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SHORT REPORT

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Use of disposable e-cigarettes among youth who vape in Canada, England and the United States: Repeat cross-sectional surveys, 2017–2023

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Abstract

Aims: To measure changes over time (between 2017 and 2023) in disposable e-cigarette use and popular brands among youth in Canada, England and the United States (US) who vaped.

Design: Nine waves of repeat cross-sectional data from the International Tobacco Control Policy Evaluation Project (ITC) Youth Tobacco and Vaping Survey.

Setting: Online surveys conducted in Canada, England and the US between 2017 and 2023.

Participants: Youth aged 16 to 19 years who had vaped in the past 30 days (n = 19 710).

Measurements: Usual type (disposable, cartridge/pod, tank) and brand of e-cigarette used; covariates sex at birth, age, race/ethnicity, cigarette smoking status, vaping on ≥20 of the past 30 days.

Findings: In 2017, the majority of youth who vaped in the past 30 days reported using refillable tank e-cigarettes, whereas disposable e-cigarettes were the least commonly used product type in Canada (10.0%), England (8.6%) and the US (14.4%). Cartridge/pods overtook tank devices in Canada and the US by 2020; however, by 2023, disposables were the leading type of e-cigarette used by youth who vaped in all three countries (Canada = 58.5%; England = 83.2%; US = 67.3%). The shift to disposables occurred among all socio-demographic groups, with few differences by vaping and smoking status. The percentage of youth who vaped that reported 'no usual' brand also decreased substantially from 2017 (29% to 42%) to 2023 (11% to 17%). The rise of disposable e-cigarettes appeared to be driven primarily by individual brands in the US (Puff Bar in 2020/2021, Elf Bar in 2022/2023) and England (Elf Bar in 2022/2023).

Conclusions: The e-cigarette market has evolved rapidly with notable shifts in the types of e-cigarettes used by youth who vape in Canada, England and the United States. Although the timing differed across countries, major shifts in device types appear to be driven by individual brands and were often accompanied by increases in vaping prevalence among youth.

KEYWORDS
adolescent, e-cigarette, electronic nicotine delivery systems, survey, vaping, youth

INTRODUCTION

The prevalence of youth vaping has been identified as a concern in a range of countries, including Canada, England and the United States (US) [1]. Canada has among the highest prevalence, with 23.6% of grade 10 to 12 students (~14–18 years old) reporting past 30-day vaping and 11.8% reporting daily vaping in 2021/2022 [2]. In England, 7.6% of 11- to 17-year-olds vaped currently in 2023, up from 3.2% in 2021 [3]. In the United States, 10% of grade 9 to 12 students (~13–18 years old) reported 'current' vaping in 2023, a reduction from the peak observed before the coronavirus pandemic [4].

The e-cigarette market in each of Canada, England and the US has rapidly evolved with respect to the design of vaping products, including the widespread adoption of salt-based nicotine e-liquids, wide-ranging flavours and colours of packaging and devices and the shift from refillable, tank-based products to cartridge/pod-based products and, more recently, disposables [4–8]. The increasing popularity of disposable e-cigarettes represents the latest evolution in product design, with concerns that these products may preferentially appeal to youth and non-smokers [3,6,7]. Indeed, in 2023, disposable e-cigarettes were the vape of choice for youth age 11 to 17 who currently vape in England [3].

Comparing vaping patterns across countries provides an opportunity to identify emergent product trends, including potential differences between markets with different regulatory frameworks for vaping products: for example, differing minimum legal age of sale (18/19 years in Canada; 18 in England; 21 in the United States as of December 2019) and limits on nicotine concentrations of e-liquids (of 20 mg/mL) in England and Canada (no federal limits in the United States). The current study examines changes over time between 2017 and 2023 in the prevalence of disposable e-cigarette use relative to other device types, as well as popular brands, among youth in Canada, England and the United States who vaped.

METHODS

The International Tobacco Control Policy Evaluation Project (ITC) Youth Tobacco and Vaping Survey is a self-completed online survey examining use of tobacco and vaping products among youth age 16 to 19 years in Canada, England and the United States. Repeat cross-sectional data were available from 117 167 respondents across nine survey waves. Annual surveys were conducted around August of each year from 2017 to 2023 (exact timing varied by year, extending into July or September), with additional surveys in February/March 2020 and 2021. A full description of the study methods can be found in the Technical Reports (available at https://davidhammond.ca/projects/tobacco-vaping/itc-youth-tobacco-ecig/).

Sample

The current analysis included a subsample of 19 710 youth age 16 to 19 years in Canada, England and the United States who had vaped in the past 30 days. Youth were recruited through Nielsen Consumer Insights Global Panel and their partners' panels, either directly or through their parents. On completion of the survey, respondents received remuneration in accordance with their panel's usual incentive structure, which could include points-based or monetary rewards (redeemed for catalogue items, as cash or donated) and/or chances to win monthly prizes.

This study was reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE 21847/31017) and the King's College London Psychiatry, Nursing and Midwifery Research Ethics Subcommittee.

Measures

Socio-demographic variables

Socio-demographic variables included age (years), sex (sex at birth, imputed from gender where missing) and race/ethnicity (assessed using country-specific questions with multiple categories, recoded to 'White/European [only]' or 'Else' [including any other race/ethnicity and not stated] to allow for cross-country comparisons).

Cigarette smoking and e-cigarette use

Self-reported cigarette smoking and e-cigarette use measures (separate) included ever use, lifetime number of cigarettes/days vaped, last time smoked cigarettes/vaped and on how many of the past 30 days respondents smoked/vaped. From these items, variables were derived for cigarette smoking status (never, experimental [smoked <100 cigarettes lifetime], former [smoked >100 cigarettes lifetime, but none in the past 30 days] or current [>100 cigarettes lifetime and smoked in the past 30 days]) and past 30-day frequency of vaping (<20 days, ≥20 days).

Type of e-cigarette/vaping device currently used most often

Type(s) of e-cigarettes/vaping devices ever tried was asked using either a pre-coded checklist (in 2017) or yes/no items with corresponding product images (from 2018 onward) for the following: disposable ('Disposable [not refillable or rechargeable] e-cigarette/vaping device'), cartridge/pod ('E-cigarette/vaping device with replaceable pre-filled cartridges [or pods]') and tanks ('E-cigarette/vaping device with a tank that you fill with liquid'). Those who had vaped in the past 30 days who had used more than one type were asked, 'Which of the following TYPES of e-cigarettes/vaping devices do you currently use MOST OFTEN?' and could select multiple options, except in 2018. Device type used most often was the primary outcome.

Brand of e-cigarette/vaping device currently used most often

Specific brand of e-cigarette/vaping device youth 'currently use most often' was asked using country-specific pre-coded brand lists; respondents could also select 'Other' and enter the brand name, or select 'I don't have a usual brand', 'Don't know' or 'Refused'.

Analysis

Post-stratification sample weights were calculated for each country, based on age, sex, geographic region and race/ethnicity (United States only). In addition, subsequent survey waves were calibrated back to 2017 for student status (student vs. not) and school grades, and used the National Youth Tobacco Survey (NYTS) in the United States and the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) in Canada to calibrate to the trend over time for smoking in the last 30 days. All analyses were conducted on the subsample of respondents who reported vaping in the past 30 days (n = 19 710), and weights for this analysis were rescaled to the size of this subsample in each wave and country.

Weighted estimates for usual device type(s) and brand are reported (excluding refusals). Unadjusted logistic regression models, stratified by country, for each device type (vs. not selected/don't know) were used to test the effects of time (i.e. wave to wave differences in use of disposables, cartridge/pods and tanks, respectively). Additional adjusted (for sex, age, race/ethnicity, smoking status, vaping on ≥20 of the past 30 days) logistic regression models, stratified by country, were used to examine correlates of disposable e-cigarette use in the most recent survey wave (2023). Odds ratios (ORs) or adjusted odds ratio (aORs) and 95% confidence intervals (CIs) are reported for models. All analyses were conducted using SAS version 9.4 (Cary, North Carolina). The analysis was not pre-registered and results should be considered exploratory.

RESULTS

Sample characteristics

Table 1 shows the characteristics of the samples in each country (n = 19 710).

TABLE 1 Sample characteristics, youth age 16 to 19 years who vaped in the past 30 days, by country (n = 19 710), weighted % (weighted n).

Sample size (unweighted n)	Canada (n = 6479)	England (n = 6106)	United States (n = 7125)
Age			
16 years	17.8 (1153)	17.7 (1080)	16.8 (1194)
17 years	21.9 (1422)	24.5 (1493)	23.1 (1647)
18 years	32.3 (2092)	34.9 (2130)	34.5 (2458)
19 years	28.0 (1812)	23.0 (1402)	25.6 (1825)
Sex[a]			
Male	50.0 (3242)	50.1 (3061)	49.1 (3497)
Female	50.0 (3237)	49.9 (3045)	50.9 (3628)
Race/ethnicity[b]			
White/European (only)	63.8 (4133)	79.0 (4825)	79.2 (5646)
Mixed/other/not stated	36.2 (2346)	21.0 (1281)	20.8 (1479)
Survey date			
2017—July/August	4.7 (303)	5.6 (341)	6.4 (458)
2018—August/September	8.7 (564)	5.2 (316)	8.7 (623)
2019—August/September	13.7 (888)	7.8 (474)	12.3 (874)
2020—February/March	15.7 (1016)	10.6 (646)	15.5 (1106)
2020—August	8.6 (560)	7.9 (485)	12.0 (858)
2021—February/March	12.2 (793)	9.3 (567)	10.9 (775)
2021—August/September	12.0 (778)	12.7 (774)	10.8 (767)
2022—August/September	13.3 (863)	20.1 (1229)	11.7 (832)
2023—August/September	11.0 (714)	20.9 (1274)	11.7 (832)

[a]Determined by response to 'sex at birth' survey item; where sex at birth was missing, inferred from gender if 'man' or 'woman' selected.
[b]Determined by response(s) to country-specific survey items with multiple categories, categorized into those who specified only White/European, or any other response; wording of the Canadian source question changed slightly, from response option 'White' in 2017 to 'European' in 2018 to 'White or European' from 2019 onward.

Usual device type(s)

Prevalence of disposable e-cigarette use

Figure 1 shows the percentage of youth who had vaped in the past 30 days who reported using each vaping device type 'most often'. In Canada, the proportion who used disposable e-cigarettes increased in each survey wave beginning in August 2020 (see Table 2). In England, the proportion who used disposables decreased between August 2020 and February 2021, followed by large increases in each survey wave thereafter. In the United States, the proportion who used disposables increased from August 2019 to February 2020 to August 2020, then remained stable before again increasing from 2021 to 2022 to 2023. As of 2023, disposables were the leading type of e-cigarette used 'most often' in all three countries (Canada = 58.5%; England = 83.2%; United States = 67.3%).

Correlates of disposable e-cigarette use

Table 3 shows the prevalence of using disposable e-cigarettes 'most often' compared to using other devices by key demographic variables,

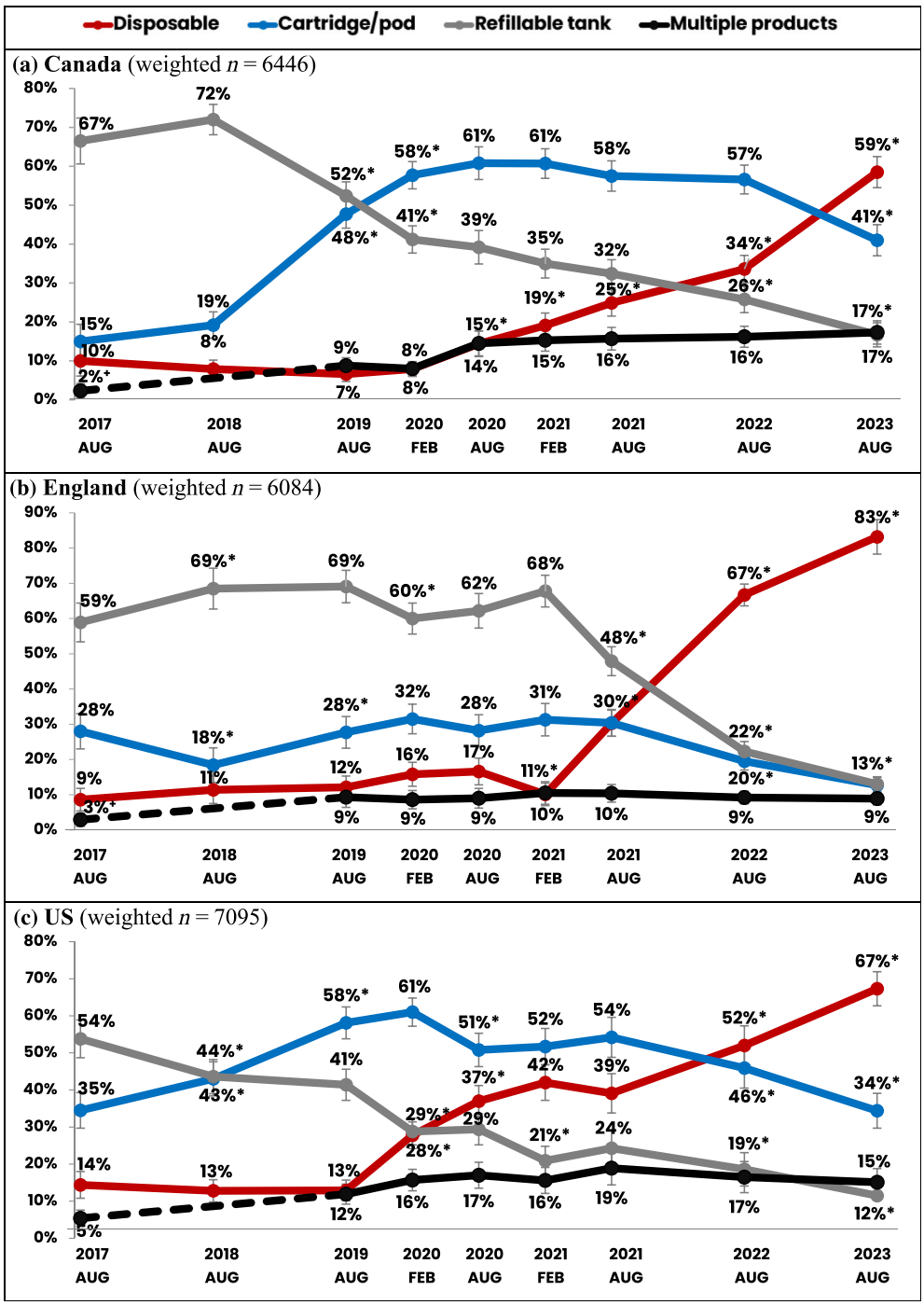

FIGURE 1 E-cigarette device type(s) used most often among youth age 16–19 years who had vaped in the past 30 days, in (a) Canada, (b) England and (c) United States, 2017–2023, % (weighted). Respondents could select more than one response, except in wave 2 (2018); percentages within country may not add to 100. Refusals (weighted n = 66) excluded from denominators. *P < 0.05 for between-wave change within country, from country-specific logistic regression models for using disposable e-cigarettes most often. +High variability (coefficient of variation >33.3%); interpret with caution. Abbreviations: US, United States.

TABLE 2 Between-wave change in use of disposable e-cigarettes 'most often', among youth age 16 to 19 years who vaped in the past 30 days, by country, 2017 to 2023.

	Canada (weighted *n* = 6446)			England (weighted *n* = 6084)			US (weighted *n* = 7095)		
Contrast[a]	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Aug 2018 vs. Aug 2017	0.77	0.45–1.32	0.346	1.38	0.79–2.40	0.260	0.87	0.59–1.30	0.505
Aug 2019 vs. Aug 2018	0.82	0.53–1.26	0.361	1.06	0.65–1.74	0.806	1.00	0.70–1.45	0.984
Feb 2020 vs. Aug 2019	1.22	0.82–1.80	0.324	1.36	0.92–2.02	0.124	**2.60**	**1.92–3.53**	**<0.001**
Aug 2020 vs. Feb 2020	**1.96**	**1.36–2.83**	**<0.001**	1.06	0.73–1.54	0.748	**1.53**	**1.19–1.97**	**0.001**
Feb 2021 vs. Aug 2020	**1.41**	**1.01–1.97**	**0.045**	**0.57**	**0.36–0.89**	**0.013**	1.23	0.94–1.61	0.128
Aug 2021 vs. Feb 2021	**1.40**	**1.06–1.84**	**0.017**	**3.85**	**2.59–5.71**	**<0.001**	0.89	0.66–1.19	0.433
Aug 2022 vs. Aug 2021	**1.53**	**1.20–1.95**	**<0.001**	**4.61**	**3.69–5.77**	**<0.001**	**1.69**	**1.24–2.30**	**<0.001**
Aug 2023 vs. Aug 2022	**2.79**	**2.22–3.51**	**<0.001**	**2.47**	**1.97–3.09**	**<0.001**	**1.89**	**1.40–2.55**	**<0.001**

Note: Bolded text denotes statistical significance (at $P < 0.05$).
Abbreviations: CI, confidence interval; OR, odds ratio; US, United States.
[a]ORs, 95% CIs and *P* values are from country-specific regression models for using disposable e-cigarettes most often.

smoking status and vaping on ≥20 of the past 30 days in 2023 (the most recent wave). In Canada, there was little evidence for any differences between sub-groups (all $P > 0.05$). In England, males had lower odds of using disposables over other device types than females (aOR = 0.65, 95% CI = 0.45–0.93), as were those who vaped on ≥20 of the past 30 days (aOR = 0.47, 95% CI = 0.33–0.68), compared to those who vaped less frequently. In the United States, youth who were age 18 (aOR = 2.08, 95% CI = 1.14–3.79) or 19 (aOR = 2.06, 95% CI = 1.05–4.06) had greater odds of using disposables over other device types than 16-year-olds, as were those who identified as any other race/ethnicity or did not state race/ethnicity (aOR = 1.62, 95% CI = 1.02–2.58), compared to those identifying only as White/European.

Usual brand

Among youth who vaped in the past 30 days, the top five brands used most often in each survey wave and country are shown in Figure 2. In 2023, brands that sold disposable products were the leading brand in each country: Elf Bar in both England (39.6%) and the United States (26.1%) and STLTH in Canada (18.2%). In addition, the percentage who reported 'I don't have a usual brand' decreased over time in each country, to approximately one-third of the 2017 estimate by 2023.

DISCUSSION

A majority of youth who had vaped in the past 30 days in Canada, England and the United States reported using disposable e-cigarettes more often than other device types in 2023. The rise of disposables was steepest in England, from 11% in February 2021 to 83% in August 2023. The current findings are highly consistent with estimates from other national surveys indicating that disposables were the most commonly reported device type among youth in 2023 in the United States (at 60.7% of middle and high school students who vaped) [4] and Great Britain (at 69% of 11- to 17-year-olds who currently vaped) [3]; to our knowledge, no comparable Canadian estimates are available.

Disposables were somewhat more popular among females, consistent with analyses of Elf Bar use in England using 2022 ITC Youth data [9], and youth who vaped less frequently in England, as well as older youth and those who did not identify as White/European in the United States. However, the magnitude of these differences was relatively modest, and disposables were the usual product type of more than half of youth in all categories examined, suggesting broad appeal among youth [10].

In all three countries, the percentage of youth who vaped that reported 'no usual' e-cigarette brand decreased approximately threefold in each country, from 29% to 42% in 2017 to 11% to 17% in 2023. The leading brands in the three countries (Elf Bar and STLTH) typically contain nicotine salt e-liquids, indicative of a general shift toward salt formulations from predominantly freebase products. In the United States and Canada, the transition to salt-based products was driven by the rise of JUUL between 2017 and 2019, and then widely adopted in other leading brands, including STLTH, Puff Bar and Vype/Vuse. Nicotine salt products are associated with highly efficient nicotine delivery [11], and their adoption was accompanied by notable increases in the prevalence of youth vaping in Canada and the United States [12,13]. In England, the rise of Elf Bar and other nicotine salt disposables since 2021 was accompanied by increases in overall prevalence and frequency of youth vaping, documented across a range of national surveys [3–5]. Although disposable vaping products have emerged with different trajectories in England, Canada and the United States, their popularity in three countries with differing policy environments suggests a broad appeal that transcends specific brands or market factors.

Regulatory proposals to restrict the sale and supply of disposable e-cigarettes in the United Kingdom [1] and elsewhere should consider the versatility of the e-cigarette market in responding to restrictions that apply only to a single product type. For example, in the United States, federal flavour restrictions on cartridge/pod e-cigarettes

TABLE 3 Use of disposable e-cigarettes 'most often', among youth aged 16–19 years who vaped in the past 30 days (n = 2820), by country, 2023, weighted % (n).

	Canada (n = 714)			England (n = 1274)			US (n = 832)		
	% (n)	aOR (95% CI)[a]	P	% (n)	aOR (95% CI)[a]	P	% (n)	aOR (95% CI)[a]	P
Age, years			0.501[b]			0.195[b]			0.078[b]
16	53.4 (55)	ref	—	82.0 (194)	ref	—	54.3 (83)	ref	—
17	60.1 (92)	1.37 (0.78–2.41)	0.265	79.8 (223)	0.83 (0.46–1.47)	0.512	66.9 (124)	1.68 (0.94–3.00)	0.078
18	56.2 (134)	1.12 (0.66–1.88)	0.677	83.2 (382)	1.08 (0.63–1.85)	0.774	71.8 (190)	**2.08 (1.14–3.79)**	**0.017**
19	62.5 (136)	1.40 (0.82–2.39)	0.214	87.2 (260)	1.46 (0.83–2.60)	0.192	71.0 (162)	**2.06 (1.05–4.06)**	**0.042**
Sex[c]									
Male	54.5 (189)	0.75 (0.53–1.06)	0.097	79.9 (455)	**0.65 (0.45–0.93)**	**0.018**	63.8 (236)	0.87 (0.55–1.37)	0.545
Female	62.4 (228)	ref	—	85.9 (604)	ref	—	70.0 (322)	ref	—
Race/ethnicity[d]									
White/European (only)	56.0 (268)	0.71 (0.49–1.03)	0.071	83.1 (786)	1.08 (0.70–1.68)	0.722	64.9 (413)	**0.62 (0.39–0.98)**	**0.042**
Mixed/other/not stated	63.8 (150)	ref	—	83.3 (274)	ref	—	75.1 (145)	ref	—
Vaping frequency									
<20 of past 30 days	59.4 (237)	ref	—	87.0 (681)	ref	—	64.9 (300)	ref	—
≥20 of past 30 days	57.4 (180)	0.92 (0.65–1.29)	0.624	77.1 (379)	**0.47 (0.33–0.68)**	**<0.001**	70.2 (258)	1.28 (0.83–1.99)	0.265
Smoking status[e]			0.704[b]			0.154[b]			0.907[b]
Never	59.4 (123)	ref	—	85.8 (183)	ref	—	70.5 (174)	ref	—
Experimental	59.9 (240)	1.02 (0.69–1.52)	0.916	82.5 (682)	0.83 (0.48–1.42)	0.491	66.2 (341)	0.88 (0.52–1.49)	0.636
Current	53.7 (41)	0.80 (0.46–1.40)	0.439	85.5 (173)	1.20 (0.60–2.39)	0.605	64.4 (22)	0.86 (0.40–1.85)	0.699
Former	51.2 (13)	0.69 (0.25–1.88)	0.468	67.9 (17)	0.40 (0.15–1.10)	0.076	71.9 (17)	1.34 (0.30–5.94)	0.696

Note: Bolded text denotes statistical significance (at $P < 0.05$).

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; US, United States.

[a]aORs, 95% CIs and associated P values are from country-specific regression models for using disposable e-cigarettes most often, controlling for age, sex, race/ethnicity, vaping frequency and smoking status.

[b]P values for overall significance given for variables with more than two levels.

[c]Determined by response to 'sex at birth' survey item; where sex at birth was missing, inferred from gender if 'man' or 'woman' selected.

[d]Determined by response(s) to country-specific survey items with multiple categories, categorized into those who specified only White/European, or any other response; wording of the Canadian source question changed slightly, from response option 'White' in 2017 to 'European' in 2018 to 'White or European' from 2019 onward.

[e]Smoking status categorized as never (never smoked a cigarette), experimental (smoked <100 cigarettes lifetime), former (smoked >100 cigarettes lifetime but none in the past 30 days) or current (>100 cigarettes lifetime and smoked in the past 30 days); n = 19 (weighted) not categorized and excluded from the model.

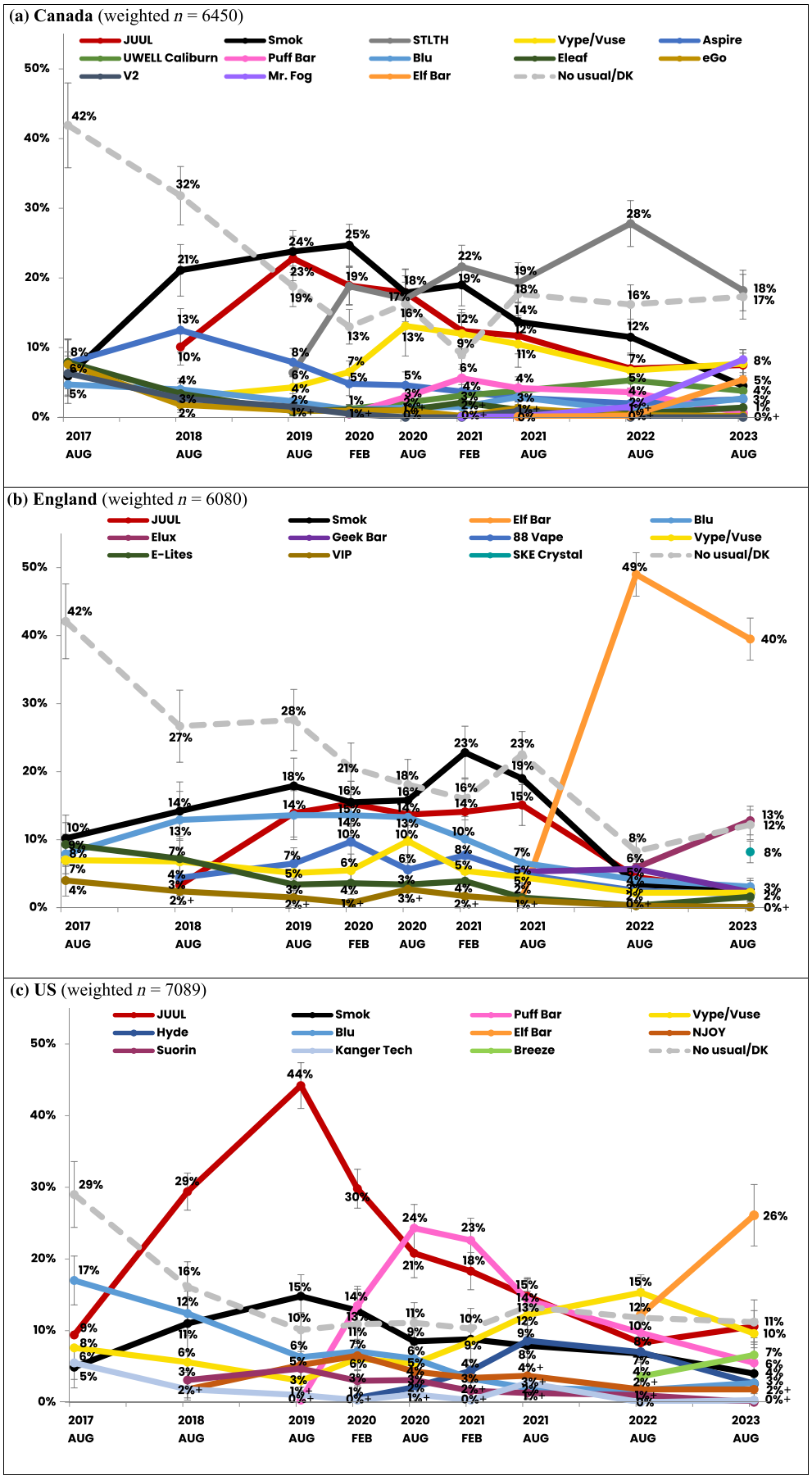

FIGURE 2 E-cigarette brand used most often among youth age 16–19 years who had vaped in the past 30 days, in (a) Canada, (b) England and (c) United States, 2017–2023, % (weighted). Brand used most often, from wave and country-specific checklists (with option to write in an 'Other' brand); top five brands from each wave shown (across all years). Refusals (weighted *n* = 91) excluded from denominators. Note: Because the 'Vype' brand transitioned to 'Vuse' in 2020, these brands are presented together; Elf Bar and Lost Mary are also presented together as they are made by the same company and products are the same (except in name). Some brands (e.g. Smok) offer a variety of device types, whereas others offer only cartridge/pod products (e.g. JUUL) or disposable products (e.g. Elf Bar, Puff Bar). +High variability (coefficient of variation >33.3%); interpret with caution. Abbreviations: DK, Don't know; US, United States.

appeared to lead to a shift to disposable e-cigarettes, which were exempted from the restrictions, among youth [14]. Rather than focussing on a particular brand or type of product design, regulations should consider the underlying attributes that preferentially appeal to youth and non-smokers compared to those who use e-cigarettes as a smoking cessation aid. Moreover, aside from the notable environmental impact of disposables, there is now little difference in the functionality of disposable versus cartridge/pod e-cigarettes on key attributes of price, branding, flavours and nicotine delivery [6].

The current study has several limitations common to population-level surveys. Self-reported responses may be subject to error and misreporting of device types, although the survey used images to help respondents identify the range of products included in each type. Samples were not probability based, but post-stratification weights were used to better represent population characteristics and improve consistency between survey waves. Findings may not generalize to other age groups or to countries with different vaping markets and regulatory environments. Strengths include using the same methods across countries and over time and large samples of youth who vape.

Conclusions

Disposable e-cigarettes have emerged as the most prevalent type of e-cigarette used by youth who vape in Canada, England and the United States. The transition toward disposable products has occurred in all countries, but was most notable in England, echoing earlier market shifts toward cartridge/pod products in the United States and Canada. Although the timing differed across countries, major shifts in product categories were largely attributable to single brands offering a range of flavours and nicotine salt-based e-liquids at a low price, and were accompanied by increases in vaping prevalence among youth. Future research should examine the relative popularity of disposable products among youth versus adults who are vaping to quit smoking.

AUTHOR CONTRIBUTIONS

David Hammond conceived of the study, designed the analysis plan, interpreted results and drafted portions of the manuscript. **Jessica L. Reid** coordinated data collection, supervised analysis, interpreted results and drafted portions of the manuscript. **Robin Burkhalter** conducted the analysis, interpreted results and revised the manuscript. Katherine East interpreted results and revised the manuscript. All authors have reviewed and approved submission of the final manuscript.

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DATA AVAILABILITY STATEMENT

Deidentified study data may be made available on request to researchers who submit a proposal that is approved by the principal investigator. Proposals should be submitted to David Hammond (dhammond@uwaterloo.ca).

DECLARATION OF INTERESTS

D.H. has testified as a paid expert witness on behalf of public health authorities in response to legal challenges from tobacco, vaping and cannabis companies. The other authors have no competing interests to declare.

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