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Original article

The E-cigarette Social Environment, E-cigarette Use, and Susceptibility to Cigarette Smoking

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A B S T R A C T

Purpose: One concern regarding the recent increase in adolescent e-cigarette use is the possibility that electronic (e-) cigarettes may be used by those who might not otherwise have used cigarettes, and that dual use, or transition to cigarette use alone, may follow.
Methods: Questionnaire data were obtained in 2014 from 11th/12th grade students attending schools in 12 communities included in the Southern California Children's Health Study. We evaluated the cross-sectional association between e-cigarette use, the social environment (family and friends' use and approval of e-cigarettes and cigarettes), and susceptibility to future cigarette use among never cigarette smokers (N = 1,694), using previously validated measures based on reported absence of a definitive commitment not to smoke.
Results: Among adolescents who had never used cigarettes, 31.8% of past e-cigarette users and 34.6% of current (past 30-day) e-cigarette users indicated susceptibility to cigarette use, compared with 21.0% of never e-cigarette users. The odds of indicating susceptibility to cigarette use were two times higher for current e-cigarette users compared with never users (odds ratio = 1.97; 95% confidence interval: 1.21–3.22). A social environment favorable to e-cigarettes (friends' use of and positive attitudes toward the use of e-cigarettes) was also associated with greater likelihood of susceptibility to cigarette use, independent of an individual's e-cigarette use.
Conclusions: E-cigarette use in adolescence, and a pro–e-cigarette social environment, may put adolescents at risk for future use of cigarettes. E-cigarettes may contribute to subsequent cigarette use via nicotine addiction or social normalization of smoking behaviors.

IMPLICATIONS AND CONTRIBUTION

A high proportion of e-cigarette users have never smoked cigarettes. Among never-smoking adolescents in this study, both individual e-cigarette use and approval and use of e-cigarettes among friends and family were strongly associated with intention to use cigarettes.

In the United States, data from the National Youth Tobacco Survey have shown that the prevalence of current (past 30-day) cigarette use among high school students has continued to decline in recent years, from 15.8% in 2011 to 9.2% in 2014, whereas the prevalence of current electronic (e-) cigarette use has increased markedly from 1.5% in 2011 to 13.4% in 2014 [1–4]. In 2014, the National Youth Tobacco Survey found that current use of e-cigarettes surpassed the use of cigarettes, a pattern which was also observed in several studies of adolescents in California [5], Connecticut [6], and Hawaii [7] and in data from the Monitoring the Future study, another nationally representative study [8].

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Increased e-cigarette use among adolescents has led to controversy about the public health implications, with some of the tobacco control community optimistic that e-cigarettes could help smokers quit or reduce combustible cigarette use. Others, however, call for a precautionary regulatory approach in light of limited current evidence that e-cigarettes reduce cigarette smoking, limited data on e-cigarette safety, and the possibility that e-cigarettes will lead to new nicotine users who otherwise would not have used products that deliver nicotine [9]. The "gateway hypothesis" has generally referred to a transition from use of a legal substance (e.g., alcohol and tobacco) to illicit drug use. It has recently been suggested that e-cigarettes could similarly act as a gateway to nicotine addiction, either through transition from e-cigarette use to cigarette use alone or dual product use [10,11], or directly through the use of nicotine-containing e-cigarettes. Moreover, the societal "denormalization" of cigarette smoking has been a major achievement of tobacco control efforts and is generally recognized as an important reason for the continuing decrease in the prevalence of smoking [12–15]; however, the increasing social acceptability of e-cigarette use could potentially lead to the social "normalization" of smoking behaviors more generally, contributing to increased use of e-cigarettes and cigarettes in adolescence. We recently found that the adolescent e-cigarette psychosocial environment, a measure of the social "acceptability" of e-cigarettes (including friends' use and attitudes toward the use of e-cigarettes), was strongly associated with cigarette smoking in a cross-sectional analysis [5].

Susceptibility to future cigarette smoking may be a useful surrogate for assessing the potential of e-cigarettes to serve as a gateway to combustible cigarettes or other tobacco products in the absence of longitudinal data. Two recent studies of adolescents evaluated the association between e-cigarette use and cognitive "susceptibility" to future cigarette smoking (i.e., lack of a firm commitment *not* to smoke) and found ever e-cigarette users with no history of cigarette use were more likely to indicate susceptibility to cigarette use than never e-cigarette users [16,17]. However, one study was conducted at a time when the prevalence of e-cigarette use in adolescents was still low (6.1% ever use), and the sample of nonsmoking e-cigarette users was small (.9% ever e-cigarette use among never cigarette smoking youth), and the other study was conducted among a younger population of youth in ninth and 10th grade with still-low rates of cigarette use. Three recent prospective cohort studies have also found that e-cigarette use was associated with increased risk of cigarette initiation [18–20]. However, the role of the social environment around e-cigarette use and susceptibility to future cigarette smoking has not been evaluated.

The state of California provides an appropriate setting for addressing the role of e-cigarettes as a gateway to cigarette smoking, as the current prevalence of e-cigarette use is high, and cigarette smoking rates have historically been among the lowest in the country. In the Southern California Children's Health Study (CHS), for example, 24% of 11th and 12th grade students had ever used e-cigarettes, and 9.6% were current users in 2014, compared with 5.7% who were current smokers [5]. Among e-cigarette users, more than 40% had never smoked a cigarette [5]. In the current analysis, we hypothesized that: (1) adolescent e-cigarette users in Southern California, including users with no history of cigarette smoking, would be more susceptible to cigarette use than never e-cigarette users and (2) a social environment favorable to e-cigarette use would increase susceptibility to cigarette smoking.

Methods

Study sample

Adolescents enrolled in the CHS in 11th or 12th grade (N = 2,097; mean age = 17.3, standard deviation = .6) were surveyed in participants' schools under study staff supervision from January 2014 to June 2014. Participants were initially recruited into the CHS in 2002–2003, when they were in kindergarten or first grade, from entire classrooms in schools in 12 communities and were surveyed annually (see Supplementary Material). The design of the study has been described previously [5,21]. The current analysis excludes adolescents reporting ever use of cigarettes; the remaining sample includes 1,694 never smokers. The participation rate among study participants enrolled in study schools during the 2014 data collection period was 87.1%.

Measures

Susceptibility to cigarette use. Susceptibility to tobacco product use has been defined as the absence of a firm commitment not to smoke [22–24]. In the present study, susceptibility to future cigarette use was assessed using validated measures. Participants were asked the following questions, with four response options (definitely not, probably not, probably yes, and definitely yes): (1) at any time in the next year do you think you will use these products?; (2) do you think in the future you will experiment with these products?; and (3) if one of your best friends were to offer you these products would you use them? For individual questions, adolescents were classified as having no susceptibility to future use if they answered "definitely not," and were susceptible if they responded "probably not," "probably yes," or "definitely yes" [22]. A composite three-measure index was also created, according to previously used methods: participants were classified as having no susceptibility in the composite index if they responded "definitely not" to all three questions [22]. In additional sensitivity analyses, we stratified the group of susceptible individuals into those with "high susceptibility" (indicating "definitely yes" or "probably yes" to any susceptibility question) and those with "low susceptibility" ("probably no") to future cigarette use.

Current/past e-cigarette use. Adolescents were asked whether they had ever tried cigarettes or e-cigarettes and the number of days used in the past 30 days. Participants who had "never tried" cigarettes or e-cigarettes (i.e., not "even one or two puffs") were classified as "never users." Those who had used e-cigarettes, but not in the last 30 days, were classified as "past users." Participants who had used e-cigarettes on at least one of the past 30 days were classified as "current e-cigarette users" [5]. The use of any other tobacco product (cigar, pipe, hookah, or smokeless tobacco) was included as a covariate (classified as never/past/current use of any product) in sensitivity analyses.

Social environment. The e-cigarette social environment was evaluated based on the following questions: (1) "how many of your four closest friends use e-cigarettes?" (0–4 friends);