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Beliefs and Experimentation with Electronic Cigarettes:

A Prospective Analysis Among Young Adults

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Abstract

Background—Previous cross-sectional studies found that positive beliefs about electronic nicotine delivery systems (commonly known as electronic cigarettes or e-cigarettes) were associated with use of these products. However, the prospective association between these beliefs and subsequent use of e-cigarettes is unclear.

Purpose—To identify the beliefs predicting subsequent use of e-cigarettes.

Methods—1379 young adults (mean age=24.1 years) from the Minnesota Adolescent Community Cohort who reported never using e-cigarettes at baseline (collected Oct 2010–Mar 2011) and completed follow-up data collection (during Oct 2011–Mar 2012) were included in this analysis. Participants' beliefs about e-cigarettes (potential as quit aids, harmfulness and addictiveness relative to cigarettes) were asked at baseline (yes/no). At follow-up, participants were asked if they had ever used e-cigarettes. Logistic regression models were used to assess the associations between beliefs about e-cigarettes and subsequent experimentation. Analysis was conducted in 2012.

Results—At follow-up, 7.4% of the sample reported ever using e-cigarettes (21.6% among baseline current smokers, 11.9% among baseline former smokers, and 2.9% among baseline nonsmokers). Participants who believed e-cigarettes can help people quit smoking and perceived e-cigarettes to be less harmful than cigarettes at baseline were more likely to report experimenting with e-cigarettes at follow-up ($p<0.05$). These associations did not differ by smoking status.

Conclusions—Given that young adults are still developing their tobacco use behaviors, informing them about the lack of evidence to support e-cigarettes as quit aids and the unknown health risk of e-cigarettes may deter young adults from trying these products.

INTRODUCTION

Tobacco use remains a prominent public health issue in the U.S.; 25.2% of all adults (aged 18 years), and 35.6% of young adults (aged 18–24 years) reported current tobacco use in 2010.¹ While the public health community is continuously working on reducing the prevalence of tobacco use in the nation, recent introduction of electronic cigarettes (e-cigarettes, also known as electronic nicotine delivery systems) in the U.S. may hamper this

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effort,² with about 3% of U.S. adults (aged 18 years) and 7% of U.S. Midwest young adults (aged 20–28) ever using e-cigarettes.^{3–5} This is problematic because young adults are still developing their tobacco use behaviors,^{6,7} and e-cigarettes may introduce young adults to tobacco use, or promote dual use of cigarettes and smokeless tobacco products.

Although some studies found that smokers who used e-cigarettes reported that e-cigarettes were helpful in smoking cessation and had used e-cigarettes to quit smoking,^{8–10} other studies showed that ever using e-cigarette is not associated with intention to quit, quit attempt, and smoking cessation.^{3,4,10–12} Addictiveness and long-term harmfulness of e-cigarettes are also unknown. Nonetheless, some young adults already hold positive beliefs about the products. A study in a U.S. regional sample of young adults found that 44.5% of the participants who were aware of e-cigarettes believed e-cigarettes can help people quit smoking, 52.8% believed that e-cigarettes are less harmful than cigarettes, and 26.3% believed that e-cigarettes are less addictive than cigarettes.⁵ Young adults who held these beliefs were more likely than those who did not to have tried e-cigarettes.⁵ However, given the cross-sectional design of previous analysis, it is unclear whether these beliefs and perceptions precede or follow the experimentation with the products. The objective of the current analysis is therefore to assess the longitudinal associations between these beliefs and subsequent experimentation with e-cigarettes.

METHODS

Study population

Data are from the Minnesota Adolescent Community Cohort (MACC). The design of the study has been detailed elsewhere.^{13,14} Briefly, participants in the MACC study were selected in 2000–2001 and through cluster random sampling of household phone numbers. Sixty geopolitical units (GPUs) in Minnesota (out of 126) were randomly selected. Five GPUs from four comparison states (North and South Dakota, Michigan, and Kansas) were chosen because of their similarity to Minnesota. Modified random-digit dialing and a combination of probability and quota sampling methods were used to obtain an even distribution of youth from ages 12 to 16.

Of the eligible households, 3636 participants in Minnesota and 605 participants in comparison states were recruited 2000–2001 (recruitment rates of 58.5% and 58.3%, respectively). An additional cohort of 585 tweens (aged 12 years) in Minnesota from the 60 Minnesota GPUs was recruited using the same modified random-digit-dialing method during 2001–2002 (a recruitment rate of 63.6%), resulting in an overall sample of 4826. Participants were surveyed every 6 months through 2007–2008, and then annually between 2008 and 2011 through computer-assisted telephone interviews using phone numbers provided by the participants (including mobile phone numbers). Recruitment and interviews were conducted by Clearwater Research, Inc. In this prospective analysis, the sample was restricted to those participants who completed the survey conducted between October 2010 and March 2011 (baseline) and the survey conducted between October 2011 and March 2012 (follow-up), and were asked about beliefs associated with e-cigarettes but had never used e-cigarettes at baseline ($n=1379$; retention rate=83.5% between two rounds). The University of Minnesota Institutional Review Board approved this study.

Measures

Participant's beliefs about e-cigarettes were assessed at baseline by asking them to rate their level of agreement with the following statements (5-point Likert scale, strongly agree to strongly disagree): *using e-cigarettes can help people quit smoking*, *using e-cigarettes is less harmful to health of the user than smoking cigarettes*, and *e-cigarettes are less addictive*

than cigarettes. Responses were collapsed into whether the participants agreed with the statements (yes=strongly agree/agree, no= not sure/disagree/strongly disagree). The Pearson correlation coefficient between these beliefs ranged from 0.28 to 0.43 ($p<0.01$). Information on participants' age, gender, race/ethnicity (non-Hispanic white versus other), and education were collected at baseline. Participants' education was classified into high school graduate or less, some college/technical school, college graduate or more. Participants' baseline smoking status was categorized into nonsmokers (never smoked 100 cigarettes in their lifetime and none in the past 30 days); former smokers (smoked 100 cigarettes in their lifetime but none in the past 30 days); and current smokers (smoked 100 cigarettes in their lifetime and at least 1 day in the past 30 days). At follow-up, participants were asked: *Have you ever used an electronic cigarette?* (yes/no).

Statistical Analysis

Logistic regression models were employed to assess the association between each belief about e-cigarettes as measured at baseline, and ever use of e-cigarettes at follow-up, adjusted for demographics and baseline smoking status. These models were not adjusted for race/ethnicity because it was not associated with beliefs e-cigarettes. Sensitivity analyses were conducted to examine whether alternative categorizations of the belief variables (i.e., including *not sure* with *disagree*, or removing *not sure* cases) would influence the findings. These analyses showed that the conclusions did not change by different categorizations. Stratified analyses by gender and smoking status were also performed. All analyses were performed in PC-SAS® version 9.2 using PROC GLIMMIX to control for clustering by GPU. All analyses were conducted in 2012.

RESULTS

Among all participants included in the analysis ($n=1379$), the average age was 24.1 (standard deviation=1.7); 48.4% of the sample was male, 90.3% was non-Hispanic white, 63.7% enrolled in or graduated from a 4-year college. Regarding smoking status at baseline, 17.8 were current smokers, 12.8% were former smokers, and 69.4% were nonsmokers. At 1-year follow-up, 7.4% ($n=102$) of the sample (who had never used e-cigarettes at baseline) reported ever using e-cigarettes: 21.6% ($n=53$) among baseline current smokers, 11.9% ($n=21$) among baseline former smokers, and 2.9% ($n=28$) among baseline nonsmokers. Participants who agreed e-cigarettes can help people quit smoking and those who agreed that e-cigarettes are less harmful than cigarettes were more likely than those who did not agree to subsequently report experimenting with e-cigarettes ($p<0.05$; Table 1). These associations did not vary by gender or smoking status.

DISCUSSION

E-cigarettes have received attention from the U.S. population since their introduction in 2007. The study showed that, among baseline nonsmokers, 2.9% of baseline nonsmokers in this U.S. regional sample of young adults reported ever using e-cigarettes at follow-up, suggesting an interest in e-cigarettes among nonsmoking young adults, a group that is still experimenting with tobacco.⁶ This study also suggested that about 12% of former young adult smokers at baseline were re-introduced to nicotine through e-cigarettes. Future prospective studies including adults of all ages are needed to confirm these findings related to e-cigarette use among nonsmokers and former smokers, and to determine the role of e-cigarettes on relapse of smoking.

While a recent review of the literature on e-cigarettes suggests that e-cigarette may be a viable reduced-harm alternative to cigarettes,¹⁵ previous studies have found that experimentation with e-cigarettes was not associated with intention to quit, making quit

attempts, or smoking cessation.^{3,4,10,11} A recent randomized trial among smokers who were not interested in quitting smoking also found no difference in cigarette consumption and smoking cessation rate between those who were assigned to using e-cigarettes with or without nicotine at 1-year follow-up.¹² Adverse events associated with e-cigarettes have been reported,¹⁶ but the risk associated with long-term e-cigarette use is largely unknown. A recent laboratory study found that e-cigarettes can significantly increase plasma nicotine levels that may be comparable to cigarette smoking,¹⁷ suggesting they are potentially as addictive as cigarettes. Despite the current state of scientific knowledge about the risks of e-cigarettes, previous studies showed that many believe e-cigarettes can help people quit smoking, are less harmful than cigarettes, and less addictive than cigarettes.^{4,5,8–10} The current analysis found that young adults who believed that e-cigarettes can help people quit smoking and e-cigarettes are less harmful than cigarettes were associated with subsequent experimentation of e-cigarettes, *smokers and nonsmokers alike*. While this is consistent with behavioral theories which posit behavioral beliefs predicting behaviors,¹⁸ understanding the specific beliefs that predict subsequent e-cigarette experimentation allows us to focus on these beliefs when designing public health messages. Results from this study suggest that messages about the lack of evidence on e-cigarette being cessation aids, and the uncertainty of the risks associated with e-cigarette use (e.g., development and perpetuation of nicotine addiction,² pneumonia and congestive heart failure¹⁶) may discourage young adults from experimenting with e-cigarettes.

Because of its regional and predominantly white sample, these findings may not be generalizable to other U.S. regions with higher racial/ethnic diversity. Given that smokers were more likely to drop out from the study, the prevalence of experimentation of e-cigarettes and potentially the associations between beliefs and subsequent e-cigarette experimentation could have been underestimated. Despite these limitations, this study provides suggestive evidence that beliefs about e-cigarettes predict subsequent experimentation with these products, and these products may re-introduce former smokers into nicotine use.

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Table 1

Adjusted associations between perceptions of e-cigarettes at baseline and use of e-cigarettes at follow-up

Perceptions of e-cigarettes at baseline	Ever used e-cigarettes at follow-up	
	%	AOR (95% CI)
Agreed that e-cigarettes can help people quit smoking		
Yes	10.0	1.98 (1.29, 3.04)
No	5.4	Ref
Agreed that e-cigarettes are less harmful than cigarettes		
Yes	10.1	2.34 (1.49, 3.69)
No	4.6	Ref
Agreed that e-cigarettes are less addictive than cigarettes		
Yes	9.3	1.16 (0.73, 1.85)
No	6.8	Ref

Estimates were adjusted for age, gender, education, and smoking status. Estimates for each perception are estimated in separate models. Bolded estimates are significant ($p < 0.05$).