**ABSTRACT**

**Background:** E-cigarettes are a type of non-combustible tobacco product designed to allow inhaled delivery of nicotine via vaporization of a nicotine-containing solution. While the health risks of cigarette smoking are well-established, e-cigarettes began to be available in the U.S. only starting in 2007, too recently for emergence of studies of long-term exposure health impacts. However, nicotine itself is implicated in having irreversible detrimental effects on developing human brains and lungs, in addition to being a substance to which adolescents can become addicted. Both the Centers for Disease Control and Prevention and the Minnesota Department of Health assert that e-cigarette use among adolescents is a significant topic of health concern. While rates of cigarette smoking among adolescents have trended downward for five years nationally and within the state of Minnesota for over a decade, in the decade since e-cigarettes have become commercially available in the U.S., rates of e-cigarette use among adolescents and young adults have doubled. This increase is now twice the rate of cigarette smoking among adolescents nationally and statewide in Minnesota.

**Methods:** For this study, I analyzed 126,868 records of students in grades eight, nine, and eleven from the 2016 Minnesota Student Survey (MSS) for prevalence and predictors of adolescent cigarette smoking and e-cigarette use. Logistic regression models were used to estimate risk for smoking cigarettes, using e-cigarettes, or concurrent use of both for key independent variables.

**Results:** Bisexual-identified students were four times more likely (adjusted odds ratio [AOR]=4.40; 95% confidence interval [CI] 4.01, 4.82) than heterosexual students to smoke cigarettes and twice as likely (AOR=2.24; 95% CI 2.06, 2.43) to use e-cigarettes. Gay/lesbian-identified students were 2.75 times more likely (AOR=2.75; 95% CI 2.27, 3.34) than heterosexual students to smoke cigarettes and 1.5 times as likely (AOR=1.50; 95% CI 1.24, 1.76) to use e-cigarettes. Students receiving free/reduced lunch were nearly twice as likely (AOR=1.92; 95% CI 1.80, 2.05) to smoke cigarettes and 1.3 times as likely (AOR=1.33; 95% CI 1.27, 1.39) to use e-cigarettes. Students reporting skipping meals due to economic hardship were over 3.5 times as likely (AOR=3.63; 95% CI 3.33, 3.95) to smoke cigarettes and 2.8 times as likely (AOR=2.79; 95% CI 2.59, 2.99) to use e-cigarettes. Increasing alcohol use and decreasing academic performance are associated with increased likelihood of cigarette smoking and e-cigarette use, more so with cigarette smoking.

**Conclusion:** Results of this study expand on existing research showing differences in psychosocial and behavioral risk profiles for adolescent cigarette smokers versus e-cigarette users. Further understanding of these predictors is critical to informing comprehensive public health strategies targeting prevention and reduction of youth tobacco and nicotine use.

**OBJECTIVE**

The objective of this study was to expand on existing research of differing risk profiles for outcomes of cigarette smoking and e-cigarette use by examining the association of demographic, socioeconomic, psychosocial and health behavioral factors as surveyed by the Minnesota Student Survey with cigarette smoking and e-cigarette use among Minnesota adolescents.

**METHODS**

**Data source:**
- 2016 Minnesota Student Survey (MSS): an anonymous, school-based, cross-sectional survey representative of 85% of Minnesota school districts (282 of 330).
- Dataset comprised of completed surveys of 168,733 Minnesota public school students surveyed across grades five, eight, nine, and eleven.
- 287 variables generated from approximately 112 questions inquiring on substance use, sexuality, academic performance and perception, and other health and lifestyle behaviors and factors.
- Some questions on the 2016 MSS, including those related to use of alcohol, drugs and tobacco are asked only of students in eighth, ninth and eleventh grades, thus data analyzed for this study was inclusive of 126,868 records for eighth, ninth and eleventh graders only.
- Inquiry into sexual identity is asked only of students in grades nine and eleven.

**Variables:**
- Dependent outcome variables:
  - Dichotomous variable categorizing students indicating they smoked cigarettes at least once in the past 30 days
  - Dichotomous variable categorizing students indicating they used e-cigarettes at least once in the past 30 days
  - Adolescent students who use cigarettes and e-cigarettes are at least one day in the past 30
- Independent variables:
  - Grade level, race/ethnicity, biological sex adjusted for in analysis of other independent variables
  - Sexual identity, economic hardship, alcohol use and academic performance

**Statistical analysis:**
- Frequency and bivariate analyses conducted using IBM SPSS Statistics for Macintosh, Version 24.0
- SAS survey/logistic method used to conduct multivariate logistic regression analysis for generating odds ratios
- All independent variables included in analysis were shown significant at a .05 level in bivariate analyses for association with cigarette, e-cigarette and/or concurrent use of both
- Final determination of independent variables used in regression analysis was guided by forward selection as outlined by Bursac et al., in conjunction with my own interests of factors for investigation

**RESULTS**

**Figure 1:** Adjusted odds ratios for cigarette smoking and e-cigarette use in the past 30 days, by sexual identity, economic indicators, and academic performance among Minnesota adolescents, Minnesota Student Survey, 2016

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cigarette Smoking</th>
<th>E-cigarette Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual identity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bisexual students</td>
<td>4x as likely</td>
<td>4.82x as likely</td>
</tr>
<tr>
<td>Heterosexual students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic indicators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students receiving free/reduced lunch</td>
<td>2.75x as likely</td>
<td>3.34x as likely</td>
</tr>
<tr>
<td>Academic performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students reporting skipping meals due to economic hardship</td>
<td>3.5x as likely</td>
<td>3.95x as likely</td>
</tr>
</tbody>
</table>

**REFERENCES**


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