Published in final edited form as:

Am J Prev Med. 2009 July ; 37(1 Suppl): S50–S55. doi:10.1016/j.amepre.2009.04.017.

Overweight in Children and Adolescents Associated with TV Viewing and Parental Weight:

Project HeartBeat!

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Abstract

Background—Parental obesity and TV viewing are risk factors for childhood obesity. This study assessed the association of children's TV viewing and computer use with body mass and examined whether parental weight status modified the association.

Methods—Cross-sectional associations of parental weight status, hours of TV viewing and computer use, and children's body composition were studied in a subsample of 526 black and nonblack children, aged 8, 11, and 14 years at baseline, enrolled in Project HeartBeat!, a longitudinal study of cardiovascular disease risk factors, 1991–1995. BMI, fat-free mass (FFM), and percent body fat (PBF) were calculated from children's body composition measured at baseline. Children's TV viewing and computer use habits and parental height and weight were self-reported. Multivariate regression analysis was used in assessing inter-relations of parental weight status and child's TV viewing and computer use habits with BMI, FFM, PBF, and risk for overweight status (BMI $\geq$ 85th percentile), adjusting for age, gender, race, and Tanner stage.

Results—Children of one or two overweight/obese parents watched an average of 22 ± 6 minutes or 30 ± 11 minutes more TV per day than children of normal-weight parents, respectively (both $p < 0.01$). In multivariate regression analyses, BMI and PBF increased significantly by 0.42 kg/m² and 1.14% (both $p < 0.001$), respectively, for each hour of TV watched among children with overweight parents, but not for those with normal-weight parents ($p_{\text{interaction}} < 0.05$). Similar results were observed for total screen time.

Conclusions—These study findings are consistent with a genetic contribution of parental weight; however, overweight/obese parents may also exhibit behavior patterns that negatively influence children's TV viewing and have an impact on child overweight status. The effect of parental BMI on children's BMI may have both a genetic and an environmental linkage.

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No financial disclosures were reported by the authors of this paper.

Introduction

For 25 years, national surveys have shown an increasing trend in the prevalence of overweight in children and adolescents.¹ Genetic and lifestyle factors play a role in the development of obesity.^{2–4} Reducing sedentary behaviors, including TV viewing, is important in preventing overweight and obesity.^{5–8} Interestingly, the increased trend in obesity^{9,10} has coincided with an increased prevalence of children watching more than 4 hours of TV per day.^{11,12} Increased TV viewing is just one of several factors, including increased energy intake, reduced energy expenditure from physical activity, and technologic advances responsible for decreased daily energy expenditure, that may be related to a net excess energy intake over long periods. In a cross-sectional study, children who watched more than 5 hours of TV per day were 4.6 times as likely to be overweight as children who watched 0–1 hour per day.¹³ Findings from longitudinal studies also show that children who watch more TV have increasing body mass, even after 6 or 11 years of follow-up assessment.^{11,14} A randomized trial among elementary schoolchildren provided evidence that TV viewing affected BMI; when time spent watching TV was reduced, relative to that for children in control schools, BMI was also reduced after 1 year.⁸

Genetic studies have shown strong correlations between parents' BMI and that of their children.¹⁵ Overweight parents are more likely than normal-weight parents to have overweight children.² In addition, parents play an important role in influencing their children's TV watching and media use patterns. Several studies demonstrated that children who watched TV extensively were from families in which parents did the same.^{4,16–18} Few studies, however, have explored whether parental overweight modifies the relationship between children's body composition and TV viewing patterns.¹⁹ The purpose of this cross-sectional study was to assess the associations of children's TV viewing and total screen time with their weight status and body composition and to examine whether the weight status of the child's parents modified these associations.

Subjects and Methods

Study Population

Project HeartBeat! was a longitudinal study of cardiovascular disease (CVD) risk factor development in children and adolescents. A total of 678 participants were enrolled in three cohorts at baseline in 1991–1993, aged 8 years ($n=159$ boys and 155 girls), 11 years ($n=104$ boys and 93 girls), and 14 years ($n=82$ boys and 85 girls). Girls composed 49.1% of the study population, and participants' self-reported race was 20.1% black and 79.9% nonblack. The complete design and methods of Project HeartBeat! have been reported previously.²⁰

For the current study analysis, participants who were not interviewed about their TV viewing at baseline ($n=102$) and/or who were missing parental height or weight data from either parent ($n=78$) were excluded. Data for 61 single parents were included in the analyses, of whom 52 were women and nine were men. Thus, data for 526 participants were available for cross-sectional analyses of associations of parental weight status, hours of TV viewing, and children's weight status. Consent was obtained from Project HeartBeat! participants and their parents, and the study was approved by the IRBs at the University of Texas Health Science Center and Baylor College of Medicine in Houston.

Measurements of Children's Body Composition and Parents' BMI

Children were barefoot and wore surgical scrub suits over underwear while anthropometric measurements were taken. Using standard protocols, trained staff measured height to the nearest 0.1 cm using a wall-mounted stadiometer. Weight was measured to the nearest 0.1 kg

with a beam-balance scale. Skinfolts at six sites were measured in triplicate to the nearest 0.1 mm, including triceps, subscapular, midaxillary, abdominal, distal thigh, and lateral calf. Fat-free mass (FFM), fat mass, and percent body fat (PBF) were calculated by the gender-specific formulas of Guo and colleagues^{21,22} based on a combination of bioelectric impedance and body measurements. BMI was calculated by standard formula (kg/m^2). For children, the cutpoint for “overweight” was ≥ 95 th percentile of the distribution from the CDC growth charts²³; “at-risk of overweight” was BMI ≥ 85 th percentile and < 95 th percentile; and “normal weight” was < 85 th percentile.

Parents completed a questionnaire at the baseline clinic visit reporting sociodemographic information, including their child’s birth date and race and their own height in inches and weight in pounds. BMI for parents was calculated using this self-reported height and weight information. Others have demonstrated self-report height and weight as valid measures in adults.²⁴

TV Viewing, Computer/Video Use, Physical Activity, and Dietary Intake

Children’s TV viewing habits and computer/video use were assessed during an in-person home interview that took place ~2 weeks after the clinic visit. Children were queried about each TV program they watched the day before and whether they watched the entire program. Interviewers referred to a TV guide/schedule to record the name of the specific program watched and its length in minutes. If the child watched less than an entire program, the interviewer determined from the child’s response how many minutes of a program the child watched, then recorded the number. Children were also asked how much time they spent the preceding day using the computer and video games.

Physical activity was assessed using a 24 hour–recall approach to obtain an estimate of minutes spent in physical activity and was adapted from a 7 day–recall instrument modified for use with pre-adolescent children. This questionnaire has been previously validated among fifth-grade children; correlations between the questionnaire and two validation standards ranged from 0.63 (accelerometer) to 0.72 (heart rate monitor).²⁵ Energy intake (kcal/day) was estimated from a food-frequency questionnaire designed for school-aged children.²⁶ Trained interviewers questioned participants about the frequency and quantity of 137 foods consumed during the preceding week. Parents assisted with the interview if their child was aged < 10 years.

Statistical Analyses

All analyses were performed with SAS, version 9.1. The date of the home interview was used to identify whether TV viewing and computer use occurred on a weekday or weekend, and in which season of the year. Minutes of TV viewing and computer/video use were converted to hours of TV viewing and computer/video use, then added together to create a variable of total screen time hours (TV hours+hours of computer and video use). Categorical variables were created to represent weight status for children and their parents. For the purpose of this analysis, the term “overweight” was used to refer to both at-risk for overweight (BMI ≥ 85 th percentile and < 95 th percentile) and “overweight” (BMI ≥ 95 th percentile) children. For sufficient power, the two categories were combined for the analysis. A categorical variable was created to represent the parents’ weight status as either normal weight (BMI $< 25 \text{ kg}/\text{m}^2$) or overweight/obese (BMI $\geq 25 \text{ kg}/\text{m}^2$).

Descriptive statistics, including Ms and frequencies, were calculated, and significance was tested using student’s *t*-test or the Mantel–Haenszel χ^2 test statistic. Logistic regression analysis was performed to evaluate the association of children’s weight status with their TV viewing and total screen time habits and parental weight status, adjusting for age, gender, and race.

Multivariate regression analyses evaluated the relationships of children's body composition (FFM, BMI, and PBF) with TV watching and total screen time. Weekend day versus weekday, season, energy intake, and minutes of physical activity were not significantly related to weight status, BMI, FFM, or PBF, and therefore were not included in the models. Interaction terms (TV viewing hours by parent weight status, gender, and race) were created and entered into the models to determine whether parental weight status modified the relationship of time spent watching TV and total screen time with children's weight status, and whether the statistical models were modified by gender or race.

Results

Of the 526 children and adolescents included in these analyses, 51.3% were girls and 10.6% were black. Baseline age-specific demographic and weight characteristics of the participants are shown in Table 1. Average BMI was 17.1, 19.1, and 21.4 kg/m² for participants aged 8, 11, and 14 years, respectively; and 22.9%, 19.1%, and 18.8% of participants, respectively, were defined as overweight. More than 60% of children had at least one parent who was overweight or obese. Over 13% of children reported not watching TV or using computers/video games the preceding day, whereas the remaining 454 children reported watching TV an average of 1.84 hours (or 110 minutes) per day. Although the proportion of children who reported watching TV on a weekday vs a weekend day was greater (86% vs 14%, respectively), the average number of hours spent watching TV was similar (1.8±1.6 for both; $p=0.63$). Only 120 children reported using computers/video games on the preceding day for about 1.0±1.2 hours. Total screen time for 459 children on the preceding day was 2.0±1.8 hours.

The distribution of the prevalence of overweight children differed significantly with parental overweight status (Table 2). More than 32% of children who had two overweight or obese parents were overweight; 13% of children who had one overweight/obese parent were overweight; and 4% who had normal-weight parents were overweight ($p<0.001$). On average, overweight children watched 43±10 more minutes of TV daily than normal-weight children (2.2 hours vs 1.5 hours; $p<0.001$). There was no significant difference (Figure 1) in the number of TV viewing hours between normal-weight and overweight children who had normal-weight parents ($p=0.43$) or between normal-weight and overweight children with two overweight/obese parents ($p=0.32$). However, among children with one overweight parent, those who were overweight watched an average of 56±15 minutes more TV than normal-weight children ($p<0.01$). Average total screen time followed a similar pattern as with TV viewing (data not shown).

In logistic regression analysis, adjusting models for age, gender, race, and Tanner stage (based on the work of Reynolds and Wines^{27,28} and later popularized by Tanner^{29,30}), the estimated OR and 95% CI for being overweight was 3.1 (95% CI=1.1, 8.6) if one parent was overweight/obese and 10.6 (95% CI=3.7, 30.2) if both parents were overweight/obese, relative to children of normal-weight parents (Table 2). Further, the ORs (95% CI) for becoming overweight with each 1-hour increase in TV viewing and total screen time were 1.3 (95% CI=1.1, 1.5) and 1.2 (95% CI=1.1, 1.4), respectively.

Further examination of the relationship between risk of overweight status and hours of TV watching by commonly reported strata (<2 hours, ≥2 hours) revealed no relationship between strata of TV hours and children's weight status in logistic regression analysis adjusting for age, gender, race, Tanner stage, and parental weight status (OR 1.72; 95% CI=0.9, 3.3). However, children who were engaged in ≥2 hours of total screen time (TV+computer time) had two times the odds of being overweight than those with <2 hours of total screen time (OR 2.1; 95% CI=1.07, 3.9). Parental weight status did not modify the relationship between hours of TV or screen time and children's weight status in the logistic regression models.

In multivariate linear regression analysis, a significant interaction by parental weight status was observed for the relationship between child body composition measures and total screen time or TV hours, even after adjusting for age, gender, race, and Tanner stage ($p_{\text{interaction}} < 0.05$). For each hour of TV and total screen time, BMI increased 0.42 kg/m² and 0.35 kg/m², respectively, among children of overweight/obese parents (both $p < 0.001$), but not among children of normal-weight parents. Body fat increased by 1.14% and 0.93% for each hour of TV or total screen time among children of overweight/obese parents (both $p < 0.001$), but not among children of normal-weight parents. TV and total screen time hours were not related to FFM in children of overweight/obese or normal-weight parents.

Discussion

Greater TV, computer, video game and other media exposure time in children is increasing and is associated with adverse health outcomes such as becoming overweight.^{12,14,31} Some studies have reported null results between TV viewing and overweight status in children,^{32,33} but the current findings are consistent with several reports showing TV viewing to be directly associated with children becoming overweight.^{7,11–14,19,34–36} The present study showed that 1 additional hour of TV watching or total screen time per day increased the odds of being overweight by 20%–30%. Not surprisingly, the study revealed that overweight children reported watching more TV than their nonoverweight counterparts, and those children who had at least one overweight parent tended to watch more hours of TV viewing than children of normal-weight parents.

In a cross-sectional study of a nationally representative sample of 1483 youth and their parents, parental weight moderated the relationship between hours of TV viewing and overweight status among adolescent girls and boys, but not among younger children.¹⁹ In a longitudinal study of adolescent girls, TV viewing predicted increases in BMI for girls with overweight parents but not for girls with normal-weight parents.³⁷ In the present study, parental weight status significantly modified the relationship of TV watching and total screen time with body composition among children of all ages. BMI and PBF were positively associated with hours of TV viewing or total screen time per day in children of overweight/obese parents, but not in children of normal-weight parents.

A mechanism for explaining the association between TV viewing and overweight is thought to be the combination of reduced physical activity and adoption of unhealthy eating patterns. Time spent watching TV or using a computer or other media is time missed from being physically active. In general, children whose levels of physical activity are low may be watching more TV than active children.^{17,38} TV watching is also associated with increased snacking and consumption of high-fat, high-sugar, or high-calorie foods^{3,4,39–43} and low intakes of fruit and vegetables,⁴⁴ all of which have been associated with greater BMI. However, energy intake and physical activity were not related to BMI or PBF, or to hours of TV viewing or total screen time in the present study.

The findings of the current study also support the evidence that obesity is familial. Parental obesity is a strong predictor of overweight and obesity in children.^{2,3,15,45} Family studies have found that parental patterns of TV watching influence those of their children. Children who watch more than 2 hours of TV per day generally have parents who are high-exposure TV viewers.^{3,4,17,18,46} Previous studies of physical activity have demonstrated that parental support of their children's participation in physical activity produces active children.^{47,48} Thus, it is reasonable to conclude that the influence or support of parents may promote their children's involvement in physical activity or inactivity, which ultimately has an impact on their children's body composition. A recent survey of youth aged 8–18 years reported their overall time of media use, including time devoted to TV viewing, video gaming, using a computer,

listening to music, reading, and using a telephone was 6.5 hours in 2004.³¹ Clearly, the use of technology has increased since the present study was conducted, and therefore, the concern for the increased prevalence of overweight and obesity in our society is warranted.

This study had several limitations. First, the cross-sectional study design limits any cause–effect conclusions from being drawn from these study findings. Second, although data were available from 526 boys and girls aged 8, 11, and 14 years, sample size may have limited the ability to detect a significant interaction between parent and child characteristics in the logistic regression models. Third, TV viewing was assessed for one 24-hour period at baseline and may not represent usual TV viewing habits of children. Further, the day of the interview was at the convenience of the parent and child, and therefore, standardization of weekday or weekend day was not considered. However, several studies have reported similar findings that overweight children report more hours of TV viewing.^{11–14} Fourth, parental height and weight information was obtained by self-report. Self-reported height is usually overestimated and weight underestimated,⁴⁹ so a systematic bias toward underestimation of BMI is expected. The effect of this bias would likely attenuate the effect of parental BMI on the relationship of child's hours of TV viewing with BMI. Finally, no information about patterns of parent TV watching was available in this study. On the other hand, the strengths of this study include the study design and the standardized procedures used in data collection, such as recording detailed TV program information to obtain a precise estimate of TV viewing hours.

The effect of parental overweight status on children's body mass may have both genetic and environmental links, especially when parents influence their children's TV viewing habits.^{4, 17,18,47} Therefore, it would be important to target family TV viewing behaviors in weight-management and obesity-prevention strategies. Watching TV, as a sedentary behavior with exposure to adverse dietary messaging, has been associated with negative health effects on children and adolescents, including reduced physical activity, violence, substance use, and other negative behaviors.⁵⁰ The American Academy of Pediatrics recommends that parents limit daily TV time to 1–2 hours per day of quality programming, remove TV sets from children's bedrooms, and encourage alternative entertainment, such as athletics and other individual physical activities. TV viewing increases the likelihood for overweight in childhood^{11–14,19,34,35} and from childhood into adulthood.⁵¹ Therefore, interventions to influence obesity by reducing sedentary behaviors, particularly TV viewing, should begin in early childhood.^{5–8}

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Figure 1.

Mean hours of children's TV viewing per day by parental weight status, Project HeartBeat! (n=526); *multiple regression adjusted for age, gender, and race; $p<0.01$

Table 1

Baseline demographic and selected characteristics of participants, Project HeartBeat!, 1991–1995 ($n=526$), n (%) unless otherwise indicated

Characteristic	Aged 8 years ($n=236$)	Aged 11 years ($n=157$)	Aged 14 years ($n=133$)
Age (years, M [SD])	8.1 (0.2)	11.1 (0.3)	14.0 (0.1)
Gender			
Boys	118 (50)	75 (48)	63 (47)
Girls	118 (50)	82 (52)	70 (53)
Race			
Nonblack	208 (88)	138 (88)	124 (93)
Black	28 (12)	19 (12)	9 (7)
BMI (kg/m^2, M [SD])	17.1 (2.8)	19.1 (3.6)	21.4 (4.1)
Fat-free mass (M [SD])	22.4 (3.9)	30.8 (5.9)	44.1 (6.7)
Percent body fat (M [SD])	23.3 (8.0)	25.2 (8.6)	22.5 (8.0)
Child weight status^a			
Nonoverweight	182 (77.1)	127 (80.9)	108 (81.2)
Overweight	54 (22.9)	30 (19.1)	25 (18.8)
Parental weight status^b			
No overweight/obese parents	88 (37.3)	43 (27.4)	41 (30.8)
One overweight/obese parent	117 (49.6)	75 (47.8)	66 (49.6)
Two overweight/obese parents	31 (13.1)	39 (24.8)	26 (19.6)
TV viewing (hours per day, M [SD])	1.5 (1.6)	1.7 (1.6)	1.6 (1.6)
Total screen time (hours per day, M [SD])	1.7 (1.9)	1.9 (1.7)	1.7 (1.7)

^aNonoverweight, BMI <85th percentile; overweight, BMI $\geq$ 85th percentile

^bOverweight/obese, BMI $\geq$ 25 kg/m^2

Table 2

Logistic regression model predicting child overweight from TV viewing time and parental weight status, Project HeartBeat!, 1991–1995 ($n=526$)

Characteristic	Overweight (≥ 85 th percentile of BMI [%])	OR* (95% CI)
TV viewing on preceding day (hours/day)	13.5	1.3 (1.1, 1.5)
Total screen time on preceding day (hours/day)	13.5	1.2 (1.1, 1.4)
Overweight/obese parent^a		
0	4.0	1.0
1	12.8	3.1 (1.1, 8.6)
2	32.3	10.6 (3.7, 30.2)

^a Overweight/obese, BMI ≥ 25 kg/m²

* Adjusted for age, gender, race, and Tanner stage