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Use of E-Cigarettes Among Current Smokers: Associations Among Reasons for Use, Quit Intentions, and Current Tobacco Use

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Abstract

Introduction: Research has documented growing availability and use of e-cigarettes in the United States over the last decade.

Methods: We conducted a national panel survey of current adult cigarette smokers to assess attitudes, beliefs, and behaviors relating to e-cigarette use in the United States ($N = 2,254$).

Results: Among current cigarette smokers, 20.4% reported current use of e-cigarettes on some days and 3.7% reported daily use. Reported reasons for e-cigarette use included: quit smoking (58.4%), reduce smoking (57.9%), and reduce health risks (51.9%). No significant differences in sociodemographic characteristics between e-cigarette users and nonusers were observed. Prior quit attempts were reported more frequently among e-cigarette users (82.8%) than nonusers (74.0%). Intention to quit was reported more frequently among e-cigarette users (64.7%) than nonusers (46.8%). Smokers intending to quit were more likely to be e-cigarette users than those not intending to quit (odds ratio [OR] = 1.90, CI =1.36–2.65). Those who used e-cigarettes to try to quit smoking (OR = 2.25, CI = 1.25–4.05), reduce stress (OR = 3.66, CI = 1.11–12.09), or because they cost less (OR = 3.42, CI = 1.64–7.13) were more likely to report decreases in cigarette smoking than those who did not indicate these reasons. Smokers who reported using e-cigarettes to quit smoking (OR = 16.25, CI = 8.32–31.74) or reduce stress (OR = 4.30, CI = 1.32–14.09) were significantly more likely to report an intention to quit than those who did not indicate those reasons for using e-cigarettes.

Conclusions: Nearly a quarter of smokers in our study reported e-cigarettes use, primarily motivated by intentions to quit or reduce smoking. These findings identify a clinical and public health opportunity to re-engage smokers in cessation efforts.

Introduction

Despite considerable declines in the prevalence of smoking among U.S. adults since the mid-1960s, 18.1 % of adults are current cigarette smokers.[1] Cigarette smoking remains the most frequent cause of preventable morbidity, mortality, and excess healthcare costs in the United States.[2] Although quitting smoking significantly reduces the risk of smoking-related illnesses, and 68.8% of current adult

cigarette smokers in the United States want to stop smoking, only 42.7% of smokers have attempted to quit smoking cigarettes.[3]

Electronic nicotine delivery devices, commonly known as "e-cigarettes," have become increasingly popular in several countries and over the last several years, research has documented growing availability, marketing, and use of e-cigarettes in the United States.[4–13] A consistent finding from this emerging and quickly evolving area

of research is that current and former smokers are more likely to be aware of and use e-cigarettes than nonsmokers.[5–7] E-cigarette users generally endorse beliefs that e-cigarettes are healthier than regular cigarettes, can help them reduce or quit smoking and alleviate cravings and withdrawal from regular cigarettes.[4,7,14–16] Unlike conventional cigarettes, those who use e-cigarettes are more likely to be White, higher educated, and have higher income; consistent with targeted marketing towards these groups.[5,12] However, e-cigarette use has not been shown to be associated with long term quitting [4,16–18] and intentions to quit and quit attempts have not been consistently shown to be associated with e-cigarette use.[6,19] In a randomized controlled trial comparing one brand of e-cigarette both with and without nicotine to medicinal nicotine patch, the e-cigarette users were no more likely to quit at 6 months than nicotine patch users.[20] Another randomized controlled trial comparing use of an e-cigarette model containing two different strengths of nicotine to a no-nicotine model to asses smoking reduction and abstinence among current smokers demonstrated reductions in smoking and smoking abstinence with use of both nicotine and non-nicotine e-cigarettes.[21]

To enable timely tracking of this rapidly evolving landscape and advance our understanding of current smokers' use of e-cigarettes as a means to smoking reduction, we developed a national survey to assess current attitudes, beliefs, and behaviors relating to e-cigarette use among current cigarette smokers in the United States. We assessed differences between e-cigarette users and nonusers in sociodemographic characteristics and smoking-related behaviors and intentions among current smokers. Our analyses also examined reasons for use of e-cigarettes and associations with intentions to quit and impact on current tobacco use.

Methods

Survey Design and Implementation

Data for our analyses were collected through a probability-based, web-enabled panel survey developed by the authors and implemented by GfK (formerly Knowledge Networks). The sample was drawn from GfK's Knowledge Panel which includes approximately 55,000 non-institutionalized adults aged 18 and older who were recruited to the panel through the use of an address-based frame supplemented by a random digit dial sampling frame.[22] Panel members must complete a profile survey to be included in the panel. This survey asks a series of demographic questions to inform a profile for each panel member that enables selection of subpopulations, such as smokers, for recruitment.

Our survey was fielded in April and May, 2014. A total of 4,814 panel members profiled as current smokers were identified and invited to participate. A total of 2,663 completed the survey resulting in a completion rate of 55.3%. Many of the survey items were taken from prior surveys and were cognitively tested as part of these prior efforts. The survey was also pilot tested to ensure respondents were able to understand and complete the survey. Further details on GfK's empanelment method, sampling design and methodology have been previously published.[22]

Measures

Sociodemographic Measures

The following sociodemographic variables, obtained from the GfK demographic profile data, were included in our analyses: age, education, race/ethnicity, sex, income, urban/rural status, and employment status.

Current Tobacco Use

Upon agreeing to participate in the survey, respondents from GfK's panel of respondents profiled as smokers were asked about their smoking behavior to confirm their current smoking status with the following survey items: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you now smoke cigarettes every day, some days, or not at all?" Respondents who indicated that they had not smoked 100 cigarettes during their life ($n = 22$), those who responded that they smoke cigarettes "not at all" ($n = 252$), and those who refused to answer either question ($n = 3$ and $n = 12$, respectively), were excluded from our analyses.

Current E-Cigarette Use and Reasons for Use

Current e-cigarette use was assessed with the following item: "Do you now use e-cigarettes (e.g., BluCig, NJoy, V2, Red Dragon, etc.)?" Response options included "Every day," "Some days," and "Not at all." A picture of three different e-cigarettes was included in the survey with text describing how e-cigarettes work, offering alternative names of e-cigarettes, and describing specific brands of e-cigarettes. Respondents who indicated using e-cigarettes were asked "What are the reasons you now use e-cigarettes?" The following yes/no response options were provided to respondents: "A way to reduce the health risks of smoking"; "To try to quit smoking cigarettes"; "As a way of cutting down the number of cigarettes that I smoke"; "Because I find the flavors appealing"; "Not as strong/less nicotine/lighter/no tar"; "Habit/addicted"; "Out of curiosity"; "Stress/relax/nerves"; "That's what I've always smoked/what I like"; "Cost/cheaper than cigarettes"; "Because I can use them in places where I can't smoke cigarettes (e.g., indoors)"; and "Because they are less harmful to use around family/friends/children than cigarettes."

Cessation History, Intention to Quit Smoking, and Impact of E-Cigarette Use on Cigarette Use

Prior smoking cessation attempts were assessed with the item: "Have you tried to quit smoking in the past?" Intention to quit was also assessed: "Are you seriously considering quitting smoking cigarettes or cigars in the next six months?" Respondents who reported using e-cigarettes were also asked "Now that you are using e-cigarettes, do you smoke…fewer cigarettes; about the same number of cigarettes; more cigarettes; no cigarettes at all; or I did not smoke cigarettes before e-cigarettes."

Data Analysis

Demographic characteristics and smoking behaviors were compared between e-cigarette users ($n = 582$; including "everyday" and "some days" use) and nonusers ($n = 1,672$). To ascertain the reasons for use of e-cigarettes, additional analyses were limited to e-cigarette users only. Associations between e-cigarette use reasons and the following outcomes were assessed: intention to quit smoking cigarettes during the next 6 months, impact of e-cigarette use on current smoking and whether e-cigarettes were used every day or only some days. All data were weighted to be nationally representative and to correct for biases introduced through noncoverage, nonresponse, and panel attrition. Due to the complex nature of the survey data, variance was estimated using the Taylor series method.[23] Differences between categorical variables were tested using the Rao-Scott chi-square test which is a design-adjusted version of the Pearson chi-square appropriate to sample data.[24] Logistic regression models, weighted to account for deviations from a pure equal probability sample design, sampling and non-sampling error, sample design and nonresponse,

were used to assess the following: (a) independent associations of smoking behaviors and intentions with e-cigarette use among all smokers; (b) independent associations of reasons for use of e-cigarettes with intentions to quit smoking cigarettes among e-cigarette users; and (c) independent associations of reasons for use of e-cigarettes with impact of use of e-cigarettes on current cigarette smoking among e-cigarette users. Only variables that were statistically significant at the bivariate level were entered into the final models. In all instances, *p* values <.05 were considered statistically significant. All analyses were conducted using SAS version 9.3 (SAS Institute Inc.).

Results

Sociodemographic Characteristics by E-Cigarette Use

Weighted estimates for the sociodemographic characteristics of the total sample and for e-cigarette users and nonusers are summarized in Table 1. No significant differences in sociodemographic characteristics were observed between e-cigarette users and nonusers (Table 1). Among our sample of current smokers, 24.1% reported

current e-cigarette use, with 20.4% indicating use on some days and 3.7% indicating everyday use.

Current Tobacco Use, Prior Quit Attempts, and Intention to Quit

Table 2 summarizes weighted estimates of smoking behavior for the total sample and by e-cigarette use among smokers. The majority of smokers reported smoking regular flavor cigarettes every day within 30 min of waking. No significant differences in type of cigarette smoked (i.e., menthol, regular flavor), smoking frequency, and time to smoking after waking were observed between smokers who also smoked e-cigarettes and those who do not. Over three-quarters of smokers indicated that they had previously tried quitting smoking and just over half reported an intention to quit within 6 months. Prior quit attempts were reported more frequently among e-cigarette users than among nonusers. Intention to quit within 6 months was also reported more frequently among e-cigarette users compared to nonusers.

To assess independent associations of smoking behaviors and intentions with use of e-cigarettes, we entered those variables that

Table 1. Weighted[a] Estimates of Sociodemographic Characteristics for the Total Sample and by E-Cigarette Use Among Smokers (*N* = 2,254)

	Total *N* (%)	E-cigarette user *n* (%)	Non-e-cigarette user *n* (%)	*p* value[b]
	2,254	582 (24.1)	1,672 (75.9)	
Age in years				.62
18–29	225 (17.9)	69 (19.6)	156 (17.3)	
30–44	380 (28.5)	101 (25.1)	279 (29.6)	
45–59	898 (33.9)	232 (34.1)	666 (33.8)	
60+	751 (19.8)	180 (21.2)	571 (19.3)	
Sex				.37
Male	910 (49.6)	209 (46.8)	701 (50.5)	
Female	1,344 (50.4)	373 (53.2)	971 (49.5)	
Race/ethnicity				.08
White, non-Hispanic	1,819 (68.6)	491 (73.7)	1,328 (67.0)	
Multiracial/other, non-Hispanic	129 (6.5)	39 (8.7)	90 (5.8)	
Hispanic	124 (10.6)	26 (8.095)	98 (11.4)	
Black, non-Hispanic	182 (14.4)	26 (9.7)	156 (15.8)	
Marital status				.12
Never married	354 (23.7)	83 (19.7)	271 (25.0)	
Married	990 (41.1)	251 (38.8)	739 (41.8)	
Living with partner	258 (11.3)	75 (14.8)	183 (10.2)	
Divorced/widowed/separated	652 (23.9)	173 (26.7)	479 (23.0)	
Education				.79
Less than high school	115 (10.4)	32 (12.2)	83 (9.9)	
High school	563 (46.1)	143 (45.2)	420 (46.4)	
Some college	1,053 (33.1)	278 (32.1)	775 (33.4)	
Bachelor's degree or higher	523 (10.4)	129 (10.5)	394 (10.3)	
Income				.37
<25,000	623 (33.439)	143 (28.4)	480 (35.0)	
25,000–39,999	438 (19.7)	127 (21.3)	311 (19.2)	
40,000–74,999	685 (24.0)	177 (25.1)	508 (23.6)	
>75,000	508 (23.0)	135 (25.2)	373 (22.2)	
Rural/urban status				.95
Rural	403 (21.1)	101 (21.3)	302 (21.1)	
Urban	1,851 (78.9)	481 (78.7)	1,370 (78.9)	
Employment status				.48
Not employed	1,074 (47.7)	266 (45.6)	808 (48.4)	
Employed	1,180 (52.3)	316 (54.4)	864 (51.6)	

Note. [a]*N* is unweighted, % is weighted; *p* value from Rao-Scott chi-square.
[b]*p* values from Rao-Scott chi-square test.

Table 2. Weighted[a] Estimates of Smoking Behavior for the Total Sample and by E-Cigarette Use Among Smokers (*N* = 2,254)

	Total N (%)	E-cigarette user *n* (%)	Non-e-cigarette user *n* (%)	*p* value[b]
Smoking frequency				.21
Some days	410 (19.8)	98 (23.1)	312 (18.8)	
Every day	1,844 (80.2)	484 (76.9)	1,360 (81.2)	
Time to smoke after waking				.82
Within 5 min	398 (19.2)	115 (18.7)	283 (19.4)	
6–30 min	978 (41.2)	265 (43.1)	713 (40.5)	
31–60 min	405 (17.0)	103 (17.4)	302 (16.9)	
After 60 min	454 (21.9)	96 (20.5)	358 (22.3)	
Refused	19 (0.7)	3 (0.3)	16 (0.9)	
Type of cigarette smoked[c]				.14
Regular flavor	1,484 (61.9)	387 (65.9)	1,097 (60.7)	
Menthol	689 (34.6)	170 (31.4)	519 (35.5)	
Other	34 (1.3)	11 (1.8)	23 (1.2)	
No usual type	37 (2.2)	11 (0.9)	26 (2.6)	
Prior quit attempts[d]				.01
Yes	1,790 (76.1)	503 (82.8)	1,287 (74.0)	
No	457 (23.9)	77 (17.2)	380 (26.0)	
Intention to quit within next 6 months[e]				<.001
Yes	1,239 (51.1)	377 (64.7)	862 (46.8)	
No	1,001 (48.9)	202 (35.3)	799 (53.2)	

Note. [a]*N* is unweighted, % is weighted.
[b]*p* values from Rao-Scott chi-square test.
[c]Refusals omitted (*n* = 10).
[d]Refusals omitted (*n* = 7).
[e]Refusals omitted (*n* = 14).

were significantly associated with e-cigarette use in the bivariate analyses (current smoking, past quit attempts, and intention to quit) into a logistic regression model. In the multivariable model, only intention to quit remained significantly associated with e-cigarette use, where smokers intending to quit within in the next 6 months were significantly more likely (odds ratio [*OR*] = 1.90; CI = 1.36–2.65) to be e-cigarette users than those not intending to quit.

Smoking Reduction and Intention to Quit

E-cigarette users were asked to assess their current level of tobacco smoking given their use of e-cigarettes. The majority reported smoking fewer cigarettes (54.1%) now that they use e-cigarettes while 40.6% reported smoking about the same number of cigarettes and 1.7% reported smoking more cigarettes. We conducted a cross tabulation with chi-square of reported reduction in smoking after e-cigarette initiation and intention to quit which revealed a significant association (χ^2 = 32.39 (1), *p* < .01). Among e-cigarette users who reported an intention to quit smoking cigarettes, 70.3% reported that they had reduced cigarette use since initiating use of e-cigarettes whereas among respondents who did not report an intention to quit, only 32.8% reported that they reduced cigarette use since initiating use of e-cigarettes.

Reason for Use of e-Cigarettes and Smoking Reduction

Smokers who reported using e-cigarettes were asked a series of questions about their reasons for using e-cigarettes. Table 3 summarizes the weighted estimates of reasons for use among the e-cigarette users, by reported impact of use of e-cigarettes on use of regular cigarettes (decreased use/no decrease in use), and by intention to quit smoking cigarettes within 6 months (yes/no). The most frequently reported

reasons for e-cigarette use were to quit smoking, to reduce smoking, to reduce the health risks of smoking, and to enable smoking indoors. E-cigarette users who indicated that they had reduced their use of cigarettes since initiating use of e-cigarettes endorsed the following reasons significantly more frequently than those reporting no decreased use of cigarettes since initiating e-cigarettes: reduce health risks, try to quit smoking, reduce smoking, e-cigarettes not as strong, addicted to e-cigarettes, reduce stress, cost less, and less harmful to others. Those reporting no decrease in cigarette use more frequently endorsed being curious as a reason for e-cigarette use than those reporting a reduction in cigarette use.

The reasons for e-cigarette use that were found to have a significant impact on cigarette use were entered into a multivariable logistic regression (Table 4). E-cigarette users who used e-cigarettes to try to quit smoking (*OR* = 2.25; CI = 1.25–4.05), to reduce stress (*OR* = 3.66; CI = 1.11–12.09), or because they cost less (*OR* = 3.42; CI = 1.64–7.13) were more likely to report a decrease in smoking cigarettes than e-cigarette users who did not endorse those reasons. Smokers reporting using e-cigarettes out of curiosity were less likely to report a decrease in cigarette use (*OR* = 0.25; CI = 0.12–0.51) than those who did not endorse that reason.

Reason for Use of E-Cigarettes and Intention to Quit

We also assessed bivariate associations between reasons for use of e-cigarettes and reported intentions to quit regular cigarettes (Table 3). E-cigarette users who intended to quit smoking within 6 months more frequently endorsed the following reasons than those who were not intending to quit: reduce health risks, try to quit smoking, reduce smoking, reduce stress, cost less, and less harmful to others.

When these significantly associated reasons were entered into a multivariable logistic regression model, only the reasons try to

Table 3. Weighted[a] Estimates of Reasons for E-Cigarette Use by Smoking Reduction Behaviors (N = 579)

Reason for e-cigarette use	Total N (%)	Decreased use of cigarettes[b] n (%)	No decreased use of cigarettes n (%)	p value	Considered quitting n (%)	Did not consider quitting n (%)	p value[c]
Reduce health risks				<.01			<.001
Yes	299 (51.9)	205 (60.6)	93 (41.4)		227 (60.9)	70 (35.8)	
No	283 (48.1)	151 (39.4)	130 (58.6)		150 (39.1)	132 (64.3)	
Try to quit smoking				<.0001			<.001
Yes	353 (58.4)	256 (72.6)	97 (42.1)		302 (79.4)	50 (20.3)	
No	229 (41.6)	100 (27.5)	126 (57.9)		75 (20.7)	152 (79.7)	
Reduce smoking				<.01			<.001
Yes	367 (57.9)	249 (67.2)	116 (46.7)		254 (66.2)	110 (41.8)	
No	215 (42.1)	107 (32.9)	107 (53.3)		123 (33.8)	92 (58.2)	
Appealing flavor				.53			.70
Yes	75 (14.7)	47 (13.0)	27 (16.2)		53 (15.5)	22 (13.4)	
No	507 (85.3)	309 (87.0)	196 (83.8)		324 (84.5)	180 (86.6)	
Not as strong, lighter				<.05			.06
Yes	90 (15.9)	74 (21.6)	16 (9.1)		68 (19.5)	22 (9.7)	
No	492 (84.1)	282 (78.4)	207 (91.09)		309 (80.5)	180 (90.4)	
Addicted to e-cigarettes				<.01			.58
Yes	34 (7.099)	27 (11.2)	7 (1.7)		26 (7.9)	8 (5.5)	
No	548 (93.0)	329 (88.8)	216 (98.3)		351 (92.1)	194 (94.5)	
Curious				<.05			.40
Yes	78 (16.0)	32 (10.8)	45 (22.4)		47 (14.0)	30 (18.9)	
No	504 (84.0)	324 (89.2)	178 (77.6)		330 (86.0)	172 (81.1)	
Stress reduction				<.0001			<.001
Yes	63 (11.9)	47 (18.6)	16 (3.5)		49 (16.2)	14 (4.3)	
No	519 (88.1)	309 (81.4)	207 (96.5)		328 (83.8)	188 (95.7)	
Cost less				<.0001			<.05
Yes	139 (24.5)	106 (36.8)	33 (9.2)		98 (29.2)	41 (16.2)	
No	443 (75.5)	250 (63.3)	190 (90.9)		279 (70.8)	161 (83.8)	
Can smoke indoors				.60			.25
Yes	289 (46.8)	164 (45.7)	123 (49.3)		166 (43.5)	120 (52.1)	
No	293 (53.2)	192 (54.4)	100 (50.7)		211 (56.6)	82 (47.9)	
Less harmful to others				<.001			.01
Yes	192 (32.9)	135 (41.8)	56 (21.1)		136 (38.8)	56 (22.7)	
No	390 (67.1)	221 (58.2)	167 (78.9)		241 (61.2)	146 (77.3)	

Note. [a]N is unweighted, % is weighted.

[b]Refusals, response "I always smoked e-cigarettes" were omitted (n = 3).

[c]p values from Rao–Scott chi-square test.

quit smoking and reduce stress remained significant (Table 4). Smokers who reported using e-cigarettes as a means to quit smoking (OR = 16.25; CI = 8.312–31.74) or to reduce stress (OR = 4.30; CI = 1.32–14.09) were significantly more likely to report an intention to quit than those who did not.

Discussion

Similar to other published studies, we observed that e-cigarette users were more likely to report an intention to quit smoking within 6 months than smokers who did not use e-cigarettes.[7] Our analyses add to the previous research by providing an examination of the reasons for use of e-cigarettes, and the impact of stated reasons on current tobacco use and intentions to quit.[25] Similar to prior research,[4,7,14–16,25,26] we observed that the vast majority of smokers endorsed reasons for e-cigarette use related to quitting and reducing, and reduction in health risks. Results of our multivariable logistic regression analyses point to use of e-cigarettes as a means to quit smoking and to reduce stress as reasons that are independently associated with both intention to quit smoking and reduced use of cigarettes. An additional reason independently associated with reduced

use of cigarettes was the lower cost of e-cigarettes. This finding has potential significance because as the price of cigarettes continues to increase, there will be added motivation to switch to alternative nicotine delivery systems that cost less. This could increase the motivation of smokers to stop using tobacco by a means that is more "satisfying" than currently approved nicotine delivery systems like nicotine gum, patch, lozenge, and spray.

E-cigarette users who reported an intention to quit more frequently reported reducing cigarette use after using e-cigarettes than those who did not indicate an intention to quit. Taken together, this pattern may mean that some current smokers may be using e-cigarettes to reduce smoking with the intent of quitting smoking, or it could mean that some current smokers who are using e-cigarettes to quit are not successful at quitting, but are successful at reducing smoking. Our data are cross-sectional and did not include recent quitters or former smokers, which limits the interpretation of these findings. In depth, qualitative studies and longitudinal studies are needed to fully answer these important research questions.

E-cigarette use has been linked with intentions to quit smoking and prior quit attempts in some studies and not in others.[4,14,18,19,21,25,27–29] Our study adds to the literature by providing

Table 4. Logistic Regression Models Predicting Smoking Fewer Cigarettes Since Starting E-Cigarettes (Model 1) and Intention to Quit Smoking in the Next 6 Months (Model 2) Associated With Reasons for Using e-Cigarettes

Model 1. Odds of smoking fewer cigarettes since starting e-cigarettes

	OR	95% Wald confidence limits	
Reduce health risks	0.85	0.44	1.68
Try to quit smoking	**2.25**	**1.25**	**4.05**
Reduce smoking	1.26	0.66	2.40
Not as strong, lighter	2.30	0.95	5.58
Addicted to e-cigarettes	3.67	0.69	19.47
Curious	0.25	0.12	0.51
Stress reduction	**3.66**	**1.11**	**12.09**
Cost less	**3.42**	**1.64**	**7.13**
Less harmful to others	1.48	0.72	3.03

Model 2. Odds of intending to quit in next 6 months

	OR	95% Wald confidence limits	
Reduce health risks	1.30	0.62	2.73
Try to quit smoking	**16.25**	**8.32**	**31.74**
Reduce smoking	1.05	0.48	2.29
Stress reduction	**4.30**	**1.32**	**14.07**
Cost less	0.49	0.19	1.23
Less harmful to others	1.26	0.59	2.70

Note. OR = odds ratio.

insight on why some smokers actually use e-cigarettes, including reasons such as desire to quit smoking, stress reduction, and to save money, while also assessing the impact of these reasons for e-cigarette use on cigarette reduction.

Although these findings are cross-sectional and do not include cessation outcome data, they contribute additional insights to the debate about whether or not e-cigarette use among smokers may be useful in supporting cessation. The results of our study contribute to our understanding of how reasons for e-cigarette use correlate with reduction behavior and intention to quit among e-cigarette users. This article is the first, to our knowledge, to examine the relationship between reasons for e-cigarette use and intentions to quit and the relationship between reasons for e-cigarette use and cigarette reduction behavior. These analyses show that e-cigarette users who reduced cigarette use after starting e-cigarettes are more likely to report smoking cessation as a reason for use than those who did not reduce cigarette use after starting e-cigarettes. We also found that e-cigarette users who intend to quit within 6 months were more likely to report smoking cessation as a reason for e-cigarette use. These findings highlight the potential utility for counselors and clinicians to see e-cigarette use as an opportunity to discuss cessation and to recognize that reduction may function as an intermediate step towards the ultimate goal of complete cessation, especially among smokers motivated to quit. It is important to note that complete cessation must remain a critical public health goal since sustained dual use of cigarettes and e-cigarettes may confer substantial disease risk in that even low levels of cigarette smoking increases one's risk for cardiovascular disease and lung cancer.[30] Moreover, it is possible that using both products would help to sustain nicotine addiction, which

might deter complete quitting and sustain the cigarette smoking, despite users' intentions to quit.

In sum, our results suggest that a majority of smokers who use e-cigarettes recognize the need to reduce or stop smoking, which reflects an important opportunity to help these smokers quit. A large percentage of smokers reported using e-cigarettes to quit or reduce smoking; this may reflect the unfortunate reality that Food and Drug Administration approved smoking cessation medications are only modestly effective and nicotine replacement products are designed to be non-reinforcing and thus less than optimal as a substitute for smoking.

Limitations

The cross-sectional design of our survey precludes analyses of causal associations and characterization of trends over time. Another potential limitation of the survey data is that it relies on self-reported behaviors rather than objective measures of smoking. However, while some evidence of under-reporting has been documented, self-reported smoking is thought to be generally valid.[31] A related limitation is the blunt measurement of e-cigarette use through self-report, which does not fully capture the frequency or duration of use. Another possible limitation is the overall survey response rate. While the cooperation rate for the survey was 55.8%, this does not take into account the initial screening rate for developing the panel, and therefore is an overestimate of the actual response rate.

Implications and Future Research

A sizable minority of the current smokers in our sample used e-cigarettes, primarily motivated by intentions to quit or reduce smoking. This points to an opportunity for clinical and public health education efforts to clarify the lack of evidence around the impact of use of e-cigarettes on health, and to re-engage smokers in conversations about the dangers of smoking and opportunities for support in cessation efforts.

Future research is encouraged to investigate toxicity and dependence associated with e-cigarette use, and research to contribute to our understanding of initiation and use of e-cigarettes, including transition to use of other tobacco products exclusively or in combination with e-cigarettes. Additional randomized controlled trials are needed to rigorously evaluate e-cigarettes in combination with other therapies as a means to reduce and/or quit smoking. Without the aforementioned research, it is premature to disregard the potential detrimental effects of e-cigarettes as well as the potential impact they may have on cessation.

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Declaration of Interests

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