Weight Management and Fruit and Vegetable Intake Among US High School Students*

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ABSTRACT

BACKGROUND: Consumption of fruits and vegetables is often recommended to promote healthy weight. The purpose of this study was to examine associations between fruit and vegetable intake and common weight management behaviors among US high school students who were trying to lose or stay the same weight.

METHODS: Data from the 1999, 2001, and 2003 national high school Youth Risk Behavior Surveys were combined and the analyses stratified by gender (females, N = 16,709; males, N = 10,521). We considered 3 common weight management strategies—being physically active (ie, moderate activity for 30 minutes on 5 or more days per week or vigorous activity for 20 minutes on 3 or more days per week), eating a reduced calorie or fat diet, and limiting TV viewing. Sufficient fruit and vegetable intake was defined as eating 5 or more servings per day. Odds ratios (ORs) were calculated using logistic regression.

RESULTS: Only 21.3% of females and 24.7% of males ate sufficient fruits and vegetables. Being physically active was associated with sufficient fruit and vegetable intake. Eating a reduced calorie or fat diet and limiting TV viewing (among males) were associated with sufficient fruit and vegetable intake only among physically active students. The odds of sufficient fruit and vegetable intake were greatest among female (OR = 3.01) and male (OR = 2.91) students who combined all 3 strategies (31.5% of females, 21.6% of males).

CONCLUSIONS: Interventions that promote fruit and vegetable intake within the context of healthy weight management may be more effective if they combine nutrition and physical activity strategies. Further research is needed to test this approach.

Keywords: nutrition and diet; physical fitness and sport; child and adolescent health.

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The increasing prevalence of overweight among children, adolescents, and adults highlights the need for healthy and effective dietary strategies for weight management.[1] Diets rich in fruits and vegetables are associated with lower risks for many chronic diseases, including cancer, cardiovascular disease, and stroke.[2] Because fruits and vegetables are high in water and fiber content, low in calories and energy density, and nutrient rich, they are an important part of a healthy diet and have the potential to reduce long-term risk for obesity and unhealthy weight gain if substituted for energy-dense nutrient-poor foods (eg, foods high in fat, added sugars, and calories).[3,4] In 2001, *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* listed specific action steps schools should take including ''Provide food options that are low in fat, calories, and added sugars, such as fruits, vegetables, whole grains, and low-fat or nonfat dairy foods.''[5] Action steps for families and communities included ''Promote healthful dietary patterns, including consumption of at least five servings of fruits and vegetables a day.''[5]

Researchers are beginning to examine the relationship between fruit and vegetable consumption and weight management.[3] Although data directly relating intake of fruits and vegetables with risk of obesity and long-term weight gain are limited, studies of adults have suggested that increasing intake of fruits and vegetables may reduce long-term risk of obesity and weight gain.[6,7] School-based interventions to prevent obesity among youth have successfully incorporated a variety of strategies, including increased consumption of fruits and vegetables.[8,9] Planet Health is an example of an effective middle school–based obesity intervention that targeted 4 behavioral changes: reduced TV viewing, increased moderate and vigorous physical activity, reduced consumption of high-fat foods, and increased consumption of fruits and vegetables.[8] The prevalence of obesity among girls in intervention schools was reduced compared with controls. The intervention reduced hours of TV viewing among both girls and boys and increased fruit and vegetable consumption and resulted in a smaller increment in total energy intake among girls. Researchers have proposed 2 primary mechanisms for the association between TV viewing and obesity: reduced energy expenditure through displacement of physical activity and increased dietary energy intake either during viewing or as a result of food advertising.[8,10] An elementary school–based controlled intervention successfully reduced body mass index (BMI) while increasing physical activity and fruit and vegetable consumption among students.[9]

Increasing consumption of fruits and vegetables and levels of physical activity are 2 key strategies implemented by states in the Centers for Disease Control and Prevention's (CDC) Nutrition and Physical Activity Program to Prevent Obesity and Other Chronic Diseases.[11] No recommendations exist about the amount of fruits and vegetables that needs to be consumed to help prevent unhealthy weight gain; however, national health objectives for the year 2010 recommend at least 5 servings of fruits and vegetables daily as part of a healthy diet.[12] Current dietary guidelines for adolescents recommend even more fruits and vegetables based on age, gender, and activity levels.[4] About half (46%) of US high school students report that they are trying to lose weight, yet only 20% of all students consume 5 or more servings of fruits and vegetables daily.[13]

To develop interventions that effectively promote fruit and vegetable consumption within the context of healthy weight management, information is needed on fruit and vegetable intake among youth who are trying to control their weight and whether fruit and vegetable intake varies by the types of weight management strategies employed. The objectives of our study were 2-fold: (1) to identify patterns of weight management behavior involving 3 commonly recommended strategies (ie, being physically active, eating a reduced calorie or fat diet, and limiting TV viewing) among US high school students who were trying to lose weight or maintain their current weight and (2) to describe the associations between these weight management behaviors and the consumption of fruits and vegetables.

METHODS

Survey Design

The Youth Risk Behavior Surveillance System was implemented in 1990 by the CDC to monitor priority health risk behaviors among youth over time. We combined data from the 1999, 2001, and 2003 national Youth Risk Behavior Survey (YRBS) so that we could examine patterns of weight-related behaviors among female and male students who reported trying either to lose weight or to stay the same weight. Each of these surveys used a similar 3-stage cluster sample design to obtain a nationally representative sample of high school students in the United States. Details of the sample design have been described previously.[14] A general description of the sampling methods is provided here.

Primary sampling units (PSUs), consisting of large counties or groups of smaller adjacent counties, were

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selected from 16 strata formed according to the degree of urbanization and the relative percentages of black and Hispanic students in the PSU. The PSUs were selected with probability proportional to the total school enrollment in the PSU. At the second stage of sampling, schools were selected with probability proportional to school enrollment size. Schools with substantial numbers of black and Hispanic students were sampled at relatively higher rates. The final stage of sampling consisted of randomly selecting, within each chosen school and in each grade, 1 or 2 intact classes of a required subject, such as English or social studies. All students in the selected classes were eligible to participate in the survey. School-level and student-level nonresponse rates for the YRBS were small and did not vary systematically by school and student characteristics. Weighting factors were used in analyses to adjust for oversampling of black and Hispanic students, as well as school-level nonresponse (based on school size, urbanicity, and proportion of minority students) and student-level nonresponse (based on gender, race/ethnicity, and grade in school). The final, overall weights were scaled, so the weighted count of students equaled the total sample size, and the weighted proportions of students in each grade matched national population projections.

The questionnaire was administered in the classroom by trained data collectors. Students recorded responses on computer-scannable answer sheets. 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 YRBS was approved by the CDC Institutional Review Board.

Measures

Weight management goals were assessed by the question: ''Which of the following are you trying to do about your weight?'' Response options included ''lose weight,'' ''stay the same weight,'' ''gain weight,'' and ''I am not trying to do anything about my weight.'' 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 (during the past 7 days) to 4 or more times per day. Vigorous physical activity was assessed by the question: ''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?'' Moderate physical activity was assessed by the question: ''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?'' Consumption of a reduced calorie or fat diet was assessed by the question: ''During the past 30 days, did you eat less food, fewer calories, or foods low in fat to lose weight or keep from gaining weight?'' TV viewing was assessed by the following question: ''On an average school day, how many hours do you watch TV?''

Self-reported height and weight were used to calculate BMI, expressed as body weight in kilograms divided by the square of height in meters (kg/m^2). Three body weight categories were created using age- and sex-specific cut points for BMI percentiles based on growth charts produced by CDC.[15] Students were categorized as overweight (BMI $\geq$95th percentile), at risk for overweight (85th-94th percentile), or normal/underweight ($<$85th percentile). Although adolescents may under- or overreport their height and weight, many studies of adolescents have found strong correlations between BMI calculated from self-reported versus measured height and weight.[16-18] A recent national study of adolescents found that the correlation between BMI calculated from self-reported versus measured height and weight was r = .92.[18] Using self-reported height and weight correctly classified 96% of teens with respect to overweight (BMI $\geq$95th percentile); girls were no more likely than boys to be misclassified using self-reported height and weight.[18]

Because frequencies for consumption of fruits and vegetables, physical activity, and TV viewing time were not normally distributed, these behaviors were analyzed as categorical variables. Cut points for these behaviors were chosen in a manner consistent with year 2010 national health objectives.[12] Students who ate 5 or more servings of fruits and vegetables daily were considered to include sufficient fruits (objective 19-5) and vegetables (objective 19-6) in their diet. Students who participated in at least 30 minutes of moderate physical activity on 5 or more days per week (objective 22-6) or at least 20 minutes of vigorous physical activity on 3 or more days per week (objective 22-7) were considered physically active. Watching TV more than 2 hours per day was considered excessive (objective 22-11).

Data Analyses

The study population was limited to students who reported they were trying either to lose weight or to stay the same weight. Separate analyses were performed for female and male students using SUDAAN, a software package that accounts for complex sample design and weighting factors.[19] We first described the demographic characteristics, body weight category, and weight management goals and behaviors of

students. We also examined how the prevalence of eating sufficient fruits and vegetables varied by demographics, body weight category, and weight management goals and behaviors. Finally, logistic regression was used to examine the associations between fruit and vegetable intake and being physically active, eating a reduced-calorie or -fat diet, and limiting TV viewing, controlling for demographics, body weight category, and weight management goals (ie, lose weight vs stay the same weight). To make conservative comparisons of unadjusted data, prevalence estimates were considered to be significantly different if their 95% confidence intervals (CIs) did not overlap. Adjusted odds ratios (ORs) were considered to be statistically significant if $p < .05$.

RESULTS

In the 1999, 2001, and 2003 YRBS, school response rates ranged from 75% to 80%, student response rates ranged from 83% to 86%, overall response rates ranged from 63% to 67%, and sample sizes ranged from 13,601 to 15,349. Our analyses were limited to students who reported they were trying to lose weight or stay the same weight. This population included 77.4% (95% CI: 75.6-79.1) (N = 16,709) of all female students and 48.2% (95% CI: 46.6-49.8) (N = 10,521) of male students.

Prevalence of Overweight and Weight Management Goals and Behaviors

Among students trying to lose weight or stay the same weight, females were less likely than males to be overweight (8.8% vs 23.9%) or at risk for overweight (15.4% vs 22.2%) (Table 1). However, females were more likely than males to be trying to lose weight (77.9% vs 57.9%), to eat a reduced calorie or fat diet (69.7% vs 47.7%), and to limit TV viewing to no more than 2 hours per day (63% vs 56%). Females were less likely than males to be physically active (63.6% vs 75.5%). Only 31.5% of female students and 21.6% of male students combined all 3 weight management strategies—a physically active lifestyle, a reduced calorie or fat diet, and limited TV viewing. Among female students, the next most common behavior patterns involved a reduced calorie or fat diet combined with either physical activity (15.0%) or limited TV viewing (14.3%). Among male students, the next most common behavior patterns involved physical activity combined with limited TV viewing (20.9%) or physical activity alone (18.0%).

Table 1. **Demographics, BMI Category, and Weight Management Goals and Behaviors, by Sex Among US High School Students Trying to Lose Weight or Stay the Same Weight**

	Females	Males
Categories	**% (95% CI)**	**% (95% CI)**
Race/ethnicity		
White	64.5 (60.8-68.0)	62.6 (58.7-66.4)
Black	12.3 (10.6-14.3)	12.6 (10.7-14.9)
Hispanic	13.1 (11.3-15.3)	15.0 (13.0-17.3)
Other	10.0 (7.8-12.7)	9.7 (8.0-11.8)
Age (years)		
≤14	11.4 (10.3-12.5)	10.9 (9.7-12.1)
15	26.1 (24.8-27.5)	26.3 (24.9-27.7)
16	27.0 (26.0-28.0)	26.0 (24.9-27.3)
≥17	35.5 (34.2-36.8)	36.8 (35.3-38.3)
BMI (percentile)*		
≥95	8.8 (8.0-9.7)	23.9 (22.2-25.7)
85-94	15.4 (14.5-16.3)	22.2 (20.9-23.5)
<85	75.8 (74.4-77.1)	54.0 (52.3-55.6)
Weight management goals		
Lose weight	77.9 (76.9-78.9)	57.9 (56.1-59.7)
Stay same weight	22.1 (21.1-23.1)	42.1 (40.3-43.9)
Weight management behaviors		
Types		
Physical activity†	63.6 (62.3-64.9)	75.5 (73.8-77.1)
Diet‡	69.7 (68.0-71.4)	47.7 (46.4-49.0)
TV§	63.4 (61.5-65.2)	55.9 (53.8-57.9)
Patterns		
Physical activity†/diet‡/TV§	31.5 (29.9-33.1)	21.6 (19.9-23.3)
Physical activity†/diet‡	15.0 (14.1-16.0)	15.0 (13.6-16.5)
Physical activity†/TV§	10.6 (9.7-11.6)	20.9 (19.5-22.3)
Physical activity†	6.5 (5.6-7.5)	18.0 (16.7-19.4)
Diet‡/TV§	14.3 (13.5-15.3)	6.3 (5.6-7.0)
Diet‡	9.1 (8.4-9.9)	4.8 (4.2-5.6)
TV§	7.0 (6.4-7.7)	7.1 (6.3-8.0)
None	6.0 (5.3-6.7)	6.3 (5.6-7.2)

*Using self-reported height and weight, BMI (weight [kg]/height [m]^2), age-specific, and gender-specific percentiles based on growth charts developed by CDC.
†Participated in moderate physical activity at least 30 minutes on 5 or more days per week or vigorous physical activity at least 20 minutes on 3 or more days per week.
‡Ate less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight during the past 30 days.
§Limited TV viewing to 2 or fewer hours on a typical school day.

Prevalence of 5 or More Servings of Fruits and Vegetables Daily

Among students who were trying to lose weight or stay the same weight, females (21.3%) were less likely than males (24.7%) to eat 5 or more servings of fruits and vegetables daily (Table 2). Male students who were trying to lose weight were less likely to eat sufficient fruits and vegetables (22.8%) than those who were trying to stay the same weight (27.4%). Among female and male students, sufficient fruit and vegetable intake was more prevalent among those who were physically active and those who ate a reduced-calorie or -fat diet. Sufficient fruit and vegetable intake was most prevalent among females (28.1%) and males (32.7%) who combined physical activity with a reduced-calorie or -fat diet and limited TV viewing.

Associations of Physical Activity, Diet, and TV Viewing With Fruit and Vegetable Intake

Among females, sufficient fruit and vegetable intake was independently associated with being

Table 2. **Consumption of 5 or More Servings of Fruits and Vegetables Daily, by Sex Among US High School Students Trying to Lose Weight or Stay the Same Weight**

	≥5 Servings per Day	
	Females	Males
Categories	**% (95% CI)**	**% (95% CI)**
Total population	21.3 (20.1-22.6)	24.7 (23.2-26.3)
Race/ethnicity		
White	20.3 (19.1-21.6)	23.2 (21.2-25.3)
Black	24.8 (18.9-31.7)	28.3 (24.8-32.0)
Hispanic	21.9 (19.5-24.4)	25.6 (22.9-28.5)
Other	22.5 (19.1-26.4)	29.2 (24.5-34.5)
Age (years)		
≤14	19.4 (16.8-22.4)	29.7 (24.5-35.5)
15	22.3 (20.3-24.5)	23.3 (20.9-26.0)
16	22.7 (20.5-25.1)	24.5 (22.2-26.9)
≥17	20.2 (18.7-21.8)	24.3 (22.0-26.8)
BMI (percentile)*		
≥95	21.3 (17.6-25.4)	25.8 (23.1-28.7)
85-94	20.9 (18.0-24.1)	24.1 (21.2-27.3)
<85	21.1 (19.9-22.3)	24.4 (22.7-26.2)
Weight management goals		
Lose weight	21.4 (19.9-22.9)	22.8 (21.0-24.6)
Stay same weight	21.2 (19.2-23.4)	27.4 (25.4-29.5)
Weight management behaviors		
Types		
Physical activity†		
Yes	25.8 (24.3-27.4)	27.3 (25.6-29.0)
No	13.5 (11.8-15.3)	16.6 (14.8-18.7)
Diet‡		
Yes	22.6 (21.1-24.2)	27.7 (25.9-29.6)
No	18.5 (16.9-20.3)	21.9 (20.2-23.7)
TV§		
Yes	22.1 (20.9-23.4)	25.4 (23.6-27.2)
No	20.1 (17.7-22.8)	23.7 (21.6-26.1)
Patterns		
Physical activity†/diet‡/TV§	28.1 (25.9-30.5)	32.7 (30.1-35.4)
Physical activity†/diet‡	26.0 (22.9-29.5)	29.1 (25.7-32.8)
Physical activity†/TV§	22.2 (19.1-25.6)	24.9 (22.4-27.6)
Physical activity†	20.9 (17.1-25.3)	22.3 (19.2-25.8)
Diet‡/TV§	12.6 (10.7-14.9)	15.5 (11.7-20.3)
Diet‡	13.4 (10.6-16.9)	18.4 (14.1-23.6)
TV§	14.3 (10.9-18.6)	14.2 (11.1-17.8)
None	14.5 (10.0-20.6)	18.2 (14.7-22.4)

*Using self-reported height and weight, BMI (weight [kg]/height [m]^2), age-specific, and gender-specific percentiles based on growth charts developed by CDC.
†Participated in moderate physical activity at least 30 minutes on 5 or more days per week or vigorous physical activity at least 20 minutes on 3 or more days per week.
‡Ate less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight during the past 30 days.
§Limited TV viewing to 2 or fewer hours on a typical school day.

physically active (OR = 2.25), eating a reduced-calorie or -fat diet (OR = 1.29), and limiting TV viewing (OR = 1.15), controlling for race/ethnicity, age, BMI, and weight management goals (Table 3). Among males, sufficient fruit and vegetable intake was independently associated with being physically active (OR = 2.02) and eating a reduced-calorie or -fat diet (OR = 1.60).

The regression models for female and male students were each tested (Wald F statistic) for interactions between weight management behaviors

Table 3. **Adjusted ORs for Consumption of 5 or More Servings of Fruits and Vegetables Daily by Weight-Related Behaviors and Level of Physical Activity Among US High School Students Trying to Lose Weight or Stay the Same Weight**

	≥5 Servings per Day		
		Physically Active Youth†	
Weight Management Behaviors	**Total**	**Yes**	**No**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**
Females			
Physical activity†			
Yes	2.25* (1.92-2.65)		
No	1.00 (referent)		
Diet‡,§			
Yes	1.29* (1.10-1.52)	1.45* (1.21-1.73)	1.00 (0.77-1.29)
No	1.00 (referent)	1.00 (referent)	1.00 (referent)
TV‖			
Yes	1.15* (1.01-1.31)		
No	1.00 (referent)		
Males			
Physical activity†			
Yes	2.02* (1.73-2.35)		
No	1.00 (referent)		
Diet‡,§			
Yes	1.60* (1.44-1.79)	1.72* (1.53-1.94)	1.12 (0.80-1.56)
No	1.00 (referent)	1.00 (referent)	1.00 (referent)
TV‡,‖			
Yes	1.13 (0.96-1.34)	1.21* (1.00-1.47)	0.80 (0.57-1.12)
No	1.00 (referent)	1.00 (referent)	1.00 (referent)

*$p < .05$.
†Participated in moderate physical activity at least 30 minutes on 5 or more days per week or vigorous physical activity at least 20 minutes on 3 or more days per week.
‡Significant interaction with physical activity (Wald F, $p < .05$).
§Ate less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight during the past 30 days.
‖Limited TV viewing to 2 or fewer hours on a typical school day.

(Table 3). Among females, physical activity acted as an effect modifier (Wald F = 10.51, p = .002) for the association between eating a reduced-calorie or -fat diet and sufficient fruit and vegetable intake. Only among physically active females was sufficient fruit and vegetable intake associated with eating a reduced-calorie or -fat diet (OR = 1.45). Among males, physical activity acted as an effect modifier for a reduced-calorie or -fat diet (Wald F = 4.26, p = .04) and limited TV viewing (Wald F = 5.42, p = .02). Only among physically active males was sufficient fruit and vegetable intake associated with eating a reduced-calorie or -fat diet (OR = 1.72) and with limited TV viewing (OR = 1.21).

Next, we examined the association between fruit and vegetable intake and patterns of weight management behavior among female and male students who were trying to lose weight or stay the same weight, controlling for race/ethnicity, age, BMI, and weight management goals (Table 4). In the absence of physical activity, eating a reduced-calorie or -fat diet and limiting TV viewing, either alone or in combination, were not associated with sufficient fruit and vegetable

Table 4. **Adjusted ORs for Consumption of 5 or More Servings of Fruits and Vegetables Daily, by Sex Among US High School Students Trying to Lose Weight or Stay the Same Weight**

Independent Variables	≥5 Servings per Day	
	Females	Males
	OR (95% CI)	OR (95% CI)
Race/ethnicity		
White	1.00 (referent)	1.00 (referent)
Black	1.46* (1.07-2.00)	1.52* (1.24-1.85)
Hispanic	1.21* (1.02-1.44)	1.24* (1.01-1.51)
Other	1.23 (0.97-1.55)	1.53* (1.13-2.08)
Age (years)		
≤14	1.00 (referent)	1.00 (referent)
15	1.28* (1.02-1.62)	0.70* (0.50-0.98)
16	1.40* (1.11-1.77)	0.77 (0.57-1.05)
≥17	1.26* (1.03-1.54)	0.78 (0.55-1.11)
BMI (percentile)[†]		
≥95	1.06 (0.80-1.39)	1.21 (0.99-1.48)
85-94	1.00 (0.83-1.20)	1.08 (0.88-1.32)
<85	1.00 (referent)	1.00 (referent)
Weight management goals		
Lose weight	0.88 (0.74-1.06)	0.62* (0.52-0.74)
Stay same weight	1.00 (referent)	1.00 (referent)
Weight management behavior patterns		
Physical activity[‡]/diet[§]/TV[‖]	3.01* (2.06-4.39)	2.91* (2.18-3.88)
Physical activity[‡]/diet[§]	2.49* (1.71-3.62)	2.33* (1.71-3.17)
Physical activity[‡]/TV[‖]	2.00* (1.30-3.08)	1.69* (1.26-2.25)
Physical activity[‡]	1.83* (1.14-2.94)	1.40* (1.01-1.92)
Diet[§]/TV[‖]	1.10 (0.75-1.61)	0.95 (0.59-1.55)
Diet[§]	1.11 (0.78-1.56)	1.28 (0.85-1.93)
TV[‖]	1.22 (0.73-2.03)	0.83 (0.58-1.20)
None	1.00 (referent)	1.00 (referent)

*$p < .05$.
[†]Using self-reported height and weight, BMI (weight [kg]/height [m]^2), age-specific, and gender-specific percentiles based on growth charts developed by CDC.
[‡]Participated in moderate physical activity at least 30 minutes on 5 or more days per week or vigorous physical activity at least 20 minutes on 3 or more days per week.
[§]Ate less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight during the past 30 days.
[‖]Limited TV viewing to 2 or fewer hours on a typical school day.

intake. Sufficient fruit and vegetable intake was associated with a physically active lifestyle, either alone or combined with other weight management strategies. The greatest likelihood of sufficient fruit and vegetable intake was found among female (OR = 3.01) and male (OR = 2.91) students who combined all 3 weight management strategies. Male students who were trying to lose weight were less likely to eat 5 or more servings of fruits and vegetables daily than those who were trying to stay the same weight (OR = 0.62).

Finally, we ran a series of logistic regression models to test whether survey year was an effect modifier of the associations between fruit and vegetable intake and weight-related behaviors. We found that the interaction terms between survey year and each of the weight-related behaviors were not significant. Therefore, the associations presented in Tables 3 and 4 were consistent over time (1999-2003) and did not change significantly by survey year.

DISCUSSION

Intervention studies seeking to reduce chronic disease risk by increasing consumption of fruits and vegetables while decreasing fat intake have often found significant weight loss among participants during follow-up.[3,20,21] Despite the potential weight management and health-related benefits of fruit and vegetable consumption, in our study of high school students who were trying to lose weight or stay the same weight, only 21.3% of females and 24.7% of males ate 5 or more servings of fruits and vegetables daily. These estimates are consistent with previous research that has found fruit and vegetable intake among adolescents to be less than recommended.[22-24]

In our study, sufficient fruit and vegetable intake was independently associated with a physically active lifestyle, eating a diet low in calories or fat, and (among females) limited TV viewing. Previous research has found increased fruit and vegetable intake among youth who reported exercising to lose weight or to keep from gaining weight and among physically active adults.[25-27] In addition, athletic adolescents tend to have healthier eating habits (eg, more likely to eat breakfast, dairy products, fruit, fruit juice, and salads) and have better nutrient intake than their nonathletic peers.[28,29] Other studies have found an inverse association between hours of TV viewing and consumption of fruits and vegetables.[30,31] This is not surprising because TV advertising directed at children and adolescents primarily promotes energy-dense nutrient-poor convenience and fast foods.[32,33]

A unique contribution of our study is the finding that being involved in a physically active lifestyle modifies the association between fruit and vegetable intake and TV viewing or eating a reduced calorie or fat diet. Only among females and physically active males was limited TV viewing associated with sufficient fruit and vegetable intake, and only among physically active students was eating a diet low in calories or fat associated with sufficient fruit and vegetable intake. Examining patterns of weight-related behavior, we found that limited TV viewing and eating a diet low in calories or fat, either individually or in combination, were not associated with sufficient fruit and vegetable intake. However, sufficient fruit and vegetable intake was associated with a physically active lifestyle, alone or in combination with limited TV viewing or a diet low in calories or fat. The greatest likelihood of sufficient fruit and vegetable intake was found among students who combined all 3 weight control strategies. It remains unclear whether participation in physical activity predisposes to healthier food choices or if healthy food choices and

physical activity are both part of a more healthy approach to life. Physically active youth may view weight management as part of a healthy lifestyle that includes increased intake of fruits and vegetables, while physically inactive youth may view weight control as a separate goal unrelated to lifestyle. More research is needed to identify potential determinants and mediators of these associations.

Several study limitations must be acknowledged. The accurate measurement of physical activity, inactivity, and dietary intake is difficult and complex. Because these data were collected as part of a broad-based surveillance system, only a limited number of self-reported questions were available to measure these study variables. The extent to which students may under- or overreport these behaviors is unclear, but we should note that most items measuring health risk behaviors on the YRBS have acceptable reliability.[34] It is possible that we misclassified some students regarding eating a reduced calorie or fat diet because their motivation for eating ''less food, fewer calories, or foods low in fat'' was not ''to lose weight or keep from gaining weight.'' Misclassification should be minimal because we limited the analysis to students who reported they were trying to ''lose weight'' or ''stay the same weight'' when asked the question, ''Which of the following are you trying to do about your weight?'' Finally, the data in this study are cross-sectional and cannot be used to imply a causal relationship between the weight-related behaviors of students and their fruit and vegetable intake.

Interventions that seek to promote fruit and vegetable intake within the context of healthy weight management may be more effective if they capitalize on the strong association between physical activity and fruit and vegetable intake and employ a combination of nutrition and physical activity strategies. Further research is needed to identify the reasons underlying the association between physical activity and fruit and vegetable consumption and whether promoting a healthy diet and physical activity together is more effective in changing these behaviors than promoting them individually.[35] National campaigns like the 5 A Day program to promote fruit and vegetable consumption and the VERB campaign to promote physical activity among preteens can be effective.[36,37] Communities can ensure access to a variety of reasonably priced fruits and vegetables, as well as access to safe parks and recreational facilities. Media literacy education and TV turnoff projects that encourage active alternatives to TV viewing can help young people achieve a more physically active lifestyle while at the same time reducing exposure to messages that encourage consumption of energy-dense nutrient-poor convenience and fast foods.[32,33,38] Schools can help by creating environments that promote healthy eating and physical activity.[39,40] School food service can limit access to energy-dense nutrient-poor foods such as candy, chips, and soft drinks and provide a variety of nutritious foods, such as fruits and vegetables, at attractive prices. Opportunities to increase physical activity include daily physical education classes, recess time for elementary school students, intramural sports or physical activity clubs, classroom-based physical activity breaks, and walk-to-school programs. Together, national, community, school, and media efforts can help stem the increasing prevalence of overweight among youth in the United States.

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