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Electronic cigarette: users profile, utilization, satisfaction and perceived efficacy

(revised version, changed not marked)

Running head E-cigarette survey

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DECLARATION OF INTEREST

Jean-François Etter's salary is paid by the University of Geneva. He has served as an expert consultant for the World Health Organization regarding electronic nicotine delivery systems (ENDS). He consulted for Pfizer, a manufacturer of smoking cessation medications, in 2006-2007 (on the Swiss varenicline advisory board), and received medications for a clinical trial from Pfizer in 2006. No competing interest since then.

Chris Bullen's salary is paid by The University of Auckland and his research is supported by grants from the New Zealand Health Research Council (HRC), the University of Auckland and the NZ Heart Foundation. He has previously undertaken tobacco control research supported by the New Zealand Ministry of Health, and by Niconovum, Sweden, prior to the purchase of this company by RJ Reynolds. He is currently an investigator on a study involving reduced nicotine cigarettes in which the products were purchased by the University of Auckland from Vector Group Ltd, US. He has previously undertaken research on ENDS funded by HealthNZ, in which the study products were supplied by Ruyan, Hong Kong; and he is the principal investigator on an HRC-funded efficacy trial of ENDS that will use products provided by a NZ-based ENDS retailer. Other than these relationships, he has no conflicts of interest to declare.

ABSTRACT

Aims. To assess the profile, utilization patterns, satisfaction and perceived effects among users of electronic cigarettes ("e-cigarettes").

Design and Setting. Internet survey in English and French in 2010.

Participants. Visitors of websites and online discussion forums dedicated to e-cigarettes and to smoking cessation.

Findings. There were 3587 participants (70% former tobacco smokers, 61% men, mean age 41 years). The median duration of electronic cigarette use was 3 months, users drew 120 puffs/day and used 5 refills/day. Almost all (97%) used e-cigarettes containing nicotine. Daily users spent $33 per month on these products. Most (96%) said the e-cigarette helped them quit smoking or reduce their smoking (92%). Reasons for using the e-cigarette included the perception it was less toxic than tobacco (84%), to deal with craving for tobacco (79%) and withdrawal symptoms (67%), to quit smoking or avoid relapsing (77%), because it was cheaper than smoking (57%) and to deal with situations where smoking was prohibited (39%). Most ex-smokers (79%) feared they might relapse to smoking if they stopped using the e-cigarette. Users of nicotine-containing e-cigarettes reported better relief of withdrawal and a greater effect on smoking cessation than those using non-nicotine e-cigarettes.

Conclusions. E-cigarettes were used much as people would use nicotine replacement medications: by former smokers to avoid relapse or as an aid to cut down or quit smoking. Further research should evaluate the safety and efficacy of e-cigarettes for administration of nicotine and other substances, and for quitting and relapse prevention.

INTRODUCTION

Electronic cigarettes (referred hereafter as e-cigarettes and by some authorities as electronic nicotine delivery systems, ENDS) look like tobacco cigarettes, but do not contain tobacco. Instead, they comprise a metal casing within which a battery-powered atomiser produces a vapour for inhalation from cartridges that contain humectants (e.g. propylene glycol or glycerol), flavours, nicotine or in some cases other medications (rimonabant, amino-tadalafil) (1-3). Their appearance, size, handling and oral inhalation characteristics resemble those of tobacco cigarettes and may be important in their popularity and in assisting smokers to quit.

E-cigarettes are popular. Google searches for “electronic cigarettes” increased by 5000% over the past two years (4), and 9% of U.K. smokers and 9% of Polish teenage smokers report having used them (5, 6). Many smokers report using them to quit smoking (7, 8), or to “smoke” in smokefree places (7). However, because there are no data supporting the marketers’ claim that e-cigarettes help smokers quit, the World Health Organization and the U.S. Food and Drug Administration (FDA) have asked them not to make therapeutic claims (9, 10).

Few research reports on e-cigarettes are available (11-19). In clinical studies, e-cigarettes appear to attenuate craving for tobacco, despite delivering very little nicotine to the blood (16, 17, 20). Laboratory testing has shown that some e-cigarette cartridges may contain toxic components, including low levels of carcinogens (12, 14, 19). Many questions remain unanswered: are e-cigarettes safe, are they addictive, who uses them, why and how are they used, are they effective for smoking cessation or reduction (21, 22)? Also unanswered are questions about their wider impact: are they used by young non-smokers, could they be a gateway to tobacco use or nicotine dependence, and could their use in public places undermine smokefree laws (4, 6, 19, 22-24)?

Conducting clinical trials of these devices is challenging: there is a lack of safety data, the regulatory environment makes conducting trials of such novel devices difficult (14, 22, 25), and trials are expensive and time-consuming to conduct. Therefore, until trials can be undertaken, user surveys are a means of gathering information about the effects of this product on a range of outcomes (5-7). The aim of this study was to describe e-cigarette users, assess how and why they used this product, their satisfaction with the product and its perceived effects.

METHODS

We posted a questionnaire on the smoking cessation website Stop-Tabac.ch (26-28), in English and French, and used data collected between March and October 2010 (data collection will continue until December 2011). We contacted discussion forums and websites informing about e-cigarettes or selling them, and asked them to publish links to the survey (http://www.stop-tabac.ch/fr_hon/ECIG_EN). Participants were >18 years, and current, past and never-users of e-cigarettes were eligible. We recorded IP addresses (i.e. computer numbers) to identify and delete duplicate records, and collected saliva vials in a subsample of participants, for cotinine analysis (results reported separately) (29). The sample size initially expected was 1500, but participation was greater than expected. The survey was approved by the ethics committee of the Geneva University Hospitals.

The questionnaire, based on prior work by the authors (7, 17, 22), assessed:

- Prior or current use of e-cigarettes, and intention to use them.
- Dosage, puffs/day, brand, flavors, cost and where obtained.
- Duration of use, delivery of nicotine, ease in staying off cigarettes.
- Effect on smoking cessation and on tobacco withdrawal symptoms (Minnesota Withdrawal Form) (30), in participants who had used the e-cigarette during a quit attempt.
- Respiratory symptoms (Clinical COPD Questionnaire) (31, 32).
- Reasons for using and reasons for stopping use.
- Side effects, acceptability and satisfaction.
- Use of smoking cessation medications (nicotine therapy, bupropion and varenicline).
- Smoking status, cigarettes per day and time to first cigarette.
- Currently trying to quit or reduce smoking, intention to quit, confidence in ability to quit.
- Age, sex, income, education, country, and, from May 2010 onwards, where respondents learned about the survey.

Statistical analyses

We compared current and former smokers, and users of e-cigarettes containing nicotine with those using e-cigarettes without nicotine. There is a concern that participants enrolled on forums and websites that defend the rights of e-cigarette users may deliberately answer in a way that is favourable to their agenda (e.g. exaggerating satisfaction or under-reporting side effects). To test this hypothesis, we compared two groups: a) the 1005 users who learned about the survey on websites where the right to use e-cigarettes is often debated and

advocated: E-cigarette-forum.com (n=782), Vapersforum.com (n=129), Casaa.org (n=32), the UK Vapers forum (n=23), Vapersclub.com (n=20) or Forum-ecigarette.com (n=19), with b) the 83 participants who learned of the survey on more neutral sites, including Stop-tabac.ch (n=26) (a smoking cessation website with some factual, neutral information on e-cigarettes), on Google (n=30) or on other sites unrelated to e-cigarettes (n=27).We used ANOVAs to compare means, Mann-Whitney *U* tests to compare medians and chi-square tests to compare proportions. For most variables, we reported medians rather than means, because medians are less sensitive to extreme values. We used linear regression models to test associations between continuous variables with 95% confidence intervals around the point estimates as a measure of precision. Prices in currencies other than USD were converted to USD. A p-value of <0.05 was used as the cut-off for judging statistical significance.

RESULTS

Participant characteristics

The raw data file included 3659 records, but we deleted 66 doubles entries (i.e. duplicate answers by the same persons identified by computer numbers) and 6 records of people aged <18. The median age of the 3587 participants was 41 years (25^{th} and 75^{th} percentiles: 31 and 50 years), most were men (61%), former smokers (70%) and answered the English version of the questionnaire (79%) (Table 1). Distribution of respondents by country was: U.S. (62%), France (14%), U.K. (6%), Switzerland (4%), Canada (3%), and other countries (11%). Participants learned about the survey on the following websites: E-cigarette-forum.com (53%), Vapersforum.com (9%), the Sedansa website (3%), the Totally Wicked website (2%), Casaa.org (2%), Google (2%), Stop-tabac.ch (2%), the UK Vapers forum (2%) and other websites (25%). Most participants (58%) had obtained a diploma that would give access to university, and household income tended to be above average. Among current smokers, most reported currently trying to quit or to reduce their tobacco use. Very few (n=4) never smokers used nicotine-containing e-cigarettes but of these, three said they used them to deal with their craving for tobacco and to avoid relapsing to smoking, indicating they were actually former smokers misclassified as never smokers. Most participants were current users of e-cigarettes, but 15.2% were never users and 1.3% were past users.

Daily users vs. never users of e-cigarettes

There were more men (65% vs 46%, p<0.001) and more former smokers (77% vs 42%, p<0.001) among daily e-cigarette users than among never users. Daily users were more likely

to have ever used bupropion (30 vs 19%, p<0.001) and nicotine therapy (70 vs 64%, p<0.001), but not varenicline. Among current smokers, daily e-cigarette users smoked fewer cigarettes than never users (13 vs 16 cig./day, p<0.001). However, *before* they first started using the e-cigarette, daily e-cigarette users smoked more tobacco than never users (25 vs 16 cig./day, p=<0.001). Among smokers, e-cigarette users were also more likely than never users to be currently trying to quit smoking (71 vs 51%, p<0.001) or trying to reduce their tobacco use (96 vs 72%), and more confident in their ability to quit ("very sure": 17 vs 6%, p<0.001), and had lower scores on the Clinical COPD Questionnaire (total score: 1.25 vs 1.79, p<0.001). Among former smokers, the duration of smoking abstinence was shorter in daily users than in never users (105 vs 150 days, p=0.001).

Utilization

The most used brands varied by country. Among daily users living in the U.S., the most used brands were: Joye (40.5%), Vapor4Life (9.2%), Janty (5.8%), Totally Wicked (5.8%) and PureSmoker (5.3%); in France: Janty (27.5%), Joye (19.8%), Sedansa (13.7%), Kyozen (6.9%) and CigLib (6.9%); and in the UK: TECC (19.9%), Totally Wicked (17.6%), Titan (13.2%), Joye (11.8%) and Screwdriver (9.6%). The most used models (sold under various brand names) were the 510 (40.5% of daily e-cig users), the eGo (11.3%), the KR808 (9.1%), the 901 (6.4%) and the Tornado (5.1%). The flavours used most were tobacco (39% of users), mint-menthol (15%), various fruit flavours (14%), coffee (9%), vanilla (5%) and chocolate (3%). The tobacco flavour was rated lower (83% "good" or "very good") than for all other flavours combined (93%, χ^2=115, p<0.001). The models tested in previous studies (14-19, 24, 33) were seldom or never used by respondents: Njoy (n=10, 0.3%), Liberty (n=8, 0.3%), Ruyan (n=5, 0.2%), Smoking Everywhere (n=4, 0.1%), Gamucci (n=4, 0.1%), Crown Seven (n=0), inLife (n=0), Supersmoker (n=0) and VapCig (n=0).

Among daily users of the e-cigarette, the median duration of the current episode of use was three months, but 15% had been using it for one or more years. Daily users drew an average of 120 puffs per day (Table 2). Almost all daily users (97%) said their e-cigarette contained nicotine. The median capacity of refill bottles was 20 ml and the median nicotine concentration in the liquid, uniform across brands and models, was 18 mg/ml (Table 2). Daily

users used two bottles of refill liquid per month, refilled their e-cigarette five times a day, and each refill or cartridge lasted two hours. The average price per kit was 60 USD, and daily users spent 33 USD per month for their e-cigarettes (including refill liquid and cartridges, batteries, components). Almost all daily users (96%) bought their e-cigarettes on the internet and about half (45%) intended to continue using them for another year or more. Daily users used their e-cigarette mainly at home (98% “often” and “very often”), in their car (90%) and at work (71%), but less frequently in cafes/restaurants/bars/discos (43%), in public transport (15%) or during business meetings (13%).

Satisfaction

Most current smokers reported that the e-cigarette helped them reduce their smoking (92%), and most former smokers (96%) said that it helped them quit smoking. Most ever users (89%) said that it was easy to abstain from smoking while using the e-cigarette (Table 3). Most users (94%) were willing to recommend it to a friend, and satisfaction ratings were high (mean=9.3 on a 0-10 scale). Few (10%) still experienced the urge to smoke while using the e-cigarette, and most former smokers (79%) feared that they would relapse to smoking if they stopped using it.

Most ever users (91%) liked the e-cigarette’s taste and the sensation while inhaling (Table 3). However, 22% reported that it burned the throat or gave a dry mouth or dry throat (26%). Similar proportions suggested the vapour should be more concentrated (20%) and that it should be easier to draw (inhale) on the e-cigarette (20%). One third thought that the cartridges and batteries ran out too quickly, 18% said that the liquid sometimes leaked from the device, and 8% reported that their e-cigarette had broken down at some stage. Only a small proportion expressed concerns that the e-cigarette might be toxic (6%) or could lead to dependence (8%), but most feared that it might one day be banned by authorities (83%).

Linear regression modelling showed that the price of e-cigarette kits was not associated with the length of battery life, but was associated with the duration that refill cartridges lasted: for

each additional 10 USD spent per kit, refills lasted 0.5 hours longer (t=3.1, 95% confidence interval: 0.2 to 0.9 hours, p=0.002). There were no statistically significant associations between price and technical problems such as break downs or leakage.

Reasons for use

E-cigarettes were used because they were perceived to be less toxic than tobacco (84%), to quit smoking or avoid relapsing (77%), to deal with craving for tobacco (79%) and tobacco withdrawal symptoms (67%), and because they were cheaper than smoking (57%) (Table 4). Other less common reasons were to avoid bothering other people with tobacco smoke (44%), to deal with smokefree situations (39%) or to avoid having to go outside to smoke (34%). Fewer used the e-cigarette to reduce tobacco consumption (28%), and far fewer reported being unable to stop using it (4%).

Reasons for stopping use

Those who had stopped using e-cigarettes (n=47) indicated that they had done so because they didn't need it anymore (41% "rather" plus "strongly agree"), because they thought they would not relapse to smoking even if they stopped (33%), because of the product's poor quality (35%), because it did not reduce cravings (33%), because they relapsed to smoking (25%), because it did not help them quit smoking (21%), because they feared its side effects (21%) or because they replaced it with a smoking cessation medication (10%).

Withdrawal symptoms

For participants who had used the e-cigarette during a quit attempt and who reported withdrawal symptoms ("moderate" or "severe") (30), table 5 shows the proportion who also reported whether the e-cigarette relieved symptoms. Craving to smoke was the symptom most relieved by the e-cigarette (90%). The effects of e-cigarettes on suppressing withdrawal symptoms were reported as being greater by former smokers than current smokers, and greater by users of nicotine-containing e-cigarettes than users of non-nicotine e-cigarettes (Table 5).

Use to inhale other substances

Very few ever users (n=27, 0.9%) reported having used the e-cigarette to inhale other substances than the liquid designed for that purpose. The substances disclosed were cannabis (n=5, 0.2%), vitamins (n=3), flavours (n=2), herbs (n=2), and vodka (n=1). The median duration of e-cigarette use to inhale these substances was five days, but only one day among those who used cannabis.

Comparing users of e-cigarettes containing or not containing nicotine

Compared with users of non-nicotine e-cigarettes, users of nicotine-containing e-cigarettes were more likely to be men and smoked more tobacco cigarettes per day before they first started using e-cigarettes (Table 1). However, there was no between-group difference for current smoking status. Those who used nicotine-containing e-cigarettes were more likely to be daily users, they used their first e-cigarette of the day earlier in the day, drew more puffs on their e-cigarette, used more refills per day and more bottles per month, their refill cartridges lasted less, and more of them intended to use e-cigarettes for another year or more (Table 2). Users of nicotine-containing e-cigarettes were also more likely to answer that it helped them quit or reduce their smoking, they were more satisfied with it, in particular with its taste and with the sensation while inhaling, more likely to say that they feared relapsing if they stopped using it, but they were also more likely to answer that e-cigarette use burned their throat (Table 3). Most of the reasons for using the e-cigarette were more frequently endorsed by users of nicotine-containing e-cigarettes than by users of non-nicotine e-cigarettes, in particular use to deal with craving and withdrawal (Table 4).

Comparing current and former tobacco smokers

Former smokers were more likely than current smokers to use the e-cigarette and to have ever used smoking cessation medications (Table 1). Among daily e-cigarette users, the duration of use was longer in former smokers than in current smokers (Table 2). Former smokers also took more puffs per day, were less likely to use the tobacco flavour, used larger refill bottles, their refills or cartridges lasted less, and they spent more per month than current smokers.

Former smokers were also more likely to say that the e-cigarette helped them quit or reduce their smoking, to report that it helped improve their respiratory symptoms, and to use e-cigs to deal with tobacco withdrawal symptoms (Table 3).

Comparing participants enrolled on e-cigarette forums with those enrolled on neutral sites

The 1005 participants enrolled on e-cigarette forums/websites were more likely to be former smokers than the 83 participants enrolled on "neutral" websites (72.3 vs 43.9%, $p<0.001$), more likely to be daily e-cigarette users (93.2 vs 31.1%, $p<0.001$), had used the e-cigarette longer (current episode of use: 91 days vs 14 days [medians], $p=0.003$), were generally more satisfied with the e-cigarette, but indicated the same reasons for using them (Table 6). When analyses were restricted to former smokers, differences in several satisfaction variables were smaller and often non-significant: e.g. satisfaction rating (0-10 scale): mean=9.6 in both groups ($t=0.2$, $p=0.8$), "e-cigarette burns the throat" (16.3 vs 25.0%, $\chi^2=0.8$, $p=0.7$); "fear e-cigarette might be toxic" (6.1 vs 0%, $\chi^2=2.0$, $p=0.75$).

DISCUSSION

The main finding of this survey, which enrolled predominantly self-selected visitors of websites dedicated to e-cigarettes, is that e-cigarettes were used largely by former smokers as an aid to quit smoking, to avoid relapse and to deal with withdrawal symptoms, much as people use nicotine replacement therapy (NRT). Use of e-cigarettes in smokefree places was cited relatively less frequently, but many participants used them because they were perceived to be less toxic and cheaper than tobacco. Daily users spent 33 USD per month for e-cigarettes, which is much cheaper than smoking one pack a day (incurring a cost of about 150-200 USD per month in the respondents' countries). This is also substantially cheaper than smoking cessation medications (which, at the recommended dosage, cost about the same as smoking one pack a day). Thus, an important reason for the popularity of e-cigarettes (5, 6) is most probably their price.

Several other findings raise questions needing further research. For example, it would be interesting to investigate why e-cigarettes have more appeal to men than to women. Only one never smoker used nicotine-containing e-cigarettes, a finding that could reflect the fact that under-age consumers were ineligible for the survey, or that contrary to the hypothesis expressed by some authors (4, 23, 24), e-cigarettes do not facilitate initiation to nicotine use in young never smokers.

The duration of use in former smokers (five months) was substantially longer than use of NRT (usually a few days to a few weeks) (34-36). This suggests either that our sampling method resulted in the self-selection of long-term users, or that e-cigarettes are actually used longer-term than NRT, for reasons that deserve investigation.

It is not clear why one brand (Joye) and one model (the 510) dominated the market. This may result from successful marketing, or perhaps users may communicate about their preferred brands in online forums, and the best brands may gain popularity this way. It may be that some brands were overrepresented in this survey because of links from websites selling these brands, in particular Totally Wicked and Sedansa. The models used in previous studies were seldom or never used by participants in this study (14-19, 24). To ensure validity and generalizability, future studies should use the most popular models.

Very few respondents (3% of users) used e-cigarettes without nicotine. This could suggest that despite two studies showing very low absorption of nicotine (16, 17), it may be an important ingredient of this product, perhaps because of its taste in addition to its pharmacological properties on withdrawal relief. Alternatively, users might have greater expectations for nicotine-containing products, so these products are purchased more commonly. Interestingly, the concentration of nicotine in the liquid was uniform across the various brands (18 mg/ml), suggesting that manufacturers reached a consensus. It is not clear how this particular concentration was arrived at, but few users said that e-cigarettes should provide more nicotine, despite the low nicotine absorption observed in the two clinical studies noted above (16, 17). The uniformity of nicotine content across the different brands makes it possible to compare them. The average content of nicotine per bottle, 360 mg (20 ml x 18 mg/ml), is of concern because the fatal dose of nicotine is estimated to be 30-60 mg for adults

and 10 mg for children (2). Thus, these refill bottles are extremely dangerous and should be replaced by sealed, tamper-proof, leak resistant cartridges.

Daily use (120 puffs and 5 refills per day, that is, 24 puffs per refill) was in the range of the number of puffs inhaled by daily cigarette smokers. However, the average 24 puffs per refill is considerably less than the 170-300 smokeable puffs reported from in vitro tests (i.e. the number of puffs before the aerosol density decreased) (18). This could mean that users switch cartridges when the flavour or the nicotine taste fade out, and this may occur much sooner than a decrease in aerosol density. A dosage of 120 puffs/day suggests a more intense use than the 10 puffs or 5 minutes puffing tested in clinical reports (15-17). An implication of this is that laboratory tests should allow users to puff substantially more before outcomes are measured, to mimic actual utilization by experienced users.

The flavour used most was tobacco, even though this flavour rated lowest for satisfaction, possibly because some users did not sample all available flavours before choosing one. The sensation of a burning throat and dry mouth or throat was due in part to nicotine, whether it is also due to the humectants should be investigated.

Perceived effect on smoking and withdrawal symptoms

Our data suggest that e-cigarettes may help smokers quit smoking, reduce their cigarette consumption and attenuate craving and tobacco withdrawal symptoms. Users of nicotine-containing e-cigarettes reported only slightly superior effects on withdrawal than users of non-nicotine e-cigarettes, suggesting that nicotine delivery explains only part of the effect of these devices on withdrawal, and that the sensory and behavioural components of the e-cigarette are also important. Of interest, current smokers who used the e-cigarette had fewer respiratory symptoms than smokers who did not use it (a difference of 0.54 points on the Clinical COPD Questionnaire), which we speculate might be a consequence of reduced smoking. This difference is substantial, as it is larger than the minimally clinically important difference for this questionnaire (0.4 points) (32), and very close to the difference of 0.6 points previously reported between patients with moderate and severe COPD (31).

Use for other substances

E-cigarettes represent a new way to administer substances to the respiratory tract. However, very few people reported using e-cigarettes to inhale substances other than the liquid designed for that purpose, and when they did, it was only briefly. Of course, some respondents may not have disclosed illicit drug use. Some e-cigarettes have been found to contain tadalafil analogues, rimonabant, and several other substances and medications (3), with unknown effects.

Study limitations

This study was conducted in a self-selected sample of visitors of discussion forums and websites dedicated to e-cigarettes, some of which defend the right to use e-cigarettes in the face of mounting pressure for regulation or prohibition of this product (19, 37, 38). However, organized multiple responding did probably not occur: a check of IP addresses showed that there were few double entries by the same participants, and double entries were deleted. Users enrolled on e-cigarette forums/websites differed from participants enrolled on "neutral" sites on several accounts (mainly smoking status and current use of e-cigarettes), but when taking smoking status into account, the opinions of these two groups did not differ very much. Nevertheless, it is still possible that some respondents gave the answers that they thought might help defend their position (e.g. by reporting more satisfaction, more effects on smoking cessation, fewer concerns about safety). Whether we also over-sampled satisfied users, long-term users or heavy users of e-cigarettes is unknown. Thus, while our results provide new and interesting information, e-cigarettes are probably somewhat less satisfactory and less effective than reflected in these data, and our results should be interpreted with caution and may have limited generalizability. Finally, technology progresses rapidly, and our results may not apply to future models.

Conclusions

E-cigarettes were used mainly by former smokers as an aid to quit smoking and avoid relapse. These products were perceived as satisfactory, useful and efficacious, and almost all users preferred nicotine-containing e-cigarettes. Despite its limitations, this study adds to the still small body of knowledge about e-cigarettes and provides valuable additional information for smokers, clinicians, regulators and policy makers. Further research should address the safety and efficacy of using e-cigarettes to deliver nicotine and other substances, and assess their effectiveness as an aid to quitting and relapse prevention.

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Table 1. Characteristics of study participants: Internet (English and French), March-October 2010

	All	Current smokers	Former smokers	Statistic	p-value	E -cig with nicotine	E-cig without nicotine	Statistic	p-value
Number of respondents	3587	1051	2508			2850	112		
Version (% English)	78.9	65.0	84.8	χ^2=176	<0.001	91.9	67.9	χ^2= 76.4	<0.001
Age*	41 (31, 50)	42 (31, 52)	40 (32, 50)	U= 115164	0.11	41 (31, 50)	42 (31, 51)	U= 145209	0.75
Sex (men, %)	61.3	58.2	62.5	χ^2=5.7	0.017	64.6	47.3	χ^2= 14.0	<0.001
Household income (%)									
Below average	27.7	31.2	26.2	χ^2= 17.6	0.004	28.1	28.5	χ^2= 10.1	0.071
Average	30.9	29.8	31.5			30.9	25.0		
Above average	36.4	32.9	37.9			36.5	36.6		
E-cigarette use:				χ^2=372	<0.001			χ^2=42.8	<0.001
Daily	80.8	61.7	89.2			96.7	84.8		
Occasional (not daily)	2.7	6.3	1.0			2.5	11.6		
Past users	1.3	2.6	0.8			0.8	3.6		
Never users	15.2	29.5	9.0			--	--		
Ever used nicotine therapy (%)	68.1	62.9	70.5	χ^2=36.1	<0.001	69.4	60.4	χ^2= 8.8	0.031
Ever used bupropion (%)	28.0	25.3	29.1	χ^2=7.5	0.058	29.9	32.4	χ^2= 0.7	0.86
Ever used varenicline (%)	18.4	16.2	19.4	χ^2=20.6	<0.001	18.6	22.0	χ^2= 18.5	<0.001
Smoking status									
Daily smokers	19.0					12.1	12.5	χ^2= 14.7	0.002
Occasional (non-daily)	10.5					12.0	9.8		
Former smokers	70.2					75.8	75.9		
Never smokers	0.3					0.1	1.8		
Daily smokers									
Tobacco cigarettes/day now*		15 (10, 20)				15 (8, 20)	12 (7, 20)	U= 2027	0.37
Cig./day before using e-cig*		25 (20,30)				25 (20, 30)	17 (11, 21)	U= 1049	0.001
Minutes to first cig. of the day*		15 (5, 30)				10 (5, 30)	15 (9, 38)	U= 1886	0.25
Sure they could quit smoking if they tried (very sure, %)		11.2				15.0	23.1	χ^2= 2.4	0.48
Decided to quit next 30 d. (%)		35.4				34.4	38.5	χ^2= 1.7	0.63
Now trying to quit smoking (%)		60.1				68.2	64.3	χ^2= 0.1	0.76
Currently trying to reduce cig./day (%)		84.4				94.7	92.9	χ^2= 0.1	0.76
Duration of most recent quit attempt (days)*		21 (3, 122)				21 (2, 91)	21 (1, 274)	U= 1255	0.42
Former smokers									
Days since quit smoking*			107 (41,251)			105 (42, 238)	112 (35, 254)	U= 81142	0.69

* Median (25th and 75th centiles)

Table 2. Utilization patterns among daily e-cigarette users

	All daily e-cig users	Current smokers	Former smokers	Statistic	p-value	E-cig with nicotine	E-cig without nicotine	Statistic	p-value
N daily users	2896	647	2234			2757	95		
Duration current episode of use (days)*	91 (28, 274)	49 (14, 152)	152 (49, 274)	U= 498148	<0.001	91 (28,274)	91 (16, 152)	U= 108394	0.18
Use e-cig minutes after waking*	20 (10, 45)	20 (10, 60)	20 (10, 45)	U= 658777	0.17	20 (10, 45)	30 (15, 90)	U= 90702	<0.001
Puffs per day drawn on e-cig*	120 (80, 200)	100 (70, 200)	120 (80, 200)	U= 611447	0.04	120 (80,200)	100 (50, 200)	U= 103405	0.011
Capacity of refill bottles (ml)*	20 (10, 30)	15 (10, 30)	30 (10, 30)	U= 478601	<0.001	20 (10, 30)	15 (10, 30)	U= 80939	0.20
Nicotine in liquid (mg per ml)*	18 (12, 24)	18 (13, 24)	18 (12, 24)	U= 568704	0.88	18 (12, 24)	0 (0, 0)	U= 4384	<0.001
Bottles per month*	2 (1, 3)	2 (1, 3)	2 (1, 3)	U= 517168	0.001	2 (1, 3)	1.3 (0.5, 4)	U= 82030	0.003
Refills/cartridges per day*	5 (2, 10)	4 (2, 10)	5 (3, 10)	U= 534495	<0.001	5 (2, 10)	3 (1, 10)	U= 91982	0.001
Refill / cartridge lasts? (hours)*	2 (1, 5)	3 (1, 6)	2 (1, 5)	U= 574500	<0.001	2 (1, 5)	3 (1, 12)	U= 102312	0.019
Duration of battery (hours)*	6 (3, 10)	5 (3, 10)	6 (3, 10)	U= 625419	0.37	6 (3, 10)	6 (3, 12)	U= 116736	0.76
Price per kit (USD)*	60 (42, 80)	59 (40, 80)	65 (44, 80)	U= 594056	0.002	60 (42, 80)	67 (41, 106)	U= 108436	0.092
Monthly spending (USD)*	33 (20, 50)	30 (19, 50)	35 (20, 50)	U= 483114	0.004	35 (20, 50)	25 (16, 36)	U= 65295	<0.001
Intends to use for >1 year (%)	45.4	50.2	44.0	χ^2=21.2	0.012	45.4	41.3	χ^2= 44.8	<0.001
Ever used e-cig and tobacco on the same day (%)	65.2	95.7	56.4	χ^2=707	<0.001	65.7	50.0	χ^2= 11.7	0.11
If dual use: duration (days)*	5 (1, 19)	19 (5, 60)	1 (1, 5)	U= 211625	<0.001	5 (1, 19)	5 (1, 19)	U= 39680	0.71

* Median (25th and 75th centiles)

Table 3. Satisfaction with the e-cigarette, in ever users

	All ever users	Current smokers	Former smokers	χ^2	p-value	E-cig with nicotine	E-cig without nicotine	χ^2	p-value
N ever users	3037	740	2279			2850	112		
E-cig helped reduce smoking? (a lot, %)	92.2	86.7	94.3	86.7	<0.001	99.0	88.7	33.0	<0.001
E-cig ever broke down? (often, %)	8.0	11.3	7.0	27.1	<0.001	8.0	5.4	3.9	0.27
Liquid leaks out? (sometimes+often, %)	18.4	21.9	17.2	17.8	0.001	18.1	24.9	9.2	0.057
Would recommend e-cig to a friend (absolutely, %)	94.3	89.9	95.8	44.0	<0.001	94.9	86.2	19.4	0.001
Satisfaction, 0-10 scale (mean)	9.3	8.7	9.5	F=261	<0.001	9.4	9.1	F=8.8	0.003
Burns throat (somewhat+strongly, %)	22.1	23.8	15.7	25.9	<0.001	18.0	10.8	8.9	0.012
Rather + strongly agree (%)									
Still feel urge to smoke when using it	9.5	22.5	5.4	545	<0.001	9.3	9.8	5.7	0.22
Easy to abstain from smoking when using e-cig	88.6	82.4	90.3	536	<0.001	89.3	75.7	32.6	<0.001
Fears that e-cig might be toxic	6.0	9.1	5.1	25.9	<0.001	5.8	8.9	8.4	0.077
Fear that e-cigs will be banned	82.7	80.2	83.5	5.2	0.27	83.6	64.3	36.8	<0.001
Wonders what is composition of e-liquid	25.7	32.2	23.7	35.1	<0.001	25.4	29.7	2.8	0.59
The battery is discharged too quickly	37.0	44.0	34.8	40.4	<0.001	36.9	35.1	4.8	0.31
Refill cartridges are emptied too quickly	44.2	51.2	41.8	28.0	<0.001	44.6	37.3	4.8	0.31
Difficult to adjust nicotine dose with it	8.3	12.9	6.7	119	<0.001	8.0	--	--	--
Likes the taste of e-cig	91.2	86.3	92.6	50.0	<0.001	91.7	85.7	10.3	0.036
Likes sensation when inhales vapor	91.4	87.3	92.8	79.7	<0.001	92.0	86.6	13.5	0.009
Uses it because it causes no bad odors	89.6	89.5	89.7	12.8	0.012	90.1	83.6	14.9	0.005
E-cig causes a dry mouth/throat	26.2	29.1	25.1	8.5	0.07	26.4	24.3	5.5	0.24
Should provide faster relief of craving	9.7	17.5	7.4	116	<0.001	9.6	9.3	8.3	0.080
E-cig should provide more nicotine	4.2	7.9	3.0	69.1	<0.001	4.4	0.9	32.8	<0.001
Vapor should be more concentrated	19.7	28.3	16.9	67.4	<0.001	19.2	27.0	12.1	0.017
It should be easier to draw on e-cig	20.4	29.3	17.5	75.7	<0.001	20.1	27.0	9.2	0.057
Is afraid of becoming addicted to e-cig	7.7	10.0	7.0	11.5	0.021	7.8	1.8	18.3	0.001
Former smokers: Fears that will start smoking again if stopped using it	--	--	79.2	--	--	80.0	63.9	26.5	<0.001
Did e-cig help you stop smoking? (a lot + definitely, %)	--	--	96.0	--	--	96.4	90.6	62.2	<0.001

Table 4. Reasons for using the electronic cigarette, among ever users

Among ever e-cig users: I use (used) the e-cig ... (very true, %)	All ever users	Current smokers	Former smokers	χ^2	p-value	E-cig with nicotine	E-cig without nicotine	χ^2	p-value
N ever users	3037	740	2279			2850	112		
E-cig less toxic than tobacco	83.5	81.1	84.3	5.2	0.16	84.5	64.2	55.3	<0.001
To deal with craving for tobacco	79.0	77.3	79.7	2.3	0.52	80.1	61.5	28.0	<0.001
To quit smoking or avoid relapsing	76.8	57.7	83.0	207	<0.001	77.2	69.6	6.9	0.075
To deal with withdrawal symptoms	66.5	60.2	68.7	17.8	<0.001	67.7	40.9	39.5	<0.001
E-cig cheaper than smoking	57.3	53.8	58.4	8.2	0.041	58.2	43.9	32.6	<0.001
To avoid bothering others with tobacco smoke	43.6	42.4	44.0	5.4	0.14	44.0	38.7	6.1	0.11
To deal with situations where one cannot smoke (at work, etc.)	39.4	45.6	37.4	22.5	<0.001	39.9	30.0	21.5	<0.001
To avoid having to go outside to smoke	34.4	36.9	33.6	14.0	0.003	34.9	29.1	24.7	<0.001
To reduce tobacco consumption in preparation of a quit attempt	27.8	42.4	23.0	169	<0.001	17.8	28.2	15.2	0.002
To reduce tobacco consumption with *no* intention to quit smoking	20.3	23.5	19.2	94.6	<0.001	20.5	15.6	13.7	0.003
Because is unable to stop using it	4.4	4.4	4.4	3.3	0.35	4.5	2.8	4.9	0.18

Table 5. Relief of withdrawal symptoms, in those who used e-cigarettes during an attempt to quit smoking

In those reporting "moderate" and "severe" symptoms, did e-cigarette relieve it? % (N) "a lot" on 5-pt scale	All ever users	Current smokers	Former smokers	χ^2	p-value	E-cig with nicotine	E-cig without nicotine	χ^2	p-value
	% (N)	% (N)	% (N)			% (N)	% (N)		
Craving to smoke	90.0	75.7	94.5	104	<0.001	90.7	76.9	18.1	<0.001
	(1457)	(342)	(1112)			(1378)	(52)		
Angry, irritable, frustrated	82.5	70.5	85.8	30.6	<0.001	83.2	78.1	3.4	0.33
	(1089)	(227)	(858)			(1033)	(32)		
Anxious, nervous	80.8	64.5	85.4	52.8	<0.001	81.4	71.4	11.7	0.009
	(1078)	(231)	(844)			(1022)	(35)		
Restless, impatient	77.9	65.0	81.6	42.2	<0.001	78.9	68.6	9.1	0.028
	(950)	(203)	(744)			(889)	(35)		
Difficulty concentrating	74.0	63.4	77.0	14.4	0.002	74.8	64.0	2.0	0.56
	(773)	(161)	(609)			(731)	(25)		
Depressed mood, sad	70.9	59.8	74.0	12.0	0.007	71.4	71.4	5.1	0.16
	(622)	(123)	(497)			(581)	(21)		
Insomnia, sleep problems	53.4	44.2	56.0	8.1	0.044	54.1	43.5	21.4	<0.001
	(573)	(114)	(455)			(532)	(23)		
Appetite, hungry, weight gain	52.7	42.1	55.7	9.5	0.023	52.8	48.4	0.7	0.87
	(733)	(146)	(583)			(685)	(31)		

Table 6. Comparison of participants enrolled on e-cigarette forums with those enrolled on other websites

Selected variables	Enrolled on e-cig forums	Enrolled on Stop-tabac or Google	Statistic	p-value
N	1005	83		
Smoking status (%)				
Daily smokers	14.5	48.8	χ^2=72.5	<0.001
Occasional (non-daily)	13.0	4.9		
Former smokers	72.3	43.9		
Never smokers	0.3	2.4		
E-cigarette use (%)				
Daily	93.2	30.1	χ^2=456.8	<0.001
Occasional (not daily)	3.1	1.2		
Past users	1.0	1.2		
Never users	2.7	67.5		
In daily e-cigarette users				
Use e-cig containing nicotine (%)	97.6	100	χ^2=0.6	0.45
Duration current episode of use (days)*	91 (21, 274)	14 (5, 152)	U=6164	0.003
Puffs per day drawn on e-cig*	100 (70, 200)	200 (65, 300)	U=7696	0.15
Bottles of e-liquid per month*	1.5 (1, 3)	1.5 (1, 3)	U=7546	0.94
Refill / cartridge lasts? (hours)*	3 (1, 6)	3.5 (2, 8)	U=8876	0.17
In ever users				
E-cig helped reduce smoking? (a lot, %)	93.2	80.8	χ^2=13.1	0.011
Satisfaction, 0-10 scale (mean)	9.4	8.9	t=2.1	0.03
Would recommend e-cig to a friend (absolutely, %)	95.5	88.5	χ^2=49.7	<0.001
Burns throat (somewhat+strongly, %)	17.9	41.6	χ^2=34.5	<0.001
Fears that e-cig might be toxic	6.3	18.5	χ^2=9.4	0.052
In ex-smokers: e-cig helped quit smoking (a lot + definitely, %)	96.1	93.3	χ^2=11.5	0.02
Opinions (agree, %)				
Fear that e-cigs will be banned	86.0	84.6	χ^2=4.5	0.34
E-cig causes a dry mouth/throat	23.9	33.3	χ^2=4.7	0.32
Should provide faster relief of craving	6.7	4.3	χ^2=3.5	0.32
Afraid of becoming addicted to e-cig	6.8	14.8	χ^2=11.9	0.02
Reasons for using e-cig (very true, %)				
E-cig less toxic than tobacco	85.4	77.8	χ^2=4.7	0.20
To deal with craving for tobacco	82.4	88.9	χ^2=1.7	0.64
To quit smoking or avoid relapsing	76.8	84.6	χ^2=2.4	0.49
To deal with withdrawal symptoms	66.5	76.9	χ^2=3.5	0.33

* Median (25^{th} and 75^{th} centiles)