WHAT'S KNOWN ON THIS SUBJECT: There is a relationship between smoking, weight concerns and dietary behaviors in adolescents.

WHAT THIS STUDY ADDS: This study is the first examination of the relationship among cigarette smoking, weight-related smoking expectancies, and dietary behaviors in a large, geographically diverse sample of adolescents. We also wanted to determine whether these relationships were altered by intensity of smoking.

abstract

OBJECTIVE: The objective of this study was to examine the association of cigarette smoking and weight concerns in adolescents, given that adolescents may begin smoking or have difficulty quitting because of their expectancies of the effects of smoking on body weight.

METHODS: This study used data from a cross-sectional survey of 4523 Connecticut high school adolescents to assess the influence of gender, smoking intensity, and dietary-restrictive behavior on smoking-related weight concerns.

RESULTS: Heavy smokers were significantly less likely to engage in healthy dietary restrictions than nonsmokers; however, light smokers did not differ from nonsmokers. Both light and heavy smokers were significantly more likely to engage in unhealthy dietary restriction when compared with nonsmokers. In the model that was used to examine smokers only, heavy smokers were significantly less likely to engage in healthy dietary restriction than light smokers, but smoking level was not associated with unhealthy dietary restrictions. Dietary restrictions are significantly associated with smoking-related weight concerns; however, this seems to be related to type of dietary-restrictive behavior, with greater weight concerns observed only in those smokers who engaged in unhealthy dietary restrictions and not in those who engaged in healthy dietary restrictions or no restrictions.

CONCLUSIONS: Although limited by its cross-sectional nature, the findings from this large, geographically diverse sample have clinical implications for smoking prevention and cessation interventions in adolescents. Pediatrics 2010;126:e66–e72

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KEY WORDS
adolescence, smoking, dietary habits, weight management

ABBREVIATIONS
SCQ—Smoking Consequences Questionnaire
OR—odds ratio
CI—confidence interval
ANOVA—analysis of variance

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FINANCIAL DISCLOSURE: Dr Potenza consults for and is an advisor to Boehringer Ingelheim, has consulted for and has financial interests in Somaxon, has received research support from the Mohegan Sun Casino and Forest Laboratories, and has consulted for law offices and the federal public defender’s office on issues related to impulse control disorders; the other authors have no financial relationships relevant to this article to disclose.
Each day, >4000 adolescents who are aged 12 to 17 years try their first cigarette in the United States, and nearly 75% of them eventually become dependent. According to a national survey, rates of adolescent smoking within the past month are 14% for 10th-graders and 22% for 12th-graders. It is interesting that many adolescent smokers report having a desire to quit, although few adolescents seek help in smoking cessation programs. It is important to understand the factors that may contribute to the initiation and maintenance of smoking in adolescents, as well as to the ambivalence about quitting and failed attempts at cessation.

One factor that plays a role in smoking behavior is the belief that adolescents have about smoking as a method of weight control. Various studies suggested that anywhere from 15% to 40% of adolescents endorse this belief, with higher levels of concurrence among smokers than nonsmokers. The level of agreement with smoking as a means to control weight increases with previous smoking history, with never smokers least likely to agree, regular smokers more likely to agree, experimental smokers even more likely to agree, and never smokers being the most likely to agree. Furthermore, female adolescents are more likely to endorse this belief than their male counterparts.

A number of studies have used structured questionnaires to examine weight-related smoking expectancies among college-aged smokers. Daily college smokers scored significantly higher than occasional and never smokers on a factor of the Smoking Consequences Questionnaire (SCQ), which is used to assess the perceived impact of smoking on appetite-weight control, with female students reporting significantly greater weight-related smoking expectancies than male students. Similar findings were reported in other college-aged samples by using different scales that measure beliefs about the consequences of smoking. Copeland and Carney also reported that weight-related smoking expectancies were significantly associated with smoking rates, with heavier smokers reporting higher expectancies.

Few studies have examined weight-related smoking expectancies in high school–aged adolescents. Our group observed in a small sample of well-characterized high school–aged, daily smokers that the belief that smoking helps to control weight was positively associated with smoking rate and negatively associated with number of years smoking. In addition, female adolescents who smoked more cigarettes reported more concern about gaining weight on quitting, but this did not hold true for male adolescents. We also found that male adolescents with higher BMI were more likely to report smoking to control weight than were female adolescents. More recently, Bean et al examined attitudes toward smoking and weight control in rural high school students and found that girls believed that people smoke to control weight, but boys had stronger beliefs that quitting smoking would lead to weight gain.

Although it is unknown what portion of adolescents begins smoking as a means of controlling weight, weight gain is a significant concern among this population. There is an increased prevalence of obesity and dieting behaviors among adolescents: 16.0% of adolescents are mildly overweight, and 13.0% are severely overweight. Furthermore, dietary behaviors are not just popular with overweight adolescents but also common among normal-weight adolescents, indicating that these youth are typically trying to maintain a healthy body weight or prevent gaining weight.

Weight control strategies range from healthier forms, such as exercise and dietary restriction, to more serious weight loss measures, such as purging and fasting. Whereas moderate changes in diet and exercise have been shown to be safe, significant psychological and physical consequences may occur with extreme or unhealthy dieting practices. Increased frequency of dieting and purging behavior have been shown to be independently associated with increased health-risk behavior in female adolescents and to a lesser extent in male adolescents, and purgers, compared with nonpurging adolescents, are more likely to use alcohol, tobacco, and drugs. In fact, many studies consider cigarette smoking as a method of unhealthy weight control, suggesting that anywhere from 9% to 34% of young smokers use smoking as a weight loss strategy, a behavior more commonly seen in female individuals.

To the best of our knowledge, none of these studies examined the relationship that smoking has to other forms of weight control strategies, both unhealthy and healthy. Various forms of weight control may have different implications for tobacco use in adolescents. Furthermore, weight control practices among adolescents may be associated with the beliefs that adolescents have about the effectiveness of smoking to control weight.

This study is the first examination of the relationship among cigarette smoking, weight-related smoking expectancies, and dietary behaviors in a large, geographically diverse sample of high school–aged adolescents. Moreover, we wanted to determine whether any of these relationships were altered by intensity of smoking. We hypothesized that heavier smokers would engage in more dietary-restrictive behaviors when compared with nonsmokers and light smokers.
We explored whether light smokers, heavy smokers, and nonsmokers differed in the type of dietary-restrictive behavior (healthy versus unhealthy). Last, we hypothesized that adolescent smokers who also endorsed dietary-restrictive behaviors would have higher weight-related smoking expectancies.

**METHOD**

**Procedures**

Letters were mailed to 122 public high schools in Connecticut and were followed by telephone calls to determine interest in survey participation. Schools were offered a statistical summary report of the prevalence of high-risk behaviors in their school to encourage participation. School administrators were left telephone messages, but only a few calls were returned. Of those returned calls, the responses varied on the basis of the school’s various commitments for that year. For schools that expressed an interest in participating, permission was obtained from the administration and/or the board of education. In most cases, the superintendent and/or the school board provided permission after consulting with the principal at each school. The schools that agreed to participate had an interest in receiving the survey data for their school or were schools with which we had ongoing or previous relationships. The final sample included schools from each geographic region of Connecticut, with schools from each of the state’s district reference groups, which are groupings of schools on the basis of the socioeconomic status of the families in the school district. Although this was not a random sample of public high schools in Connecticut, the demographics of this sample are similar to the sample of Connecticut residents who were aged 14 to 18 and were described in the 2000 Census.

After approval from school officials, information letters about the survey were sent home to parents; parents were asked to call the school if they did not want their child to participate. When no message was received from a parent, the student was assumed to have permission to participate. This waiver of parental permission procedure was approved by all schools and the investigational review board of the Yale University School of Medicine. There were approximately none to a few students in each school who were unable to complete the survey because their parents declined their participation. The entire student body (ie, grades 9–12) was targeted for administration of the survey; however, a few schools preferred to limit the involvement of their students to a random sample of each grade or selected grades. In some schools, surveys were administered in a school-wide assembly; in other schools, surveys were administered in English or health classes. Each school was visited on a single day by research staff, who explained the study, distributed the surveys, answered questions, and collected the completed surveys.

Students were told that their participation was voluntary, were told that they could choose not to complete the survey if they wished, and were reminded to keep surveys anonymous by not writing their name or other identifying information anywhere on the survey. When a student chose not to participate or his or her parent denied permission for participation, he or she was able to work quietly at his or her desk during the survey administration. Students were given a pen as a token of appreciation.

Data were scanned into an electronic database and cleaned and checked for accuracy before analyses were performed. All of the surveys were included in the analyses except for the few that were returned completely blank at each school. The surveys that had incomplete items or sections were considered missing data, and questions were excluded when >1 response was incorrectly circled.

**Measures**

The survey consisted of 153 questions that inquired about demographic characteristics, substance use, and other high-risk behaviors. For assessment of tobacco use, participants were asked whether they ever smoked a cigarette. Students who responded yes to this question were asked a series of other questions about the frequency and quantity of their smoking. Smoking status was defined on the basis of past-month cigarette consumption and categorized into 3 groups of smokers: nonsmokers (no cigarettes in the past 30 days), light smokers (<1 cigarette per day and up to 7 cigarettes per day), and heavy smokers (>7 cigarettes per day).

Weight-related smoking expectancies were ascertained by using the likelihood ratings of the Appetite-Weight Control Factor of the SCQ. Likelihood ratings (outcomes that are desirable to the participant) seem to be more sensitive than desirability ratings (outcomes that are desirable to the participant) or subjective expected utility scores (weighting probability ratings by desirability ratings) to differences in smoking status. Participants who endorsed smoking were given 5 possible consequences of smoking and were asked to rate the likelihood of each consequence on a 10-point scale from “completely unlikely” to “completely likely.” The statements included, “Smoking controls my appetite,” “Smoking keeps my weight down,” “Cigarettes keep me from overeating,” “Cigarettes keep me from eating more than I should,” and, “Smoking...
helps me control my weight." Scores were an average across all items. The SCQ shows evidence of good internal consistency, high factor loadings, and coefficient as ranging from .72 to .97. Dietary behaviors were assessed by using 5 questions from the Youth Risk Behavior Survey. This national survey shows moderate test–retest reliability, and although validity has not been assessed, self-reports can be affected by both cognitive and situational factors that may or may not threaten the validity of self-reports of this behavior. All participants were asked, during the past 30 days, "Did you exercise to lose weight or keep from gaining weight?" "Did you eat less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight?" "Did you go without eating for 24 hours or more (also called fasting) to lose weight or keep from gaining weight?" "Did you take any diet pills, powders, or liquids without a doctor’s advice to lose weight or keep from gaining weight?" and, "Did you make yourself vomit or take laxatives to lose weight or to keep from gaining weight?" These 5 behaviors were stratified into “healthy” and “unhealthy” dietary practices. “Healthy” dieting was endorsement of either or both of the first 2 items (exercise or eat less). “Unhealthy” dieting was endorsement of any or all of the last 3 items (fasting, diet pills, or vomiting). Other researchers in the field of dietary restriction use similar guidelines to distinguish healthy versus unhealthy dietary behaviors.

Participants were asked their height in feet and inches and also asked for their best guess of their weight in pounds. BMI was calculated with weight in pounds multiplied by 703 and divided by the square of height in inches. A BMI <18.5 was considered underweight, BMI between 18.5 and 25.0 was considered normal weight, and BMI >25.0 was considered overweight/obese.

### Data Analysis

All analyses were conducted by using SAS software (SAS Institute, Cary, NC). A multinomial logistic regression model was used to investigate the relationship between smoking level (nonsmoker, light smoker, heavy smoker) and type of dietary restriction (no restriction, healthy restriction, unhealthy restriction). A second binary logistic regression model was used to look at the subsample of smokers to determine differences between heavy and light smokers on dietary restrictions. Odds ratios (ORs) and 95% confidence intervals (CIs) for were calculated. An analysis of variance (ANOVA) compared weight-related smoking expectancies between light smokers and heavy smokers. Another ANOVA compared weight-related expectancies between light and heavy smokers and between smokers who reported dietary behaviors and those who did not. Analyses were conducted by using both unadjusted and adjusted models for gender, grade, and BMI.

### RESULTS

Of the 4523 adolescents surveyed, 4182 provided information about smoking behavior during the past month. Non-smokers composed 79% (n = 3323) of the group, light smokers composed 13% (n = 530), and heavy smokers composed 8% (n = 329). Comparisons of participants with complete data and those without complete data indicated that there was no significant difference by BMI (P = .16), but respondents with missing data were more likely to be nonwhite and Hispanic (P < .0001 for both), older (P = .0003), and male (P < .0001). The demographic characteristics of the final sample are summarized in Table 1.

In terms of healthy dietary restriction, heavy smokers were significantly less likely to engage in these behaviors than were nonsmokers (OR: 0.58 [95% CI: 0.44–0.77]; χ² = 14.74, P < .0001), whereas light smokers did not differ from nonsmokers (OR: 0.93 [95% CI: 0.75–1.15]). χ² = 0.46, P = 0.50. In terms of unhealthy dietary restrictions, both light (OR: 2.67 [95% CI: 2.08–3.43]; χ² = 59.14, P < .0001) and

### TABLE 1 Demographic Characteristics of Sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Whole Sample (n = 4182)</th>
<th>Light Smokers (n = 530)</th>
<th>Heavy Smokers (n = 329)</th>
<th>Nonsmokers (n = 3323)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
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<tr>
<td>Male</td>
<td>47.5</td>
<td>38.5</td>
<td>52.7</td>
<td>47.2</td>
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<tr>
<td>Female</td>
<td>52.5</td>
<td>61.5</td>
<td>47.4</td>
<td>52.8</td>
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<tr>
<td>Grade</td>
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<tr>
<td>9</td>
<td>31.5</td>
<td>24.7</td>
<td>23.4</td>
<td>33.3</td>
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<td>10</td>
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<td>25.6</td>
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<td>11</td>
<td>25.6</td>
<td>29.8</td>
<td>31.4</td>
<td>24.4</td>
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<td>12</td>
<td>15.6</td>
<td>21.9</td>
<td>18.8</td>
<td>14.3</td>
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<tr>
<td>Race</td>
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<td></td>
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</tr>
<tr>
<td>White</td>
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<td>82.8</td>
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<tr>
<td>Black</td>
<td>10.1</td>
<td>5.3</td>
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<tr>
<td>Hispanic</td>
<td>14.2</td>
<td>12.1</td>
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<td>Dietary restriction</td>
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<tr>
<td>No restrictions</td>
<td>35.3</td>
<td>30.9</td>
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<tr>
<td>Healthy restrictions</td>
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<tr>
<td>Unhealthy restrictions</td>
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<tr>
<td>BMI</td>
<td></td>
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<tr>
<td>Underweight (BMI &lt;18.5)</td>
<td>11.1</td>
<td>8.3</td>
<td>6.5</td>
<td>12.2</td>
</tr>
<tr>
<td>Overweight (BMI &gt;25.0)</td>
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<td>24.8</td>
<td>28.1</td>
<td>20.5</td>
</tr>
<tr>
<td>Normal weight (BMI 18.5–25.0)</td>
<td>67.2</td>
<td>66.9</td>
<td>65.5</td>
<td>67.0</td>
</tr>
</tbody>
</table>
heavy smokers (OR: 2.92 [95% CI: 2.20–3.87]; \(\chi^2 = 55.63, P < .0001\)) were significantly more likely to engage in these behaviors when compared with nonsmokers. Analyses that controlled for gender, grade, and BMI suggested that the association between smoking level and dietary restrictions was either mediated or confounded by a combination of these variables, but no single factor that influenced the results was identified (Table 2).

In the model that was used to examine smokers only, heavy smokers were significantly less likely to engage in healthy dietary restriction than were light smokers (OR: 0.62 [95% CI: 0.45–0.87]; \(\chi^2 = 7.54, P = .006\), but smoking level was not associated with unhealthy dietary restriction (OR: 1.094 [95% CI: 0.780–1.540]; \(P = .60\)). Controlling for grade, gender, and BMI did not alter the results. Boys were significantly more likely than girls to be heavy smokers (Table 3). We also tested an interaction between gender and dietary restrictions; however, it was nonsignificant, suggesting that the association between smoking and dietary restrictions does not differ between boys and girls.

In analyses of weight-related smoking expectancies on the SCQ, ANOVA results indicated that heavy smokers were more likely to endorse weight-related smoking expectancies than were light smokers (\(F_{1,819} = 32.7, P < .0001\)). We ran additional analyses to determine whether the very low level smokers (ie, those who smoked \(<1\) cigarette per day) were different from other smokers. Pairwise comparisons did indicate that the extra low group \((<1)\) had significantly lower scores on weight-related smoking expectancies than the group of adolescents who smoked 3 to 7 cigarettes per day \((P < .05)\); however, when we repeated the ANOVA on smoking expectancies after separating the groups into \(<1\) to 2 cigarettes per day, 3 to 7 cigarettes per day, and \(>7\) cigarettes per day, the results were not significantly different.

When weight-related smoking expectancies by dietary-restrictive behaviors were examined, ANOVA results also indicated that dietary restrictions were significantly associated with weight-related smoking expectancies in smokers (\(F_{2,818} = 33.9, P < .0001\)). Specifically, among all adolescent smokers, those who engaged in unhealthy dietary restrictions had significantly greater weight-related smoking expectancies than those who engaged in no dietary restrictions \((t = 7.55, P < .0001)\); however, those who engaged in healthy dietary restrictions did not differ from those who engaged in no dietary restrictions \((t = 1.08, P = .2783)\). Controlling for gender, grade, and BMI did not alter results.

**DISCUSSION**

The results of this study suggest that adolescent smokers engage in more dietary-restrictive behaviors and may also have strong expectations about the role of cigarette smoking in assisting with weight control. Although a considerable number of adolescents report engaging in some type of dietary behavior, adolescent smokers seem to engage in more unhealthy dietary-restrictive behaviors when compared with nonsmokers. Comparisons within smokers on dietary behaviors indicated that heavy smokers were less likely to engage in healthy dietary behaviors, but the 2 groups did not differ in their endorsement of un-
healthy forms of dietary restrictions, indicating that these differences were not attributable to quantity/frequency of tobacco use and that smokers, in general, engaged in more unhealthy dietary-restrictive behaviors. Results also indicated that the association between smoking and dietary restrictions did not differ in boys and girls, although boys were more likely to be heavy smokers.

Regarding weight-related smoking expectancies, adolescents who were heavier smokers were more likely to have greater expectancies for weight control from smoking when compared with lighter smokers, similar to previous findings with college-aged smokers. Furthermore, as hypothesized, heavier smokers who engaged in unhealthy weight control methods reported higher weight-related smoking expectancies than those who reported none of these behaviors or healthy forms of dietary restriction.

This study has important clinical implications for adolescents. First, heavier smokers have greater weight-related smoking expectancies than lighter smokers, with smokers who also engage in unhealthy forms of weight control having greater smoking expectancies. Thus, smokers, independent of their smoking rate, tend to engage in more forms of unhealthy dieting than nonsmokers, including use of tobacco as an “unhealthy” means to control weight. Lighter smokers may struggle with weight issues and turn to smoking as a means to control weight, first using healthy forms of dietary restriction and then progressing to more unhealthy forms. Over time, these smokers may increase their smoking, rely more on cigarettes as a means to control weight, and turn to methods of unhealthy dieting. This may reflect a progression in an interaction between increased cigarette consumption or tobacco dependence and dietary behaviors. Because we cannot directly confirm this hypothesis from cross-sectional data, future studies should investigate the relationships between smoking and dieting over time.

Our results also suggest that there is a need to promote healthy methods of weight maintenance and dispel the notion of tobacco use as a weight control method for adolescent smokers. Adolescents should be made aware that there are other ways to lose weight that are more effective and healthier, and such messages should be included in educational curricula, especially when discussing quitting smoking. In addition, cessation programs should build into their behavioral treatments a focus on the concern about gaining weight as a result of quitting and alternative methods to maintain a healthy weight.

A few limitations of this study should be noted. First, as noted previously, the data analyzed were cross-sectional in nature, which precludes establishment of causal relationships between the variables. Future longitudinal studies should further investigate relationships between smoking initiation and initiation of dietary behaviors. Furthermore, self-reported information may have biases, including inaccurate reporting of tobacco use, dietary behaviors, and other measures. Finally, objective data were not collected to calculate BMI, with collected information reflecting a perceived BMI (on the basis of self-reported height and weight) rather than a measured one; however, data from the Youth Risk Behavior Survey, which asks for self-reported height and weight followed by measurements, have revealed that self-report data are reliable. A notable strength of this study is that it included a large geographically diverse sample of adolescents to examine weight-related smoking behaviors, whereas other studies focused on college samples or relatively smaller adolescent samples.

CONCLUSIONS

This study suggests that smokers engage in less healthy dietary behaviors and more unhealthy weight control methods than do nonsmokers. Heavy smokers also endorse greater weight-related smoking expectancies than light smokers, with smokers who engage in unhealthy dietary restrictions having greater expectancies than those who engage in no dietary restrictions. Future research needs to examine these relationships further in both promotion and maintenance of smoking behavior and evaluate behavioral and pharmacologic methods to address these issues clinically with adolescent smokers.

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