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# Changing patterns of first e-cigarette flavor used and current flavors used by 20,836 adult frequent e-cigarette users in the USA

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## Abstract

**Background:** Understanding the role that flavors play in the population's use of e-cigarettes and the impact that flavored e-cigarette products have on the population's use of more harmful tobacco products, like conventional cigarettes, has been identified by the US Food and Drug Administration (FDA) as a public health research priority. The purpose of the study was to assess the first e-cigarette flavor and current e-cigarette flavors used by a large non-probabilistic sample of adult frequent users of e-cigarettes in the USA and assess how flavor preferences vary by cigarette smoking status and time since first e-cigarette purchase.

**Methods:** An online survey assessed the first e-cigarette flavor and current e-cigarette flavors used by a non-probabilistic sample of 20,836 adult frequent e-cigarette users in the USA. Differences in e-cigarette flavor preferences between current smokers, former smokers, and never-smokers and trends in the first flavor used across time of e-cigarette use initiation were assessed.

**Results:** The majority ( $n = 15,807$ ; 76.4%) of sampled frequent e-cigarette users had completely substituted e-cigarettes for conventional cigarettes—"switchers"—and were currently using rechargeable, refillable vaping devices. Among them, the proportion of first e-cigarette purchases that were fruit-flavored increased from 17.8% of first purchases made before 2011 to 33.5% of first purchases made between June 2015 and June 2016. Tobacco-flavored first purchases almost halved during this time (46.0% pre-2011 to 24.0% between 2015 and 2016). Fruit/fruit beverage (73.9 to 82.9% of sampled users), dessert/pastry (63.5 to 68.5% of sampled users), and candy, chocolate, or sweets (48.7 to 53.4% of sampled users) were the most popular currently used e-cigarette flavors. Tobacco and menthol flavors, the two most popular flavors for initiating e-cigarette use prior to 2013, now rank as the 5th and 6th most popular currently used e-cigarette flavors, respectively.

**Conclusions:** Adult frequent e-cigarette users in the USA who have completely switched from smoking cigarettes to using e-cigarettes are increasingly likely to have initiated e-cigarette use with non-tobacco flavors and to have transitioned from tobacco to non-tobacco flavors over time. Restricting access to non-tobacco e-cigarette flavors may discourage smokers from attempting to switch to e-cigarettes.

**Keywords:** E-cigarettes, Flavors, E-liquids, Tobacco, Smoking, Cigarettes, Harm reduction, Vapers, Vaping

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candy and dessert (50%) flavors than were older adults (47 and 27%, respectively). Older adults were significantly more likely than younger adults to be using tobacco-flavored e-cigarettes (13 vs. 1%). Additionally, exclusive e-cigarette users were more likely than dual users to endorse “liking of flavors” as a reason for current e-cigarette use (69.8 vs. 48.9%), suggesting the use of non-tobacco flavors may be positively associated with smokers’ likelihood of transitioning to exclusive e-cigarette use.

Despite evidence of a potential role of non-tobacco e-cigarette flavors in helping adults to quit or reduce cigarette smoking, the same concerns that led the US Congress to ban the sale of cigarettes with characterizing flavors in 2009 now exist for e-cigarettes. In particular, concerns have been raised that fruit and sweet e-liquid flavors will attract youth and non-smokers to e-cigarette use, that use of flavored e-cigarettes will habituate youth to the effects of nicotine, and in turn, youth who would otherwise not have smoked in the absence of flavored e-cigarettes will “graduate” to use of more harmful tobacco products, such as cigarettes, that deliver nicotine more efficiently [14]. These concerns are borne from data that show the majority of youth and young adults who have ever tried an e-cigarette started their use with fruit or sweet flavors rather than a tobacco flavor and that rates of use of flavored tobacco products are higher among youth and young adults than among older adults [15–18]. Other research suggests adolescents’ intentions to try using e-cigarettes are linked to the availability of non-tobacco flavors [19, 20]. Concerns have also been raised about the long-term health effects of inhalation of e-cigarette flavorings [13].

While the Tobacco Control Act does not ban the sale of flavored e-cigarette products, it does not pre-empt state and local governments from restricting or banning the sale of these products. The city of Chicago, for example, in 2013 adopted an ordinance that prohibited the sale of flavored tobacco products, including menthol cigarettes and e-cigarettes, within 500 ft of schools [21]. In June 2017, the city of San Francisco became the first US city to sign into law an ordinance prohibiting the sale of all flavored tobacco products, including all flavors of e-liquid except tobacco flavor [22]. This ordinance came into effect in April 2018, though the fate of the ordinance will be decided by San Francisco voters after a petition drive by R.J. Reynolds Tobacco Company gained enough signatures to put the ordinance on a ballot in San Francisco County on June 5, 2018 [23]. Both the Chicago and San Francisco ordinances were adopted as precautionary measures in the absence of an established scientific basis for estimating that restricting the use and availability of e-cigarettes in characterizing flavors would be appropriate for the benefit and protection of the

public health. The ANPRM recently announced by FDA represents the first steps to establishing a scientific basis for the regulation of flavors in tobacco products, including e-cigarettes, that weighs the risks and benefits of flavored e-cigarettes to the population as a whole, including their appeal to, use by, and effect of the tobacco use behaviors of current users, former users, and non-users of tobacco products.

The present study sought to obtain information on the flavor preferences of frequent e-cigarette users for two main reasons. First, frequent e-cigarette users should be at greater risk of being harmed by and addicted to e-cigarettes compared to infrequent users and former users. Understanding the extent to which different flavors are used by this sub-group, and the effect that frequent use of different flavors has on cigarette smoking, is therefore of great importance to assessing the likelihood that frequent use of different e-cigarette flavors is likely to add or reduce risk of harm to users. Second, much of what is known about the flavor preferences of e-cigarette users is based on surveys of nationally representative samples that are largely comprised of infrequent e-cigarette users. The extent to which the flavor preferences of infrequent e-cigarette users apply to frequent e-cigarette users is unclear.

Assessing the first use and current use of flavored e-cigarettes and e-liquids among current smokers, former smokers, and never smokers who currently use e-cigarettes on a frequent basis can therefore help inform the potential population health impact of these products. The purpose of the present study was to assess the first e-cigarette flavor and current e-cigarette flavors used by a large non-probabilistic sample of adult frequent users of e-cigarettes in the USA.

## Methods

### Recruitment materials

A study invitation called for individuals aged 18 years or older, living in the USA, who have ever used an e-cigarette, even a single puff, to complete a 20-min online survey about their current and past use of e-cigarettes and conventional tobacco cigarettes. “E-cigarette use” was defined as “use of any cigalike, pre-filled device, eGo-style vaping device, Mod-style vaping device, or advanced personal vaporizer.” The study invitation clarified that people who smoke cigarettes, used to smoke cigarettes, or have never smoked cigarettes were equally welcome to complete the survey. The invitation contained a web-link to the survey homepage. Data collection ran from May 1 to June 30 2016. No financial or other incentive was offered in exchange for participation. A favorable ethical opinion of this study was given by the University of Strathclyde Research Ethics Committee.



**Table 1** Criteria for classification of frequent e-cigarette users into six Tobacco Use Pathway (TUP) groups

Num.	TUP group label	TUP group definition
1	Switchers	A lifetime smoker ( $\geq 100$ cigarettes smoked) who smoked cigarettes regularly <i>prior</i> to initiating e-cigarette use <i>and</i> had quit smoking completely (no smoking in the past 30 days) at the time of survey <i>and</i> was a frequent e-cigarette user at the time of survey.
2	Dual users of cigarettes and e-cigarettes	A lifetime smoker ( $\geq 100$ cigarettes smoked) who smoked cigarettes regularly <i>prior</i> to initiating e-cigarette use <i>and</i> was a current smoker (smoked in the past 30 days) <i>and</i> a frequent e-cigarette user at the time of survey.
3	Former smoker-turned-dual users	A lifetime smoker ( $\geq 100$ cigarettes smoked) who had quit smoking completely <i>prior</i> to initiating e-cigarette use <i>and</i> was a current smoker (smoked in the past 30 days) <i>and</i> a frequent e-cigarette user at the time of survey.
4	Former-smoker e-cigarette users	A lifetime smoker ( $\geq 100$ cigarettes smoked) who had quit smoking completely <i>prior</i> to initiating e-cigarette use <i>and</i> has not re-initiated regular smoking <i>since</i> initiating e-cigarette use <i>and</i> was a frequent e-cigarette user at the time of survey.
5	Never-smoker-turned-dual users	A lifetime never-smoker ( $< 100$ cigarettes smoked) who was not smoking at the point of his/her first use of an e-cigarette <i>and</i> was a current smoker <i>and</i> a frequent e-cigarette user at the time of survey.
6	Never-smoker e-cigarette users	A lifetime never-smoker ( $< 100$ cigarettes smoked) who was not smoking at the point of his/her first use of an e-cigarette <i>and</i> was not a current smoker at the time of survey <i>and</i> was a frequent e-cigarette user at the time of survey.

statistics—mean (SD) or number (%)—are reported for demographic variables. Chi-square ( $\chi^2$ ) tests compared the prevalence of first e-cigarette flavor purchased, separately for each time period of first e-cigarette purchase. Cross-tabulations and chi-square tests compared the prevalence of first e-cigarette purchases that were flavored to taste like “tobacco” versus “fruit/fruit beverage” between different TUP groups. Logistic regression analyses were conducted to evaluate the association between the first e-cigarette purchases that were flavored to taste like “tobacco” versus “fruit/fruit beverage” and TUPs and time period of first e-cigarette purchase. Similar analyses were conducted for current use of tobacco and fruit/fruit beverage flavored e-cigarettes. The analyses were adjusted for age and gender, and the time period of first e-cigarette purchase was entered in the model as an ordinal scale variable to estimate the change in odds of tobacco and fruit/fruit beverage flavored first e-cigarette purchases associated with each change in time period from  $\geq 5$  years (reference group: coded as 1) to less than 12 months ago (coded as 4). A  $p$  value  $< 0.05$  was considered statistically significant, and all analyses were conducted in SPSS v24.

## Results

### Participants

After removal of 286 duplicate entries, 758 entries from individuals not living in the USA (Canada  $n = 289$ ; UK  $n = 291$ ; country of residence not specified  $n = 178$ ), and 396 entries from individuals who did not indicate where they found out about the survey, a sample of 22,411 US-based, adult ( $\geq 18$  years), ever-users of e-cigarettes was retained for preliminary analysis. Within this sample, 20,836 (92.9%) respondents were frequent e-cigarette users at the time of survey. The distribution of these 20,836 respondents across the six TUPs is shown in Table 2. Demographic characteristics of the frequent e-cigarette users, stratified by Tobacco Use Pathway Group, are summarized in Table 3. Demographic characteristics are not reported for former smokers-turned-dual users or never smokers-turned-dual users due to low cell sizes. Thus, the analyses of flavor preferences were confined to 20,676 participants.

### E-cigarette device format currently used

The majority of frequent e-cigarette users in each TUP group reported current main use of a rechargeable e-cigarette device with a refillable tank/reservoir

**Table 2** Classification of 20,836 US adult frequent e-cigarette users into six Tobacco Use Pathway Groups (TUPs)

Num.	TUP group	N	% of total sample	% of frequent EC users
1	Switchers	15,807	70.5	75.9
2	Dual users of cigarettes and e-cigarettes	1330	5.9	6.4
3	Former smoker-turned-dual users	129	0.6	0.6
4	Former-smoker e-cigarette users	2483	11.1	11.9
5	Never-smoker-turned-dual users	31	0.1	0.1
6	Never-smoker e-cigarette users	1056	4.7	5.1

**Table 3** Demographic characteristics of 20,676 US adult frequent e-cigarette users classified into four Tobacco Use Pathway (TUP) groups (*Continued*)

Variable	Switchers (n = 15,807)	Dual users (n = 1330)	Former smoker e-cigarette users (n = 2483)	Never smoker e-cigarette users (n = 1056)	Total (n = 20,676)
	N (%)	N (%)	N (%)	N (%)	N (%)
Some college, no degree	5496 (34.8)	462 (34.8)	812 (32.8)	336 (31.9)	7106 (34.4)
Associate degree—voc/occup.	1736 (11.0)	119 (9.0)	269 (10.9)	83 (7.9)	2207 (10.7)
Associate degree—academic	1070 (6.8)	78 (5.9)	149 (6.0)	63 (6.0)	1360 (6.6)
Bachelor's degree	2325 (14.7)	178 (13.4)	287 (11.6)	105 (10.0)	2895 (14.0)
Master's degree	513 (3.2)	37 (2.8)	64 (2.4)	35 (3.3)	649 (3.1)
Professional school degree	131 (0.8)	9 (0.7)	10 (0.4)	7 (0.7)	157 (0.8)
Doctorate degree	95 (0.6)	8 (0.6)	11 (0.4)	3 (0.3)	117 (0.6)
Total	15,786 (100.0)	1329 (100.0)	2479 (100.0)	1054 (100.0)	20,648 (100.0)
Vape advocacy group membership					
CASAA	10,442 (66.1)	694 (52.2)	1620 (65.2)	500 (47.3)	13,256 (64.1)
SFATA	1512 (9.6)	60 (4.5)	313 (12.6)	107 (10.1)	1992 (9.6)
NBS	3126 (19.8)	221 (16.6)	640 (25.8)	302 (28.6)	4289 (20.7)
AVA	1432 (9.1)	108 (8.1)	307 (12.4)	117 (11.1)	1964 (9.5)

(switchers = 85.7%; dual users = 87.9%; former smoker e-cigarette users = 81.6%; and never smoker e-cigarette users = 79.8%). Current main use of an e-cigarette kit (rechargeable with pre-filled cartridges) was less than 1% in all TUP groups, and current main use of disposable e-cigarettes was essentially zero in all TUP groups.

#### First e-liquid flavor purchased

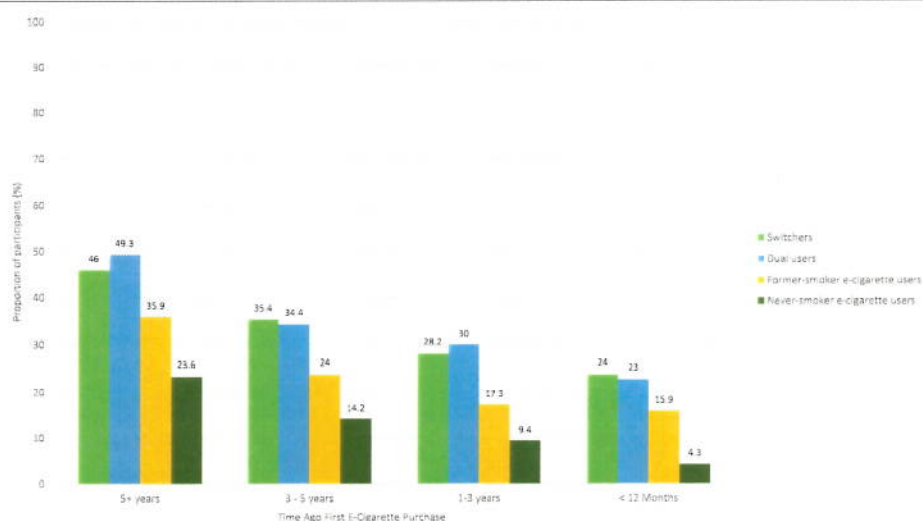
The lengths of time since participants made their first e-cigarette are summarised in Table 4. Chi-square tests indicated statistically significant differences in the prevalence of first e-cigarette flavor purchased at all time points of e-cigarette use initiation ( $p < 0.001$  for all). Tobacco flavor was the most popular first flavor purchased by those who initiated e-cigarette use  $\geq 5$  years ago and between 3 and 5 years ago but declined among those who initiated e-cigarette use 1–3 years ago and in the past 12 months (Fig. 1). First e-liquid purchases that were menthol/mint-flavored had also steadily declined, from being ranked second most common first flavor prior to 2011 to being ranked fourth in the past 12 months. Since 2013, fruit-flavored e-liquids have replaced tobacco-flavored e-liquids as the most popular flavors with which participants had initiated e-cigarette use. The proportion of first e-cigarette purchases that were desert/pastry-flavored had also increased consistently, from being ranked fifth most common first flavor prior to 2011 to being ranked third in the past 12 months (Table 4).

Figures 2 and 3 show that, in each of the four TUP groups, the proportion of first e-liquid purchases that were tobacco-flavored had declined over time,

while the proportion of first e-liquid purchases that were fruit-flavored had increased over time. The lowest prevalence of tobacco-flavored first e-cigarette purchases was observed among former smoker e-cigarette users and never smoker e-cigarette users (Fig. 2). Since 2011, the highest rate of fruit-flavored first e-cigarette purchases has consistently been among never smoker e-cigarette users.

Chi-square tests indicated a statistically significant difference in the prevalence of tobacco flavor initiation between TUP groups overall ( $p < 0.001$ ) and statistically significant differences between TUP groups within each time period of e-cigarette use initiation (all  $ps < 0.001$ ). The proportions of switchers and dual users who initiated e-cigarette use with a tobacco-flavored product were similar in all four time periods. For fruit/fruit beverage flavors, statistically significant differences were observed overall ( $p < 0.001$ ) and for each time point of e-cigarette use initiation ( $p = 0.006$  for  $> 5$  years,  $p < 0.001$  for all other time points). The proportions of switchers and dual users who initiated e-cigarette use with a fruit-flavored e-cigarette were similar except among those who initiated e-cigarette use 5 or more years ago.

Logistic regression analysis (Table 5) showed that odds of a tobacco-flavored first e-cigarette purchase reduced with the recency of the first e-cigarette purchase, from " $> 5$  years ago" to "in the past 12 months." Additionally, switchers and dual users were each four times more likely than never smoker e-cigarette users to have initiated e-cigarette use with a tobacco-flavored product;



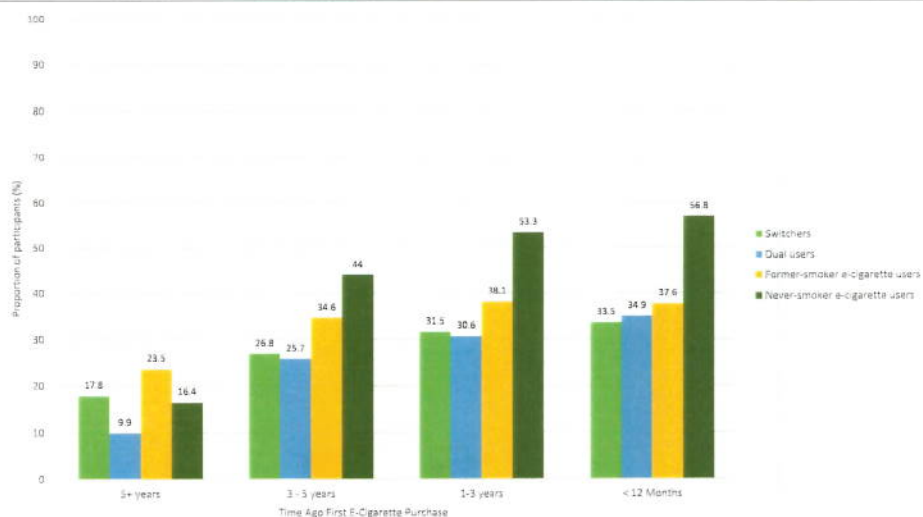
**Fig. 2** Proportion of e-cigarette first purchases that were flavored to taste like tobacco stratified by time since first e-cigarette purchase and Tobacco Use Pathway (TUP) group

e-cigarette purchase, with the highest odds of current use of fruit-flavored product observed among those who purchased their first e-cigarette in the past 12 months. Though the odds of current use of a fruit-flavored product had increased over time in all groups, switchers, dual users, and former smoker e-cigarette users were significantly less likely than never smoker e-cigarette users to be current users of fruit-flavored products.

## Discussion

This study assessed first and current use of tobacco and non-tobacco e-cigarette flavors by a non-probabilistic

sample of 20,836 adults in the USA who were using e-cigarettes on a frequent basis, of whom 15,807 (75.9%) had completely switched from smoking cigarettes to using e-cigarettes. Results indicated that adults who have completely switched from smoking cigarettes to using e-cigarettes in the past 5 years are increasingly likely to have initiated e-cigarette use with vapor products not flavored to taste like tobacco. E-cigarette flavors that are not available through cigarettes—particularly fruit, dessert, and pastry flavors—were found to have increasingly replaced tobacco and menthol as the preferred flavors with which adult smokers, former smokers, and never smokers have initiated e-cigarette use.



**Fig. 3** Proportion of first e-cigarette purchases that were flavored to taste like fruit/fruit beverage stratified by time since first e-cigarette purchase and Tobacco Use Pathway (TUP) group

**Table 6** Logistic regression analysis of the association between current use of tobacco-flavored e-liquids and fruit/fruit beverage-flavored e-liquids and Tobacco Use Pathway Group and time of first e-cigarette purchase

Variable	B	OR	95% CI	P
Current use of tobacco flavor				
Never smoker e-cigarette users (referent)				
Switchers	0.78	2.18	1.69–2.81	< 0.001
Dual users	0.97	2.63	1.97–3.51	< 0.001
Former smoker e-cigarette users	0.43	1.54	1.16–2.03	< 0.001
Time of FEP				
> 5 years (referent)				
< 12 months	−0.84	0.43	0.38–0.50	< 0.001
1–3 years	−0.82	0.44	0.39–0.49	< 0.001
3–5 years	−0.39	0.68	0.61–0.76	< 0.001
Current use of fruit-fruit beverage flavor				
Never smoker e-cigarette users (referent)				
Switchers	−0.45	0.64	0.54–0.75	< 0.001
Dual users	−0.36	0.70	0.57–0.86	< 0.001
Former smoker e-cigarette users	−0.35	0.70	0.59–0.85	< 0.001
Time of FEP				
> 5 years (referent)				
< 12 months	0.49	1.62	1.46–1.81	< 0.001
1–3 years	0.47	1.61	1.46–1.77	< 0.001
3–5 years	0.28	1.32	1.20–1.45	< 0.001

TUP Tobacco Use Pathway, FEP First E-cigarette purchase

Between 2011 and 2016, the proportion of first e-cigarette purchases that were flavored to taste like a fruit had almost doubled, while tobacco-flavored first e-cigarette purchases had almost halved. These data suggest a transition in flavor preference at e-cigarette use initiation over time, from tobacco to non-tobacco flavors, which is consistent with data from a US nationally representative survey that found both former-smoking, exclusive e-cigarette users and dual users reported significantly higher rates of current use of a non-tobacco-flavor—72.5 and 72.9%, respectively—compared to initiation [11]. The proportions of switchers and dual users who initiated e-cigarette use with fruit flavors did not significantly differ among those who initiated e-cigarette use after 2011. This finding contrasts with the data from a US nationally representative survey that showed former smokers who had become exclusive e-cigarette users were significantly more likely than dual users of conventional cigarettes and e-cigarettes to have initiated e-cigarette use with a non-tobacco flavor (65.7 vs. 47.3%) [11]. One potential explanation for these contrasting findings is the different frequencies of e-cigarette use in the samples analyzed; the majority of individuals in the US nationally representative sample were likely to have been infrequent e-cigarette users—i.e., used an e-cigarette on less than 20 of the past 30 days—whereas the present study included only

frequent users. The present findings therefore indicate that switchers and dual users were equally likely to have initiated e-cigarette use with fruit-flavored e-cigarettes at any time after 2011, but both have been increasingly likely to have initiated e-cigarette use with a fruit-flavored e-cigarette.

Current e-cigarette use among participants was dominated by use of non-tobacco flavors, mainly fruit/fruit beverage, dessert/pastry, and/or candy/chocolate/sweets flavors. Once the most popular first flavors purchased by switchers and dual users, tobacco and menthol/mint currently rank as the 5th and 6th most commonly used flavors. Comparable odds of current use of fruit/fruit beverage flavor were observed in switchers, dual users, and never smoker e-cigarette users. These findings suggest both that non-tobacco flavors are comparably attractive to smokers who may or may not intend to quit smoking as they are to non-smokers and that non-tobacco flavors are not more strongly associated with dual use (i.e., continuing to smoke) than they are with quitting smoking. Given that the taste of increasingly preferred e-cigarette flavors such as fruits, desserts, and pastries are very different from the taste of a conventional cigarette, the increasing likelihood that adults will initiate e-cigarette use and currently use an e-cigarette use with a non-tobacco flavor could have the



by a specific sub-group of US adult e-cigarette user—those who are using e-cigarettes on a daily or near-daily basis. The recruitment methods were therefore biased towards outlets where such sub-group of e-cigarette user was most likely to be found, and so conclusions therefore do not represent the flavor preferences or patterns of e-cigarette use of US adults who are using e-cigarettes only experimentally or infrequently, patterns which together account for approximately 79% of all e-cigarette use in the USA [24]. The flavor preferences and patterns of e-cigarette use reported by the present sample of frequent e-cigarette users may more closely represent those of the 21.3% of current e-cigarette users in the USA who use e-cigarettes daily [24]. Conclusions about changing flavor preferences are also unlikely to be applicable to US adults who do not frequently use rechargeable, refillable devices, as there is evidence that preferences for tobacco and menthol flavors vary between users of closed-system and open system devices. A consumer representative survey of 2000 US e-cigarette users, for example, found that 84% of users of advanced tanks (refilled with open liquid) currently used non-tobacco flavors compared to 54% of users of rechargeable cigalikes (reloaded with prefilled cartridges) [25]. Users of advanced tanks were significantly less likely than users of rechargeable “cigalikes” to be using tobacco (16 vs 46%) or menthol (18 vs. 25%) flavors and significantly more likely to be using fruit (36 vs. 15%) and sweet (11 vs. 4%) flavors. These self-reported device-specific data closely approximate distributor shipment to retail data for February 2016 [26], which show tobacco and menthol flavors accounted for 67% of the total volume of cartridges shipped to retail in 2016 compared to 50% of the total volume of liquids shipped to retail. Lastly, the study conclusions may not apply to frequent e-cigarette users who do not engage with e-cigarette advocacy groups and online forums.

Another limitation is the study's reliance on accurate self-reporting of the nature and timing of behaviors that may have occurred up to several years ago. Additionally, the cross-sectional design and non-probabilistic sampling method prevent conclusions about the relative effectiveness of tobacco versus non-tobacco flavored e-cigarettes for producing smoking cessation. Finally, participants in this study were not asked to identify the flavors they were using at the point at which they stopped smoking and so were not asked how frequently they were using each flavor at the point at which they stopped smoking.

## Conclusions

This study identified an increasing popularity of non-tobacco flavors and declining popularity of tobacco flavors by over 15,000 adult frequent e-cigarette users

who formerly smoked cigarettes. The findings suggest that access to a variety of non-tobacco flavored e-liquid may be important for encouraging and assisting adults to use e-cigarettes in place of conventional cigarettes. Restricting the availability of non-tobacco flavors could reduce adult smokers' interest in switching to e-cigarettes or rationalize a return to cigarette smoking among frequent e-cigarette users whose journey towards smoking abstinence started with, progressed to, and is being sustained by frequent use of e-cigarettes containing non-tobacco flavors. A tobacco products regulatory framework that balances adult smokers' increasingly common preference to try to quit smoking by using e-cigarettes that do not taste like cigarettes, with measures that reduce the appeal and use of e-cigarettes by non-smokers and youth, may accelerate the US progress towards the end of the tobacco smoking epidemic that causes the premature death of approximately 480,000 Americans each year [27].

## Abbreviations

ANPRM: Advanced Notice of Proposed Rule Making; AVA: American Vaping Association; CASAA: Consumer Advocates for Smoke-free Alternatives Association; FD&C: Food, Drug and Cosmetic Act; FDA: US Food and Drug Administration; FEP: First E-cigarette purchase; NBS: Not Blowing Smoke; PATH: Population Assessment of Tobacco and Health; SFATA: Smoke Free Alternatives Trade Association; THR: Tobacco harm reduction; TUP: Tobacco Use Pathway; US: United States

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## Availability of data and materials

The datasets analyzed in the current study are available from the corresponding author on reasonable request.

## Authors' contributions

CR and NM conceived of the study. CR, NM, and MN developed the questionnaire. CR and TD performed the statistical analysis. CR, NM, TD, and MN helped to draft the manuscript. All authors read and approved the final manuscript.

## Ethics approval and consent to participate

A favorable ethical opinion of this study was given by the University of Strathclyde Research Ethics Committee. Participants were presented with an Informed Consent Form and gave consent to participate online.

## Competing interests

In the past 3 years, the employer of CR, NM, and TD, the Centre for Substance Use Research, has received funding from several e-cigarette