Associations of Body Mass Index and Perceived Weight With Suicide Ideation and Suicide Attempts Among US High School Students

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Background: Previous research with adolescents has shown associations of body weight and perceptions of body size with suicide ideation and suicide attempts, but it is unclear whether these associations are direct or whether a mediating effect exists.

Objectives: To determine if body mass index and perceived weight are associated significantly with suicide ideation and suicide attempts, controlling for weight control practices, and if perceived weight mediates the associations of body mass index with suicide ideation and suicide attempts.

Design, Setting, and Participants: Data were analyzed from the 2001 Youth Risk Behavior Survey, a school-based survey administered to a nationally representative sample of students in grades 9 through 12 (N=13,601).

Main Outcome Measure: Self-reported past-year suicide ideation and suicide attempts, compared by perceived weight and body mass index category, calculated from self-reported height and weight.

Results: Body mass index category was associated significantly with suicide ideation (among all students) and suicide attempts (among white and Hispanic students) without perceived weight in the model but not with perceived weight added to the model. In contrast with those who perceive themselves as about the right weight, students who perceived themselves as very underweight (odds ratio [OR], 2.29 [95% confidence interval (CI), 1.46-3.59]), slightly underweight (OR, 1.36 [95% CI, 1.03-1.79]), slightly overweight (OR, 1.33 [95% CI, 1.12-1.58]), and very overweight (OR, 2.50 [95% CI, 1.73-3.60]) had greater adjusted odds of suicide ideation. Among white students, perceiving oneself as very underweight (OR, 3.04 [95% CI, 1.40-6.58]) or very overweight (OR, 2.74 [95% CI, 1.21-6.23]) was associated with greater odds of suicide attempts. Perceiving oneself as very underweight was associated with greater odds for suicide attempts among black (OR, 2.86 [95% CI, 1.10-7.45]) and Hispanic (OR, 3.40 [95% CI, 1.54-7.51]) students.

Conclusions: How adolescents perceive their body weight may be more important than their actual weight in terms of increased likelihood of suicidal behavior. Regardless of body mass index, extreme perceptions of weight appear to be significant risk factors for suicidal behavior; important racial/ethnic differences exist.

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During the past 20 years, the percentage of US adolescents who are overweight has tripled, from 5% in 1980 to 15% by 2000. Among adolescents, negative mental health outcomes are the most widespread health consequence associated with overweight and obesity. Adolescent girls who are overweight or obese are at increased risk for considering suicide (suicide ideation) and for suicide attempts.

Perceived weight, or self-described body size, also has been shown to be associated with suicide attempts among adolescent girls, though the direction of this association was not specified. Significant associations of actual and perceived weight with suicide ideation and attempts have not been found for adolescent boys.

Adolescents who engage in unhealthy weight control practices such as binging, vomiting, taking laxatives or diet pills, or fasting to lose weight are more likely to exhibit extremes of body mass index (BMI) and inaccurate perceptions of body size and weight. While associations of BMI and perceived weight with suicidal behavior have been examined only

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in a few studies, numerous clinical and general population studies have found that adolescents with unhealthy weight control practices are at increased risk for suicide ideation, suicide attempts, and death by suicide. These associations appear to be significant among both male and female adolescents.

Previous studies of associations of body weight, perceived weight, and weight control practices with suicidal behavior have tended to include measures of BMI, perceived weight, or weight control practices but not all 3, even though they might be important covariates. Thus, the independent effects of BMI and perceived weight controlling for weight control practices on suicidal behavior are not clear. For example, associations of BMI and body weight perception with suicidal behavior may be confounded by weight control practices. Also, BMI and perceived weight may each directly affect adolescent suicidal behavior or an indirect, or mediating, effect may exist. Related research has shown that perceived weight mediates the association of BMI with adolescent depression. A similar mediating effect with adolescent suicidal behavior is possible.

Using a nationally representative sample of adolescents, this study tested 2 hypotheses: (1) BMI and perceived weight will be associated individually with suicide ideation and suicide attempts, controlling for weight control practices, and (2) perceived weight will mediate the association of BMI with suicide ideation and suicide attempts.

STUDY PARTICIPANTS

Data from the national 2001 Youth Risk Behavior Survey (YRBS) were analyzed. The YRBS used a 3-stage cluster design to draw a sample representative of students in grades 9 through 12 in the United States. Additional details on the YRBS sampling strategy have been described previously. Data from 13,601 students in 150 schools were available for analysis. This sample of students had the following demographic characteristics: 51.3% were female; 67.3% white; 13.0% black; 12.0% Hispanic; 7.6% other race/ethnicity; 8.9%, 14 years or younger; 22.3%, aged 15 years; 26.2%, aged 16 years; 26.3%, aged 17 years; and 16.3%, 18 years or older.

INSTRUMENT AND PROCEDURES

The YRBS was reviewed and approved by an institutional review board at the Centers for Disease Control and Prevention, Atlanta, Ga. Trained data collectors administered the paper-and-pencil questionnaires to whole classrooms during a regular class period. In 2001, the YRBS questionnaire consisted of 95 items and assessed participation in 6 categories of risk behavior: (1) those that contribute to unintentional injury and violence, (2) tobacco use, (3) alcohol and other drug use, (4) sexual behaviors that contribute to unintended pregnancy and sexually transmitted diseases, (5) unhealthy dietary behaviors, and (6) physical inactivity.

Body mass index (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. Body mass index based on self-reported height and weight previously has been shown to correlate highly with BMI based on measured height and weight (r=0.89; mean difference, 2.6 kg/m²). Using Centers for Disease Control and Prevention growth charts as a reference, a 5-level categorical variable was created based on the BMI percentile for age and sex. The 5 categories were underweight (≤5th percentile), at risk for underweight (6th-15th percentile), normal weight (16th-84th percentile), at risk for overweight (85th-94th percentile), and overweight (≥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.

Suicide ideation was measured by the question, “During the past 12 months, did you ever seriously consider attempting suicide?” Response options were yes or no. Suicide attempt was measured by the question, “During the past 12 months, how many times did you actually attempt suicide?” For this study, responses were collapsed into 2 categories, 0 times vs 1 or more times. These questions have demonstrated substantial reliability. The 2-week test-retest k was 83.8% for suicide ideation and 76.4% for suicide attempts.

Two healthy weight control practices 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?” (dieting) and “During the past 30 days, did you exercise to lose weight or to keep from gaining weight?” (exercise). Three unhealthy weight control practices 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?” (fasting), “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?” (diet pills), and “During the past 30 days, did you vomit or take laxatives to lose weight or to keep from gaining weight?” (vomiting). For all 5 weight control practice questions, response options were yes or no.

STATISTICAL ANALYSIS

Data were weighted to adjust for nonresponse and oversampling of black and Hispanic students. All analyses were performed on weighted data using SUDAAN, a software package that accounts for the complex sampling design. Logistic regression was used to calculate adjusted odds ratios (ORs) and 95% confidence intervals (CIs). Separate models were run for each dependent variable (suicide ideation and suicide attempts). Each model controlled for demographic variables, including race/ethnicity, sex, and age, and for potential confounders, including current smoking behavior (“During the past 30 days, on how many days did you smoke cigarettes?” 0 days or 1 or more days) and physical activity (engaged in either moderate physical activity for at least 30 minutes on 5 or more days per week or vigorous physical activity for at least 20 minutes on 3 or more days per week, yes or no). Because of power limitations, final models only retained significant (P≤.05) weight control practice and confounding variables. Demographic variables always were retained in the final models.

To test for the mediating role of perceived weight in the association of BMI category with suicidal behavior, a mediation analysis was conducted according to the methods discussed by Baron and Kenny and Holmbeck. The Figure provides a visual representation of the model tested in this study. The following conditions were tested: (1) BMI category is associated with perceived weight (pathway A); (2) BMI category is associated with suicidal behavior (pathway B); (3) perceived weight is associated with suicidal behavior, controlling for BMI category (pathway C); and (4) the association of BMI...
category with suicidal behavior is weaker when perceived weight is included in the model than when perceived weight is not included.

Pathway A was tested using multinomial logistic regression to calculate the odds of perceiving oneself as very or slightly underweight in contrast to about the right weight and very or slightly overweight in contrast to about the right weight for each BMI category. For each dependent variable, pathways B and C were tested with 2 logistic regression models. In model 1, pathway B was tested by regressing suicide ideation and suicide attempts on BMI category without perceived weight in the model. In model 2, pathway C was tested by adding perceived weight to model 1. Finally, the strength of association of BMI category with suicide ideation and suicide attempts in model 1 (without perceived weight) was compared with those values in model 2 (with perceived weight). The main effects of BMI category and perceived weight on suicide ideation and suicide attempts were interpreted from model 2.

Since preliminary analysis revealed the association of BMI category and perceived weight with suicide attempts significantly varied by race/ethnicity, the suicide attempt model results are presented separately for white, black, and Hispanic students. (Because of small sample size, results are not presented for students who characterized their race/ethnicity as American Indian or Alaskan Native, Asian, or Native Hawaiian or Other Pacific Islander.) There was no evidence that BMI and perceived body weight with suicide ideation and attempts varied by sex.

RESULTS

Approximately 12% of students were missing a response to the suicide-attempt question. Therefore, these students were excluded from models with suicide attempt as the dependent variable. Students with a missing value on this question were more likely to be male (OR, 1.31 [95% CI, 1.10-1.56]), black (OR, 4.15 [95% CI, 3.17-5.44]), or Hispanic (OR, 2.36 [95% CI, 1.73-3.21]) than white, obese than normal weight (OR, 1.49 [95% CI, 1.20-1.86]), perceive themselves as underweight than normal weight (OR, 2.97 [95% CI, 2.05-4.30]), and to fast (OR, 1.33 [95% CI, 1.06-1.66]); they were less likely to engage in the recommended minimum level of physical activity per week (OR, 0.82 [95% CI, 0.68-0.99]) and to eat less to lose or maintain weight (OR, 0.76 [95% CI, 0.63-0.92]).

Table 1 provides the prevalence estimates and crude ORs for BMI category, perceived weight, suicide ideation, and suicide attempts by sex and race/ethnicity. Table 2 provides the prevalence estimates and crude ORs for suicide ideation and suicide attempts by BMI category and perceived weight.

Among all students, controlling for race/ethnicity, sex, age, current smoking status, and significant weight control practices, BMI category was associated significantly with perceived weight (Table 3). This finding supports pathway A (Figure). Using “about the right weight” as a referent, underweight students were more likely to perceive themselves as underweight and overweight students were more likely to perceive themselves as overweight. A similar association was observed among white, black, and Hispanic students (results not shown).

Table 4 presents the association of BMI category with suicide ideation, without (model 1) and with (model 2) perceived weight in the model, controlling for sex, race/ethnicity, age, current smoking status, and unhealthy weight control practices. Without perceived weight in the model, BMI was associated significantly with suicide ideation. Specifically, the odds of suicide ideation were greater among students who were underweight (OR, 1.40 [95% CI, 1.01-1.92]) and overweight (OR, 1.30 [95% CI, 1.10-1.54]) than among students who were normal weight. When perceived weight was added to the model, the association of BMI category with suicide ideation became nonsignificant. Perceived weight was significant, with greater odds of suicide ideation among students who perceived themselves as very underweight (OR, 2.29 [95% CI, 1.46-3.59]), slightly underweight (OR, 1.36 [95% CI, 1.03-1.79]), slightly overweight (OR, 1.33 [95% CI, 1.12-1.58]), and very overweight (OR, 2.50 [95% CI, 1.73-3.60]) than among students who perceived themselves as about the right weight.

Table 5 presents the association of BMI with suicide attempts separately by race/ethnicity, without (model 1) and with (model 2) perceived weight in the model, controlling for sex, age, current smoking status, and unhealthy weight control practices. Among white students, BMI was associated significantly with suicide attempts without perceived weight in the model. Specifically, the odds of suicide attempts were greater among white students who were underweight (OR, 1.71 [95% CI, 1.05-2.79]), slightly overweight (OR, 1.29 [95% CI, 1.02-1.64]), and overweight (OR, 1.18 [95% CI, 1.48-3.22]) than among white students who were normal weight. When perceived weight was added to the model, the association of BMI category with suicide ideation became nonsignificant. Perceived weight was significant, with greater odds of suicide attempt among white students who perceived themselves as very underweight (OR, 3.04 [95% CI, 1.40-6.58]) and very overweight (OR, 2.74 [95% CI, 1.21-6.23]) than among white students who perceived themselves as about the right weight.

Among black students, BMI category was not associated significantly with suicide attempts with or without perceived weight in the model. Perceived weight was associated significantly with suicide attempts, however, with greater odds of suicide attempt among black students who perceived themselves as very underweight (OR, 2.86 [95% CI, 1.10-7.45]) than among those who perceived themselves as about the right weight.
Among Hispanic students, when perceived weight was not in the model, BMI category was associated significantly with suicide attempts, with greater odds of suicide attempt among Hispanic students who were underweight (OR, 2.65 [95% CI, 1.27-5.53]) than those who were about the right weight. The association of BMI category with suicide attempts became nonsignificant when perceived weight was added to the model. The association of perceived weight with suicide attempts was significant, with greater odds of suicide attempt among His-
panic students who perceived themselves as very underweight (OR, 3.40 [95% CI, 1.54-7.51]) than among those who perceived themselves as about the right weight.

Our results suggest that, regardless of actual BMI, students with extreme perceptions of body size are at increased risk for suicide ideation and suicide attempts, though important racial/ethnic differences exist. In our sample of both male and female students, without adjusting for perceived weight, BMI category was associated significantly with suicide ideation among all students and with suicide attempts among white and Hispanic (but not black) students. Although other studies also have documented an association of BMI with suicidal behavior,3,4 this association previously has been reported significant only among female students who perceived themselves as about the right weight.

Following the guidelines for mediation analysis suggested by Baron and Kenny,22 and Holmbeck,23 we found that perceived weight met all 4 specified conditions for a full mediator in the association of BMI with suicidal behavior. This finding is consistent with related research that has shown that perceived weight mediates the association of BMI with adolescent depression.15,16 Adolescents who perceive their body size to be extreme (either overweight or underweight) are at increased risk for several negative psychological outcomes, including body weight dissatisfaction,24 negative perception of self,25 negative self-concept,25 and depression.25 Because these negative psychological outcomes also are associated with suicidal behavior among adolescents,27-20 they may represent a potential mechanism through which perceived weight is associated with suicidal behavior.

Suicide ideation was more likely even among students whose perceptions of body size deviated only slightly from “about the right weight.” We found suicide ideation was more likely among students who perceived themselves as anything other than about the right weight. This association did not vary significantly by race/ethnicity or sex. Because nearly one half of students perceived themselves as either slightly or very overweight or slightly or very underweight, these results suggest that a sizeable proportion of students may be at increased risk for suicide ideation.

Important racial/ethnic differences were observed in the association of perceived weight with suicide attempts. Our finding that perceptions of overweight were not associated significantly with suicide attempts among black students is consistent with the greater acceptance of increased body size that has been documented among black women.2

The association of unhealthy weight control practices with suicidal behavior has been well documented.5,6,9,14 Because unhealthy weight control practices also are associated with extremes of BMI and inaccurate weight perceptions,3,6 research on the association of BMI and perceived weight with suicidal behavior should control for unhealthy weight control practices to reduce the possibility that significant findings result from a spurious association. To our knowledge, this is the first study to simultaneously document (1) the association of BMI and suicidal behavior controlling for weight control practices and (2) the mediating effect of perceived weight in this association. Based on these results, it appears that, even when controlling for weight control practices, suicide ideation and suicide attempts are more likely among adolescents with extreme weight perceptions.
This study is subject to at least 4 limitations. First, our measure of BMI is based on self-reported height and weight, which correlates more strongly with perceived weight than BMI based on actual height and weight. However, BMI based on self-reported height and weight has been shown to correlate highly with BMI based on measured height and weight. Second, the data are cross-sectional and therefore causality cannot be inferred. The time frame assessed for suicide ideation and suicide attempts was the past 12 months, while past 30-day weight control practices were assessed. Future research with longitudinal data will be important for establishing temporal sequence. Third, the data do not include students who died by suicide, and multivariate analyses with suicide ideation and suicide attempts were more likely to be obese, perceive themselves as underweight, and engage in unhealthy weight control practices. Thus, these students tended to have characteristics associated with a higher risk for negative psychological outcomes and their exclusion from analysis may have resulted in weaker associations than would have been observed had they been included. Fourth, this study was not able to assess the contribution of several factors commonly associated with suicidal behavior, such as mental illness, family function, and access to firearms. Suicide is a human behavior that results from the influence of many factors. While this study showed an association of perceived weight with suicidal behavior, perceived weight alone does not explain why a person exhibits suicidal behavior. However, the presence of extreme-weight perception may serve as a warning for increased suicide risk and the need to investigate the presence of other risk factors.

Despite these limitations, results from this study provide new information on the nature of the association of BMI, perceived weight, and suicidal behavior and suggest that the likelihood of suicidal behavior may be more dependent on how youths perceive their body weight than on their actual body weight. Suicide ideation and suicide attempts were more likely among youths who perceived themselves as very overweight or very overweight, although racial/ethnic differences were found. This finding highlights the importance of including measures of perceived weight in future research on body size and suicidal behavior. Future research should focus on identifying the determinants of perceived weight and explaining the mechanism through which extreme perceptions of weight independent of actual weight increase the likelihood of suicide ideation and suicide attempts. In addition, research is needed on the association of perceived weight with other less extreme mental health outcomes.

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Table 5. Adjusted Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Suicide Attempts by Race/Ethnicity Among US High School Students*

<table>
<thead>
<tr>
<th>BMI category</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
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<td></td>
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<tr>
<td>Normal</td>
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<tr>
<td>Slightly overweight</td>
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<td>Overweight</td>
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<tr>
<td>Very underweight</td>
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<td></td>
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<tr>
<td>About right</td>
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<td></td>
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<tr>
<td>Slightly overweight</td>
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<tr>
<td>Very overweight</td>
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<td>Female</td>
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<td>Age</td>
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<td>Current smoking</td>
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<td>Fasting</td>
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<td>Diet pills</td>
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<tr>
<td>Vomiting</td>
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<tr>
<td>OR (95% CI)</td>
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</table>

Abbreviations: BMI, body mass index; NA, not applicable; NI, variable not included in final model (only significant behavioral control variables were retained in final models).

*Model 1 excludes perceived weight. Model 2 includes perceived weight.
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REFERENCES


**Correction**

Errors in Tables. In the article “Associations of Body Mass Index and Perceived Weight With Suicide Ideation and Suicide Attempts Among US High School Students” by Eaton et al published in the June issue of the *ARCHIVES* (2005;159:513-519), 2 rows of data in the “Perceived Weight” section of Table 1 should have been deleted. The corrected section of Table 1 is given in the tabulation below. Also, the subheadings for the “BMI Category” section in Tables 1, 2, 4, and 5 should have read as follows: Underweight, At Risk for Underweight, Normal Weight, At Risk for Overweight, and Overweight.

**Table 1. Prevalence and Crude Odds Ratios (ORs) for Body Mass Index (BMI) Category, Perceived Weight, Suicide Ideation, and Suicide Attempt by Sex and Race/Ethnicity Among US High School Students—Youth Risk Behavior Survey, 2001**

<table>
<thead>
<tr>
<th>Perceived Weight</th>
<th>Very Underweight</th>
<th>Slightly Underweight</th>
<th>About Right</th>
<th>Slightly Overweight</th>
<th>Very Overweight</th>
</tr>
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<td><strong>Sex</strong></td>
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<tr>
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<td>16.0</td>
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<td>13.8</td>
<td>1.00 (Referent)</td>
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<td>1.40 (1.05-1.85)</td>
<td>11.3</td>
<td>0.80 (0.67-0.96)</td>
<td>51.4</td>
</tr>
</tbody>
</table>

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