E-Cigarette Use Is Associated With Intentions to Lose Weight Among High School Students

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Abstract

Introduction: Recent literature has demonstrated individuals may be using electronic cigarettes (e-cigarettes) as a method of weight loss and/or management. Furthermore, e-cigarette companies are developing and patenting technologies related to e-cigarettes and weight loss. This study aims to determine the association between intentions to lose weight and e-cigarette use behaviors among a nationally representative sample of high school students.

Methods: Data were obtained from the 2015 Youth Risk Behavior Surveillance survey. Participants were 12,847 students in grades 9–12 in the United States. Multivariate multinomial logistic regression models assessed the association between past 30-day e-cigarette use and weight loss intentions among 9–12 grade students. Subsample analyses were conducted, stratified by sex. Covariates included perceived weight, sex, race/ethnicity, grade, and past 30-day tobacco use.

Results: Overall, 23.7% of the sample used e-cigarettes in the past 30 days. E-cigarette use was associated with 1.38 (95% CI = 1.07% to 1.78%) greater risk of intentions to lose weight among the full sample, controlling for covariates. Among girls, e-cigarette use was associated with 1.44 (95% CI = 1.05% to 1.97%) greater risk of intentions to lose weight, controlling for covariates. Among boys, e-cigarette use was associated with 1.40 (95% CI = 1.04% to 1.88%) greater odds of intentions to gain weight, controlling for covariates.

Conclusion: Findings show a significant association between e-cigarette use and intentions to lose weight among high school students, among the full sample. Interestingly, e-cigarette use was statistically associated with intentions to gain weight among boys. Longitudinal study is needed to further examine this relationship.

Implications and Contribution: This is the one of the first studies reporting on e-cigarette use and weight loss intentions among adolescents, both highly prevalent among this population. These findings are an important development in the study of e-cigarette use given the established link between conventional cigarette smoking and weight loss and/or management.
exclusive e-cigarette users. As such, the US Surgeon General recently declared e-cigarette use by youth and young adults to be a public health crisis.

Understanding motivations for e-cigarette among youth is vital for developing public health interventions. Qualitatively and quantitatively research has identified a number of reasons and motivations for e-cigarette use across age groups. Cigarette smoking cessation, social acceptability, cost, smell, convenience (eg, use where cigarettes are prohibited), flavors, novelty, recreation, and experimentation with new technology have all been identified as reasons for e-cigarette initiation and sustained use. Research has found similar motivations for using e-cigarettes among youth and adults.

Recent literature among young adults has demonstrated individuals may be using e-cigarettes as a method of weight loss and/ or management, with one study finding weight concerns were associated greater e-cigarette use frequency among young adults. Furthermore, e-cigarette companies are developing and patenting technologies related to e-cigarettes and weight loss. However, research has yet to examine this association among adolescents, a more vulnerable population. This is a gap in public health literature given the high prevalence of both e-cigarette use and intentions to lose or maintain weight among adolescents. As such, it is important to investigate the relationships between intentions to lose weight and e-cigarette use among youth.

Study Aims and Hypotheses
This study aims to determine the association between intentions to lose weight and e-cigarette use behaviors among a sample of high school students. First, we hypothesize that past 30-day e-cigarette use will be associated with greater relative risk of intentions to lose weight among the full population. Second, we hypothesize that past 30-day e-cigarette use will be associated with greater relative risk of intentions to lose weight for both boys and girls. To the best of our knowledge, this is the first study to examine the association between weight loss behaviors and e-cigarette use among high school students in a nationally representative sample.

Methods
Study Sample and Population
Data were obtained from the Youth Risk Behavior Surveillance survey, United States, 2015, a three-stage cluster sample design to produce a nationally representative sample of 9–12 grade students in the United States. Data were collected from 125 private and public schools for a final sample size of 15,624. However, 2590 (16.6%) participants had missing data and were thus excluded from analysis, resulting in a final sample of 13,034.

Measures
Weight-Related Intentions
Weight-related intentions served as the outcome variable in this analysis. Participants were asked “Which of the following are you trying to do with your weight?” with possible answers being “lose weight,” “gain weight,” “stay the same,” and “I am not trying to do anything about my weight.” Individuals that reported not trying to do anything about their weight were analyzed as the referent group (coded as 0). Those that reported “very” or “slightly” overweight were categorized as “overweight” (coded as 1). Those that reported “very” or “slightly” underweight were categorized as “underweight” (coded as 2). Recent literature among young adults has demonstrated individuals may be using e-cigarettes as a method of weight loss and/ or management, with one study finding weight concerns were associated greater e-cigarette use frequency among young adults. Furthermore, e-cigarette companies are developing and patenting technologies related to e-cigarettes and weight loss. However, research has yet to examine this association among adolescents, a more vulnerable population. This is a gap in public health literature given the high prevalence of both e-cigarette use and intentions to lose or maintain weight among adolescents. As such, it is important to investigate the relationships between intentions to lose weight and e-cigarette use among youth.

E-Cigarette Use
Past 30-day e-cigarette use was the independent variable in this analysis. Participants were asked “During the past 30 days, on how many days did you use an electronic vapor product?” with those responding with anything other than “0 days” considered past 30-day e-cigarette users.

Covariates
Self-described body weight was included as a covariate. All participants were asked “how do you describe your weight?” Those that reported “about the right weight” were coded as the referent group (coded as 0). Those that reported “very” or “slightly” underweight were categorized as “underweight” (coded as 1). Those that reported “very” or “slightly” overweight were categorized as “overweight” (coded as 2). Sociodemographic favors use were included as covariates. Race/ethnicity was categorized into the following groups: non-Hispanic white, Hispanic/Latino-only, Hispanic/Latino-Multiracial, non-Hispanic black, and “other.” For the purposes of this study, “other” included Asian, non-Hispanic Multiracial, and American Indian or Alaska Native/Native Hawaiian or Other Pacific Islander. Sex is a dichotomous variable with males coded as 0 and females coded as 1. Age was an ordinal variable with groups being 18 and older (coded as 0), 17 (coded as 1), 16 (coded as 2), 15 (coded as 3), and 14 or younger (coded as 4).

Past 30-day use of tobacco products was included as a covariate, given the high prevalence of dual and poly tobacco use among youth as well as the known association between cigarette use and weight loss behaviors. A participant who reported any use of cigarettes, smokeless tobacco (eg, chewing tobacco, snuff, or dip), or cigar products including cigarillos or little filtered cigars in the past 30 days was considered a “tobacco user” (coded as 1).

Attrition Analyses
Prior to testing study hypotheses, t test and chi-square analyses were conducted to determine if participants with complete data (N = 13,034), differed significantly from participants with incomplete data (n = 2590) across all study variables. Attrition analyses revealed that excluded cases were older and more likely to be past 30-day e-cigarette users. Included and excluded cases did not differ across any other covariate.

Statistical Analyses
Data were weighted to be representative of all students in grades 9–12 attending public and private schools in the United States. Prior to testing the study hypothesis, chi-square tests were used to compare e-cigarette use behaviors by each covariate. The study hypothesis was tested using a multivariate multinomial logistic regression model to assess the relationship between weight loss behavior and past 30-day e-cigarette use, controlling for all covariates. Subsequent subsample analyses were conducted, stratified by sex. All analyses were conducted using STATA 14.0 (College Station, TX).

Results
Descriptive Statistics
Overall, 23.7% of the sample used e-cigarettes in the past 30 days. Furthermore, 45.8% of the study sample reported trying to lose weight and 17.1% reported trying to stay the same. A sizable portion of the study sample were past 30-day other tobacco users (17.3%).
**Table 1. Descriptive Statistics by Weight Intentions (Youth Risk Behavior Surveillance [YRBS] 2015, N = 13,034)**

<table>
<thead>
<tr>
<th></th>
<th>Full sample (N = 13,034)</th>
<th>Not trying to change weight (n = 22,477)</th>
<th>Trying to lose weight (n = 6,307)</th>
<th>Trying to stay the same weight (n = 2,193)</th>
<th>Trying to gain weight (n = 2,287)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of sample</td>
<td>100</td>
<td>18.9</td>
<td>45.8</td>
<td>17.1</td>
<td>18.3</td>
</tr>
<tr>
<td>E-cigarette use&lt;sup&gt;b&lt;/sup&gt; Yes</td>
<td>23.7%</td>
<td>19.1%</td>
<td>25.4%</td>
<td>20.8%</td>
<td>27.1%</td>
</tr>
<tr>
<td>Tobacco use&lt;sup&gt;b&lt;/sup&gt;    Yes</td>
<td>17.6%</td>
<td>14.4%</td>
<td>17.0%</td>
<td>15.7%</td>
<td>24.3%</td>
</tr>
<tr>
<td>Self-described body weight Underweight</td>
<td>14.3%</td>
<td>16.2%</td>
<td>3.3%</td>
<td>8.9%</td>
<td>45.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>About right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overweight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td>Males</td>
<td>51.0%</td>
<td>34.9%</td>
<td>53.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Females</td>
<td>49.0%</td>
<td>65.1%</td>
<td>82.3%</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td>14 (or younger)</td>
<td>10.2%</td>
<td>10.9%</td>
<td>10.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>26.0%</td>
<td>28.1%</td>
<td>25.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16</td>
<td>24.8%</td>
<td>25.3%</td>
<td>25.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
<td>23.6%</td>
<td>22.1%</td>
<td>23.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 (or older)</td>
<td>15.4%</td>
<td>13.6%</td>
<td>15.3%</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td>Non-Hispanic white</td>
<td>54.2%</td>
<td>63.8%</td>
<td>52.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hispanic/Latino</td>
<td>22.5%</td>
<td>16.9%</td>
<td>26.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Hispanic, black</td>
<td>13.5%</td>
<td>10.6%</td>
<td>11.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.8%</td>
<td>8.8%</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

<sup>a</sup>Row may not add up to 100% due to rounding.

<sup>b</sup>Past 30-day use of corresponding product.

<sup>c</sup>“Other” is where a response was “Asian, non-Hispanic,” “American Indian/Alaska Native, non-Hispanic,” or “native Hawaiian and other Pacific Islanders, non-Hispanic.”

<sup>d</sup>Unweighted sample size.
Table 2. Multinomial Logistic Regression Models of Weight Intentions and Past 30-Day Electronic Cigarette Use (Youth Risk Behavior Surveillance [YRBS], 2015; N = 13 034)

<table>
<thead>
<tr>
<th></th>
<th>Not trying to change weight (n = 2247)</th>
<th>Trying to lose weight (n = 6307)</th>
<th>Trying to stay the same weight (n = 2193)</th>
<th>Trying to gain weight (n = 2287)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relative risk ratio</td>
<td>95% Confidence interval</td>
<td>Relative risk ratio</td>
<td>95% Confidence interval</td>
</tr>
<tr>
<td>Full sample (N = 13 034)</td>
<td>1.00 (Ref)</td>
<td>1.38* (1.07 to 1.78)</td>
<td>1.09 (0.90 to 1.32)</td>
<td>1.29 (0.96 to 1.72)</td>
</tr>
<tr>
<td>E-cigarette usea</td>
<td>1.00 (Ref)</td>
<td>1.18 (0.95 to 1.68)</td>
<td>1.29 (0.96 to 1.72)</td>
<td>1.40* (1.04 to 1.88)</td>
</tr>
<tr>
<td>Girls only (n = 6568)</td>
<td>1.00 (Ref)</td>
<td>1.18 (0.95 to 1.68)</td>
<td>1.26 (0.95 to 1.68)</td>
<td>1.29 (0.96 to 1.72)</td>
</tr>
<tr>
<td>Boys only (n = 6448)</td>
<td>1.00 (Ref)</td>
<td>1.26 (0.95 to 1.68)</td>
<td>1.18 (0.86 to 1.64)</td>
<td>1.40* (1.04 to 1.88)</td>
</tr>
</tbody>
</table>

All models adjusted for age, sex, and race/ethnicity, past 30-day tobacco use, and perceived body weight. E-cigarette = electronic cigarette.

*p < .05.

The sample was evenly distributed by sex and grade. Further descriptive statistics can be found in Table 1.

E-Cigarette Use and Weight-Related Intentions

As seen in Table 2, e-cigarette users had a 1.38 (95% CI = 107% to 1.78%) greater relative risk of intentions to lose weight, relative to not trying to change their weight status, when adjusting for sex, race/ethnicity, grade, past 30-day tobacco use, and perceived body weight.

The first subsample analysis revealed female e-cigarette users had a relative risk of a 1.44 (95% CI = 105% to 1.97%) for intentions to lose weight, relative to not trying to change their weight, when adjusting for race/ethnicity, grade, past 30-day tobacco use, and perceived body weight. The second subsample analysis revealed male e-cigarette users had a relative risk of a 1.44 (95% CI = 104% to 1.88%) for intentions to gain weight, relative to not trying to change their weight, when adjusting for race/ethnicity, grade, past 30-day tobacco use, and perceived body weight.

Discussion

Our findings indicate there is an association between e-cigarette use and intentions to lose weight among high school students. Note that the significant association is presented even when controlling for strong predictors of weight loss intentions including past 30-day tobacco use and perceived body weight. Study findings are consistent with previous research that found a sizable portion (13.5%) of surveyed adult e-cigarette users reported using weight management. One possible explanation for the study findings is that individuals may rely on e-cigarettes for weight loss and/or management given that e-cigarettes contain nicotine, a stimulant and appetite suppressant. Similarly, as e-cigarettes are available in a wide range of flavors, including candy and fruit, individuals may use e-cigarettes as a supplement for calorically dense foods as a method of weight loss and/or management.

Subsample analyses revealed an interesting dichotomy in the association between e-cigarette use and weight-related intentions by sex. Among girls, e-cigarette use was strongly associated with intentions to lose weight. Among boys, e-cigarette users had greater relative risks to intentions to gain weight, relative to those not trying to change their weight. This variance by sex is unique to e-cigarette use, as use of conventional cigarettes for weight loss has been reported for males and females. As such, longitudinal study is needed to fully understand the relationship between intentions to lose weight and e-cigarette use, particularly among youth.

These findings are an important development in the study of e-cigarette use behaviors given the established link between use of conventional cigarettes and weight loss and/or management. Cigarette manufacturers have used marketing tactics aimed at exploiting intentions to lose weight in an effort to recruit new smokers. As e-cigarette manufacturers appear to be developing and patenting technologies related to e-cigarettes and weight loss, it is important to monitor the marketing tactics of this industry so as not to repeat similar predatory marketing tactics with this new tobacco product. Furthermore, as e-cigarette marketing exposure is particularly common among youth and this marketing exposure is associated with greater odds of e-cigarette use, future research is warranted to determine if e-cigarette manufacturers are using messages related to weight loss in their marketing.

This study has some limitations. First, analyses are cross-sectional, which prohibits causal inferences. Longitudinal study is needed to further investigate the relationship between intentions to lose weight and e-cigarette use among high school students. Second, this study was unable to control for e-cigarette characteristics including device type, nicotine concentration, flavors, and behavioral use patterns (eg, frequency and strength of inhalation), each of which has been shown to affect weight behavior. Consequently, this study was unable to control for any current or previous eating disorder diagnoses, which has been found to be associated with e-cigarette use. And fourth, although this study found a significant association between e-cigarette use and intentions to lose weight, even controlling for strong predictors (eg, sex, self-described body weight), this dataset did not contain variables related to direct motivations for e-cigarette use. As such, these findings can only demonstrate a strong statistically association between behavior (ie, e-cigarettes use) and intentions to lose weight, but cannot speak directly to e-cigarette use for the purposes of weight loss or management.

Despite these limitations, this study has implications for public health. Specifically, future research must monitor motivations for e-cigarette use to determine if these devices are being used for weight loss.
loss and/or management by youth. Furthermore, marketing strategies used by e-cigarette manufacturers must be monitored to ensure messages related to weight loss and body image are not used as predatory marketing tactics to recruit adolescent users.

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Declaration of Interests
None declared.

References