



Published in final edited form as:

*Addict Behav.* 2022 April ; 127: 107220. doi:10.1016/j.addbeh.2021.107220.

## Quitting Electronic Cigarettes: Factors Associated with Quitting and Quit Attempts in Long-term Users

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### Abstract

Some electronic cigarette (e-cigarette) users are interested in quitting e-cigarette use, though few studies have assessed what factors contribute to this interest. This study aimed to identify factors associated with e-cigarette quitting interest and quitting behaviors in exclusive, long-term e-cigarette users. These e-cigarette users were surveyed in January 2017 (baseline) and June 2019 (follow-up), with an average follow-up period of 2.4 years. At baseline, the sample had been e-cigarette users for an average of 5.6 years. Among the 221 participants, 205 (92.8%) did not intend to quit using e-cigarettes at baseline. At follow-up, 196 (88.7%) continued exclusive e-cigarette use, 17 (7.7%) quit e-cigarettes, 8 (3.6%) became dual users, and none became exclusive smokers. At baseline, 16 users intended to quit e-cigarettes, 2 (12.5%) of whom quit at follow-up. Predictors of quitting e-cigarettes included no previous cigarette smoking ( $\beta=-3.7$ ,  $OR=.021$ ,  $p<.01$ ), lower Penn State Electronic Cigarette Dependence Index score ( $\beta=-0.21$ ,  $OR=0.81$ ,  $p=.011$ ), and lower number of devices used per day ( $\beta=-1.9$ ,  $OR=0.15$ ,  $p=.015$ ). Intending to quit e-cigarettes at baseline was not predictive of quitting at follow-up. At follow-up, 57 (25.8%) had tried to quit in the past. Overall predictors of trying to quit included interest in quitting at baseline ( $\beta=1.7$ ,  $OR=5.3$ ,  $p<.01$ ) and using a drip-fed atomizer ( $\beta=1.0$ ,  $OR=2.7$ ,  $p=.022$ ). These results suggest that long-term exclusive e-cigarette users generally have little interest in stopping e-cigarette use, and that type of device used, smoking history, e-cigarette dependence, number of devices used, and intention to quit are associated with e-cigarette quitting behaviors.

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**CONTRIBUTORS:** All authors were involved with the study design and the writing of the protocol. JY and ES conducted the statistical analysis. ES wrote the first draft of the manuscript and all authors contributed to revisions and have approved the final manuscript.

**DECLARATION OF INTERESTS:** JF has done paid consulting for pharmaceutical companies involved in producing smoking cessation medications, including GSK, Pfizer, Novartis, J&J, and Cypress Bioscience, and received a research grant from Pfizer Inc. There are no competing interests to declare for other authors.

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## Keywords

E-cigarette; Tobacco use; Quitting E-cigarettes

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## 1.0 Introduction

Electronic cigarettes (e-cigarettes) continue to be widely used. The 2019 National Health Interview Survey conducted by the CDC found that 4.5% of U. S. adults were current e-cigarette users, a rise from 3.2% in 2018 (Cornelius et al., 2020; Creamer et al., 2019). Adult e-cigarette users are often current or former smokers seeking an alternative to cigarette smoking (Glasser et al., 2017; Stallings-Smith & Ballantyne, 2019; Yong et al., 2019). As adults switch to using e-cigarettes there is concern that they could develop e-cigarette dependence or that long-term use could be harmful (National Academies of Sciences, Engineering, and Medicine et al., 2018).

While e-cigarettes are known to deliver fewer toxicants than cigarettes, they are not harmless and the long-term consequences of use are still unknown (National Academies of Sciences, Engineering, and Medicine et al., 2018). Some studies suggest relatively little harm resulting from short term use (i.e. <1 year) (Hajek et al., 2019). Other studies have suggested possible negative effects on cardiovascular and pulmonary health in humans and animals, though the long-term effects on these organ systems are not known (Tsai et al., 2020). This potential for long-term harm provides grounds for investigating e-cigarette quitting among e-cigarette users, as quitting may become important for future risk reduction.

Relatively little research has been done to characterize e-cigarette quitting. One report based on the Population Assessment of Tobacco and Health (PATH) Study data suggested that interest in quitting could be as high as 62.4% among e-cigarette users, with over 25% having tried to quit before (Rosen & Steinberg, 2020). Other studies, however, have found lower interest in quitting. For instance, a study of e-cigarette users involved in online e-cigarette communities found that less than 4% of e-cigarette users were interested in quitting in the next 2 months, with 73.4% reporting no past attempts to reduce use (Skerry et al., 2018). One study of long-term e-cigarette users reported that 66% of those surveyed had no interest in quitting, and only 10% had previously tried to quit (Etter, 2019). One recent trial of young (age 18–24) e-cigarette users found that an e-cigarette-cessation text-messaging program increased quit rates among young e-cigarette users who wanted to quit, showing that there is some motivation to quit among young adults as well (Graham et al., 2021). These studies provide valuable information about quitting interest but say little about what differentiates those who are interested in quitting from those who are not. The limited number of studies which do address differentiating characteristics have found age, income, education, perceived quitting barriers, nationality, status as a medical student, and presence of chronic respiratory conditions as possible influences on quitting interest or attempts (Garey et al., 2019; Jankowski et al., 2019). These studies have not addressed factors like device use or device characteristics. These may be relevant directly, as device type or nicotine strength can impact nicotine delivery, or indirectly, as factors like device cost, complexity, or frequency of use may be proxies for personal buy-in or interest in e-cigarettes. The purpose

of this study is to explore e-cigarette quitting behaviors as they relate to e-cigarette device characteristics and use behaviors in a longitudinal cohort of exclusive, long-term e-cigarette users. Specifically, this study describes e-cigarette and cigarette use status at baseline and follow-up (2.4 years later), investigates behaviors and device characteristics associated with intending to quit e-cigarettes, trying to quit e-cigarettes, and quitting e-cigarettes, as well as qualitatively describing e-cigarette quitting methods reported by users.

## 2.0 Methods

### 2.1 Sample

Participants in this study are part of a longitudinal cohort of e-cigarette users. This cohort was originally surveyed from 2012 to 2015 using a 158-item survey (wave 1). Participants were recruited using a link posted on websites such as [e-cigarette-forum.com](http://e-cigarette-forum.com), [webmd.com](http://webmd.com) and the NJOY website. Participants were asked about their e-cigarette use, device characteristics (device type, atomizer details, and cost), and related behaviors. At the end of the wave 1 survey, participants could provide contact information if they were interested in participating in future research. Of the 6493 participants who completed the survey, 1863 (28.7%) were interested in future research and provided contact information. Further details about the wave 1 survey are described elsewhere (Foulds et al., 2015, Yingst et al., 2015).

In January 2017 (wave 2) and June 2019 (wave 3), attempts were made to re-contact the 1863 wave 1 participants who provided contact information (follow-up period ~2.4 years between wave 2 and 3). Both the wave 2 and wave 3 surveys used the following procedure. Email invitations with unique links to the online survey were sent up to 4 times. The invitations stated that current e-cigarette use was not required to complete the survey. Telephone call reminders were also attempted. Further details about the wave 2 survey are described elsewhere (Yingst, Foulds, Veldheer, & Du, 2019). Wave 3 survey invitations used updated contact information from wave 2. Of the 1863 who consented to being re-contacted, 649 (34.8%) participated in the wave 2 survey, 573 (30.8%) participated in the wave 3 survey, and 425 (22.8%) participated in both wave 2 and 3.

The present study included only participants who were exclusive e-cigarette users at wave 2 who answered the question about quitting interest at wave 2, and who answered all relevant questions about e-cigarettes, smoking, and quit attempts at wave 3. Of the 425 who responded to both surveys, 221 (52.0%) met these inclusion criteria (Supplementary Table 1). These criteria allowed us to consider only baseline exclusive e-cigarette users and to have data on e-cigarette and smoking statuses at follow-up, with accompanying data involving e-cigarette quitting behaviors.

Data from wave 2 and wave 3 were used in this study, as wave 1 was limited in that it did not ask certain questions, such as number of devices used per day and device purchase location, which were of interest. For this study, wave 2 data will be considered “baseline” data and wave 3 data will be considered “follow-up” data. All three survey studies were approved by Penn State College of Medicine Institutional Review Board.

## 2.2 Measures

Participants answered questions about their demographics, e-cigarette use, e-cigarette device, and other tobacco product use at baseline and follow-up (Supplementary Table 2). Baseline demographics are reported (Table 1). The Penn State Electronic Cigarette Dependence Index (PSECDI) was used as a measure of nicotine dependence. PSECDI scores range from 0 to 20, with a low score indicating less nicotine dependence and a high score indicating more nicotine dependence (0–3 = not dependent, 4–8 = low dependence, 9–12 = medium dependence, and 13+ = high dependence) (Foulds et al., 2015).

Participants at baseline were categorized as intending or not intending to quit using e-cigarettes by their response to the question, “Are you planning to continue using your e-cig for at least the next year, or quit within that time frame?” Response options included “I’ll quit the e-cig within a year,” “I plan to continue using the e-cig,” and “Don’t Know.” Those who answered “I plan to continue using the e-cig” or “Don’t Know” were categorized as not intending to quit.

Current e-cigarette use was defined as any e-cigarette use in the past 7 days. Current cigarette smoking was defined as any cigarette smoking in the past 7 days. Those who reported no current e-cigarette or cigarette use at follow-up were considered stoppers. Those who reported current e-cigarette use but no current cigarette smoking at follow-up were considered continuers. Those who reported using e-cigarettes and smoking cigarettes at follow-up were considered dual users. Those who reported current cigarette smoking but no current e-cigarette use at follow-up were considered exclusive smokers.

Attempts to quit e-cigarettes at follow-up were assessed via the question, “Have you ever tried to quit using your e-cig?” Participants who tried to quit using e-cigarettes at follow-up were asked to respond to the open-ended question “What methods did you use when you tried to quit using your e-cig?”

Study data were collected and managed using REDCap electronic data capture tools hosted at Penn State Milton S. Hershey Medical Center and College of Medicine. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies (Harris et al., 2009).

## 2.3 Data analysis

Data was analyzed using SAS 9.4. Means and frequencies were used to describe basic demographics, e-cigarette usage, and smoking status of participants. A figure was created to illustrate follow-up smoking and e-cigarette use status for those who intended and did not intend to quit using their e-cigarette at baseline. To evaluate interest in quitting at baseline, chi-square analysis and independent t-tests were used to describe differences in behavior and device characteristics reported between those who intended and did not intend to quit e-cigarettes at baseline. Then, a stepwise logistic regression model predicting intent to quit at baseline was used to determine which device or behavioral characteristics significantly impacted intent to quit. To evaluate past quit attempts and e-cigarette quitting at follow-up, chi-square analysis and independent t-tests were used to describe differences in behavior and device characteristics reported at baseline between those who did and those who did

not try to quit e-cigarettes at follow-up, as well as differences between those who did and those who did not quit e-cigarettes at follow-up. Stepwise logistic regression models predicting ever trying to quit at follow-up and quitting e-cigarettes at follow-up were also used to determine which device or behavioral characteristics significantly impacted ever trying to quit and quitting e-cigarettes. Each of the stepwise logistic regression models initially included most of the 2017 baseline characteristics (Table 2), while the final models included only variables that related to the outcome with a  $p$ -value $<0.1$ . To describe users' e-cigarette quitting methods, qualitative free-text responses were given descriptive labels by two independent evaluators (ES and JY). Descriptive labels were compared between the evaluators and discussed until agreement was reached for all responses.

## 3.0 Results

### 3.1 Demographics and e-cigarette use

General baseline demographics and e-cigarette use behaviors are reported in Table 1. Notably, the sample had used e-cigarettes for an average of 5.6 years, 83.7% were using “mod” devices, with an average cost of \$90. This suggests that this sample may be more immersed in e-cigarette culture and possibly more affluent than average e-cigarette users.

### 3.2 Intention to quit e-cigarettes at baseline and follow-up tobacco use status

Of the long-term exclusive e-cigarette users ( $n=221$ ) at baseline, the majority of participants intended to continue using their e-cigarette ( $n=205$ , 92.8%), while few intended to quit using their e-cigarette ( $n=16$ , 7.2%). Bivariate analysis of differences in behavior and device characteristics reported at baseline for those who did and did not intend to quit is reported in Table 2. Those who intended to quit were less likely to have used another e-cigarette device in the past, used a fewer number of e-cigarette devices in the past, and were more likely to use to avoid cravings for tobacco, avoid withdrawal symptoms, or because they cannot stop use (all  $p<.05$ ). However, these significant differences did not remain when controlling for all relevant variables using a stepwise logistic regression model predicting intent to quit.

Of the 16 participants who reported intention to quit e-cigarettes at baseline, 14 continued to use e-cigarettes at follow-up (87.5%), while 2 quit using e-cigarettes (12.5%). Only one participant who intended to quit e-cigarettes at baseline started smoking cigarettes at follow-up (6.3%). Of the 205 participants who did not intend to quit e-cigarettes at baseline, 190 continued to use e-cigarettes by follow-up (92.7%), while 15 quit using e-cigarettes and reported no cigarette smoking (7.3%). Only 7 participants not intending to quit e-cigarette use reported smoking cigarettes at follow-up as dual users (3.4%). (Figure 1)

### 3.3 Quit attempts at follow-up

By follow-up, roughly a quarter of the long-term exclusive e-cigarette users in this study reported trying to quit e-cigarette use overall ( $n=57$ , 25.8%). Of those who intended to quit at baseline ( $n=16$ ), about half had tried to quit at follow-up ( $n=9$ , 56.3%), while about a quarter of those not interested in quitting at baseline ( $n=205$ ) reported trying to quit at follow-up ( $n=48$ , 23.4%).

Bivariate analysis of differences in behavior and device characteristics reported at baseline for participants who did and did not try to quit using e-cigarettes at follow-up is reported in Table 2. Those who attempted to quit were less likely to use a tank atomizer, were less likely to use e-cigarettes because they are less harmful than cigarettes, and were more likely to intend to quit e-cigarettes at baseline, compared with those who did not attempt to quit (all  $p < .05$ ). Stepwise logistic regression determined that attempting to quit was associated with intending to quit at baseline and using a drip-fed atomizer (Table 2).

### 3.4 Quitting at follow-up

At follow-up, 17 (7.7%) participants reported quitting e-cigarettes without initiating cigarette smoking. The majority ( $n=204$ , 92.3%) continued e-cigarette use. Bivariate analysis of differences in behavior and device characteristics reported at baseline for participants who did and did not quit using e-cigarettes at follow-up is reported in Table 2. Those who quit were less likely to be ever cigarette smokers ( $p < .01$ ) compared to those who did not quit. Those who quit were also younger, had a lower PSECDI score, were more likely to use a drip-fed atomizer, used a lower nicotine concentration, used fewer devices in a normal day, used fewer e-liquid flavors in the past, used their e-cigarette fewer times per day, and were more likely to use e-cigarettes to reduce, quit, or prevent a relapse of tobacco use (all  $p < .05$ ). Stepwise logistic regression determined that predictors of quitting e-cigarette use included no previous cigarette smoking, having a lower PSECDI score, and reporting a fewer number of devices used per day (Table 2). Those who quit reported their reason for quitting as “just experimenting” ( $n=13$ , 76.5%), “concerned about health risks” ( $n=2$ , 11.8%), and “using an e-cig didn’t feel like smoking cigarettes” ( $n=1$ , 5.9%), with one non-response (5.9%).

### 3.5 Quitting methods

Of those who had tried to quit e-cigarettes ( $n=57$ ), 55 provided a free-text response describing their quitting methods. Seven of these responses were excluded because the response described how to use e-cigarettes to quit smoking cigarettes, leaving 48 responses for analysis. Some participants mentioned multiple methods in their response. Many participants tried to quit using e-cigarettes “cold turkey,” which is abrupt and complete cessation from e-cigarette use (26 mentions). One participant said, “[I] just quit. [I] just wanted to see how tough [quitting] was, not because I needed to quit using it. Turns out it is really easy to quit using ecigs. I just choose to use it.” Another common strategy was to taper the nicotine concentration of their e-liquid (15 mentions). As one participant described, “I reduced nicotine content in my e-liquid as I increased vapor production. Eventually I cut from 1mg/ml to 0.5 mg/ml. After a month at that level, I mixed up the rest of my ingredients into a non-nicotine bearing e-liquid, and vaped that for a few weeks. Then I put it down and haven’t looked back.” Another participant said, “I decrease[d] the dosage to 0 nicotine then just stopped it altogether in a matter of a few weeks.” Other participants reported using nicotine replacement products to help them quit e-cigarettes, citing use of nicotine gum (4 mentions), patches (5 mentions), or lozenges (2 mentions). Other strategies included using smoking cessation medication (3 mentions) and reducing frequency of e-cigarette use (3 mentions). (Table 3)

## 4.0 Discussion

The majority of the long-term exclusive e-cigarette users involved in this study were not interested in quitting e-cigarettes at baseline in 2017 (92.8%). Our findings agree with most studies evaluating e-cigarette quitting, including two studies of long-term e-cigarette users (Etter, 2019; Jankowski et al., 2019; Rosen & Steinberg, 2020; Skerry et al., 2018). Our study also demonstrates strong adherence to exclusive e-cigarette use, as even after two years, 88.7% of respondents reported continued exclusive use. This suggests that exclusive e-cigarette users who have been using for a prolonged period of time (i.e. 5.6 years in this sample) are relatively stable with their e-cigarette use. For those who did quit, the majority had not intended to quit at baseline and stated their reason for quitting as “just experimenting,” suggesting that users’ interest may come and go over time, with less direct motivating factors as compared to smokers who quit cigarettes.

We found that ever smoking cigarettes was associated with decreased likelihood of quitting e-cigarette use. This may be due to a lack of interest in quitting, as only 7% of former cigarette smokers in this study reported intending to quit at baseline, with about half of respondents reporting using e-cigarettes because they were less harmful than cigarettes and about a third reporting use as a substitute for cigarettes (Table 2). Previous research has also reported that a common reason for e-cigarette use is a desire to avoid relapsing to cigarettes, so this may be a significant motivator for long-term e-cigarette use (Yong et al., 2019). Additionally, lower PSECDI scores (indicating lower e-cigarette dependence) were associated with increased likelihood of quitting. This parallels the previously established relationship between lower nicotine dependence and greater likelihood of quitting cigarettes (Vangeli et al., 2011).

Use of drip-fed atomizers, in comparison to prefilled cartridges or tank systems, was associated with increased chances of trying to quit e-cigarettes. This could be due to the greater maintenance associated with these devices. Drip-fed atomizers (rebuildable dripping atomizers, RDAs) are atomizers which have an exposed heat source (coil) which is wicked with cotton that needs to be replaced frequently. This increased maintenance requirement may make quitting more appealing. However, the literature regarding drip-fed atomizers is sparse, so further study of this atomizer type would be needed to understand its impact on quitting. Additionally, quitting or trying to quit e-cigarettes may be impacted by personal investment in e-cigarettes, as prior qualitative studies have suggested that some users consider it to be a hobby (Harrell et al., 2019; Pokhrel et al., 2015). In this study, we found that users who did not quit also used significantly more flavors of e-liquid and more devices, possibly indicating greater personal interest in e-cigarettes. These users may not quit because they enjoy the hobby-like aspects of e-cigarettes such as customizing their devices, trying flavors, or trying different devices.

Among those who attempted to quit, 17% mentioned using nicotine replacement therapy (NRT), while 6% mentioned use of an FDA-approved smoking cessation medications. This result is similar to a previous study which reported that approximately 24% of adult established e-cigarette users from a national sample reported use of NRT to quit, while 16% reported use of FDA-approved medications (Rosen & Steinberg, 2020). Currently,

the marketing of NRT and FDA-approved medications are aimed at cigarette smokers (i.e. dosing instructions based on cigarettes per day), so it is unclear how e-cigarette users would translate these instructions to attempt to quit e-cigarettes. More research is needed to understand the potential benefits (and possibly appropriate dosing) of NRT and medications for quitting e-cigarette use.

We also identified that tapering the nicotine concentration of e-liquid was a popular method for quitting e-cigarettes. While, to our knowledge, there are no studies systematically evaluating the effectiveness of tapering for quitting e-cigarettes, one case study and anecdotal evidence on user forums suggest this method may be effective (Sahr et al., 2020; Struik & Yang, 2021). Because of its parallels to tapering used with some nicotine replacement products (e.g. nicotine patches), and limited data suggesting e-cigarette tapering can be used during smoking cessation, future research on the effectiveness of tapering in e-cigarette quitting may be warranted (Hsia et al., 2017; Lee et al., 2018). In addition, as the US Food and Drug Administration (FDA) determines regulatory requirements for e-cigarette products, the availability of varied nicotine strengths and the relationship to quitting should be considered. While e-liquid refills are available at incremental nicotine strengths (i.e. 24, 18, 12, 6, 3, and 0 mg/mL), prefilled pods offered by Juul or NJOY only offer 59 or 35 mg/mL pods, which poses a barrier to concentration tapering (*NJOY ACE PODS*, n.d.; *What Is the Size of a JUULpod*, 2020).

The strength of this study is that it provides insight into long-term exclusive e-cigarette users, a group for which data is currently limited, and provides follow-up on those users. Limitations of this study include self-selection of respondents, which may lean towards those more invested in e-cigarettes. Although survey invitations stated that current e-cigarette use was not required for participation, those who stopped using e-cigarettes or began smoking may have disproportionately stopped responding, possibly skewing follow-up results towards continued exclusive e-cigarette users. Self-selection may have also limited data collection about prior quit attempts, reducing responses involving both successful e-cigarette quitting and unsuccessful quitting resulting in smoking relapse. In addition, because very few participants in our study reported intending to quit or quitting, the sample size for these subgroups is small, leading to variability in the data. Since a large number of survey items were assessed in each model, chances of type 1 error are increased as well. Also, the sample only included baseline exclusive e-cigarette users, so the results of this study are likely not generalizable to long-term dual users, young users, or new users. Finally, pod-based salt nicotine e-cigarettes such as JUUL were not prominent at the time many of the participants began using e-cigarettes. If this survey was repeated with a sample who began using e-cigarettes after 2018, pod device use could be more prevalent and interest in quitting could be different.

## 5.0 Conclusions

The vast majority of long-term exclusive e-cigarette users in this study had little interest in quitting e-cigarettes at baseline (2017) and continued e-cigarette use at follow-up (2019), with few reverting to cigarette smoking, suggesting that exclusive use of e-cigarettes is relatively stable for some long-term users. Over a quarter had tried to quit e-cigarettes at



some point in the past. Some e-cigarette users showed willingness to try NRT, medication, or nicotine tapering during prior quit attempts, so development of effective cessation protocols for users may further facilitate quitting. E-cigarette quitting behaviors were found to be associated with factors like atomizer type, number of devices used, ever smoking cigarettes, e-cigarette dependence, and intention to quit e-cigarettes, factors which should be considered for future study to advise e-cigarette quitting.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## FUNDING:

This work was supported by an internal grant from Penn State Social Science Research Institute (PI: JF). JF and JY are primarily funded by the National Institutes of Health (under award numbers R01 DA048428, U01 DA045517). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Food and Drug Administration.

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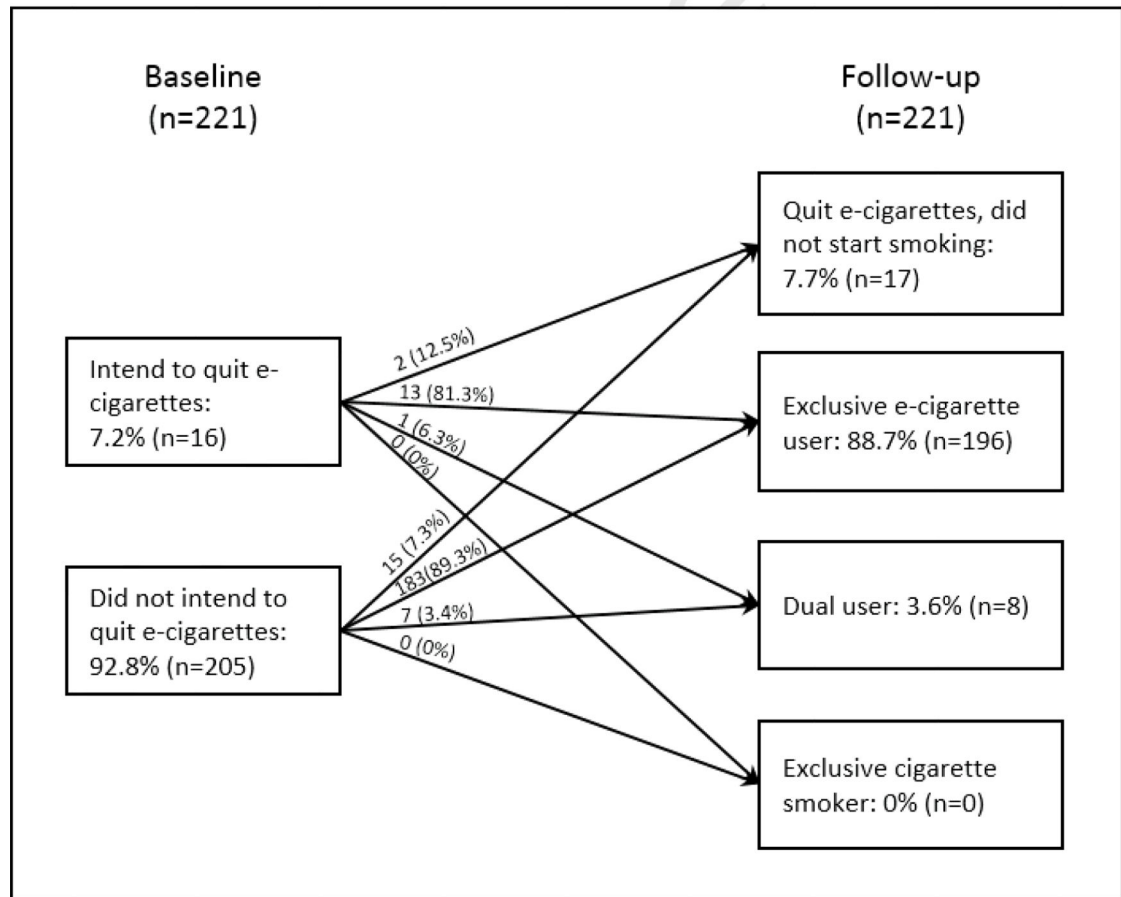
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### Highlights

- Most long-term e-cigarette users were not interested in quitting at baseline (2017)
- Most long-term e-cigarette users continued e-cigarette use at follow-up (2019)
- Few long-term e-cigarette users relapsed to cigarette smoking at follow up (2019)
- About a quarter of long-term e-cigarette users tried to quit in the past
- Participants who tried to quit used a variety of quitting techniques
- E-cigarette quitting behaviors were affected by device and behavioral factors

## Changes in smoking and e-cigarette use status from baseline to follow-up by intention to quit



**Figure 1.**  
Changes in smoking and e-cigarette use status from baseline to follow-up by intention to quit

**Table 1**

General e-cigarette user baseline characteristics and device usage

Survey Item	Baseline Sample (n=221)
% (n) Male	68.8 (152)
Mean age (SD)	45.7 (12.1)
% (n) White	93.2 (206)
% (n) Live in USA	90.1 (199)
% (n) Ever smoked cigarettes *	97.3 (215)
Mean duration of e-cigarette use (in years) (SD) (n=215)	5.6 (3.6)
% (n) used an e-cig in past 7 days	100 (221)
Mean times used per day (SD) **	21.3 (23.4)
% (n) use mod style device	83.7 (185)
% (n) use tank atomizer	83.7 (185)
Mean device cost (in US dollars)(SD)	90.2 (71.3)
Mean nicotine concentration (in mg/ml) (SD) (n=218)	9.1 (10.5)
Mean PSECDI Score (Score 0–20) (SD)	8.6 (3.7)

\* Participants who indicated any cigarette smoking in their lifetime were defined as ever smoking cigarettes.

\*\* Using an e-cigarette one “time” was described as taking around 15 puffs, or using an e-cigarette for around 10 minutes.

**Table 2**

Comparison of e-cigarette user baseline characteristics to quitting intention at baseline, trying to quit at follow-up, and quitting at follow-up

Survey Item	Intended to quit at baseline (n=16)	Did not intend to quit at baseline (n=205)	p-value*	Odds ratio [β] (95% CI) (p-value)**	Tried to quit as of follow-up (n=57)	Did not try to quit as of follow-up (n=164)	p-value*	Odds ratio [β] (95% CI) (p-value)**	Quit as of follow-up (n=17)	Did not quit as of follow-up (n=204)	p-value*	Odds ratio [β] (95% CI) (p-value)**
<b>Demographics</b>												
% (n) Male	75.0 (12)	68.3 (140)	0.5771	-	63.2 (36)	70.7 (116)	0.2878	-	58.8 (10)	69.1 (142)	0.3566	-
Mean age (SD)	42.1 (12.8)	46.0 (12.0)	0.2086	-	43.6 (13.0)	46.5 (11.7)	0.1194	-	40.1 (11.6)	46.2 (12.0)	0.0462	-
% (n) White	87.5 (14)	93.7 (192)	0.3455	-	87.7 (50)	95.1 (156)	0.0556	-	88.2 (15)	93.6 (191)	0.3958	-
% (n) Live in USA	81.3 (13)	90.7 (186)	0.2224	-	94.7 (54)	88.4 (145)	0.1696	-	94.1 (16)	89.7 (183)	0.5594	-
% (n) Ever smoked cigarettes***	93.8 (15)	97.6 (200)	0.3663	-	96.5 (55)	97.6 (160)	0.6686	-	82.4 (14)	98.5 (201)	<0.0001	0.021 [-3.7] (0.002-0.22) {0.0013}
Mean PSECDI Score (Score 0–20) (SD)	8.6 (4.9)	8.6 (3.6)	0.9947	-	8.3 (4.6)	8.7 (3.4)	0.5790	-	6.8 (4.6)	8.7 (3.6)	0.0453	0.81 [-0.21] (0.69–0.95) {0.0105}
<b>Device type</b>												
% (n) Cigalike	6.3 (1)	5.9 (12)	0.9483	-	5.3 (3)	6.1 (10)	0.8176	-	0.0 (0)	6.4 (13)	-	-
% (n) Advanced	0.0 (0)	7.8 (16)	-	-	10.5 (6)	6.1 (10)	0.2664	-	17.7 (3)	6.4 (13)	0.0848	-
% (n) Mod	93.8 (15)	82.9 (170)	0.2588	-	80.7 (46)	84.8 (139)	0.4752	-	82.4 (14)	83.8 (171)	0.8746	-
% (n) Misc.	0.0 (0)	3.4 (7)	-	-	3.5 (2)	3.1 (5)	0.8644	-	0.0 (0)	3.4 (7)	-	-
<b>Atomizer and Nicotine Use</b>												
% (n) Use prefilled cartridges/cartomizers	6.3 (1)	3.9 (8)	0.6473	-	5.3 (3)	3.7 (6)	0.5975	-	0.0 (0)	4.4 (9)	-	-
% (n) Use a tank system	93.8 (15)	82.9 (170)	0.2588	-	75.4 (43)	86.6 (142)	0.0496	-	70.6 (12)	84.8 (173)	0.1273	-
% (n) Use a drip-fed system	0.0 (0)	13.2 (27)	-	-	19.3 (11)	9.8 (16)	0.0581	2.7 [1.0] (1.2–6.4) {0.0219}	29.4 (5)	10.8 (22)	0.0242	-
% (n) Use a sub ohm tank	68.8 (11)	51.7 (106)	0.1884	-	43.9 (25)	56.1 (92)	0.1108	-	41.2 (7)	53.9 (110)	0.3118	-

Survey Item	Intended to quit at baseline (n=16)	Did not intend to quit at baseline (n=205)	p-value*	Odds ratio [β] (95% CI) (p-value)**	Tried to quit as of follow-up (n=57)	Did not try to quit as of follow-up (n=164)	p-value*	Odds ratio [β] (95% CI) (p-value)**	Quit as of follow-up (n=17)	Did not quit as of follow-up (n=204)	p-value*	Odds ratio [β] (95% CI) (p-value)**
Mean nicotine concentration (in mg/ml) (SD) (n=218)	6.6 (8.7)	9.3 (10.6)	0.3228	-	8.4 (14.1)	9.3 (9.0)	0.6528	-	5.9 (5.2)	9.3 (10.8)	0.0247	-
% (n) Use > 1 nicotine concentration regularly	6.3 (1)	15.1 (31)	0.3314	-	17.5 (10)	13.4 (22)	0.4454	-	17.7 (3)	14.2 (29)	0.6993	-
<b>Device Cost</b>												
% (n) Cost of device > \$50	56.3 (9)	70.2 (144)	0.2428	-	70.2 (40)	68.9 (113)	0.8576	-	58.8 (10)	70.1 (143)	0.3332	-
Mean cost of device (in USD) (SD)	74.7 (57.9)	91.4 (72.4)	0.3690	-	96.3 (77.9)	88.0 (69.2)	0.4515	-	70.5 (55.3)	91.8 (72.5)	0.2387	-
<b>Purchase Location</b>												
% (n) Purchased online	56.3 (9)	62.4 (128)	0.6233	-	63.2 (36)	61.6 (101)	0.8331	-	58.8 (10)	62.3 (127)	0.7795	-
% (n) Purchased at a vape shop	43.8 (7)	35.1 (72)	0.4880	-	35.1 (20)	36.0 (59)	0.9041	-	41.2 (7)	35.3 (72)	0.6268	-
% (n) Purchased from some other source	0.0 (0)	2.4 (5)	-	-	1.8 (1)	2.4 (4)	0.7646	-	0.0 (0)	2.5 (5)	-	-
<b>Device History and E-Liquid Flavor</b>												
Mean number of devices used in a normal day (SD)	1.4 (0.6)	1.6 (1.0)	0.2808	-	1.6 (1.1)	1.6 (1.0)	0.6449	-	1.1 (0.6)	1.7 (1.0)	0.0192	0.15 [-1.9] (0.033-0.69) (0.0146)
% (n) Have used another device in the past	87.5 (14)	98.1 (201)	0.0124	-	96.5 (55)	97.6 (160)	0.6686	-	100 (17)	97.1 (198)	0.4734	-
Mean number of devices used in the past (SD) (n=215)	6.1 (4.3)	11.5 (15.2)	0.0015	-	8.8 (11.3)	12.0 (15.7)	0.1052	-	7.2 (7.7)	11.5 (15.2)	0.0565	-
% (n) Preferred e-liquid flavor is tobacco or menthol	18.8 (3)	33.2 (68)	0.2342	-	24.7 (14)	34.8 (57)	0.1556	-	17.7 (3)	33.3 (68)	0.1833	-
Mean number of e-liquid flavors ever used (SD)	24.5 (37.8)	32.6 (40.9)	0.4415	-	26.0 (34.9)	34.2 (42.3)	0.1874	-	18.8 (16.2)	33.2 (41.9)	0.0056	-
<b>Reasons for Using E-Cigarettes</b>												
% (n) Use because they think they are less	37.5 (6)	49.3 (101)	0.3643	-	35.1 (20)	53.1 (87)	0.0194	-	29.4 (5)	50.0 (102)	0.1027	-



Survey Item	Intended to quit at baseline (n=16)	Did not intend to quit at baseline (n=205)	p-value*	Odds ratio [β] (95% CI) (p-value)**	Tried to quit as of follow-up (n=57)	Did not try to quit as of follow-up (n=164)	p-value*	Odds ratio [β] (95% CI) (p-value)**	Quit as of follow-up (n=17)	Did not quit as of follow-up (n=204)	p-value*	Odds ratio [β] (95% CI) (p-value)**
harmful compared to tobacco												
% (n) Use because e-cigs are more pleasant or convenient for self or others	6.3 (1)	5.9 (12)	0.9483	-	8.8 (5)	4.9 (8)	0.2818	-	11.8 (2)	5.4 (11)	0.2833	-
% (n) use to reduce, quit, or prevent relapse of tobacco use	31.3 (5)	36.1 (74)	0.6968	-	40.4 (23)	34.2 (56)	0.3998	-	58.8 (10)	33.8 (69)	0.0388	-
% (n) use to avoid cravings, withdraw, or can't stop use	18.8 (3)	4.4 (9)	0.0146	-	8.8 (5)	4.3 (7)	0.1962	-	0.0 (0)	5.9 (12)	-	-
% (n) use because e-cigs cost less than smoking	0.0 (0)	2.0 (4)	-	-	0.0 (0)	2.4 (4)	-	-	0.0 (0)	2.0 (4)	-	-
% (n) Use for some other reason	6.3 (1)	2.4 (5)	0.3663	-	7.0 (4)	1.2 (2)	0.0203	-	0.0 (0)	2.9 (6)	-	-
<b>Other Perceptions and Behaviors</b>												
Mean e-cig addictiveness perception (Score 1–5) (SD) ****	2.6 (1.4)	2.6 (1.3)	0.9450	-	2.6 (1.4)	2.6 (1.2)	0.9739	-	2.6 (1.5)	2.6 (1.3)	0.8313	-
Mean times used per day *****	14.5 (13.3)	21.8 (23.9)	0.0620	-	16.6 (11.6)	22.9 (26.1)	0.0791	-	13.8 (9.4)	21.9 (24.1)	0.0066	-
Mean time until first puff after waking in the morning (minutes) (SD)	31.9 (29.2)	37.5 (59.6)	0.5130	-	49.8 (64.7)	32.6 (55.0)	0.0545	-	97.1 (147.8)	32.0 (39.9)	0.0891	-
% (n) intended to quit e-cigs at baseline	-	-	-	-	15.8 (9)	4.3 (7)	0.0038	5.3 [1.7] (1.7–16.1) {0.0037}	11.8 (2)	6.9 (14)	0.4537	-

\* p-values were calculated from bivariate analysis using chi square analysis or independent t-tests, where appropriate. Chi square analyses with a cell value of 0 were invalid, thus p-values were reported as “.”.

\*\* Odds ratios, β, 95% CI, and p-values were the result of stepwise logistic regression models predicting which survey items significantly impacted intent to quit e-cigarettes at baseline, ever trying to quit e-cigarettes at follow-up, and quitting e-cigarettes at follow-up, with survey items not identified as significant reported as “.”.

\*\*\* Participants who indicated any cigarette smoking in their lifetime were defined as ever smoking cigarettes.

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E-cig addictiveness perception scoring: Participants were asked if non-tobacco users who tried e-cigs would be likely to become addicted e-cigs. Numerical values were assigned as follows: Very Unlikely = 1, Somewhat unlikely = 2, Neither likely nor unlikely = 3, Somewhat likely = 4, Very likely = 5.

\*\*\*\*\*  
Using an e-cigarette one "time" was described as taking around 15 puffs, or using an e-cigarette for around 10 minutes.

**Table 3**

User reported e-cigarette quitting methods, categorized by theme

E-cigarette Quitting Theme	Mention Count*
Cold Turkey	26
Taper or Reduce Nicotine Concentration of E-liquid	15
Reduced Frequency of E-cigarette Use	3
Nicotine Replacement Therapy	
<i>Patch</i>	5
<i>Gum</i>	4
<i>Lozenge</i>	2
<i>Unspecified NRT</i>	1
Total	12
Medications	
<i>Chantix</i>	1
<i>Unspecified Medication</i>	2
Total	3
Misc.	
<i>"Nothing"</i>	2
<i>"Switched to snus"</i>	1
Total	3

\* Some respondents mentioned multiple quitting themes in their responses. Each mention was counted, allowing for multiple mentions from the same respondent. (Total respondents: 48. Total mention count: 62.)