Socioeconomic status and adolescent e-cigarette use: The mediating role of e-cigarette advertisement exposure

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ABSTRACT

Among adolescents, low socioeconomic status (SES) is associated with greater exposure to tobacco cigarette advertising and cigarette use. However, associations among SES, e-cigarette advertising and e-cigarette use are not well understood. This study examined exposure to e-cigarette advertisements as a mediator of the relationship between SES and adolescent e-cigarette use. Adolescents ($N = 3473$; 51% Female) from 8 high schools in Connecticut completed an anonymous survey in Spring 2015. Mediation analysis was used to examine whether the total number of sources of recent e-cigarette advertising exposure (e.g., TV, radio, billboards, magazines, local stores [gas stations, convenience stores], vape shops, mall kiosks, tobacco shops, social media) mediated the association between SES (measured by the Family Affluence Scale) and past-month frequency of e-cigarette use. We clustered for school and controlled for other tobacco product use, age, sex, race/ethnicity and perceived social norms for e-cigarette use in the model. Our sample recently had seen advertisements via 2.1 (SD = 2.8) advertising channels. Mediation was supported (indirect effect: $\beta = 0.01$, SE = 0.00, 95% CI [0.001, 0.010], p = 0.02), such that higher SES was associated with greater recent advertising exposure, which, in turn, was associated with greater frequency of e-cigarette use. Our study suggests that regulations to reduce youth exposure to e-cigarette advertisement may be especially relevant to higher SES youth. Future research should examine these associations longitudinally and evaluate which types of advertisements target different SES groups.

1. Introduction

E-cigarettes are the most popular tobacco product among adolescents, with 11.3% of high school students reporting current use (Jamal, 2017). Understanding factors that contribute to the uptake of e-cigarettes may inform the development of interventions to prevent youth exposure to nicotine and other potentially harmful constituents of e-cigarettes. As noted in the recent Surgeon General's report on e-cigarettes, nicotine sustains addiction and interferes with typical adolescent brain development (US Department of Health and Human Services, 2016). While there is limited understanding of the health effects of e-liquid constituents, emerging evidence suggests that e-cigarette constituents may pose cardiovascular and respiratory risks (Bhatnagar, 2017; Shields et al., 2017). Further, many recent studies, including our own, have also observed that e-cigarette use progresses to future cigarette use among youth (Bold et al., 2018; Soneji et al., 2017). Thus, e-

cigs are not without risks (Bhatnagar, 2017; Shields et al., 2017) and e-cig use progresses to future cigarette use among youth (Bold et al., 2018; Soneji et al., 2017). It is especially important to examine factors that contribute to e-cigarette use among vulnerable populations, such as youth with low socioeconomic status (SES). Low SES is associated with increased tobacco use among youth, greater likelihood of progression to chronic cigarette smoking in adulthood, and greater difficulty quitting smoking, all of which contribute to downstream disparities in cardiovascular disease, cancer and tobacco-related mortality (Nandi et al., 2014; Stringhini et al., 2017). However, few studies have examined the associations between SES and factors that affect the uptake of e-cigarettes by youth.

1.1. SES and e-cigarette use

Although studies of the association between SES and e-cigarette use

are scant, a recent study reported that low SES is associated with greater likelihood of past-month e-cigarette use among adolescents (Simon et al., 2017). However, other studies examining associations with past-month (Barrington-Trimis et al., 2015) and lifetime e-cigarette use (Moore et al., 2015) have observed no association. In adults, preliminary evidence suggests that high SES is associated with current e-cigarette use among current cigarette smokers (Brown et al., 2014), and trying e-cigarettes for smoking cessation among daily smokers (Pokhrel et al., 2014). Given these varied findings, further research is needed to clarify the association between SES and adolescent e-cigarette use. While incorporating many important variables, none of the aforementioned studies incorporated advertising exposure, which is known to influence tobacco use (Mantey et al., 2016). Further research is also needed to explore potential mediators of the association between SES and e-cigarette use. A mediator is a variable that statistically accounts for the effects of an independent variable on a dependent variable, and when considered with theory, explains how or why variables are related (Baron and Kenny, 1986). Understanding mediators of the relationship between SES and e-cigarette use may support the development of regulations to reduce SES-based disparities in tobacco exposure by identifying malleable targets for regulation. For example, regulations may limit the quantity of advertising in areas that are disproportionately targeted by tobacco companies.

1.2. Advertising exposure: a potential mediator of the association between SES and e-cigarette use

Advertising exposure may mediate the relationship between SES and e-cigarette use. Research has shown that e-cigarette advertisement spending has increased from $6.4 million in 2011 to $115 million in 2014 (Centers for Disease Control and Prevention, 2016), with the most popular sources of advertisement being retail stores, followed by internet, television, and magazines/newspapers (Duke et al., 2014; Singh et al., 2016). Nearly 70% of middle and high school students report seeing e-cigarette advertisements in these venues (Centers for Disease Control and Prevention, 2016). Consistent with advertising's theorized and empirically demonstrated ability to influence consumer attitudes and behavior (Nichifor, 2014), exposure to e-cigarette advertising has been associated with intentions to use and use of e-cigarettes in adolescents (Farrelly et al., 2015; Mantey et al., 2016) and e-cigarette use among young adults (Pokhrel et al., 2015).

Traditionally, residing in a low SES community, rather than a high SES community, is associated with greater exposure to cigarette advertisements (Seidenberg et al., 2010). Specifically, low-income communities often have more tobacco retailers, larger advertisements, lower mean advertised prices, and more advertisements located near schools (Seidenberg et al., 2010). However, at least one study has shown that higher SES, rather than lower SES, is associated with e-cigarette advertisement exposure among adults (Emery et al., 2014). Although it remains unclear why this may occur, high SES groups may be targeted because they are more likely than low SES groups to be early adopters of new technology (Kennedy and Funk, 2016; Pampel et al., 2010; Rogers, 2010) or more likely to have disposable income to buy new products (U.S. Bureau of Labor Statistics, 2017). Moreover, e-cigarette use may be more socially acceptable because the potential harms are not perceived to be as high as those of traditional cigarettes, even in highly educated populations (Baeza-Loya et al., 2014). Despite evidence for differential exposure by SES among adults, the association between SES and adolescent e-cigarette advertising exposure is unknown. However, given the findings that higher SES is associated with greater exposure to e-cigarette messaging in adults (Emery et al., 2014), and exposure to e-cigarette advertising is associated with greater ever use, current use, and susceptibility to use of e-cigarettes in adolescents (Camenga et al., 2018; Mantey et al., 2016), it is plausible to expect that advertising exposure mediates the association between SES and e-cigarette use.

1.3. The current study

The current study is the first to examine whether exposure to e-cigarette advertisement mediates the relationship between SES and past-month frequency of e-cigarette use among adolescents, while controlling for predictors of adolescent e-cigarette use (i.e., grade-level, sex, race/ethnicity, perceived e-cigarette use norms, and prior tobacco use). Previous research has shown that boys are twice as likely as girls to currently use e-cigarettes (Barrington-Trimis et al., 2015), white youth are more likely than racial/ethnic minorities to use e-cigarettes (Anand et al., 2015), reporting peer and family use of e-cigarettes is associated with e-cigarette use (Barrington-Trimis et al., 2015), and use of other tobacco products is associated with e-cigarette use (Geidne et al., 2016). Although research on SES, advertisement exposure, and adolescent e-cigarette use is lacking, based on the adult literature on SES and e-cigarette use (Brown et al., 2014; Emery et al., 2014), we hypothesized that adolescents from higher SES backgrounds will have greater exposure to e-cigarette advertisement and that this exposure will be associated with greater use of e-cigarettes.

2. Methods

2.1. Survey procedures

Adolescents (N = 7045) from 8 high schools in Connecticut completed a survey in Spring 2015. Study procedures were approved by the Yale University Institutional Review Board and school administrators. Schools from 7 of 9 district reference groups (i.e. 9 different groups of schools in Connecticut that respectively share similar family income, parental education, parental occupation, and use of a language other than English at home) participated in the survey. Parents were notified of the study and instructed to contact the school if they wanted their child excluded from the survey. As a result, 2 students were excluded. Research staff informed students that their participation was voluntary and that their data would remain anonymous. Following these consent procedures, school-wide, paper and pencil surveys were administered during homeroom. Students received pens to compensate them for their study participation.

2.2. Sample

Two versions of the survey that assessed tobacco-related attitudes and behaviors were randomly administered in each high school. The current analysis is based on the subset of adolescents (n = 3473) who received the version containing all variables of interest in this study.

2.3. Measures

2.3.1. Frequency of e-cigarette use
Following the prompt, "How many days out of the past 30 did you use e-cigarettes?", participants wrote the number of days they had used e-cigarettes in the past 30 days.

2.3.2. Socioeconomic status (SES)
SES was assessed using the Family Affluence Scale (FAS), which has shown to be a reliable and a valid measure of SES among adolescents (Boyce and Dallago, 2004; Boyce et al., 2006). The 4 items examine 1) whether an adolescent's family owns a car, van, or truck (no = 0; yes one = 1; yes, two or more = 2), 2) whether an adolescent has his/her own bedroom (no = 0; yes = 1), 3) the number of laptops/computers an adolescent's family owns (none = 0; 1 = 1; 2 = 2; > 2 = 3), and 4) whether an adolescent's family had vacationed in the past 12 months (not at all = 0; once = 1; twice = 2; more than twice = 3). A summary score was created from the four items, with higher scores indicating higher SES.