E-Cigarette Use in the Past and Quitting Behavior in the Future: A Population-Based Study

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Objectives. We examined whether smokers who used e-cigarettes are more likely to quit after 1 year than smokers who had never used e-cigarettes.

Methods. We surveyed California smokers (n = 1000) at 2 time points 1 year apart. We conducted logistic regression analyses to determine whether history of e-cigarette use at baseline predicted quitting behavior at follow-up, adjusting for demographics and smoking behavior at baseline. We limited analyses to smokers who reported consistent e-cigarette behavior at baseline and follow-up.

Results. Compared with smokers who never used e-cigarettes, smokers who ever used e-cigarettes were significantly less likely to decrease cigarette consumption (odds ratio [OR] = 0.51; 95% confidence interval [CI] = 0.30, 0.87), and significantly less likely to quit for 30 days or more at follow-up (OR = 0.41; 95% CI = 0.18, 0.93). Ever-users of e-cigarettes were more likely to report a quit attempt, although this was not statistically significant (OR = 1.15; 95% CI = 0.67, 1.97).

Conclusions. Smokers who have used e-cigarettes may be at increased risk for not being able to quit smoking. These findings, which need to be confirmed by longer-term cohort studies, have important policy and regulation implications regarding the use of e-cigarettes among smokers. (*Am J Public Health.* 2015;105: 1213–1219. doi:10.2105/AJPH.2014.302482)

The use of electronic cigarettes (e-cigarettes)—also known as electronic nicotine delivery systems, personal vaporizers, and vaping cigarettes—is a recent and rapidly expanding phenomenon. These names refer to a battery-operated device that electronically heats a liquid (sometime referred to as "e-juice") containing nicotine and propylene glycol, plus flavors, to create a misty vapor mimicking cigarette smoke that is inhaled by the smoker (who is commonly known as the "vaper"). This increasing use of e-cigarettes has become a controversial issue among health professionals, policymakers, vapers, and the general public. According to the surgeon general's recent recommendations, e-cigarettes need to be regulated and their use in the population closely monitored, especially given the doubling of use among youths within just 1 year (between 2011 and 2012).[1]

The main controversy surrounding the use of e-cigarettes is whether they are of benefit to smokers, as an alternative to cigarettes and for harm reduction, or whether they cause more harm to society by introducing and propagating new forms of nicotine addiction.[2] At present, there is a scarcity of data to help guide decisions regarding the potential harm versus benefits of e-cigarettes, a situation that has led to claims and counterclaims by opponents and proponents of e-cigarette use.[3] If smokers quit traditional cigarettes and instead use e-cigarettes to maintain their nicotine addiction (but without the degree of exposure to known carcinogenic byproducts of tobacco combustion), this may be a viable harm reduction strategy that can become a powerful tool for tobacco control.

Most of the evidence that users and proponents of e-cigarettes employ have been anecdotal and not scientifically validated; recently, however, more studies on this topic have appeared. One of the first, a pilot study funded by the manufacturers of an e-cigarette brand from Italy, included 40 smokers who were given e-cigarettes and followed up for 24 weeks. The authors reported a 22.5% rate of sustained abstinence from cigarettes among e-cigarette users, a rate comparable to the effects of nicotine replacement therapy in experimental settings.[4] However, this study was underpowered because of the small number of participants. A more recent and larger 3-arm trial of e-cigarette use from New Zealand randomized participants to use e-cigarettes (nicotine or placebo) or nicotine patches to quit smoking. Abstinence rates at 6-month follow-up were low across conditions (4.1%–7.8%), with the highest rate found with nicotine e-cigarettes and the lowest with placebo e-cigarettes,[5] but no significant differences emerged. In addition to its low statistical power, the study included a potential methodological bias because those in the e-cigarette arm of the trial were mailed the device and cartridges while those in the nicotine patch arm were mailed a voucher (thus requiring that they obtain the nicotine patches). The difference in dose of nicotine and type of e-cigarettes is an additional major limiting factor in interpreting these results across different studies.

An earlier study of a convenience sample of 81 ever-users of e-cigarettes concluded that most participants were using them to quit smoking,[6] but it provided no clear indication of how successful they were. A larger follow-up survey of e-cigarette users by the same authors indicated that almost all former smokers (96%) agreed that e-cigarettes helped them quit smoking and 57.7% of current smokers believed that e-cigarettes would help them quit or avoid relapsing.[7] However, these studies were biased toward self-selected current users without any comparison groups, and the actual influence on quitting among ever-users versus never-users is unknown. More recently, a meta-analysis by Grana et al. found that all 4 prospective studies that assessed the influence of e-cigarette use on quitting behavior found that e-cigarette use did not assist smokers in quitting.[8]

We prospectively assessed how ever using e-cigarettes, compared with never using them, affected abstinence and smoking habits among smokers in the general population. Given that previous data suggest that smokers mostly use

e-cigarettes to quit smoking, we hypothesized that smokers in the general population who have tried or who currently use e-cigarettes are more likely to succeed in quitting than smokers who never used them, after controlling for level of addiction, quitting intentions, and smoking behavior.

METHODS

We drew the data for this study from the California Smokers Cohort (CSC), a longitudinal survey designed to investigate factors that predict cigarette cessation behaviors among current and former smokers in California. The study comprised a baseline survey to establish a cohort of current and former smokers and a follow-up survey to determine changes in smoking behaviors, including reduced consumption, quit attempts, and duration of abstinence. The baseline survey was conducted from July 26, 2011, to April 29, 2012. The follow-up survey was conducted from November 6, 2012, to January 16, 2013. The baseline survey interviewed by telephone 4350 residents of California aged 18 to 59 years who had smoked at least 100 cigarettes during their lifetime (response rate = 23.4%). The follow-up consisted of 1745 interviews with the original respondents, of whom 1000 were smokers at baseline. In this study, we examined these 1000 baseline smokers. Interviews for both waves of the study were conducted via landline and cell phone and administered in English and Spanish.

To validate the current CSC study, we compared study findings regarding e-cigarette use and population characteristics with data from our separate cross-sectional California Longitudinal Smokers Survey (CLSS), which is a representative sample of smokers who participated in the 2009 California Health Interview Survey. The latter survey is a biannual population-based random sample (random-digit-dial telephone interview) of California residents that uses the same survey questionnaire as that used for the CSC. In the CLSS follow-up telephone interview, which began in July 2011and concluded in December 2011, participants were recruited who were identified as smokers in the California Health Interview Survey and agreed to be followed up.[9] In total, a sample of 1718 current smokers was weighted to the age, gender, geographic place of residence, and ethnicity of the population of adult California smokers, as previously described.[9,10]

History of Tobacco and E-Cigarette Use

Survey questions and data collection procedures were identical for the baseline and follow-up CSC. Current smokers were those who reported smoking at least 100 cigarettes in their lifetime and smoked cigarettes on at least some days at the time of the survey. Smoking status was categorized according to reported smoking frequency: either every day (daily) or some days (nondaily).

We asked all participants if they had heard of electronic cigarettes or e-cigarettes, and provided them with a description as follows: electronic cigarettes, also known as e-cigarettes, are devices that look like cigarettes and contain nicotine but do not produce tobacco smoke; some brands are The Safe Cig, Green Smoke, and Blu. If they answered that they had heard of them, we then asked them, "What describes you best regarding your use of e-cigarettes: you have used e-cigarettes, you might use e-cigarettes, or you will never use e-cigarettes?"

Independent predictors of tobacco behavior. To determine nicotine dependence, we asked smokers how soon after they awoke they smoked their first cigarette, with responses categorized as smoked within 30 minutes of waking up (more addicted smokers) and waited 30 minutes or more after waking up (less addicted smokers). We used 30 minutes as the cutoff for this variable because it is the median value for the number of minutes smokers in the CLSS reported smoking their first cigarette after waking up.

To determine intentions to quit, we asked smokers to choose 1 of 4 options as their future intention for quitting: (1) never expect to quit, (2) might quit in the future but not in the next 6 months, (3) will quit in the next 6 months, or (4) will quit in the next month. To increase the stability of the regression model, we combined responders in the first 2 groups into 1 category, "no current intention to quit," and smokers in the last 2 groups into another category, "intending to quit in the next 6 months."

TABLE 1—Characteristics of Study Participants: California Smokers Cohort, 2011–2012

Characteristic	No.	% of Sample (SE)
Baseline data (predictors)		
E-cigarette use		
Have used	236	24.1 (1.37)
Might use	352	35.9 (1.53)
Will never use	306	31.2 (1.48)
Never heard of	86	8.8 (0.90)
Age, y		
18–44	302	30.2 (1.45)
45–59	698	69.8 (1.45)
Gender		
Male	478	47.8 (1.58)
Female	522	52.2 (1.58)
Education, y		
≤ 12	348	34.8 (1.51)
13–15	449	44.9 (1.57)
≥ 16	203	20.3 (1.27)
Ethnicity		
Hispanic	99	9.9 (0.94)
Non-Hispanic White	726	72.6 (1.41)
All others	175	17.5 (1.20)
Smoking status		
Daily smoker	837	83.7 (1.17)
Nondaily smoker	163	16.3 (1.17)
Time to first cigarette in the morning		
≤ 30 min	595	60.8 (1.56)
> 30 min	384	39.2 (1.56)
Intend to quit smoking in the next 6 mo		
Yes	415	43.4 (1.60)
No	542	56.6 (1.60)
Follow-up data (outcomes)		
Any quit attempt in last year		
Yes	361	40.7 (1.65)
No	525	59.3 (1.65)
Prolonged abstinence for at least 1 mo		
Yes	94	9.4 (0.92)
No	906	90.6 (0.92)
20% reduction in monthly no. of cigarettes		
Yes	294	33.6 (1.60)
No	581	66.4 (1.60)

Note. The sample size was n = 1000.

We also included the following sociodemographic characteristics in the model: gender, age (18–44 and 45–59 years), years of education (≤ 12, 13–15, and ≥ 16 years), and ethnicity (Hispanic, Non-Hispanic White, and all others).

Outcome variables. We chose 3 smoking behavior variables as outcomes related to e-cigarette use: quit attempts, reduction in the number of cigarettes smoked, and current abstinence from cigarette use. We dichotomized reduction in the number of cigarettes smoked according to whether a smoker's monthly number of cigarettes was reduced by 20% or more at follow-up compared with baseline. We included monthly rather than daily number of cigarettes smoked to accommodate nondaily smokers.

We assessed self-reported quit attempts by response at follow-up to the question, "During the past 12 months, have you quit smoking intentionally for one day or longer?"

We considered those reporting a duration of abstinence of 1 month or longer to be currently abstinent. We calculated the 1-month duration by subtracting the date of the follow-up interview from the date of the start of their most recent quit attempt that lasted 1 day or longer.

Statistical Analyses

We calculated crude odds ratios, adjusted odds ratios, and their 95% confidence intervals by using logistic regression analyses separately for each of the 3 different outcomes (quit attempt, reduction of cigarette smoking by 20% or more, and abstention from smoking for 1 month or more), with the outcome event being "yes." The main predictor was the use of e-cigarettes, which, for the purposes of the current study, we categorized as (1) a report of "will never use e-cigarettes" at baseline and follow-up (reference group in regression models) and (2) a report of "have used e-cigarettes" at baseline and follow-up. We excluded from analyses those who reported that they "might use e-cigarettes" at both time points or changed their reporting at follow-up, as they did not represent a definitive group of users or never-users and might overlap with both. The final sample for the multivariable analyses for all outcomes included 368 participants. In secondary analyses, we included all the categories of e-cigarettes in the models (but excluded those who had not heard about e-cigarettes), and the adjusted odds ratios were unchanged. The multivariable logistic regression model included as covariates age, gender, education, ethnicity, smoking status, intention to quit, and time to first cigarette.

We performed all analyses with SAS for Windows 7, version 9.3 (SAS Institute, Cary, NC). For the CLSS comparison data, we weighted all reported parameter estimates to be representative of the population of adult smokers in California. We calculated weighted frequencies, standard deviations, and standard errors by the paired unit jackknife method, using 80 jackknife samples.[5]

RESULTS

We found comparable results for e-cigarette use in both the CSC and CLSS populations. Female smokers were more likely than males to report ever using e-cigarettes in both the CSC (odds ratio [OR] = 1.66; 95% confidence interval [CI] = 1.18, 2.35) and the CLSS (OR = 2.05; 95% CI = 1.01, 4.16). Non-Hispanic Whites were more likely than other ethnic groups to ever use e-cigarettes in the CSC (OR = 2.8; 95% CI = 1.3, 6.05) and the CLSS (OR = 1.93; 95% CI = 1.31, 2.84). Daily smokers in both populations were more likely than nondaily smokers to ever use e-cigarettes in the CSC (OR = 2.01; 95% CI = 1.26, 3.22) and the CLSS (OR = 2.25; 95% CI = 0.99, 5.16). Other variables were not significantly associated with e-cigarette use in either population.

The CSC population demographics of the respondents at baseline and responses to the e-cigarette question are presented in Table 1. A quarter of smokers (24.1%; SE = 1.37) reported ever using e-cigarettes, 31.2% (SE = 1.48) said they would never use them, and 35.9% (SE = 1.53) said they might use them in the future. Overall, only 8.8% of smokers (SE = 0.90) had not heard about e-cigarettes. At the 1-year follow-up, 40.7% (SE = 1.65) reported making at least 1 quit attempt in the past year, 33.6% (SE = 1.60) reported decreasing cigarette consumption by 20% or more in the past year, and 9.4% (SE = 0.92) reported abstaining for at least 1 month.

The primary analyses were longitudinal models of the CSC data (including e-cigarette use category, other baseline smoking variables, and demographics) to predict the 3 outcomes at follow-up. Figure 1 shows the frequency of the 3 outcomes (quit attempt at follow-up, 20% decrease in cigarette consumption at follow-up, and abstention for 1 month or longer at follow-up), dichotomized into the 2 categories "ever used e-cigarettes" and "will never use e-cigarettes" as reported at baseline. In multivariable logistic regression analyses (Table 2), there was a positive association between using e-cigarettes and making a quit attempt at follow-up, but it did not reach statistical

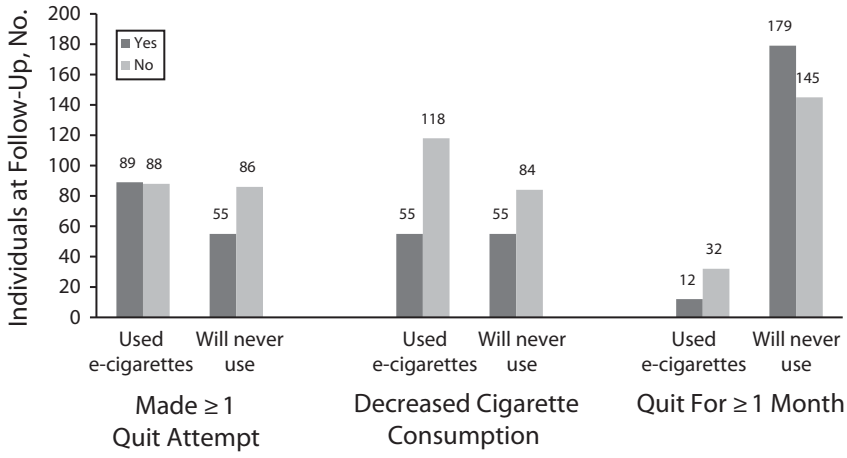

FIGURE 1—Cigarette quit attempts, decreased cigarette consumption, and abstinence for 1 month or more at follow-up, by use of e-cigarettes: California Smokers Cohort, 2011–2012.

TABLE 2—Multivariable Logistic Regression Baseline Predictors of Making a Quit Attempt at 12-Month Follow-Up as a Function of E-Cigarette Use: California Smokers Cohort, 2011–2012

Variable	No. (%)	AOR (95% CI)
E-cigarette use		
Have used	177 (55.7)	1.15 (0.67, 1.97)
Will never use	141 (44.3)	1.00 (Ref)
Age, y		
18–44	107 (33.6)	2.13* (1.20, 3.79)
45–59	211 (66.4)	1.00 (Ref)
Gender		
Male	171 (53.8)	0.91 (0.67, 1.24)
Female	147 (46.2)	1.00 (Ref)
Education, y		
≤ 12	115 (36.2)	0.76 (0.45, 1.29)
> 12	203 (63.8)	1.00 (Ref)
Ethnicity		
Non-Hispanic White	231 (72.6)	0.74 (0.42, 1.33)
All others	87 (23.4)	1.00 (Ref)
Smoking status		
Daily smoker	269 (84.6)	0.79 (0.37, 1.72)
Nondaily smoker	49 (15.4)	1.00 (Ref)
Time to first cigarette in the morning		
≤ 30 min	189 (60.0)	0.51* (0.29, 0.89)
> 30 min	126 (40.0)	1.00 (Ref)
Intend to quit smoking in next 6 mo		
Yes	128 (41.8)	4.66* (2.74, 7.94)
No	178 (58.2)	1.00 (Ref)

Note. AOR = adjusted odds ratio; CI = confidence interval. The sample size was n = 318. Modeled odds ratio simultaneously adjusts for addiction (time to first cigarette in the morning), age, gender, education, ethnicity, desire to quit smoking, and smoking status. "Have used" and "will never use" include only those respondents with consistent responses at baseline and follow-up.
*$P < .05$.

significance (adjusted odds ratio [AOR] = 1.15; 95% CI = 0.67, 1.97).

Examination of the smoking reduction outcome is shown in Table 3. Compared with never using e-cigarettes, use of e-cigarettes was associated with a statistically significant lower likelihood of decreasing cigarette consumption by 20% or more during the 1-year period (AOR = 0.51; 95% CI = 0.30, 0.87).

Table 4 shows logistic regression analyses of baseline predictors of abstinence (1 month or more) at follow-up. Smokers ever using e-cigarettes were significantly less likely to be abstinent at follow-up (AOR = 0.41; 95% CI = 0.186, 0.93) than smokers who reported they would never use e-cigarettes. In the same models, daily smokers were less likely to quit for 1 month, and those who intended to quit in the next 6 months were significantly more likely to quit for 1 month or more.

DISCUSSION

The study findings contradicted our primary hypothesis that smokers who had ever used e-cigarettes would be more likely to abstain from smoking cigarettes at 1 year follow-up than those who stated they would never use these products. In the present sample, a history of e-cigarette use was significantly associated with cessation failure rather than success. The other findings from our study indicated that e-cigarette ever-users were less likely to reduce their cigarette smoking and more likely to attempt quitting during the follow-up period, although the latter finding was not statistically significant.

Our study did not identify whether participants used e-cigarettes for the purpose of quitting. However, other studies have consistently indicated that smokers who use e-cigarettes do so primarily to help them quit or to decrease cigarette consumption.[6,7,11]

Few population-based observational studies have produced results indicating that e-cigarettes assist smokers in quitting. A cross-sectional national study in the United States did not find an association between e-cigarette use and quit attempts.[12] However, in another cross-sectional study from the United Kingdom, it was found that smokers who used e-cigarettes in their most recent quit attempt were more likely to be abstinent than those not using any assistance or using nicotine replacement therapy.[13] The authors acknowledged the limitation of recall bias because of their cross-sectional design and the potential for e-cigarette users to differentially misreport their level of addiction or smoking behavior. Furthermore, the cessation rate among the unaided group in that population was unusually high (approximately 15%) compared with commonly reported rates of 4% to 5%. The authors used the United Kingdom's Smoking Toolkit Study, describing it as a nationally representative sample of smokers.[13] However, the description of the original Smoking Toolkit study sample clearly indicates that it was not; interviewers selected those who were most likely to be available to participate and the study never reported a response rate.[14] Although weighting can be used to approximate representation of the general population, it does not overcome the likely bias from enrolling as participants smokers committed to quitting. This selection bias can undermine findings from a cross-sectional study given the recall bias. E-cigarettes have been proposed to be more effective for heavily addicted smokers who are less likely to quit through other means.[4] Our study avoided some of these selection and recall biases of cross-sectional studies by being prospective and following up the smokers for 1 year and reinterviewing them for their smoking behavior, a study design recommended for future studies by the authors

TABLE 3—Multivariable Logistic Regression Baseline Predictors of Decreasing Monthly Cigarette Consumption at 12-Month Follow-Up as a Function of E-Cigarette Use: California Smokers Cohort, 2011–2012

Variable	No. (%)	AOR (95% CI)
E-cigarette use		
Have used	173 (55.5)	0.51* (0.30, 0.87)
Will never use	139 (44.5)	1.00 (Ref)
Age, y		
18–44	104 (33.3)	2.13* (1.21, 3.75)
45–59	208 (66.7)	1.00 (Ref)
Gender		
Male	168 (53.9)	1.17 (0.70, 1.94)
Female	144 (46.2)	1.00 (Ref)
Education, y		
≤ 12	113 (36.2)	0.86 (0.51, 1.46)
> 12	199 (63.8)	1.00 (Ref)
Ethnicity		
Non-Hispanic White	226 (72.4)	0.67 (0.38, 1.16)
All others	86 (27.6)	1.00 (Ref)
Smoking status		
Daily smoker	264 (84.6)	2.60* (1.18, 5.75)
Nondaily smoker	48 (15.4)	1.00 (Ref)
Time to first cigarette in the morning		
≤ 30 min	185 (59.9)	0.74 (0.43, 1.28)
> 30 min	124 (40.1)	1.00 (Ref)
Intend to quit smoking in next 6 mo		
Yes	126 (41.9)	1.95* (1.15, 3.28)
No	175 (58.1)	1.00 (Ref)

Note. AOR = adjusted odds ratio; CI = confidence interval. The sample size was n = 312. Modeled odds ratio simultaneously adjusts for addiction (time to first cigarette in the morning), age, gender, education, ethnicity, desire to quit smoking, and smoking status. "Have used" and "will never use" include only those respondents with consistent responses at baseline and follow-up.
*$P < .05$.

of the UK study.[13] Other recent population-based prospective studies have reported findings consistent with our finding that e-cigarette use is not related to quitting behavior at follow-up.[11,15–17]

Although assessment of e-cigarette use was limited in the present study, we attempted to enhance validity by assessing consistency of e-cigarette use across both time points and excluding inconsistent reports. Our study is among the few prospective investigations to suggest that past or current users of e-cigarettes are heavy smokers who are consistently less likely to achieve sustained abstinence than those who have never tried e-cigarettes, regardless of other smoking characteristics.

These findings are at odds with data from trials and experimental studies demonstrating that e-cigarettes have some positive influence on quitting behavior—comparable to that of the nicotine patch—although these studies showed very low rates of success.[5] As with conventional cigarettes, clinical trials and experimental studies of e-cigarettes are generally more favorable to cessation treatment and attempts than observational studies. Clinical trials provide valuable information about the efficacy and efficiency of cessation therapy methods, but they rarely reflect true behavior and cessation in the general population. For example, the successful quitting rate among participants in a clinical trial is usually 20% or more, whereas in the general population the annual cessation rate does not exceed 5%.[18]

There is much controversy about the usefulness of e-cigarettes as a tobacco cessation tool.[3] Only prospective studies can determine the impact of e-cigarettes on quitting because they offer temporality. Our prospective study of this population of smokers demonstrated that smokers who experiment with or use e-cigarettes are less likely to be abstinent, a finding supported by other prospective studies. We adjusted for the important predictors of cessation such as addiction level, intention to quit, and smoking status, in addition to demographic variables, and the final results were independent of these factors.

Although we adjusted for these variables in the multivariable model of the CSC prospective analyses, there may be residual confounding from other unmeasured variables related to quitting successfully or the characteristics of our sample. However, we compared the predictors of use of e-cigarettes for both our population and a representative population from the CLSS, and they were not different. This suggests that there are no major systematic confounders that we missed that might explain these results. However, this comparison does not replace probability sampling. We also found that the covariates in the model related to smoking, such as addiction level and quitting intention, were in the expected direction in terms of e-cigarette use at baseline or quitting behavior at follow-up, which provides assurances about the internal validity of the model and the variables.

An important limitation in our study is that we did not ask smokers who quit if they tried using e-cigarettes in their last successful quit attempt. When we developed the questionnaire for the survey in 2010, e-cigarettes were still limited in use and not known to be used for quitting purposes. However, our aim in this study was not to determine whether e-cigarettes can be considered an effective quitting aid, but rather to describe the behavior of smokers who are drawn to these products and to determine whether they are more likely to become successful quitters. It could be that smokers not trying to quit are the ones who end up using e-cigarettes, which would explain our findings; however, we

TABLE 4—Multivariable Logistic Regression Baseline Predictors of Prolonged Abstinence From Smoking at 12-Month Follow-Up as a Function of E-Cigarette Use: California Smokers Cohort, 2011–2012

Variable	No. (%)	AOR (95% CI)
E-cigarette use		
Have used	191 (51.9)	0.41* (0.18, 0.93)
Will never use	177 (48.1)	1.00 (Ref)
Age, y		
18–44	125 (34.0)	1.40 (0.61, 3.21)
45–59	243 (66.0)	1.00 (Ref)
Gender		
Male	197 (53.5)	1.11 (0.52, 2.38)
Female	171 (46.5)	1.00 (Ref)
Education, y		
≤ 12	128 (34.8)	1.28 (0.57, 2.86)
> 12	240 (65.2)	1.00 (Ref)
Ethnicity		
Non-Hispanic White	264 (71.7)	0.89 (0.39, 2.03)
All others	104 (28.3)	1.00 (Ref)
Smoking status		
Daily smoker	294 (79.9)	0.25* (0.11, 0.58)
Nondaily smoke	74 (20.1)	1.00 (Ref)
Time to first cigarette in the morning		
≤ 30 min	215 (59.4)	1.38 (0.59, 3.25)
> 30 min	147 (40.4)	1.00 (Ref)
Intend to quit smoking in next 6 mo		
Yes	156 (44.6)	2.98* (1.32, 6.73)
No	194 (55.4)	1.00 (Ref)

Note. AOR = adjusted odds ratio; CI = confidence interval. The sample size was n = 368. Modeled odds ratio simultaneously adjusts for addiction (time to first cigarette in the morning), age, gender, education, ethnicity, desire to quit smoking, and smoking status. "Have used" and "will never use" include only those respondents with consistent responses at baseline and follow-up.
*$P < .05$.

adjusted for intention to quit in the models and the association between e-cigarette use and not being abstinent was consistent and independent of intention to quit. We actually found that e-cigarette users were more likely to make quit attempts than nonusers, although this did not reach statistical significance. It may be that e-cigarette use is increasing the nicotine dose of smokers and their level of dependence, making them less capable of quitting, but further studies are needed to address this possibility.

In conclusion, our study demonstrates for the first time in a population-based study in California that e-cigarette users do not appear to abstain successfully, at least within a year. These findings held after we accounted for key influences on cessation outcomes, including smoking status and dependence. Given the rapidly growing use of e-cigarettes, these findings are important for generating further studies that specifically look at the role of e-cigarettes as cessation tools among the general population of smokers, and directly address the validity of claims regarding cessation efficacy. ■

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Contributors

W. K Al-Delaimy conceptualized and oversaw the analyses, conducted the literature review, and drafted the article. M. G. Myers, D. R. Strong, and C. R. Hofstetter contributed to the data analysis plan, the development of measures, and the interpretation of the results. E. C. Leas analyzed the data. All authors contributed to revisions of the article.

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Human Participant Protection

Ethical approval for the California Smokers Cohort was provided by the Human Subjects Protection Committee of the University of California, San Diego. Participants verbally provided informed consent to participate in the study.

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