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E-cigarette openness, curiosity, harm perceptions and advertising exposure among U.S. middle and high school students

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ABSTRACT

Understanding factors associated with youth e-cigarette openness and curiosity are important for assessing probability of future use. We examined how e-cigarette harm perceptions and advertising exposure are associated with openness and curiosity among tobacco naive youth. Findings from the 2015 National Youth Tobacco Survey (NYTS) were analyzed. The 2015 NYTS is a nationally representative survey of 17,711 U.S. middle and high school students. We calculated weighted prevalence estimates of never users of tobacco products (cigarettes, cigars/cigarillos/little cigars, waterpipe/hookah, smokeless tobacco, bidis, pipes, dissolvables, e-cigarettes) who were open to or curious about e-cigarette use, by demographics. Weighted regression models examined how e-cigarette harm perceptions and advertising exposure were associated with openness using e-cigarettes and curiosity about trying e-cigarettes. Among respondents who never used tobacco products, 23.8% were open to using e-cigarettes and 25.4% were curious. Respondents that perceived e-cigarettes cause a lot of harm had lower odds of both openness (OR = 0.10, 95% CI = 0.07, 0.15) and curiosity about e-cigarettes (OR = 0.10, 95% CI = 0.07, 0.13) compared to those with lower harm perception. Respondents who reported high exposure to e-cigarette advertising in stores had greater odds of being open to e-cigarette use (OR = 1.22, 95% CI = 1.03, 1.44) and highly curious (OR = 1.25, 95% CI = 1.01, 1.53) compared to those not highly exposed. These findings demonstrate that youth exposed to e-cigarette advertising are open and curious to e-cigarette use. These findings could help public health practitioners better understand the interplay of advertising exposure and harm perceptions with curiosity and openness to e-cigarette use in a rapidly changing marketplace.

1. Introduction

Electronic cigarettes (e-cigarettes) are battery-powered devices capable of delivering nicotine and varying compositions of flavorings, propylene glycol, glycerin, and other constituents to the user in the form of an aerosol. Since becoming available in the U.S., e-cigarette use has proliferated: e-cigarette sales grew from \$274.6 million in 2012 to \$636.2 million in 2013, an increase of 132.5% (Giovenco et al., 2015). Nielsen estimates that e-cigarette sales were near \$850 million in 2015 (Vonder, 2015). The e-cigarette market continues to evolve as new types, models, flavors and nicotine strengths become available (Cobb et al., 2015). By January 2014, it was estimated that > 460 brands of e-cigarettes were available online (Cobb et al., 2015). In 2016, FDA estimated that there were 4000 to 8000 product formulations for e-liquids and 640 to 800 for electronic nicotine delivery systems (US Food and Drug Administration, 2016).

E-cigarettes are now the most commonly used tobacco product among middle school and high school students (Singh et al., 2016a). During 2011–2015, current use of e-cigarettes increased from 0.6% to 5.3% among middle school students and from 1.5% to 16.0% among high school students (Arrazola et al., 2015). Youth use of products containing nicotine, including e-cigarettes, is unsafe (U.S. Department, 2016). Nicotine is known to impact adolescent brain function and development (England et al., 2015; Goriounova and Mansvelter, 2012), cause addiction, and could lead to sustained tobacco product use (*The Health Consequences of Smoking: Nicotine Addiction. A Report of the Surgeon General*, 1988). Data from cross-sectional and longitudinal studies suggest that e-cigarette use is strongly associated with other tobacco use, especially the use of combustible products (including cigarettes, cigars, and hookahs) (Miech et al., 2017; U.S. Department, 2016; Wills et al., 2017). Further, recent cross-sectional studies found that e-cigarette use among youth was associated with cigarette smoking

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intentions (Bunnell et al., 2015a), and higher odds of ever, current, and established cigarette smoking (Dutra and Glantz, 2014).

Due to the rapidly changing marketplace, it is important to understand factors that may lead to youth e-cigarette use. Cognitive constructs in youth including susceptibility, curiosity and openness have been examined as predictors of e-cigarette use. Curiosity, which is considered to develop after someone experiences unpleasant feelings of uncertainty and is motivated to reduce these unpleasant feelings through exploratory behavior (Litman and Jimerson, 2004), has been associated with future cigarette use (Nodora et al., 2014; Pierce et al., 2005) and has been cited as a reason for e-cigarette experimentation (Kong et al., 2015) and initiation (Pepper et al., 2014). In 2014, approximately one quarter (25.8%) of youth who never used e-cigarettes reported curiosity about e-cigarettes (Margolis et al., 2016). Openness, similar to susceptibility (Mays et al., 2016), indicates the lack of a firm commitment not to use tobacco products (Coleman et al., 2015). Openness captures interest in trying e-cigarettes and is considered part of the progression to regular tobacco use (Mowery et al., 2004). While curiosity has been studied in youth, openness has not been extensively studied in youth. In young adults (ages 18–29), 25.5% of reported openness to using e-cigarettes (Mays et al., 2016).

Potential drivers of openness include advertising and harm perceptions. Youth and young adults have lower harm perceptions of e-cigarettes compared to combusted cigarettes, which could be driving their high levels of curiosity and openness to using e-cigarettes (Margolis et al., 2016). Although studies have not examined harm perceptions and openness, studies have found that youth and young adults who believe e-cigarettes are less harmful than combusted cigarettes are more likely to be curious about e-cigarettes (Margolis et al., 2016) and to experiment with them (Choi and Forster, 2014).

Another key factor that influences patterns of tobacco product use is advertising. Experimental and population-based studies have found that exposure to e-cigarette advertising is associated with greater curiosity to try e-cigarettes (Villanti et al., 2016), openness to e-cigarette use (Mantey et al., 2016), and use of e-cigarettes (Mantey et al., 2016). Advertising can promote initiation and continued use of cigarettes (Evans et al., 1995; Lovato et al., 2011). Tobacco product advertising is related to tobacco product initiation among youth (U.S., 2012). Although cigarette advertising has been prohibited from U.S. television since 1971 (Eckard, 1991), e-cigarette advertising is currently allowed on television without restriction (US Food and Drug Administration, 2016). Youth are often exposed to e-cigarette advertising, as nearly 70% of middle and high school students were exposed to e-cigarette advertisements from at least one source in 2014 (Singh et al., 2016b). This exposure may lead to curiosity and openness to try e-cigarettes. Duke et al. (Duke et al., 2014) found that youth exposure to television e-cigarette advertisements as measured by target rating points (TRPs) increased from < 100 quarterly TRPs in 2011 to 347 TRPs during April–June 2013, reflecting a 256% increase from 2011 to 2013.

A previous study found that harm perceptions and advertising exposure are associated with curiosity about e-cigarettes in middle and high school students that had never used combustible tobacco products with comparable findings for never tobacco user (Margolis et al., 2016). However, this study (Margolis et al., 2016) did not examine openness as a potential unique predictor of tobacco use among tobacco naïve youth. Tobacco naïve youth are an important population to study as recent debate has posited that e-cigarettes are increasing tobacco use among youth (Dutra and Glantz, 2014) and several recent longitudinal studies in the US including one conducted by Miech et al. with a national sample of 12th grade students (Miech et al., 2017) and one by Wills et al. with high school students in Hawaii (Wills et al., 2017) have examined e-cigarette use by youth and subsequent cigarette smoking. While the role of e-cigarettes in the progression of other tobacco use is unclear more data would be useful to better understand constructs like openness to trying e-cigarettes among students that have never used any tobacco product. Understanding the prevalence of openness among

youth and the factors that influence youth never tobacco users to be open to e-cigarettes is important to prevent tobacco use. Therefore, this study used data from the National Youth Tobacco Study (NYTS) and is the first to provide an estimate of openness among youth in a nationally representative sample of youth and to examine how e-cigarette harm perceptions and advertising exposure are associated with e-cigarette openness among youth who reported never having used any tobacco products in 2015. Due to the rapidly changing e-cigarette marketplace and youth uptake of e-cigarettes, we also present data on e-cigarette curiosity in 2015 as a continuation of the 2014 analysis of youth that had never used combustible products (Margolis et al., 2016).

2. Methods

2.1. Sample

NYTS is a cross-sectional, school-based, self-administered, pencil-and-paper questionnaire administered to U.S. middle and high school students. A three-stage cluster sampling procedure was used to generate a nationally representative sample of U.S. public and private school students in grades 6–12. This report uses data from 2015 NYTS. The sample included 17,711 respondents; the response rate was 63.4% (Singh et al., 2016a). The Centers for Disease Control and Prevention Human Research Protection Office and the Office of Management and Budget approved the NYTS protocol.

2.2. Measures

2.2.1. Tobacco use

Ever use of a tobacco product was measured using items assessing whether respondents had ever tried cigarette smoking, even one or two puffs; had ever tried smoking bidis, pipe tobacco, cigars, cigarillos, or little cigars, even one or two puffs; had ever used chewing tobacco, snuff, or dip, even just a small amount; and had ever used an e-cigarette or hookah/waterpipe, even once or twice. Youth were classified as “never users of tobacco” if they responded *no* to all of these items ($n = 10,419$).

Additional items also measured more detailed e-cigarette behaviors and responses to these items suggested some inconsistencies in participants' e-cigarette use. Therefore, participants who had inconsistencies in their responses about e-cigarette use were considered missing from the sample of never users ($n = 115$). Inclusion of these respondents did not change our findings.

2.2.2. Openness

The two items that measured openness to e-cigarettes were: *Do you think you will try an electronic cigarette or e-cigarette soon?* and *If one of your best friends were to offer you an electronic cigarette or e-cigarette, would you use it?* Response options for both items were *Definitely yes*, *Probably yes*, *Probably not* and *Definitely not*. Based on prior research (Coleman et al., 2015; Mays et al., 2016), those who answered *definitely not* to both items were considered “not open to using e-cigarettes” and those who indicated anything other than *Definitely not* to one or both items were categorized as “open to using e-cigarettes.”

2.2.3. Curiosity

E-cigarette curiosity was measured with one item that asked, *Have you ever been curious about using an electronic cigarette, or e-cigarette, even once or twice*, and included the options *Definitely yes*, *Probably yes*, *Probably not*, and *Definitely not*. Following previous research on tobacco curiosity (Margolis et al., 2016; Portnoy et al., 2014), those who responded *Definitely yes* and *Probably yes* were classified as “highly curious.” Those who responded *Probably not* were classified as “somewhat curious” and those who responded *Definitely no* were classified as “not curious.”

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