

## RESEARCH ARTICLE

# Associations of Trying to Lose Weight, Weight Control Behaviors, and Current Cigarette Use Among US High School Students

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## ABSTRACT

**BACKGROUND:** Approximately one-quarter of high school students currently use cigarettes. Previous research has suggested some youth use smoking as a method for losing weight. The purpose of this study was to describe the association of current cigarette use with specific healthy and unhealthy weight control practices among 9th–12th grade students in the United States.

**METHODS:** Youth Risk Behavior Survey data (2005) were analyzed. Behaviors included current cigarette use, trying to lose weight, and current use of 2 healthy and 3 unhealthy behaviors to lose weight or to keep from gaining weight. Separate logistic regression models calculated adjusted odds ratios (AORs) for associations of current cigarette use with trying to lose weight (Model 1) and the 5 weight control behaviors, controlling for trying to lose weight (Model 2).

**RESULTS:** In Model 1, compared with students who were not trying to lose weight, students who were trying to lose weight had higher odds of current cigarette use (AOR = 1.30, 95% CI: 1.15–1.49). In Model 2, the association of current cigarette use with the 2 healthy weight control behaviors was not statistically significant. Each of the 3 unhealthy weight control practices was significantly associated with current cigarette use, with AORs for each behavior approximately 2 times as high among those who engaged in the behavior, compared with those who did not.

**CONCLUSION:** Some students may smoke cigarettes as a method of weight control. Inclusion of smoking prevention messages into existing weight management interventions may be beneficial.

**Keywords:** nutrition and diet; smoking and tobacco; risk behaviors.

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Although lifetime and current cigarette use among high school students declined during 1999–2003, it remained unchanged during 2003–2005.<sup>1</sup> Because nearly one-quarter of high school students report current cigarette use,<sup>2</sup> significant progress needs to be made to achieve the Healthy People 2010 objective to reduce current cigarette use among high school students to < 16%.<sup>3</sup> Understanding adolescent motivation may help to reduce cigarette use.

Among adolescents, weight control may be one of several perceived benefits of cigarette use. Indeed, previous research has shown associations between smoking and trying to lose weight, particularly among female adolescents.<sup>4–11</sup> For example, Delveno et al found that female high school students who smoked were more likely to report intentions to lose weight when compared with nonsmokers.<sup>9</sup> Studies of the association between cigarette use and trying to lose weight that include both male and female adolescents produce inconsistent findings: some show no association among males<sup>4,7,12</sup> and others show significant associations among both males and females.<sup>13,14</sup> Variation by race/ethnicity also has been found. With the exception of black females, Fulkerson found that adolescent female smokers of nonwhite and multiple racial/ethnic groups were as likely as white adolescent females to smoke to lose or control weight.<sup>14</sup> In addition, Asian American and American Indian adolescent males were more likely than white adolescent males to smoke to lose or control weight, whereas black, Hispanic, and multiple race adolescent males were as likely as white adolescent males to smoke to lose or control weight.<sup>14</sup>

Several studies examine the relationship of smoking to specific weight control behaviors, including healthy behaviors (dieting and exercise) and unhealthy behaviors (vomiting; fasting; binge and purge behavior; and laxative, diet pill, and diuretic use).<sup>7,9,12,15–17</sup> For example, Neumark-Sztainer and Hannan found cigarette use significantly associated with dieting and bingeing and purging behavior among girls, though not among boys,<sup>12</sup> whereas Lowry et al found associations between smoking and healthy weight control behaviors (exercising) among male students and unhealthy weight control behaviors (fasting, taking diet pills, and vomiting or using laxatives) among male and female students.<sup>7</sup> We did not locate any published studies that examined racial/ethnic differences in the association between smoking and weight control behaviors.

Although associations between cigarette use and trying to lose weight and specific weight control behaviors have been examined previously, these associations have not been tested to identify whether each behavior is independently associated with cigarette use. As a result, it is unclear whether trying to lose weight is an independent risk factor for cigarette use or whether trying to lose weight is merely a

proxy for specific healthy or unhealthy weight control behaviors that are directly associated with cigarette use. In addition, actual body weight and perceptions of body weight may be confounders in the association between trying to lose weight and cigarette use,<sup>14</sup> but most studies do not control for these factors.<sup>7,9,13,15,17</sup> The purpose of this study is to address shortcomings in the literature concerning 9th–12th grade students by testing (1) whether trying to lose weight and specific healthy and unhealthy weight control behaviors are independently associated with current cigarette use, while controlling for body mass index (BMI) and perceived weight and (2) whether these associations vary by sex or race/ethnicity.

## METHODS

### Sample and Survey Administration

The national school-based Youth Risk Behavior Survey, implemented by the Centers for Disease Control and Prevention (CDC) and approved by an institutional review board at the CDC, monitors the prevalence of priority health risk behaviors among youth. In spring 2005, a 3-stage, cluster-sample design was used to obtain a nationally representative sample of students in grades 9–12. Parental permission was obtained before survey administration in accordance with local procedures, and participation in the survey was voluntary. Students completed anonymously the self-administered, 98-item questionnaire in their classrooms during a regular class period and recorded their responses directly onto a computer-scannable booklet or answer sheet.

The sampling strategy has been described elsewhere.<sup>18,19</sup> The school response rate was 78%, the student response rate 86%, and the overall response rate 67%. Usable questionnaires were returned by 13,917 students. A weighting factor was applied to each student record to adjust for nonresponse and the oversampling of black and Hispanic students.

### Procedures

Student demographic characteristics included sex, grade (9th, 10th, 11th, or 12th), and race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or other). Current cigarette use was measured by the question, “During the past 30 days, on how many days did you smoke cigarettes?” Response options were collapsed dichotomously as 0 days or  $\geq 1$  day. Trying to lose weight was measured by the question, “Which of the following are you trying to do about your weight?” Response options were collapsed to create 2 categories, “lose weight,” or all other options (i.e., “gain weight,” “stay the same weight,” or “I am not trying to do anything about my weight”). Because results from this study can add to the existing literature, current cigarette use and trying to lose weight were

dichotomized in the manner described to be consistent with previously published studies on this topic.

Two healthy weight control behaviors were assessed by the following questions: “During the past 30 days, did you eat less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight?” (ate less food, fewer calories, or foods low in fat) and “During the past 30 days, did you exercise to lose weight or to keep from gaining weight?” (exercise). Three unhealthy weight control behaviors were assessed by the following questions: “During the past 30 days, did you go without eating for 24 hours or more (also called fasting) to lose weight or to keep from gaining weight?” (went without eating for  $\geq$  24 hours); “During the past 30 days, did you take any diet pills, powders, or liquids without a doctor’s advice to lose weight or to keep from gaining weight? (Do not include meal replacement products such as Slim Fast)” (took diet pills, powders, or liquids); and “During the past 30 days, did you vomit or take laxatives to lose weight or to keep from gaining weight?” (vomited or took laxatives). Response options for all 5 weight control behavior questions were “yes” or “no.”

BMI (calculated as weight in kilograms divided by the square of height in meters) was calculated from the metric conversion of self-reported height in inches and weight in pounds. Using CDC growth charts as a reference,<sup>2,20</sup> a 5-level categorical variable was created on the basis of the BMI percentile for age and sex. The 5 categories were underweight ( $\leq$  5th percentile), at risk for underweight (6th–15th percentile), normal weight (16th–84th percentile), at risk for overweight (85th–94th percentile), and overweight ( $\geq$  95th percentile). Perceived weight was measured by the question, “How do you describe your weight?” Response options were “very underweight,” “slightly underweight,” “about the right weight,” “slightly overweight,” and “very overweight.”

### Data Analysis

All statistical analyses, including prevalence estimates, adjusted odds ratios (AORs), and corresponding 95% confidence intervals, were performed on weighted data using SAS-Callable SUDAAN®,<sup>21</sup> a statistical software package that accounts for the complex sampling design. Two logistic regression models were run: Model 1 calculated the association between trying to lose weight and current cigarette use and Model 2 calculated the association between the 5 weight control behaviors and current cigarette use, controlling for trying to lose weight. All models controlled for sex, race/ethnicity, grade, perceived weight, and BMI category. AORs were considered significant if the corresponding 95% confidence intervals did not include 1.0.

Interaction terms were added to Model 2 to test whether the association between the independent

variables (trying to lose weight and the 5 weight control behaviors) and the dependent variable (current cigarette use) varied by sex and race/ethnicity. An interaction term for each pairwise combination of demographic variable with independent variable (e.g., sex  $\times$  trying to lose weight) was created and entered simultaneously into the model. An interaction was considered statistically significant if its corresponding Wald statistic p-value was  $<.05$ .

## RESULTS

Table 1 reports the prevalence of demographic characteristics, current cigarette use, trying to lose weight,

**Table 1. Prevalence of Demographic Characteristics, Current Cigarette Use, Trying to Lose Weight, and Weight Control Behaviors Among US High School Students—United States, 2005**

	%	95% CI $\pm$
Demographic characteristics		
Sex		
Female	49.5	1.0
Male	50.5	1.0
Race/ethnicity		
White*	61.9	4.0
Black*	14.6	2.6
Hispanic	15.1	1.8
Other	8.3	2.0
Grade		
9 <sup>th</sup>	29.1	1.4
10 <sup>th</sup>	25.9	1.0
11 <sup>th</sup>	23.3	1.0
12 <sup>th</sup>	21.7	1.3
BMI		
Underweight	2.1	0.3
At risk for underweight	4.6	0.5
Normal	64.6	1.4
At risk for overweight	15.7	0.9
Overweight	13.1	0.9
Perceived weight		
Very underweight	1.9	0.4
Slightly underweight	12.2	0.8
About the right weight	54.4	1.3
Slightly overweight	26.9	0.9
Very overweight	4.6	0.6
Current cigarette use <sup>†</sup>		
Trying to lose weight	23.0	2.3
45.6	1.2	
Healthy weight control behaviors		
Exercised <sup>‡</sup>	60.0	1.4
Ate less food, fewer calories, or foods low in fat <sup>‡</sup>	40.7	1.2
Unhealthy weight control behaviors		
Went without eating for $\geq$ 24 hours <sup>‡</sup>	12.3	0.9
Took diet pills, powders, or liquids <sup>‡</sup>	6.3	1.0
Vomited or took laxatives <sup>‡</sup>	4.5	0.5

\*Non-Hispanic.

<sup>†</sup>Smoked cigarettes on  $\geq$  1 of the 30 days preceding the survey.

<sup>‡</sup>To lose weight or to keep from gaining weight during the 30 days preceding the survey.

BMI, body mass index; CI, confidence interval.

and weight control behaviors among US high school students. Of the students who responded, 61.9% were white, 14.6% black, and 15.1% Hispanic. Approximately half of the students were female (49.5%). Students were distributed by grade as follows: 29.1% in 9th grade, 25.9% in 10th grade, 23.3% in 11th grade, and 21.7% in 12th grade. Nearly one-quarter (23.0%, 95% CI ± 2.3) reported current cigarette use. Just under one-third described themselves as slightly (26.9%, 95% CI ± 0.9) or very overweight (4.6%, 95% CI ± 0.6). However, 15.7% (95% CI ± 0.9) were at risk for becoming overweight, and 13.1% (95% CI ± 0.9) were overweight. Almost half (45.6%) were trying to lose weight. Of the 5 weight control behaviors examined, exercising was the most commonly reported (60.0%, 95% CI ± 1.4), followed by ate less

food, fewer calories, or foods low in fat (40.7%, 95% CI ± 1.2). Vomited or took laxatives was the least frequently reported weight control behavior during the past 30 days (4.5%, 95% CI ± 0.5).

Table 2 presents the prevalence and AORs of current cigarette use by demographic characteristics and weight control behaviors among US 9th–12th grade students. Trying to lose weight was associated with current cigarette use in Model 1 (without adjusting for the 5 weight control behaviors), but not in Model 2 (after adjusting for the 5 weight control behaviors). In Model 1, students who were trying to lose weight had higher odds of current cigarette use than students not trying to lose weight (AOR = 1.3, 95% CI: 1.2–1.5). In Model 2, no significant association was found between current cigarette use and the 2 healthy weight control

**Table 2. Prevalence and Adjusted Odds Ratios (AOR) of Current Cigarette Use\* by Demographic Characteristics and Weight Control Behaviors Among 9th–12th Grade Students—United States, 2005**

	% (95% CI)	Model 1 <sup>†</sup> AOR (95% CI) AOR (95% CI)	Model 2 <sup>‡</sup> AOR (95% CI) AOR (95% CI)
Demographic characteristics			
Sex			
Female	23.0 (20.4–25.8)	1.0 (0.9–1.1)	0.9 (0.8–1.0)
Male	23.0 (20.7–25.3)	referent	referent
Race/ethnicity			
White <sup>§</sup>	25.9 (23.0–29.2)	referent	referent
Black <sup>§</sup>	12.9 (11.1–14.8)	<b>0.4 (0.3–0.5)</b>	<b>0.4 (0.3–0.5)</b>
Hispanic	22.0 (18.7–25.8)	0.8 (0.6–1.1)	0.8 (0.6–1.1)
Other	19.4 (15.4–24.1)	<b>0.7 (0.5–0.9)</b>	0.7 (0.5–1.0)
Grade			
9 <sup>th</sup>	19.7 (17.5–22.1)	referent	referent
10 <sup>th</sup>	21.4 (18.4–24.8)	1.1 (0.9–1.3)	1.1 (0.9–1.3)
11 <sup>th</sup>	24.3 (21.2–27.7)	<b>1.3 (1.1–1.5)</b>	<b>1.3 (1.1–1.5)</b>
12 <sup>th</sup>	27.6 (24.0–31.5)	<b>1.5 (1.2–1.8)</b>	<b>1.5 (1.3–1.8)</b>
BMI			
Underweight	24.4 (18.4–31.6)	1.2 (0.8–1.7)	1.3 (0.9–1.9)
Risk of underweight	21.1 (17.2–25.7)	0.9 (0.7–1.2)	0.9 (0.7–1.2)
Normal weight	21.8 (19.5–23.3)	referent	referent
Risk of overweight	26.3 (23.3–29.7)	<b>1.3 (1.2–1.5)</b>	<b>1.3 (1.2–1.5)</b>
Overweight	25.0 (21.1–29.4)	<b>1.2 (1.0–1.6)</b>	<b>1.3 (1.0–1.7)</b>
Perceived weight			
Very underweight	23.7 (17.9–30.8)	1.3 (0.8–1.9)	1.0 (0.6–1.6)
Slightly underweight	23.0 (20.2–26.0)	<b>1.1 (1.0–1.3)</b>	1.1 (0.9–1.2)
About the right weight	21.6 (19.3–24.1)	referent	referent
Slightly overweight	25.2 (22.2–28.5)	0.9 (0.8–1.1)	0.9 (0.7–1.0)
Very overweight	26.5 (21.4–32.4)	0.9 (0.7–1.3)	0.8 (0.6–1.1)
Trying to lose weight	25.6 (22.9–28.6)	<b>1.3 (1.2–1.5)</b>	1.1 (0.9–1.3)
Weight control behaviors			
Exercised <sup>  </sup>	23.6 (21.3–26.2)	NI	0.9 (0.7–1.1)
Ate less food, fewer calories, or foods low in fat <sup>  </sup>	26.4 (23.6–29.4)	NI	1.0 (0.9–1.1)
Went without eating for ≥ 24 hours <sup>  </sup>	42.2 (37.3–47.3)	NI	<b>2.3 (2.0–2.8)</b>
Took diet pills, powders, or liquids <sup>  </sup>	48.3 (43.0–53.6)	NI	<b>2.1 (1.6–2.8)</b>
Vomited or took laxatives <sup>  </sup>	50.8 (44.1–57.5)	NI	<b>2.1 (1.5–2.7)</b>

\*Smoked cigarettes on ≥ 1 of the 30 days preceding the survey.

<sup>†</sup>To lose weight or to keep from gaining weight during the 30 days preceding the survey.

<sup>‡</sup>Association of the 5 weight control behaviors with current cigarette use, controlling for trying to lose weight, sex, race/ethnicity, grade, perceived weight, and BMI category.

<sup>§</sup>Non-Hispanic.

<sup>||</sup>Association of trying to lose weight with current cigarette use while controlling for sex, race/ethnicity, grade, perceived weight, and BMI category.

BMI, body mass index; CI, confidence interval; NI, not included in model.

Significant AORs are in bold.

behaviors: eating less food, fewer calories, or foods low in fat (AOR = 1.0, 95% CI: 0.9–1.1) or exercising (AOR = 0.9, 95% CI: 0.7–1.1). Each of the 3 unhealthy weight control behaviors was significantly associated with current cigarette use. Compared with students who did not engage in the behavior, the odds of current cigarette use were higher among students who went without eating for  $\geq 24$  hours (AOR = 2.3, 95% CI: 2.0–2.8); took diet pills, powders, or liquids (AOR=2.1, 95% CI: 1.6–2.8); and vomited or took laxatives (AOR = 2.1, 95% CI: 1.5–2.7).

Table 3 reports Wald chi-square ( $\chi^2$ ) and p-values for interactions of sex, race/ethnicity, and grade with trying to lose weight and weight control behaviors in association with current cigarette use. None of the interaction terms tested were statistically significant, indicating the associations between trying to lose weight and the 5 weight control behaviors with current cigarette use did not vary statistically by sex, race/ethnicity, or grade.

**Table 3. Wald Chi-Square ( $\chi^2$ ) and p-Value for Interactions of Sex, Race/Ethnicity, and Grade With Trying to Lose Weight and Weight Control Behaviors in Association With Current Cigarette Use\* Among 9th–12th Grade Students—United States, 2005**

Interaction Term	Interaction Term <sup>†</sup> Wald $\chi^2$ (p-value)
Trying to lose weight	
× Sex	0.01 (0.91)
× Race/ethnicity	0.09 (0.96)
× Grade	0.11 (0.95)
Exercised <sup>‡</sup>	
× Sex	0.21 (0.65)
× Race/ethnicity	1.00 (0.40)
× Grade	0.51 (0.68)
Ate less food, fewer calories, or foods low in fat <sup>‡</sup>	
× Sex	0.05 (0.83)
× Race/ethnicity	1.35 (0.27)
× Grade	0.84 (0.48)
Went without eating for $\geq 24$ hours <sup>‡</sup>	
× Sex	0.01 (0.94)
× Race/ethnicity	1.01 (0.40)
× Grade	0.72 (0.55)
Took diet pills, powders, or liquids <sup>‡</sup>	
× Sex	1.23 (0.27)
× Race/ethnicity	2.39 (0.08)
× Grade	0.56 (0.65)
Vomited or took laxatives <sup>‡</sup>	
× Sex	0.71 (0.40)
× Race/ethnicity	0.51 (0.68)
× Grade	0.79 (0.50)

\*Smoked cigarettes on  $\geq 1$  of the days preceding the survey.

<sup>†</sup>Interaction terms added to Model 2, which included the main effects of sex, race/ethnicity, grade, body mass index category, perceived weight, trying to lose weight, the 2 healthy weight control behaviors, and the 3 unhealthy weight control behaviors.

<sup>‡</sup>To lose weight or to keep from gaining weight during the 30 days preceding the survey.

## DISCUSSION

Trying to lose weight was associated with current cigarette use before, but not after, adjusting for healthy and unhealthy weight control behaviors. When the model controlled for trying to lose weight, students who engaged in unhealthy weight control behaviors, but not healthy weight control behaviors, were more likely to report current cigarette use. These findings suggest that trying to lose weight per se is not a risk factor for current cigarette use. In fact, students who are engaging in healthy weight control behaviors (ie, exercising or eating less food, fewer calories, or foods low in fat) are no more likely to currently use cigarettes than students who are not engaging in these behaviors. However, students who engage in unhealthy weight control behaviors (ie, went without eating for  $\geq 24$  hours; took diet pills, powders, or liquids; or vomited or took laxatives) were more likely to currently use cigarettes than students who did not engage in the behaviors.

This study is 1 of the first to examine systematically whether trying to lose weight is independently associated with current cigarette use and to examine the association of specific healthy and unhealthy weight loss behaviors with current cigarette use, while controlling for perceived body weight and BMI category. The results of this study indicate that the association of unhealthy weight control behaviors with cigarette use is significant regardless of students' BMI or perceived body weight. Although previous research has documented significant differences by sex and race/ethnicity,<sup>7,13,14,17</sup> we found that these associations did not vary by sex or race/ethnicity. The results of this study may differ from previous studies because this study included both male and female students and controlled for BMI. Additionally, previous studies may have examined only healthy or only unhealthy weight control behaviors, but not both.

This study is subject to at least 2 limitations. Data are based on self-report and the extent of under-reporting and over-reporting of behaviors cannot be determined; however, the survey questions have been shown to demonstrate good test-retest reliability.<sup>22</sup> In addition, data are cross-sectional and causality cannot be inferred.

The results from this study have direct implications for interventions designed to promote healthy weight among adolescents. School health curricula that promote healthy weight control should incorporate education on healthy weight loss strategies and emphasize the negative health consequences of cigarette smoking. In addition, it may be important to incorporate smoking prevention messages into existing weight management interventions, health curricula, and educational materials, especially those that target adolescents who

use unhealthy weight control practices. A first step toward this is increasing awareness among school health educators and health care providers of the use by adolescents of smoking for weight loss.

In light of our findings, it also may be important to identify whether smoking cessation programs have unanticipated consequences, such as increasing the risk of unhealthy weight control practices. If adolescents who smoke to lose weight are also prone toward using other unhealthy weight control practices, then they might be at increased risk for other unhealthy weight control behaviors if they successfully quit smoking. As such, it may be appropriate to incorporate healthy weight control education into smoking cessation programs.

Further research is needed to examine the behavioral determinants and factors underlying the association between unhealthy weight control practices and cigarette smoking, and should examine whether these associations vary by sex or race/ethnicity, as has been documented in previous studies.<sup>8,14</sup>

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