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The association of adolescents' television viewing with Body Mass Index percentile, food addiction, and addictive phone use

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ABSTRACT

Television (TV) viewing remain a popular forms of screen time for adolescents. Greater TV viewing is associated with a number of negative consequences for adolescent health. In a changing media landscape, it is important to understand adolescents' overall and commercial TV exposure, and how TV viewing is linked to health risks (e.g., obesity, food addiction, and phone addiction). The purpose of this study was to: 1) examine differences by age, gender, race/ethnicity, and parental education in overall TV and commercial TV viewing and 2) investigate whether adolescents who watch more overall TV and commercial TV programming were more likely to have a higher BMI percentile, more addictive eating, and more addictive phone use. A sample of 190 adolescents (13–16 years of age) completed Time-Use Diaries (TUDs) in 2015–2017. We found that girls had more overall weekday TV time than males. No other gender differences were detected for weekend TV time or commercial TV time. Higher BMI percentile was not correlated with greater overall or commercial TV viewing. However, we did identify a positive association between overall TV viewing and commercial TV viewing with addictive-eating and addictive phone use. This effect was mainly driven by boys. To our knowledge, this is the first study to investigate patterns of television viewing and addictive-like eating and addictive phone use. We conclude that adolescents, particularly boys, with higher TV viewing may be more likely to present with problems with addictive eating behavior and phone use. Our findings add to the research on the behavioral health correlates of TV viewing among adolescents.

1. Introduction

Adolescents are major consumers of television (TV) viewing. As of 2019, the largest proportion (i.e., 39%) of an adolescent's (13–18 year old) screen time was TV viewing (Rideout & Robb, 2019). Further, 57% of adolescents report watching TV every day, and watch an average of 1 h and 49 min of TV daily (Rideout & Robb, 2019). There are known chronological and demographic differences in TV watching. For example, due to school schedules, TV viewing is higher on weekends than on weekdays or school days, likely more so for youth who do not have recreational activities to engage in during the weekends (Bucksch et al., 2016; Engberg et al., 2020). Demographic differences in TV viewing among adolescents have widened over the past few decades. Based on the most recent nationwide study of adolescents' screen time by Common Sense Media, adolescents from lower-income households [defined as less than $35,000 annual household income] watch TV for nearly 2 h per day, compared to 1 h and 23 min among adolescents in higher-income households [defined as household incomes $\geq$ $100,000] (Rideout & Robb, 2019). Further, differences by race/ethnicity indicate greater TV viewing among African American/Black adolescents (approximately 2 h per day) compared to White peers (approximately 1.5 h per day (Rideout & Robb, 2019);). Although most recent research on gender differences in TV viewing time do not indicate significant differences in hours of TV watching per day (Rideout & Robb, 2019), there are differences in TV viewing preference and impact. Specifically, girls report enjoying TV watching more than boys, whereas boys report greater enjoyment of watching online videos (e.g., via Youtube or streaming networks) (Rideout & Robb, 2019).

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Greater TV viewing is associated with a number of negative consequences for adolescent health, in particular heightened risk for obesity, with disrupted sleep as a potential mediating variable (Robinson et al., 2017). Indeed, there is evidence linking a reduction in overall screen time (TV viewing, gaming, and computer usage) with changes in obesity risk behaviors (e.g., less energy intake and decreases in BMI) (Robinson et al., 2017). Specific to TV viewing, research has supported exposure to commercials (versus an increase in sedentary behavior) as a primary contributor to obesity risk in youth (Domoff et al., 2020; Robinson et al., 2017). Food companies spend more than $1 billion dollars on food marketing targeted toward 12–17 year olds (Commission, 2012). In fact, it is estimated that adolescents (12–17 year olds) see over 15 advertisements for food, beverages, or restaurants on TV per day (Shehan & Harris, 2014). The content of these commercials promotes unhealthy foods and drinks, with high levels of added sodium, fats, and sugars (Powell et al., 2011).

Exposure to commercials for nutrient-poor, calorie-dense foods is associated with increased total intake of these foods (Andreyeva et al., 2011; Folkvord et al., 2016a; Folkvord et al., 2016b; Wiecha et al., 2006) and eating in the absence of hunger (Temple et al., 2007), as food commercials may unconsciously prime adolescents to desire and consume certain foods (Harris et al., 2082). Adolescents are also at a cognitive disadvantage when they view these advertisements. Compared to adults, adolescents have a lower ability to inhibit impulsive behaviors (Pechmann et al., 2005) and are more sensitive to reward (Friemel et al., 2010). High reward drive coupled with low inhibitory control is associated with a greater likelihood of addictive behaviors (Bickel et al., 2012). Evidence is emerging that some adolescents may be more prone to developing addictive patterns of eating the highly rewarding foods featured in food commercials (Schiestl & Gearhardt, 2018). Thus, adolescents who watch more overall TV and commercial TV programming (i.e., TV shows or videos with commercials embedded within) may have a higher weight and addictive-like eating.

In reviewing the impact of food commercials on adolescent obesogenic risk, it is important to consider the marked shifts in *how* adolescents consume television programming. The number and type of devices available for watching TV programs has expanded from traditional TV sets to include mobile devices (e.g., Smartphones and Tablets) and computers. Although adolescents report still spending the majority of their TV time watching TV on a traditional TV set (approximately 1 h 7 min per day) (Rideout & Robb, 2019), 38 min (approximately 36% of total TV time) is viewed via other devices, such as Smartphones (22 min), computers (10 min), and Tablets (5 min) (Rideout & Robb, 2019).

Given concerns about excessive or "addictive" phone use among adolescents (Common Sense Media), it is also critical to examine whether engaging in the rewarding activity of TV watching on Smartphones may contribute to addictive phone use in adolescents. Adolescents who exhibit addictive phone use feel dependent on their phones, have trouble cutting back on phone use, and have experienced problems in their functioning due to their phone use (e.g., disrupted relationships with others related to excessive phone use), among others (Domoff et al., 2019a). Addictive phone use has been linked to poorer outcomes for adolescent health and development, including disrupted sleep (Domoff et al., 2019b) and poorer academic performance (Domoff et al., 2020). Although greater social media use is associated with higher levels of addictive phone use (Domoff et al., 2020), no prior studies have investigated the association between viewing TV content and addictive phone use. It is likely that youth who feel dependent on their phones will have higher amounts of TV time, especially given the changes in how youth view TV (i.e., youth spend more time watching TV on mobile devices and less time watching TV on traditional TV sets; see the 2019 Common Sense Media Census (Rideout & Robb, 2019)).

In a changing media landscape, it is more important than ever to understand adolescents' overall and commercial TV exposure. The use of time-use diaries (TUDs) may be a useful tool for describing adolescent TV and commercial TV exposure. In contrast to retrospective self-reports that ask individuals to recall experiences in the past (which, with a long delay could lead to biased reporting) (Fomby et al., 2019), TUDs are usually completed directly after the activity occurs (Thomas Juster et al., 2003), which improves the validity of their data. TUDs ask for a chronology of events and time spent completing different behaviors or activities for a designated day or 24-h period directly after the designated time period, and overall have less bias (Thomas Juster et al., 2003).

In the current study of 193 adolescents (13–16 years of age), we aimed to use TUD data to 1) examine differences by age, gender, race/ethnicity, and parental education in overall TV and commercial TV viewing. We also 2) investigated whether adolescents who watch more overall TV and commercial TV programming were more likely to have a higher BMI percentile, more addictive eating, and more addictive phone use.

2. Materials and methods

2.1. Participants

The current study is drawn from a larger parent study examining adolescents' neural responsiveness to fast food advertisements (Gearhardt et al., 2020). A total of 193 adolescents participated, with 190 participants (98.4%) submitting at least one Time Use Diary (TUD; see Table 1 for participant characteristics). Of the participants with TUD data, 190 participants (100%) completed at least one weekday TUD and 184 participants (96.8%) completed at least one weekend day TUD. Data collection occurred between July 2015 and August 2017.

2.2. Procedure

Participants were invited to complete two lab visits (approximately one week apart), which consisted of survey completion, anthropometric measurement, and a neuroimaging paradigm (see Gearhardt et al., 2020, for additional information). After completing the lab visits, participants were provided instructions to complete four TUDs (two weekdays and two weekend days) on their own. See TUD description below for more details. Participants were compensated for completion of each portion of the study, including prorated compensation for completing TUDs. For each survey completed, participants were paid $8.00 and if they completed all four surveys, they received $10.00 per survey completed. For every survey completed between 6:00 p.m. and 9:00 p.m., participants could earn an extra five dollars for a total possible of $60.00 for all four surveys.

Participants provided written assent and a parent or legal guardian provided written informed consent. All study procedures were approved

Table 1
Sample characteristics.

	M (SD)/n (%)
Age	14.28 (1.04)
Gender	
Female	97 (51.1%)
Male	93 (48.9%)
Ethnicity	
Hispanic	17 (8.9%)
Race	
White	134 (70.5%)
Black	25 (13.2%)
Biracial	16 (8.4%)
Other	15 (7.9%)
Parent Education level	
Less than high school or less	26 (13.7%)
High school diploma	10 (5.3%)
Some college courses	23 (12.1%)
Associate's degree	13 (6.8%)
Bachelor's degree	44 (23.2%)
Advanced degree	74 (38.9%)

by the Institutional Review Board at the University of Michigan.

2.3. Measures

2.3.1. Demographic characteristics

Participants provided information about their age, gender, ethnicity, race, and highest education level of parent in the household. Race/ethnicity was categorized as White or non-White; and parental education was categorized as college degree or higher or no college degree attained.

2.3.2. Body Mass Index (BMI) percentile

Participants wore light clothing (i.e., without jackets, socks, or shoes) for their anthropometric measurements. Height was measured using an O'Leary Acrylic Stadiometer height (in centimeters, to the nearest tenth); weight was measured using a Detecto Portable Scale (in kilograms, to the nearest tenth). Gender, age, height, and weight were used to calculate BMI percentiles (Centers for Disease Control and Prevention BMI Calculator, 2018).

2.3.3. The dimensional Yale Food Addiction Scale for children 2.0

(dYFAS-C 2.0) (Schiestl & Gearhardt, 2018). The dYFAS-C 2.0 consists of 16 items ($\alpha = .90$), adapted from the adult version of the Yale Food Addiction Scale 2.0 (Gearhardt et al., 2016). Items include, "When I started to eat certain foods, I found it hard to stop" and "When I cut down or stopped eating certain foods, I craved them a lot more." Participants responded to questions on a Likert-scale, ranging from 0 (never) to 4 (always). Items were summed to calculate a total score, with higher scores indicating greater endorsement of symptoms of food addiction. As this scale was published after the current study commenced, a total of 127 participants completed this measure.

2.3.4. Addictive patterns of use (APU) scale

Participants were administered the APU scale (Domoff et al., 2019a), which consists of nine items assessing excessive use of Smartphones ($\alpha = .85$). Items include "During the last year, how often have there been times when all you could think about was using your phone?" and "During the last year, how often have you felt restless or tense when you were unable to use your phone?" Participants responded to items on a Likert scale from 1 (Never) to 5 (Very often). Mean scores were calculated to provide a summary score. An additional tenth item on the APU scale requests participants to indicate which activities they do most on their phones (e.g., view social media, engage in other forms of entertainment, play games, etc.). Administration of the APU scale commenced part-way through the study, with a total of 111 participants receiving this scale.

2.3.5. Time use diary (TUD) protocol and items

Participants were sent personalized links via email and text message to remotely complete TUDs on four random days (two weekday and two weekend days) in a two-week period following the lab assessments. Emails, with links to the TUD (presented as an online Qualtrics survey), requested that participants complete the TUD between 6:00 p.m. and 9:00 p.m. on the day they received the email. Participants were instructed to complete the TUD based on the *past* 24 h and answered questions about their television viewing time in 3-h intervals. Two different versions of the TUD were used, with minor differences in lay out of questions. Calculation of TUD variables will be provided in the next section.

For each TUD, participants were first provided these instructions: "For the next few questions, when we say television show, we're referring to either: (1) TV episodes or TV show clips that you watched on any electronic medium (e.g. phone, tablet, computer, TV set) OR (2) Any programming (e.g. movies, documentaries, sporting events) that you watched on a television set." Then, participants were asked, "Between 6:00 p.m. - 9:00 p.m. yesterday [repeated for each 3-h interval up through "Between 3:00 p.m.–6:00 p.m. today"], did you watch a television show?" If they responded "Yes," they were then asked to select all the times (provided in 30 min intervals), they watched TV (and then were provided with follow up questions for each interval). In the second version of the TUD, participants were additionally asked to specify the names of the shows they watched during each segment (whereas in the first version of the TUD, participants were asked this question later in the series of follow-up questions). If participants endorsed watching TV, they also answered questions specific to each 30 min interval, including "What were you watching the show on?" (with the following response options: TV set, computer, tablet, phone, other) and "Were there commercials in the show you were watching?" Participants were also asked, "Were you watching live TV?"

2.3.6. TUD-derived variables

Each TUD was coded as either a weekday or weekend day as follows: if the participant completed a TUD on Monday through Friday, their responses were based on Sunday-Thursdays, respectively. As such, their responses were considered as "Weekdays" because the evening prior would have been a "school night." If the participants completed a TUD on Saturday or Sunday, the 24-h response period was the day before, starting on Friday evening or Saturday evening (a non-school night), and thus, was coded as a weekend day.

If participants only provided 1 TUD for a weekday or weekend, that value was used as their weekday or weekend day television program viewing time; if participants had two weekdays and two weekend days, these values were averaged to create an average weekday TV program viewing time and average weekend TV program viewing time, respectively. If participants had more than two weekday or weekend day TUDs, the first two submitted weekday (or weekend day) TUDs were averaged to create the TV program viewing time.

To calculate the overall TV viewing variable, the number of 30-min intervals for which a participant endorsed watching TV were summed and multiplied by 30 (to give an estimate of minutes of overall TV time). To calculate the commercial TV viewing variable, the total number of 30-min intervals for which participants endorsed watching TV programming that included commercials were summed and multiplied by 30 (to give an estimate of minutes of overall commercial TV time). This was done separately for weekday ($n = 190$) and weekend ($n = 184$) TUDs. To describe the proportion of time participants viewed live programming, we divided the number of live TV viewing segments by total number of TV viewing segments. Similarly, to describe how participants watched the TV program (i.e., on a traditional TV, computer, or mobile device, etc.), we divided the number of segments for each type of device by total number of TV segments. Of the 190 participants with at least one TUD, 14 participants did not complete items specific to whether they were watching "live" TV or which device they watched TV for each segment (i.e., 176 participants, or 85% of total sample, have complete TUD data).

2.3.7. Statistical analyses

All variables used in this study were investigated for missing data and normality. All overall TV viewing and commercial TV viewing variables were skewed (skewness statistics ranging from 1.76 to 3.00). Thus, non-parametric analyses that do not require normal distributions were used. For Aim 1, Spearman rho correlations were used to investigate the association of overall and commercial TV viewing variables with age. Mann-Whitney U tests were used to investigate the association of overall and commercial TV viewing variables with sex, race (White/non-White), ethnicity (Hispanic/non-Hispanic) and parental education (no college degree/college degree). For Aim 2, Spearman rho correlations were used to investigate the association of overall and commercial TV viewing variables with BMI percentile, dimensional food addiction scores and addictive phone use. Due to identified sex differences in TV watching, exploratory analyses were conducted in which these correlation matrixes were stratified by sex.

3. Results

3.1. Descriptive statistics

The mean age of the participants was 14.28 (SD = 1.04) years. The average BMI was 24.11 (SD = 5.36) and the average BMI percentile was 73.71 (SD = 24.50). The sample was 48.9% male (n = 93) and 51.1% female (n = 97); 70.5% identified as White (n = 134), followed by 13.2% identifying as Black/African American (n = 25; see Tables 1 and 2 for additional demographic characteristics). In our sample, adolescents averaged 84.95 min (SD = 93.88) of television viewing on weekdays, of which 34.50 min (SD = 58.92; 40.6% of overall TV time) was commercial television programming (see Table 3).

Additionally, adolescents averaged 102.88 min (*SD* = 116.86) of television viewing on weekend days, of which 44.43 min (*SD* = 76.06; 43.2% of overall TV time) was commercial television programming. Across the TUD data, adolescents reported watching limited live TV (*M* = 24%, *SD* = 33%). Further, the greatest proportion of TV time was viewed via traditional TV sets (64%), followed by Smartphones (15%) and Computers (12%; see Table 4).

3.2. Aim 1

Differences in screen time emerged by gender only. Specifically, adolescent girls had higher weekday TV time (M = 99.90 min, SD = 104.68) compared to adolescent boys (M = 69.35 min, SD = 78.66). There were no other differences by gender on the other television viewing variables. No significant differences were found for age, race, ethnicity, or parental education (all *ps* > .05).

3.3. Aim 2

For the overall sample, overall TV viewing on weekdays and weekends was positively associated with dYFAS 2.0 scores and APU scores, but not BMI percentile. Commercial TV viewing on weekdays and weekends was positively associated with dYFAS 2.0 scores, but not APU scores nor BMI percentile (see Table 5).

Exploratory gender stratified analyses found that for boys, overall TV viewing on weekdays and weekends was associated with dYFAS 2.0 scores (Table 6a). Boys' overall weekday (but not weekend) TV viewing was positively associated with APU scores (Table 6a). There were no significant associations with BMI percentile. The same pattern of results was demonstrated for commercial TV viewing (see Table 6a).

For girls, the only significant finding was a positive association between overall weekday TV viewing and dYFAS 2.0 scores (see Table 6b.)

4. Discussion

To our knowledge, this is the first study to investigate patterns of television viewing and addictive-like eating and addictive phone use. In a sample of 190 adolescents, we found that girls had more overall weekday TV time than males. No other gender differences were detected for weekend TV time or commercial TV time. No differences by age, race, ethnicity, or parental education were identified in overall or commercial TV viewing. In contrast to prior studies, we did not find an association between higher BMI percentile and overall or commercial TV viewing. However, the current study did identify a positive association between overall TV viewing and commercial TV viewing with addictive-eating and addictive phone use. This effect was driven largely by boys. This highlights that adolescents, particularly boys, with higher TV viewing may be more likely to present with problems with addictive eating behavior and phone use.

Adolescents have higher reward and lower inhibitory control (Friemel et al., 2010; Pechmann et al., 2005). This psychological profile increases the risk of engagement with highly rewarding substances (e.g., alcohol) and behaviors (e.g., risky sex). TV viewing is also rewarding (Sussman & Moran, 2013), thus adolescents who are prone to eating addictively may also be watching higher levels of TV. Commercial TV viewing was also associated with addictive eating in adolescents. The dominant commercial content viewed by adolescents is for nutrient-poor, calorie-dense foods (e.g., sugar-sweetened beverages, cheeseburgers). These types of food commercials are effective at activating reward systems of brain and can increase overeating of unhealthy foods (Andreyeva et al., 2011; Folkvord et al., 2015; Folkvord et al., 2016a; Gearhardt et al., 2020; Wiecha et al., 2006). Thus, adolescents at risk for addictive eating who watch more food commercials may be more likely to experience more eating-related problems. However, the current findings are correlational and it will be important for future studies to identify whether there are causal connections in the association of overall and commercial TV viewing with addictive eating in adolescents.

Our study additionally found that TV viewing was associated with greater addictive phone use. Prior research has indicated that higher amounts of screen time (across all media) associate with screen media "addiction" in children (Domoff et al., 2019c). Specific to Smartphone use, hours of social media are associated with greater phone addiction scores (Domoff et al., 2020). Although social media use and gaming are two screen-based activities most often considered as driving adolescents' Smartphone overuse, our study suggests that youth who watch more TV may also be susceptible to excessive use of Smartphones—-which is especially relevant given that adolescents are more regularly using Smartphones to watch TV programs. But, as with our finding linking TV viewing with addictive eating, it may also be possible that youth who are susceptible to highly rewarding activities engage in a variety of behaviors to excess. Indeed, prior research has found overlap in problematic screen use across media platforms (i.e., a sizeable proportion of youth have both problematic internet and problematic phone use (Lee et al., 2018)), suggesting an underlying phenotype for behavioral addiction risk. Future research examining this trans-behavioral risk profile, as well as identifying which phone activities (e.g., social media use, texting/communication apps, mobile gaming) associate with higher levels of excessive phone use, is recommended.

Exploratory analyses by gender indicate that associations between TV viewing and addictive eating and phone use were mostly driven by boys in our study. Although we did not have a priori hypotheses about which gender may be at higher risk, media effects research indicates that boys may be more susceptible to multiple types of problematic media use. For example, Lee et al. (2018) found a greater prevalence of boys in the "dual-problem users" group, indicating that boys were far more likely to have both internet and smartphone addiction, compared to girls. Future research should examine which aspects of streaming networks and online videos (e.g., auto-play, personalized messages and menus) promote greater user engagement and risk, to expand upon this finding. Nonetheless, caregivers and clinicians may seek to screen for addictive eating and addictive phone use in boys who report high amounts of TV viewing.

Previous studies examining adolescent TV viewing time had much larger samples (Bucksch et al., 2016; Rideout & Robb, 2019), and more racial/ethnic diversity, potentially contributing to the differences in TV viewing amounts found in our study. However, in examining average TV

Table 2
Demographic characteristics by gender and race (two categories).

	Total	Boys	Girls	White	Not White
BMI percentile	73.71 (24.50)	71.01 (25.58)	76.29 (23.40)	71.77 (25.37)	78.49 (21.96)
dYFAS-C 2.0	26.20 (8.41)	23.67 (6.28)	28.59 (9.38)	26.22 (7.98)	26.25 (9.44)
APU	1.83 (0.60)	1.55 (0.48)	2.05 (0.60)	1.79 (0.55)	1.92 (0.71)

Note. Means and standard deviations presented. BMI = Body Mass Index; dYFAS-C 2.0 = Dimensional Yale Food Addiction Scale for Children, 2.0 (range: 0–64); APU = Addictive Patterns of Use Scale (range: 1–5).

Table 3
Adolescents' television viewing time.

Time of the Week	Average TV time (SD)	Boys	Girls	White	Not White	Average Commercial TV time (SD)	Boys	Girls	White	Not White
Weekday	84.95 (93.88)	69.35 (78.66)	99.90 (104.68)	85.52 (89.98)	83.57 (103.44)	34.50 (58.92)	29.68 (47.07)	39.12 (68.31)	31.46 (51.83)	41.79 (73.19)
Weekend	102.88 (116.86)	87.03 (103.06)	118.39 (127.60)	96.64 (108.41)	118.30 (135.41)	44.43 (76.06)	40.38 (70.49)	48.39 (81.32)	40.53 (78.25)	54.06 (70.13)

Table 4
Proportions of TV time by type of device.

Device	Proportion of Total TV time (M, SD)
TV set	.65 (.37)
Computer	.12 (.26)
Tablet	.05 (.18)
Phone	.15 (.27)
Other	.01 (.07)

Note. Proportion was calculated by dividing the number of segments of TV viewing per device by total number of segments of TV time.

Table 5
Associations of TV time with BMI percentile, Food Addiction (YFAS), and Addictive Phone Use (APU).

	1	2	3	4	5	6	7
1. Average Weekday TV (min)	–						
2. Average Weekend TV (min)	.42[a]	–					
3. Average Weekday Commercial (min)	.58[a]	.27[a]	–				
4. Average Weekend Commercial (min)	.24[a]	.61[a]	.51[a]	–			
5. BMI percentile	-.07	-.02	-.08	.03	–		
6. YFAS Score	.31[a]	.22[b]	.22[b]	.20[b]	.32[a]	–	
7. APU Score	.34[a]	.21[b]	.09	.05	.08	.49[a]	–

[a] Spearman Rho correlation is significant at the 0.01 level (2-tailed).
[b] Spearman Rho correlation is significant at the 0.05 level (2-tailed).

viewing time by race/ethnicity in prior studies, we found comparable amounts. For example, Rideout and Robb (2019) found that White adolescents had significantly lower amounts of TV viewing time than their non-White peers. Specifically, they found that White adolescents averaged approximately 90 min of TV viewing time per day—consistent with the average amount of time we found in our sample (i.e., approximately 85 min on weekdays and 103 min on weekend days). Another null finding was that TV viewing time was not significantly associated with BMI percentile, as found in prior literature. However, we did find an association between TV viewing and addictive eating, which has been implicated in obesity risk (e.g. (Domoff et al., 2019c)). As such, longitudinal research examining these associations over time should be conducted, given that adolescents who endorse food addiction may be at risk for future weight gain.

4.1. Limitations

This study had limitations that are important to acknowledge. First, this study was correlational—associations among TV viewing and adolescent health cannot be used to infer causality. All of the participants were located in the southern Michigan region, limiting the generalizability of the findings and the diversity of the sample in terms of race/ethnicity, adolescent age, and parental education was limited. As such, demographic differences reported herein should be seen as preliminary and requiring a larger, more diverse sample of participants (across adolescence) to draw generalizable conclusions. While a strength of this study was the use of TUDs, a larger number of study participants could power stronger results. Additionally, participants completed TUDs during the school year and during summer/holiday breaks. Though this would not impact the associations reported herein, the timing of the year could have added error to total rates of TV viewing.

Table 6
Gender Stratified Correlations

(a) Boys

	1	2	3	4	5	6	7
1. Average Weekday TV (min)	–						
2. Average Weekend TV (min)	.51**	–					
3. Average Weekday Commercial (min)	.63**	.32**	–				
4. Average Weekend Commercial (min)	.26*	.59**	.52**	–			
5. BMI percentile	-.12	-.08	-.04	.13	–		
6. YFAS Score	.32*	.34**	.31*	.38**	.20	–	
7. APU Score	.63**	.16	.29*	-.01	-.06	.53**	–

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
Note. YFAS = Yale Food Addiction Scale and APU = Addictive Phone Use.

(b) Girls

	1	2	3	4	5	6	7
1. Average Weekday TV (min)	–						
2. Average Weekend TV (min)	.32**	–					
3. Average Weekday Commercial (min)	.52**	.21*	–				
4. Average Weekend Commercial (min)	.20	.64**	.49**	–			
5. BMI percentile	-.05	.03	-.13	-.08	–		
6. YFAS Score	.26*	.06	.17	.06	.40**	–	
7. APU Score	-.02	.09	-.21	-.03	.12	.30*	–

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
Note. YFAS = Yale Food Addiction Scale and APU = Addictive Phone Use.

Future research should continue to explore the types of screen media adolescents are interacting with so that commercial exposure can be further characterized (e.g., investigating whether adolescents are using their phones while watching commercial TV segments; examining the number of media/devices adolescents have in their bedroom or household). Similarly, given how the media landscape is changing drastically, future research could consider substitution or complementarity among media devices to further illuminate how adolescents are exposed to commercial TV segments. Further research into how companies are changing the way they advertise to adolescents on these new forms of media and streaming platforms will be an important future direction. Additionally, longitudinal and experimental research that addresses the limitations of this study are critical.

5. Conclusions

This study utilized TUD data in adolescents (13–16 years of age) to evaluate demographic differences and examine if there is a link between television time and BMI percentile, addictive eating, and addictive phone use. A strength of this study was the use of TUDs to quantify TV viewing and validated measures of addictive-like eating and addictive phone use. Girls in our study had higher amounts of TV time, compared

to boys. However, we found that overall television time was associated with addictive-like eating and addictive phone use, particularly among boys (though an association between weekday TV viewing and food addiction scores emerged for girls). Consistent with prior research on problematic screen use across multiple platforms, our study supports that youth who are susceptible to highly rewarding activities may engage in a variety of behaviors to excess (i.e., indicating an underlying phenotype for behavioral addiction risk). Future research examining this trans-behavioral risk profile, as well as examining the longer-term health outcomes associated with TV viewing and addictive behaviors in adolescents is highly recommended.

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CRediT authorship contribution statement

Sarah E. Domoff: Conceptualization, Writing - original draft, Writing - review & editing. **Emma Sutherland:** Data curation, Writing - original draft, Writing - review & editing. **Sonja Yokum:** Writing - review & editing. **Ashley N. Gearhardt:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2020.104990.

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