



Original Investigation

# Gender Differences in Reasons for Using Electronic Cigarettes and Product Characteristics: Findings From the 2018 ITC Four Country Smoking and Vaping Survey

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## Abstract

**Introduction:** Little is known about why males are more likely to use electronic cigarettes (ECs) compared with females. This study examined gender differences in reasons for vaping and characteristics of EC used (device type, device capacity, e-liquid nicotine strength, and flavor).

**Methods:** Data were obtained from 3938 current ( $\geq 18$  years) at-least-weekly EC users who participated in Wave 2 (2018) ITC Four Country Smoking and Vaping Survey in Canada, the United States, England, and Australia.

**Results:** Of the sample, 54% were male. The most commonly cited reasons for vaping in females were "less harmful to others" (85.8%) and in males were "less harmful than cigarettes" (85.5%), with females being more likely to cite "less harmful to others" (adjusted odds ratio [aOR] = 1.64,  $p = .001$ ) and "help cut down on cigarettes" (aOR = 1.60,  $p = .001$ ) than males. Significant gender differences were found in EC device type used ( $\chi^2 = 35.05$ ,  $p = .043$ ). Females were less likely to report using e-liquids containing  $>20$  mg/mL of nicotine, and tank devices with  $>2$  mL capacity (aOR = 0.41,  $p < .001$  and aOR = 0.65,  $p = .026$ , respectively) than males. There was no significant gender difference in use of flavored e-liquids, with fruit being the most common flavor for both males (54.5%) and females (50.2%).

**Conclusion:** There were some gender differences in reasons for vaping and characteristics of the product used. Monitoring of gender differences in patterns of EC use would be useful to inform outreach activities and interventions for EC use.

**Implications:** Our findings provide some evidence of gender differences in reasons for vaping and characteristics of EC used. The most common reason for vaping reported by females was "less

harmful to others," which may reflect greater concern by female vapers about the adverse effects of secondhand smoke compared with male vapers. Gender differences might be considered when designing gender-sensitive smoking cessation policies. Regarding characteristics of EC products used, we found gender differences in preferences for e-liquid nicotine strength and device capacity. Further studies should examine whether the observed gender differences in EC use reasons and product characteristics are predictive of smoking cessation. Furthermore, studies monitoring gender-based marketing of ECs may be considered.

## Introduction

Electronic cigarettes (EC) have become popular and evolved rapidly in recent years.<sup>1-3</sup> Given the popularity of ECs, examining the pattern of use across various segments of the population may help understand the impact of these products. Although gender differences in tobacco use and reasons for smoking have been extensively studied,<sup>4-7</sup> gender differences in EC use is an under-researched area.

Previous literature has reported gender differences in the EC devices and e-liquids used by females versus males. Online surveys among adult vapers<sup>8,9</sup> found that females preferred vaping devices that resembled cigarettes. This has implications for cessation as newer generation EC devices (eg, refillable tanks) have been found to be more effective for quitting than prefilled models.<sup>10,11</sup> Previous studies also found that females were more likely than males to use e-liquids that are sweet,<sup>8</sup> fruit flavor,<sup>12</sup> nontobacco flavor,<sup>9</sup> and of lower nicotine strength.<sup>9</sup> On the contrary, males were more likely than females to report that they preferred tobacco flavor.<sup>12</sup> These gender differences are important to understand because research has found that e-liquid flavors can moderate the effect that ECs have on reducing smoking.<sup>13</sup> Given that the type of EC device and content of e-liquids may affect patterns of EC use, monitoring gender differences in characteristics of EC use may have implications for the utility of ECs as a nicotine replacement device and the regulation of flavorings in ECs.

Findings are mixed on gender differences in reasons for EC use. An online survey in the United States found that males were more likely than females to report continuing to use ECs for the following reasons: help cut down smoking, concern about health consequences from combustible cigarettes and for enjoyment. In contrast, females were more likely than males to report continuing to use ECs to deal with stress.<sup>9</sup> By contrast, a study from Spain found no gender differences in the reasons for using ECs among current EC users.<sup>12</sup> Furthermore, a study in England found that female smokers who never used EC were more likely to try ECs if vaping could help control their weight.<sup>14</sup> However, another study from the United States found no gender differences in reported vaping for weight control.<sup>15</sup> These inconsistent results and the fact that EC products as well as the regulatory environment are quickly evolving suggest that further research is needed to explore the role of gender in reasons for EC use.

Currently, EC regulations differ across countries. For instance, in England, ECs are regulated under the Tobacco and Related Products Regulation 2016,<sup>16</sup> which implements the European Union Tobacco Product Directive (EU TPD) regulation.<sup>17</sup> These regulations have restricted EC capacity to no more than 2 mL and e-liquid to a nicotine strength to no more than 20 mg/mL since May 2017. In Canada, e-liquids that contain 66 mg/mL of nicotine or more are prohibit to sale<sup>18</sup>; however, there is no regulation regarding device capacity at the time of this study. By contrast, the United States have no regulations regarding device capacity and nicotine strength use. Regarding e-liquid flavors, the United States has banned fruit and mint flavored

cartridge-based EC products since February 2020.<sup>19</sup> However, there is no specific regulation on e-liquid flavor in England, Canada and Australia. To our knowledge, there is no regulation on EC device types in England, Canada and the United States. In Australia, the retail sale of nicotine-containing ECs is prohibited, and sale of non-nicotine ECs is also illegal in several states in Australia.<sup>20</sup>

The present study used data from the Wave 2 (2018) International Tobacco Control Four Country Smoking and Vaping (ITC 4CV2) Survey in Canada, the United States, England, and Australia. Our aims were to examine gender differences in reasons for vaping and characteristics of EC use (type of device, capacity of device, e-liquid nicotine strength, and e-liquid flavor) among current (ie, at least weekly) EC users. Based on previous literature, we hypothesized that gender differences in characteristics of EC use may be similar to those found for conventional cigarettes; therefore, we expected to find gender differences in type (device type and capacity) and content (e-liquid nicotine strength and flavors) of EC product used. We considered our investigation of gender differences in reasons for EC use to be exploratory due to mixed findings to date and did not have a priori hypotheses.

## Methods

### Participants and Study Design

Participants were from the Wave 2 ITC 4CV2 Survey conducted from February to July 2018 in Canada, the United States, England, and Australia. The ITC 4CV Surveys are an expansion of the original ITC Four Country Survey (ITC 4C).<sup>21</sup> The objective of the ITC 4CV Surveys are to examine nicotine-related products, with a particular focus on the use of ECs. Methodological details for each country are available online (<https://itcproject.org/methods>). In brief, the ITC 4CV2 Survey sample comprised the following subsamples: (1) recontact smokers and former smokers who had participated in the 4CV1 Survey, (2) newly recruited current smokers and former smokers (ie, quit smoking in the previous 24 months) from country-specific panels, regardless of vaping status, (3) recontact vapers who had participated in the 4CV1 Survey, and (4) newly recruited current vapers (using a vaping device at least weekly) from country-specific panels, regardless of smoking status. The newly recruited smoker and vaper samples in each country were designed to be representative of smokers and at-least-weekly vapers, respectively, and used either probability-based sampling frames or nonprobability opt-in sampling frames, or a combination of these methods.<sup>22</sup> This study included only the EC users who reported currently using ECs at least weekly, regardless of their smoking status.

The survey protocols and all materials of the ITC 4CV Survey, including the survey questionnaires, were cleared for ethics by Office of Research Ethics, University of Waterloo, Canada (ORE#20803/30570, ORE#21609/30878); Research Ethics Office,

King's College London, UK (RESCM-17/18-2240); Human Research Ethics, Cancer Council Victoria, Australia (HREC1603); Human Ethics, Research Management Office, University of Queensland, Australia (2016000330/HREC1603); and Institutional Review Board Medical University of South Carolina (waived due to minimal risk). All participants provided consent to participate.

## Measures

### Outcomes

#### *Reasons for Using ECs*

The survey assessed reasons for use using the question: "Which of the following are reasons that you use e-cigarettes (vape)?:" (1) "less harmful than cigarette," (2) "less harmful to others," (3) "more acceptable," (4) "enjoyment," (5) "use in smoke free areas," (6) "affordability," (7) "weight control," (8) "help cut down on cigarettes" (asked daily/weekly smokers only,  $N = 2753$ ), (9) "help quit smoking" (asked daily/weekly smokers only,  $N = 2753$ ), and (10) "help stay quit" (asked recent quitters only: identify as smokers who quit smoking in last 24 months and has smoked  $\geq 100$  lifetime cigarettes,  $N = 484$ ). Response options were "yes" or "no," with refuse/don't know recoded as "no."<sup>23</sup> Respondents could report more than one reason. The analyses were stratified by smoking status in order to understand reasons for vaping in the context of smoking cessation: overall sample, regular smoker (smoking at least weekly), occasional smokers (smoking monthly/less than monthly), and quitters.

#### *EC Product Characteristics*

Questions about the appearance of the device and device type were combined to create an analytic variable, similar to a previous ITC study.<sup>24</sup> First, participants were asked to describe the appearance of the type of EC currently used most, selecting from the following choices: (1) "looking like an ordinary cigarette, including shape, size and colour"; (2) "look similar in shape and size to an ordinary cigarette, but is a different colour"; (3) "looks similar in shape to a pen, but may not be round, and is pen-sized or larger"; (4) "looks like a box-shaped battery with a mouthpiece"; and (5) "looks different than any of the options described above." Participants were also asked to describe the type of EC currently used most, categorizing the device type as (1) "It is disposable not refillable (non-rechargeable)," (2) "it uses replaceable pre-filled cartridge (rechargeable)," and (3) "It has a tank that you fill with liquids (rechargeable)." Responses were combined thus<sup>21</sup>: (1) "cigalikes" (a combination of "looks like an ordinary cigarette" and "it is disposable" or "cartridge-based"); (2) "pen-style cartridge" (a combination of "similar in shape to a pen" and "uses a cartridge-based refill"); (3) "pen-style tank" (a combination of "similar in shape to a pen" and "has a refillable tank"); (4) "box tank" (a combination of "box-shaped with a mouthpiece" and "refillable tank"); and (5) "all other combinations" (a combination of all other choices).

Participants were also asked to report the tank/cartridge capacity of EC device used, and the responses were grouped as follows: (1) 2 mL or less, (2) more than 2 mL, and (3) don't know (valid response), with "refuse" responses recoded as missing data ( $N = 4$  for tank,  $N = 9$  for cartridge).

#### *EC Nicotine Strength and Flavor*

Flavor was assessed by asking all respondents: "Which of the following flavors of e-cigarettes or e-liquid have you used in the past thirty days," to which participants could "select" or "not select" from a list of flavors, with "refuse/don't know" responses coded as missing data ( $N = 43$ ). The responses were grouped into seven

categories as follows: (1) unflavored, (2) tobacco, (3) menthol/mint, (4) tobacco/menthol mix, (5) fruit, (6) candy/sweet/dessert/chocolate, and (7) other flavors.

Nicotine strength of the e-liquid was assessed by asking the participants: "What is the nicotine strength of the e-liquid you currently use most?" The response options were grouped as (1) no nicotine, (2) 20 mg/mL or less, (3) more than 20 mg/mL, and (4) "don't know" (valid response), with "refuse" response recoded as missing data ( $N = 4$ ).

Because there are different regulations regarding EC product characteristics (device capacity, nicotine strength, e-liquid flavor, and device type), the analyses were stratified by country (Canada, United States, England, and Australia).

## Demographics

### Covariates

The following control variables were included in adjusted analyses: country (Canada, United States, England, and Australia), age (18–24, 25–39, 40–54,  $\geq 55$ ), ethnicity (White, non-White in Canada, United States, England; English speaking, non-English speaking in Australia), socioeconomic status (SES)<sup>25</sup> (derived from household income and education level), pattern of product use, and urges to smoke.

Pattern of product use was classified similar to a previous ITC study.<sup>25</sup> There are three categories of current use for each product: daily, nondaily (less than daily but at least monthly use for smokers and less than daily but at least weekly for vapers), and no current use. Therefore, there are four types of concurrent use: (1) predominant smokers (daily smokers and nondaily vapers); (2) dual daily users (daily use of both products); (3) predominant vapers (daily vapers and nondaily smokers); and (4) nondaily concurrent user (nondaily use of both products); plus there are two types of exclusive users of EC: exclusive daily vapers and exclusive nondaily vapers.

SES was classified similar to a previous ITC study.<sup>25</sup> We combined four-level indices of education and income (low, medium, high, don't know/refuse) by treating don't know/refuse in the medium category, and then combining such that either or both high was coded as "high SES," either or both low was coded "low SES," with the remainder in the "middle SES" category.

Strength of urges to smoke was assessed in smokers and ex-smokers by asking "In general, how strong have urges to smoke been in the last 24 hours?" The response was ranked from: "0" as "no urge to smoke" to "5" as "extremely strong." Strength of urges to smoke was used to represent the severity of cigarette dependence in our sample. The rationale for using this variable is based on a previous longitudinal study,<sup>26</sup> which compared the different measures of cigarette dependence (strength of urge to smoke, the Fagerstrom Test of Nicotine dependence, and the Heaviness of Smoking Index) among smokers in England, and found that all of the measures can predict the success of quit attempts, but strength of urge to smoke had the strongest association and suggested that rating of strength of urge to smoke may be a valuable measures of cigarette dependence.

## Statistical Analysis

Sample characteristics (demographic data and smoking/vaping status) were presented by unweighted frequencies and unweighted percentages. Analyses were weighted to country-representative samples using a cross-sectional weight for current EC users. Descriptive statistics and bivariate analyses were conducted on the overall sample and stratified by either smoking status or country, with

$\chi^2$  tests used to evaluate descriptive differences. Complex Sample Logistic Regression (ie, CSLOGISTIC) analyses were performed with gender as the independent variable and reasons for EC use and characteristics of ECs used as the dependent variables. All analyses were conducted using SPSS version 25.0. Missing data were handled using listwise deletions, and no imputations were made. An alpha level of .05 was used to evaluate statistical significance for the product characteristic models (ie, device type, capacity, and nicotine strength) but for modeling EC use reasons and e-liquid flavor, a Bonferroni correction was made to protect type I error rate given the multiple comparisons conducted.

### Reasons for EC Use

Gender differences in reasons for vaping were examined. Binary logistic regression was conducted to examine the association between gender and the endorsement of each reason for vaping (yes/no) in the overall sample and by smoking status. Given the multiple comparisons (seven tests for overall sample analysis and 24 tests for three subgroup analyses) conducted to examine the gender differences in reasons for vaping, we used a Bonferroni correction; thus, a  $p$ -value of .007 and .002 was used as cut-off for statistical significance for reasons for vaping in the overall sample and subgroup analyses, respectively. The regression models controlled for country, age, ethnicity, SES, vaping frequency (daily vs weekly), and urges to smoke.

### EC Device Characteristics

We examined gender differences in type of EC device (cigalike, box tank, pen-style tank, pen-style cartridge, and others) and device capacity ( $\leq 2$  and  $> 2$  mL). Chi-square tests were used to evaluate gender differences in the type of device used.

A multinomial logistic regression (with referent set to “cigalike” because it is the model that has been on the market the longest time) was conducted to examine whether gender was associated with device preference in current EC users. We performed three stages of analysis. First, we examined the unadjusted association between gender and device type. In the second stage, the model adjusted for ethnicity, SES, country, pattern of product use, age, and urges to smoke. Finally, we added an interaction term between gender and age group to examine the moderating effect of age group on the association between gender and device preference, adjusting for all other variables listed above. We examined age group because a previous longitudinal study found that tank devices were more likely to be used by older respondents.<sup>11</sup>

A multivariate logistic regression was then conducted to examine the association between gender and device capacity ( $\leq 2$  and  $> 2$  mL), adjusting for the same variables as above.

### EC Nicotine Strength and Flavor

We examined gender differences in the nicotine strength and e-liquid flavors used. Multivariable logistic regression analysis was conducted to examine the association between gender and e-liquid characteristics: nicotine strength ( $\leq 20$  mg/ml and  $> 20$  mg/ml) and each flavor of e-liquid (selected/not selected). Given the multiple comparisons conducted to examine the gender differences of e-liquid flavor (seven tests for binary logistic regression), we used a Bonferroni correction; thus, a  $p$ -value of 0.007 was applied as a cut-off for statistical significance for e-liquid flavor comparison. As above, the models controlled for country, age, ethnicity, SES, pattern of product use, and urges to smoke.

## Results

### Demographic Characteristics

Overall, 54.3% of the sample were male, 50.0% were from England, and 80.9% were White. Sixty-one percent of participants vaped daily, and 55.9% smoked daily. The most common pattern of use was dual daily user (30.1%), followed by predominant smoker (25.9%). There were no significant gender differences in pattern of product use ( $\chi^2 = 19.21$ ,  $p = .17$ ). Further details are presented in [Supplementary Table S1](#).

### Gender Differences in Reasons for EC Use by Smoking Status

Overall, the most commonly cited reason for EC use was “less harmful to others” (85.8%) in females and “less harmful than cigarettes” (85.5%) in males. Females were significantly more likely to cite “less harmful to others” than males (adjusted odds ratio [aOR] = 1.64, 95% confidence interval [CI] = 1.24–2.18,  $p = .001$ ). [Table 1](#) shows the relationships between gender and reasons for vaping by smoking status.

### Daily/Weekly Smokers

Among daily/weekly smokers, the most common reason for vaping in both females and males was “help cut down on cigarettes” (85.3% and 77.1%, respectively); in the adjusted analysis, females were significantly more likely to cite this reason than males (aOR = 1.60, 95% CI = 1.21–2.11,  $p = .001$ ).

### Monthly/Less Than Monthly Smokers

Among monthly/less than monthly smokers, the most common cited reason for vaping in females was “less harmful to others” (93.6%) compared with “less harmful than cigarettes” (85.4%) in males; in the adjusted analysis, females were significantly more likely to cite this reason than males (aOR = 4.91, 95% CI = 1.82–13.25,  $p = .002$ ).

### Quitters

For recent quitters, the most commonly cited reasons for vaping in females and males were “help to stay quit from cigarettes” (92.3%) and “less harmful than cigarettes” (93.0%), respectively. However, the adjusted analysis was not significant.

### The Relationship Between Gender and EC Product Characteristics

#### Device Type

The most common device type was a box-shaped device with a refillable tank (39.0%), followed by pen-style with a refillable tank (29.1%), cigalike (19.1%), and pen-style cartridge (9.3%). The relationship between gender and device type was significant ( $\chi^2 = 35.05$ ,  $p = .043$ ); more males reported using box-shaped device with refillable tanks than females (42.0% and 34.9%, respectively), and more females reported using pen-style with a refillable tank than males (33.4% and 26.3%, respectively).

Box-shaped devices with a refillable tank were the most common device in all age groups except in the group of  $\geq 55$  years, which reported pen-style with a refillable tank as the most common device. However, there was a significant gender by age group interaction (Wald  $F = 3.52$ ,  $p = .007$ , see [Supplementary Table S2](#)) on device type. Among 26–40 and  $\geq 55$  year olds, males were more likely to report using a box-shaped device with a refillable tank than females

**Table 1.** Logistic Regression of the Association Between Gender and Reasons for Vaping, Overall and by Smoking Status

	Overall (N = 3938)				Daily/weekly smoker (N = 2753)				Monthly/less than monthly smoker (N = 232)				Quitter (N = 873)			
	Male	Female	p	95% CI	Male	Female	p	95% CI	Male	Female	p	95% CI	Male	Female	p	95% CI
Less harmful than cigarette (%)	85.5	83.3			74.3	74.5			85.4	85.4			93	90.7		
aOR	1	0.85	.296	0.62-1.15	1	0.97	.784	0.75-1.24	1	0.660	.428	0.24-1.85	1	0.64	.261	0.29-1.39
Less harmful to others (%)	79.6	85.8			69.8	77.8			75.9	93.6			85.7	92.0		
aOR	1	1.64	.001*	1.24-2.18	1	1.43	.005	1.11-1.84	1	4.91	.002**	1.82-13.25	1	2.01	.052	0.99-4.07
More acceptable than smoking (%)	75	77.3			69.8	73.7			63.1	84.1			78.9	79.0		
aOR	1	1.1	.527	0.82-1.46	1	1.14	.309	0.89-1.45	1	2.74	.022	1.16-6.49	1	0.96	.888	0.57-1.63
Enjoyment (%)	74.1	77.2			66.1	65.8			77.1	87.3			78.7	79.0		
aOR	1	1.18	.230	0.90-1.54	1	0.97	.823	0.77-1.23	1	1.918	.201	0.71-5.22	1	1.502	.186	0.82-2.75
Smoke-free area (%)	64.9	64.5			63.1	64.3			56.9	76.3			64.8	65.1		
aOR	1	1.05	.724	0.80-1.37	1	1.03	.835	0.81-1.29	1	2.29	.044	1.02-5.13	1	1.00	.979	0.62-1.64
Affordability (%)	74.8	76.3			64.7	64.9			64.2	73.3			85.6	89.6		
aOR	1	1.11	.408	0.86-1.14	1	0.94	.602	0.74-1.19	1	1.48	.348	0.65-3.39	1	1.37	.289	0.77-2.44
Control appetite/weight (%)	26.9	25.8			28.5	25.8			30.8	26.7			25.2	24.8		
aOR	1	0.91	.517	0.67-1.22	1	0.90	.369	0.69-1.15	1	1	.993	0.44-2.27	1	0.99	.970	0.58-1.70
Help quit cigarette (%)					68.7	73.7										
aOR	—	—	—	—	1	1.26	.065	0.99-1.61	—	—	—	—	—	—	—	—
Help cut down on cigarette (%)					77.1	85.3										
aOR	—	—	—	—	1	1.60	.001**	1.21-2.11	—	—	—	—	—	—	—	—
Help stay quit from cigarette*** (%) (N = 484)																
aOR	—	—	—	—	—	—	—	—	—	—	—	—	88.2	92.3	.518	0.53-3.53

Percentages are weighted; aOR = odds ratio adjusted for age, country, socioeconomic status, ethnicity, vaping frequency, and urges to smoke; CI = confidence interval. Significant after Bonferroni correction for multiple hypothesis testing ( $p \leq .007^*$  [overall sample] and  $p \leq .002^{**}$  [subgroup analyses]). Gender (male or female) is the independent variable and endorsement of each reason for vaping is the dependent variable. \*\*\*Help stay quit from cigarette\* was asked in recent quitters only (identify as smokers who quit smoking in last 24 mo and has smoked  $\geq 100$  lifetime cigarettes,  $N = 484$ ). Bold values represent statistical significance at  $p \leq .007^*$  [overall sample] and  $p \leq .002^{**}$  [subgroup analyses].

**Table 2. Gender Differences in EC Device Type by Age Group Among At-Least-Weekly EC Users**

Type	Overall																									
	18–24 y (N = 1045)		24–40 y (N = 1081)		40–55 y (N = 909)		≥55 y (N = 903)		F-test	p																
	Male	Female	Male	Female	Male	Female	Male	Female																		
	N = 2140	N = 1798	χ <sup>2</sup>	p	F-test	p	χ <sup>2</sup>	p	F-test	p																
Cigarette	615 (19.5%)	431 (18.7%)	35.05	.043*	2.5	201 (16.1%)	106 (8.3%)	24.46	.243	1.37	208 (19.6%)	117 (15.6%)	44.03	.013*	3.31	119 (22.3%)	87 (20.7%)	2.75	.865	0.32	87 (19.1%)	121 (30%)	46.72	.001*	5.02	
Pen-style cartridge	297 (9.5%)	204 (8.9%)			75 (6.6%)	67 (7.6%)			101 (9.5%)	58 (8.2%)					77 (13.1%)	52 (12.5%)			44 (8.4%)	27 (6.5%)						
Pen-style tank	498 (26.3%)	567 (33.4%)			99 (29.9%)	118 (24.8%)			110 (18.4%)	120 (36.2%)					115 (24.3%)	139 (28.9%)			174 (37.2%)	190 (40.9%)						
Box tank	678 (42%)	522 (34.9%)			178 (43.9%)	166 (52.2%)			206 (49.8%)	142 (38.2%)					162 (37.7%)	134 (35%)			132 (31.9%)	80 (14.8%)						
Others	52 (3%)	74 (4.3%)			17 (3.6%)	18 (7.1%)			6 (2.7%)	13 (1.8%)					8 (2.6%)	16 (3%)			21 (3.4%)	27 (7.8%)						

Percentages are weighted, N (%).  
 \*Statistically significant ( $p < .05$ ).  
 Bold values represent statistical significance at  $p = .05$ .

(49.8% and 38.2%,  $\chi^2 = 44.03, p = .013$  and 31.9% and 14.8%,  $\chi^2 = 46.72, p = .001$ , respectively). Table 2 shows gender differences in device type by age group.

### Device Capacity

There was a significant association between tank capacity and gender in overall sample (Wald  $F = 4.08, p = .017$ ). Females were less likely than males to report using tank devices with >2-mL capacity (28.2% and 36.5%, aOR = 0.65,  $p = .026$ , 95% CI = 0.44–0.95, see Table 3). However, 26.6% of participants could not report the capacity of tank device they used.

Because there are different regulations regarding device capacity, the analyses were stratified by country. No significant gender difference was found in England (where the EU TPD enforces a 2-mL limit), the United States, and Canada; in Australia, more males reported using devices with >2-mL capacity than females (81.3% vs 28.3%,  $\chi^2 = 47.48, p < .001$ , see Supplementary Table S3).

### E-liquid Nicotine Strength

In the overall sample, the most commonly reported nicotine strength was 20 mg/mL or less (77.5%). The adjusted logistic regression analysis showed that females were less likely than males to report using e-liquids containing >20 mg/mL of nicotine (3.3% and 6.2%, aOR = 0.41,  $p < .001$ , 95% CI = 0.26–0.67, see Table 3). When the analysis was stratified by country, in England where the EU TPD enforces a ≤20 mg/mL limit, more males reported using e-liquids containing >20 mg/mL than females (5.7% vs 1.5%,  $\chi^2 = 47.48, p = .01$ , see Supplementary Table S3).

### E-liquid Flavors

Overall, there were no gender differences in the use of e-liquid flavors (Table 3). Fruit was the most common flavor for both genders (54.5% for male and 50.2% for female), followed by tobacco (34.2% for male and 31.2% for female, see Table 3). However, the use of menthol/mint flavors was more frequently reported by females than males in the United States (31.7% and 22.4%,  $\chi^2 = 10.16, p = .024$ , see Supplementary Table S3).

## Discussion

There were two key findings of this study. First, the most commonly cited reason for vaping differed by gender; for females, this was “less harmful to others,” whereas for males, this was “less harmful than cigarettes.” Second, there were some gender differences in EC product characteristics. Specifically, male users were more likely to report using larger device capacity (>2 mL) and stronger nicotine strengths (>20 mg/mL), both of which exceed the EU TPD regulation, than female users. There were no gender differences in e-liquid flavor used overall, with the exception that females in the United States were more likely to use menthol/mint flavors than males.

### Reasons for Vaping

The finding that the most common reason for vaping among females was that ECs are less harmful to others may reflect that females use ECs because they are more concerned about the adverse effects of secondhand smoke on those around them. This would be consistent with findings from previous studies, which have shown that females were more likely than males to support smoke-free policies in university,<sup>27</sup> homes,<sup>28,29</sup> vehicles,<sup>29</sup> and outdoor spaces.<sup>30</sup> Moreover,

**Table 3.** Logistic Regression Showing the Association Between Gender and Device Capacity, Nicotine Strength, and E-liquid Flavor in All Current At-Least-Weekly EC Users

	Overall (N = 3938)			
	Male	Female	<i>p</i>	95% CI
Tank capacity (reference: capacity ≤ 2 mL), N = 2313				
>2 mL (%)	36.5	28.2		
aOR	1	0.65	<b>.026*</b>	0.44–0.95
Don't know (valid response) (%)	25.1	31.8		
aOR	1	1.18	.427	0.78–1.79
Cartridge capacity (reference: capacity ≤ 2mL), N = 1163				
>2 mL	26.2	18.8		
aOR	1	0.76	.284	0.8–2.15
Don't know (valid response) (%)	32.8	40.3		
aOR	1	0.82	.430	0.74–2.07
Nicotine strength (reference: <20 mg), N = 3934				
>20 mg (%)	6.2	3.3		
aOR	1	0.41	<b>&lt;.001*</b>	0.26–0.67
No nicotine (%)	9.2	7		
aOR	1	0.80	.329	0.51–1.26
Don't know (valid response) (%)	9.5	8.8		
aOR	1	1.07	.780	0.68–1.66
**Flavor (reference: not selected), N = 3724				
No flavor (%)	2.9	2.9		
aOR	1	1.15	.692	0.58–2.26
Tobacco (%)	34.2	31.2		
aOR	1	0.77	.043	0.59–0.99
Mix tobacco/menthol (%)	7.3	8.9		
aOR	1	1.21	.316	0.83–1.76
Menthol/mint (%)	28.4	30.6		
aOR	1	1	.997	0.75–1.34
Fruit (%)	54.5	50.2		
aOR	1	0.86	.259	0.67–1.12
Candy/sweet/dessert/chocolate (%)	28.8	30.5		
aOR	1	1.11	.488	0.82–1.52
Others (%)	23.4	17.3		
aOR	1	0.74	.048	0.54–0.99

All models are adjusted for ethnicity, age, socioeconomic status, country, pattern of product use, and urges to smoke. aOR = adjusted odds ratio; CI = confidence interval.

\*Statistically significant value for capacity and nicotine strength analyses ( $p \leq .05$ ).

\*\*Statistically significant after Bonferroni correction for e-liquid flavor analyses ( $p \leq .007$ ).

Bold values represent statistical significance at  $p \leq .05$  (capacity and nicotine strength analyses) and  $p \leq .007$  (e-liquid flavor analyses).

an ITC study of smokers in Canada, United States, England, and Australia found that males were more likely to smoke in cars with nonsmokers than females.<sup>31</sup>

Our results showed that the most cited reason for vaping among male vapers overall was “less harmful than cigarettes.” This finding is consistent with a US survey,<sup>9</sup> which found that males were more likely to report using ECs because they were concerned about the harms of combustible cigarettes than females.<sup>9</sup>

In summary, a better understanding of gender differences in reasons for EC use can help inform practice and regulatory decisions. For example, gender differences might be considered when designing gender-sensitive messages regarding smoking cessation such as when designing the policies for women, one might emphasize the harm of smoking to others, while also underscoring the reasons for completely stopping smoking rather than just stopping when around others.

### Device Characteristics

We found that the refillable devices were the most common device type used by both genders, which is consistent with the findings of

a previous study based on data from the Wave 1 ITC 4CV Survey.<sup>24</sup> Moreover, our findings showed that males more frequently reported using box-shaped tanks than females, whereas females more frequently reported using pen-style devices than males. Previous research has shown that women are more sensitive to non-nicotine stimuli<sup>4</sup> and prefer ECs that look like a cigarette than men.<sup>8</sup> A pen-style device is more like a cigarette, smaller, and slimmer than a box-shaped tank; therefore, it may be more attractive to females. On the other hand, some research suggests that males are more sensitive to nicotine dosing<sup>4,32</sup> and box-shaped tank devices can deliver nicotine more effectively<sup>33</sup>; therefore, this might be a reason why males are more likely to report using a box-shaped tank device. As device type has been found to be associated with cessation,<sup>11</sup> these gender preferences need to be taken into account.

Regarding tank size, we found that males were more likely than females to report using tank capacity greater than 2 mL. However, we did not find this gender difference in the England sample where the EU TPD enforces a 2-mL limit, but this gender difference was found in Australian sample. Interestingly, more than a quarter of participants could not report the volume of the devices they used,

suggesting that this feature may not be important for some of our participants, or they may not know the capacity of their device.

We did not find an overall gender difference in use of e-liquid flavors, with fruit flavor being the most commonly reported by both genders. However, previous online surveys have shown gender differences including a US study that found that males preferred tobacco flavor more than females.<sup>8,9</sup> Given that these findings are inconsistent, regular monitoring of gender differences in preferences and use of e-liquid flavors may be needed. We did, however, find that more females than males used mint/menthol in the United States, suggesting that females may be less affected by any ban of e-cigarette flavors that excludes menthol.

There is some evidence that flavors might enhance the rewarding and reinforcing effects of nicotine-containing ECs<sup>34</sup> and flavors may be an important consideration for acceptability of ECs to smokers who are trying to quit smoking.<sup>35,36</sup> Therefore, understanding gender differences in e-liquid flavors used will be important, particularly as some jurisdiction move to restrict flavors.

Although our findings showed that most users reported that their products contained  $\leq 20$  mg/mL of nicotine, within the range of EU TPD regulation, males were more likely than females to report using  $>20$  mg/mL of nicotine. These results are consistent with a previous online US study of 1815 EC users, which found that women were more likely than men to report using lower nicotine concentration.<sup>9</sup>

### Limitations

This study has some limitations. First, our participants came from four high-income countries, so our results may not be generalizable to other countries. Second, we did not examine gender differences in lesbian, gay, bisexual, and transgender (LGBT) respondents, which is important given that those who identify as LGBT have a higher prevalence of smoking than the general population.<sup>37</sup> Therefore, more research is needed on differences by sexual orientation and gender identity. Third, our analyses did not specifically study gender differences in the use of specific products, such as JUUL, which had become increasingly popular in some countries.<sup>38,39</sup> Therefore, more research on gender differences in the use of popular products is needed. Fourth, although we constricted our analyses to at least weekly vapers, we did not stratify the sample by their frequency of EC use. Given that frequency of use may affect the reasons of EC use, further research that separates the sample by vaping frequency should be considered. Last, the use of self-report questionnaires may introduce a source of bias that can affect validity, such as social desirability bias, particularly in regards to using banned products (eg, over 20 mg/mL nicotine concentration).

However, a strength is the large sample size covering the four high-income countries, in which each country has different regulations for ECs. Use of the same survey questions across the four countries allowed for cross-country comparisons. Moreover, our survey collected highly detailed data on EC use and product characteristics, which has allowed us to examine detailed aspects of EC use.

### Conclusion

Our findings provide some evidence of gender differences in reasons for vaping and characteristics of EC products used. Although females are more likely than males to endorse less harm to others as a reason to vape, males are more likely to report using e-liquid nicotine strengths above 20 mg/mL and device capacity greater than 2 mL. Both genders frequently reported using refillable tank devices

than other styles. Given the mixed findings in the literature, monitoring of gender differences in patterns of EC use and reasons for use are needed. Future studies could also examine whether these observed gender differences may affect smoking cessation.

### 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>.

### Funding

This work was supported by grants from the US National Cancer Institute (P01 CA200512), the Canadian Institutes of Health Research (FDN-148477), and the National Health and Medical Research Council of Australia (APP1106451).

### Declaration of Interests

K.M.C. 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. K.M.C. also has served as paid expert witness in litigation filed against the tobacco industry. G.T.F. has served as an expert witness on behalf of governments in litigation involving the tobacco industry. A.M. is a UK National Institute for Health Research (NIHR) Senior Investigator. The views expressed in this article are those of the authors and not necessarily those of the NIHR or the UK Department of Health and Social Care. All other authors have no conflicts of interest to declare.

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