Journal of Adolescent Health 60 (2017) 660–666

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

Electronic Cigarette Use by Youth: Prevalence, Correlates, and Use Trajectories From Middle to High School

Erika Westling, Ph.D. *, Julie C. Rusby, Ph.D., Ryann Crowley, M.S., and John M. Light, Ph.D.

Oregon Research Institute, Eugene, Oregon

Article history: Received August 26, 2016; Accepted December 22, 2016
Keywords: E-cigarettes; Adolescents; Substance use

A B S T R A C T

Purpose: The aim of this study was to examine the use of electronic cigarettes (e-cigarettes) among adolescents over time, including correlates of lifetime use by eighth grade and trajectories of current use across ninth grade.
Methods: Participants (N = 1,091) from seven school districts in Oregon, United States, completed four self-report surveys on substance use, from the spring of eighth grade (M age = 14.4 years old; standard deviation = .50) through the spring of ninth grade.
Results: Overall, 27.7% of eighth graders had used e-cigarettes, and 16.8% were current e-cigarette users (used in the past 30 days); use did not significantly differ by gender or ethnicity. Correlates of e-cigarette lifetime use by eighth grade included lifetime and current use of marijuana, alcohol, cigarettes, and chewing tobacco. Five percent of students were "accelerators," on average using e-cigarettes 14 of the last 30 days in eighth grade, increasing to daily use (30/30 days) by the end of ninth grade. Across all substances, those in the accelerator group were more likely to have reported lifetime substance use by eighth grade and current substance use in ninth grade, compared to the "infrequent/no use" group.
Conclusions: A sizeable proportion of young adolescents are using e-cigarettes, and e-cigarette use is highly correlated with use of other substances, including marijuana. Adolescents who progress to daily e-cigarette use in high school are more likely to use other substances compared to low or nonusers. E-cigarettes may be a relatively new addition to a constellation of substances being actively used by a segment of the youth population.

IMPLICATIONS AND CONTRIBUTION

Prevalence rates for e-cigarettes are high among youth, and 5% of students reported daily use by the end of ninth grade. E-cigarette users were more likely to use other substances as well, including marijuana, indicating that e-cigarettes may be a new addition to at-risk youths' constellation of substances.

Electronic cigarettes (e-cigarettes) are increasingly popular and are being widely marketed to [1,2] and utilized by adults and youth alike [3]. Battery-powered e-cigarettes typically deliver nicotine and likely other harmful substances via heating a liquid solution into inhalable vapor [4]. Often this liquid is flavored to taste fruity or sweet and may be appealing to youth for this reason [5], but these flavorings may also pose respiratory health risks [6,7]. E-cigarettes have just become regulated by the Food and Drug Administration (FDA) but thus far are considered to have minimal health risks by adolescents. Only a quarter of high school students know that they may contain nicotine, and a majority is not aware of what is in them at all [8]. In fact, e-cigarettes do pose a health risk and typically contain nicotine as well as inhalation toxins that children and adolescents should not be consuming [4,6,7].

As tobacco use is commonly initiated during adolescence, the appeal and widespread availability of e-cigarettes to youth is a major public health concern [9,10]. Adolescent use of e-cigarettes is rapidly increasing [11–13], and although the sale of tobacco

Conflicts of Interest: The authors have no conflicts of interest to disclose.

* Address correspondence to: Erika Westling, Ph.D., Oregon Research Institute, 1776 Millrace Drive, Eugene, OR 97403.
E-mail address: erikaw@ori.org (E. Westling).

1054-139X/
http://dx.doi.org/10.1016/j.jadohealth.2016.12.019

products is prohibited for those under 18 years, minors appear to have easy access to e-cigarettes [14]. From 2011 to 2015, current (last 30 days) use of e-cigarettes increased dramatically in a nationally representative United States survey for both middle (.6%–5.3%) and high school students (1.5%–16.0%) [11]. Other nationwide data from the Youth Risk Behavior Surveillance of high school students found that 44.9% had used electronic vaping devices and 24.1% reported current use [12]. Finally, in the 2015 national Monitoring the Future (MTF) survey, current use was 9.5% for eighth-graders and 14.0% for tenth-graders, more than twice the prevalence rate of conventional cigarettes [13].

While nationally representative samples are important for tracking trends in tobacco use, state samples are important to provide insight into geographical variations in population norms, such as ethnic and cultural differences. Small cross-sectional studies of California, Florida, and Hawaii youth indicate varying prevalence rates in different regions. In a 2013 survey of 410 Southern Californian seventh-graders, lifetime use was 11.0% (they did not ask current use) [15]. In Florida, current use among sixth–eighth graders increased from 1.5% in 2011 to 4.0% in 2014 [16]. In Hawaii, a 2013 survey of ninth- and tenth-graders found higher prevalence rates; lifetime use was 29%, and current use was 18% [17]. Although these studies demonstrate differing rates of use across a variety of geographical areas, longitudinal research is needed to track trajectories across time, as well as co-use or progression to use of other substances, as there may be some geographical variations in these patterns. The current study adds to this knowledge by examining another geographic area, the Pacific Northwest; by including longitudinal data; and by following adolescents during a risky period, from middle school into high school.

While both adults and youth use e-cigarettes at relatively high rates, youth patterns of use appear to be distinctly different from those of adults. While adult e-cigarette users are typically current or former conventional cigarette users [18], a significant number of adolescents who initiate and continue to use e-cigarettes have never tried any other type of tobacco product [13,19,20] and are using them out of curiosity, attractive flavoring, or for pleasure [21]. One of the first published longitudinal studies of high school students indicates that ninth grade e-cigarette-only users were more likely to use other combustible tobacco products in tenth grade compared to e-cigarette never users [22]; other studies tracking adolescents over time have found similar results [23–25]. Similarly, the 2015 MTF survey found that teen e-cigarette users were more likely than nonusers (30.7% vs. 8.1%) to use cigarettes, cigars, or hookahs within 6 months [13]. Another cross-sectional study of Icelandic tenth graders found that adolescent e-cigarette users were more likely than nonusers to report using alcohol, chewing tobacco, and marijuana [26]. Thus, initial studies indicate that e-cigarettes may be a gateway to use of other tobacco products for adolescents and may be a newer addition to an adolescent user's repertoire of substances. If e-cigarettes are leading to or accompanying use of other substances and have health risks and e-liquid contents that adolescents are not aware of [8], additional longitudinal studies are needed to identify students at risk of becoming regular e-cigarette users and to track associations between e-cigarette use and use of other (tobacco and nontobacco) substances. The current study examines trajectories of e-cigarette use patterns and investigates associations between using e-cigarettes and other substances in adolescence.

There are also some indications of differences in e-cigarette use by gender and ethnicity. In the MTF nationwide sample, males were significantly more likely to be e-cigarette users, especially in later high school grades [13]. The Florida Youth Tobacco Survey of middle and high school students collected in 2014 found no significant gender difference in current e-cigarette use by middle school students, but in high school, males were significantly more likely to be current e-cigarette users [16]. The Youth Risk Behavior Surveillance showed that tenth-grade males were significantly more likely to have used e-cigarettes compared to tenth-grade females (45.3% vs. 41.2%) and Hispanics used at significantly higher rates than white non-Hispanics (51.9% vs. 43.2%) [12]. Further studies examining demographic characteristics of youth who use e-cigarettes are needed to design policies and counter-marketing strategies that will reach at-risk youth. By examining gender and ethnicity as predictors of e-cigarette use in our sample, we are adding to this literature. We hypothesized that Hispanics and males would be more likely to report e-cigarette use and that regular e-cigarette users would be more likely to use cigarettes, chewing tobacco, alcohol, and marijuana compared to low or nonusers of e-cigarettes.

The purpose of this study is to examine prevalence rates of e-cigarette use in eighth graders, to investigate correlates (gender, ethnicity, use of other substances) of e-cigarette use, and to examine classes of early usage patterns from the year prior to the transition into high school (eighth grade) through the first year of high school (ninth grade). This is a critical period for many youth, as the transition from middle to high school is an especially risky period of exposure and use of substances, and identification of adolescents who are using and increasing their use of e-cigarettes over time is needed to determine predictors and correlates of regular use [27]. Therefore, we also examine whether gender and ethnicity predict membership of e-cigarette classes, as well as odds ratios by class of use of cigarettes, chewing tobacco, alcohol, and marijuana.

Methods

Data were collected via Web-based computer surveys at 11 middle schools in seven school districts in Oregon. Schools were selected based on having above-average rates of students receiving free and reduced lunch, a proxy for serving lower income households. Schools were also selected to provide both rural and suburban locations. Parents of all 1,409 eighth grade students in participating districts were mailed a description of the study along with an opt-out card to return if they did not want their child to participate in the study; 107 (7.6%) opted out. An additional 40 students (2.8%) were ineligible for participation due to being a ward of the state, not able to read English/Spanish, or seldom attending school, and 74 students (5.3%) were no longer attending participating schools at the time of the assessment. Out of the final sample of 1,188 eligible eighth graders, we obtained data on 1,130 (95%), collected from 2014–2016. Project staff administered the surveys during regular classes.

Of the 1,130 students who completed the eighth grade baseline survey, 1,091 (97%) answered items on e-cigarette use and were included in analyses. Participants completed three more surveys in the fall, winter, and spring of their ninth grade year, for a total of four timepoints. Surveys were done every 3 months during the school year based on a recent study showing seasonal variation in substance use onset [28], highlighting the importance to assess patterns of e-cigarette initiation and escalation in