

Reasons for regular vaping and for its discontinuation among smokers and recent ex-smokers: findings from the 2016 ITC Four Country Smoking and Vaping Survey

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ABSTRACT

Aims To examine current and ex-smokers' reasons for continuing or discontinuing regular use of nicotine vaping products (NVPs). **Design and participants** Cross-sectional study of 2722 current daily/weekly, and 921 ex-daily/weekly, adult vapers who were either current or ex-cigarette smokers when surveyed. **Setting** 2016 ITC Four Country Smoking and Vaping wave 1 (4CV1) surveys conducted in the United States ($n = 1159$), England ($n = 1269$), Canada ($n = 964$) and Australia ($n = 251$). **Measurements** Current vapers were asked about the following reasons for regular NVP use: less harmful to others, social acceptance, enjoyment, use in smoke-free areas, affordability and managing smoking behaviour. Ex-vapers were asked about the following reasons for discontinuing regular NVP use: addiction concerns, affordability, negative experiences, perceived social unacceptability, safety concerns, product dissatisfaction, inconvenience, unhelpfulness for quitting, unhelpfulness for managing cravings and not needed for smoking relapse prevention. Possible correlates of NVP use and discontinuation, including smoking status, smoking/vaping frequency, quit duration (ex-smokers only), country, age and type of NVP device used, were examined using multivariate logistic regression models. **Findings** For current smokers, the top three reasons for current regular NVP use were: helpful for cutting down smoking (85.6%), less harmful to others (77.9%) and helpful for quitting smoking (77.4%). The top three reasons for discontinuing vaping were: not being satisfying (77.9%), unhelpfulness for cravings (63.2%), and unhelpfulness for quitting smoking (52.4%). For ex-smokers, the top three reasons for current vaping were: enjoyment (90.6%), less harmful to others (90%) and affordability (89.5%); and for discontinuing were: not needed to stay quit (77.3%), not being satisfying (49.5%) and safety concerns (44%). Reported reasons varied by user characteristics, including age, country and NVP device type. **Conclusions** Regular use of nicotine vaping products is mainly motivated by its perceived benefits, especially for reducing or quitting smoking, whereas its discontinuation is motivated by perceived lack of such benefits, with some variation by user characteristics.

Keywords Discontinuation, ex-smokers, nicotine products, use reasons, vaping, vaping current smokers.

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INTRODUCTION

The world-wide popularity of nicotine vaping products (NVPs, e.g. e-cigarettes) has increased dramatically in recent years, with the majority of users being current and former smokers [1]. Although the availability of NVPs has been a divisive issue in the tobacco control community [2,3], limited evidence suggests that NVPs may be an effective cessation aid [4], leading some to advocate their potential for harm reduction [5]. However, there is a current lack

of sufficient understanding of why, and among whom, regular use of NVPs occurs. That is, whether smokers and ex-smokers are primarily using NVPs for smoking cessation, compared with recreational use, or other reasons. Similarly, there is limited research that has explored why people discontinue using NVPs which, for smokers, can provide insight into the limits of current NVPs as potential substitutes for smoking, and for ex-smokers can help clarify the perceived utility of NVPs for cessation maintenance and longer-term use.

To date, several studies have examined people's motivations for using NVPs. Current and former smokers often cite the potential for NVPs to help them quit or cut down smoking, and perceive them as less harmful than cigarettes [1,6–12]. They also report using NVPs to evade smoke-free policies because they are cheaper than cigarettes, for the flavours, lack of odour, safety for bystanders and out of curiosity [1]. Reasons can also vary, based on the user's age and choice of the type of NVP. For example, older adults [13,14] and open tank system users [14] are more likely to cite smoking cessation as their reason for vaping compared to younger adults and those using disposable closed system NVPs. However, most studies emphasize reasons for initiating NVP use rather than for ongoing NVP use, or in some cases conflate the two, making it difficult to know what the main drivers are of continued use.

Similarly, only a small number of studies have examined why people stop using NVPs [7,9,11,15–17]. While some past vapers report that they only ever intended casual/experimental use [9,16], many report dissatisfaction with the quality or utility of NVPs [9,11,16], including that NVPs were not helpful for reducing cravings or quitting smoking, or were not a satisfying substitute for smoking cigarettes or using other tobacco products. Other reasons include not needing NVPs any more to sustain abstinence from cigarettes [11]; thinking they would not relapse to smoking even if they stopped using NVPs [11]; the high perceived cost of NVPs [9,17]; or concerns about potential health effects [11,17]. Thus, there appear to be many reasons for discontinuation of NVP use, which probably depends on the user's characteristics, as well as their expectations and experiences of NVPs.

Taking into account the heterogeneity of smokers and vapers is an important—and often overlooked—aspect of much of the published literature. Reasons for continued or discontinued use of NVPs would probably vary as a function of the user's age, smoking status, quit duration and/or vaping frequency. Using the 2015 International Tobacco Control (ITC) survey data from the United Kingdom and Australia, Ma *et al.* [18] found that factors influencing intentions to vape varied as a function of whether people were smoking only, vaping only, dual users or non-users of either product, underscoring the need to examine groups by smoking and vaping status. Biener *et al.* [17] found that among a sample of young adults in the United States, reasons for discontinuation of vaping varied by smoking status. Current smokers reported stopping because vaping was too expensive, they liked another tobacco product better and it was not strong enough, whereas for former smokers, the reasons for stopping included that vaping was bad for their health, it made them feel sick and they preferred another product (tobacco product).

Developing a better understanding of reasons for NVP use can help to inform practice and regulatory decisions by providing a more accurate picture of how and why NVPs are being used by smokers and recent quitters (e.g. for smoking cessation versus recreation). Further, examining reasons why regular users stop using NVPs will provide more meaningful information (rather than focusing on experimenters) as to the potential of NVPs as a smoking substitute or cessation aid. It is also useful to monitor reasons for discontinuation over time, given the evolution of the NVP market.

The present study uses data from the 2016 ITC Four Country Smoking and Vaping wave 1 (4CV1) surveys conducted in the United States, England, Canada and Australia to examine reasons for current regular (i.e. at least weekly) use, and for discontinuing regular use, of NVPs among current smokers and recent ex-smokers. We will also explore whether reasons for regular vaping and discontinuing use differ by vaping frequency, user's age, device type, smoking frequency (among smokers only) and quit duration (ex-smokers only). NVP regulatory policies are evolving in the four countries studied, with the United States and England at the time of the survey having less restrictive policies towards the sale and marketing of NVPs as opposed to the more restrictive policy environment in Australia and Canada. However, in Canada the law restricting the sale of NVPs in retail locations is under transition, and at the time of our survey was not being enforced, allowing vape shops to flourish [19]. Thus, reasons for vaping and discontinuing vaping may differ across countries depending on the regulatory environment impacting access to NVPs.

METHODS

Design and sample

Study participants came from the 2016 ITC 4CV1 survey, which is an expansion of the previous ITC 4 Country Project that included adult smokers (aged 18+) from the United States, England, Canada and Australia. Methodological details for the 4CV1 study are described in the Thompson *et al.* supplemental methods paper [20] and are also available in a technical report [21]. In brief, the ITC 4CV1 sample in each country was designed to be as representative as possible of smokers and NVP users (e.g. by age and sex), and comprises the following respondents: (1) re-contacted smokers and quitters who participated in the previous cohort of the ITC 4 Country Project [22], regardless of NVP use, (2) newly recruited current smokers and recent quitters (quit smoking during the past 24 months), regardless of NVP use and (3) newly recruited current NVP users (use at least weekly). Newly recruited respondents were from online panels using either probability-based sampling frames or non-probability opt-in panels, or a combination of these. The response rates

for replenishment samples ranged from 15.2 to 49.6% by country [20].

Given the focus on understanding motivations behind regular (rather than occasional/experimental) use of NVPs (either currently or in the past), and the fact that only a small number were using nicotine-free NVPs, the analytical sample ($n = 3643$ consisting of 1159, 1269, 964 and 251 from the United States, England, Canada and Australia, respectively) was limited to participants who reported ever using vaping products with nicotine on a daily/weekly basis (2722 current vapers and 921 ex-vapers). This sample was divided into four groups based on their smoking and vaping status at the time of the 4CV1 survey: (1) smoking vapers ($n = 2283$) defined as currently both smoking and vaping on a daily/weekly basis; (2) ex-smoking vapers ($n = 439$) defined as currently vaping daily/weekly but not currently smoking; (3) smoking ex-vapers ($n = 764$) defined as currently smoking daily/weekly, vaping daily/weekly in the past but not currently vaping at all; and (4) ex-smoking ex-vapers ($n = 157$) defined as vaping and smoking daily/weekly in the past but not currently doing either. To fulfil a different research goal, these four groups were defined differently to those in Borland *et al.* [23] in this Supplement.

Measures

Main outcomes

The survey asked a range of smoking- and vaping-related questions, including reasons for using or stopping the use

of NVPs (e-cigarettes), to which respondents had to answer 'yes' or 'no', with refusal/don't know responses coded as 'no' (see Table 1 for details). Preliminary correlational analysis indicated that the question items were low to moderately correlated with each other ($r = 0.20$ – 0.50 for reasons to vape items and $r = 0.01$ – 0.49 for reasons to stop vaping items), justifying keeping them as individual items rather than grouping them into a smaller number of meaningful categories. Nevertheless, in order to examine quitting as the primary reason from other reasons for continuation or discontinuation of vaping, we created two composite measures: (1) a three-category quit–reduce composite measure, coded as all who mentioned 'quitting smoking' as a reason to vape, those who mentioned cutting down but not quitting and all who mentioned neither; and (2) a three-category quit–craving composite measure based on responses to the 'no help for quitting smoking' and 'no use to stop cravings' as reasons to stop vaping, coded as those who mentioned both reasons, those who mentioned either reason and those who mentioned neither.

Covariates

These included age, sex, income, education, ethnicity (white versus non-white or English-speaking versus non-English-speaking in Australia), country, smoking frequency (daily versus non-daily, smokers only), vaping frequency (daily versus non-daily), NVP device type currently used most/last used [closed system devices that are disposed of after use (referred to as disposables);

Table 1 Survey questions assessing reasons for vaping and for stopping vaping.

Topic	Question wording	Asked of smokers/ex-smokers
<i>Reasons to vape</i>		
Less harmful to others	Vaping is less harmful than smoking to other people around me	Both
More acceptable	Vaping is more acceptable than smoking to people around me	Both
Enjoyment	I enjoy vaping	Both
Use in smoke-free area	I can vape in places where I can't smoke	Both
More affordable	I save money by vaping instead of smoking	Both
Help cut down	Vaping helps me cut down on the number of cigarettes I smoke	Smokers only
Help quit smoking	Vaping might help me stop smoking eventually	Smokers only
Help stay quit	Vaping might help me stay quit	Ex-smokers only
<i>Reasons to stop vaping</i>		
Becoming addicted	I felt myself becoming addicted to vaping	Both
Cost too much	E-cigarettes cost too much	Both
Negative experiences	I had some negative experiences using them	Both
Uncomfortable in public	I felt uncomfortable using them in public	Both
Safety concerns	I was concerned about the safety of using them (overheating, spilling/leaking liquids, etc.)	Both
Not satisfying	I didn't find them satisfying enough	Both
Too much effort	I found it all to be too much effort	Both
No help for quitting	I decided that they were not going to help me quit smoking	Smokers only
No use to stop cravings	They didn't help deal with cravings to smoke	Smokers only
Not needed to stay quit	I no longer needed them to keep from smoking	Ex-smokers only

rechargeable devices that use replaceable pre-filled cartridges of (referred to as pre-filled cartridge systems) rechargeable devices that allow for refillable e-liquids (referred to as open tank systems)], quit interest (smokers only), quit duration (quit < 1 year versus quit > 1 year, ex-smokers only) and sample source (ITC cohort, commercial panels, and US opt-in).

Statistical analysis

All analyses were conducted using Stata version 14. Multivariate logistic regression analyses were conducted to examine the independent association of smoking frequency (smokers only), quit duration (ex-smokers only), vaping frequency (current vapers only), country of residence, age group and device type, with endorsement of each of the reasons for vaping. Similar analyses were also conducted for reasons for stopping vaping but limited to smokers, as the sample size for ex-smokers was too small to obtain reliable estimates. All regression models controlled for: income, education, ethnicity, gender, quit interest (smokers only) and sampling recruitment source. Cases with any missing data were removed from the regression analyses. The margins command was employed to compute prevalence estimates of adjusted predictions at means for both reasons to vape and reasons to stop vaping and, where possible, differences by smoking status in prevalence estimates were also tested. Survey sampling weights calibrated using national benchmark surveys were used to adjust all prevalence estimates to be representative of the relevant populations in each country (see Thompson *et al.* [20] for details on weights).

Additional analyses were conducted to estimate the association of the quit–reduce composite measure with quit intentions and wanting to quit among current smokers who vaped, to help validate that vaping for smoking cessation and/or smoking reduction served as indices of quit motivations. Similarly, we also estimated the association of the quit–craving composite measure with each of the other stated reasons for stopping vaping to determine their overlap. All confidence intervals (CIs) and statistical significance were tested at the 95% confidence level.

Ethics approval

The survey protocols and all materials, including the survey questionnaires, were cleared for ethics by the Research Ethics Office, King's College London, UK; the Office of Research Ethics, University of Waterloo, Canada; and the Human Research Ethics, Cancer Council Victoria, Australia. All participants provided consent to participate.

RESULTS

Sample characteristics

Throughout all countries, smoking vapers were more likely to be daily smokers, aged 18–39 years, and male. Approximately half expressed an interest in quitting tobacco cigarettes (see Table 2). The likelihood of being an ex-smoking vaper tended to increase with age, and was more common among women in all countries except Australia. The majority of ex-smoking vapers had quit smoking more than 12 months prior to the survey. Throughout all countries, most ex-vapers who currently smoked were older and most smoked daily, with more than one-third expressing interest in quitting. Ex-vapers who were also ex-smokers were mainly aged 40–54 years, women, and had quit in the past year.

Reasons for current vaping

For current smokers, the top three reasons for current regular vaping (Fig. 1) were help with cutting down smoking (85.6%), less harmful to others (77.9%) and help with quitting smoking (77.4%). Approximately 23% of the smoking–vaper sample did not nominate quitting as a reason, of whom 6% vaped to cut down smoking but not to quit, and the remaining 17% vaped only for other reasons. The top reasons for current regular vaping among all ex-smokers (Fig. 1) were enjoyment (90.6%), less harmful to others (90.0%), affordability (89.5%) and help to stay quit (88.3%).

When compared to current smokers who vaped regularly, their ex-smoker counterparts were significantly more likely to cite vaping being less harmful to others [adjusted odds ratio (aOR) = 1.68, 95% CI = 1.06–2.66, $P = 0.027$] and also more likely to vape regularly for enjoyment (aOR = 2.25, 95% CI = 1.45–3.50, $P < 0.001$) (Fig. 1). These two groups did not differ on other common reasons for vaping regularly except for a marginal effect on affordability, whereby ex-smokers were more likely to cite affordability as a reason to vape than current smokers (aOR = 1.45, 95% CI = 1.00–2.11, $P = 0.052$).

Current smokers

Among current smokers, daily vapers were more likely than non-daily vapers to endorse help with quitting smoking (aOR = 1.71, 95% CI = 1.31–2.23, $P < 0.001$), cutting down smoking (aOR = 1.41, 95% CI = 1.06–1.88, $P = 0.019$), enjoyment (aOR = 2.18, 95% CI = 1.69–2.80, $P < 0.001$), affordability (aOR = 1.43, 95% CI = 1.12–1.83, $P = 0.004$) and being more acceptable than smoking (aOR = 1.30, 95% CI = 1.02–1.67, $P = 0.037$) as reasons for vaping (Table 3a).

Compared to Australian smokers, Canadian and English smokers were less likely to endorse help with quitting

Table 2 Sample characteristics by smoking and vaping status for each country separately and combined.

Variables (%)	Smoking vapers					Ex-smoking vapers					Smoking ex-vapers					Ex-smoking ex-vapers				
	US	EN	CA	AU	Total	US	EN	CA	AU	Total	US	EN	CA	AU	Total	US	EN	CA	AU	Total
	n = 779	n = 730	n = 658	n = 116	n = 2283	n = 137	n = 169	n = 97	n = 36	n = 439	n = 211	n = 312	n = 156	n = 85	n = 764	n = 32	n = 58	n = 53	n = 14	n = 157
Age group (years)																				
18–24	27.0	35.2	25.8	4.3	28.1	2.9	5.9	12.4	8.3	6.6	18.5	9.6	18.0	2.4	13.0	3.1	8.6	18.9	0	10.2
25–39	44.9	30.3	34.8	33.6	36.8	17.5	12.4	22.7	22.2	17.1	19.0	23.7	18.6	21.2	21.1	28.1	37.9	28.3	21.4	31.2
40–54	12.2	16.3	28.6	41.4	19.7	24.1	27.8	40.2	36.1	30.1	21.8	32.4	26.9	31.8	28.3	36.4	29.0	30.7	44.4	32.6
55+	15.9	18.2	10.8	20.7	15.4	55.5	53.9	24.7	33.3	46.2	40.8	34.3	36.5	44.7	37.7	34.4	25.9	25.5	28.6	27.4
Female	43.5	31.8	45.6	31.9	39.8	52.6	52.1	57.7	36.1	52.2	49.3	54.8	53.2	52.9	52.8	46.9	51.7	62.3	71.4	56.1
White	77.7	89.2	74.7	74.8	80.3	93.3	97.0	93.8	94.4	94.9	81.9	94.6	87.9	94.1	89.7	80.7	98.3	86.8	92.9	90.4
Income																				
Low	23.6	20.4	22.3	17.2	21.9	27.0	17.8	18.6	11.1	20.3	37.4	22.4	23.7	23.5	26.9	34.4	22.4	18.9	21.4	23.6
Medium	24.3	26.6	31.8	24.1	27.2	24.8	35.5	21.7	25.0	28.3	26.5	34.9	25.6	30.6	30.2	31.3	27.6	28.3	28.6	28.7
High	51.7	47.8	40.7	54.3	47.4	46.0	38.5	51.6	61.1	45.6	36.0	36.9	39.7	42.4	37.8	34.4	46.6	50.9	50.0	45.9
No information	0.4	5.2	5.2	4.3	3.5	2.2	8.3	8.2	2.8	5.9	0	5.8	10.9	3.5	5.0	0	3.4	1.9	0	1.9
Education																				
Low	25.0	21.8	27.0	20.0	24.3	33.6	27.6	36.1	36.1	32.1	36.0	34.3	38.3	32.9	35.4	34.4	31.0	26.4	35.7	30.6
Medium	29.1	39.1	40.5	40.0	36.1	34.3	43.6	43.3	38.9	40.2	44.6	38.2	43.5	43.5	41.6	43.8	32.8	54.7	57.1	44.6
High	45.8	39.1	32.5	40.0	39.6	32.1	28.8	20.6	25.0	27.7	19.4	27.5	18.2	23.5	22.9	21.9	36.2	18.9	7.1	24.8
Smoking frequency																				
Daily	82.7	79.5	77.2	87.9	80.3	NA	NA	NA	NA	NA	93.4	94.2	96.8	97.7	94.9	NA	NA	NA	NA	NA
Weekly	17.3	20.5	22.8	12.1	19.7	NA	NA	NA	NA	NA	6.6	5.8	4.2	2.3	5.1	NA	NA	NA	NA	NA
Quit smoking duration																				
Quit ≤ 12 months	NA	NA	NA	NA	NA	16.8	32.5	42.3	36.1	30.1	NA	NA	NA	NA	NA	65.6	72.4	47.2	57.1	61.2
Quit > 12 months	NA	NA	NA	NA	NA	83.2	67.5	57.7	63.9	69.9	NA	NA	NA	NA	NA	34.4	27.6	52.8	42.9	38.9
Vaping frequency																				
Daily	55.9	55.8	42.4	51.7	51.8	91.2	92.3	65.0	94.4	86.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Weekly	44.1	44.2	57.6	48.3	48.2	8.8	7.7	35.1	5.6	13.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Quit smoking																				
Interest Yes	49.4	50.9	47.0	54.3	49.5	NA	NA	NA	NA	NA	37.9	36.9	41.7	32.9	37.7	NA	NA	NA	NA	NA

Percentages are unweighted. NA = not applicable; US = United States; EN = England; CA = Canada; AU = Australia.

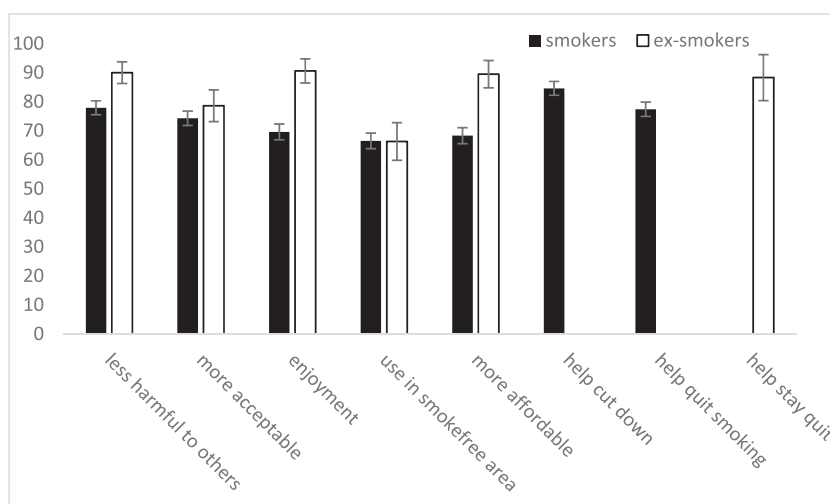


Figure 1 Reasons for regular vaping by smoking status

smoking (aOR = 0.54, 95% CI = 0.31–0.96, $P = 0.036$; and aOR = 0.47, 95% CI = 0.27–0.84, $P = 0.010$, respectively) and enjoyment (aOR = 0.54, 95% CI = 0.31–0.95, $P = 0.032$; and aOR = 0.39, 95% CI = 0.22–0.69, $P = 0.001$, respectively) as reasons to vape (Table 3a). Canadian and US smokers were also less likely to endorse affordability as a reason compared to their Australian counterparts (aOR = 0.42, 95% CI = 0.23–0.76, $P = 0.004$; and aOR = 0.54, 95% CI = 0.29–0.99, $P = 0.047$, respectively).

Smokers aged 40+ were significantly more likely than 18–24-year-olds to cite help with cutting down smoking (40–54-year-olds: aOR = 1.93, 95% CI = 1.23–3.01, $P = 0.004$; 55+-year-olds: aOR = 3.31, 95% CI = 1.87–5.84, $P < 0.001$) and affordability (40–54-year-olds: aOR = 1.49, 95% CI = 1.03–2.16, $P = 0.035$; 55+-year-olds: 1.55, 95% CI = 1.02–2.34, $P = 0.038$) and less likely to endorse enjoyment (40–54-year-olds: AOR = 0.64, 95% CI = 0.44–0.94, $P = 0.021$; 55+-year-olds: aOR = 0.37, 95% CI = 0.25–0.56, $P < 0.001$) as reasons for vaping (Table 3a).

Compared to disposable users, respondents who used open tank system devices were more likely to endorse help to quit smoking (aOR = 2.19, 95% CI = 1.45–3.29, $P < 0.001$), help cutting down (aOR = 2.91, 95% CI = 1.87–4.53, $P < 0.001$), enjoyment (aOR = 1.88, 95% CI = 1.26–2.81, $P = 0.002$) and affordability (aOR = 2.91, 95% CI = 1.97–4.30, $P < 0.001$) as reasons for vaping (Table 3a). Open tank system users were also more likely than pre-filled cartridge users to endorse help to quit smoking (aOR = 1.56, 95% CI = 1.17–2.07, $P = 0.002$), help cutting down (aOR = 2.20, 95% CI = 1.59–3.06, $P < 0.001$), social acceptability (aOR = 1.32, 95% CI = 1.00–1.75, $P = 0.050$), enjoyment (aOR = 1.34, 95% CI = 1.02–1.77, $P = 0.036$) and affordability (aOR = 1.94, 95% CI = 1.48–2.55, $P < 0.001$) as

reasons for vaping. Like open tank system users, pre-filled cartridge users were also more likely than disposable users to cite affordability as a reason to vape (aOR = 1.50, 95% CI = 1.03–2.19, $P = 0.036$).

Compared to those vaping for other reasons, those endorsing help with quitting were significantly more likely to have intentions to quit smoking (aOR = 3.45, 95% CI = 2.45–4.85, $P < 0.001$, results not shown in the table) and to also report wanting to quit (aOR = 3.27, 95% CI = 2.05–5.22, $P < 0.001$). However, those who endorsed cutting down but not to quit did not differ on these measures to those only reporting other reasons for vaping (aOR = 1.06, 95% CI = 0.62–1.81, $P = 0.822$ for intending and aOR = 1.48, 95% CI = 0.72–3.04, $P = 0.287$ for wanting to quit).

Ex-smokers

Ex-smokers who vaped daily were more likely to cite enjoyment (aOR = 3.42, 95% CI = 1.40–8.36, $P = 0.007$) and affordability (aOR = 2.83, 95% CI = 1.05–7.66, $P = 0.041$) as a reason than their weekly counterparts (Table 3b). Those who had quit more than 1 year ago were more likely to endorse enjoyment (aOR = 4.78, 95% CI = 2.19–10.40, $P < 0.001$), less harmful to others (aOR = 4.06, 95% CI = 1.74–9.51, $P = 0.001$) and use in smoke-free areas (aOR = 1.97, 95% CI = 1.07–3.61, $P = 0.030$) as a reason than those who had quit in the past year.

Ex-smokers aged 25+ were less likely to vape regularly because vaping is less harmful to others than those aged 18–24 (25–39-year-olds: aOR = 0.08, 95% CI = 0.01–0.84, $P = 0.035$; 40–54-year-olds: aOR = 0.07, 95% CI = 0.01–0.60, $P = 0.016$; 55+-year-olds: aOR = 0.10, 95% CI = 0.01–0.89, $P = 0.039$, see Table 3b). Compared to 18–24-year-olds, older ex-smokers (25+ years) were

Table 3 Reasons for current regular vaping among smokers (a) and ex-smokers (b).

(a) Smokers' reasons to vape regularly	Daily vapers n = 1175	Weekly vapers n = 1094	Daily smokers n = 1822	Weekly smokers n = 447	CA n = 654	US n = 772	EN n = 728	AU n = 115	18-24 years n = 637	25-39 years n = 833	40-54 years n = 449	55+ years n = 350	Disposable n = 304	Pre-filled cartridge n = 877	Open tank-system n = 1088	Total N = 2269
Less harmful to others (%)	79.5	75.9	78.0	77.2	74.3	82.1	76.0	77.0	80.9	79.2	73.3	79.7	74.5	75.9	79.7	77.9
aOR	1.23	ref	1.05	ref	0.86	1.37	0.94	ref	ref	0.90	0.65*	0.92	ref	1.08	1.35	
More acceptable (%)	76.6	71.6	74.4	73.9	73.8	72.7	76.6	73.4	71.6	72.6	75.0	77.3	71.4	71.3	76.7	74.3
aOR	1.30*	ref	1.03	ref	1.02	0.96	1.18	ref	ref	1.05	1.19	1.35	ref	0.99	1.32	
Enjoyment (%)	76.8	60.3	68.5	74.0	69.8	73.4	62.4	81.0	78.2	72.8	69.8	57.3	59.3	67.1	73.3	69.6
aOR	2.18***	ref	0.76	ref	0.54*	0.65	0.39**	ref	ref	0.74	0.64*	0.37***	ref	1.40	1.88**	
Use in smoke-free areas (%)	67.9	65.0	65.7	70.3	59.7	66.9	72.8	63.0	62.5	67.3	68.0	66.0	69.3	65.4	66.6	66.5
aOR	1.14	ref	0.81	ref	0.87	1.19	1.57	ref	ref	1.23	1.27	1.16	ref	0.84	0.88	
More affordable (%)	71.9	64.0	68.4	67.8	60.5	66.3	75.4	78.4	60.8	68.5	69.8	70.6	51.4	61.3	75.5	68.3
aOR	1.43**	ref	1.03	ref	0.42**	0.54*	0.84	ref	ref	1.40	1.49*	1.55*	ref	1.50*	2.91***	
Help cut down (%)	86.6	82.1	85.0	82.3	83.8	84.4	84.8	88.4	75.4	81.3	85.5	91.0	73.8	78.8	89.1	85.6
aOR	1.41*	ref	1.22	ref	0.68	0.71	0.73	ref	ref	1.42	1.93**	3.31***	ref	1.32	2.91***	
Help quit smoking	81.5	72.1	77.4	77.5	77.3	78.1	74.8	86.3	72.8	77.8	78.5	78.1	66.8	73.8	81.4	77.4
aOR	1.71***	ref	0.99	ref	0.54*	0.57	0.47*	ref	ref	1.32	1.37	1.34	ref	1.40	2.19***	
(b) Ex-smokers' reasons to vape regularly:																
Daily vapers n = 343		Weekly vapers n = 59	Quit ≤ 1 year n = 117	Quit > 1 year n = 285	CA n = 88	US n = 129	EN n = 150	AU n = 35	18-24 years n = 22	25-39 years n = 72	40-54 years n = 122	55+ years n = 186	Disposable n = 11	Pre-filled cartridge n = 77	Open tank-system n = 314	Total N = 402
Less harmful to others (%)	91.1	80.8	77.8	93.4	92.9	80.1	92.1	94.1	99.0	89.0	86.1	90.4	88.7	87.5	90.5	90.0
aOR	2.43	ref	ref	4.06**	0.83	0.25	0.73	ref	ref	0.08*	0.07*	0.10*	-	ref	1.36	

(Continues)

Table 3. (Continued)

(b) Ex-smokers' reasons to vape regularly:		Daily vapers n = 343	Weekly vapers n = 59	Quit ≤ 1 year n = 117	Quit > 1 year n = 285	CA n = 88	US n = 129	EN n = 150	AU n = 35	18–24 years n = 22	25–39 years n = 72	40–54 years n = 122	55+ years n = 186	Disposable n = 11	Prefilled cartridge n = 77	Open tank-system n = 314	Total N = 402
More acceptable (%)		79.8	71.5	72.0	81.5	80.3	69.7	81.7	85.0	74.3	75.6	75.7	83.7	73.2	86.1	76.8	78.6
aOR		1.57	ref	ref	1.71	0.72	0.40	0.78	ref	ref	1.07	1.08	1.77	–	ref	0.53	
Enjoyment (%)		92.0	77.1	77.1	94.1	84.6	88.8	92.7	94.2	99.2	91.3	90.4	85.8	63.5	82.1	92.2	90.6
aOR		3.42**	ref	ref	4.78***	0.34	0.48	0.78	ref	ref	0.08*	0.08*	0.05**	–	ref	2.57*	
Use in smoke-free areas (%)		68.7	51.4	55.6	71.1	52.5	68.9	70.7	62.1	49.8	70.3	61.2	69.8	63.0	62.1	67.3	66.3
aOR		2.07	ref	ref	1.97*	0.67	1.35	1.47	ref	ref	2.39	1.59	2.32	–	ref	1.26	
More affordable (%)		90.9	77.8	85.9	90.9	83.4	84.9	93.6	86.6	84.3	88.8	88.5	91.3	74.5	70.1	92.1	89.5
aOR		2.83*	ref	ref	1.63	0.78	0.87	2.26	ref	ref	1.49	1.44	1.97	–	ref	4.94***	
Subset asked#:		n = 173	n = 30	n = 115	n = 88	n = 48	n = 43	n = 90	n = 22	n = 19	n = 39	n = 61	n = 84	n = 0	n = 34	n = 169	n = 203
Help stay quit (%)		91.9	66.4	89.6	86.2	95.7	72.1	92.8	100.0	67.6	93.3	90.8	86.4	–	71.4	91.5	88.3
aOR		38.2**	ref	ref	0.68	–	0.37	ref	–	–	ref	1.16	1.75	–	ref	6.74*	

Weighted estimates: aOR = odds ratio adjusted for sex, income, education, ethnicity, sample source and quit intentions (smokers only), along with the other main effect variables (vaping frequency, smoking frequency, country or age group) shown in the table; – = estimate could not be computed either because of collinearity or insufficient number; # = asked only of those quit for less than 2 years; US = United States; EN = England; CA = Canada; AU = Australia; significant at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

also less likely to vape regularly for enjoyment (25–39-year-olds: aOR = 0.08, 95% CI = 0.01–0.84, $P = 0.035$; 40–54-year-olds: aOR = 0.08, 95% CI = 0.01–0.72, $P = 0.025$; 55+-year-olds: aOR = 0.05, 95% CI = 0.01–0.45, $P = 0.008$).

Compared to pre-filled cartridge system users, open tank system users were significantly more likely to endorse enjoyment (aOR = 2.57, 95% CI = 1.11–5.92, $P = 0.027$) and affordability (aOR = 4.94, 95% CI = 2.19–11.10, $P < 0.001$) as a reason to vape regularly (Table 3b).

Among the subgroup who had quit for less than 2 years and were asked whether help staying quit was a reason for vaping, overall 88.3% cited this as a reason (Table 3b). Among this subgroup, daily vapers (91.9%) were more likely to endorse this as a reason than their weekly counterparts (66.4%). Of the four countries, this reason was the least endorsed by those from the United States (72.1%), but was notably endorsed by all in Australia.

Reasons for stopping regular vaping

The top three reasons for stopping regular vaping among smokers (Fig. 2) were lack of satisfaction with vaping (77.9%), unhelpfulness for dealing with cravings (63.2%) and unhelpfulness for quitting smoking (52.4%). The top three reasons for stopping regular vaping among ex-smokers were no longer needing it to maintain smoking abstinence (77.3%), lack of satisfaction (49.5%) and safety concerns (44.0%). When compared to smokers who had stopped vaping, ex-smokers who had stopped vaping were more likely to stop because of addiction concerns (aOR = 2.86, 95% CI = 1.59–5.15, $P < 0.001$), but were less likely to stop because of a lack of product satisfaction

(aOR = 0.28, 95% CI = 0.18–0.44, $P < 0.001$, see Table 4).

Current smokers

Compared to weekly smokers, daily smokers were less likely to discontinue regular vaping because of fear of addiction and being uncomfortable vaping in public (Table 4).

Compared to 18–24-year-olds, those aged 25–39 were less likely to endorse cost as a reason for discontinuation (aOR = 0.31, 95% CI = 0.12–0.77, $P = 0.012$, see Table 4). Similarly, compared to the 18–24-year-old group, those aged over 25 were less likely to endorse becoming addicted as a reason for discontinuation (25–39-year-olds: aOR = 0.22, 95% CI = 0.08–0.61, $P = 0.004$; 40–54-year-olds: aOR = 0.24, 95% CI = 0.09–0.67, $P = 0.006$; 55+-year-olds: aOR = 0.18, 95% CI = 0.06–0.51, $P = 0.001$). The 25–39-year-olds were also less likely than 18–24-year-olds to endorse being uncomfortable in public as a reason (aOR = 0.41, 95% CI = 0.17–0.96, $P = 0.040$).

Compared to users of disposable devices, open tank system users were less likely to discontinue regular vaping because of cost (aOR = 0.52, 95% CI = 0.28–0.95, $P = 0.033$) but, along with users of pre-filled cartridge systems, were more likely to discontinue because of too much effort required to use them (tank system: aOR = 1.87, 95% CI = 1.02–3.44, $P = 0.045$; cartridge system: aOR = 2.69, 95% CI = 1.45–4.98, $P = 0.002$; see Table 4).

Compared to Australian smokers, those from the United States and England were significantly less likely to endorse being uncomfortable vaping in public as the reason for discontinuation (aOR = 0.36, 95% CI = 0.18–0.71, $P = 0.004$; and aOR = 0.51, 95% CI = 0.27–0.95, $P = 0.034$, respectively; see Table 4). Further, those from

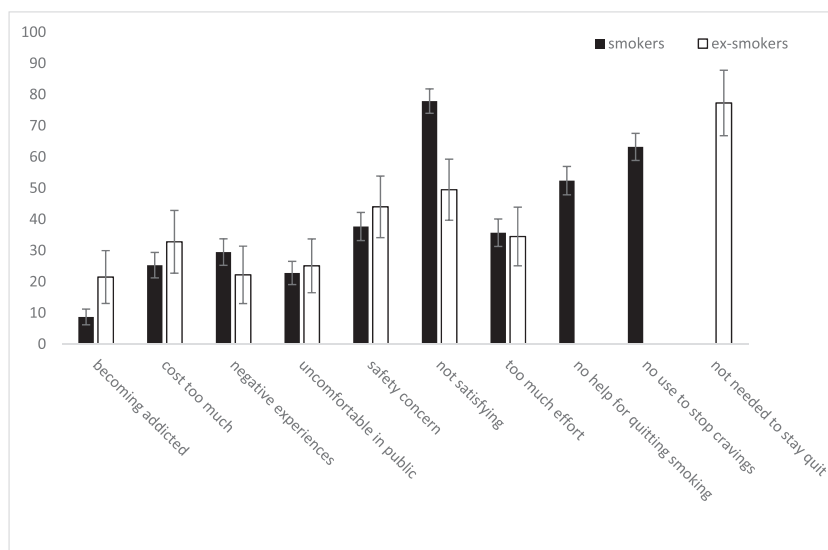


Figure 2 Reasons for stopping regular vaping by smoking status

Table 4 Reasons for stopping regular vaping.

Reasons for stopping regular vaping	Overall sample by smoking status		Among smokers only												
	Smokers n = 744	Ex-smokers n = 155	Daily smokers n = 705	Weekly smokers n = 39	CA n = 147	US n = 206	EN n = 306	AU n = 85	18-24 years n = 98	25-39 years n = 158	40-54 years n = 210	55+ years n = 278	Disposable n = 107	Pre-filled cartridge n = 261	Open tank-system n = 376
Becoming addicted	8.7	21.5	7.0	26.4	6.8	8.8	7.8	5.2	25.0	6.8	7.5	5.5	3.9	9.4	7.9
aOR	ref	2.86***	0.21**	ref	1.32	1.76	1.54	ref	ref	0.22**	0.24**	0.18**	ref	2.56	2.13
Cost too much	25.3	32.8	24.7	40.0	21.3	26.7	26.6	26.2	41.1	17.8	30.1	26.7	31.5	33.5	19.2
aOR	ref	1.45	0.49	ref	0.76	1.03	1.02	ref	ref	0.31*	0.62	0.52	ref	1.10	0.52*
Negative experiences	29.5	22.2	28.9	32.7	38.4	22.8	33.1	21.7	24.3	23.5	36.3	31.3	30.8	27.5	29.8
aOR	ref	0.68	0.84	ref	2.26*	1.07	1.78	ref	ref	0.96	1.78	1.42	ref	0.85	0.95
Uncomfortable in public	22.8	25.1	21.2	40.4	33.1	15.8	21.0	34.4	36.4	19.0	20.3	23.7	19.3	22.2	23.0
aOR	ref	1.13	0.40*	ref	0.94	0.36**	0.51*	ref	ref	0.41*	0.45	0.54	ref	1.19	1.25
Safety concern	37.7	44.0	38.0	30.3	46.5	26.6	44.7	34.9	45.3	31.5	40.3	39.5	37.8	38.2	36.9
aOR	ref	1.30	1.41	ref	1.62	0.68	1.51	ref	ref	0.56	0.82	0.79	ref	1.02	0.96
Not satisfying	77.9	49.5	78.5	73.1	76.4	76.7	82.4	68.2	73.4	77.6	75.4	82.6	76.9	80.8	76.5
aOR	ref	0.28***	1.34	ref	1.50	1.53	2.18*	ref	ref	1.26	1.11	1.73	ref	1.27	0.98
Too much effort	35.7	34.5	34.9	51.2	33.3	34.7	38.6	34.0	26.1	34.9	37.1	39.3	22.2	43.5	34.9
aOR	ref	0.95	0.51	ref	0.97	1.03	1.22	ref	ref	1.52	1.67	1.83	ref	2.69**	1.87*
No help for quitting smoking	52.4	NA	52.7	46.9	57.6	52.0	53.0	41.2	50.3	48.8	46.1	63.1	57.3	54.6	49.3
aOR	NA	NA	1.26	ref	1.93	1.54	1.60	ref	ref	0.94	0.84	1.69	ref	0.90	0.72
No use to stop cravings	63.2	NA	63.4	60.5	66.7	56.6	68.0	59.3	55.7	60.8	60.9	70.4	69.2	65.2	59.9
aOR	NA	NA	1.13	ref	1.38	0.90	1.46	ref	ref	1.23	1.24	1.90	ref	0.83	0.66
Not needed to stay quit	NA	77.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

aOR = odds ratio adjusted for sex, income, education, ethnicity, sample source and quit intentions (smokers only), along with the other main effect variables shown in the table; NA = not applicable; US = United states; EN = England; CA = Canada; AU = Australia; * Significant at $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

England were more likely to endorse lack of satisfaction ($aOR = 2.18$, 95% CI = 1.00–4.77, $P = 0.050$) as their reason for stopping regular vaping, whereas those from Canada were more likely to discontinue because of negative experiences ($aOR = 2.26$, 95% CI = 1.14–4.45, $P = 0.019$).

Overall, 44.5% of smokers endorsed both unhelpfulness for quitting smoking and unhelpfulness for cravings as reasons for stopping regular vaping, another 26.0% endorsed one of these reasons, and the remaining 29.5% did not cite either reason (results not shown in the table). Nearly all (96.4%) those who cited both reasons also cited not satisfying as a reason to stop regular vaping.

DISCUSSION

The two key findings from this study are, first, that most smokers and ex-smokers reported vaping regularly either to quit smoking or to stay quit, with a minority doing so for other reasons (e.g. to protect others); and secondly, vaping was discontinued either because NVPs were perceived not to be helpful for quitting smoking or because they were no longer needed to maintain cessation. The reasons for the use and discontinuation of NVPs were found to vary by smoking status (current smoker versus ex-smoker), type of NVP device used, the age of the respondent and country of residence (see Supporting information, Tables S1 and S2, respectively), thus underscoring the need to consider user's characteristics when designing interventions to either encourage or discourage NVP use.

Even among smokers who reported vaping for reasons other than quitting, there may be benefits if using NVPs leads to significantly reduced cigarette consumption. However, unless vaping eliminates smoking completely the full health benefits would not be realized, as dual users remain exposed to the full range of toxicants from smoking even if they are only smoking at a reduced level [24]. For ex-smokers, reasons beyond relapse prevention, such as enjoyment and reduced harm to others, are likely to be factors influencing longer-term vaping. The extent to which this is cause for concern depends on how harmful long-term vaping is; while it is widely accepted that completely substituting NVPs for cigarettes reduces exposure to numerous toxicants and carcinogens, the safety of long-term exclusive use of NVPs is unknown [5]. Nonetheless, gaining enjoyment for ex-smokers is of value independent of its utility as a tool for smoking cessation.

Among vapers who smoke, it will be important to look longitudinally to determine if those vaping for reasons other than cessation are more or less likely to subsequently quit smoking. On theoretical grounds, this is likely to be a function of the relative difference in immediate enjoyment/satisfaction gained from the two products, with transitions to vaping probably limited in those who

do not think it provides the same, or greater, level of enjoyment as smoking. This may be particularly important for those who are more motivated by short-term consequences. In this regard, younger people appear to be more motivated by reasons other than quitting. Consistent with past research [25], younger smokers were more likely to report vaping for affective reasons such as enjoyment, while middle-aged and older smokers were more likely to vape for instrumental purposes such as cost-savings.

Not surprisingly, our study shows that most smokers discontinue regular vaping because of product dissatisfaction. For vaping to become a viable quitting aid or long-term substitute for smokers, it may need to be comparable to smoking in terms of managing cravings (e.g. nicotine can be delivered by NVPs similar to that of cigarettes), as well as being able to meet some of the other expectations which were also endorsed as reasons, such as being convenient, affordable, socially acceptable and safe. It is intriguing that concern about being addicted to vaping appears to be deterring a small but non-trivial number of smokers, particularly those aged 18–24, from continuing to vape. This could reflect either a subgroup of mainly non-addicted smokers who are concerned about being addicted to nicotine regardless of the mode of delivery, or those who are misinformed about the harmfulness of nicotine even when it is decoupled from combustible tobacco [26]. Research has shown that at the time of our study, the proportion of people who perceived vaping as less harmful than smoking was decreasing over time [27–29], and such misperceptions may discourage smokers from exclusive and/or sustained use of the products.

Smokers aged 18–24 were also more likely to discontinue use because of public disapproval of vaping compared to older smokers. As younger smokers are likely to be less addicted than older smokers, it may be easier for young smokers to stop vaping if they perceive it to be socially unacceptable in public places or to violate smoke-free laws.

There is also some evidence of country differences in reasons for use and discontinuing use. The greater endorsement of enjoyment and help with smoking cessation among smokers in Australia compared to Canada and England probably reflects the more restrictive regulatory environment in Australia, which discourages regular vaping among smokers and necessitates extra effort to access the product, which is only likely if there is sufficient experiential and instrumental value to motivate it. The greater perceived affordability as a reason for vaping among smokers in Australia compared to Canada and the United States may be due in part to the significantly higher tax on tobacco products in Australia [30], and more directly, the need for Australians to purchase e-liquids in bulk online, which is associated with reduced unit cost.

The greater endorsement of social unacceptability of vaping (i.e. feeling uncomfortable vaping in public) as a

reason for discontinuation of regular vaping in Australia compared to the United States is also consistent with the greater restrictiveness of NVPs in Australia. Our past research indicates that smokers from the United Kingdom were more likely to think vaping is socially acceptable than Australian smokers mainly because they were more exposed to vaping in both public and private places, consistent with the more permissive NVP regulatory environment in the United Kingdom [31]. It is noteworthy that endorsement of vaping being more socially acceptable than smoking as a reason to vape was similar among countries, suggesting that differences in vaping regulatory environments appear to influence perception not of the acceptability of vaping relative to smoking, but only that of vaping itself; that is, the extent to which vapers feel comfortable vaping in public. As smoke-free laws are extended to vaping, this is likely to increase the social constraints on vaping which, in turn, may serve as a motivation for some to quit vaping and possible relapse to smoking for others.

Consistent with past research [14], reasons for regular vaping and its discontinuation also vary by device type. Current smokers who used an open tank system were more likely to vape for enjoyment, smoking reduction and smoking cessation purposes compared to those who used a disposable (closed system) device. This is consistent with the greater flexibility of open tank systems (i.e. the ability to vary the nicotine content, temperature setting and flavouring) and also their superiority in nicotine delivery [32], making them better able to manage nicotine cravings, and hence more satisfying to use than disposable ones. In fact, once smokers have successfully switched from smoking to vaping, enjoyment becomes a much more important motivator for regular vaping among open tank-system users than among disposable (closed system) users.

Concern about addiction (i.e. 'becoming addicted') and the effort required (i.e. 'too much effort') to vape were two reasons that appear to be much more likely to motivate current smokers to discontinue regular vaping if they use either a pre-filled cartridge system or an open tank system than if they use disposable ones. The superior nicotine delivery of non-disposable devices is probably a factor contributing to concern regarding addiction, while the greater flexibility of these devices also makes them more cumbersome to use. However, open tank system users were less likely to discontinue due to cost than disposable (closed system) users, reflecting the cost advantage of the open tank systems, a main motivation for ongoing use, especially among former smokers.

Among recent ex-smokers, while there was no significant difference in nominating staying quit as a reason, those who had quit for longer appear to be driven to vape more by affective and instrumental reasons, such as the pleasure they derive from vaping, the reduced harmful exposure to others and the ability to use in smoke-free areas.

This suggests that while staying quit is still a reason to vape for most ex-smokers, it is a less important reason, as the perceived risk of relapse declines over time. It would be useful for future study to explicitly test this by relating stated reasons to confidence in staying quit.

Strengths and limitations

Study strengths include the large sample size spanning four countries, allowing comparisons between regulatory environments, as well as our ability to look at reasons for use as a function of smoking status, quit duration and vaping frequency; important categorizations that have often been overlooked in the existing literature. However, this study has several limitations. First, the list of reasons studied is not exhaustive, and may have missed other important ones. Secondly, finer-grained analysis was not possible due to the yes/no response option. Thirdly, self-report data may be affected by social desirability biases (e.g. reporting it because it sounds important rather than because it is a genuine reason). Fourthly, cross-sectional data preclude our ability to understand within individuals how their stated reasons change over time and whether they translate into action, e.g. whether stated help with quitting actually prompts subsequent quitting, although we found evidence of stated quitting reason being related to expressed intention and desire to quit smoking. Fifthly, the generalizability of findings may be limited by the use of 'opt-in' panel samples, although this is probably mitigated through the use of sampling weights.

CONCLUSIONS

Regular use of nicotine vaping products by smokers and ex-smokers is mainly motivated by their perceived benefits for reducing or quitting smoking and by harm reduction via reducing bystanders' exposure to second-hand tobacco smoke, whereas its discontinuation tends to be motivated by failed utility for smoking cessation (among smokers) and/or product dissatisfaction and safety concern. For ex-smokers, no longer needing to stay quit dominated reasons for discontinuing. Non-cessation reasons given by a small minority may lead to 'accidental' quitting, but may also make continuing to smoke easier, a possibility worthy of being monitored.

Declaration of interests

K.M.C. has served on advisory committees for Pfizer, Inc. to assist them in ways to promote access to smoking cessation treatments. He has also served as a paid expert witness in litigation filed against the tobacco industry. J.E.T. and G.T.F. have served on behalf of governments in response to legal challenges from the tobacco industry. None of the other authors has any conflict of interest to declare.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Data S1

Table S1 Summary of differences in reasons for regular vaping by user groups, country and device type among smokers and ex-smokers.

Table S2 Summary of differences in reasons for stopping regular vaping by user groups.