Research Papers

Television Viewing and its Associations with Overweight, Sedentary Lifestyle, and Insufficient Consumption of Fruits and Vegetables Among US High School Students: Differences by Race, Ethnicity, and Gender

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ABSTRACT: *Television (TV) viewing has been associated with overweight, decreased physical activity, and unhealthy dietary behavior among children and adolescents, and may represent a modifiable cause of childhood obesity. This study examined race, ethnic, and gender-specific differences in these associations among high school students in the United States. The study analyzed data from the 1999 national Youth Risk Behavior Survey, a representative sample (N = 15,349) of US high school students. Logistic regression tested for significant associations. TV viewing on an average school day exceeded 2 hours/day among 43% of students; it was greater among Black (74%) and Hispanic (52%) than White (34%) students. Overall, 11% of students were overweight, 31% of students were sedentary (ie, did not participate in moderate or vigorous physical activity at recommended levels), and 76% ate less than five servings/day of fruits and vegetables. Watching TV more than 2 hours/day was associated with being overweight, being sedentary, and eating insufficient fruits and vegetables among White females, and with being overweight among Hispanic females. No significant associations were found among Black females. TV viewing was associated with being overweight and eating insufficient fruits and vegetables among White males. No significant associations were found among Hispanic males. Among Black males, TV viewing was associated with greater participation in physical activity. These findings suggest the presence of cultural factors to consider when developing interventions to promote physical activity, healthy eating, and healthy weight through reduced TV viewing among adolescents.* (J Sch Health 2002;72(10):413-421)

Childhood obesity has more than doubled over the past 20 years, and it represents the most prevalent nutritional disease among youth in the United States.[1,2] Among children and adolescents, body mass index (BMI), a measure of body weight adjusted for stature, correlates not only with measures of body fatness,[3] but with secondary complications of obesity.[4,5] More than 60% of overweight children have at least one additional risk factor for cardiovascular disease, such as elevated blood pressure, hyperlipidemia, or hyperinsulinemia.[5] In addition, overweight and obesity track from childhood into adulthood,[6-9] and adolescent obesity has been linked to higher all-cause mortality in adulthood.[10]

Obesity results from an energy imbalance created by factors that increase energy intake or reduce energy expenditure. Television (TV) viewing may promote obesity both by displacing participation in physical activity that would expend more energy, and by increasing dietary energy intake, either during viewing or as a result of food advertising.[11,12] Other than sleep, time spent watching TV represents the single greatest source of physical inactivity among American children.[12] In addition, evidence suggests TV viewing relates inversely to measures of physical fitness,[13,14] participation in physical activity,[15,16] and active involvement in sports.[17] Both snacking while watching TV[18] and between-meal snacking[19] relate directly to the amount of TV viewed. Exposure to food advertisements may produce incorrect nutritional beliefs among children.[20] Television advertising and programming tend to emphasize high-calorie foods of poor nutritional quality, rather than nutritionally rich foods such as fruits and vegetables.[21] Increased TV viewing among children and adolescents has been associated with potentially unhealthy dietary practices, such as increased consumption of high-fat foods.[22,23] In the United States, diets high in fat tend to be low in fruits and vegetables and complex carbohydrates.[24]

Television viewing appears to relate causally to obesity, and is increasingly the target of interventions designed to reduce obesity among US children. Studies that did not demonstrate associations between TV viewing and overweight usually involved smaller, regional samples of youth.[13,15,16] Most cross-sectional studies involving nationally representative samples of children and adolescents demonstrated significant associations between hours spent watching TV and adiposity.[11,14,25,26] In addition, several national prospective studies of children and adolescents demon-

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strated that TV viewing predicts increased adiposity.[11,25,27] Finally, recent intervention studies provide evidence that reduction in TV viewing can reduce or prevent obesity among youth.[28-30] A randomized controlled study of middle-school students sought to reduce obesity by decreasing TV viewing, decreasing consumption of high-fat foods, increasing fruit and vegetable intake, and increasing moderate and vigorous physical activity.[29] The intervention reduced TV viewing time among girls and boys. Among girls, but not boys, reductions in TV viewing time predicted reductions in obesity and mediated the intervention effect, providing additional evidence for a causal pathway.

Health and education professionals need information about demographic differences in the prevalence and interrelatedness of TV viewing, overweight, physical activity, and dietary intake to develop effective and targeted interventions to reduce childhood obesity. One study of ninth-grade students in four ethnically diverse northern California high schools looked for demographic variation in the relationships among TV viewing and overweight, physical activity, and dietary intake that might explain some of the variation in these associations found in other studies.[22] This study extends the current literature by analyzing a nationally representative sample of US high school students to describe race, ethnic, and gender-specific differences in associations between TV viewing and being overweight, being sedentary, and eating insufficient fruits and vegetables.

METHODS

Study Design

This study analyzed data from the 1999 national school-based Youth Risk Behavior Survey (YRBS), part of the Youth Risk Behavior Surveillance System implemented by the Centers for Disease Control and Prevention (CDC) to monitor the prevalence of priority health-risk behaviors among youth.[31] The 1999 YRBS used a three-stage cluster sample design to produce a representative sample of US public and private high school students in grades 9 through 12. The first-stage sampling frame contained 1,270 primary sampling units (PSUs), consisting of large counties or groups of smaller, adjacent counties. Fifty-two PSUs were selected from 16 strata formed according to degree of urbanization and the relative percentage of Black and Hispanic students in the PSU. The PSUs were selected with probability proportional to the total school enrollment within the PSU.

At the second stage of sampling, 187 schools were selected with probability proportional to school enrollment size. To ensure the sample contained sufficient numbers of students in racial and ethnic subgroups to analyze subgroup differences, schools with substantial numbers of Black and Hispanic students were sampled at higher rates than were other schools.

The final stage of sampling consisted of randomly selecting one or two intact classes of a required subject, such as

Table 1
Prevalence of Television Viewing on an Average School Day Among High School Students, by Number of Hours Watched and Demographic Characteristics – United States, 1999

Demographic Categories	No.	≤ 2 hrs/day %	(95% CI)	3 or 4 hrs/day %	(95% CI)	≥ 5 hrs/day %	(95% CI)
Total Population	15,349	57.2	(54.3-60.2)	28.9	(26.8-31.0)	13.9	(11.8-15.9)
Grade							
9th	3,786	49.0	(44.2-53.8)	32.3	(28.5-36.1)	18.7	(14.3-23.0)
10th	3,787	53.7	(49.1-58.3)	31.1	(28.4-33.8)	15.3	(11.3-19.2)
11th	3,885	62.3	(58.7-65.9)	26.4	(24.2-28.5)	11.3	(8.7-14.0)
12th	3,823	66.9	(63.1-70.7)	24.6	(21.7-27.5)	8.4	(6.6-10.2)
Race / Ethnicity							
Black	4,283	26.3	(23.3-29.2)	34.7	(32.2-37.1)	39.1	(36.0-42.1)
Hispanic	4,106	47.8	(45.1-50.4)	36.6	(33.8-39.3)	15.7	(12.9-18.4)
White	5,407	65.8	(61.7-69.9)	26.9	(23.3-30.5)	7.3	(5.8-8.8)
Females x Race / Ethnicity							
All Females	7,828	59.0	(55.6-62.5)	27.5	(25.1-29.9)	13.5	(11.4-15.6)
Black	2,196	25.6	(22.1-29.1)	37.0	(32.2-41.7)	37.4	(34.4-40.5)
Hispanic	2,052	48.4	(44.4-52.4)	36.5	(33.3-39.8)	15.1	(12.0-18.1)
White	2,797	69.0	(64.2-73.9)	24.1	(20.3-27.9)	6.9	(5.1-8.7)
Males x Race / Ethnicity							
All Males	7,445	55.5	(52.0-59.0)	30.3	(27.5-33.0)	14.2	(11.9-16.5)
Black	2,066	27.0	(24.0-30.1)	32.1	(28.6-35.7)	40.8	(35.2-46.5)
Hispanic	2,034	47.3	(42.4-52.2)	36.4	(32.5-40.3)	16.3	(11.7-20.8)
White	2,594	62.8	(58.5-67.2)	29.5	(25.0-33.9)	7.7	(6.3-9.1)

CI indicates confidence interval.

English or social studies, from grades 9 through 12 at each selected school. All students in the selected classes were eligible to participate in the survey. A weighting factor was applied to each student record to adjust for the varying probabilities of selection at each stage of sampling, student nonresponse, and oversampling of Black and Hispanic students. The final weights were scaled so that the weighted count of students equaled the total sample size, and the weighted proportions of students in each grade matched national population projections.

Survey procedures were designed to protect student privacy and allow for anonymous participation. Following local procedures, parental consent was obtained prior to survey administration. The questionnaire, containing 92 items, was administered in the classroom by trained data collectors. Additional details of the 1999 YRBS methodology were described previously.[32] The YRBS has been reviewed and approved by an Institutional Review Board at CDC.

Data Analyses

TV viewing was assessed by the following question: "On an average school day, how many hours do you watch TV?" Response options ranged from "I do not watch TV on an average school day" to "5 or more hours per day." Participation in moderate physical activity and vigorous physical activity were assessed by the following two questions: "On how many of the past 7 days did you participate in physical activity for at least 30 minutes that did not make you sweat or breathe hard, such as fast walking, slow bicycling, skating, pushing a lawn mower, or mopping floors?" and "On how many of the past 7 days did you exercise or participate in physical activity for at least 20 minutes that made you sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic activities?" Consumption of fruits and vegetables was measured by 6 separate questions, all of the form: "During the past 7 days, how many times did you...[drink 100% fruit juices; eat fruit; eat green salad; eat potatoes (not fried); eat carrots; eat other vegetables]?" Response options for each food frequency question ranged from 0 times (in the past 7 days) to 4 or more times per day. Students also were asked their current height and weight without shoes.

Self-reported height and weight were used to calculate

Table 2
Prevalence of Overweight, Sedentary Lifestyle, and Insufficient Fruit and Vegetable Consumption Among High School Students, by Demographic Characteristics – United States, 1999

Demographic Categories	No.	Overweight [a] %	Overweight [a] (95% CI)	Sedentary Lifestyle[b] %	Sedentary Lifestyle[b] (95% CI)	< 5 Fruits and Vegetables [c] %	< 5 Fruits and Vegetables [c] (95% CI)
Total Population	15,349	10.8	(9.6-12.0)	30.5	(28.7-32.3)	76.1	(74.5-77.8)
Grade							
9th	3,786	12.6	(10.7-14.4)	22.8	(18.6-26.9)	74.4	(72.4-76.5)
10th	3,787	10.9	(8.5-13.3)	31.1	(26.4-35.8)	76.9	(74.2-79.6)
11th	3,885	11.4	(9.1-13.7)	37.5	(35.0-40.1)	76.9	(74.7-79.2)
12th	3,823	7.8	(5.4-10.2)	32.4	(28.6-36.2)	76.5	(72.8-80.2)
Race / Ethnicity							
Black	4,283	12.5	(8.9-16.1)	40.0	(35.3-44.6)	72.2	(66.3-78.0)
Hispanic	4,106	13.5	(11.2-15.7)	35.2	(30.8-39.5)	76.0	(73.0-78.9)
White	5,407	10.1	(8.2-12.0)	28.2	(26.0-30.4)	77.5	(75.6-79.3)
Females x Race / Ethnicity							
All Females	7,828	7.7	(6.6-8.8)	37.3	(35.0-39.6)	76.6	(74.2-79.1)
Black	2,196	12.8	(8.5-17.0)	47.5	(44.1-50.9)	69.8	(57.6-81.9)
Hispanic	2,052	9.5	(6.5-12.6)	45.8	(40.7-50.9)	79.0	(76.2-81.8)
White	2,797	6.4	(4.7-8.1)	34.8	(32.2-37.3)	78.5	(76.9-80.0)
Males x Race / Ethnicity							
All Males	7,445	13.7	(11.6-15.9)	23.7	(21.0-26.4)	75.6	(73.2-78.1)
Black	2,066	12.3	(7.4-17.1)	32.0	(23.8-40.1)	74.8	(72.0-77.5)
Hispanic	2,034	17.3	(14.0-20.7)	24.4	(19.7-29.1)	72.8	(67.7-77.9)
White	2,594	13.5	(10.6-16.4)	21.9	(18.1-25.8)	76.5	(73.5-79.5)

CI indicates confidence interval.
a - Based on self-reported height and weight, body mass index (BMI = weight [kg] / height [m]^2) ≥ 95th percentile was used to define overweight, using growth charts developed by the Centers for Disease Control and Prevention for youth aged 2 to 20 years.
b - Did not participate in moderate or vigorous physical activity at recommended levels.
c - Ate < 5 servings/day of fruit, fruit juice, green salad, potatoes (not fried), carrots, or other vegetables during the past seven days.

Table 3

Prevalence and Adjusted Odds Ratios for Overweight, Sedentary Lifestyle, and Insufficient Fruit and Vegetable Consumption Among High School Students, by Race, Ethnicity, Gender, and Number of Hours of Television Watched on an Average School Day – United States, 1999

Demographic Categories TV Viewing	Overweight [a]			Sedentary Lifestyle[b]			< 5 Fruits and Vegetables[c]		
	%	OR	(95% CI)	%	OR	(95% CI)	%	OR	(95% CI)
Total Population									
≥ 5 hrs/day	14.1	1.57*	(1.19-2.07)	39.8	1.65*	(1.36-2.00)	76.1	1.31	(1.01-1.70)
3 or 4 hrs/day	13.6	1.56*	(1.32-1.84)	30.2	1.10	(0.91-1.33)	79.3	1.36*	(1.13-1.64)
≤ 2 hrs/day	8.6	1.00	(referent)	28.6	1.00	(referent)	74.5	1.00	(referent)
Black									
≥ 5 hrs/day	13.2	1.08	(0.79-1.48)	44.5	1.12	(0.89-1.42)	73.5	0.93	(0.72-1.21)
3 or 4 hrs/day	12.1	1.02	(0.64-1.63)	33.0	0.62*	(0.45-0.87)	68.5	0.73	(0.53-1.00)
≤ 2 hrs/day	11.9	1.00	(referent)	42.7	1.00	(referent)	75.1	1.00	(referent)
Hispanic									
≥ 5 hrs/day	14.2	1.18	(0.68-2.04)	40.1	1.29	(0.76-2.17)	70.3	0.70	(0.45-1.08)
3 or 4 hrs/day	16.8	1.55	(0.83-2.91)	30.3	0.75	(0.55-1.04)	77.1	0.97	(0.72-1.30)
≤ 2 hrs/day	10.8	1.00	(referent)	37.2	1.00	(referent)	77.2	1.00	(referent)
White									
≥ 5 hrs/day	19.2	2.73*	(1.46-5.13)	35.0	1.73*	(1.15-2.60)	82.1	1.63*	(1.01-2.63)
3 or 4 hrs/day	14.2	1.88*	(1.47-2.41)	29.2	1.26*	(1.02-1.55)	83.0	1.71*	(1.27-2.30)
≤ 2 hrs/day	7.5	1.00	(referent)	27.2	1.00	(referent)	74.6	1.00	(referent)
All Females									
≥ 5 hrs/day	11.6	1.67	(0.83-3.38)	48.7	1.93*	(1.44-2.59)	75.2	1.29	(0.93-1.79)
3 or 4 hrs/day	9.9	1.61*	(1.14-2.28)	40.8	1.37*	(1.08-1.74)	81.5	1.60*	(1.16-2.20)
≤ 2 hrs/day	5.7	1.00	(referent)	33.4	1.00	(referent)	74.6	1.00	(referent)
Black Females									
≥ 5 hrs/day	12.5	0.89	(0.53-1.52)	53.3	1.54*	(1.14-2.07)	70.3	0.84	(0.56-1.26)
3 or 4 hrs/day	12.2	0.90	(0.46-1.76)	44.5	1.03	(0.77-1.38)	65.9	0.68	(0.39-1.18)
≤ 2 hrs/day	13.0	1.00	(referent)	43.4	1.00	(referent)	74.2	1.00	(referent)
Hispanic Females									
≥ 5 hrs/day	11.4	1.92*	(1.20-3.08)	56.4	1.77*	(1.04-3.03)	76.4	0.90	(0.56-1.44)
3 or 4 hrs/day	13.8	2.45*	(1.13-5.34)	42.4	0.93	(0.62-1.41)	81.9	1.28	(0.90-1.82)
≤ 2 hrs/day	6.0	1.00	(referent)	44.9	1.00	(referent)	77.9	1.00	(referent)
White Females									
≥ 5 hrs/day	14.2	3.38	(0.74-15.4)	46.2	2.38*	(1.43-3.97)	82.7	1.55	(0.86-2.80)
3 or 4 hrs/day	9.6	2.20*	(1.49-3.24)	41.3	1.67*	(1.26-2.23)	85.5	1.90*	(1.30-2.77)
≤ 2 hrs/day	4.6	1.00	(referent)	31.8	1.00	(referent)	75.4	1.00	(referent)
All Males									
≥ 5 hrs/day	16.3	1.51*	(1.11-2.05)	31.3	1.38	(0.96-1.99)	77.0	1.34	(0.94-1.91)
3 or 4 hrs/day	16.8	1.50*	(1.14-1.97)	20.6	0.84	(0.59-1.20)	77.3	1.21	(0.92-1.58)
≤ 2 hrs/day	11.6	1.00	(referent)	23.5	1.00	(referent)	74.4	1.00	(referent)
Black Males									
≥ 5 hrs/day	13.8	1.29	(0.99-1.69)	35.9	0.78	(0.57-1.07)	76.7	1.03	(0.51-2.09)
3 or 4 hrs/day	12.0	1.15	(0.67-1.97)	19.0	0.31*	(0.13-0.75)	71.7	0.78	(0.47-1.30)
≤ 2 hrs/day	10.9	1.00	(referent)	41.9	1.00	(referent)	76.1	1.00	(referent)
Hispanic Males									
≥ 5 hrs/day	16.5	0.90	(0.41-1.96)	24.6	0.86	(0.43-1.74)	64.7	0.56*	(0.31-1.00)
3 or 4 hrs/day	19.7	1.21	(0.61-2.40)	18.2	0.54	(0.28-1.05)	71.8	0.75	(0.48-1.18)
≤ 2 hrs/day	15.9	1.00	(referent)	29.2	1.00	(referent)	76.6	1.00	(referent)
White Males									
≥ 5 hrs/day	23.1	2.47*	(1.64-3.73)	25.5	1.24	(0.61-2.52)	81.7	1.66	(0.97-2.85)
3 or 4 hrs/day	17.6	1.76*	(1.17-2.65)	19.9	0.91	(0.59-1.39)	80.9	1.59*	(1.12-2.27)
≤ 2 hrs/day	10.4	1.00	(referent)	22.5	1.00	(referent)	73.7	1.00	(referent)

OR indicates odds ratio adjusted for demographics (grade, gender, and race/ethnicity). CI indicates confidence interval. *$p < 0.05$.

a - Based on self-reported height and weight, body mass index (BMI = weight [kg] / height [m]^2) ≥ 95th percentile was used to define overweight, using growth charts developed by the Centers for Disease Control and Prevention for youth aged 2 to 20 years.

b - Did not participate in moderate or vigorous physical activity at recommended levels.

c - Ate < 5 servings/day of fruit, fruit juice, green salad, potatoes (not fried), carrots, or other vegetables during the past seven days.

Table 4

Independent Effects of Overweight, Sedentary Lifestyle, and Insufficient Fruit and Vegetable Consumption on the Prevalence and Adjusted Odds Ratios for Excessive Television Viewing on an Average School Day Among High School Students, by Race, Ethnicity, and Gender – United States, 1999

	Watched More Than Two Hours of TV on Average School Day											
Independent Variables	**Total Population**			**Black**			**Hispanic**			**White**		
	%	**OR**	**(95% CI)**	**%**	**OR**	**(95% CI)**	**%**	**OR**	**(95% CI)**	**%**	**OR**	**(95% CI)**
Total Population												
Overweight [a]												
Yes	54.2	1.55*	(1.33-1.82)	74.6	1.05	(0.77-1.43)	61.9	1.46	(0.88-2.41)	51.5	2.05*	(1.51-2.80)
No	41.1	1.00	(referent)	73.2	1.00	(referent)	50.8	1.00	(referent)	32.4	1.00	(referent)
Sedentary Lifestyle[b]												
Yes	46.5	1.20*	(1.03-1.41)	72.0	0.82*	(0.69-0.98)	49.4	0.90	(0.64-1.27)	36.7	1.29*	(1.03-1.60)
No	41.1	1.00	(referent)	74.9	1.00	(referent)	53.8	1.00	(referent)	33.2	1.00	(referent)
< 5 Fruits and Vegetables[c]												
Yes	43.9	1.35*	(1.17-1.55)	72.7	0.91	(0.74-1.13)	51.5	0.92	(0.69-1.24)	36.4	1.61*	(1.27-2.05)
No	38.8	1.00	(referent)	76.6	1.00	(referent)	54.5	1.00	(referent)	25.9	1.00	(referent)
Females												
Overweight [a]												
Yes	55.5	1.61*	(1.07-2.41)	73.7	0.89	(0.54-1.48)	69.1	2.28*	(1.16-4.52)	51.0	2.37*	(1.22-4.59)
No	39.4	1.00	(referent)	74.8	1.00	(referent)	48.7	1.00	(referent)	29.6	1.00	(referent)
Sedentary Lifestyle[b]												
Yes	47.4	1.45*	(1.21-1.73)	76.6	1.35	(0.97-1.89)	52.5	1.09	(0.76-1.56)	37.5	1.66*	(1.33-2.08)
No	37.1	1.00	(referent)	72.4	1.00	(referent)	50.9	1.00	(referent)	27.5	1.00	(referent)
< 5 Fruits and Vegetables[c]												
Yes	42.5	1.49*	(1.23-1.81)	72.7	0.86	(0.63-1.17)	52.4	1.22	(0.89-1.68)	33.6	1.56*	(1.16-2.09)
No	36.0	1.00	(referent)	78.2	1.00	(referent)	48.7	1.00	(referent)	21.6	1.00	(referent)
Males												
Overweight [a]												
Yes	53.4	1.50*	(1.16-1.94)	75.5	1.24	(0.95-1.60)	57.9	1.18	(0.68-2.04)	51.8	1.91*	(1.35-2.73)
No	42.9	1.00	(referent)	71.6	1.00	(referent)	53.0	1.00	(referent)	35.1	1.00	(referent)
Sedentary Lifestyle[b]												
Yes	45.0	0.96	(0.69-1.34)	64.7	0.47*	(0.28-0.79)	43.5	0.67	(0.35-1.29)	35.6	0.97	(0.60-1.56)
No	44.2	1.00	(referent)	76.9	1.00	(referent)	55.7	1.00	(referent)	37.6	1.00	(referent)
< 5 Fruits and Vegetables[c]												
Yes	45.2	1.25*	(1.01-1.54)	72.7	1.00	(0.70-1.45)	50.4	0.73	(0.47-1.14)	39.2	1.63*	(1.20-2.21)
No	41.4	1.00	(referent)	74.4	1.00	(referent)	59.1	1.00	(referent)	29.6	1.00	(referent)

OR indicates odds ratio adjusted for demographics (grade, gender, and race/ethnicity). CI indicates confidence interval. *$p < 0.05$.

a - Based on self-reported height and weight, body mass index (BMI = weight [kg] / height [m]^2) ≥ 95th percentile was used to define overweight, using growth charts developed by the Centers for Disease Control and Prevention for youth aged 2 to 20 years.

b - Did not participate in moderate or vigorous physical activity at recommended levels.

c - Ate < 5 servings/day of fruit, fruit juice, green salad, potatoes (not fried), carrots, or other vegetables during the past seven days.

BMI, expressed as body weight in kilograms divided by the square of height in meters (kg/m^2). Following current guidelines for evaluation and treatment of childhood obesity,[33] students with a BMI equal to or greater than the 95th percentile, using gender and age-specific cut-points from recently revised growth charts produced by CDC,[34] were considered overweight. Because frequencies for TV viewing time, physical activity, and consumption of fruits and vegetables were not normally distributed, these behaviors also were analyzed as categorical variables. Cut points for these behaviors were chosen in a manner consistent with national health objectives[35] and recommendations.[36-38] Watching TV more than 2 hours/day was considered to be excessive.[35,38] Students who did not participate in at least 30 minutes of moderate physical activity on 5 or more days/week, or at least 20 minutes of vigorous physical activity on 3 or more days/week, were considered to have a sedentary lifestyle (ie, inadequate participation in moderate and vigorous physical activity).[35,36] Students who ate less than 5 servings/day of fruits and vegetables were considered to include insufficient fruits and vegetables in their diet.[35,37]

All analyses were conducted on the total student population and major racial, ethnic, and gender subgroups (White, Black, Hispanic, female, male). First, we examined demographic variation in prevalence estimates for TV viewing, overweight, sedentary lifestyle, and insufficient fruit and vegetable consumption. Next, separate logistic regression models tested individual associations between TV viewing as an independent variable and the dependent variables of overweight, sedentary lifestyle, and insufficient fruit and vegetable consumption, controlling for demographic characteristics. Because overweight, physical activity, and dietary intake are interrelated, a final set of logistic regression models were analyzed to determine if these factors were associated independently with TV viewing. In these models, independent variables for overweight, sedentary lifestyle, and insufficient consumption of fruits and vegetables were entered together, with demographic variables, and excessive TV viewing served as the dependent variable. Prevalence estimates, adjusted odds ratios (ORs), and corresponding 95% confidence intervals (CIs) were calculated using weighted data and SUDAAN, statistical analysis software that accounts for the complex sample design.[39] Differences between prevalence estimates were considered statistically significant if 95% CIs did not overlap, and adjusted ORs were considered statistically significant if 95% CIs did not include 1.0, or p-value < 0.05.

RESULTS

The school response rate was 77%, and the student response rate was 86%, for an overall response rate of 66%. Data from 15,349 questionnaires completed in 144 schools were available for analysis. Demographic characteristics of students were as follows: 49.6% female; 60.8% White, 14.1% Black, 10.4% Hispanic, 14.7% other; and 28.9% 9th grade, 26.0% 10th grade, 23.6% 11th grade, 21.4% 12th grade. All high school students were included in analyses. However, race and ethnic-specific results are presented only for White, Hispanic, and Black youth, where sample size allowed stable estimates.

Among all high school students, 42.8% watched TV more than two hours on an average school day, and 13.9% of students watched TV at least five hours (Table 1). The prevalence of excessive TV viewing (more than 2 hours/day) was greater among students in lower grades, and was greater among Black (73.7%) and Hispanic (52.2%) than White (34.2%) students. Racial and ethnic variation in TV viewing time was similar among female and male students.

One of 10 (10.8%) students was overweight, 30.5% of students had a sedentary lifestyle (ie, did not participate in moderate or vigorous physical activity at recommended levels), and 76.1% of students ate fewer than 5 servings/day of fruits and vegetables (Table 2). Overweight was more common among 9th grade students (12.6%) than 12th grade students (7.8%), and more common among male students (13.7%) than female students (7.7%). The prevalence of overweight was greater among Black females (12.8%) than White females (6.4%), but did not vary by race or ethnicity among male students. A sedentary lifestyle was more common among students in higher grades, females, and racial and ethnic minorities. Insufficient consumption of fruits and vegetables did not vary by demographic category.

Separate logistic regression models were used to identify race, ethnic, and gender-specific associations between hours of TV viewed as an independent variable, and the dependent variables of overweight, sedentary lifestyle, and insufficient consumption of fruits and vegetables, controlling for demographics (Table 3). Among the total student population, watching TV more than 2 hours/day was associated with being overweight. In further subgroup analyses, TV viewing was associated with being overweight only among White and Hispanic females, and among White males. TV viewing also was associated with a sedentary lifestyle among the total student population, and among White, Hispanic, and Black female students, but not among male students. Among Black males, TV viewing appeared related inversely to a sedentary lifestyle. Finally, TV viewing was associated with eating insufficient fruits and vegetables among the total student population, and among White female and White male students. Among Hispanic males, TV viewing was related inversely to insufficient consumption of fruits and vegetables.

Overweight, physical activity, and dietary intake are interrelated. To determine if these factors were independently associated with TV viewing, a final set of logistic regression models were analyzed. In these models, independent variables for overweight, sedentary lifestyle, and insufficient consumption of fruits and vegetables were entered together, with demographic variables. Excessive TV viewing served as the dependent variable (Table 4). Among the total student population, and among White female students, being overweight, being sedentary, and eating insufficient fruits and vegetables each were independently associated with watching TV more than 2 hours/day. Among White male students, being overweight and eating insufficient fruits and vegetables each were independently associated with excessive TV viewing, while sedentary lifestyle was not associated with TV viewing. Among Hispanic females, only being overweight was associated with excessive TV viewing. Among Black males, a sedentary lifestyle was inversely associated with TV viewing. Overweight, sedentary lifestyle, and eating insufficient fruits and vegetables were not independently associated with excessive TV viewing among Hispanic males or Black females.

DISCUSSION

Along with inadequate physical activity and unhealthy food choices, TV viewing is receiving increasing attention as a modifiable risk factor for childhood obesity.[40] The American Academy of Pediatrics recommended limiting children's total media time (including TV viewing) to no more than 2 hours of quality programming per day.[38] National objectives for promoting physical activity and healthy dietary behavior include accumulation of at least 30 minutes of moderate physical activity most days of the week, participation in vigorous physical activity that promotes development of cardiorespiratory fitness for 20 or more minutes at least 3 days per week, and increased consumption of fruits and vegetables.[35]

Among US high school students, TV viewing exceeded recommended levels among one in three (34.2%) White students, one-half (52.2%) of Hispanic students, and three of four (73.7%) Black students. In addition, 40.0% of Black students and 35.2% of Hispanic students, did not participate in moderate or vigorous physical activity at recommended levels, compared to 26.9% of White students. Consumption of fruits and vegetables did not vary significantly among racial, ethnic, or gender subgroups; however, 76.1% of all students ate less than the recommended 5 or more servings/day. Greater TV viewing and less participation in physical activity among Black and Hispanic youth compared to White youth is consistent with previous research,[26,41] and may reflect concerns about neighborhood crime and a lack of safe opportunities to be physically active.[41]

In this study, one of 10 (10.8%) high school students was overweight, and associations between TV viewing and overweight were consistent whether TV viewing was modeled as an independent variable or the dependent variable. In addition, associations between TV viewing and overweight were independent of participation in moderate or vigorous physical activity and fruit and vegetable consumption. This finding may suggest TV viewing exerts its predominant influence on overweight through effects on physical activity of less than moderate to vigorous intensity or consumption of foods which were not measured in this study. Other studies found positive associations between TV viewing and consumption of high-fat foods.[22,23]

Several study limitations must be acknowledged. Methods for measurement of TV viewing, physical activity, dietary behavior, and overweight are complex and often controversial. Because these data were collected as part of a broad-based surveillance system, only a limited number of self-reported questionnaire items were available to measure the variables analyzed. As with most studies that have examined relationships between TV viewing and other behaviors, reports of television viewing time, participation in physical activity, and dietary intake were not validated. However, the prevalence and demographic distribution of television viewing,[26] sedentary lifestyle,[41] and fruit and vegetable consumption[42] found in this study were consistent with previous research. Estimates of overweight also were based on self-reports of height and weight. However, a recent national study of adolescents found that the correlation between BMI calculated from self-reported versus measured height and weight was very strong ($r = .92$), and using self-reported height and weight correctly classified 96% of teens with respect to overweight (BMI $\leq$ 95th percentile).[43] Finally, the data are cross-sectional and cannot be used to imply a causal relationship between TV viewing and being overweight, being sedentary, or eating insufficient fruits and vegetables. Inaccuracies in measurement of study variables could weaken or obscure associations between variables. Despite these limitations the findings have important implications for efforts to reduce childhood obesity and promote physical activity and healthy eating by reducing TV viewing among youth.

The finding of race, ethnic, and gender-specific differences in TV viewing and its associations with being overweight, being sedentary, and eating insufficient fruits and vegetables suggests the presence of social and cultural factors to consider when developing interventions for youth. Among young children, there is substantial individual variability, but no ethnic or gender differences in TV viewing behavior.[16] However, by adolescence, as yet unidentified social and cultural factors have resulted in dramatic differences in TV viewing time among youth of different racial and ethnic backgrounds. These same factors also may lead to different levels of susceptibility to the influence of TV on other behaviors, such as the quantity and types of foods eaten, and the types of activities substituted for TV viewing. In this study, White students spent the least amount of time watching TV, yet demonstrated strong associations between TV viewing and being overweight, being sedentary (among females), and eating insufficient fruits and vegetables. This finding suggests White youth may have greater susceptibility to the influence of TV than Black and Hispanic youth who spent far more time watching TV, but demonstrated few associations with overweight or other weight-related behaviors. Prospective studies need to confirm the existence and possible mechanisms for demographic variation in the impact of TV viewing on overweight, physical activity, and dietary behaviors.

Demographic variation in the association between TV viewing and overweight may help to explain apparent inconsistencies in the findings from previous studies, and has important implications for development of interventions to reduce obesity by reducing TV viewing among youth. Consistent with these findings, previous studies with nationally representative samples[11,14,25,26] or that included a majority of White youth[27,44] usually found significant associations between TV viewing and being overweight. Conversely, studies that involved samples of predominantly non-White youth usually found no significant associations between TV viewing and overweight.[15,16,22] Subgroup analyses in one of these studies[22] did find a significant association between TV viewing and overweight among White male students. Recent intervention studies that demonstrated reductions in obesity by decreasing TV viewing involved samples of predominantly White youth.[28-30] These and similar interventions may need to be adapted for maximum effectiveness among other populations of youth. One of these intervention studies[29] that conducted racial, ethnic, and gender subgroup analyses found the intervention was effective in reducing obesity among Black and White females, but not among Hispanic females or Black, White, and Hispanic males. To develop effective, targeted, and culturally appropriate interventions for all youth, additional research must identify the determinants and social context of TV viewing among girls and boys from different social and cultural backgrounds.

CONCLUSION

Efforts to reduce TV viewing among youth can help reverse the epidemic of obesity in this country, while promoting physical activity and healthy eating. A variety of strategies are available to reduce TV viewing among youth.[38] Parents should monitor and limit children's TV viewing to no more than 2 hours/day, and encourage alternative entertainment such as reading, hobbies, and athletics. Health care professionals should include questions about media use in their assessments of youth, and reinforce efforts of parents to monitor and limit TV viewing. Schools and community organizations can offer youth comprehensive media education programs, and promote local TV turnoff week projects.

Reducing the amount of time spent watching TV creates opportunities for activity and may shift dietary intake away from high-calorie, high-fat foods frequently advertised on television.[40] However, for positive changes in physical activity and dietary behaviors to occur, other strategies including broad-based community efforts are needed.[45-48] Communities must create environments with safe playgrounds and parks, walking and bicycle trails, and neighborhood recreation centers with sports facilities and supervised activities for youth. Nutrition education campaigns can be sponsored by public health and community-based organizations. Schools reach almost all children and adolescents, and can have a major impact through comprehensive high-quality health and physical education programs that prepare students for a lifetime of physical activity and healthy eating, and by sponsoring after-school programs that provide youth with safe and active alternatives to watching TV. ■

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