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Effect of e-cigarette advertisement exposure on intention to use e-cigarettes in adolescents

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HIGHLIGHTS

- Ad exposure increased the intent to use e-cigarettes among non-smokers.
- Ad exposure did not increase the intent to use e-cigarettes among smokers.
- Ad exposure moderated the relation between perceived barriers and intent to use.
- Ad exposure moderated the relation between perceived benefits and intent to use.
- Ads may attract new users more than prompting switching among current smokers.

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ABSTRACT

Introduction: With the growth of electronic cigarettes use, curiosity about and experimentation with these products has increased among adolescents. The purpose of the present study was to evaluate the moderating effect of e-cigarette advertisement (ad) exposure on the relation between perceptions of use and intentions to use in youth.

Methods: Multiple regression analyses utilizing data from the 2014 National Youth Tobacco Survey (N = 17,286) were used to evaluate the effect of ad exposure, perceived harmfulness, barriers, and benefits of e-cigarette use on intentions to use among youth who had never used e-cigarettes.

Results: Models for non-smokers accounted for 15.5% of the variance in intention to use ($R^2 = 0.155$, $F(15) = 187.0$, $p < 0.001$). Results demonstrate that an increase in the number of exposures to e-cigarette ads was associated with an increase in intent to use ($b = 0.039$, $t = 7.4$, $p < 0.001$). Models also demonstrated significant interactions between ad exposure and perceptions of use on future intention to use. For smokers, models explained 11.1% of the variance in intention to use ($R^2 = 0.111$, $F(15) = 3.1$, $p < 0.001$). Ad exposure had a non-significant effect on intention to use e-cigarettes ($b = -0.010$, $t = -0.2$, $p = 0.859$). In smokers, ad exposure did not significantly affect the association between perceptions of use and intention to use.

Conclusions: Ads are most effective at attracting non-smoking youth as new users rather than promoting product switching in young cigarette smokers.

1. Introduction

Electronic cigarette (e-cigarette) use has become a growing trend among current and former users of traditional combustible cigarettes (Delnevo et al., 2016). Additionally, e-cigarettes have emerged as the most commonly used tobacco/nicotine product by high school (13.4%) and middle school (3.9%) students (Arrazola et al., 2015). The number of youth who currently use e-cigarettes has tripled from 2013 to 2014, resulting in a total of 2.4 million users (Arrazola et al., 2015). > 250,000 youth in grades 6–12, who have never tried traditional combustible cigarettes have used e-cigarettes (Centers for Disease Control and Prevention, 2014). Those who regularly use e-cigarettes are more likely to also smoke traditional combustible cigarettes and are less likely to quit smoking (Dutra & Glantz, 2014). Historically, industry advertisements have targeted youth through a variety of media advertisements and promotions (Coombs, Bond, Van, & Daube, 2011). Consistent with that trend, there are currently industry-funded campaigns publicizing e-cigarette use (McCarthy, 2014; United States Congress House and Senate, 2014). Advertisement strategies have included sponsorship of youth-oriented events and offering free samples of e-cigarettes (Campaign for Tobacco-Free Kids, 2017). These campaigns may increase the positive perceptions of using e-cigarettes and may

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impact the prevalence of use in youth. The current study evaluates how e-cigarette advertisement exposure may influence perceptions of e-cigarettes and ultimately influence youth intention to use these products.

There are approximately 466 brands and 7764 different flavors of e-cigarettes (Zhu et al., 2014), varying levels of nicotine in e-cigarettes and a variety of electronic nicotine delivery systems (ENDS). Because of the range of product types and factors influencing nicotine delivery, there is little consensus on the potential health effects of these products. Indeed, there are limited data on the overall safety and long-term health impact of e-cigarettes. Nevertheless, the data that are available suggest that increasing rates of e-cigarette use may become a major public health concern. Several short-term health outcomes associated with exposure to e-cigarettes and e-liquids have been reported including elevated diastolic blood pressure (Farsalinos, Tsiapras, Kyrzopoulos, Savvopoulou, & Voudris, 2014) and cardiac developmental deficiencies (Palpant, Hofsteen, Pabon, Reinecke, & Murry, 2015). Additional studies have found that e-liquid aerosol exposure increased respiratory resistance (Vardavas et al., 2012) and increase the risk of respiratory infection (Dinakar & O'Connor, 2016). When inhaled, e-cigarette aerosol and its components may pose a greater heath effect compared to the physical ingredients of e-liquids (Dinakar & O'Connor, 2016). E-cigarettes have shown to produce chemical emissions of carbonyl compounds, metals, NNK (a carcinogen associated with smoking-related cancers), and propylene glycol (Goniewicz et al., 2014; Offermann, 2015). The varying flavors of e-cigarettes are also cause for concern, particularly in terms of being appealing to youth. Although popular, flavoring chemicals have been deemed potentially unsafe and detrimental to health (Allen et al., 2016; Farsalinos & Polosa, 2014). Allen et al. (2016) found that of the 51 e-cigarette flavors tested, 39 contained diacetyl, 23 contained 2,3-pentanedione, and 46 contained acetoin. Specifically, diacetyl exposure as low as 0.2 ppm has been associated with bronchiolitis obliterans, also known as “popcorn lung” (Allen et al., 2016).

In addition to these potential carcinogens and toxins, one key function of e-cigarettes is to deliver nicotine; research has demonstrated that e-cigarettes deliver sufficient nicotine to significantly increase plasma nicotine and heart rate within 5 min of the first puff (Vansickel & Eissenberg, 2013). Thus, in addition to potential health concerns there is strong potential for addiction among users of electronic cigarettes (National Institute on Drug Abuse, 2017). This is of particular concern because a majority of smokers begin use and establish dependence in adolescence (U.S. Department of Health and Human Services [DHHS], 2012). In one study, mice exposed to nicotine in adolescence showed an increased likelihood of nicotine self-administration later in life (Adriani et al., 2003). This suggests that exposure in early development may increase their susceptibility to becoming addicted as adults. (Doura, Gold, Keller, & Perry, 2008) determined that nicotine exposure during adolescence results in the upregulation of α4β2-containing and α7 receptors, similar to what occurs in adults. However, research showed that in adolescents compared to adults, upregulation was more persistent (i.e., longer duration), had more binding in the midbrain and striatum, and occurred at lower doses of nicotine (Melroy-Greif, Stitzel, & Ehringer, 2016). More binding of nicotine in the midbrain and striatum results in nAChR desensitization, a decrease in dopamine release during non-reward times, and an increase in dopamine release during reward times (Rice & Cragg, 2004). These effects of binding may result in addiction in youth.

Despite the potential risks associated with e-cigarette use, individuals have become more willing to experiment based on positive perceptions of use (Ambrose et al., 2014; Amrock, Zakhar, Zhou, & Weitzman, 2015; Barrington-Trimis et al., 2015). Nearly half of adolescent e-cigarette users report they did not believe there were any health risks (Barrington-Trimis et al., 2015). Additionally, smokers often report using e-cigarettes as a substitute to conventional combustible cigarettes in an effort to reduce health risks (Ambrose et al., 2014; Amrock et al., 2015; Chapman & Wu, 2014; Roditis & Halpern-Felsher, 2015). A reduction in perceived harmfulness of e-cigarettes has shown to be associated with initiation of use and future intention to use (Berg, Barr, Stratton, Escoffery, & Kegler, 2014; Etter & Bullen, 2011; Pearson, Richardson, Niaura, Vallone, & Abrams, 2012; Rutten et al., 2015). In addition to perceiving e-cigarettes as being less harmful, many smokers, including teenagers, perceive that e-cigarettes may be an effective method to assist in cessation (Hilton, Weishaar, Sweeting, Trevisan, & Katikireddi, 2016). In recent years, there have been several randomized control trials (RCT) that have tested the effectiveness of nicotinic e-cigarettes as a cessation tool. One study found that nicotinic e-cigarettes compared to placebo (non-nicotinic) e-cigarettes assisted smokers in abstaining from smoking for at least six months (Hartmann-Boyce et al., 2016). Although there is growing evidence of the effectiveness of e-cigarettes in cessation, medical professionals and policymakers are hesitant to recommend switching to e-cigarettes because there are still many unknowns surrounding the safety and efficacy of the product.

The majority of youth and young adults are aware of e-cigarettes as an alternative to conventional cigarettes; nearly half of those were first made aware of these products through media channels (Duke et al., 2014). Youth may be exposed to e-cigarette advertisements through media such as internet websites (i.e., YouTube, Facebook, and Twitter), retail outlets, magazines or TV and movies. Not surprisingly, there is evidence that as e-cigarette advertising increases, so does the use of e-cigarettes (Nunez-Smith et al., 2010). It is well-established that ad exposure is associated with smoking behavior, including the initiation of smoking and the use of new products (Emery, Vera, Huang, & Szczypka, 2014). Ads for e-cigarettes may be particularly appealing to adolescents as the products are often depicted as fashionable, trendy, and socially acceptable (Ayers, Ribisl, & Brownstein, 2011; Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2015). Approximately 24 million youth were exposed to television e-cigarette advertisements in 2013 (Wills, Knight, Williams, Pagano, & Sargent, 2015). Given that adolescents have approximately 6 and a half hours per week of exposure to media including television, computers, and other electronic devices (U.S. Department of Health and Human Services, 2016), there is a clear need to further understand how youth perceive media regarding e-cigarettes and how this exposure may influence intent to use in the future.

The current study sought to understand if ad exposure and perceptions of use influence intention to use e-cigarettes in youth smokers and non-smokers who have never tried e-cigarettes. The results of this study may inform policy efforts to regulate e-cigarettes and their advertisement strategies. It may also inform future research by understanding the mechanisms by which e-cigarette advertisements may influence adolescents' intention to use e-cigarettes.

2. Materials & methods

2.1. Data

Data for this study come from the 2014 National Youth Tobacco Survey (NYTS), a nationally representative stratified, three-cluster representative sample of middle school (grades 6–8) and high school students (grades 9–12; (Centers for Disease Control and Prevention, 2016). Detailed information about the study design is publicly available (Centers for Disease Control and Prevention, 2016). Of 22,007 completed questionnaires, the present analysis included only participants who reported never using e-cigarettes (N = 17,286) in order to best evaluate future intention to use these products (Table 1). (See Table 2.)

2.2. Measures

Participants completed the NYTS survey at selected schools, via pencil-and-paper, self-administered questionnaire booklets. There were 81 questions in the survey that assessed current tobacco use, perceptions of a range of tobacco products, as well as exposure to different media types.