Television Watching and Soft Drink Consumption

Associations With Obesity in 11- to 13-Year-Old Schoolchildren

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Objectives: To determine the prevalence of obesity among sixth- and seventh-grade students in a school-based setting, and to identify lifestyle parameters associated with obesity.

Methods: Sixth- and seventh-grade students (n=385, 186 boys and 199 girls) from 3 schools participated in a school-based screening study, and 319 completed a short questionnaire. Height and weight were measured, and body fat as a percentage of body weight was obtained using a Tanita bioelectrical impedance scale.

Results: Overall, 35.3% of students had a body mass index (BMI; calculated as the weight in kilograms divided by the height in meters squared) at or above the 85th percentile, and half these students (17.4%) had a BMI at or above the 95th percentile. Rates were higher among Latino and lower among Asian than non-Hispanic white students. Significant associations were found between BMI and hours of television watched per evening and daily soft drink consumption. The mean (SE) BMI z score for those watching less than 2 hours per night (0.34 [0.09]) was lower than for those watching 2 or more hours per night (0.82 [0.08]; P<.001). The mean (SE) BMI z score for those consuming less than 3 soft drinks per day (0.51 [0.07]) was lower than for those consuming 3 or more soft drinks per day (1.02 [0.13]; P=.003). Latino students watched more television (2.4 hours per night) than did non-Hispanic white or Asian students (1.3 hours per night; P<.001 for each) and consumed more soft drinks (1.6 per day) than non-Hispanic white students (1.1 per day; P=.004) or Asian students (0.7 per day; P<.001).

Conclusions: Time spent watching television and the number of soft drinks consumed were significantly associated with obesity. Latinos spent more time watching television and consumed more soft drinks than did non-Hispanic white or Asian students. These findings will be beneficial in developing preventive measures for these children.


The prevalence of obesity has been growing at an alarming rate for decades in both children and adults.1-6 In children, the prevalence doubled from the late 1970s to 1994, and it is currently estimated that 25% have a body mass index (BMI) above the 85th percentile and 11% have a BMI above the 95th percentile.6 In adults, obesity is known to be an important risk factor for several chronic diseases.7-12 and among children and adolescents it has been linked to several conditions, including glucose intolerance,12 hypertension,10 and dyslipidemia.10 Moreover, in at least 2 studies half of all obese children remain obese as adults.9,13 The decrease in physical activity and the popularity of high-fat, high-calorie foods have been implicated as causative factors in the rise in obesity.14

Until recently, one of the major consequences of obesity, type 2 diabetes mellitus, accounted for fewer than 5% of cases of all childhood diabetes.15 Now, some studies of pediatric diabetes clinic populations have reported that as many as 45% of new cases of diabetes are type 2.15,16 The number of cases of type 2 diabetes is increasing in tandem with the rise in obesity rates in this age group.16-18

We describe a school-based study of nondiabetic sixth- and seventh-grade schoolchildren in Santa Barbara County, California. The purpose of the study was to assess the prevalence of obesity in this age group and to identify known risk factors and additional behaviors hypothesized to be related to developing type 2 diabetes.

METHODS

This study was approved by the Cottage Health System Institutional Review Board. During the spring of 2000 and throughout the 2000-2001 school year, letters that explained the
study were sent to the parents of sixth- and seventh-grade students at 3 schools in Santa Barbara County. Parents of participating students returned a signed written consent form. A total of 808 students at 3 schools were asked to participate in the study, and 415 (51.4%) returned signed consent forms and agreed to participate. A total of 40% of students were present in class on at least 1 of the study days and participated in data collection. However, 5 were older than 14 years, including 3 older students who assisted as classroom aids, and 1 student was confined to a wheelchair, so his height and weight could not be measured. In addition, because ethnicity is taken into account in some of the analyses and there were only 14 students who were not non-Hispanic white, Latino, or Asian, this article reports data from the 385 students in these 3 ethnic groups.

A questionnaire was pilot tested in the spring of 2000 and administered to all students during the 2000-2001 school year. During pilot testing, the questionnaire underwent several modifications and did not contain comparable health behavior questions. Therefore, only data from the 2000-2001 questionnaire (n = 305) are reported here. This final version of the questionnaire contained 18 lifestyle questions. In addition, the students were asked if they thought they had diabetes and how they would rate their weight (ie, overweight, just right, or underweight) as well as their ethnicity. The questionnaire, which was offered in English and Spanish, was designed to be completed within 3 to 5 minutes.

On the day of the test, students who had secured parental consent were escorted to the on-site testing area. Participants read and signed an assent form agreeing to participate in the project and were asked to remove their shoes and socks for height, weight, and body fat measurements. Standing height was measured to the nearest centimeter using a portable stadiometer (RoadRod; Seca Corporation, Hanover, Md). Weight in kilograms, BMI (calculated as the weight in kilograms divided by the height in meters squared), and body fat as a percentage of body weight were measured on-site using a DCA 2000+ Analyzer (Bayer Corporation, Elkhart, Ind). Students with a glycohemoglobin concentration of 5.3% of total hemoglobin or higher (n = 40; maximum glycohemoglobin, 5.7% of total hemoglobin) were asked to undergo a 2-hour oral glucose tolerance test to verify that glucose tolerance was normal. Only 16 students participated in this follow-up, but all had normal results on the glucose tolerance test.

The questionnaire administered to students included questions related to health behaviors, such as the number of hours they watched television and used the computer or played video games on school nights, the types of sports they participated in and the number of days a week they did the activity, whether they walked or biked to school, who prepared their meals and where they ate them, and the number of regular and diet soft drinks they consumed each day. Students were asked to report their race or ethnicity by selecting all that applied from a list of 5 options or entering their own. Data from students reporting only African American (n = 9) or Native American (n = 5) are not included in this paper.

Statistical analyses were done using SAS statistical software for Windows, version 8.0 (SAS Institute, Inc, Cary NC). Correlation coefficients were calculated for the continuous variables to identify possible linear associations. The means of continuous variables were compared with independent t tests to assess differences between groups. Log transformations of weight and percent body fat were performed to normalize the distributions and geometric means, and standard errors are shown for these variables. Differences in rates of obesity and overweight were compared with \( \chi^2 \) or Fisher’s exact tests, as appropriate. Logistic regression was used to control for potential confounding effects. All 2-way interactions were tested, and none were found to be statistically significant or to have a significant effect on the model.

### RESULTS

Demographic characteristics of the 385 sixth- and seventh-grade students, aged 11 to just younger than 14 years, who participated in the study are shown in Table 1. The ethnicity of the students who participated (47.1% non-Hispanic white, 41.9% Hispanic/Latino, 7.5% Asian/Pacific Islander, 2.5% African American, and 1.2% Native American) was demographically representative of students enrolled in the study schools (51.2%, 42.7%, 6.6%, 2.1%, and 0.8%, respectively) and similar to the state of California (39.5%, 32.4%, 10.9%, 6.7%, and 1.0%, respectively).

For the 3 ethnic groups included in the analyses, the mean BMI \( z \) score was 0.57 (95% confidence interval [CI], –1.43 to 2.59), and the geometric mean percent body fat was 20.6% (95% CI, 7.9% to 53.6%). The distribution of BMI \( z \) scores is shown in the Figure. Sixty-nine students (17.9%) had a BMI between the 85th and 95th percentiles, and 67 (17.4%) had a BMI above the 95th percentile (Table 2). The mean (SE) BMI \( z \) score in boys (0.63 [1.05]) was not significantly different from that in girls (0.53 [1.00]); \( t_{188} = 0.93, P = .35 \), but girls had a higher mean percent fat (24.3%) than did boys (17.2%; \( t_{188} = 7.28, P < .001 \)). A similar percentage of boys (37.6%) and girls

### Table 1. Demographic Characteristics of Participating Students

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Boys (n = 186)</th>
<th>Girls (n = 199)</th>
<th>Total (N = 385)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>12.60 (0.63)</td>
<td>12.56 (0.55)</td>
<td>12.57 (0.59)</td>
</tr>
<tr>
<td>Height, cm</td>
<td>156.1 (8.1)</td>
<td>155.0 (6.6)</td>
<td>155.5 (7.4)</td>
</tr>
<tr>
<td>Weight, kg†</td>
<td>50.6</td>
<td>49.8</td>
<td>50.2</td>
</tr>
<tr>
<td>BMI ( z ) score</td>
<td>0.63 (1.05)</td>
<td>0.53 (1.00)</td>
<td>0.57 (1.03)</td>
</tr>
<tr>
<td>Body fat, % of body weight**†</td>
<td>17.2</td>
<td>24.3</td>
<td>20.6</td>
</tr>
</tbody>
</table>

Abbreviation: BMI, body mass index.
†Geometric means.
**Percentage of body fat available for 376 students (181 boys, 195 girls).
(33.2%; \chi^2=1.11, P=.57) had a BMI at or above the 85th percentile. The percentage of students with a BMI at or above the 85th percentile was higher among Latino students (52.1%) and lower among Asian students (16.7%) than non-Hispanic white students (23.4%; Table 2).

Only 2 of the lifestyle questions, the number of hours of television watched on a school night and the total number of soft drinks consumed per day, were significantly associated with weight parameters. Television watching had weak, albeit significant, correlations with BMI z scores (\( r = 0.22, P < .001 \)) and percent fat (\( r = 0.24, P < .001 \)). Those who watched 2 or more hours of television per night had a BMI z score that was 0.48 higher (95% CI, 0.25 to 0.72, \( P < .001 \)), had 4.9% more body fat (\( t_{292} = 3.78, P < .001 \)), and were 79.9% more likely to have a BMI at or above the 85th percentile (47.1%) than those who watched less than 2 hours of television per night (26.2%; Table 3). Interestingly, the correlation between these body size parameters and the response to a similar question about computer use and playing video games was much weaker and was not statistically significant (\( r = 0.04, P = .44 \) for BMI z score; \( r < 0.01, P = .87 \) for percent fat).

Those who consumed 3 or more soft drinks per day also had a BMI z score that was 0.51 higher (95% CI, 0.17 to 0.85; \( P = .003 \)), had 4.4% more body fat, and were more likely to have a BMI at or above the 85th percentile than those who consumed fewer than 3 soft drinks per day (58.1% vs 33.2%; \chi^2=10.15, P=.006). The BMI z score and percent fat were correlated both with consumption of diet soft drinks (\( r = 0.19, P = .001 \); \( r = 0.18, P = .002 \), respectively) and regular soft drinks (\( r = 0.10, P = .08 \); \( r = 0.11, P = .06 \), respectively), so the numbers were combined into the total number of soft drinks consumed per day (Table 4). Boys and girls watched a similar amount of television (1.8 and 1.9 hours per night, respectively) and consumed a similar number of soft drinks (1.4 and 1.2 soft drinks per day), but Latino students watched more television (2.4 hours per night) and consumed more soft drinks (1.6 drinks per day) than either non-Hispanic white students (1.3 hours of television viewing, \( t_{278} = 6.46, P < .001 \); 1.1 soft drinks per day, \( t_{278} = 2.92, P = .004 \)) or Asian students (1.3 hours of television, \( t_{153} = 3.32, P = .001 \); 0.7 soft drinks per day, \( t_{153} = 2.95, P = .004 \)). Although soft drink consumption and television viewing were correlated (\( r = 0.27, P < .001 \)), in a logistic regression with BMI at or above the 85th percentile as the dependent variable, 2 or more hours of television watching (odds ratio, 1.50; 95% CI, 1.17 to 1.93) and 3 or more soft drinks per day (odds ratio, 1.61; 95% CI, 1.14 to 2.28) were each significant independent variables when the other variable was controlled for as well for age and sex (Table 5). Ethnicity accounted for much of the association with BMI at or above the 85th percentile with television viewing. When ethnicity was controlled for (excluding African Americans and Native Americans), television viewing was no longer significantly associated with BMI (odds ratio, 1.55; 95% CI, 0.90 to 2.66). However, soft drink consumption remained significant (Table 5).

This study found a high prevalence of obesity among children in a self-selected sample of almost half the sixth-
Childhood obesity is a well-studied major health problem in many populations in the United States, and television viewing and soft drink consumption have been identified as contributing factors. Previous studies have ignored consumption of sugar-free soft drinks or found no association with obesity, and the questionnaires employed to evaluate behavioral risk factors for obesity associations have been time-consuming and administered by trained staff.

This study provides further evidence of the major problem obesity imposes on schoolchildren as early as the sixth and seventh grades and the excess burden among Latino students. The study used a short (3- to 5-minute) self-administered questionnaire for children in the school setting and found that it identified significant associations between obesity and both television viewing and soft drink consumption. Furthermore, the finding that diet soft drinks had the same association as sugar-containing soft drinks suggests that it is not the calories in the drinks per se that are responsible for this association and indicates that, despite what we think we know about this burgeoning disorder, further studies are warranted.

and seventh-grade students in the 3 Santa Barbara County schools studied. We also found that the number of hours of television watched and the number of soft drinks consumed per day were associated with BMI and body fat as a percentage of body weight. A weakness of this report is that there were no data available on obesity or lifestyle of those students who chose not to participate in this study. Self-selection or selective parental permission could have biased the results. Adverse associations between television watching and metabolic rate and between television watching and obesity have been shown in other studies. One study by Robinson et al among schoolgirls similar in age to the girls in the current study refutes these findings, but an accompanying editorial points out pertinent problems with the study design, and Robinson has subsequently advocated reducing children’s television watching to prevent obesity. Children who spend more time watching television have a higher BMI and a higher percent body fat and are less physically active. The current study, which used a very simple, short, self-administered questionnaire, confirms the relationship between television watching and obesity.

Watching television can decrease the amount of time spent performing physical activities and has also been associated with increased food consumption either during viewing or as a result of food advertisements. It has been reported that children are spending more time in front of the television, watching television and videos or playing video games, than doing any other activity besides sleeping. An increase in dietary energy intake combined with decreased energy expenditure contributes to weight gain.

The association between soft drink consumption and obesity has also been described previously. Sugar-sweetened soft drinks contain empty calories and contribute to the total caloric intake. Therefore, the consumption of sugar-sweetened soft drinks could be an important contributing factor to the rise in adolescent obesity. However, in the previous study, although data were collected on consumption of diet soft drinks, there was no association with obesity, and the authors implicated the extra calories in the sugar-sweetened drinks. The present study shows that the association between soft drink consumption and obesity held whether the drinks were diet or regular.

The findings that overweight and obesity were not associated with computer use and that they were associated with diet soft drink consumption indicate that it is neither the sedentary activity alone nor the calories in the soft drinks alone that can be implicated as a cause of obesity. Although the questionnaire used in this survey did not address other activities related to television viewing and soft drink consumption, there are several possible explanations for these interesting findings. Television viewing and soft drink consumption may both be indicators of increased calorie intake. Television watching can readily be accompanied by eating, and the frequent food-related advertisements that are designed to invoke feelings of hunger may result in an associated higher food intake in those who regularly watch more television. Computer use, by contrast, keeps both hands occupied, is accompanied by fewer and less-graphic food advertisements, and is therefore less conducive to being accompanied by snacks. Similarly, calorie-rich foods may routinely be consumed along with soft drinks, regardless of whether they are regular or diet. This would suggest that both of these activities might be closely associated with food intake and that the questions included in the survey are just indicators.

Alternatively, because this was a cross-sectional survey that made no attempt to determine past activities, we do not know whether these activities preceded or followed the onset of obesity. As children become more obese and tend to be more self-conscious and less able to participate in physical activities, they may spend more time

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Table 5. Results of Logistic Regression With Body Mass Index at or Above the 85th Percentile for Age and Sex as the Dependent Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter Estimate (SE)</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Controlling for Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥2 h of television/night</td>
<td>0.4076 (0.1271)</td>
<td>1.50 (1.17-1.93)</td>
</tr>
<tr>
<td>≥3 soft drinks/d</td>
<td>0.4777 (0.1767)</td>
<td>1.61 (1.14-2.28)</td>
</tr>
<tr>
<td>Age, per year</td>
<td>0.9105 (0.2142)</td>
<td>1.67 (1.30-2.13)</td>
</tr>
<tr>
<td>Sex, female</td>
<td>0.0507 (0.1256)</td>
<td>1.06 (0.83-1.35)</td>
</tr>
<tr>
<td>Controlling for Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.2184 (0.1384)</td>
<td>1.24 (0.95-1.63)</td>
</tr>
<tr>
<td>Latino</td>
<td>0.3809 (0.1847)</td>
<td>1.46 (1.02-2.10)</td>
</tr>
<tr>
<td>Age, per year</td>
<td>0.3414 (0.2231)</td>
<td>1.41 (0.91-2.18)</td>
</tr>
<tr>
<td>Sex, female</td>
<td>-0.0876 (0.1358)</td>
<td>0.92 (0.70-1.20)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>-0.8882 (0.4256)</td>
<td>0.41 (0.18-0.95)</td>
</tr>
<tr>
<td>Latino</td>
<td>1.1282 (0.2571)</td>
<td>3.09 (1.87-5.12)</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

*Intercept equals –6.1258 without controlling for ethnicity and –5.5050 controlling for ethnicity.
alone watching television. Because of concerns about their obesity, children may also switch to diet soft drinks in an effort to reduce their caloric intake. The cross-sectional survey described here was not able to distinguish among the various possibilities.

Ethnic differences in adolescent adiposity have been recognized previously, and the current study confirmed that a greater percentage of Latino students are obese. The Latino population is known to be at higher risk of developing type 2 diabetes and other diseases, and in this study we found that Latino students were at greater risk of developing the disease by becoming more obese at young ages. In this study population, in which more than 40% of the students were Latino, we found that Latino students were more overweight, drank more sodas, and watched more television than did the non-Hispanic white or Asian students.

Our analysis indicates that increased levels of television viewing and soda intake are associated with a higher prevalence of overweight and obesity among sixth- and seventh-grade schoolchildren, and overweight can lead to increased risk of developing chronic health conditions, such as type 2 diabetes. Interventions that promote healthful lifestyle behaviors such as physical activity and limiting high-fat, high-calorie foods and beverages may be effective in reducing both the prevalence of obesity and the emerging epidemic of type 2 diabetes in children. 27,32,33

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