



Published in final edited form as:

Pediatrics. 2017 November ; 140(Suppl 2): S97–S101. doi:10.1542/peds.2016-1758K.

Screen Media Exposure and Obesity in Children and Adolescents

Thomas N. Robinson, MD, MPH^{a,b}, Jorge A. Banda, PhD^a, Lauren Hale, PhD^c, Amy Shirong Lu, PhD^{d,e}, Frances Fleming-Milici, PhD^f, Sandra L. Calvert, PhD^g, and Ellen Wartella, PhD^h

^aStanford Solutions Science Laboratory, Department of Pediatrics, Stanford University, Stanford, California

^bLucile Packard Children's Hospital Stanford, Palo Alto, California

^cProgram in Public Health, Department of Family, Population and Preventive Medicine, Stony Brook University, Stony Brook, New York

^dDepartment of Communication Studies, College of Arts, Media and Design, Northeastern University, Boston, Massachusetts

^eHealth Technology Laboratory, Department of Health Sciences, Bouvé College of Health Sciences, Northeastern University, Boston, Massachusetts

^fRudd Center for Food Policy and Obesity, University of Connecticut, Hartford, Connecticut

^gChildren's Digital Media Center, Department of Psychology, Georgetown University, Washington, District of Columbia

^hCenter on Media and Human Development, School of Communication, Northwestern University, Evanston, Illinois

Abstract

Obesity is one of the best-documented outcomes of screen media exposure. Many observational studies find relationships between screen media exposure and increased risks of obesity.

Randomized controlled trials of reducing screen time in community settings have reduced weight gain in children, demonstrating a cause and effect relationship. Current evidence suggests that screen media exposure leads to obesity in children and adolescents through increased eating while viewing; exposure to high-calorie, low-nutrient food and beverage marketing that influences children's preferences, purchase requests, consumption habits; and reduced sleep duration. Some evidence also suggests promise for using interactive media to improve eating and physical activity

Address correspondence to Thomas N. Robinson, MD, MPH, Stanford Solutions Science Laboratory, Department of Pediatrics, Stanford University, 1265 Welch Rd, MSOB X129, Stanford, CA 94305. tom.robinson@stanford.edu.

Drs Robinson and Banda conceptualized the manuscript, drafted the initial manuscript, and critically reviewed and revised the manuscript; Drs Hale, Lu, and Fleming-Milici conceptualized the manuscript and critically reviewed and revised the manuscript; Drs Calvert and Wartella critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

The analysis, conclusions, and recommendations contained in each paper are solely a product of the individual workgroup and are not the policy or opinions of, nor do they represent an endorsement by Children and Screens: Institute of Digital Media and Child Development or the American Academy of Pediatrics.

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

behaviors to prevent or reduce obesity. Future interdisciplinary research is needed to examine the effects of newer mobile and other digital media exposures on obesity; to examine the effectiveness of additional interventions to mitigate the adverse effects of media exposures on obesity and possible moderators and mediators of intervention effects; to effectively use digital media interventions to prevent and reduce obesity; and to uncover the mechanisms underlying the causal relationships and interactions between obesity-related outcomes and media content, characteristics, and context.

Obesity is one of the most challenging public health problems facing both developed and developing countries worldwide. Screen media exposure is one of the best-documented causes of obesity in children and, likewise, obesity is one of the best-documented outcomes of screen media exposure. For the purpose of this review, screen media refers to content on any technology platform with a screen.

CURRENT STATE

The relationship between screen media exposure and obesity has been widely studied. Starting in the mid-1980s,¹ many epidemiologic studies have revealed associations between screen time and obesity.² For example, in 1 longitudinal cohort study of a nationally representative sample of US 10- to 15-year-olds, there was a strong dose-response relationship between the number of hours per day children viewed television and the prevalence of overweight, and as much as 60% of the 4-year incidence of overweight was estimated to be attributable to excess television viewing.³ Longer-term cohort studies have revealed that more television viewing during childhood predicts overweight and obesity in adulthood.^{4, 5} In a longitudinal study in New Zealand, up to 17% of the overweight prevalence observed at 26 years of age was estimated to be attributable to viewing >2 hours of television per day on weekdays during childhood and adolescence.⁵ Observational studies have also revealed that greater screen time is associated with cardiometabolic risk factors more broadly, including hypertension, elevated cholesterol levels, insulin resistance, elevated inflammation, and the metabolic syndrome.²

Observational research is limited in its ability to demonstrate cause and effect relationships, and not all epidemiologic studies find significant associations between screen time and obesity in children. However, null results (those that are not statistically significant) do not indicate that a relationship does not exist. Observational studies are susceptible to errors in measuring screen time and the accompanying loss of statistical power and potential bias introduced. There have now been a number of experimental research studies in which screen media exposure was manipulated to test this relationship, demonstrating evidence of a cause and effect link between screen media exposure and excess weight gain in children.

Experimental Studies of Reducing Screen Time

A number of rigorous experimental trials tested the effects of reducing children's screen media exposure on weight gain.⁶ The first to address screen time exclusively was a 7-month, school-based randomized controlled trial among third and fourth grade children from 2 California schools.⁷ One school was randomly selected to receive an 18-lesson, multiple-

component screen-time reduction curriculum delivered by the regular classroom teachers, and it included behavior change skills, an electronic television time manager, and educational parent newsletters. The intervention targeted reducing time spent watching television, playing sedentary video games, and using computers. The other school received no intervention. Both schools received the same measures at the beginning and end of the school year. Over the 7 months of the trial, children in the school that received the screen-time reduction curriculum significantly reduced their television viewing, video game use, and number of meals eaten in front of the television. Intervention participants also significantly slowed their gain in BMI, triceps skinfold thickness, waist circumference, and waist-to-hip ratio compared with the children in the control school. In a subsequent 2-year trial, 70 4- to 7-year-olds and their families were randomly assigned to either receive a screen-time reduction intervention that involved installing an electronic television time manager in their home or a control parenting intervention.⁸ Compared with controls, children in the screen-time reduction group had significant decreases in television viewing and computer use, energy intake, and age- and sex-adjusted BMI that persisted for 2 years. An analysis of possible mediators suggested that the effects of reduced screen time on changes in BMI were associated with reductions in dietary energy intake but not increased physical activity measured by accelerometry. These studies that focused solely on reducing screen media exposure are also joined by other experimental studies of reducing screen time along with changes in diet, physical activity, and other obesity risk behaviors that have produced reduced obesity and weight gain or obesity compared with controls.⁷ Together these studies demonstrate a direct cause and effect relationship between screen media viewing and weight gain and demonstrate that reducing screen media time results in less BMI gain in children.

How Does Screen Media Exposure Lead to Obesity?

A number of possible mechanisms are thought to explain the effects of screen media exposure on obesity.^{2, 9} These include displacing physical activity, increasing energy intake from eating while viewing and/or the effects of advertising, and reducing sleep.

Although it is often assumed that screen media time displaces time spent being more physically active, epidemiologic studies have only inconsistently revealed cross-sectional or prospective associations between screen time and less physical activity. This may be because of the difficulties in validly measuring both screen media exposure and physical activity. Experimental studies of reducing screen time have generally revealed only small if any measurable increases in physical activity.⁶ This suggests that displacement of physical activity may not be a strong link between screen time and obesity.

In contrast, much more evidence supports screen media effects on energy intake as the prominent mechanism linking screen time and obesity in children. Epidemiologic studies reveal that children who consume more screen media also consume fewer fruits and vegetables and more energy-dense snacks, energy-dense drinks and fast food, receive a higher percentage of their energy from fats, and have a higher total energy intake.^{10, 11} Laboratory-based experimental studies have revealed that screen media exposure can lead to incremental energy consumption without increased feelings of hunger or compensation by

lower intake during the rest of the day.¹² Screen-time reduction interventions also have documented reductions in dietary intake compared with controls.^{7, 8}

Eating while viewing is one important way that screen media exposure increases children's energy intake. Studies have revealed that children consume a large proportion of their daily calories and meals while watching screen media. In 1 study, up to a third of daily energy intake and half of children's meals were consumed in front of a screen.¹³ Some of this effect may be because of the large amount of time spent with screens, the types of high-energy foods and beverages that are consumed while viewing, media acting as a trigger or prompt to eating, media extending the duration of eating, or media distracting from or obscuring feelings of fullness or satiety.¹⁴

Food advertising is another explanation for the link between screen media exposure and excess energy consumption.¹⁵ According to the Federal Trade Commission, food and beverage companies spent \$1.8 billion on marketing to children and adolescents in the United States in 2009.¹⁶ It is estimated that in 2014, 2- to 11-year-olds and 12- to 17-year-olds saw an average of 12.8 and 15.2 food, beverage, and restaurant advertisements per day on television, respectively.¹⁷ In addition, youth are now exposed to marketing in new media, including food company-sponsored websites, apps, and advergames as well as in advertising on third-party children's websites and marketing via mobile devices and social media.¹⁶ This new marketing is engaging and often disguised as entertainment or messages from friends, making it more difficult for children, even older children, to recognize its persuasive intent.¹⁸ Research shows that food advertising impacts children's food preference and food intake.¹⁵ Again, the strongest evidence comes from experimental studies. For example, randomized controlled trials of food commercials embedded in animated programs revealed that advertising increases automatic eating for foods not being advertised,¹⁹ and even a single 30-second commercial impacts brand preferences.²⁰ In addition, a randomized controlled trial also revealed that fast food branding altered young children's actual taste perceptions in side-by-side taste tests.²¹

Inadequate sleep is another likely mechanism linking screen media exposure, excess energy consumption, and obesity. A recent systematic literature review of screen time and sleep found that over 90% of the studies demonstrated positive associations between screen time and adverse sleep, usually measured by later bedtimes and less total sleep time.²² Sleep deprivation has been associated with increased obesity and weight gain among children, most consistently among those between ages 3 and 7.^{23, 24} At least 3 possible mechanisms have been suggested: sleep deprivation causes changes in the appetite-regulating hormones ghrelin and leptin to increase hunger and decrease satiety, short sleep duration can affect children's choices to consume more calories and fewer nutritionally-dense foods, and shorter sleep duration may lead to increased snacking and eating outside of normal mealtimes, including during the night.²³

FUTURE RESEARCH

Changes in Screen Media Exposure

Although television still represents the largest source of screen media exposure for most children, recent data suggest that children are spending more and more time using computers, video games, tablets and smartphones, and time spent using smartphones has even overtaken television among adolescents.²⁵ This has also led to changing social and physical contexts in which children are interacting with screen media content. Because this transition is happening quickly, there has been limited evidence about whether these new sources of screen media will continue to produce similar impacts on childhood obesity. The experimental studies of reducing screen time leading to less weight gain targeted total screen time from television, video games, and computers altogether.^{7, 8} The impact of using specific individual media requires empirical study but also may not reflect real-world media use. However, many of the hypothesized mechanisms linking screen media exposure to obesity, such as concurrent eating, advertising, and insufficient sleep, lead us to hypothesize that most emerging digital media, with their increased abilities for interactivity, immersion, involvement, mobility, and timely feedback, could have similar or even more profound effects on causing weight gain in children.

Using Screen Media to Prevent and Reduce Obesity

It is possible that some of the same characteristics that may make new media potentially more effective at promoting obesity can also be harnessed to prevent and reduce obesity. Some evidence suggests short-term promise for changing eating and increasing activity.²⁶ For example, a number of studies have demonstrated the potential of active video games to increase physical activity and/or reduce measures of obesity,²⁷ particularly when used as part of a more comprehensive weight-control program for overweight or obese children²⁸ or when played as a cooperative team.²⁹ However, there have been a limited number of randomized controlled trials, and most of these studies have been relatively short-term.^{27, 30}

Research Methods

Observational studies will be useful for documenting the use of and exposures to screen media and changes over time, identifying associations, and generating hypotheses about causal relationships and possible moderators and mediators of those associations. Experimental research with randomization to manipulations in exposure (eg, randomized controlled trials of increased or decreased exposure to different media sources, experiences, and/or content) is needed to demonstrate cause and effect relationships, test interventions, and determine moderators (preexisting characteristics that define different responses to exposures or interventions) and mediators (mechanisms) of these relationships.

Recommendations for Researchers: Priority Research Questions

- What are the roles of mobile and other new digital media use and patterns of use as they relate to obesity for children with different characteristics?
- What interventions mitigate the adverse effects of digital media use on obesity (individual, family, school, community, and policy) and what are the potential

moderators and mediators of intervention effects (eg, content exposure, physical activity/inactivity, diet, biological factors, and sleep, for children, teens, and young adults with different characteristics)? In brief, “What works, in which settings and contexts, among whom, and how?”

- How can we apply and integrate theories and insights from multiple disciplines (eg, behavioral science, communication, computer science, medicine, and public health) to effectively use digital media interventions to prevent and reduce obesity?
- What are the causal relationships and interactions between obesity-related outcomes and the following:

Media content (including marketing, advertising, messages, and modeling in entertainment programs and games);

Characteristics of different digital media (properties of the technology and ways the content is presented); and

Context in which media exposure occurs (eg, food environment, family, multiple media use)?

Acknowledgments

FUNDING: This special supplement, “Children, Adolescents and Screens: What We Know and What We Need to Learn,” was made possible through the financial support of Children and Screens: Institute of Digital Media and Child Development.

References

1. Dietz WH Jr, Gortmaker SL. Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. *Pediatrics*. 1985; 75(5):807–812. [PubMed: 3873060]
2. Strasburger VC. Council on Communications and Media. Children, adolescents, obesity, and the media. [published correction appears in *Pediatrics*. 2011;128(3):594]. *Pediatrics*. 2011; 128(1):201–208. [PubMed: 21708800]
3. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. *Arch Pediatr Adolesc Med*. 1996; 150(4):356–362. [PubMed: 8634729]
4. Viner RM, Cole TJ. Television viewing in early childhood predicts adult body mass index. *J Pediatr*. 2005; 147(4):429–435. [PubMed: 16227025]
5. Hancox RJ, Milne BJ, Poulton R. Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. *Lancet*. 2004; 364(9430):257–262. [PubMed: 15262103]
6. Ramsey Buchanan L, Rooks-Peck CR, Finnie RK, et al. Community Preventive Services Task Force. Reducing recreational sedentary screen time: a community guide systematic review. *Am J Prev Med*. 2016; 50(3):402–415. [PubMed: 26897342]
7. Robinson TN. Reducing children’s television viewing to prevent obesity: a randomized controlled trial. *JAMA*. 1999; 282(16):1561–1567. [PubMed: 10546696]
8. Epstein LH, Roemmich JN, Robinson JL, et al. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. *Arch Pediatr Adolesc Med*. 2008; 162(3):239–245. [PubMed: 18316661]
9. Robinson TN. Television viewing and childhood obesity. *Pediatr Clin North Am*. 2001; 48(4):1017–1025. [PubMed: 11494635]

10. Pearson N, Biddle SJ. Sedentary behavior and dietary intake in children, adolescents, and adults. A systematic review. *Am J Prev Med.* 2011; 41(2):178–188. [PubMed: 21767726]
11. Ford C, Ward D, White M. Television viewing associated with adverse dietary outcomes in children ages 2–6. *Obes Rev.* 2012; 13(12):1139–1147. [PubMed: 22958789]
12. Chaput JP, Visby T, Nyby S, et al. Video game playing increases food intake in adolescents: a randomized crossover study. *Am J Clin Nutr.* 2011; 93(6):1196–1203. [PubMed: 21490141]
13. Matheson DM, Wang Y, Klesges LM, Beech BM, Kraemer HC, Robinson TN. African-American girls' dietary intake while watching television. *Obes Res.* 2004; 12(suppl 9):32S–37S. [PubMed: 15489465]
14. Robinson TN, Matheson DM. Environmental strategies for portion control in children. *Appetite.* 2015; 88:33–38. [PubMed: 25485874]
15. McGinnis, JM, Gootman, JA., Kraak, VI., editors. Institute of Medicine Committee on Food Marketing and the Diets of Children and Youth. *Food Marketing to Children and Youth: Threat or Opportunity?*. Washington, DC: The National Academies Press; 2006.
16. Leibowitz, J., Rosch, JT., Ramirez, E., Brill, J., Ohlhausen, M. Federal Trade Commission. [Accessed December 5, 2016] A review of food marketing to children and adolescents: follow-up report. 2012. Available at: <https://www.ftc.gov/sites/default/files/documents/reports/review-food-marketing-children-and-adolescents-follow-report/121221foodmarketingreport.pdf>
17. Sheehan, C., Harris, JL. Rudd Center for Food Policy and Obesity. [Accessed December 5, 2016] Trends in television food advertising to young people: 2014 update. Updated 2015. Available at: http://www.uconnruddcenter.org/files/Pdfs/TVadstrendupdate2015_rev4-11-16.pdf
18. Harris, JL., Heard, AB., Schwartz, MB. Yale Rudd Center for Food Policy and Obesity. [Accessed December 5, 2016] Older but still vulnerable: All children need protection from food marketing. 2014. Available at: http://www.uconnruddcenter.org/files/Pdfs/Protecting_Older_Children_3_14.pdf
19. Harris JL, Bargh JA, Brownell KD. Priming effects of television food advertising on eating behavior. *Health Psychol.* 2009; 28(4):404–413. [PubMed: 19594263]
20. Borzekowski DL, Robinson TN. The 30-second effect: an experiment revealing the impact of television commercials on food preferences of preschoolers. *J Am Diet Assoc.* 2001; 101(1):42–46. [PubMed: 11209583]
21. Robinson TN, Borzekowski DL, Matheson DM, Kraemer HC. Effects of fast food branding on young children's taste preferences. *Arch Pediatr Adolesc Med.* 2007; 161(8):792–797. [PubMed: 17679662]
22. Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Med Rev.* 2015; 21:50–58. [PubMed: 25193149]
23. Miller AL, Lumeng JC, LeBourgeois MK. Sleep patterns and obesity in childhood. *Curr Opin Endocrinol Diabetes Obes.* 2015; 22(1):41–47. [PubMed: 25517022]
24. Magee L, Hale L. Longitudinal associations between sleep duration and subsequent weight gain: a systematic review. *Sleep Med Rev.* 2012; 16(3):231–241. [PubMed: 21784678]
25. Rideout, V. Common Sense Media. *The Common Sense Census: Media Use by Tweens and Teens.* San Francisco, CA: Common Sense Media; 2015.
26. Calvert SL, Staiano AE, Bond BJ. Electronic gaming and the obesity crisis. *New Dir Child Adolesc Dev.* 2013; 2013(139):51–57. [PubMed: 23483693]
27. Lu AS, Kharrazi H, Gharghabi F, Thompson D. A systematic review of health videogames on childhood obesity prevention and intervention. *Games Health J.* 2013; 2(3):131–141. [PubMed: 24353906]
28. Trost SG, Sundal D, Foster GD, Lent MR, Vojta D. Effects of a pediatric weight management program with and without active video games a randomized trial. *JAMA Pediatr.* 2014; 168(5):407–413. [PubMed: 24589566]
29. Staiano AE, Abraham AA, Calvert SL. Adolescent exergame play for weight loss and psychosocial improvement: a controlled physical activity intervention. *Obesity (Silver Spring).* 2013; 21(3):598–601. [PubMed: 23592669]

30. Quelly SB, Norris AE, DiPietro JL. Impact of mobile apps to combat obesity in children and adolescents: a systematic literature review. *J Spec Pediatr Nurs.* 2016; 21(1):5–17. [PubMed: 26494019]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript