ADDICTION RESEARCH & THEORY
2015, VOL. 24, NO.1, 80–88
http://dx.doi.org/10.3109/16066359.2015.1077947

Taylor & Francis
Taylor & Francis Group

Views of experienced electronic cigarette users

Raman Baweja[1], Katherine M. Curci[2], Jessica Yingst[3], Susan Veldheer[3], Shari Hrabovsky[3], Stephen J. Wilson[4], Travis T. Nichols[4], Thomas Eissenberg[5], and Jonathan Foulds[3]

[1]Department of Psychiatry, [2]Department of Family and Community Medicine, and [3]Department of Public Health Science, Tobacco Center of Regulatory Science, Penn State College of Medicine, Hershey, PA, USA, [4]Department of Psychology, Pennsylvania State University, University Park, PA, USA, and [5]Department of Psychology, Center for the Study of Tobacco Products, Virginia Commonwealth University, Richmond, VA, USA

ABSTRACT

Background: Awareness and use of electronic cigarettes (e-cigs) has increased significantly in the past five years, but little is known about the experiences, satisfaction, opinions and preferences of e-cigs users. *Method*: 1177 participants completed an online survey about their electronic cigarette preferences, of which 200 were randomly selected for analysis. The data were analyzed using both qualitative and quantitative methods. *Results*: Participants found the design, the ability to customize, and the quality of vapour to be the most important characteristics of the device. Participants thought the most positive aspects of e-cig use were help to quit smoking, improved overall health, and reduced cost. The negative aspects associated with its use were mainly related to side effects, such as dry mouth. When asked to explain how e-cigs were used differently than cigarettes, participants reported puffing more regularly, but taking fewer puffs per session. *Conclusions*: Experienced e-cig users stated that initiating e-cig use helped them to quit or reduce their conventional smoking, which they believe reduced their health risks. In comparison to cigarette smoking, e-cig users reported using their e-cig more times per day, but with fewer puffs at each use time. Users acknowledged that more research is needed to understand the safety and long-term effects of its use. They mentioned dry mouth as a common side effect and common problems with reliability of e-cigs. Understanding these views may help health professionals to assess and assist e-cig users, and in the future, may help regulators to improve quality and reduce risks.

KEYWORDS

Electronic cigarette, experience, survey, smoking, public health, dependence

HISTORY

Received 6 January 2015
Revised 23 July 2015
Accepted 27 July 2015
Published online 28 August 2015

Introduction

Awareness and use of electronic-cigarettes (e-cigs) has increased significantly in the United States and many other countries, particularly among current smokers (Adkison et al., 2013; Ayers, Ribisl, & Brownstein, 2011; King, Alam, Promoff, Arrazola, & Dube, 2013; Pearson, Richardson, Niaura, Vallone, & Abrams, 2012). One large survey (HealthStyles), carried out by King et al., found awareness of e-cigs among US adults has increased from 40.9 to 57.9% from 2010 to 2011. During the same time, e-cig use rose from 3.3 to 6.2% among US adults (King et al., 2013). More recently, a study of US adults by McMillen et al. identified the current use of e-cigs to be 6.8% in 2013 (McMillen, Gottlieb, Shaefer, Winickoff, & Klein, 2014). In addition, the number of e-cig devices entering the market has drastically increased (Rose et al., 2014; Zhu et al., 2014). Although the number of e-cigs users and devices has continued to increase over the past five years, little is known about user's experiences and what e-cig characteristics they value.

Prior studies have shown that e-cig users initiate use for various reasons, most frequently as a smoking cessation aid (Adkison et al., 2013; Caponnetto, Polosa, Russo, Leotta, & Campagna, 2011; Dawkins, Turner, Roberts, & Soar, 2013; Etter, 2010; Etter & Bullen, 2011; Farsalinos, Romagna, Tsiapras, Kyrzopoulos, & Voudris, 2014; Foulds, Veldheer, & Berg, 2011; Goniewicz, Lingas, & Hajek, 2013). Additionally, e-cigs are used to alleviate the craving to smoke traditional cigarettes either after quitting or as a replacement to smoking where smoking is banned (Bullen et al., 2010), or may be used by current smokers who want to reduce cigarette consumption (Caponnetto et al., 2011; Polosa et al., 2011; Siegel, Tanwar, & Wood, 2011). The increasing popularity of e-cigs may be due, in part, to their ability to satisfy nicotine cravings and provide the behavioural component associated with smoking, such as hand to mouth experience, sensory stimulation and visible smoke-like vapour (Farsalinos, Romagna, Tsiapras, Kyrzopoulos, & Voudris, 2013). The behavioural and sensory similarity

Correspondence: Raman Baweja, Department of Psychiatry, Penn State College of Medicine, 500 University drive, Hershey, PA 17033, USA.
rbaweja@hmc.psu.edu

to smoking is largely absent in nicotine replacement therapies (NRTs) and oral medications. The ability to deal both with the physical and the behavioural components may explain why the e-cigs have become more popular than approved medications over a relatively short time (Farsalinos et al., 2013; Steinberg et al., 2014).

Most of the research on e-cigs has been quantitative in nature and based on what public health researchers already know or suspect about e-cigs, requiring users to respond to a series of multi-choice or quantitative questions. This may not fully capture the users' perspective. There may be other important e-cig characteristics, or experiences of users of which public health researchers are totally unaware. Qualitative research provides an opportunity to understand how people feel about e-cigs use and why they make the choice to use e-cigs (Denzin & Lincoln, 2011; Etter, 2010). To date, only few qualitative studies focussing on e-cig users have been published (Barbeau, Burda, & Siegel, 2013; Etter, 2010; McDonald & Ling, 2015; McQueen, Tower, & Sumner, 2011; Peters, Meshack, Lin, Hill, & Abughosh, 2013). Etter used a French-language Internet survey, which was posted in 2009 in Europe. In this survey, participants ($N = 81$) answered open-ended questions about their usage pattern, reasons for use, and opinions about e-cigs. Participants reported the major motivation to use e-cigs was to quit smoking, but several respondents were also concerned about the potential toxicity of e-cigs (Etter, 2010). McQueen et al. interviewed e-cig users ($N = 15$) individually, or in small groups, who attended a convention or club meeting. This study found that there is a learning curve associated with e-cig use and that users learn over time what e-cig characteristics are important to them (McQueen et al., 2011).

Three other studies were conducted in focus group settings. The first study was conducted among a small ($N = 11$) convenience sample of e-cig users. The authors identified the following five themes about why e-cigarettes were efficacious in quitting – (1) bio-behavioural feedback, (2) social benefits, (3) hobby elements, (4) personal identity, and (5) distinction between smoking cessation and nicotine cessation (Barbeau et al., 2013). Peters et al. (2013) investigated the beliefs and perceived social norms of e-cig use among self-identified "current e-cigarette smoker" teenage boys ($N = 47$). The majority of respondents reported that they used e-cigarettes because they can be used quickly and they are easy to conceal. Finally, McDonald and Ling conducted 17 focus groups followed by 12 semistructured interviews among young adult smokers ($N = 87$) to understand the use of e-cigs and other similar "vapour" delivery systems. These young adults were integrating e-cigs into their existing patterns of tobacco use and motivation to use e-cigs included pricing, promotional events, available flavours, perceptions of safety, their desire to quit smoking, the ability to use in smoke-free spaces and the perception that e-cigarettes are novel technological gadgets (McDonald & Ling, 2015). As these products are new and rapidly evolving, and most of the products come with minimal instructions or published data, it is possible that we may learn about them by listening to those with significant experience using the products. While user perceptions may require verification via empirical study, they remain important determinants of user behaviour.

The current study aims to improve understanding of experienced e-cig users' perceptions of e-cigs and to identify factors they believe are important from a public health prospective.

Methods

The basic method for data collection has previously been described (Foulds et al., 2015), but the procedure is summarized here. Electronic cigarette users completed a comprehensive 158-item online survey aimed at understanding the use of electronic cigarettes, including how frequently they are used, reasons for use and important characteristics related to use. Participation in the study was completely voluntary. Responses to the survey were anonymous, although individuals who wished to volunteer for a separate laboratory study entered their contact details at the end of the survey. Responses were stored on REDCap (Research Electronic Data Capture), a secure, web-based application designed exclusively to support data captured for research studies (Harris et al., 2009).

The survey was first posted to the internet in December 2012. Links to the survey were posted on a variety of websites including webMD.com and sites frequented by e-cig users, including www.e-cigarette-forum.com, one of the largest e-cig user websites. Visitors to these sites were also able to cross-post the survey link to friends and other websites. Data reported here were collected from December 2012 to October 2013. This study was approved by the Penn State University Institutional Review Board.

Eligible participants were current adult e-cig users who completed all survey questions, including all open-ended questions. In the survey, participants were asked multiple choice questions followed by related open-ended questions. The following four open-ended items were asked.

(1) Compared to how you smoke/smoked your traditional cigarettes, please describe any ways that you use your e-cig differently.

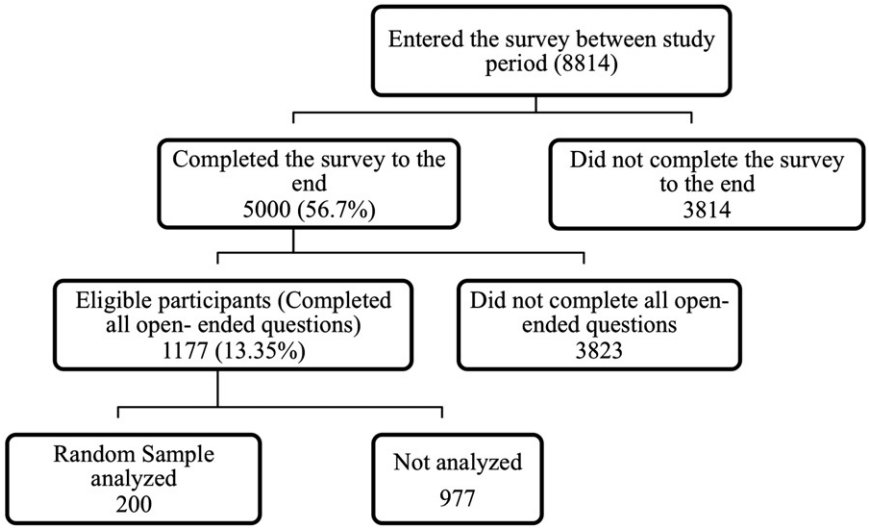

Figure 1. Flow of data collection.

(2) Please describe any other e-cig characteristics that are important to you.
(3) Please describe any other effects that you have experienced as a result of using e-cigs.
(4) Please provide any additional information you believe a public health researcher should know, in order to understand the electronic cigarette.

For the purpose of this study, a computerized SPSS (IBM Corp., Armonk, NY) program was employed to randomly select a sample of 200 participants. The flow of data collection and analysis for this study is shown in Figure 1. In this study, we used mixed methods research design (Creswell, 2012), in which we collected and analyzed both quantitative and qualitative data simultaneously to better understand experienced e-cig users' perceptions. Quantitative data were analyzed using SPSS v. 22.0 (IBM Corp., Armonk, NY). Analysis of baseline characteristics was completed on all eligible participants. Medians rather than means were used for continuous variables because medians are less sensitive to outliers (Etter, 2010). Percentages are reported on categorical data.

The qualitative data were analyzed using thematic analysis. Thematic analysis is a method used for identifying, analyzing and reporting themes in a dataset (Braun & Clarke, 2006). Specific events, thoughts and actions were coded or identified as themes by two independent evaluators (RB and KC). The evaluators read through all participant responses separately and assigned each sentence or paragraph a descriptive and interpretive code. This process was done iteratively to test, revise and refine the thematic classification of text responses. Evaluators met on a weekly basis to compare codes and to discuss the most salient themes. The final coded responses were compared between evaluators to ensure complete agreement and that all comments by participants were acknowledged. Where participant responses included more than one theme, all themes were identified.

Results

Quantitative analysis

Sample

8814 participants entered the survey between December 2012 and October 2013. Five thousand (56.7%) completed all forced-response questions while 1177 (13.4%) participants completed all forced-response and all open-ended questions. Comparison between the eligible participants who completed ($N = 1177$) and those who did not complete ($N = 3823$) all open-ended questions revealed no significant difference in sex, location, race, education or employment status. However, those who completed all the open-ended questions were significantly older than those who did not (40.7 ± 12.4 vs. 38.9 ± 12.7, $p < 0.001$). Comparisons of the random sample ($N = 200$) and the remainder of eligible participants ($N = 977$) revealed no significant difference in age, sex, location, race, education and employment status. This study examined the random sample of 200 participants, as shown in Figure 1.

Most respondents were men (73%) from the United States (87.5%). Approximately 83% were former smokers, while 17% reported continued use of smoking traditional cigarettes either occasionally or on a daily basis. Participants had an average of five previous attempts to quit smoking. Almost all former smokers (92%) quit

Table 1. Characteristics of e-cigarette users in specific sample who completed open-ended questions ($N = 200$).

Characteristic	
Age in years, median (25th and 75th percentile)	40.5 (30–50)
Male % (*n*)	73.0 (146)
USA % (*n*)	87.5 (175)
White % (*n*)	88.5 (177)
Obtained college degree % (*n*)	39.5 (79)
In Full-time or part-time employment % (*n*)	67.5 (135)
Cigarette smoking status % (*n*)	
Past user	83.0 (166)
Current occasional user	6.5 (13)
Current daily user	10.5 (21)
Days Since quit Smoking (Past cigarette users only) median (25th and 75th percentile)	255.0 (90–730)
Quit smoking ($N = 166$) % (*n*)	
Long before started using e-cigs	7.8 (13)
After started using e-cigs	92.2 (153)
History of other types of tobacco use % (*n*)	
Pipe smoker	21.5 (43)
Cigar smoker	40.0 (80)
Smokeless/chewing tobacco	34.5 (69)
Hookah user	24.5 (49)
Number of previous attempts to quit cigarettes, median (25th and 75th percentiles)	5 (3–10)

smoking after using e-cigs. Approximately 40% of the smokers also had a history of using other forms of tobacco, including pipe, cigar, chewing tobacco and hookah (Table 1).

Use of the electronic cigarette

The majority of e-cig users reported using their device for 6 months or more, and were using it approximately 15 times per day (Note: the survey defined one "time" as consisting of "around 15 puffs, or use for around 10 minutes"). Most e-cig users had tried at least three different models prior to the one they were using currently. Almost half of the users spent more than 50 U.S. dollars on their current e-cig with a weekly maintenance cost of approximately 10 U.S. dollars. The most frequently used e-cig contained a button to press prior to inhalation/puffing (79.5%), had a tank to hold the liquid (58.5%), and used both propylene glycol (PG) and vegetable glycerin (VG) (68.8%). The single most important reason cited for the use of e-cigs was the perception that it was less harmful to health (36.5%). Other frequent reasons for use were the desire to quit smoking or to prevent relapse (25%). The most frequently reported "important" e-cig characteristic was the ability to provide good vapour quality (94%), followed by long battery life (82%) and variety of liquid flavours (59%). The most frequently reported negative side effects from use were dry mouth (24%), dry cough (4%) and throat irritation (3.5%). The majority of users reported starting e-cig use to quit tobacco soon (73.5%) and almost every user reported that e-cigs helped them to quit smoking (93.5%). These results are displayed in Table 2.

Qualitative analysis

Differences in use between e-cigs and traditional cigarettes

Nine common themes were identified from 276 comments. The most frequent answers were: fewer puffs per occasion, but more frequently (53 comments, "puff on it more frequently but only do so once or twice in a row multiple times a day"); shallow or less deep inhalation (51 comments, "inhale less deeply"); less frequently (50 comments, "use my electronic cigarette less than I smoked regular cigarettes"); more frequently (39 comments); about the same in both frequency and inhalation (28 comments); deeper inhalation (23 comments); about the same in inhalation (15 comments); longer puffs (11 comments), and about the same in frequency (6 comments).

Important characteristics of E-cigs

Fifteen common themes were identified from 272 responses. The most important e-cig characteristics identified were: design (40 comments, "looks nice and feels good in my hands"); ability to control voltage (35 comments, "Variable voltage, variable watt, ability to adjust these on the fly depending on the 'juice' being used"); simple to operate and maintain (34 comments, "Ease of service and maintenance"); followed by durability (26 comments); consistent performance of e-cig device and experience (20 comments); taste and variety of flavours (18 comments); throat hit (16 comments); compatibilities of variety of e-cig components (14 comments); machine quality (14 comments); cost of e-cig device including maintenance cost (14 comments); battery life (11 comments); tank size (10 comments); safety features (10 comments); easy availability of e-cigs device components and flavours (9 comments), and the ability to customize liquids and coils (6 comments).

Effects associated with E-cig use

There were 14 themes identified from 124 responses. Approximately one-fourth of responses were related to experiencing no undesirable effects (25 comments, "No negative effects, they have all been positive"). The most common negative effects were: symptoms related to dehydration including dry mouth, chapped lips and bad breath (25 comments, "Dry mouth occurred more when I first started using the e-cig and was every time I used it"); worsening respiratory symptoms (10 comments, "Exacerbation of asthma symptoms"); side effects possibly related to nicotine effects (8 comments, "headaches are from high nicotine"); followed by throat and nasal

Table 2. E-cigarette usage patterns in specific sample who completed open-ended questions ($N = 200$).

Characteristic	
Days using e-cigarette, median (25th and 75th percentile)	240.0 (90–630)
E-cig use times per day (one "TIME" consists of around 15 puffs, or lasts around 10 minutes), median (25th and 75th percentile)	15.0 (10–25)
Number of models of e-cigs have been used prior to the current one, median (25th and 75th percentiles)	3.0 (2–5)
Price per e-cig (U.S. dollars), median (25th and 75th percentiles)	56.0 (30–128)
E-cig cost more than 50 U.S. dollars % (*n*)	49.5 (99)
Maintenance cost of vaping per week (U.S. dollars), median (25th and 75th percentiles)	10.0 (5–20)
E-cig contains button to press just prior to inhalation/puffing % (*n*)	79.5 (159)
Length and width of e-cigs as compare to cigarette % (*n*)	
• E-cig same	15.0 (30)
• E-cig smaller	2.5 (5)
• E-cig larger	82.5 (165)
Method for use of liquid % (*n*)	
• Prefilled cartridges	10.5 (21)
• Drip-feed from bottle	17.5 (35)
• Tank feed	58.5 (117)
Type of liquid used in e-cig ($N = 141$) % (*n*)	
• Propylene glycol (PG)	14.2 (20)
• Vegetable glycerin (VG)	8.5 (12)
• Both PG and VG	68.8 (97)
Single most important reason to use e-cig (>5%) % (*n*)	
• Less harmful to my health	36.5 (73)
• Quit smoking or avoid relapsing	25.0 (50)
• Less toxic than tobacco	7.0 (14)
• To reduce tobacco consumption in preparation of a quit attempt	5.5 (11)
• Prefer the taste of an e-cigs	7.0 (14)
Very important E-cig characteristics % (*n*)	
• Provides good vapour quality	94.0 (188)
• Long battery life	82.0 (162)
• Variety of liquid flavour	59.0 (118)
• Fast battery charge	22.5 (45)
• Shaped like a cigarette	11.5 (23)
Experienced effects as a result of e-cigs (quite often/once a week) (>1.5%) % (*n*)	
• Dry mouth	24.0 (48)
• Dry cough	4.0 (8)
• Throat irritation	3.5 (7)
Started using e-cigs with intention to quit tobacco soon % (*n*)	73.5 (147)
E-cigarette helped to quit smoking % (*n*)	93.5 (187)

irritations (8 comments), transient headache (6 comments), increased heart rate (5 comments). A number of other symptoms were mentioned by only one respondent.

Of the participants who reported undesirable effects, 13 spontaneously mentioned the transient nature of the undesirable effects ("In the first few months when I was trying all those new kinds I did have dry mouth & other symptoms but not with what I use now").

Positive aspects of E-cigs

There were 15 positive themes identified from 492 responses. The most frequently cited positive aspects of e-cig use were: assisted in smoking cessation and reduced cigarette consumption (81 comments, "As far as Nicotine Replacement Devices go, e-cigs are fantastic. Both my wife and I quit smoking after 15 years"); beneficial effect on health (71 comments, "My blood pressure has stabilized and have, under doctors [sic] orders, quit taking some of my medications for it"); improved breathing, decreased cough, fewer sore throats (70 comments, "Breathing is easier. No hacking cough at any time of the day"); safe way to use nicotine (42 comments, "I'm still on nicotine, but much less. I'm avoiding close to 4000 chemicals in a traditional cigarette"); followed by pleasure of inhaling and smoking-related actions (34 comments); comparatively less toxic than smoking tobacco (33 comments); improvement in sense of smell and taste (32 comments); less expensive than cigarettes (28 comments); feasibility to use e-cigs (23 comments); similar gestures or action of smoking cigarette (21 comments); not associated with unpleasant odours and ash or dirt (21 comments); taste and variety of flavours (12 comments); safe for others or bystander with no second hand smoke (10 comments); helped relieve the craving for tobacco (10 comments), and improvement in dental health (4 comments).

Information relevant to public health

The most common themes were: it helps to quit smoking (65 comments, "Without the e-cig, I am extremely skeptical my quitting would have been as easy, or as successful"), health benefits (44 comments, "my health is better in every regard,. . .stabilized blood pressure") and improvement in respiratory status (34 comments, "I can breath [sic] better. No longer have the smokers cough), and a safer way to use nicotine (33 comments, "It should be marketed as an alternate nicotine deliver system as it allows smokers to enjoy the same recreation as smoking a normal cigarette with all the benefits of inhaling water vapour instead of tar and other toxins").

Many mentioned that there was a need for more research on e-cigs safety and long-term effects (24 comments, "like to see some double-blind studies"). Some people were concerned about the harmful effects of e-cigs and their addiction potential (15 comments, "quitting an e-cig would be as hard as quitting cigarettes cold turkey"). A few commented that e-cigs are better than available nicotine replacement therapy (NRT) and Food and Drug Administration (FDA) approved medications (12 comments, "after repeated attempts to quit using NRT which did not work for me for longer than 2 months, I quit Tobacco in 2 days with an E-Cig"). A small number complained about available NRT and medications (5 comments, "Any researcher worthy of the name should press the FDA to disallow Chantix").

Regarding the regulations, a few were against regulation by the FDA (9 comments, "Please do not let our govt [sic] ban these, they are the most effective method to get off tobacco and that is the main goal"), while others were in favour of government regulation (4 comments, "I think electronic cigarettes need to be regulated equal to tradition tobacco products. Addictive additives must be prohibited or they will be just as bad as smoking").

There were also suggestions regarding how to improve the survey (11 comments, "Rather than ask how many times a day I use my e-cig, I think a more accurate measurement would be to ask how much e-juice I consume a day"). Some e-cig users commented about the difference in vaping e-cigs and cigarette smoking (7 comments "Please understand that vaping is not like smoking at all"). Respondents also mentioned a need for increased awareness of e-cig availability and efficacy (7 comments). Respondents were concerned about the use of e-cigs by adolescents and first-time users (5 comments).

Discussion

This analysis, which used both quantitative and qualitative approaches, found that many e-cig users believe that e-cigs helped them to quit smoking, and by doing so, improved their health or reduced the severity of health problems. This is consistent with other studies that found users of electronic cigarettes report reducing cigarette consumption or facilitated quitting (Caponnetto et al., 2011, 2013; Etter, 2010; Etter & Bullen, 2014; Farsalinos, Romagna, et al., 2014; Odum, O'Dell, & Schepers, 2012; Polosa et al., 2011; Siegel et al., 2011). Participants stated that when quitting smoking, the e-cig devices worked better than approved nicotine replacement therapies (NRT) and smoking cessation medications that they had tried. Participants stated that they had tried to quit multiple times but were only successful once they started using e-cigs. Interestingly, in addition to believing that e-cigs were the most helpful aid to quitting smoking, a recent study examining perceptions of e-cigarettes vs. approved nicotine replacement therapies (NRT) found that e-cig users believed that using e-cigs were less risky than using NRT (Harrell et al., 2015). Moreover, a recent study showed e-cig risk perception is associated with e-cig status; those who viewed e-cigs as less harmful than regular cigarettes were more likely to smoke fewer cigarettes per day (Sherratt, Marcus, Robinson, Newson, & Field, 2015). This suggests that there is a general belief among users that e-cigs can be a successful aid in smoking cessation. Some participants described it as a safe alternate way to use nicotine and as less harmful to smoke cigarettes.

Participants in this study were predominantly using e-cig devices that were larger than a traditional cigarette with a button to press just prior to inhalation. More than half of participants used a tank feed method for the nicotine liquid, with only a small percentage of participants using prefilled cartridges. With the increasing number of devices now available on the market (Rose et al., 2014; Zhu et al., 2014) and the reports that some devices may be more efficient at delivering nicotine (Farsalinos, Spyrou, et al., 2014; Spindle, Breland, Karaoghlanian, Shihadeh, & Eissenberg, 2015; Vansickel & Eissenberg, 2013), it was not surprising that most experienced e-cig users in this study were using advanced e-cig devices. Of the participants who reported the composition of their liquid, most were using a liquid with both propylene glycol and vegetable glycerin. When asked to rate the importance of e-cig characteristics, good vapour quality and long battery life were rated as most important.

Qualitative analysis of the participant responses to the open-ended questions revealed the opinions and

preferences of e-cig users in regards to device characteristics. In agreement with past studies (Dawkins, Kimber, Puwanesarasa, & Soar, 2015; McQueen et al., 2011; Yingst et al., 2015), many participants reported that the design of the e-cig was very important. They wanted the device to look good and feel comfortable in their hand and they liked devices that were customizable, had varying voltage and wattage, and devices that were compatible with many types of atomizers/clearomizers, etc. They found it important that the devices be durable, of high quality, reliable and consistent. Many participants commented that the ease of use and simplicity of the device was very important, along with having safety features to avoid battery overheating and liquid leakage. This information is useful because it provides insight into common problems with e-cig devices that should be considered when creating regulations on device safety and quality. It may also provide insight into the reasons why participants transition to advanced generation devices that can be customized (Yingst et al., 2015).

Although participants held a mainly positive view of e-cigs, undesirable effects associated with e-cig use were noted. Most commonly, participants stated that they experienced dry mouth, which caused bad breath, chapped lips, and dehydration. In similar studies, which measured side effects associated with e-cig use, dry mouth and related mouth conditions were also, the most commonly reported side effects (Etter, 2010; Farsalinos, Romagna, et al., 2014; Gualano et al., 2014; Polosa et al., 2011; Polosa et al., 2014). Some participants experienced an exacerbation of allergy symptoms, cough, or excessive phlegm production. Only a very small number of participants reported nausea, headache, dizziness, and throat irritation. Although participants experienced these symptoms, they were generally transient, only lasting for a short period of time after initiating use.

Our study is one of the first to examine ways in which users report smoking and using cigarettes and e-cigarettes differently. Although the responses varied greatly, the most striking response was that participants used their e-cig more times per day, but with fewer puffs at each use time. Because e-cigs are not used in the same way as cigarettes are smoked, the user can choose the duration of use or how many puffs they want to take at each use time. When smoking a cigarette, there is an easily defined quantity of use, one cigarette. This suggests that e-cig use may need to be measured differently than cigarette use or that researchers need to define what they mean by a typical "use".

Based on the same original survey, we recently reported that ex-smoking e-cig users appear to be less dependent on their e-cigs than they previously were dependent on cigarettes (Foulds et al., 2015). We suggested that this might relate to lower nicotine absorption from e-cigs. However, user responses from the current study suggest e-cig users also have a different puffing pattern from cigarette smokers that could relate to the pattern of nicotine adsorption and dependence; frequent small increments in nicotine absorption from e-cigs, versus less frequent but larger boosts in blood nicotine levels from cigarettes.

Many participants felt that they needed to defend e-cigs by making statements about how it is the only thing that has helped them to quit smoking, with some participants going as far as saying that e-cigs saved their life. Some mentioned their disappointment with currently available smoking cessation aids and medications. Also, participants wanted to stress that they have seen improvements to their health since initiating e-cig use. Not surprisingly, participants were adamant that vaping is not smoking, suggesting that they may think rules and regulations that regulate both smoking and e-cig use in a similar manner are unfair or incorrect. Some participants were in support of FDA regulation, while others were not. Some users were against regulation because they were concerned that in the future there would be difficulties getting e-cig devices or needed supplies. This is not the first to report that e-cig users are invested in the outcomes related to the regulation of the devices (Sumner, McQueen, Scott, & Sumner, 2014).

The main weakness of this study stems from the fact that the survey was completed by a convenience sample of self-selected volunteers who visited webpages relating to electronic cigarettes, and then answered all of the survey questions, including the non-compulsory open-ended questions. These individuals can be considered unusually experienced and enthusiastic users of e-cigs and so their views may not represent e-cig users as a whole.

Conclusions

Experienced e-cig users stated that initiating e-cig use helped them to quit or reduce their conventional smoking, which they believe reduced their health risks. In comparison to cigarette smoking, e-cig users reported using their e-cig more times per day, but with fewer puffs at each use time. Users acknowledged that more research is needed to understand the safety and long-term effects of use. They mentioned dry mouth as a common side effect and common problems with reliability of e-cigs. Understanding these views may help health professionals to assess and assist e-cig users, and in the future, may help regulators to improve quality and reduce risks.

Declaration of interest

JF has done paid consulting for pharmaceutical companies involved in producing smoking cessation medications including GSK, Pfizer, Novartis, J&J, and Cypress Bioscience.

This work was supported by an internal grant from Penn State Clinical Translational Science Institute (supported by the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant UL1 TR000127), Social Science Research Institute, & Cancer Institute (PI: SW). JF, SV, JY & SH are primarily funded by the National Institute on Drug Abuse of the National Institutes of Health and the Center for Tobacco Products of the U.S. Food and Drug Administration (under Award Numbers P50-DA- 036107-01, P50-DA-036105). TE is supported by the Center for Tobacco Products of the U.S. Food and Drug Administration and the National Institute on Drug Abuse of the National Institutes of Health under Award Number P50DA036105. 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.

References

Adkison, S.E., O'Connor, R.J., Bansal-Travers, M., Hyland, A., Borland, R., Yong, H.H., ... Fong, G.T. (2013). Electronic nicotine delivery systems: International tobacco control four-country survey. *American Journal of Preventive Medicine*, *44*, 207–215.

Ayers, J.W., Ribisl, K.M., & Brownstein, J.S. (2011). Tracking the rise in popularity of electronic nicotine delivery systems (electronic cigarettes) using search query surveillance. *American Journal of Preventive Medicine*, *40*, 448–453.

Barbeau, A.M., Burda, J., & Siegel, M. (2013). Perceived efficacy of e-cigarettes versus nicotine replacement therapy among successful e-cigarette users: A qualitative approach. *Addiction Science & Clinical Practice*, *8*, 5. doi: 10.1186/1940-0640-8-5.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*, 77–101.

Bullen, C., McRobbie, H., Thornley, S., Glover, M., Lin, R., & Laugesen, M. (2010). Effect of an electronic nicotine delivery device (e cigarette) on desire to smoke and withdrawal, user preferences and nicotine delivery: Randomised cross-over trial. *Tobacco Control*, *19*, 98–103.

Caponnetto, P., Campagna, D., Cibella, F., Morjaria, J.B., Caruso, M., Russo, C., & Polosa, R. (2013). EfficCiency and Safety of an eLectronic cigAreTte (ECLAT) as tobacco cigarettes substitute: a prospective 12-month randomized control design study. *PLoS One*, *8*, e66317.

Caponnetto, P., Polosa, R., Russo, C., Leotta, C., & Campagna, D. (2011). Successful smoking cessation with electronic cigarettes in smokers with a documented history of recurring relapses: A case series. *Journal of Medical Case Reports*, *5*, 585. doi: 10.1186/1752-1947-5-585.

Creswell, J.W. (2012). *Qualitative inquiry and research design: Choosing among five approaches*. Los Angeles, London, New Delhi, Singapore, Washington DC: Sage.

Dawkins, L., Kimber, C., Puwanesarasa, Y., & Soar, K. (2015). First- versus second-generation electronic cigarettes: Predictors of choice and effects on urge to smoke and withdrawal symptoms. *Addiction*, *110*, 669–677.

Dawkins, L., Turner, J., Roberts, A., & Soar, K. (2013). 'Vaping' profiles and preferences: An online survey of electronic cigarette users. *Addiction*, *108*, 1115–1125.

Denzin, N.K., & Lincoln, Y.S. (2011). *The SAGE handbook of qualitative research. Los Angeles, London, New Delhi, Singapore, Washington DC*: Sage.

Etter, J.F. (2010). Electronic cigarettes: A survey of users. *BMC Public Health*, *10*, 231.

Etter, J.F., & Bullen, C. (2011). Electronic cigarette: Users profile, utilization, satisfaction and perceived efficacy. *Addiction*, *106*, 2017–2028.

Etter, J.F., & Bullen, C. (2014). A longitudinal study of electronic cigarette users. *Addictive Behaviours*, *39*, 491–494.

Farsalinos, K.E., Romagna, G., Tsiapras, D., Kyrzopoulos, S., & Voudris, V. (2013). Evaluating nicotine levels selection and patterns of electronic cigarette use in a group of "vapers" who had achieved complete substitution of smoking. *Substance Abuse*, *7*, 139–146.

Farsalinos, K.E., Romagna, G., Tsiapras, D., Kyrzopoulos, S., & Voudris, V. (2014). Characteristics, perceived side effects and benefits of electronic cigarette use: A worldwide survey of more than 19,000 consumers. *International Journal of Environmental Research and Public Health*, *11*, 4356–4373.

Farsalinos, K.E., Spyrou, A., Tsimopoulou, K., Stefopoulos, C., Romagna, G., & Voudris, V. (2014). Nicotine absorption from electronic cigarette use: Comparison between first and new-generation devices. *Science Report*, *4*, 4133. doi: 10.1038/srep04133.

Foulds, J., Veldheer, S., & Berg, A. (2011). Electronic cigarettes (e-cigs): Views of aficionados and clinical/public health perspectives. *International Journal of Clinical Practice*, *65*, 1037–1042.

Foulds, J., Veldheer, S., Yingst, J., Hrabovsky, S., Wilson, S.J., Nichols, T.T., & Eissenberg, T. (2015). Development of a questionnaire to assess dependence on electronic cigarettes in a large sample of ex-smoking e-cig users. *Nicotine & Tobacco Research*, *17*, 186–192.

Goniewicz, M.L., Lingas, E.O., & Hajek, P. (2013). Patterns of electronic cigarette use and user beliefs about their safety and benefits: An internet survey. *Drug and Alcohol Review*, *32*, 133–140.

Gualano, M.R., Passi, S., Bert, F., La Torre, G., Scaioli, G., & Siliquini, R. (2014). Electronic cigarettes: Assessing the efficacy and the adverse effects through a systematic review of published studies. *Journal of Public Health*, doi: 10.1093/pubmed/fdu055.

Harrell, P.T., Marquinez, N.S., Correa, J.B., Meltzer, L.R., Unrod, M., Sutton, S.K., ... Brandon, T.H. (2015). Expectancies for cigarettes, e-cigarettes, and nicotine replacement therapies among e-cigarette users (aka vapers). *Nicotine & Tobacco Research*, *17*, 193–200.

Harris, P.A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J.G. (2009). Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, *42*, 377–381.

King, B.A., Alam, S., Promoff, G., Arrazola, R., & Dube, S.R. (2013). Awareness and ever-use of electronic cigarettes among U.S. adults, 2010–2011. *Nicotine & Tobacco Research*, *15*, 1623–1627.

McDonald, E.A., & Ling, P.M. (2015). One of several 'toys' for smoking: Young adult experiences with electronic cigarettes

in New York City. *Tobacco Control*, doi: 10.1136/tobaccocontrol-2014-051743.

McMillen, R.C., Gottlieb, M.A., Shaefer, R.M., Winickoff, J.P., & Klein, J.D. (2014). Trends in electronic cigarette use among U.S. adults: Use is increasing in both smokers and nonsmokers. *Nicotine & Tobacco Research*, doi: 10.1093/ntr/ntu213.

McQueen, A., Tower, S., & Sumner, W. (2011). Interviews with "vapers": Implications for future research with electronic cigarettes. *Nicotine & Tobacco Research*, *13*, 860–867.

Odum, L.E., O'Dell, K.A., & Schepers, J.S. (2012). Electronic cigarettes: Do they have a role in smoking cessation? *Journal of Pharmacy Practice*, *25*, 611–614.

Pearson, J.L., Richardson, A., Niaura, R.S., Vallone, D.M., & Abrams, D.B. (2012). e-Cigarette awareness, use, and harm perceptions in US adults. *American Journal of Public Health*, *102*, 1758–1766.

Peters, R.J., Meshack, A., Lin, M.T., Hill, M., & Abughosh, S. (2013). The social norms and beliefs of teenage male electronic cigarette use. *Journal of Ethnicity in Substance Abuse*, *12*, 300–307.

Polosa, R., Caponnetto, P., Morjaria, J.B., Papale, G., Campagna, D., & Russo, C. (2011). Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: A prospective 6-month pilot study. *BMC Public Health*, *11*, 786.

Polosa, R., Morjaria, J.B., Caponnetto, P., Campagna, D., Russo, C., Alamo, A., . . . Fisichella, A. (2014). Effectiveness and tolerability of electronic cigarette in real-life: A 24-month prospective observational study. *Internal and Emergency Medicine*, *9*, 537–546.

Rose, S.W., Barker, D.C., D'Angelo, H., Khan, T., Huang, J., Chaloupka, F.J., & Ribisl, K.M. (2014). The availability of electronic cigarettes in U.S. retail outlets, 2012: Results of two national studies. *Tobacco Control*, *23*, iii10–iii16.

Sherratt, F.C., Marcus, M.W., Robinson, J., Newson, L., & Field, J.K. (2015). Electronic cigarette use and risk perception in a Stop Smoking Service in England. *Addiction Research & Theory*, *23*, 336–342.

Siegel, M.B., Tanwar, K.L., & Wood, K.S. (2011). Electronic cigarettes as a smoking-cessation: Tool results from an online survey. *American Journal of Preventive Medicine*, *40*, 472–475.

Spindle, T.R., Breland, A.B., Karaoghlanian, N.V., Shihadeh, A.L., & Eissenberg, T. (2015). Preliminary results of an examination of electronic cigarette user puff topography: The effect of a mouthpiece-based topography measurement device on plasma nicotine and subjective effects. *Nicotine & Tobacco Research*, *17*, 142–149.

Steinberg, M.B., Zimmermann, M.H., Delnevo, C.D., Lewis, M.J., Shukla, P., Coups, E.J., & Foulds, J. (2014). E-cigarette versus nicotine inhaler: Comparing the perceptions and experiences of inhaled nicotine devices. *J Gen Intern Med*, *29*, 1444–1450.

Sumner, H.M., McQueen, A., Scott, M.J., & Sumner, W. (2014). Analysis of comments in a petition defending electronic cigarettes. *Nicotine & Tobacco Research*, *16*, 1503–1511.

Vansickel, A.R., & Eissenberg, T. (2013). Electronic cigarettes: Effective nicotine delivery after acute administration. *Nicotine & Tobacco Research*, *15*, 267–270.

Yingst, J.M., Veldheer, S., Hrabovsky, S., Nichols, T.T., Wilson, S.J., & Foulds, J. (2015). Factors associated with electronic cigarette users' device preferences and transition from first generation to advanced generation devices. *Nicotine & Tobacco Research*, doi: 10.1093/ntr/ntv052.

Zhu, S.H., Sun, J.Y., Bonnevie, E., Cummins, S.E., Gamst, A., Yin, L., & Lee, M. (2014). Four hundred and sixty brands of e-cigarettes and counting: Implications for product regulation. *Tobacco Control*, *23*, iii3–iii9.