Television Viewing and Hypertension in Obese Children

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Background: Television viewing is strongly associated with an increased risk of childhood and adolescent obesity. However, the association between TV viewing and hypertension in children is unknown. This study aimed to identify whether TV watching is associated with hypertension in obese children.

Methods: Children seen for obesity, aged 4 to 17 years, were evaluated at three pediatric centers from 2003 to 2005. In 2006–2007, a logistic regression model estimated the odds of hypertension for hours of daily TV time controlling for race, site, and body mass index (BMI) z-score.

Results: A total of 546 subjects, with a mean age of 12 years, were evaluated. The children had a mean BMI of 35.5±9.3 kg/m^2 (98.7th±0.8 percentile, z-score 2.54±0.4). TV time was positively correlated with the severity of obesity. After controlling for race, site, and BMI z-score, both the severity of obesity and daily TV time were significant independent predictors of the presence of hypertension. Children watching 2 to 4 hours of TV had 2.5 times the odds of hypertension compared with children watching 0 to <2 hours. The odds of hypertension for children watching 4 or more hours of TV were 3.3 times greater than for children watching 0 to <2 hours of TV.

Conclusions: In obese children, the amount of time spent watching TV is associated with both hypertension and the severity of obesity. Thus, TV viewing is a potential target for addressing hypertension in obese children.

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Introduction

Childhood obesity is a major health concern in the United States. As of 2004, the National Health and Nutrition Examination Survey (NHANES) estimated that 17% of children and adolescents were obese.[1] Obesity is known to increase the possibility of cardiovascular risk factors, such as hypertension.[2] Recent studies have shown that cardiovascular risk factors in childhood are significant predictors of preclinical atherosclerosis in adulthood.[3] Thus, the increased prevalence of elevated systolic and diastolic blood pressures among U.S. youth over the past 10 years is cause for concern.[4] The upward shift of blood pressure in children persists after controlling for population changes in body mass index (BMI).[4] Therefore, studies are warranted to assess the contribution of other factors to hypertension in overweight children and adolescents.

Numerous studies[5–12] have shown that time spent watching TV is strongly associated with the risk of being obese in children and adolescents. However, the majority of research has been population-based, which focuses on the risk of being obese versus normal-weight. Little attention has been given to the issue of how TV time is associated with the severity of obesity in obese children. The growing number of obese children worldwide indicates the importance of studying obesity-related issues within this group. Research focusing on an obese population may assist in further identifying prevention and treatment measures for obese children. In addition to the paucity of information available regarding TV time and the severity of obesity, little to no information exists regarding hypertension and TV viewing in obese children. One recent European study did not find an association between TV watching and blood pressure among children[9]; another found a small

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association between systolic blood pressure and TV time in boys, but no association in girls.[11] However, neither of these studies examined the association between TV viewing and blood pressure among obese children. The current study tested the hypothesis that time spent watching TV is associated with hypertension in obese children.

Methods

Participants

Subjects were children, aged 4 to 17 years, evaluated for obesity at pediatric subspecialty weight management clinics in San Diego CA, San Francisco CA, and Dayton OH, from 2003 to 2005. Data were collected prospectively, with written consent obtained from all parents, and written assent from children aged 8 years and older. Obesity, defined as a BMI greater than or equal to the 95th percentile for age and gender, was an inclusion criterion. Children with a preexisting diagnosis of hypertension requiring medication or secondary hypertension were not included in the data collection. The research protocols were approved by the institutional review boards of the University of California, San Diego; Rady Children's Hospital, San Diego; University of California, San Francisco; and Dayton Children's Hospital, Dayton, Ohio.

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Clinical Data Collection

Databases were reviewed for information on age, gender, race, ethnicity, height, weight, systolic blood pressure, and diastolic blood pressure. The child's height was measured to the nearest tenth of a centimeter using a clinical stadiometer. Weight was measured on a clinical scale to the nearest tenth of a kilogram. After 3 minutes of seated rest, blood pressure was measured twice from the right arm of the seated child using an automated sphygmomanometer, with 1 minute of rest between measurements. The average of the two measures was recorded. Cuff sizes were selected according to the circumference of the mid-upper arm, per standard protocol.[13]

Children and their parent(s) were given a written questionnaire, which was filled out by the parent(s) only if the child was aged less than 8 years, and both parent and child together if the child was between the ages of 8 and 17 years. If completed by parent and child together, they were instructed to agree on and record a single estimate of average daily time spent watching TV. Parent estimates of child viewing time have been shown to be reliable predictors of child screen time.[14] Previous research has shown high retest reliability of child self-reported TV-viewing time estimates.[15] In order to further ensure the validity of TV-viewing time estimates, the physician verbally reviewed and confirmed the time estimate obtained from the questionnaire during the clinical interview with the parent(s) and, if aged over 8 years, the child.

Clinical Data Calculations

Blood pressure measurements were converted to percentiles using the National High Blood Pressure Education Program tables, with hypertension defined as a systolic and/or diastolic blood pressure greater than or equal to the 95th percentile for the child's age, gender, and height.[16] BMI was calculated by dividing the weight of the child in kilograms by the height in meters squared. BMI percentiles and z-scores were determined from the Centers for Disease Control and Prevention (CDC) 2000 growth curves.[17] A z-score is the number of standard deviations the subject's BMI lies from the national reference mean for a given age and gender.

Data Analysis

Data were analyzed in 2006. Ranges, percentiles, standard deviations, and means were calculated for clinical and demographic variables. The association between hours of TV watched and the severity of obesity was determined with the Pearson correlation, with severe obesity defined as a BMI ≥99th percentile. Differences in BMI, BMI z-score, BMI percentile, age, and hours of TV/day between children with and without hypertension were tested with *t* tests. Differences in the proportion with hypertension between boys and girls and race/ethnicity groups were tested with chi-square tests.

A multivariate logistic regression model estimated the odds ratios (ORs) and 95% confidence intervals (CIs) with hypertension as the dependent variable, and hours of daily TV time (0 to <2 hours, 2 to <4 hours, ≥4 hours) and BMI z-score as independent variables, with additional covariates of race and site. All reported *p*-values were for two-sided tests, with effects considered statistically significant at $p<0.05$. All statistical analyses were performed using SPSS software, version 15.0.

Results

Study Sample

A total of 556 children from three pediatric subspecialty centers met the inclusion criteria for the study. Ten children with missing data were excluded from the analysis. The demographic and clinical characteristics of the remaining 546 subjects (275 boys, 271 girls) are described in Table 1. The mean age for the sample was 11.9 years. The mean BMI was 35.5 ± 9.3 kg/m^2 (98.7th$\pm$0.8 percentile, z-score$=2.54\pm0.4$). Table 1 also shows the distribution of children within the TV-time categories. The majority of children (78%) watched ≥2 hours of TV per day. Mean time spent watching TV (3.2 ± 1.8 hours per day) was similar to population norms.[6] Overall, children in the 0- to <2-hour category watched a mean of 1.0 ± 0.4 hours of TV per day; in the 2- to <4-hour category, 2.4 ± 0.5 hours per day; in the 4+-hours category, 5.0 ± 1.0 hours per day.

TV and Obesity

There was a positive correlation (r=0.17; $p<0.001$) between time spent watching TV and BMI z-score. When the 99th percentile for BMI was used as a cutpoint, those with a BMI <99th percentile watched 2.6 ± 1.8 hours of TV per day, compared to children with a BMI ≥99th percentile,

Table 1. Clinical and demographic characteristics of the study population

Characteristic	All subjects (N=546)	Subjects without hypertension (n=311)	Subjects with hypertension (n=235)
Age, mean (SD), years[a]	11.9 (3.4)	11.7 (3.5)	12.3 (3.3)
Gender, N (%)			
Male	275 (50.4)	160 (51.4)	115 (48.9)
Female	271 (49.6)	151 (48.6)	120 (51.1)
Race/ethnicity, N (%)			
African American	127 (23.3)	64 (20.6)	63 (26.8)
Asian/Pacific Islander	20 (3.7)	12 (3.9)	8 (3.4)
Hispanic	37 (6.8)	23 (7.4)	14 (6.0)
Multiracial	21 (3.8)	15 (4.8)	6 (2.6)
White	287 (52.6)	159 (51.1)	128 (54.5)
Other	54 (9.9)	38 (12.2)	16 (6.8)
Blood pressure (mm Hg)			
Systolic (mean, SD)[a]	121.0 (16.1)	110.6 (10.4)	134.7 (11.2)
Diastolic (mean, SD)[a]	65.3 (9.5)	61.9 (8.4)	69.8 (8.9)
BMI (kg/m^2)			
Mean (SD)[a]	35.5 (9.3)	33.9 (8.5)	37.6 (9.8)
Percentile, mean (SD)[a]	98.7 (0.8)	98.6 (0.9)	98.9 (0.5)
Z-score, mean (SD)[a]	2.54 (0.4)	2.49 (0.5)	2.59 (0.4)
Hours of TV/day, Mean (SD)[a]	3.1 (1.8)	2.8 (1.7)	3.6 (1.8)
TV time categories, N (%)			
0 to <2 hours/day	121 (22.2)	94 (30.2)	27 (11.5)
2 to <4 hours/day	202 (37.0)	115 (37.0)	87 (37.0)
≥4 hours/day	223 (40.8)	102 (32.8)	121 (51.5)

[a]$p<0.05$ for children with hypertension versus without hypertension.
BMI, body mass index.

who watched 3.3±1.7 hours per day ($p<0.001$). Age, gender, race, and ethnicity were not significantly different between the two groups.

TV and Hypertension

As shown in Table 1, hypertension was common in the study sample (235/546, 43%). Children with hypertension had a higher mean BMI than those without hypertension (37.6±9.8 kg/m^2 vs 33.9±8.5 kg/m^2, $p<0.05$). The mean age of the group with elevated blood pressure was higher than those without (12.3±3.3 years vs 11.7±3.5 years), and those with hypertension watched nearly 1 hour more TV per day. As shown in Table 1, the majority (89%) of obese children with hypertension watched ≥2 hours of TV per day.

In unadjusted analysis, greater amounts of daily TV watching were associated with increased odds of hypertension, as shown in Table 2. After controlling for race, site, and BMI z-score, the odds of having hypertension decreased only slightly, indicating that TV viewing is associated with hypertension independent of obesity. In the adjusted analysis, children watching 2 to <4 hours of TV had 2.5 times higher odds of having hypertension than those watching <2 hours. Children viewing ≥4 hours of TV per day had 3.3 times higher odds of having hypertension than those watching <2 hours. BMI z-score also was associated with hypertension (OR=1.62; $p=0.029$). When TV viewing time was entered into the model as a continuous variable, the odds of having hypertension increased by 26% for each hour of TV watched per day (OR=1.26, 95% CI=1.13–1.40, $p<0.001$).

Discussion

In a multicenter study of obese children, the relationship between time spent watching TV and the presence

Table 2. Logistic regression model for hypertension in obese children

	Unadjusted			Adjusted[a]		
Variable	p value	OR	95% CI (%)	p value	OR	95% CI (%)
BMI z-score	—	—	—	0.029	1.62	1.05–2.49
TV per day (hours)						
0 to <2	—	—	—	—	—	—
2 to <4	$p<0.001$	2.63	1.58–4.39	$p<0.001$	2.54	1.51–4.29
4+	$p<0.001$	4.13	2.50–6.83	$p<0.001$	3.29	1.95–5.56

[a]Adjusted for race, BMI z-score, and site.
BMI, body mass index; CI, confidence interval; OR, odds ratio.

of hypertension was examined. TV time was positively correlated with the severity of obesity. After controlling for the severity of obesity, TV time was independently associated with the presence of hypertension.

This study is the first to demonstrate an association between TV and blood pressure in obese children. Elevated blood pressure in children and adolescents is a growing concern, as it is both increasing in prevalence and often remains undiagnosed, particularly among individuals with a systolic pressure less than 140 mmHg or a diastolic pressure less than 90 mmHg. Blood pressure percentiles, which are necessary to indicate blood pressure status in children, are rarely calculated during routine office visits. Since childhood blood pressure is one of the strongest predictors of adult blood pressure,[18] hypertension present in childhood is a serious risk factor for future cardiovascular morbidity and mortality[3] and needs to be addressed.

Increased micronutrient and energy intake may also play a role in the relationship between TV and hypertension, and between TV and the severity of obesity. Research has shown that up to 35% of childrens' daily total energy consumption is consumed in front of the TV.[19,20] Foods commonly advertised on television are more frequently consumed than their unadvertised counterparts, and these advertised foods tend to be high in refined sugars (baked sweets, soft drinks) and/or high in fat (fast food, fried foods), giving them a high energy content.[21] TV-influenced intake of such high-fat and high-salt foods may contribute to the association between TV and hypertension. Sodium in particular has been associated with hypertension in adults.[22] However, studies have shown conflicting results as to the role of salt in hypertension in children.[23] Whether TV affects the intake of other micronutrients, such as calcium, potassium, and magnesium is unclear, and research on the association of these nutrients with hypertension in children is incomplete.[24] The increase in the severity of obesity also may be due to dietary choices secondary to TV viewing. TV time has been shown to increase caloric intake.[21,25] It has also been shown that TV time increases the serving size of fried foods and baked sweets by as much as 1.4 servings per week.[21] Together, these factors may contribute to an increase in energy intake not balanced by an increase in energy expenditure, contributing to the relationship between TV and the severity of obesity in this study.

Television viewing by children also increases perceived psychological stress,[26] promoting amygdala activation, which alters both sympathetic efferent output and hypothalamic–pituitary–adrenal axis responsiveness.[27] Urinary glucocorticoid excretion is linked to aspects of the metabolic syndrome, including blood pressure.[28] In addition, there is evidence for the role of stress and glucocorticoids in promoting increased caloric intake of "comfort foods," adiposity, and the metabolic syndrome.[29,30] Several studies have shown relationships between stress and unhealthy dietary practices in adolescents[31] and children.[32] Thus, psychological stress secondary to TV viewing may lead to an increase in visceral adiposity, insulin resistance, and sympathetic nervous system activation, all of which may play a role in the association between TV and hypertension, and TV and the severity of obesity in obese children.[33]

The strengths of this study included its large sample size and multicenter design, which allowed for a broad age range and ethnic diversity. Many previous studies have focused only on a narrow age range[6] or ethnic population.[9,12] The limitations of this study involved the cross-sectional nature of the analysis, which prevented determination of causation of the associations found. In addition, unmeasured familial factors such as socioeconomic status might play a role in the association between TV viewing and hypertension, and thus should be taken into account in future studies. Furthermore, the cross-sectional design allowed for only one sitting for the measurement of blood pressure. Prior to ethe stablishment of a medical diagnosis of hypertension, three measurements on separate office visits are needed. Finally, the measure of television time relied on individual recall. However, self-reported questionnaires have been used in most studies to date on this topic,[5–12] and parent reports have been shown to be reasonably accurate estimates of child TV time.[14] Furthermore, TV-time estimates were reviewed and confirmed with the parent and child in addition to the initial questionnaire.

The current study illustrates the need for considerable physician and family involvement to decrease TV time among obese children. The American Academy of Pediatrics (AAP) recommends that children watch less than 2 hours of TV per day,[34] but reports that only half (51%) of pediatricians make this recommendation to patients.[35] One recent study has shown that many parents do not consider the risks of television viewing to apply to their child.[36] In this study, only 20% of obese children already comply with these guidelines, and nearly 89% of obese children with hypertension watch 2 or more hours of TV per day. Thus, although decreasing TV time may not be a universal strategy, TV viewing is an attractive target for intervention, particularly among obese children with hypertension. Several studies have demonstrated that changing TV time alone can lead to weight loss, without any changes in physical activity.[37–39] Further intervention studies are warranted to determine whether similar results could be obtained for reducing blood pressure in obese children.

Conclusion

There is a significant association between hours of television watched and both the severity of obesity and

the presence of hypertension in obese children. The magnitude of the associations found in this study indicates the need for increased physician and parental compliance to the AAP guidelines for TV viewing. One recent study suggests several strategies to meet these recommendations and to limit negative health outcomes associated with TV viewing; for example, by removing the TV from the child's bedroom and forbidding TV watching while eating.[36] Mechanistic and interventional studies are warranted to determine the causes underlying the association between TV time and hypertension, and whether decreasing TV time can improve blood pressure status in obese children.

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