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## Original Research

# Ethnic and sex differences in E-cigarette use and relation to alcohol use in California adolescents: the California Health Interview Survey



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## ABSTRACT

**Objectives:** E-cigarette use is not only prevalent among adolescents but is growing at an alarming rate. This study sought to determine e-cigarette use prevalence and its relation to alcohol use as a potential gateway drug, and how this may differ by sex and ethnicity in a multi-ethnic sample of California adolescents.

**Study design:** Cross-sectional survey.

**Methods:** We included data from 1806 adolescents (weighted to 3.0 million) aged 12–17 in the 2014 and 2015 California Health Interview Survey (CHIS) cycles. The prevalence of e-cigarette use was calculated within sex and ethnic groups and the prevalence of alcohol use according to e-cigarette use was also examined with sample weighting providing population estimates. Multiple logistic regression models were built to predict the odds of using alcohol from e-cigarette use status adjusted for sociodemographic and other characteristics.

**Results:** The prevalence of e-cigarette use was 9.1% (projected to 0.3 million) overall in California adolescents but highest in boys among non-Hispanic Whites (15.1%) and in Asian girls (13.3%). Among e-cigarette users, 61.3% of boys and 71.0% of girls reported using alcohol as well. The logistic regression odds of alcohol use, adjusted for age, ethnicity, body mass index, cigarette smoking status, socioeconomic status, parents' education level, and insurance status among e-cigarettes users (compared with non-users) was 9.2 in girls and 3.1 in boys (both  $P < 0.01$ ). Asians/others, non-Hispanic whites and Hispanics were similarly at increased odds: 17.8, 5.4, and 3.0, respectively ( $P < 0.01$  for Asians/others and for whites) of using alcohol compared with their non-e-cigarette using counterparts, respectively.

**Conclusion:** Attention needs to be paid to the high prevalence of e-cigarette smoking as well as its potential as a gateway drug for alcohol drinking in adolescents, especially among girls and Asians.

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## Introduction

E-cigarette use over the past decade has become increasingly prevalent among adolescents in the United States. From 2011 to 2016, the prevalence of e-cigarette use increased from 0.6% to 4.3% in middle school students and from 1.5% to 11.3% in high school students.<sup>1,2</sup> The recently reported Children's Health Study in Southern California also showed increases from 9.0% in 2004 to 13.7% in 2014 among 12th graders, similar to the 14.7% prevalence of cigarette smoking in 2001.<sup>3</sup> Also, the 2012 National Youth Tobacco Survey also showed boys to have significantly higher use than girls (8.1% vs 5.5%) among adolescent e-cigarette users aged 12–17. Non-Hispanic whites ranked the highest in e-cigarette use compared with non-Hispanic Black, Hispanic, and non-Hispanic Asians (8.1% vs 3.3%, 6.2% and 2.3%, respectively).<sup>4</sup> In the only prior report from the adolescent California Health Interview Survey, e-cigarette use in 2014 was noted to be prevalent in 8.2% of girls and 12.3% of boys, and ranged from 5.8% in Asians and 15.5% in whites.<sup>5</sup> It was also more likely among ever-smokers of conventional cigarettes, individuals above 200% of the Federal Poverty Level, US citizens, and those who spoke English only at home.<sup>5</sup>

The modern e-cigarette, invented by Chinese Pharmacist Hon Lik, was proposed to help cigarette users find a safer alternative to smoking and discourage people from using tobacco cigarettes. Even though the e-cigarette contains substantially less tobacco than normal cigarettes, they are still harmful to the human body, yet their use has proven to be rather convincing among adolescents and young adults.<sup>6</sup> Several studies have also examined how alcohol use is associated with adolescent e-cigarette use. A teen public health survey in England has shown that adolescents who drank alcohol were more likely to have tried e-cigarettes than those who did not drink alcohol.<sup>7</sup> The same survey also showed that binge drinkers were even more likely to access e-cigarettes when compared with moderate drinkers and non-drinkers. A Hong Kong survey has shown that e-cigarette users are 2.2 times more likely to drink alcohol than non-users.<sup>8</sup> Another contributing factor is that e-cigarette users have past experience with regular tobacco use. In one survey, 11% out of the 24% who tried e-cigarettes were, in fact, tobacco users in the past and out of the 12.9% of students who were e-cigarette users, only 5.9% of them had never smoked a tobacco cigarette before.<sup>9</sup>

However, whether the popularity of e-cigarette use differs by sex and ethnicity, and impacts on its relation to alcohol use is not well established. Our study is unique from past studies in evaluating the relation between e-cigarette smoking and alcohol use, and how this differs by sex and ethnicity.

## Methods

We included data from the 2014 and 2015 cycles of the California Health Interview Survey (CHIS), a population-based cross-sectional telephone survey with a multistage sampling

design that is representative of the noninstitutionalized California population. Detailed information about the CHIS methodology is available elsewhere.<sup>10–13</sup> CHIS is administered through a computer-assisted telephone interview system which includes two separate samples: a statewide landline random digit dial sample and a statewide cellphone sample. In households with adolescents (aged 12–17 years), one adolescent is randomly selected and interviewed directly after obtaining parental permission and consent. A total of 1806 adolescents representing approximately three million adolescents from California in 2014–2015 completed the survey with a response rate of 37.2% and 16.7% in each year respectively. Interviews were conducted in English, Spanish, Chinese, Vietnamese, Korean, and Tagalog to capture the rich diversity of the California population. The sample was weighted to compensate for the probability of selection and a variety of other factors resulting from the design and administration of the survey. Detailed weighting procedures were previously described.<sup>10</sup>

E-cigarette and alcohol use was determined as a positive response to the question of 'Ever smoked electronic cigarettes' and 'Ever had more than a few sips of alcoholic drinks', respectively. Demographic characteristics of age, gender, race/ethnicity, socioeconomic status, parental educational level, and insurance type were included in the analyses. Race/ethnicity was defined and separated into four categories: Hispanic, non-Hispanic white, non-Hispanic Asian, and other/multiple races. Socioeconomic status was measured into four different groups based on the percentage of federal poverty level: 0–99%, 100–199%, 200–299%, and 300% and above. Respondents' parental education level was recorded through a questionnaire with the options of no formal education, grade 1–8, high-school diploma, some college or vocational school, and bachelor's degree and above. Adolescents' insurance type was based on their responses of uninsured, Medicaid, employment based, private purchased, or other public insurance. Household income information, parental education level and adolescents' insurance type were reported by parents and all the other information was reported by adolescents.

Other health factors and behaviors were also examined as potential risk factors. Tobacco cigarette use was defined as self-reported 'ever smoked cigarettes'. Fruit and vegetable consumption was based on whether or not the respondent reported having eaten five or more servings of fruit/vegetables a day. Physical activity was recorded based on answers to the statement: 'you are physically active for at least 60 min every day during a typical week'.

We used the Chi-squared test of proportions and Student t-test to compare the distribution and means of demographic characteristics between e-cigarette users and non-e-cigarette users as well as the bivariate association of e-cigarette use and alcohol use. To evaluate the independent relationship between e-cigarette use and alcohol use, we conducted logistic regression analyses stratified by sex and ethnicity. An initial unadjusted logistic regression model was built followed by two adjusted models controlling for age and sex, and further adjusting for body mass index, tobacco cigarette use, socioeconomic status, parental education level, and insurance

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