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Original Investigation

The Association of E-cigarette Flavors With Satisfaction, Enjoyment, and Trying to Quit or Stay Abstinent From Smoking Among Regular Adult Vapers From Canada and the United States: Findings From the 2018 ITC Four Country Smoking and Vaping Survey

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Abstract

Aims: This study examined whether nontobacco flavors are more commonly used by vapers (e-cigarette users) compared with tobacco flavor, described which flavors are most popular, and tested whether flavors are associated with: vaping satisfaction relative to smoking, level of enjoyment with vaping, reasons for using e-cigarettes, and making an attempt to quit smoking by smokers.

Methods: This cross-sectional study included 1603 adults from Canada and the United States who vaped at least weekly, and were either current smokers (concurrent users) or former smokers (exclusive vapers). Respondents were categorized into one of seven flavors they used most in the last month: tobacco, tobacco–menthol, unflavored, or one of the nontobacco flavors: menthol/mint, fruit, candy, or "other" (eg, coffee).

Results: Vapers use a wide range of flavors, with 63.1% using a nontobacco flavor. The most common flavor categories were fruit (29.4%) and tobacco (28.7%), followed by mint/menthol

(14.4%) and candy (13.5%). Vapers using candy (41.0%, $p < .0001$) or fruit flavors (26.0%, $p = .01$) found vaping more satisfying (compared with smoking) than vapers using tobacco flavor (15.5%) and rated vaping as very/extremely enjoyable (fruit: 50.9%; candy: 60.9%) than those using tobacco flavor (39.4%). Among concurrent users, those using fruit (74.6%, $p = .04$) or candy flavors (81.1%, $p = .003$) were more likely than tobacco flavor users (63.5%) to vape in order to quit smoking. Flavor category was not associated with the likelihood of a quit attempt ($p = .46$). Among exclusive vapers, tobacco and nontobacco flavors were popular; however, those using tobacco (99.0%) were more likely than those using candy (72.8%, $p = .002$) or unflavored (42.5%, $p = .005$) to vape in order to stay quit.

Conclusions: A majority of regular vapers in Canada and the US use nontobacco flavors. Greater satisfaction and enjoyment with vaping are higher among fruit and candy flavor users. While it does not appear that certain flavors are associated with a greater propensity to attempt to quit smoking among concurrent users, nontobacco flavors are popular among former smokers who are exclusively vaping. Future research should determine the likely impact of flavor bans on those who are vaping to quit smoking or to stay quit.

Implications: Recent concerns about the attractiveness of e-cigarette flavors among youth have resulted in flavor restrictions in some jurisdictions of the United States and Canada. However, little is known about the possible consequences for current and former smokers if they no longer have access to their preferred flavors. This study shows that a variety of nontobacco flavors, especially fruit, are popular among adult vapers, particularly among those who have quit smoking and are now exclusively vaping. Limiting access to flavors may therefore reduce the appeal of e-cigarettes among adults who are trying to quit smoking or stay quit.

Introduction

Flavored combustible tobacco products (eg, fruit, candy, menthol cigarettes, or cigars) have been shown to be associated with initiation of smoking (particularly among youth), subsequent established smoking, and reduced smoking cessation.[1–3] Thus, in accordance with Article 9 and 10 guidelines of the WHO Framework Convention on Tobacco Control,[4,5] some countries and subjurisdictions have restricted or banned flavors in tobacco products. While tobacco flavorings in most countries remain unregulated across the globe, Canada was one of the first countries to implement a national ban for flavored additives (in 2009) and menthol (in 2017) in combustible tobacco products, and in 2009, the United States banned characterizing flavors other than tobacco or menthol in cigarettes and roll-your-own tobacco.

Although Canada and the United States have restricted and banned flavors for combustible cigarettes, nicotine vaping products (most commonly known as "*e-cigarettes*") are available in an ever-expanding range of e-liquid flavors with varying nicotine strengths. The majority of scientific research on e-cigarette flavors has focused on their association with youth uptake of vaping, most often with popular fruit and candy flavors,[2,6,7] but recent studies in the United States have shown that adult vapers (including current and former smokers, and nonsmokers) also demonstrate a preference for a range of flavors, and commonly use nontobacco flavored e-cigarettes.[8–13]

In light of data that have shown increased uptake of flavored e-cigarettes among US youth,[14,15] the US Food and Drug Administration and various US state and local governments have, or are considering restricting flavors with the exception of tobacco (and menthol in some jurisdictions). In November 2019, Massachusetts became the first state to permanently ban flavored e-liquids (including menthol, but not tobacco). The US government also announced enforcement action to ban unauthorized flavored cartridge-based e-cigarettes, with the exception of tobacco and menthol.[16] In Canada, some provinces are also considering such measures. For example, British Columbia has proposed the toughest restrictions on vaping in Canada, including a reduction in access to flavored e-liquids.[17] Ontario is also considering flavor restrictions,[18] and Nova Scotia was the first province to implement a flavor ban on April 1, 2020.[19]

While restricting or banning e-cigarette flavors other than tobacco could help to reduce youth experimentation and use of e-cigarettes, it might also make e-cigarettes less attractive to smokers and former smokers, as a smoking substitute, or as a way to quit smoking. Therefore, this paper examined e-cigarette flavor preferences among regular adult vapers in Canada and the United States, all of whom were either current or former smokers. Previous research has shown that e-cigarette users in the two countries prefer similar flavors and e-cigarette brands, and the two countries had similar e-cigarette federal regulations at time of this study, with neither restricting any e-cigarette flavors. Specifically, this paper aimed to: (1) determine whether nontobacco flavors are more commonly used compared with tobacco flavor, and describe which flavors are most popular; (2) examine whether specific flavors are associated with greater relative vaping satisfaction compared with cigarettes, and the level of enjoyment with vaping; and (3) determine whether specific flavors are associated with reasons for using e-cigarettes: for enjoyment (all vapers), to help reduce cigarette consumption or quit smoking (among concurrent users), or to stay abstinent from smoking (among former smokers now exclusively vaping). Given the uncertainty about the functional role of flavors in e-cigarette use, we did not have any preconceived hypotheses about how e-cigarette flavors might relate to product satisfaction, enjoyment, and trying to quit or stay abstinent from smoking. Thus, the analyses presented in this paper should be seen descriptive and exploratory.

Methods

The ITC Four Country and Vaping Survey (ITC 4CV) is a cohort study that consists of parallel online surveys conducted in Canada, United States, England, and Australia. In addition to respondents

retained from the ITC Four Country Survey (https://itcproject.s3.amazonaws.com/uploads/documents/4c-w28-tech-report-sept.pdf) (the predecessor of ITC 4CV), adults (≥18 years) were recruited by commercial panel firms in each country as cigarette smokers, former smokers, and/or at least weekly e-cigarette users. The sample in each country was designed to be as representative as possible of cigarette smokers (eg, by age, gender, and region). All data were collected online, and respondents were remunerated.

Study Eligibility

The current cross-sectional analysis used data from the 2018 (Wave 2) ITC 4CV Survey (conducted February to July 2018), and included 1603 current daily and weekly vapers from Canada and the United States who, (1) were still smoking cigarettes at least monthly (*concurrent users*) or (2) had quit smoking at the time of the survey (*exclusive vapers*). Respondents who were excluded from the study included those who: had never smoked, smoked cigarettes less than monthly, were not currently using an e-cigarette at least weekly, or had never heard of an e-cigarette (n = 4854).

Eligible respondents had to also provide valid responses to items that assessed the use of e-cigarette flavors in order to be included in the present analyses. Of the original 1650 at least weekly vapers, 47 respondents either did not answer the question about flavors, or reported that they did not know which flavor they used in the last 30 days. A study flow diagram is presented in Supplementary Figure S1.

Further descriptions of the methods used in each country are presented in the ITC Wave 2 (2018) technical report (4CV2 2018 Technical Report) and in Thompson et al.[20]

Data Weighting

Weighting survey data is one of the major components in survey sampling, and involves attaching a weight to each unit of the selected sample in order to obtain estimates of population parameters of interest. This process essentially incorporates a method of rebalancing the data, in order to more accurately reflect the population. This is especially important for complex survey designs.[21]

In the current study, cross-sectional weights were computed for all respondents. In brief, respondents were first divided into four broad user groups: (1) cigarette-only users, (2) concurrent users, (3) exclusive e-cigarette users, and (4) quitters. Quitters were further divided into four subgroups: (1) those who had quit within the last year, but were using an e-cigarette at the time of wave 2 data collection; (2) those who had quit 1–5 years ago, but were using an e-cigarette at the time of data collection; (3) those who had quit within the last year and were not using an e-cigarette at the time of data collection; and (4) those who had quit 1–5 years ago and were not using an e-cigarette at the time of data collection. In addition to the four groups and four subgroups, respondents were further subdivided according to the following cross-tabs: user group × gender, user group × age group, user group × geographic region, user group × ethnicity (United States only), and user group × education (United States only). A *raking procedure* (a method for adjusting the sampling weights of the sample data based on known population characteristics)[22] was then applied to calibrate the weights using the abovementioned cross-tabs and calibration figures based on national surveys (the 2017 National Health Interview Survey [NHIS] in the United States and the 2017 Canadian Tobacco Alcohol and Drugs Survey [CTADS] in Canada). The resulting weights are designed to make respondents in each of the four groups representative of the corresponding population at the time of wave 2 data collection.

Measures

Independent Variable

Flavor categories: Daily and weekly vapers were asked to select, from a list of 11 categories, any flavors they had used in the last 30 days. Among the vapers who reported the use of multiple flavors, a follow-up question asked which flavor they use most often. Respondents were first categorized into "non-tobacco flavors" (menthol/mint + fruit + candy + "other" flavors) or "tobacco" flavor (which also included unflavored and tobacco/menthol mix) in order to estimate nontobacco flavor use. For all other analyses, all respondents were categorized into one of seven flavor groups: (1) tobacco; (2) tobacco and menthol mix; (3) menthol/mint; (4) fruit; (5) candy (also includes desserts, sweets, and chocolate); (6) "other" flavors (cloves, spices, coffee, alcoholic or nonalcoholic beverages); or (7) unflavored.

Covariates

Sociodemographic variables: Sociodemographic data were collected by the commercial panels and verified at the time of survey completion, and included age, gender, and country of residence.

Smoking variables: At the time of completing the 2018 survey, respondents were classified as a *current smoker* (smoked cigarettes daily or nondaily, but at least monthly, and had smoked at least 100 cigarettes in their lifetime), or as a *former smoker*: either as a *recent quitter* (quit smoking ≤2 years ago) or *long-term quitter* (quit >2 years ago).

E-cigarette use: Respondents were asked if they currently used e-cigarettes *daily* or *weekly* at the time of the 2018 survey. If they responded "yes," they were defined as being a *regular vaper* (and included in this study). Respondents who also smoked cigarettes were classified as *concurrent users*, and those who formerly smoked cigarettes were classified as *exclusive vapers*.

Outcomes

1. Satisfaction with vaping: *How satisfying is vaping (using e-cigarettes), compared to smoking ordinary cigarettes?* Responses were categorized as: "relatively more satisfying," "relatively equally as satisfying," or "relatively less satisfying." For clarity in reporting, this outcome will be referred to as "*relative vaping satisfaction*."
2. Level of vaping enjoyment: *How much do you enjoy using e-cigarettes or vaping devices?* Responses were categorized as: "very much/extremely" versus "other" (moderately, slightly, not at all).
3. Planning to quit smoking: All concurrent users were asked: *Are you planning to quit smoking*? Responses were categorized as: "yes, within the next 6 months" versus "other" (sometime in the future beyond 6 months/not planning to quit smoking/don't know).
4. Quit smoking attempt: All concurrent users were asked: *How many times have you tried to quit smoking in the past 18 months?* Responses were categorized as "attempted to quit smoking at least once" versus "did not make a quit smoking attempt."
5. Reasons for using e-cigarettes: Current e-cigarette users were asked why they use e-cigarettes. The responses included in this

paper were: (1) "I enjoy vaping" (asked of all regular vapers); (2) "vaping might help me stop smoking" and "vaping helps me cut down on the number of cigarettes I smoke" (asked of concurrent users only); and (3) "vaping might help me stay quit" (asked of recent former smokers only). Responses were categorized as: "yes" versus "no/I don't know."

Statistical Analyses

Unweighted frequencies were used to describe the study sample. Weighted frequencies were computed for all seven e-cigarette flavor categories. Differences were tested using binomial distributions and compared: (1) "non-tobacco flavors" versus "tobacco flavor/unflavored/tobacco/menthol mix" and (2) "tobacco flavor against the other six primary flavor groups." A Bonferroni adjustment was used to account for multiple comparisons. Weighted frequencies were also computed by vaping status and age.

Multivariable regression models were used to compute and compare weighted cross-sectional estimates for flavors. The first model examined responses to the question "*how satisfying is vaping, compared to smoking ordinary cigarettes?*" The outcomes were: "more satisfying," "equally as satisfying," and "less satisfying." "Less satisfying" was used as the reference group. Next, we examined the level of vaping enjoyment ("very/extremely enjoyable" vs. "other"). Finally, we examined whether enjoyment was endorsed as a reason for vaping ("yes" vs. "no/don't know"). The models adjusted for age, gender, country of residence, smoking status (current smokers vs. former smokers), and vaping frequency (daily vs. weekly).

The next four regression models were restricted to concurrent users, and computed and compared weighted cross-sectional estimates of flavors by the following outcomes: (1) reason for vaping: (i) vaping helps me cut down on the number of cigarettes I smoke ("yes" vs. "no/don't know"); (ii) vaping may help me quit smoking ("yes" vs. "no/don't know"); (2) planning to quit smoking ("yes, within the next 6 months" vs. "other"); and (3) attempted to quit smoking in the last 18 months ("at least one quit attempt" vs. "no quit attempts"). An interaction between flavor group and age was tested in the models examining proximal quit outcomes (planning to quit and quit attempts). Each model controlled for age, gender, country of residence, smoking frequency (daily vs. nondaily), and vaping frequency.

Finally, a regression model was used to compute weighted estimates for "vaping may help me stay quit" ("yes" vs. "no/don't know") among exclusive vapers who had recently quit smoking (≤2 years ago, $n = 196$). Covariates included age, gender, country of residence, and vaping frequency.

Respondents who refused to answer a question or responded "I don't know" (if it was not a valid response) were removed from the applicable analysis. The tobacco flavor group was used as the reference variable in all analyses. All confidence intervals (CIs) were computed at the 95% confidence level. Analyses were conducted using SAS Version 9.4 (SAS Institute Inc, 2013, Cary, NC).

Results

The respondents' (unweighted) baseline characteristics are presented in Table 1. The sample comprised of 73.7% concurrent users and 26.3% exclusive vapers (former smokers). Overall, 54.2% of respondents were from the United States, 51.4% were male, 74.4% were white, had an average age of 39.3, 58.8% were daily vapers, and 51.3% were daily smokers.

Flavors Used Among Regular Vapers

This study found that the majority of regular vapers reported primarily using nontobacco flavors (weighted percent 63.1%, $p < .0001$) compared with tobacco/unflavored/tobacco/menthol mix (36.9%). Among the seven individual flavor groups, significantly more vapers reported primarily using fruit (29.4%) or tobacco (28.7%) compared with the other flavors (all, $p < .0001$): menthol/mint (14.4%), candy (13.5%), tobacco/menthol mix (6.2%), other flavors (5.8%), and unflavored (2.0%). There was no difference between fruit and tobacco ($p = .59$) flavors (Figure 1). There were no differences in primary flavor used between Canada and the United States ($p = .08$).

Flavors Used by Vaping Status

Among concurrent users, tobacco was the most common flavor (31.5%), followed by fruit (25.6%), menthol/mint (15.6%), candy (12.1%), tobacco/menthol mix (8.3%), "other" (5.3%), and unflavored (1.6%). Exclusive vapers most commonly reported using fruit (36.4%), followed by tobacco (22.9%), candy (15.8%), menthol/mint (13.9%), "other" (7.1%), unflavored (2.1%), and tobacco/menthol mix (1.9%). See Figure 1.

There were significant differences between concurrent users and exclusive vapers ($p < .0001$), with exclusive vapers being more likely to use fruit ($p = .001$) or candy flavors ($p = .02$), and less likely to use tobacco ($p = .001$) or tobacco/menthol mix ($p = .003$) flavors.

Flavors Used by Age

The most common flavor being used by vapers aged 18–24 was fruit (42.7%) followed by candy (19.2%). Unflavored was used the least (0.9%). Those aged 25–39 most often used fruit (35.7%) followed by tobacco flavor (21.2%). Unflavored was used the least (1.4%). Those aged 40–54 most often used tobacco flavor (35.4%), followed by fruit (24.9%), with unflavored being the least common (1.3%). The oldest age group (55+) used tobacco flavor most often (39.8%), followed by fruit (17.5%) and menthol (16.3%). Again, unflavored was the least common (4.8%) (Figure 2).

Compared with the oldest age group (55+): vapers aged 18–24 were less likely to use tobacco ($p < .0001$), or tobacco/menthol mix ($p < .0001$), and more likely to use fruit ($p < .0001$) or candy ($p < .0001$). Vapers aged 25–39 were less likely to use tobacco flavor ($p < .0001$), and more frequently used fruit ($p < .0001$) or candy ($p < .0001$). Vapers aged 40–54 were more likely to use candy ($p = .02$).

Satisfaction With Vaping Compared With Smoking

Of 1603 respondents, 1588 respondents had complete data and were included in the analysis. Overall, 22.5% of vapers reported vaping to be more satisfying compared with smoking, and 30.1% reported vaping to be as equally as satisfying as smoking. Flavor was found to be significantly associated with relative satisfaction with vaping compared with smoking cigarettes in the main model ($p < .001$). Vapers using candy (41.0%, odds ratio [OR] = 3.65, 95% CI: 2.05–6.48, $p < .0001$) or fruit (26.0%, OR = 1.95, 95% CI: 1.22–3.11, $p = .01$) reported being relatively more satisfied (vs. less satisfied) than vapers using tobacco flavor (15.5%). There were no differences between flavors and being equally as satisfied (vs. less satisfying) with vaping compared with smoking cigarettes (Table 2).

Table 1. Sample Characteristics of Regular (Daily or Weekly) Vapers

Characteristics, *n* (% unweighted)	Concurrent users *n* = 1182 (73.7%)	Exclusive vapers *n* = 421 (26.3%)	Total *N* = 1603
Country of residence			
Canada	594 (50.3)	141 (33.5)	735 (45.9)
United States	588 (49.7)	280 (66.5)	868 (54.2)
Age			
18–24	415 (35.1)	47 (11.2)	462 (28.8)
25–39	316 (26.7)	102 (24.2)	418 (26.1)
40–55	265 (22.4)	119 (28.3)	384 (24.0)
55+	186 (15.7)	153 (36.3)	339 (21.2)
Average age (standard deviation)	36.7 (15.1)	46.7 (15.4)	39.3 (15.8)
Gender			
Male	643 (54.4)	181 (43.0)	824 (51.4)
Female	539 (45.6)	240 (57.0)	779 (48.6)
Income			
Low	434 (36.7)	120 (28.5)	554 (34.6)
Moderate	322 (27.2)	123 (29.2)	445 (27.8)
High	392 (33.2)	168 (39.9)	560 (34.9)
Not reported	34 (2.9)	10 (2.4)	44 (2.7)
Education			
Low	332 (28.1)	125 (29.7)	457 (28.5)
Moderate	518 (43.8)	204 (48.5)	722 (45.0)
High	327 (27.7)	91 (21.6)	418 (26.1)
Not reported	5 (0.4)	1 (0.2)	6 (0.4)
Race/ethnicity			
White	827 (70.0)	365 (86.7)	1192 (74.4)
Other	344 (29.1)	55 (13.1)	399 (24.9)
Not reported	11 (91.7)	1 (8.3)	12 (0.8)
Smoking status			
Daily smoker	823 (69.6)	—	823 (51.3)
Nondaily smoker	359 (30.4)	—	359 (22.4)
Recent former smoker	—	196 (46.6)	196 (12.2)
Long-term former smoker	—	225 (53.4)	225 (14.0)
Vaping frequency			
Daily vaper	583 (49.3)	360 (85.5)	943 (58.8)
Weekly vaper	599 (50.7)	61 (14.5)	660 (41.2)
Primary e-cigarette flavor			
Tobacco	321 (27.2)	99 (23.5)	420 (26.2)
Tobacco/menthol mix	74 (6.3)	12 (2.9)	86 (5.4)
Mint/menthol	191 (16.2)	65 (15.4)	256 (16.0)
Fruit	335 (28.3)	140 (33.3)	475 (29.6)
Candy	182 (15.4)	62 (14.7)	244 (15.2)
"Other" flavor	60 (5.1)	29 (6.9)	89 (5.6)
Unflavored	19 (1.6)	14 (3.3)	33 (2.1)

Level of Vaping Enjoyment

Overall, 1596 respondents had complete data and were included in the analysis. Among them, 710 (45.2%) reported vaping to be very or extremely enjoyable. Flavors were found to be significantly associated with level of vaping enjoyment in the overall model ($p < .001$), where vapers who used fruit (50.9%, OR = 1.60, 95% CI: 1.07–2.39, $p = .02$) or candy (60.9%, OR = 2.39, 95% CI: 1.50–3.81, $p = .0002$) were more likely to report vaping to be very/extremely enjoyable compared with those who primarily used tobacco flavor (39.4%) (Table 2).

Plans to Quit Smoking

Of the 1180 concurrent users who had complete data and were included in the analysis, 46% reported that they were planning to quit smoking within the next 6 months, with the highest proportion among those using candy flavor (53.9%), and the lowest among those using tobacco flavor (39.6%). There were no significant differences between flavors for plans to quit smoking ($p = .28$). There was no interaction between age and flavor ($p = .72$) (Table 2).

Attempt to Quit Smoking in the Last 18 Months

Of the 1174 concurrent users who answered this question (only eight refused to answer the question), 50.5% of reported that they had made at least one quit attempt in the last 18 months, but there were no significant differences between flavor groups ($p = .46$). There was no interaction between age and flavor ($p = .31$) (Table 2).

Reasons for Vaping

Enjoyment

Overall, 1592 respondents had complete data and were included in the model. Overall, 76.8% reported that they were vaping for enjoyment, 15.7% reported that they were not vaping for enjoyment,

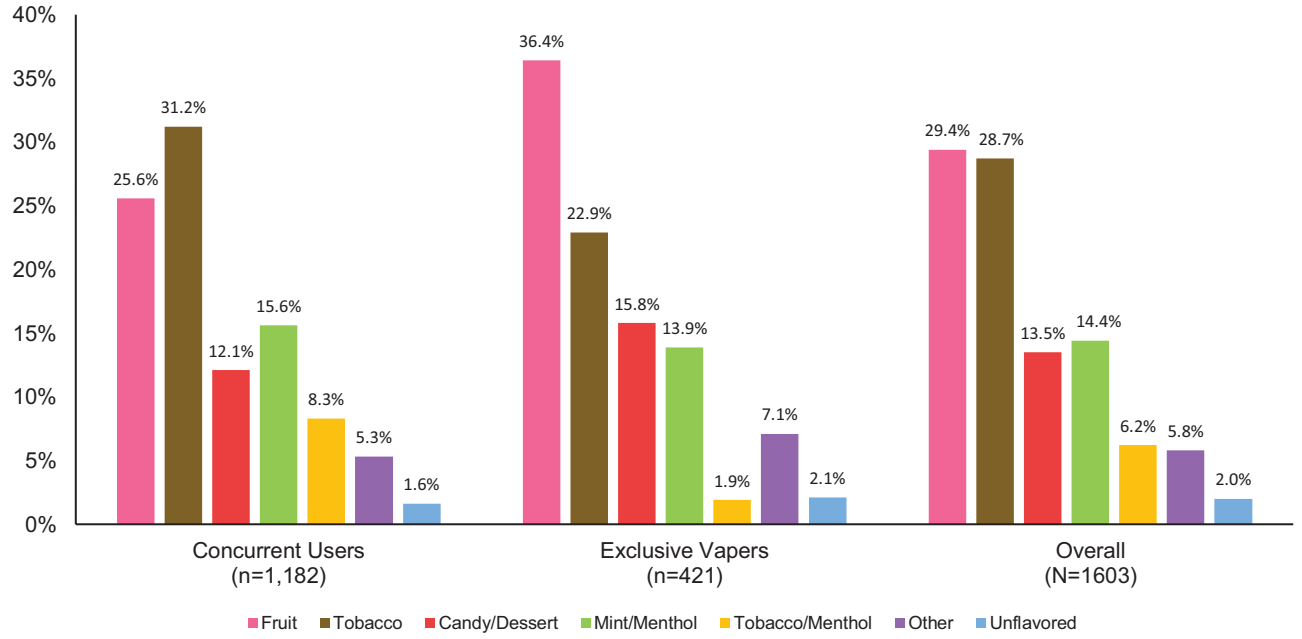

Figure 1. E-cigarette flavors used by regular adult vapers in Canada and the United States in 2018 ($N = 1603$). Data are weighted.

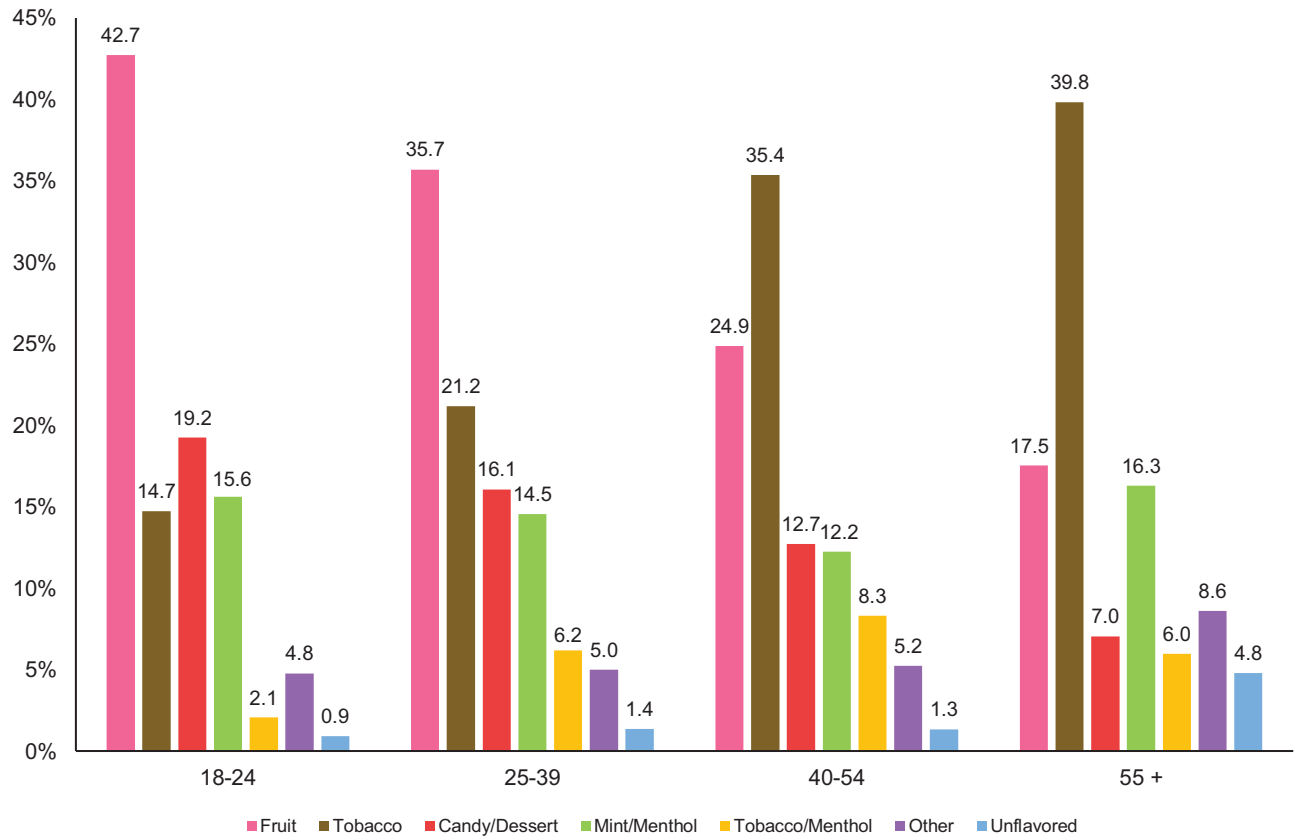

Figure 2. E-cigarette flavors used by regular adult vapers in 2018 by age group ($N = 1603$). Data are weighted.

and 5.9% did not know. Flavors were found to be significantly associated with vaping enjoyment ($p < .0001$), where vapers who used fruit (83.8%, OR = 2.25, 95% CI: 1.41–3.60, $p < .001$) or candy (80.9%, OR = 1.85, 95% CI: 1.09–3.15, $p = .02$) reported vaping for enjoyment significantly more than those who reported using tobacco flavor (69.6%). Those who use unflavored e-cigarettes reported vaping for enjoyment significantly less (31.5%, OR = 0.20, 95% CI: 0.08–0.54, $p = .001$) than tobacco (and all other flavors) (Table 2).

Table 2. Satisfaction With Vaping Compared With Smoking, Level of Enjoyment With Vaping, Quit Smoking Attempts, and Reasons for Using E-cigarettes by Flavor

Outcome	*N*	Tobacco	Tobacco/menthol	Menthol/mint	Fruit	Candy	Other Flavors	Unflavored	Flavor $p^{\dagger}$
Vaping satisfaction compared with cigarettes, *n*	1588	418	85	252	472	242	87	32	**<.001**
More satisfying, weighted %	428	15.5	20.7	21.2	26.0	41.0	20.8	11.0	
More satisfying vs. less satisfying, OR (95% CI)	722	Reference	1.68 (0.69–4.05)	1.46 (0.82–2.61)	1.95 (1.22–3.11)	3.65 (2.05–6.48)	1.80 (0.81–3.99)	0.56 (0.15–2.15)	
p value		Reference	.25	.20	.01	<.0001	.15	.40	
Equally satisfying, weighted %	428	33.4	38.5	30.6	29.7	21.7	41.0	23.6	
Equally satisfying vs. less satisfying, OR (95% CI)	722	Reference	1.45 (0.72–2.90)	0.98 (0.59–1.63)	1.03 (0.65–1.63)	0.89 (0.51–1.57)	1.64 (0.82–3.30)	0.56 (0.17–1.85)	
p value		Reference	.30	.93	.89	.70	.16	.34	
Level of vaping enjoyment, *n*	1596	417	85	256	473	244	88	33	**<.001**
Very much/extremely, weighted %	710	39.4	41.3	38.9	50.9	60.9	40.7	21.0	
Very much/extremely vs. moderately/slightly/not at all, OR (95% CI)	886	Reference	1.08 (0.52–2.24)	0.98 (0.62–1.55)	1.60 (1.07–2.39)	2.39 (1.50–3.81)	1.06 (0.58–1.92)	0.41 (0.15–1.10)	
p value		Reference	.83	.93	.02	.0002	.86	.08	
Plans to quit smoking[a], *n*	1180	321	74	191	334	181	60	19	.28
Yes, within 6 months, weighted %	546	39.6	53.7	39.3	41.5	53.9	47.5	41.2	
Yes vs. not w/in 6 months/not at all/don't know, OR (95% CI)	634	Reference	1.77 (0.87–3.59)	0.98 (0.60–1.61)	1.08 (0.69–1.70)	1.78 (1.04–3.04)	1.38 (0.65–2.90)	1.07 (0.32–3.54)	
p value		Reference	.12	.95	.74	.03	.40	.92	
Attempt to quit smoking to the last 18 months[a], *n*	1174	317	74	190	333	181	60	19	.46
Yes, weighted %	613	51.7	47.5	57.6	49.2	49.2	44.1	28.3	
Yes vs. no, OR (95% CI)	561	Reference	0.85 (0.43–1.67)	1.27 (0.78–2.08)	0.91 (0.58–1.42)	0.91 (0.53–1.54)	0.74 (0.34–1.60)	0.37 (0.12–1.19)	
p value		Reference	.63	.34	.67	.71	.44	.10	
Reasons for vaping									
Enjoyment, *n*	1592	417	86	252	474	242	89	32	**<.0001**
Yes, weighted %	1192	69.6	78.9	73.6	83.8	80.9	76.6	31.5	
Yes vs. No/I don't know, OR (95% CI)	400	Reference	1.63 (0.82–3.25)	1.22 (0.76–1.94)	2.25 (1.41–3.60)	1.85 (1.09–3.15)	1.43 (0.71–2.86)	0.20 (0.08–0.54)	
p value		Reference	.16	.41	<.001	.02	.32	.001	
Reduce cigarette consumption[a], *n*	1099	306	74	179	305	166	52	17	.07
Yes, weighted %	859	82.2	86.5	77.0	86.2	86.6	86.8	52.5	
Yes vs. No/I don't know, OR (95% CI)	240	Reference	1.38 (0.62–3.08)	0.73 (0.40–1.31)	1.36 (0.76–2.43)	1.40 (0.76–2.57)	1.42 (0.59–3.41)	0.24 (0.06–0.89)	
p value		Reference	.43	.29	.31	.28	.43	.03	
May help me quit smoking[a], *n*	1098	306	73	178	305	167	52	17	**.04**
Yes, weighted %	755	63.5	74.7	69.2	74.6	81.1	67.6	60.9	
Yes vs. No/I don't know, OR (95% CI)	343	Reference	1.70 (0.84–3.44)	1.29 (0.74–2.23)	1.68 (1.02–2.76)	2.46 (1.37–4.42)	1.20 (0.50–2.87)	0.90 (0.21–3.81)	
p value		Reference	.14	.37	.04	.003	.68	.88	

Table 2. Continued

Outcome	*N*	Tobacco	Tobacco/menthol	Menthol/mint	Fruit	Candy	Other Flavors	Unflavored	Flavor $p^{\dagger}$
Vaping might help me stay quit smoking[b], *n*	196	38	6	28	73	34	14	3	**.03**
Yes, weighted %	176	99.0	89.7	91.8	93.3	72.8	90.2	42.5	
Yes vs. No/I don't know	20	Reference	0.09 (<0.001–12.52)	0.11 (0.01–1.53)	0.14 (0.01–1.49)	0.03 (0.003–0.27)	0.09 (0.003–2.82)	0.01 (<0.001–0.22)	
p value	20	Reference	.34	.10	.10	.002	.17	.005	

All data are weighted and adjusted. CI = confidence interval; OR = odds ratio.

[a]Analyses included concurrent users only.

[b]Analyses included exclusive vapers only.

[†]*p* value is for "flavor" in the main model (bolded p-values were significant); the *p* values in the outcome column are comparisons for tobacco (reference) vs. the other six flavors.

Vaping Helps Reduce Cigarette Consumption

Overall, 1099 concurrent users had complete data and were included in the model. The majority of concurrent users (83.3%) reported that vaping helps them cut down on the number of cigarettes that they smoke; 12.6% reported "no," and 2.1% of vapers did not know. The highest proportion of concurrent users who reported vaping to help them reduce cigarette consumption used candy (86.6%) or fruit (86.2%), and the fewest used unflavored (52.5%), but overall, there were no significant differences between flavors (p = .07) (Table 2).

Vaping to Help With Quitting Smoking

1098 concurrent users had complete data and were included in the model. The majority of concurrent users reported that vaping may help them quit smoking (78.3%), 17.0% reported "no," and 4.7% did not know. Significantly more concurrent users using candy (81.1%, OR = 2.46, 95% CI: 1.37–4.42, p = .003) or fruit (74.6%, OR = 1.68, 95% CI: 1.02–2.76, p = .04) reported that they were vaping to help them quit smoking compared with the tobacco flavor group (63.5%) (Table 2).

Flavors Used by Exclusive Vapers (Recent Former Smokers) for Smoking Abstinence

Nearly all exclusive vapers/recent former smokers (91.0%) reported that vaping may help them stay quit smoking, 6.7% reported no, and 2.3% reported that they did not know. Among those who recently switched to exclusive vaping (quit smoking in the last 2 years), a variety of tobacco and nontobacco flavors were popular: tobacco (99.0%), fruit (93.3%), menthol/mint (91.8%), other flavors (90.2%), or tobacco/menthol mix (89.7%). Those who were using tobacco were more likely than those using candy (72.8%, OR = 0.03, 95% CI: 0.003–0.27, p = .002) or unflavored (42.5%, OR = 0.01, 95% CI: <0.001–0.22, p = .005) to vape in order to stay quit smoking (Table 2).

Discussion

There appears to be a wide range of flavor preferences among regular adult vapers in Canada and the United States. This study found that about two-thirds of vapers (who either smoke or formerly smoked) reported primarily using nontobacco flavors such as fruit, candy, menthol, or other flavors (eg, coffee, spices), although flavor popularity differed by age and smoking status. Younger and exclusive vapers (former smokers) more frequently reported using fruit and candy flavors, whereas older adults and concurrent users reported primarily using tobacco flavor, followed closely by fruit. Unflavored e-liquids were least preferred among all regular vapers (as well as tobacco/menthol mix among exclusive vapers). Compared with vapers using tobacco flavor, those using fruit or candy flavors were more likely to report vaping as very or extremely enjoyable and relatively more satisfying compared with smoking. Concurrent users using fruit and candy were more likely to believe that vaping may help them quit smoking, but flavors were not associated with vaping to reduce smoking, plans to quit smoking, or an attempt to quit smoking. A variety of flavors, including tobacco and fruit, are popular among exclusive vapers who reported vaping may help them stay abstinent from smoking, but fewer endorsed candy or unflavored e-cigarettes for this reason.

A recent systematic review reported similar findings about e-cigarette flavor preferences, where there appears to be a wide range of preferences among regular vapers, with these preferences

differing by age and smoking status.[9] Similar to our findings, the review concluded that vapers prefer flavored e-liquids (as opposed to unflavored), and that younger consumers prefer sweet flavors (fruit, candy/sweets), with adults preferring tobacco, as well as fruit and menthol. Similarly, older adults in our study were using fruit flavors second after tobacco flavors. Research also indicates that the wide variety of flavors available, and the ability to "mix-and-match" flavors may maintain e-cigarette use.[12] Many other recent studies from the United States and Canada have also shown a preference among adults for sweet flavors over tobacco flavors, where there has been a shift in preference for fruit over tobacco in recent years.[8,10,12,23–25]

There are several reasons why current and former smokers use e-cigarettes: they are helpful for reducing cigarette smoking, for quitting smoking or staying abstinent from smoking, satisfaction, pleasure, and enjoyment.[26–29] Satisfaction, pleasure, and enjoyment with vaping are likely key factors in continuing to vape, and in easing the transition from smoking to vaping.[29,30] It has been shown that a lack of satisfaction with vaping is associated with stopping regular use (eg, was not a satisfying substitute for smoking cigarettes).[26] Nontobacco flavored e-cigarettes may help enhance the relationship between satisfaction and enjoyment with vaping, as it has been reported that the use of flavors other than tobacco is associated with greater satisfaction with vaping.[24] Our study also found that satisfaction (relative to smoking) and enjoyment with vaping were greater when using candy or fruit flavors, and lower when using tobacco or unflavored e-cigarettes.

Some of the outcomes of interest in this study were not as consistently associated with flavor preferences. For example, most exclusive vapers reported a variety of flavors (tobacco or nontobacco flavors) to help them stay abstinent from smoking. Additionally, although concurrent users who reported using fruit or candy flavors were more likely to believe that vaping may help them quit smoking, no flavor category influenced the propensity to report using vaping to reduce cigarette consumption, having plans to quit smoking within 6 months, or having attempted to quit smoking in the last 18 months. Interestingly, where the majority of concurrent users reported vaping to help reduce their cigarette consumption, far fewer reported that they planned on quitting smoking in the next 6 months, and only half attempted to quit in the last year and a half. This is problematic, as concurrent use of e-cigarettes while smoking may not necessarily reduce health risks.[31–34] As planning to quit smoking is likely often at an early stage of initiating e-cigarette use, flavors may not play a key role in the early contemplation phase. Thus, the findings from this study may suggest that flavor choice may differ between different stages of e-cigarette use. It may take time for smokers to get used to vaping, (considering most smokers have long histories of tobacco use and have had several failed past quit attempts) and early concurrent users may have not experimented with different devices, flavors, and/or adequate nicotine dosages.[30]

E-cigarettes are a popular cessation aid, surpassing other approved cessation therapies such as licensed nicotine replacement therapy and prescription medications in many countries, including United States and Canada.[35–37] There is evidence from randomized controlled trials (RCTs) and observational studies that e-cigarettes can be helpful for quitting smoking,[37–43] but this conclusion has not been found in other observational studies.[9,44–46] Moreover, there is little evidence how e-cigarette flavors may play a role in successful smoking cessation. One recent randomized trial has suggested that there may be a cessation benefit for certain flavored e-cigarettes. The study, conducted by Hajek et al. in the United Kingdom found a significant smoking cessation benefit of e-cigarettes over nicotine replacement therapy among smokers trying to quit when used along with behavioral cessation support. Fruit flavors were most commonly used at three of the four follow-up measures (weeks 1, 4, and 52), followed by tobacco flavor, and then menthol/mint and sweets/candy flavors.[38] While our study did not measure actual smoking cessation, we did find that there was no consistent flavor pattern (or benefit) for many of the outcomes we measured, which are indicators of being more likely to actually quit. For example, our study showed that among concurrent users, flavor was not associated with making a quit smoking attempt. While flavors do not appear to have played a key role in attempts to quit smoking, health care providers should strongly encourage concurrent users to quit (either with another approved cessation therapy, or at least by encouraging complete substitution with an e-cigarette[47]), especially considering that half of concurrent users in this study attempted to quit smoking, and were not successful in doing so. Additionally, health care providers should also help former smokers maintain abstinence by adequately addressing how to cope with nicotine withdrawal and cravings to smoke.

While policies that restrict or ban e-cigarette flavors other than tobacco may help to reduce youth experimentation and use of e-cigarettes, it might also make e-cigarettes less attractive to smokers and former smokers as a smoking substitute for cigarettes, or as a way to stay abstinent from smoking. Considering that 480 000 deaths in the United States,[48] and 45 000 in Canada,[49] are attributed to tobacco smoking each year, more research is needed to understand the role different flavors may play in prompting smokers to try e-cigarettes and continue using them, especially as a complete substitute for smoking. Indeed, the US Food and Drug Administration (FDA) has identified the impact that flavor product bans may have on smoking behaviors as a public health research priority.[50] The findings from our study, obtained during a period of changing e-cigarette regulations in many countries, introduce a number of important issues for future research on the impact banning e-cigarette flavors.

This study had a number of strengths, such that it is a large population study spanning across two countries, with representative e-cigarette users in Canada and the United States. Additionally, we had a large enough sample that enabled comparisons between multiple e-cigarette flavor categories. The findings from this paper however should be interpreted with some caution, as there are some limitations to consider. First, this study was a cross-sectional study design, therefore it cannot be used to demonstrate causality or temporality. Second, some of the sample sizes were small (particularly the exclusive vaper group and for certain flavors), and thus the lack of statistical significance for some tests may have been due to low power. Third, we were unable to stratify some of the outcomes by user group due to small sample sizes. Fourth, among concurrent users, we did not assess if the respondent's current primary flavor was used at the time of the quit attempt, so we cannot determine which flavor was unsuccessful. Finally, these results are limited to adults in Canada and the United States (where flavor preferences are similar), and thus may not apply to other countries or populations of interest (eg, youth or nonsmokers).

Conclusion

This study shows that a variety of nontobacco flavors, especially fruit, are popular among adult regular vapers, particularly among those who have quit smoking and are now exclusively vaping, although flavor preferences differed by age and smoking status. While

this study cannot determine if different flavor preferences are associated with successful smoking cessation, it suggests that flavors may help boost satisfaction and enjoyment with vaping, which may be key factors in helping ease the transition from smoking to exclusive vaping. Further research is warranted to more fully understand how e-cigarette flavors may play a role in vaping patterns over time, and whether they can successfully aid in smoking cessation and help prevent relapse back to smoking. Notably, research is needed to examine the impact of banning popular nontobacco flavored e-cigarettes, as it is currently unknown what consequences may occur if e-cigarette users do not have access to their preferred flavor.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at https://academic.oup.com/ntr.

Supplementary data are available at *Nicotine & Tobacco Research* online.

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Ethics approval

Study questionnaires and materials were reviewed and provided clearance by Research Ethics Committees at the following institutions: University of Waterloo (Canada, ORE#20803/30570, ORE#21609/30878), King's College London, United Kingdom (RESCM-17/18-2240), Cancer Council Victoria, Australia (HREC1603), University of Queensland, Australia (2016000330/HREC1603); and Medical University of South Carolina (waived due to minimal risk). All participants provided consent to participate.

Declaration of Interests

KMC has received payment as a consultant to Pfizer, Inc, for service on an external advisory panel to assess ways to improve smoking cessation delivery in health care settings. KMC and DH have served as paid expert witness in litigation filed against the tobacco industry. GTF and DH have served as expert witnesses on behalf of governments in litigation involving the tobacco industry. All other authors have no conflicts of interest to declare.

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