



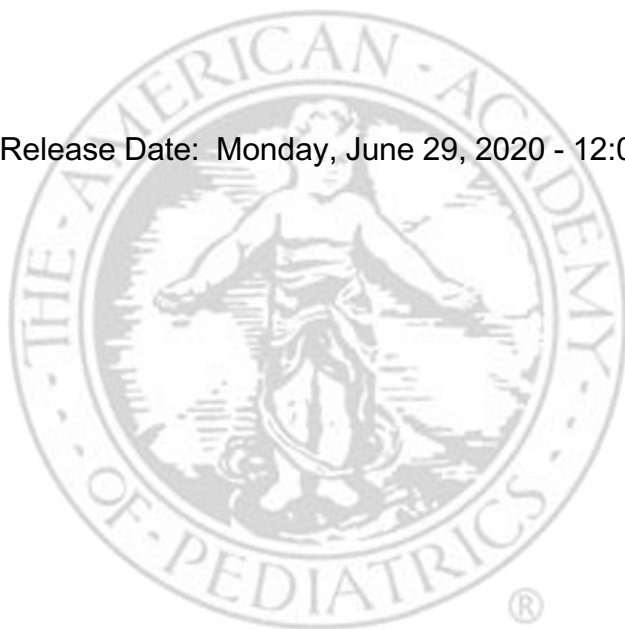
PEDIATRICS

E-cigarette Marketing Regulations and Youth Vaping: Cross-Sectional Surveys, 2017–2019

David Hammond, PhD, Jessica L. Reid, MSc, Robin Burkhalter, MMath, Vicki L. Rynard, MSc

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E-cigarette Marketing Regulations and Youth Vaping: Cross-Sectional Surveys, 2017–2019

David Hammond, PhD, Jessica L. Reid, MSc, Robin Burkhalter, MMath, Vicki L. Rynard, MSc

abstract

BACKGROUND: Increased electronic cigarette (e-cigarette) use among young people is often attributed to industry marketing practices; however, the effectiveness of regulations that limit e-cigarette advertising and promotions has yet to be examined. New federal legislation that liberalized the Canadian e-cigarette market in May 2018, along with differences in provincial regulations, provides an opportunity to examine the impact of regulatory restrictions on e-cigarette marketing.

METHODS: Repeat cross-sectional surveys of 12 004 16- to 19-year-olds in Canada, completed online in 2017, 2018, and 2019. Logistic regression models were used to examine differences over time in exposure to e-cigarette marketing and e-cigarette use, including between provinces with differing strengths of marketing restrictions.

RESULTS: The percentage of youth surveyed who reported noticing e-cigarette promotions often or very often approximately doubled between 2017 and 2019 (13.6% vs 26.0%; adjusted odds ratio [AOR] = 2.24, 95% confidence interval [CI] = 1.97–2.56). Overall exposure to marketing was generally more prevalent in provinces with fewer regulatory restrictions. Respondents who reported noticing marketing often or very often were more likely to report vaping in the past 30 days (AOR = 1.41, 95% CI = 1.23–1.62), past week (AOR = 1.44, 95% CI = 1.22–1.70), and ≥ 20 days in the past month (AOR = 1.42, 95% CI = 1.11–1.81, $P = .005$). Provinces with low restrictions on marketing had higher prevalence of vaping in the past 30 days (AOR = 1.50, 95% CI = 1.25–1.80, $P < .001$), and in the past week (AOR = 1.65, 95% CI = 1.33–2.05, $P < .001$).

CONCLUSIONS: Exposure to marketing and the prevalence of vaping increased among Canadian youth after the liberalization of the e-cigarette market in 2018. Comprehensive provincial restrictions on e-cigarette marketing were associated with lower levels of exposure to marketing and lower prevalence of e-cigarette use.



School of Public Health and Health Systems, University of Waterloo, Waterloo, Ontario, Canada

Dr Hammond conceptualized and designed the study and drafted sections of the initial manuscript; Ms Reid helped design the data collection instruments, coordinated and supervised data collection, and drafted sections of the initial manuscript; Ms Burkhalter led the data analysis and drafted sections of the initial manuscript; Ms Rynard carried out data management and weighting and assisted with analyses; and all authors reviewed and revised the manuscript and approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

WHAT'S KNOWN ON THIS SUBJECT: Although increased vaping among youth is often attributed to industry marketing, the effectiveness of regulations that limit electronic cigarette (e-cigarette) marketing has yet to be examined. In Canada, federal legislation liberalized the e-cigarette market in 2018, and provincial regulations differ in strength.

WHAT THIS STUDY ADDS: Exposure to marketing and the prevalence of vaping increased among Canadian youth after the liberalization of the e-cigarette market. Comprehensive provincial restrictions on e-cigarette marketing were associated with lower levels of exposure to marketing and lower prevalence of e-cigarette use.

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Electronic cigarette (e-cigarette) use among North American youth has increased considerably over the past 2 years.¹⁻³ According to recent estimates, approximately one-quarter of Canadian youth have used e-cigarettes in the past 30 days, with increasing prevalence of daily or near daily use, similar to trends in the United States.^{2,3} Increased use of e-cigarettes among young people is frequently attributed to industry marketing practices. Leading e-cigarette brands such as JUUL are currently being investigated by the US Food and Drug Administration for targeting young people through social media with lifestyle-oriented imagery.⁴⁻⁷ Few federal restrictions are placed on e-cigarette marketing in the US, except that marketing materials cannot include unauthorized claims of reduced harm or cessation.⁸ One of the leading Canadian brands, Vype, has also been the focus of disciplinary action from Health Canada over lifestyle marketing in public areas,⁹ and Health Canada has issued advisories to retailers regarding compliance with federal regulations.¹⁰

Estimates from population-based studies indicate widespread exposure to e-cigarette marketing among youth.¹¹ In 2017, approximately three-quarters of Canadian youth reported exposure to e-cigarette marketing in the past 30 days, and in the United States increasing exposure over time is indicated.^{12,13} Greater exposure to e-cigarette advertising and promotions is associated with increased likelihood of use,^{11,12,14-16} including in prospective cohort studies, in which exposure to advertising at baseline predicts subsequent e-cigarette use.^{17,18} In experimental studies, exposure to e-cigarette advertisements has increased positive perceptions and interest in using e-cigarettes among young people, including among “never” users.¹⁹⁻²¹ These findings are consistent with the evidence that

tobacco marketing increases smoking behavior among young people by promoting positive attitudes and beliefs toward tobacco use while reducing perceptions of risk.^{22,23}

Recent regulatory changes had a substantial impact on the e-cigarette market in Canada. Before implementation of the *Tobacco and Vaping Products Act* (TVPA) in May 2018, e-cigarettes containing nicotine could not be sold or advertised in Canada without premarket approval.²⁴ Although e-cigarettes were still widely available in vape shops and online, there was little coordinated advertising or promotion, and the market was composed of smaller brands.²⁵ After the TVPA, e-cigarettes containing nicotine became legally available for sale, which increased retail access for major international brands, such as JUUL and Vype. The TVPA also permitted marketing, including advertisements in mass media channels, such as radio, television, and print, and at the point of sale, so long as the content of ads did not appeal to youth or include “lifestyle” advertising or personal testimonials. Several provinces implemented supplementary restrictions on e-cigarette advertising, including Quebec and Manitoba, which implemented comprehensive restrictions similar to tobacco products, including a ban on retail displays and advertisements. Other provinces, such as Alberta and Saskatchewan, added few restrictions beyond the federal requirements. Although Canada legalized recreational cannabis in October 2018, cannabis or tetrahydrocannabinol (THC) vape oils were not permitted until 2020 and are subject to more comprehensive restrictions than nicotine e-cigarettes, similar to tobacco products in Canada.

To date, there is little evidence on the impact of regulatory restrictions on exposure to e-cigarette marketing

among young people. In 3 studies that included comparison of exposure across countries with different restrictions, the conclusions were that marketing exposure was higher among youth and adults in the United States and Canada compared with England and Australia, countries with greater restrictions.^{12,26,27}

The implementation of the TVPA in 2018 and the differing regulatory restrictions across Canadian provinces has created the conditions for a “natural experiment” to test the impact of e-cigarette marketing: although marketing practices increased in all provinces in 2018, we hypothesize that they increased to a greater extent in provinces with fewer restrictions. Accordingly, in our current study, we had 3 primary objectives: (1) to examine changes in exposure to e-cigarette marketing before and after implementation of the TVPA, (2) to examine whether exposure differed on the basis of the strength of provincial marketing restrictions, and (3) to test whether exposure to e-cigarette marketing was associated with the prevalence of vaping.

METHODS

Data Source

Data are from waves 1 to 3 of the International Tobacco Control Policy Evaluation Project (ITC) Youth Tobacco and Vaping Survey, conducted in Canada, England, and the United States. Online surveys were conducted in July and August 2017 (wave 1), August and September 2018 (wave 2), and August and September 2019 (wave 3). The same methods and recruitment protocols were used in all 3 countries. Respondents were recruited from the Nielsen Consumer Insights Global Panel, which maintains panels in Canada, England, and the United States, as well as their partners’ panels. The Nielsen panel is recruited by using both probability

and nonprobability sampling methods 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 ~2% in vaping and smoking prevalence across waves. Eligible respondents included youth aged 16 through 19 at the time of recruitment. Respondents were recruited either directly or through their parents. E-mail invitations (with a unique link) were sent to panelists after targeting for age criteria. Panelists known to be parents were also contacted; those who confirmed they had 1 or more children aged 16 to 19 living in their household were asked for permission for their child to complete the survey (if more than 1 child, specifically the one whose birthday was coming up next). After eligibility screening, all potential respondents were provided with information about the study and were asked to provide consent.

The current analyses are based on the cross-sectional samples of Canadian respondents to the ITC Youth Tobacco and Vaping Survey. In Canada, the total number of respondents completing the survey was 4491 in 2017, 4298 in 2018, and 4501 in 2019. Respondents were excluded from the sample if they failed a data integrity check ($n = 144$ in 2017, $n = 134$ in 2018, and $n = 191$ in 2019), had missing or invalid data on key variables (age, sex, province, ever or last smoked and vaped; $n = 323$ in 2017; $n = 86$ in 2018; $n = 107$ in 2019), or had participated in a previous wave of the study ($n = 233$ in 2018; $n = 68$ in 2019). The analytic sample included 4024 participants recruited at wave 1, 3845 recruited at wave 2, and 4135 recruited at wave 3. A full description of the study methods, including survey cooperation rates, is available in the Technical Reports.²⁸

This study was reviewed and received ethics clearance through a University of Waterloo Research Ethics

Committee (ORE#21847) and the King's College London Psychiatry, Nursing, and Midwifery Research Ethics Subcommittee.

Measures

Marketing Exposure

Self-reported exposure to marketing was measured by response to the item, "In the last 30 days, how often have you noticed things that promote e-cigarettes/vaping?" (never, rarely, sometimes, often, very often, don't know, refused). Overall exposure to marketing was analyzed as a binary outcome (often or very often versus never, rarely, or sometimes). To determine whether the categorization of this outcome impacted the results, parallel models to those reported in the paper were fitted using an alternative categorization (often, very often, or sometimes versus never or rarely), as well as linear models in which the outcome was treated as a continuous variable. The pattern of differences between survey waves and between provinces was similar regardless of which variable or categorization was used. Therefore, results using the binary variable are presented. Respondents reporting "don't know" or "refused" ($n = 296$ in wave 1, $n = 292$ in wave 2, $n = 244$ in wave 3) were excluded from analysis of this measure.

Respondents who indicated noticing marketing at least rarely were asked whether they noticed e-cigarettes or vaping devices or e-liquid being advertised in each of 15 specific settings.

Provincial Restrictions on Marketing

Variables were created to categorize the strength of marketing restrictions in each province on the basis of information sourced from summaries of legislation.²⁹ Separate policy strength indicator variables were created to indicate whether e-cigarette advertisements were permitted in each of the following channels (0 = prohibited, 1 =

permitted): television, radio, billboards (restricted in Quebec, Manitoba, Prince Edward Island, Nova Scotia), and advertisements or product displays inside and outside stores (restricted in British Columbia, Manitoba, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador). A policy strength index was also created to reflect the overall level of marketing restrictions across provinces: low restrictions (4) were in Alberta and Saskatchewan; low-moderate restrictions (3) were in Ontario; moderate restrictions (2) were in New Brunswick and Newfoundland and Labrador; high-moderate restrictions (1) were in British Columbia; and high restrictions (0) were in Quebec, Manitoba, Nova Scotia and Prince Edward Island.

Vaping and Smoking Behavior

Respondents were asked to report their vaping and smoking behavior, including the last time they used an e-cigarette or vaped (analyzed as past 30-day and past-week vaping) and the number of days they vaped in the past 30 days (analyzed as ≥ 20 days versus less).

Analysis

Poststratification sample weights were constructed for each country, based on age, sex, and geographic region, and rescaled to the sample size. In addition, the US National Youth Tobacco Survey and the Canadian Student Tobacco, Alcohol and Drugs Survey were used to calibrate to the trend over time for past 30-day smoking (see Technical Reports²⁸).

Regression models were fitted for 3 primary outcomes: (1) overall marketing exposure, (2) exposure to marketing in specific channels, and (3) vaping prevalence. All models included indicator variables for survey wave (2017, 2018, or 2019), province nested within policy

TABLE 1 Sample Characteristics (*n* = 12 004)

	2017, <i>n</i> = 4024	2018, <i>n</i> = 3845	2019, <i>n</i> = 4135	Total, <i>n</i> = 12 004
Age				
Mean (SD)	17.6 (1.1)	17.5 (1.1)	17.5 (1.1)	17.5 (1.1)
Sex, ^a <i>n</i> (%)				
Male	2073 (51.5)	1979 (51.5)	2121 (51.3)	6173 (51.4)
Female	1953 (48.5)	1866 (48.5)	2014 (48.7)	5832 (48.6)
Race or ethnicity, ^b <i>n</i> (%)				
White only	2354 (58.5)	1807 (47.0)	2225 (53.8)	6385 (53.2)
Mixed, other, not stated	1671 (41.5)	2038 (53.0)	1910 (46.2)	5620 (46.8)
Province, <i>n</i> (%)				
British Columbia	539 (13.4)	514 (13.4)	550 (13.3)	1603 (13.4)
Alberta	498 (12.4)	496 (12.9)	486 (11.8)	1479 (12.3)
Saskatchewan	112 (2.8)	103 (2.7)	139 (3.4)	354 (2.9)
Manitoba	166 (4.1)	145 (3.8)	180 (4.4)	491 (4.1)
Ontario	1649 (41.0)	1581 (41.1)	1699 (41.1)	4929 (41.1)
Quebec	811 (20.2)	769 (20.0)	829 (20.0)	2409 (20.1)
New Brunswick	70 (1.7)	81 (2.1)	79 (1.9)	230 (1.9)
Nova Scotia	115 (2.9)	83 (2.1)	101 (2.5)	299 (2.5)
Newfoundland and Labrador	54 (1.3)	57 (1.5)	53 (1.3)	164 (1.4)
Prince Edward Island	11 (0.3)	15 (0.4)	20 (0.5)	46 (0.4)
Alcohol use, <i>n</i> (%)				
Any in past 12 mo	2413 (61.7)	2158 (58.0)	2183 (54.9)	7070 (58.2)
Cigarette use, <i>n</i> (%)				
Any in past 30 d	428 (10.6)	383 (10.0)	384 (9.3)	1195 (10.0)

^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 a survey item with multiple categories, categorized into those who specified only white or European, or any other response; wording of the source question changed slightly, from response option “White” in 2017 to “European” in 2018 to “White or European” in 2019.

strength (low restrictions, low-moderate, moderate, high-moderate, high restrictions), and a 2-way interaction term between survey wave and policy strength. All regression models were adjusted for age (16–17 vs 18–19), sex, and race or ethnicity (white versus other).

First, overall exposure to marketing was examined in a logistic regression model using the binary outcome (often or very often versus never, rarely, or sometimes). Second, separate logistic regression models were estimated for exposure to each of the 15 specific marketing channels

(inside stores, billboards, etc). For these models, the overall “policy strength” variable was replaced by a binary variable indicating whether the specific marketing channel was permitted or prohibited within each province. Finally, 3 logistic regression models were estimated to examine differences over time in the prevalence of vaping in the past 30 days, past week, and ≥ 20 days in the past month. The “overall marketing exposure” variable was included as a predictor variable in these models.

Adjusted odds ratios (AORs), 95% confidence intervals (CIs), and weighted estimates are reported, unless otherwise noted. Respondents with missing data on outcome measures or covariates were excluded from models on a case-wise basis. Analyses were conducted by using SAS 9.4.

RESULTS

The weighted sample characteristics across the 3 waves are shown in Table 1. Across all years, participants had an average age of 17.5 years, 51% were male, and 53% self-identified as white. In addition, 58% reported consuming alcohol in the past year, and 10% reported smoking a cigarette in the past 30 days.

TABLE 2 Self-Reported Exposure to E-cigarette Marketing in Specific Channels by Survey Year

Channel	2017, <i>n</i> (%)	2018, <i>n</i> (%)	2019, <i>n</i> (%)	Change Between 2017 and 2019, AOR (95% CI)
In stores that sell cigarettes	1468 (43.5)	1328 (40.4)	1898 (53.2)	1.48 (1.33–1.65)
Outside stores that sell cigarettes	1302 (38.1)	1265 (37.9)	1721 (47.5)	1.47 (1.32–1.63)
On websites or social media (Facebook, Twitter, YouTube, Instagram, or Snapchat)	1453 (41.5)	1507 (44.3)	1975 (46.9)	1.60 (1.44–1.78)
On billboards or posters	675 (19.6)	796 (23.6)	1210 (33.0)	2.02 (1.80–2.28)
On television or radio	635 (18.2)	637 (18.9)	1088 (29.5)	1.88 (1.66–2.12)
At kiosk or temporary sales locations	970 (28.4)	836 (25.0)	1051 (29.2)	1.04 (0.93–1.17)
At events like fairs, markets, festivals, sporting events, or music concerts	701 (20.7)	665 (20.0)	918 (25.7)	1.32 (1.17–1.49)
In print newspapers or magazines	530 (15.7)	557 (16.7)	739 (20.5)	1.37 (1.20–1.57)
Taxis or buses/public transit	367 (10.8)	455 (13.6)	731 (20.2)	2.08 (1.80–2.41)
In flyers	385 (11.2)	458 (13.7)	642 (17.7)	1.69 (1.45–1.96)
In bars or pubs	406 (12.8)	460 (14.4)	584 (17.4)	1.42 (1.22–1.66)
In e-mail or text messages	301 (8.6)	372 (10.9)	502 (13.6)	1.67 (1.41–1.97)
At a pharmacy	339 (9.9)	330 (9.8)	466 (12.8)	1.33 (1.13–1.57)
At the movies	238 (6.9)	267 (8.0)	408 (11.2)	1.69 (1.40–2.04)
In regular postal mail	134 (3.9)	157 (4.6)	236 (6.5)	1.69 (1.32–2.16)

Self-Reported Exposure to E-cigarette Marketing

The proportion of respondents who reported noticing e-cigarette promotions in the last 30 days increased from 2017 to 2019: in 2017, 13.6% reported noticing promotions often or very often, which increased to 15.5% in 2018 (AOR = 1.18, 95% CI = 1.02–1.36, $P = .03$) and 26.0% in 2019 (versus 2017: AOR = 2.24, 95% CI = 1.97–2.56, $P < .001$; versus 2018: AOR = 1.91, 95% CI = 1.68–2.16, $P < .001$). Often noticing e-cigarette promotions was more prevalent among youth who were 18 or 19 years old (AOR = 1.15, 95% CI = 1.04–1.28, $P = .01$) and females (AOR = 1.19, 95% CI = 1.07–1.32, $P = .002$).

As illustrated in Fig 1, noticing e-cigarette promotions often or very often was generally more prevalent in 2019 among provinces with fewer regulatory restrictions on e-cigarette promotions. The interaction between year and policy strength in the logistic regression model was significant ($P < .001$). The likelihood of often noticing promotions increased from 2017 to 2019 for all provinces except those with high restrictions (high: AOR = 1.27, 95% CI = 0.95–1.71, $P = .10$; moderate-high: AOR = 2.55, 95% CI = 1.76–3.71, $P < .001$; moderate: AOR = 3.40, 95% CI = 1.65–7.00, $P < .001$; low-moderate: AOR = 2.40, 95% CI = 2.00–2.88, $P < .001$; low: AOR = 3.74, 95% CI = 2.70–5.19, $P < .001$). In addition, the increase in often noticing promotions between 2017 and 2019 was substantially greater among provinces with fewer restrictions compared with provinces with the most restrictions (moderate-high: AOR = 2.00, 95% CI = 1.25–3.22, $P = .004$; moderate: AOR = 2.66, 95% CI = 1.22–5.80, $P = .01$; low-moderate: AOR = 1.88, 95% CI = 1.33–2.65, $P < .001$; low restrictions: AOR = 2.93, 95% CI = 1.89–4.54, $P < .001$). For example, the increase seen from 2017 to 2019 was 2.93 times greater in

provinces with low restrictions (AOR = 3.74) than in those with high restrictions (AOR = 1.27).

Self-Reported Exposure to Marketing in Specific Channels

Self-reported noticing of e-cigarette marketing in specific channels is shown in Table 2. Respondents were most likely to notice marketing inside and outside stores that sold cigarettes, followed by digital media, and billboards. As shown in Table 2, exposure to marketing increased between 2017 and 2019 for all channels except kiosks.

Provincial regulations on e-cigarette marketing differed across 5 specific channels: inside stores, outside stores, billboards, television, and print. As illustrated in Fig 2, respondents in provinces with no restrictions on that specific channel were more likely to notice promotions in the following places, and this difference was larger in 2019 than 2017. This was the case for promotions inside stores (AOR = 1.43, 95% CI = 1.15–1.78, $P = .001$), outside stores (AOR = 1.49, 95% CI = 1.19–1.87, $P < .001$), and on billboards (AOR = 1.70, 95% CI =

1.24–2.32, $P < .001$), and to a lesser extent for television (AOR = 1.32, 95% CI = 0.96–1.80, $P = .09$); there were no differences for print advertising (AOR = 1.16, 95% CI = 0.84–1.62, $P = .37$).

Prevalence of Vaping and Exposure to Marketing

The overall prevalence of vaping in Canada increased between 2017 and 2019 for all outcomes: vaping in the past 30 days (2017 = 8.4%, 2018 = 12.1%, 2019 = 17.8%; $P < .001$), in the past week (2017 = 5.1%, 2018 = 7.5%, 2019 = 12.3%; $P < .001$), and on ≥ 20 days in the past month (2017 = 1.8%, 2018 = 2.4%, 2019 = 5.7%; $P < .001$). Respondents who reported noticing marketing often or very often were more likely to report vaping in the past 30 days (AOR = 1.41, 95% CI = 1.23–1.62, $P < .001$), in the past week (AOR = 1.44, 95% CI = 1.22–1.70, $P < .001$), and on ≥ 20 days in the past month (AOR = 1.42, 95% CI = 1.11–1.81, $P = .005$).

As indicated in Fig 3, the prevalence of vaping in the past 30 days increased from 2017 to 2019 for all provinces (high restrictions: AOR = 2.09, 95% CI = 1.52–2.87, $P < .001$;

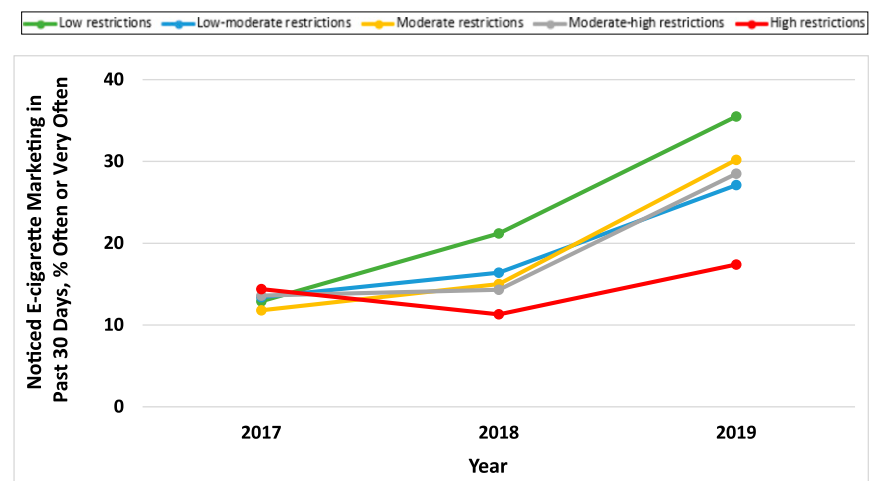


FIGURE 1

Noticing e-cigarette marketing often or very often, by strength of provincial marketing regulations, 2017 to 2019 ($n = 12\,004$). Low restrictions were in Alberta and Saskatchewan; low-moderate restrictions were in Ontario; moderate restrictions were in New Brunswick and Newfoundland and Labrador; moderate-high restrictions were in British Columbia; and high restrictions were in Quebec, Manitoba, Nova Scotia, and Prince Edward Island.

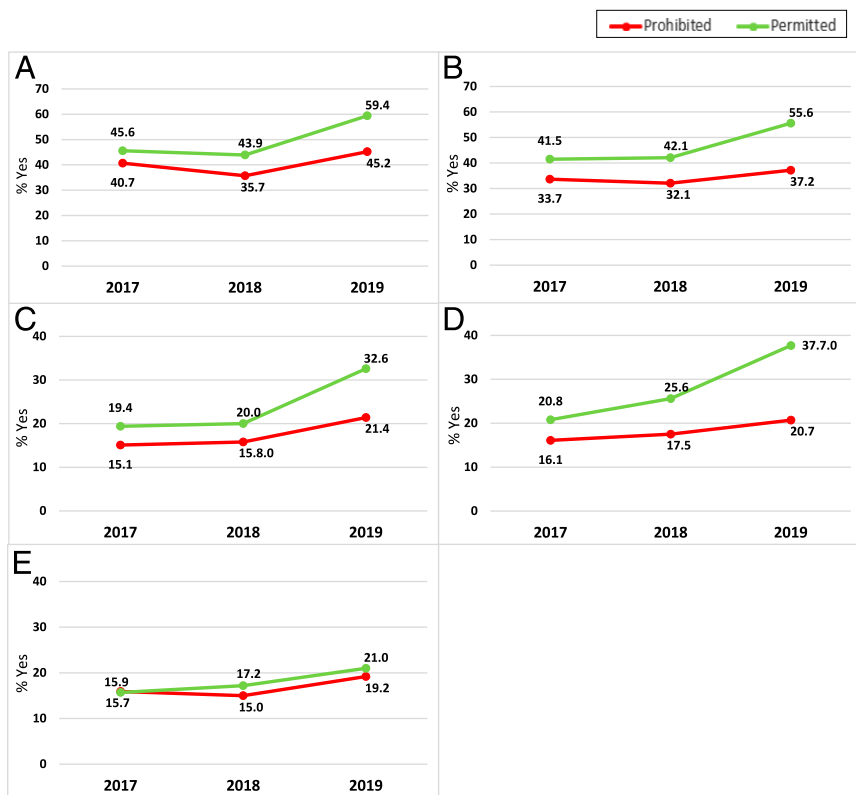


FIGURE 2 Noticing e-cigarette advertisements and promotions permitted and prohibited in specific channels by province, 2017 to 2019. A, Noticed ads inside stores and shops. B, Noticed ads outside stores and shops. C, Noticed ads on television or radio. D, Noticed ads on billboards or posters. E, Noticed ads in newspapers or magazines.

moderate-high: AOR = 2.25, 95% CI = 1.45–3.50, $P < .001$; moderate: AOR = 2.70, 95% CI = 1.24–5.86, $P = .01$; low-moderate: AOR = 2.84, 95% CI = 2.26–3.57, $P < .001$; low: AOR = 2.28, 95% CI = 1.59–3.25, $P < .001$). Similarly, the prevalence of vaping in the past week increased from 2017 to 2019 for all provinces (high restrictions: AOR = 1.98, 95% CI = 1.35–2.91, $P < .001$; moderate-high: AOR = 3.67, 95% CI = 2.01–6.72, $P < .001$; moderate: AOR = 3.09, 95% CI = 1.19–8.01, $P = .02$; low-moderate: AOR = 3.18, 95% CI = 2.37–4.27, $P < .001$; low: AOR = 2.41, 95% CI = 1.59–3.64, $P < .001$). The prevalence of vaping on ≥ 20 days in the past month increased from 2017 to 2019 in all provinces except those with moderate restrictions (high restrictions: AOR = 2.46, 95% CI = 1.41–4.28, $P = .001$; moderate-high: AOR = 5.00, 95% CI = 1.76–14.2, $P =$

.003; moderate: AOR = 2.38, 95% CI = 0.60–9.45, $P = .22$; low-moderate: AOR = 4.01, 95% CI = 2.41–6.67, $P < .001$; low: AOR = 3.59, 95% CI = 1.74–7.41, $P < .001$).

Compared with provinces with the strongest marketing restrictions, across all waves, the prevalence of vaping in the past 30 days was higher in provinces with moderate-high (AOR = 1.30, 95% CI = 1.06–1.59, $P = .01$) and low restrictions (AOR = 1.50, 95% CI = 1.25–1.80, $P < .001$), whereas the prevalence of vaping in the past week was also higher among provinces with moderate-high restrictions (AOR = 1.27, 95% CI = 1.00–1.62, $P = .05$) and low restrictions (AOR = 1.65, 95% CI = 1.33–2.05, $P < .001$). The interaction between year and policy was not significant for past 30-day ($P = .14$),

past-week ($P = .12$), or vaping on ≥ 20 days in the past month ($P = .61$).

DISCUSSION

Young Canadians reported substantial increases in exposure to e-cigarette marketing after the introduction of new federal legislation permitting the sale and marketing of nicotine-containing e-cigarettes in May 2018. The youth surveyed were most likely to report exposure to marketing at retail outlets, which is consistent with the implementation in mid-2018 and 2019 of prominent in-store advertising and product displays for international brands such as JUUL and Vype. In most cases, these promotions were positioned at the point-of-sale counter, immediately adjacent to candy and other products popular among children and youth.³⁰ Along with increased exposure from more traditional marketing channels, including billboards, radio, and print media, youth also reported substantial increases in exposure to digital marketing, including social media and internet ads. Digital marketing may have originated in Canada, as well as through exposure to cross-border digital marketing from the United States to social media campaigns such as those conducted by JUUL and other companies in the United States.^{5,6,23} Findings are consistent with research in the United States that documents increased exposure to e-cigarette marketing over the same period is indicated, including the importance of retail stores as a primary source of exposure.^{15,21,31}

E-cigarette marketing was strongly associated with increased vaping behavior at the individual level. In addition, vaping increased in all provinces between 2017 and 2019; although this increase occurred at a similar rate across provinces, those with greater marketing restrictions had lower overall vaping prevalence.

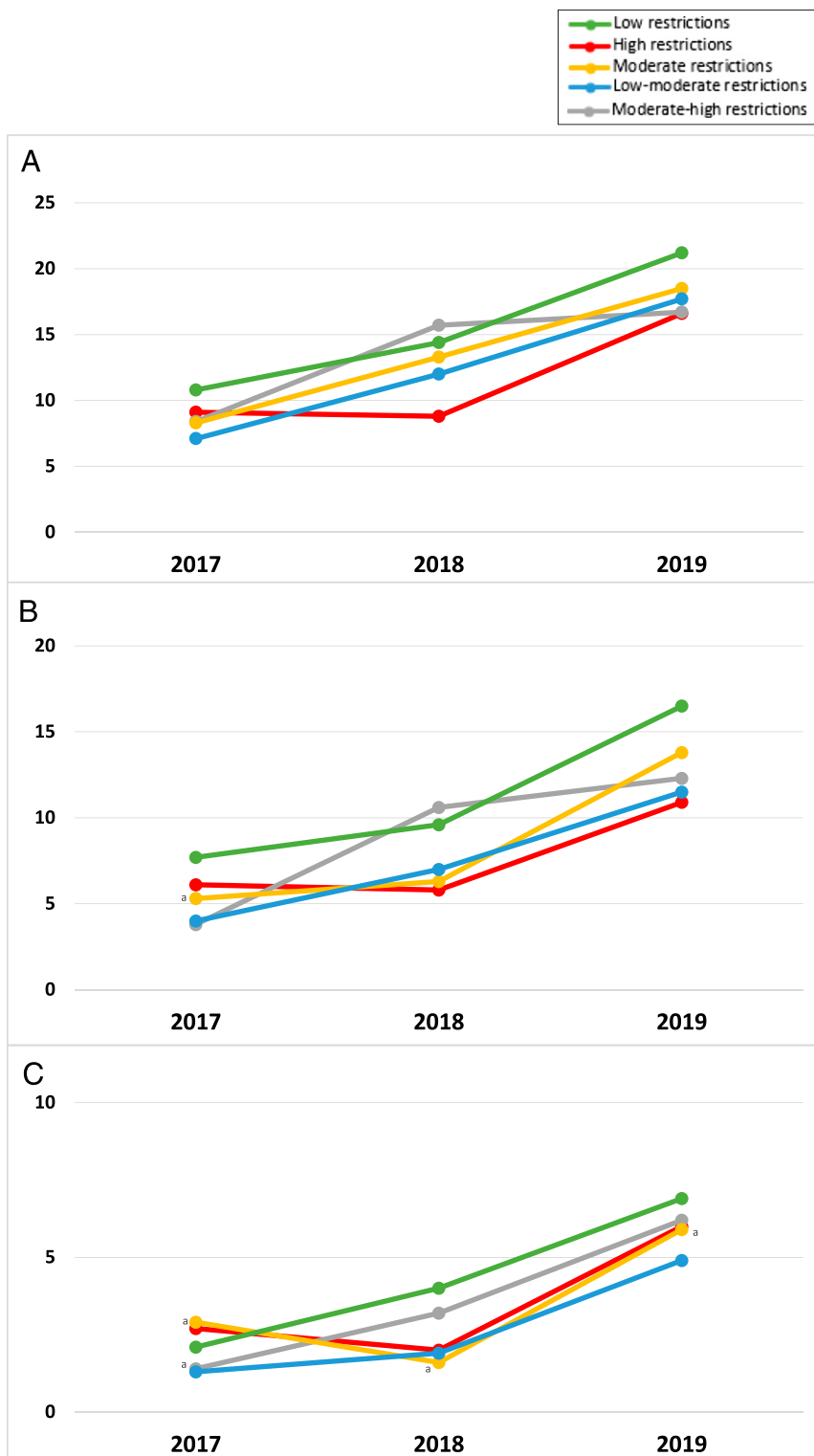


FIGURE 3 Prevalence of vaping by strength of provincial marketing restrictions, 2017 to 2019. A, Prevalence of vaping in the past 30 days. B, Prevalence of vaping in the past week. C, Prevalence of vaping ≥ 20 days in the past month. ^aHigh variability, interpret with caution.

The findings are consistent with those from both experimental^{18,19} and prospective cohort studies,^{20,21} the results of which collectively suggest a causal effect of e-cigarette advertisements on use among young people.

Exposure to e-cigarette marketing was less prevalent in provinces with more comprehensive regulations. Indeed, in provinces such as Quebec and Manitoba, the frequency of youth who noticed marketing often or very often did not increase between 2017 and 2019. Also demonstrated in the findings is specificity in terms of the impact of regulations in particular marketing channels: youth living in provinces with restrictions on billboards, television, and in-store and exterior ads were less likely to report noticing marketing in each of these channels. With these findings, we suggest that proposals in Canada and the United States to restrict e-cigarette advertising in these channels may be effective in reducing youth exposure. Several Canadian provinces and US states have also proposed that e-cigarette sales be restricted to adult-only stores, which is an alternative regulatory approach to reduce promotion to youth in retail settings, the most common source of marketing exposure. The findings are also consistent with previous evidence in which national-level differences in marketing regulations were examined: youth and adult exposure to e-cigarette advertising is lower in countries with greater restrictions, such as Australia and Canada before the “opening” of the e-cigarette market in 2018.^{12,27}

This study is subject to limitations common to survey research, including response bias. For example, self-reported measures of marketing exposure may be subject to recall biases. In particular, the “overall” measure of marketing may have been interpreted differently across respondents and should, therefore, be interpreted within the context of the

data for specific marketing channels. In previous studies, self-reported recall of tobacco marketing has been associated with objective data on the presence of marketing and audience viewership numbers measured using gross rating points.^{32,33} Self-reported exposure to media campaigns is higher in markets in which a given campaign aired more frequently or in countries that permit greater marketing.^{26,34–36} In the current study, we did not examine other factors that may have contributed to the increase in youth vaping. For example, the effects of marketing on vaping behavior may be mediated by the emergence of nicotine salt-based products with very high concentrations of nicotine, such as JUUL.³⁷ Whereas marketing may increase the likelihood that a young person tries an e-cigarette, nicotine delivery may promote the transition from experimental to regular use, as is the case for conventional cigarettes.^{22,23} To our knowledge, there were no other notable differences in the e-cigarette market across provinces, including e-cigarette products, or policies such as taxation. Finally, participants were not recruited using probability-based sampling; therefore, the findings do not

provide representative estimates. However, the same methodology was used across survey years, and the prevalence estimates are consistent with those from other national benchmark studies.³

CONCLUSIONS

Increased exposure to e-cigarette marketing in Canada is strongly associated with increases in youth vaping. With our findings, we provide empirical support for the effectiveness of more comprehensive regulatory restrictions that are being considered at the federal and provincial levels in Canada. Health Canada and each of the 10 provinces have proposed restrictions on e-cigarette marketing, including federal regulations that would align restrictions on e-cigarettes with those on tobacco products.³⁸ With the current findings, we highlight the importance of restrictions on newer forms of marketing, such as digital media, as well as traditional advertising channels, including the point-of-sale. The impact of such restrictions on e-cigarette use among adult smokers is unclear; however, it is notable that the prevalence of e-cigarette use among adult smokers

has changed very little over the same period in which advertising exposure and prevalence of use among young people have increased.⁶ Therefore, marketing restrictions may have a relatively greater impact on reducing youth use than discouraging adult smokers from using e-cigarettes.

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ABBREVIATIONS

AOR: adjusted odds ratio
CI: confidence interval
e-cigarette: electronic cigarette
ITC: International Tobacco Control Policy Evaluation Project
TVPA: *Tobacco and Vaping Products Act*

Data Sharing Statement: Deidentified individual participant data (including data dictionaries) will be made available, in addition to study protocols. The data will be made available upon publication to researchers who provide a methodologically sound proposal for use in achieving the goals of the approved proposal. Proposals should be submitted to Dr Hammond (dhammond@uwaterloo.ca).

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Address correspondence to David Hammond, PhD, School of Public Health and Health Systems, University of Waterloo, 200 University Ave W, Waterloo, ON, Canada N2L 3G1. E-mail: dhammond@uwaterloo.ca

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