Prevalence of vaping and smoking among adolescents in Canada, England, and the United States: repeat national cross sectional surveys

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ABSTRACT

OBJECTIVE
To examine differences in vaping and smoking prevalence among adolescents in Canada, England, and the United States.

DESIGN
Repeat cross sectional surveys.

SETTING
Online surveys in Canada, England, and the US.

PARTICIPANTS
National samples of 16 to 19 year olds in 2017 and 2018, recruited from commercial panels in Canada (n=7891), England (n=7897), and the US (n=8140).

MAIN OUTCOME MEASURES
Prevalence of vaping and smoking was assessed for use ever, in the past 30 days, in the past week, and on 15 days or more in the past month. Use of JUUL (a nicotine salt based electronic cigarette with high nicotine concentration) and usual vaping brands were also assessed. Logistic regression models examined differences in vaping and smoking between countries and over time.

RESULTS
The prevalence of vaping in the past 30 days, in the past week, and on 15 days or more in the past month increased in Canada and the US between 2017 and 2018 (P<0.001 for all), including among non-smokers and experimental smokers, with no changes in England. Smoking prevalence increased in Canada (P<0.001 for all measures), with modest increases in England, and no changes in the US. The percentage of ever vapers who reported more frequent vaping increased in Canada and the US (P<0.01 for all), but not in England. The use of JUUL increased in all countries, particularly the US and Canada—for example, the proportion of current vapers in the US citing JUUL as their usual brand increased threefold between 2017 and 2018.

CONCLUSIONS
Between 2017 and 2018, among 16 to 19 year olds the prevalence of vaping increased in Canada and the US, as did smoking in Canada, with little change in England. The rapidly evolving vaping market and emergence of nicotine salt based products warrant close monitoring.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Vaping among adolescent has increased over the past five years in Canada, England, and the US; however, frequent vaping has been rare, particularly among non-smokers

A new generation of nicotine salt vaping devices has emerged, such as JUUL, with high nicotine concentrations in North America; the impact of the market transition to nicotine salt products is largely unknown

In 2018, Canada also introduced a more permissive regulatory framework, which increased marketing and access to vaping products

WHAT THIS STUDY ADDS

The prevalence and frequency of vaping among US and Canadian adolescents increased between 2017 and 2018, along with increases in smoking among Canadian adolescents

Fewer changes were observed among adolescents in England, possibly as a result of greater marketing restrictions and maximum nicotine limits under the European Tobacco Product Directive

The findings suggest that vaping among young people might be changing in North American markets, in parallel with the rise of JUUL and the rapid emergence of nicotine salt vaping products

Introduction

Vaping most likely represents a less harmful mode of nicotine delivery compared with inhalation of smoke from combustible cigarettes.[1] Although the number and levels of toxicants are lower in aerosol from electronic cigarettes than from tobacco smoke, long term exposure to e-cigarette vapor might cause nicotine dependence and increase the risk of respiratory and cardiovascular health effects.[1] In addition, though the use of e-cigarettes might assist established smokers in quitting smoking,[2] there are widespread concerns that vaping could undermine reductions in smoking among young people.[1] A robust association has been found between smoking and vaping, including in prospective cohort studies, showing that young people who vape have an increased risk of subsequent smoking, and vice versa.[3-5] The extent to which these associations are causal remains unclear, as common risk factors could account for a substantial proportion of the association; however, it is also plausible that exposure to nicotine in one product might increase use of the other product.[1 3 6]

Regulatory frameworks for vaping products continue to evolve as countries seek a balance between preventing vaping among non-smokers without discouraging current smokers from switching to vaping.[2] In May 2018, Canada implemented more permissive vaping policies as part of the Tobacco and Vaping Products Act.[7] Previously, e-cigarettes containing nicotine could not be sold or advertised in Canada without premarket approval. Although no products were approved for

legal sale, e-cigarettes containing nicotine were widely available in vape shops and online, in addition to non-nicotine e-cigarettes from traditional retail outlets.[8] In May 2018, e-cigarettes containing nicotine became legally available for sale, which increased retail access, including for major international brands such as JUUL and Vype. The new act also permits greater advertising and promotion of vaping products, including mass media advertisements and point-of-sale displays, unless prohibited at the provincial level. Overall, the vaping market in Canada experienced rapid change, bringing it closer to the less restrictive regulatory settings in countries such as England and the US. In England, e-cigarettes can enter the market either as medicines or as consumer products. Currently, all e-cigarettes are sold as consumer products and can also be recommended through local stop smoking services.[9] E-cigarettes sold in England are subject to the European Tobacco Product Directive, which requires health warnings, restricts certain forms of marketing, and imposes a nicotine limit of 20 mg/mL of e-liquid, in addition to codes of practice that restrict more egregious marketing practices.[10] In the US, manufacturers are prohibited from making misleading health or cessation claims, although e-cigarettes are subject to fewer restrictions on advertising and promotion than in England.[11] All three countries prohibit the sale of e-cigarettes to minors.

Relatively little evidence exists on the impact of different regulatory approaches on vaping prevalence. Among adults, preliminary evidence suggests that more restrictive measures might be associated with lower prevalence of vaping, although there are notable exceptions, possibly as a result of low compliance with regulations in many restrictive markets.[8 12] One study of middle school and high school students examined differences between South Korea and the US and found lower rates of both vaping and smoking in South Korea, where regulations on vaping are stronger.[13] To date, however, almost no evidence exists that compares vaping among young people across countries with different regulatory frameworks.

Despite a lack of studies that directly compare vaping among young people across countries, indirect comparisons using national surveillance data suggest common trends in Western markets. In Canada, vaping increased among adolescents aged 15-19 between 2013 and 2015 but did not change significantly in 2017.[14] Among grade 10-12 students, the most recent estimates indicate that 14.6% reported vaping in the past 30 days in 2016-17.[15] Smoking among adolescents has been declining in Canada for several decades, although the rate of decline seems to have slowed in recent years: prevalence decreased an average of less than 1 percentage point each year over the past decade, with no statistically significant change observed in either of Canada's national monitoring surveys since 2015.[14 15] The most recent data from 2017 estimated smoking prevalence at 8% among 15 to 19 year olds.[14]

Similar trends in vaping among adolescents have been reported in the US: increases were observed between 2011 and 2013, and in 2014-15, followed by declines in 2016 and 2017.[16] However, data from 2018 indicate marked increases in vaping among adolescents: the National Youth Tobacco Survey estimated past 30 day vaping among high school students at 20.8%, compared with 11.7% in 2017, consistent with trends from the 2018 Monitoring the Future study.[17 18] Meanwhile, cigarette smoking declined among US adolescents at a consistent rate between 2011 and 2017. The Monitoring the Future study suggested this decline continued into 2018 (with an absolute decrease of 0.8% in past 30 day smoking), whereas the National Youth Tobacco Survey reported an increase of 0.5% in 2018, for a past 30 day smoking prevalence of 8.1% among high school students.[17 18] The reason for the discrepancy between surveys is unclear, given that both are nationally representative school based surveys conducted in the first half of the calendar year. Fewer data exist on smoking and vaping among adolescents in England. Non-probability samples suggest that ever vaping has increased among 17 and 18 year olds, from 2015 (21.7%) to 2018 (28.2%), as has weekly vaping (0.8% in 2015, 2.9% in 2018). The same non-probability samples suggest that smoking has decreased over the past decade in England: "regular" smoking among 17 and 18 year olds declined from 8.3% in 2015 to 7.2% in 2018.[9]

The vaping market in North America has evolved rapidly over the past two years owing to the growth of JUUL e-cigarettes and similar products.[19] JUUL uses benzoic acid and nicotine salt technology to deliver higher concentrations of nicotine than conventional e-cigarettes; indeed, the nicotine concentration in the standard version of JUUL is more than 50 mg/mL, compared with typical levels of 3-24 mg/mL for other e-cigarettes.[20 21] JUUL was introduced to the US market in 2015, with the largest growth occurring in 2018, such that JUUL now accounts for about half the e-cigarette market.[19] JUUL became available for sale in England in July 2018 (although with the nicotine level capped at 20 mg/mL), and in Canada in September 2018. One of the central questions surrounding JUUL is the extent to which use among young people has contributed to its growth. News reports and social media analyses suggest that both the marketing and discreet product design of JUUL are particularly appealing to young people, whereas several cross sectional surveys suggest increasing levels of awareness and use.[19 22 23] Overall, there is a need to examine whether vaping among adolescents might be shifting in response to changes in the design of vaping products and the emergence of nicotine salt based technology.

In the current study, we compared changes between 2017 and 2018 in the prevalence of vaping and cigarette smoking among 16 to 19 year olds in Canada, England, and the US. This age group captures a substantial proportion of both vaping and smoking initiation in all three countries.[9 14] In particular, we examined whether changes to the Canadian vaping market, as a result of the new regulatory framework in 2018, were associated with changes in the prevalence of smoking or vaping.

Although no major regulatory changes for vaping were implemented in the US or England over the same period, the US product market underwent considerable change after the emergence of JUUL. Because of the combination of regulatory changes and introduction of JUUL in Canada, we hypothesized that the greatest increases in vaping would occur in Canada, followed by the US (with the highest penetration of JUUL), with the least change in England.

Methods

Data source

Data are from the first two waves of the International Tobacco Control Policy Evaluation Project (ITC) Youth Tobacco and Vaping Survey, conducted in Canada, England, and the US. Online surveys were conducted in July to August 2017 (wave 1) and August to September 2018 (wave 2). The same methods and recruitment protocols were used in all three countries. Respondents were recruited from the Nielsen Consumer Insights Global Panel, which maintains panels in Canada, England, and the US, as well as their partners' panels. The Nielsen panel is recruited using both probability and non-probability sampling methods in each country. Nielsen selected random samples from the online panels in each country. We identified target sample sizes of 4500 for each country at each wave, based on sample size calculations to detect an absolute change of about 2% in vaping and smoking prevalence across waves. Eligible respondents included adolescents aged 16 through 19 at the time of recruitment. Respondents were recruited either directly or through their parents. Email invitations (with a unique link) were sent to a random sample of panelists (after targeting for age criteria); panelists known to be ineligible were not invited. Nielsen also contacted panelists known to be parents; those who confirmed they had one or more children aged 16-19 living in their household were asked for permission for their son or daughter to complete the survey (if more than one, specifically the one whose birthday was next). After eligibility screening, we provided potential respondents with information about the study and asked them to provide consent to participate. A restriction on small screen size was applied to ensure that images presented in the survey could be viewed with a minimum amount of scrolling or distortion.

The current analyses are based on the repeat cross sectional samples of the ITC Youth Tobacco and Vaping Survey. A total of 13 468 respondents completed the wave 1 survey and 13 423 respondents completed the wave 2 survey. Overall, 724 participants (n=382 at wave 1; n=342 at wave 2) were excluded from the sample based on data integrity checks. We also excluded participants from the analyses based on missing or incomplete data on variables required for calculating weights or determining smoking or vaping status. The analytic sample included 12 128 participants recruited at wave 1 and 11 800 newly recruited participants at wave 2. A full description of the study methods can be found in the technical report.[24]

Measures

Respondents were asked if they had ever tried an e-cigarette/vaped, the number of days they had used an e-cigarette/vaped in their lifetime, and the last time they had used an e-cigarette/vaped (analyzed as ever, past 30 day, and past week vaping). Parallel questions were asked for cigarette smoking, and used to derive ever, past 30 day, and past week smoking. In addition, respondents were classified as never smokers, experimental smokers (smoked fewer than 100 cigarettes in lifetime), current smokers (smoked at least 100 cigarettes in lifetime and smoked in past 30 days), or former smokers (smoked at least 100 cigarettes in lifetime but had not smoked in past 30 days). Participants who had vaped in the past 30 days were asked the number of days that they had vaped in the past 30 days. Race/ethnicity was assessed using adapted census questions in each country. To allow for cross country comparisons, we recoded the country specific measures into white (only) or other (including any other race/ethnicity and not stated). We also assessed alcohol and cannabis use in the past 12 months.

Participants who had vaped in the past 30 days were asked to report the specific brand of e-cigarette/vaping device they "currently use most often," using country specific pre-coded checklists, including options for writing in an "Other," "I don't have a usual brand," "Don't know," and "Refused." In 2018, we asked respondents who vaped in the past year to report any (other) brands used in the past 12 months using the same pre-coded checklist. In addition, all participants were shown an image of JUUL and asked if they had ever used the product. The full survey is available in the technical report.[24]

Statistical analysis

We constructed post-stratification sample weights for each country, based on age, sex, geographic region, and race/ethnicity (US only), and rescaled to the sample size in each country (see technical report [24] for details). To examine changes in prevalence of smoking and vaping between waves, we estimated logistic regression models, adjusting for age (grouped as 16-17 and 18-19 years), sex, and race/ethnicity (white versus other). We examined differences between countries by testing the two way interaction between country and wave. Unless stated otherwise, we report weighted estimates, adjusted odds ratios, and 99% confidence intervals. Respondents with missing data on outcome measures or covariates were excluded from models on a case-wise basis; sample sizes for all analyses are reported in the tables. Analyses were conducted using SAS 9.4.

Patient and public involvement

No patients were involved in setting the research question or the outcome measures, nor were they involved in developing plans for recruitment, design, or implementation of the study. No patients were asked to advise on interpretation or writing up of results. The

results of the research will be disseminated to study participants on request, and to stakeholders and the broader public as relevant.

Results

Table 1 presents the characteristics of respondents in each country. No differences were observed within countries between 2017 and 2018, with the exception of Canada, where fewer respondents identified only as white (adjusted odds ratio 0.63, 99% confidence interval 0.56 to 0.72; P<0.001), and cannabis use in the past 12 months increased (1.33, 1.15 to 1.54; P<0.001).

Prevalence of vaping and smoking

Table 2 presents changes in the prevalence of vaping and smoking across the three countries. Prevalence of all vaping and smoking measures increased between 2017 and 2018 in Canada. No changes were observed for vaping in England, with modest increases in smoking in the past week and 15 days or more in the past month. In the US, the prevalence of vaping in the past 30 days, past week, and 15 days or more in the past month increased, with no changes in smoking behavior. For smoking and vaping ever, in the past 30 days, and in the past week, changes between 2017 and 2018 were significantly different by country and were greatest in Canada (P<0.001 for all).

Changes in vaping prevalence by smoking status

Table 3 shows changes in vaping by smoking status from 2017 to 2018. In Canada, vaping increased among never smokers and experimental smokers, for all measures except 15 days or more in the past month. In the US, vaping increased among never smokers and experimental smokers, for all measures except ever vaping. No changes in vaping were observed by smoking status in England, or among current smokers in any country.

Ratio of ever to more frequent use

Table 4 shows the percentage of ever vapers who reported more recent vaping. In Canada and the US, the percentage of ever vapers who reported vaping in the past 30 days, the past week, and vaping 15 days or more in the past month increased in 2018, compared with 2017. No changes were observed in England. In 2018, ever smokers in Canada were also more likely to report smoking in the past 30 days, past week, and 15 days or more in the past month compared with 2017; ever smokers in England were more likely to report smoking 15 days or more in the past month compared with 2017, with no changes observed in the US.

Comparing differences between countries in 2018, ever vapers in the US were most likely, and ever vapers in England were least likely, to report vaping in the past 30 days, past week, and 15 days or more in the past month, except the US was not significantly different from Canada (P=0.014) for vaping in the past week (table 4). For example, 15.4% of ever vapers in the US also reported vaping on 15 days or more in the past month, compared with 6.8% in England (adjusted odds ratio 2.58, 99% confidence interval 1.71 to 3.90; P<0.001). Ever smokers in Canada reported significantly higher percentages than ever smokers in the US of smoking in the past 30 days, past week, and on 15 days or more in the past month (table 4).

In 2018, the ratio of ever use to more recent use tended to be greater for smoking than vaping in Canada and England but greater for vaping than smoking in the US, with the notable exception that similar percentages of ever vapers and ever smokers used on 15 days or more in the past month in the US.

Usual vaping brand and use of JUUL

Table 5 shows the vaping brands used most often by those who had vaped in the past 30 days in 2017 and 2018. In the US, the proportion of past 30 day vapers who reported JUUL as their usual brand increased from 9.4% in 2017 to 28.1% in 2018 (adjusted odds ratio 3.79, 99% confidence interval 2.28 to 6.31; P<0.001). In 2017, no one who had vaped in the past 30 days in Canada or England reported JUUL as their usual brand; in 2018, this increased to 10.3% of past 30-day vapers in Canada and 3.3% in England. In 2018, when asked about brands used in the past 12 months, 41.4% of past year vapers in the US indicated they had used JUUL, compared with 17.7% in Canada and 6.1% in England.

In 2018, 15.8% of respondents in the US reported they had ever tried JUUL, significantly more than in Canada (7.0%; adjusted odds ratio 2.51, 99% confidence interval 2.04 to 3.09; P<0.001) and England (2.2%; 8.55, 6.05 to 12.09; P<0.001).

Discussion

This study found increases in the prevalence of vaping among adolescents aged 16-19 years in the US and

Table 1 | Sample characteristics (weighted), by survey wave and country. Values are percentages (numbers) unless stated otherwise

	Canada		England		US	
Characteristics	2017 (n=4038)	2018 (n=3853)	2017 (n=3995)	2018 (n=3902)	2017 (n=4095)	2018 (n=4045)
Mean (SD) age (years)	17.6 (1.05)	17.5 (1.08)	17.5 (1.02)	17.6 (1.05)	17.5 (1.08)	17.5 (1.07)
Male	51.4 (2077)	51.5 (1984)	51.3 (2050)	51.3 (2003)	51.1 (2094)	51.1 (2068)
White (only) race/ethnicity*	58.4 (2358)	47.1 (1816)	79.4 (3172)	77.0 (3005)	73.4 (3006)	73.4 (2970)
Alcohol use (any) in past 12 months†	61.6 (2415)	59.9 (2227)	76.1 (2974)	74.8 (2852)	41.5 (1659)	38.8 (1529)
Cannabis use (any) in past 12 months†	22.5 (892)	26.8 (1009)	18.1 (708)	17.5 (673)	21.2 (851)	22.5 (894)

*Wording of Canadian source question changed slightly, from response option "White" in 2017 to "European" in 2018.
†Respondents missing data for alcohol use and cannabis use were removed from these calculations.

Table 2 | Changes in prevalence of smoking and vaping between 2017 and 2018 among adolescents aged 16-19 years, by country. Values are weighted percentages (numbers) unless stated otherwise

	Canada				England				US			
Vaping and smoking measures	2017 (n=4038)	2018 (n=3853)	Adjusted odds ratio (99% CI) for change*	P value	2017 (n=3995)	2018 (n=3902)	Adjusted odds ratio (99% CI) for change*	P value	2017 (n=4095)	2018 (n=4045)	Adjusted odds ratio (99% CI) for change*	P value
Vaping												
Ever	29.3 (1182)	37.0 (1425)	1.50 (1.31 to 1.71)	<0.001	33.7 (1348)	32.7 (1276)	0.96 (0.84 to 1.09)	0.38	31.3 (1283)	33.6 (1360)	1.11 (0.97 to 1.28)	0.05
Past 30 days	8.4 (340)	14.6 (562)	1.95 (1.58 to 2.40)	<0.001	8.7 (347)	8.9 (346)	1.03 (0.82 to 1.29)	0.77	11.1 (454)	16.2 (655)	1.55 (1.28 to 1.88)	<0.001
Past week	5.2 (208)	9.3 (357)	1.99 (1.53 to 2.60)	<0.001	4.6 (184)	4.6 (178)	0.99 (0.73 to 1.36)	0.96	6.4 (262)	10.6 (429)	1.74 (1.37 to 2.22)	<0.001
≥15 days in past 30 days	2.1 (85)	3.6 (139)	1.86 (1.23 to 2.79)	<0.001	2.0 (80)	2.2 (87)	1.13 (0.71 to 1.79)	0.49	3.0 (124)	5.2 (210)	1.75 (1.23 to 2.49)	<0.001
Cigarette smoking												
Ever	31.9 (1288)	36.6 (1412)	1.31 (1.15 to 1.50)	<0.001	40.4 (1615)	39.8 (1555)	0.98 (0.86 to 1.12)	0.75	32.3 (1322)	33.1 (1337)	1.04 (0.90 to 1.19)	0.51
Past 30 days	10.7 (431)	15.5 (599)	1.60 (1.32 to 1.94)	<0.001	15.6 (622)	16.4 (641)	1.08 (0.91 to 1.29)	0.23	11.0 (451)	12.2 (494)	1.12 (0.91 to 1.38)	0.15
Past week	7.6 (308)	11.9 (460)	1.71 (1.37 to 2.14)	<0.001	9.8 (391)	11.3 (441)	1.19 (0.97 to 1.47)	0.03	8.5 (347)	8.8 (356)	1.04 (0.82 to 1.32)	0.67
≥15 days in past 30 days	4.8 (196)	7.4 (286)	1.64 (1.24 to 2.15)	<0.001	5.0 (200)	6.4 (248)	1.31 (0.99 to 1.72)	0.01	4.6 (189)	5.1 (205)	1.10 (0.81 to 1.50)	0.42

*Change from 2017 to 2018, in logistic regression models within country, adjusting for age, sex, and race/ethnicity.

Canada in 2018, to the highest levels recorded to date. For example, between 2017 and 2018, the prevalence of vaping in the past 30 days among the adolescents increased by 5 percentage points in the US and 6 percentage points in Canada. These findings are consistent with recent data from national benchmark surveys conducted in the US: the prevalence of vaping in the past 30 days increased by 8.9% in the National Youth Tobacco Survey[16] and 6.8% in the Monitoring the Future study,[18] compared with 5.1% in the current study. No Canadian data from 2018 were available with which to compare our findings; however, the findings are consistent with media and anecdotal reports from high schools of increased vaping among young people.

Increased vaping among adolescents was observed for overall prevalence as well as for the transition ratio—the percentage of ever vapers who vaped more frequently. Indeed, in the US the percentage of ever users who reported using on 15 days or more in the past month was similar for vaping and smoking. This represents a notable departure from previous years, in which vaping among adolescents was generally characterized by infrequent, experimental use.[9 16 17] In 2018, prevalence of vaping on 15 days or more in the past month increased to 5% in the US and 4% in Canada. These findings are consistent with 2018 data from the US National Youth Tobacco Survey, in which the proportion who vaped on at least 20 days in the past month increased among current vapers, from 20% in 2017 to 28% in 2018.[16] We are unaware of any comparable estimates from national surveys in Canada or England.

The current findings also show the rapid rise of JUUL as a vaping brand among adolescents in 2018 in the US, as well as its emergence in Canada and England almost immediately after being introduced to these markets. The increase in JUUL use among adolescents is consistent with the increase in JUUL sales over the same period, which were almost entirely responsible for the overall growth in the US vaping market.[19] The increase in past 30 day JUUL users in the US—from 1.0% in 2017 to 4.5% in 2018—accounts for more than two thirds of the overall increase in prevalence of past 30 day vaping in the US. Between 2017 and 2018, the proportion of Canadian adolescents who usually used JUUL increased from 0% to 10%, despite the device being on the market for only one month. Industry data indicate substantial increases in Canadian sales of JUUL in the four months after data collection for the current study, similar to the trajectory of US sales observed over the past year.[25]

Although JUUL use increased among adolescents in 2018, JUUL alone does not account for all of the increase in vaping among young people. This was particularly the case in Canada, where JUUL was only the third most popular brand at the time of the survey in September 2018. However, the nicotine salt technology popularized by JUUL has since been adopted by most other brands. Indeed, all five of the leading brands among adolescents in Canada and the US, and four of the five leading brands in England, were available for sale in 2018 with nicotine salt e-liquid options. For example, Smok—the leading brand used by young people in Canada and England in 2018—released nicotine salt versions in March of 2018. The popularity of products such as JUUL among adolescents could be due to several factors, including the modern, sleek appearance of the device and highly effective social marketing.[19] The widespread adoption of JUUL's nicotine salt delivery system, however, suggests an important role of the product technology. With conventional e-cigarettes, the high nicotine concentrations present in JUUL and similar nicotine salt products would typically produce

Table 3 | Changes in prevalence of vaping between 2017 and 2018 among adolescents aged 16-19 years, by country and smoking status.* Values are weighted percentages (numbers) unless stated otherwise

	Never smokers				Experimental smokers				Current smokers			
Vaping measures by country	2017	2018	Adjusted odds ratio (99% CI) for change†	P value	2017	2018	Adjusted odds ratio (99% CI) for change†	P value	2017	2018	Adjusted odds ratio (99% CI) for change†	P value
Canada	n=2750	n=2441			n=1011	n=1123			n=196	n=239		
Ever	13.5 (373)	19.8 (483)	1.61 (1.30 to 1.99)	<0.001	58.7 (594)	64.3 (723)	1.30 (1.00 to 1.67)	0.009	79.8 (156)	76.7 (183)	0.98 (0.47 to 2.06)	0.94
Past 30 days	2.3 (63)	5.0 (122)	2.35 (1.51 to 3.65)	<0.001	18.2 (184)	28.7 (323)	1.85 (1.37 to 2.50)	<0.001	34.8 (68)	43.5 (104)	1.56 (0.85, 2.87)	0.06
Past week	0.8 (22)	2.7 (66)	3.68 (1.86 to 7.28)	<0.001	11.0 (111)	18.1 (203)	1.86 (1.27 to 2.72)	<0.001	28.8 (56)	33.0 (79)	1.29 (0.68 to 2.44)	0.30
≥15 days in past 30 days	0.2 (5)	0.6 (14)	3.86 (0.88 to 16.98)	0.02	4.5 (45)	6.6 (74)	1.59 (0.90 to 2.81)	0.04	15.1 (29)	18.0 (43)	1.27 (0.58 to 2.81)	0.43
England	n=2380	n=2347			n=1287	n=1250			n=238	n=266		
Ever	11.9 (284)	11.8 (276)	0.97 (0.76 to 1.26)	0.79	61.2 (787)	59.7 (746)	0.93 (0.75 to 1.17)	0.44	86.7 (206)	84.1 (223)	0.87 (0.42 to 1.78)	0.62
Past 30 days	1.6 (39)	1.7 (39)	1.03 (0.53 to 2.01)	0.91	15.2 (195)	15.8 (197)	1.04 (0.76 to 1.42)	0.77	35.7 (85)	38.7 (103)	1.08 (0.65 to 1.81)	0.70
Past week	0.5 (12)	0.4 (9)	0.77 (0.20 to 2.94)	0.61	7.5 (97)	8.2 (102)	1.08 (0.71 to 1.66)	0.62	22.2 (53)	22.9 (61)	1.01 (0.55 to 1.86)	0.96
≥15 days in past 30 days	0.2 (4)	0.1 (1)	0.31 (0.02 to 5.53)	0.30	3.1 (41)	3.7 (47)	1.18 (0.61 to 2.25)	0.52	10.8 (26)	13.4 (36)	1.27 (0.59 to 2.76)	0.42
US	n=2773	n=2708			n=1082	n=1121			n=182	n=173		
Ever	13.1 (363)	16.0 (432)	1.24 (0.99 to 1.56)	0.012	65.5 (708)	67.1 (752)	1.10 (0.84 to 1.43)	0.38	85.4 (155)	81.4 (141)	0.75 (0.30 to 1.88)	0.42
Past 30 days	2.4 (66)	5.9 (160)	2.56 (1.69 to 3.88)	<0.001	24.4 (264)	33.6 (377)	1.57 (1.19 to 2.07)	<0.001	55.2 (100)	55.7 (96)	1.03 (0.53 to 1.99)	0.91
Past week	1.1 (31)	3.0 (82)	2.72 (1.48 to 4.98)	<0.001	13.5 (146)	22.7 (255)	1.89 (1.35 to 2.65)	<0.001	36.3 (66)	44.8 (78)	1.48 (0.75 to 2.91)	0.13
≥15 days in past 30 days	0.5 (14)	1.5 (40)	3.05 (1.17 to 7.93)	0.003	6.0 (64)	10.5 (118)	1.85 (1.14 to 3.00)	0.001	19.8 (36)	23.4 (41)	1.27 (0.57 to 2.80)	0.44

*Former smokers were not analyzed, owing to small sample size.
†Change from 2017 to 2018, in logistic regression models within country and smoking status group, adjusting for age, sex, and race/ethnicity.

a bitter, aversive sensation in the mouth and throat; however, nicotine salt products generate vapor with a lower pH level, which is known to reduce nicotine impact in the upper airways.[20 21 26] Thus, products such as JUUL might facilitate deeper inhalation and deliver nicotine as effectively as combustible cigarettes but without the aversive effects of smoke inhalation.[20 21]

Although JUUL and other nicotine salt e-cigarettes are available in England, they are sold with lower nicotine concentrations because of the EU limits of 20 mg/mL. For example, JUUL pods in England contain less than half the nicotine concentration of US and Canadian products.[27] Therefore, the impact of the market transition to nicotine salt products might have been mitigated in England by lower nicotine levels,

Table 4 | Recency and frequency of vaping and cigarette smoking among ever users, by country. Values are weighted percentages (numbers) unless stated otherwise

	Canada				England				US			
Vaping and smoking measures	2017	2018	Adjusted odds ratio (99% CI) for change*	P value	2017	2018	Adjusted odds ratio (99% CI) for change*	P value	2017	2018	Adjusted odds ratio (99% CI) for change*	P value
Vaping, among ever vapers	n=1182	n=1425			n=1348	n=1276			n=1283	n=1360		
Past 30 days	28.8 (340)	39.5 (562)	1.69 (1.33 to 2.16)	<0.001	25.8 (347)	27.1 (346)	1.08 (0.84 to 1.39)	0.44	35.4 (454)	48.1 (655)	1.69 (1.34 to 2.13)	<0.001
Past week	17.6 (208)	25.0 (357)	1.69 (1.26 to 2.26)	<0.001	13.7 (184)	13.9 (178)	1.03 (0.74 to 1.43)	0.83	20.4 (262)	31.6 (429)	1.79 (1.37 to 2.34)	<0.001
≥15 days in past 30 days	7.2 (85)	9.7 (139)	1.53 (1.00 to 2.34)	<0.01	5.9 (80)	6.8 (87)	1.17 (0.73 to 1.87)	0.39	9.7 (124)	15.4 (210)	1.69 (1.17 to 2.44)	<0.001
Smoking, among ever cigarette smokers	n=1288	n=1412			n=1615	n=1555			n=1322	n=1337		
Past 30 days	33.4 (431)	42.4 (599)	1.46 (1.16 to 1.83)	<0.001	38.5 (622)	41.3 (641)	1.13 (0.92 to 1.38)	0.12	34.1 (451)	36.9 (494)	1.12 (0.88 to 1.42)	0.23
Past week	23.9 (308)	32.6 (460)	1.55 (1.20 to 1.98)	<0.001	24.2 (391)	28.4 (441)	1.25 (1.00 to 1.56)	0.01	26.3 (347)	26.6 (356)	1.00 (0.77 to 1.31)	0.97
≥15 days in past 30 days	15.2 (196)	20.2 (286)	1.42 (1.06 to 1.92)	0.002	12.4 (200)	16.0 (248)	1.35 (1.01 to 1.80)	0.007	14.3 (189)	15.3 (205)	1.06 (0.77 to 1.47)	0.64

*Change from 2017 to 2018, in logistic regression models within country, adjusting for age, sex, and race/ethnicity.

Table 5 | Top five vaping brands among past 30 day vapers in 2017 and 2018, by country. Values are weighted percentages (numbers)

	Canada				England				US			
Brand	2017 (n=340)		2018 (n=560)		2017 (n=347)		2018 (n=344)		2017 (n=454)		2018 (n=654))	
Usual brand*	Other	9.2 (31)	Smok	20.8 (116)	Smok	10.1 (35)	Smok	14.3 (49)	blu	16.9 (77)	JUUL	28.1 (184)
	Eleaf	8.3 (28)	Aspire	10.8 (61)	E-lites	9.2 (32)	blu	12.9 (44)	JUUL	9.4 (43)	blu	12.7 (83)
	eGo	7.6 (26)	JUUL	10.3 (58)	blu	7.8 (27)	E-lites	7.4 (25)	Vuse	7.6 (34)	Smok	10.7 (70)
	Aspire	7.3 (25)	blu	4.6 (26)	Vype	6.9 (24)	Vype	6.9 (24)	Other	5.8 (26)	Vuse	5.4 (36)
	V2	6.2 (21)	Eleaf	3.8 (21)	Other	5.7 (20)	Aspire	4.7 (16)	KangerTech	5.5 (25)	Aspire	4.5 (30)
No usual brand		20.9 (71)		18.5 (104)		23.5 (82)		18.3 (63)		15.2 (69)		10.3 (67)
Don't know		20.8 (71)		11.3 (63)		18.0 (62)		8.9 (31)		13.6 (62)		5.8 (38)

Column percentages do not add to 100, as only five most popular brands are reported.
*Reported among participants who vaped in past 30 days (excluding n=5 who did not answer question).

which could explain why England did not experience the same increases in vaping among adolescents as Canada and the US. Additionally, at the time of the 2018 survey, JUUL was restricted to a limited number of retail outlets in England (although the company announced an expansion to the convenience store sector in March 2019). Lower levels of vaping in England may also reflect greater marketing restrictions for vaping products or differences in public health messaging around vaping products and reasons for use. Overall, there is a need for additional research to examine the potential impact of nicotine salt products on initiation and patterns of vaping among adolescents. Continued monitoring of recent trends in vaping behavior, including specific product types, is critical.

The increase in smoking among Canadian adolescents raises important questions about the association between vaping and smoking behavior. After several decades of steady decline, smoking among 15 to 19 year olds did not change significantly between 2015 and 2017, and no other national estimates are available for 2018.[14] If the increase in smoking prevalence in Canada was directly related to an increase in vaping, similar increases in smoking would be expected among US adolescents, who reported a similar rise in vaping; however, no statistically significant changes in smoking were observed between 2017 and 2018 in the US. Estimates from the current study are closer to the 0.5% increase in past 30 day smoking observed in the National Youth Tobacco Survey study[16 17] than the 0.8% decrease recorded in the Monitoring the Future study in 2018.[18] The greater increase in smoking in Canada might reflect emergent trends leading up to the legalization of non-medical cannabis in October 2018. Cannabis use increased among Canadian adolescents in 2018, consistent with Canada's benchmark survey, which also found an increase in cannabis use among adolescents in the six months before its legalization.[28] Given that smoking is the primary mode of cannabis use, and some users mix cannabis with tobacco (although to a lesser extent in North America than in Europe), it is plausible that greater cannabis use could increase cigarette smoking. However, supplemental tests indicated that the increase in smoking and vaping prevalence in Canada remained statistically significant after adjusting for cannabis use. Therefore, without discounting the possibility of common upstream determinants, the increases in vaping and smoking in Canada from 2017 to 2018 were not directly related to increased cannabis use over the same period.

Limitations of this study

The accuracy of prevalence estimates derived from non-probability based samples warrants consideration. Prevalence estimates from the current study were highly consistent with nationally representative benchmark surveys. For example, the prevalence of vaping in the past 30 days among US adolescents was 16.2% in 2018, which lies between the National Youth Tobacco Survey estimate of 20.8% for high school students and the Monitoring the Future study estimate of 14.2% for vaping nicotine among 8th, 10th, and 12th graders.[16 18] Past 30 day prevalence of smoking in 2018 was estimated at 8.1% of high school students by the National Youth Tobacco Survey[16] and 7.6% of 12th graders by the Monitoring the Future study[18] compared with 12.2% among 16 to 19 year olds in the current study; our estimate is somewhat higher, but also includes older adolescents and those not in school. In Canada, no 2018 data are available for comparison; however, Canadian estimates for smoking prevalence in 2017 (10.7%) were less than 1% lower than the Canadian Community Health Survey,[29] and slightly higher than the 8% reported for 15 to 19 year-olds from the Canadian Tobacco, Alcohol and Drugs Survey.[15] Overall, the current findings are within the range of estimates provided by the largest national surveys in the US and Canada. Unfortunately, there are no nationally representative probability based surveys of adolescents in England with which to compare our findings. In addition, all three countries used the same methodology in 2017 and 2018, including sample recruitment, survey measures, and weighting procedures. To examine the possibility that the 2018 sample could have been more prone to "risky" behaviors in general, we tested differences in the prevalence of alcohol and cannabis use between 2017 and 2018. No differences were observed across years in any of the countries, with the exception that cannabis use increased among Canadian adolescents, consistent with Canada's benchmark cannabis survey.[28] Therefore, while we acknowledge the limitations of non-probability samples, estimates from the current study show a high level of consistency with national benchmarks, and are robust after accounting for other risk behaviors that are highly correlated

with smoking and vaping. In addition, though fewer Canadian respondents identified only as white in 2018, this difference is likely attributable to a wording change in the source race/ethnicity question wherein "White" was renamed "European"; the proportion of respondents selecting "Don't know" or "Refused" increased (from 1.9% to 7.9%), as did "Other" responses (many of whom entered "Canadian," which could not be assumed white), all categorized as not white (only).

Conclusions and policy implications

The findings indicate increases in vaping among adolescents in Canada and the US. The study also provides empirical support to the widely held belief that young people have contributed to the increase in use of JUUL and the larger market wide shift to nicotine salt vaping products. In contrast, few differences were observed among adolescents in England, where there are mandatory limits on the nicotine concentration of e-liquids and greater restrictions on marketing. Although changes in the product market may be the most plausible explanation for differences in vaping across the study countries, additional research is required before population level changes in vaping can be attributed to specific regulatory and market factors. The current findings should also be interpreted within the broader context of overall trends in smoking and vaping, in which the prevalence of tobacco use among adults continues to decrease. Though the impact of vaping products on smoking rates remains highly contentious, it is unfortunate that the characteristics that enhance the effectiveness of e-cigarettes as smoking cessation aids—namely, efficient nicotine delivery—also increase their potential to promote addiction among young people. Before 2018, there was relatively little evidence of regular vaping among adolescents that might be indicative of nicotine addiction; however, the emergence of JUUL and nicotine salt based products might signal a change. Given how rapidly the vaping market is evolving, it is critically important to continue monitoring vaping behavior, including specific products and more frequent use, among adolescents. Rather than fuel the debate over trade-offs between less harmful nicotine alternatives for adult smokers versus increased initiation among adolescents, the findings should direct attention to regulatory measures that more selectively target these vaping products to adult smokers. This discussion has come to the fore, as Health Canada and the US Food and Drug Administration contemplate measures to protect young people, including greater restrictions on advertising and promotion, flavors, and retail access to e-cigarettes.[30 31] Finding the optimal regulatory balance that provides smokers with reasonable access to effective products, while restricting features of such products that appeal to adolescents, represents a priority for tobacco control, and for public health more generally.

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Transparency: The lead author (DH) affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

1 National Academies of Sciences, Engineering, and Medicine. *Public health consequences of e-cigarettes*. The National Academies Press, 2018, accessed 3 Dec 2018, doi:10.17226/24952.

2 Hajek P, Phillips-Waller A, Przulj D, et al. A randomized trial of e-cigarettes versus nicotine-replacement therapy. *N Engl J Med* 2019;380:629-37. doi:10.1056/NEJMoa1808779

3 Hammond D, Reid JL, Cole AG, Leatherdale ST. Electronic cigarette use and smoking initiation among youth: a longitudinal cohort study. *CMAJ* 2017;189:E1328-36. doi:10.1503/cmaj.161002

4 Leventhal AM, Stone MD, Andrabi N, et al. Association of e-cigarette vaping and progression to heavier patterns of cigarette smoking. *JAMA* 2016;316:1918-20. doi:10.1001/jama.2016.14649

5 East K, Hitchman SC, Bakolis I, et al. The association between smoking and electronic cigarette use in a cohort of young people. *J Adolesc Health* 2018;62:539-47. doi:10.1016/j.jadohealth.2017.11.301

6 Levy DT, Warner KE, Cummings KM, et al. Examining the relationship of vaping to smoking initiation among US youth and young adults: a reality check. *Tob Control* 2018; published online 20 Nov. doi:10.1136/tobaccocontrol-2018-054446

7 Health Canada. Vaping products. May 2018. www.canada.ca/en/health-canada/news/2018/05/backgrounder-vaping-products.html (accessed 3 Dec 2018).
8 Hammond D, White CM, Czoli CD, Martin CL, Magennis P, Shiplo S. Retail availability and marketing of electronic cigarettes in Canada. *Can J Public Health* 2015;106:e408-12. doi:10.17269/CJPH.106.5105
9 McNeill A, Brose LS, Calder R, Bauld L, Robson D. *Vaping in England: an evidence update February 2019. A report commissioned by Public Health England.* Public Health England, 2019, www.gov.uk/government/publications/vaping-in-england-an-evidence-update-february-2019, accessed 28 Feb 2019.
10 European Commission. Directive 2014/40/EU of the European Parliament and of the Council of 3 April 2014 on the approximation of the laws, regulations and administrative provisions of the Member States concerning the manufacture, presentation and sale of tobacco and related products and repealing Directive 2001/37/ECe. www.eur-lex.europa.eu; 2014. Contract No. 1.
11 U.S. Food and Drug Administration. Vaporizers, E-Cigarettes, and other Electronic Nicotine Delivery Systems (ENDS). www.fda.gov/TobaccoProducts/Labeling/ProductsIngredientsComponents/ucm456610.htm
12 Gravely S, Fong GT, Cumming KM, et al. Awareness, ever-trial, and use of electronic cigarettes among 10 countries: Findings from the ITC Project. *Int J Environ Res Public Health* 2014;11:11691-704. doi:10.3390/ijerph111111691
13 Cho HJ, Dutra LM, Glantz SA. Differences in adolescent e-cigarette and cigarette prevalence in two policy environments: South Korea and the United States. *Nicotine Tob Res* 2018;20:949-53. doi:10.1093/ntr/ntx198
14 Government of Canada. Detailed tables for the Canadian Student Tobacco, Alcohol and Drugs Survey 2016-17. www.canada.ca/en/health-canada/services/canadian-student-tobacco-alcohol-drugs-survey/2016-2017-supplementary-tables.html#t1 (accessed 3 Dec 2018).
15 Government of Canada. Canadian Tobacco, Alcohol and Drugs Survey (CTADS): summary of results for 2017. www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary.html (accessed 15 Feb 2019).
16 Gentzke AS, Creamer M, Cullen KA, et al. Vital signs: tobacco product use among middle and high school students — United States, 2011-2018. *MMWR Morb Mortal Wkly Rep* 2019;68:157-64. doi:10.15585/mmwr.mm6806e1
17 Wang TW, Gentzke A, Sharapova S, Cullen KA, Ambrose BK, Jamal A. Tobacco product use among middle and high school students - United States, 2011-2017. *MMWR Morb Mortal Wkly Rep* 2018;67:629-33. doi:10.15585/mmwr.mm6722a3
18 Johnston LD, Miech RA, O'Malley PM, Bachman JG, Schulenberg JE, Patrick ME. *Monitoring the Future national survey results on drug use 1975-2018: Overview, key findings on adolescent drug use.* Institute for Social Research, University of Michigan, 2019, www.monitoringthefuture.org//pubs/monographs/mtf-overview2018.pdf, accessed 15 Feb 2019.
19 Huang J, Duan Z, Kwok J, et al. Vaping versus JUULing: how the extraordinary growth and marketing of JUUL transformed the US retail e-cigarette market[Epub 31 May 2018]. *Tob Control* 2019;28:146-51. doi:10.1136/tobaccocontrol-2018-054382
20 Goniewicz ML, Boykan R, Messina CR, Eliscu A, Tolentino J. High exposure to nicotine among adolescents who use Juul and other vape pod systems ('pods'). *Tob Control* 2018; published online 7 Sep. doi:10.1136/tobaccocontrol-2018-054565
21 Talih S, Salman R, El-Hage R, et al. Characteristics and toxicant emissions of JUUL electronic cigarettes. *Tob Control* 2019; published online 11 Feb. doi:10.1136/tobaccocontrol-2018-054616
22 Willett JG, Bennett M, Hair EC, et al. Recognition, use and perceptions of JUUL among youth and young adults[Epub 18 April 2018]. *Tob Control* 2019;28:115-6. doi:10.1136/tobaccocontrol-2018-054273
23 Vallone DM, Bennett M, Xiao H, Pitzer L, Hair EC. Prevalence and correlates of JUUL use among a national sample of youth and young adults. *Tob Control* 2018; published online 29 Oct. doi:10.1136/tobaccocontrol-2018-054693
24 Hammond D, Reid JL, White CM, Boudreau C. ITC Youth Tobacco and E-Cigarette Survey: Technical Report – Wave 1 (2017). Waterloo, ON: University of Waterloo, 2018. http://davidhammond.ca/projects/tobacco-control/itc-youth-tobacco-ecig/ (accessed 3 Dec 2018).
25 Willard H. 2019 CAGNY Investor Presentation. Altria, 2019. http://investor.altria.com/Cache/1500117496.PDF?O=PDF&T=&Y=&D=&FID=1500117496&iid=4087349 (accessed 28 Feb 2019).
26 U.S. Department of Health and Human Services. *How tobacco smoke causes disease: the biology and behavioral basis for smoking-attributable disease: A report of the Surgeon General.* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2010.
27 Geller M. Fast-growing e-cigarette maker JUUL to launch in UK. Reuters, 2018 Jul 16. www.reuters.com/article/us-juul-britain/fast-growing-e-cigarette-maker-juul-to-launch-in-uk-idUSKBN1K62WC (accessed 3 Dec 2018).
28 Statistics Canada. National Cannabis Survey: 3rd Quarter, 2018. www150.statcan.gc.ca/n1/daily-quotidien/181011/t001b-eng.htm (accessed 3 Dec 2018).
29 Statistics Canada. Canadian Community Health Survey. Health Fact Sheets; Smoking 2017. www150.statcan.gc.ca/n1/pub/82-625-x/2018001/article/54974-eng.htm (accessed 3 Dec 2018).
30 U.S. Food and Drug Administration. Statement from FDA Commissioner Scott Gottlieb, M.D., on proposed new steps to protect youth by preventing access to flavored tobacco products and banning menthol in cigarettes. 2018 Nov 15. www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm625884.htm (accessed 3 Dec 2018).
31 Health Canada. Notice of Intent – Potential Measures to Reduce the Impact of Vaping Products Advertising on Youth and Non-users of Tobacco Products. Government of Canada. 2019 Feb 7. www.canada.ca/en/health-canada/programs/consultation-measures-reduce-impact-vaping-products-advertising-youth-non-users-tobacco-products/notice-document.html (accessed 15 Feb 2019).