.6% of the sample was found to have obesity.

Associations between TV Viewing and Health

After adjusting for age, sex, race/ethnicity, and other screen device use (**Table III**), TV viewing was associated with

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