Title: Prevalence and Correlates of Electronic Cigarette Use Among Canadian Students, 2014-15

Authors: Annie Montreuil, PhD[1,2], Marjorie MacDonald, PhD[3], Mark Asbridge, PhD[4], T. Cameron Wild, PhD[5], David Hammond, PhD[6], Steve Manske, EdD[7], Erin Rutherford, MSc[8]

Affiliations and addresses:
1 Institut national de santé publique du Québec, Montréal, Québec, Canada
2 Département de psychologie, Université du Québec à Montréal, Montréal, Québec, Canada
3 School of Nursing, University of Victoria, Victoria, British Columbia
4 Department of Community Health and Epidemiology, Dalhousie University, Halifax
5 School of Public Health, University of Alberta, Edmonton, Alberta
6 School of Public Health and Health Systems, University of Waterloo, Waterloo, Ontario
7 Propel Centre for Population Health Impact, University of Waterloo, Waterloo, Ontario
8 Health Canada, Ottawa, Ontario

Address correspondance to:
Annie Montreuil, Institut national de santé publique du Québec, 190 boul. Crémazie Est, Montréal, Québec, CANADA H2P 1E2, annie.montreuil@inspq.qc.ca, 514-864-1600, 3529.

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Abstract

Background: The past decade has seen a decline in tobacco smoking among youth, along with the introduction of e-cigarettes into the market. This study reports the first nationally generalizable data on the prevalence of e-cigarette use among grade 6-12 students in Canada, focusing on variations across provinces, sociodemographic variables and smoking related indicators.

Methods: 42,094 students participated in the 2014/2015 Canadian Student Tobacco, Alcohol and Drug Survey (CSTADS), a biennial, school-based survey administered to grades 6-12 students in all Canadian provinces. Logistic regression models were fitted to estimate the odds of ever and past 30-day e-cigarette use by sociodemographic variables and smoking related indicators.

Results: Data show that 18% of Canadian students reported ever using e-cigarettes and 6% past 30-day use. Substantial variations were observed across provinces. E-cigarette use was higher among males, students in grades 10-12, current and former smokers as well as never smokers susceptible to smoking, and students who tried other tobacco products, who perceived access to e-cigarette was easy and perceived no risk of harm from regular use.

Interpretation: These findings suggest that many Canadian students, including non-smokers, are trying e-cigarettes, despite the fact that nicotine e-cigarettes are not approved for sale in Canada.

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Introduction

The past decade has seen a decline in tobacco smoking among youth in many countries[1-3]. Over the same period, electronic cigarettes (e-cigarettes or vapour devices) were introduced into the market[4]. E-cigarettes are devices in which a liquid solution, which may contain flavours and/or nicotine, is heated to create an aerosol that is inhaled[5] mimicking the feel and experience of conventional cigarette smoking to a greater extent than other non-combustible delivery methods, such as patches, inhalers, and gum[6]. Lifetime use of e-cigarettes is common among teenagers in many countries, including the US, UK, France, and Poland; in the US, use has surpassed cigarette smoking[1, 7-9]. Concerns about e-cigarette use have led to fierce debate in the public health community, with advocates arguing that e-cigarettes have significant potential for harm reduction[6, 10] while others argue that e-cigarettes could be a gateway to conventional tobacco use among youth and may renormalize smoking[11, 12]. Most studies indicate that e-cigarette use primarily occurs among conventional cigarette smokers with few non-smokers engaging in regular e-cigarette use[7, 13-15]. However, a substantial number of young non-smokers try e-cigarettes, raising concerns about the possibility that e-cigarettes may be an initial step in the pathway to conventional smoking and other tobacco use. In addition, evidence suggests that e-cigarette use among never-smoking youth is related to susceptibility to future cigarette smoking[16] and initiation of combustible tobacco products[17, 18]. The evidence of a causal relationship, however, is limited[17, 19].

Long term trend data on e-cigarette use are limited and not yet available in Canada. In Quebec, ever and past 30-day use of e-cigarettes among students in grades 7-11 were 34% and 6% respectively in 2012-13[16]. Ever e-cigarette use among students grades 7-12 in Ontario was 15% in 2013 (14) and 10% in a 2015 study of grade 9 students in the Niagara region[20]. In comparison, in 2015, 16% of US high school students (grades 9-12) and 5% of middle school students (grades 6-8) reported using e-cigarettes in the past 30 days, a significant increase from 1.5% and 0.6% in 2011[1]. In the United Kingdom, lifetime rates of e-cigarette use ranged from 8% to 12% in 2013-14[15, 21-22] while more than monthly use ranged from 0.4 to 2%[23]. The literature on e-cigarette use in Canada is limited due to the absence of representative data among high and middle school students. Long term monitoring of e-cigarette and other tobacco product use is important for surveillance and public health. To this end, Health Canada's Canadian Student Tobacco Alcohol and Drug Survey (CSTADS)[24] included questions on e-cigarette use beginning in the 2014/2015 cycle. Drawing on these data, we report the first available nationally generalizable data on e-cigarette use among Canadian students in grades 6 to 12. Our aim is to: 1) describe the prevalence of e-cigarette use across the country, focusing on variations across sociodemographic variables, tobacco use, susceptibility to smoking, perceptions of access and perceptions of risk of harm from using e-cigarettes; 2) examine to what extent these factors are associated with e-cigarette use.

Methods

Study Design

CSTADS is a biennial, provincially-generalizable, paper-and-pencil, school-based survey administered to students across Canada (www.cstads.ca). The target population for 2014/2015 CSTADS was Canadian students in grades 6-12 (grades 6 to secondary 5 in Quebec) attending private, public, and Catholic schools in all 10 Canadian provinces, excluding schools in the three territories. A generalizable sample was achieved at the national and provincial levels, with the exception of New Brunswick due to a low response rate. However, national estimates do include data from participating New Brunswick schools.

A stratified single stage cluster design with strata based on health region smoking rate and type of school was employed. In each province, two or three health region smoking rate strata and two school-level

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strata were defined. Schools were randomly selected within each stratum to ensure a generalizable sample within each province.

A total of 336 schools from 128 school boards (47% of eligible schools approached) and 42,094 students (66% of eligible students approached) were successfully recruited. The survey was administered by teachers in classrooms between October 2014 and May 2015. Questionnaires were available in English and French.

Ethics approval was obtained from the Health Canada Research Ethics Board, the Office of Research Ethics at the University of Waterloo, and from ethics review boards located at institutions and school boards in each province. Depending on school board requirements, parents/guardians provided active permission or active information-passive permission for their child to participate. Students with parental permission were invited to participate on the survey implementation day, and were provided an opportunity to refuse participation.

Measures

The primary outcome measures of interest were self-reported ever and past 30-day e-cigarette use. Other measures included ever use and past 30-day use of other tobacco products, ethnicity, socioeconomic status (SES) of school neighbourhood, current smoking status, perceived risk of harm associated with e-cigarette use on a regular basis, perceived ease of access to e-cigarettes, and susceptibility to use cigarettes. These measures are defined in Table 1. Sociodemographic variables of gender (male, female), grade (6-12; grades 6 to secondary 5 in Quebec), province of residence, and school location (urban, rural) were also analysed.

Table 1: Measures used in this study

Measure	Definition
Ever use of e-cigarettes	Have you ever tried any of the following? Using e-cigarettes (electronic cigarettes). *Response options* – yes or no
Past 30-day use of e-cigarettes	In the last 30 days, did you use any of the following? E-cigarettes (electronic cigarettes). *Response options* – yes or no.
Ever use of other tobacco products	Have you ever tried any of the following? Smoking little cigars or cigarillos (plain or flavoured); Smoking cigars (not including little cigars or cigarillos, plain or flavoured); Smoking roll-your-own cigarettes (tobacco only, in rolling papers); Smoking bidis (little cigarettes hand-rolled in leaves, tied with string at the ends, and may come in different flavours); Using smokeless tobacco (chewing tobacco, pinch, snuff, or snus); Using a water-pipe (hookah) to smoke sheesha (herbal or tobacco); Using blunt wraps (a tube made of tobacco used to roll cigarette tobacco). *Response options* – yes or no for each product. Students who answered yes for at least one of the products were considered having made use of other tobacco products.
Past 30-day use of other tobacco products	In the past 30 days, have you used any of the following? (same as above)
Ethnicity	How would you describe yourself? *Response options* - White, Black, West Asian/Arab, South Asian (Indian, …), East/Southeast Asian (Chinese, ...), Latin American/Hispanic, Aboriginal (First Nations, Métis, Inuit, …), Other. West Asian/Arab, South Asian and East/Southeast Asian were combined into Asian.
Socioeconomic status	Median household income drawn from the 2011 Canadian Census, and based

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(SES) of school neighbourhood	on the geographic forward sortation area (first three digits of the postal code) where the school is located. Divided into tertiles by province and categorized into low, middle, high.
Smoking status	Assessed based on responses to two questions: Have you ever smoked 100 or more whole cigarettes in your life? *Response options* – Yes or No. On how many of the last 30 days did you smoke one or more cigarettes? *Response options* – None; 1 day; 2 to 3 days; 4 to 5 days; 6 to 10 days; 11 to 20 days; 21 to 29 days; 30 days (every day). Current Smoker: Respondents who reported smoking at least 100 cigarettes in his or her lifetime, and who reported smoking at least one whole cigarette during the past 30 days. Former Smoker: Respondents who reported smoking at least 100 cigarettes in his of her lifetime, but not in the past 30 days. Never Smoker: Respondents who reported not smoking 100 or more whole cigarettes in his or her lifetime but might have smoked a whole cigarette.
Perceived risk of harm associated with e-cigarette use	How much do you think people risk harming themselves when they do each of the following activities? Use an e-cigarette (electronic cigarette) on a regular basis. *Response options* - No risk, Slight risk, Moderate risk, Great risk, I do not know
Perceived ease of access to e-cigarettes	How difficult do you think it would be for you to get an e-cigarette (electronic cigarette)? *Response options* - very difficult, fairly difficult, fairly easy, very easy, I do not know
Susceptibility to smoking cigarettes	Assessed among students who never had a puff of cigarette in their lifetime, using three questions: (1) Do you think in the future you might try smoking cigarettes? (2) If one of your best friends was to offer you a cigarette, would you smoke it? (3) At any time during the next year do you think you will smoke a cigarette? *Response options* - Definitely yes, Probably yes, Probably not, Definitely not. Students who answered "Definitely not" to all three questions were considered not susceptible to smoking cigarettes in the future. All other students were considered susceptible to smoking cigarettes.

Statistical Analyses

Descriptive statistics were used to estimate the weighted prevalence of ever and past 30-day e-cigarette use across sociodemographic indicators, other tobacco product use, smoking status, smoking susceptibility, ease of access to e-cigarettes, and perceived harm.

Unadjusted logistic regression models were fitted to estimate the odds of ever and past 30-day e-cigarette use by sociodemographic variables, current smoking status, perceived harm associated with e-cigarette use, ever use of other tobacco products, and perceived ease of access to e-cigarettes. Adjusted logistic regression models were also fitted and included the same variables as covariates. ORs shown are respectively unadjusted and adjusted odds ratios with 95% confidence intervals.

Survey weights were used to adjust for sample selection (school and class levels), non-response (school, class, and student levels), and post-stratification of the sample population relative to grade and sex distribution in the total population. Bootstrap weights were used for confidence interval calculation of

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the prevalence estimates and all regression analyses to account for survey design effects on variance estimates.

Results

Table 2 presents prevalence estimates for ever use and past 30-day use of e-cigarettes among Canadian students by socio-demographics and smoking related indicators. Table 3 presents bivariate logistic regression analyses of the socio-demographic and smoking related indicators on ever and past 30-day use.

Ever use and past 30-day use of e-cigarettes

In Canada, 17.7% of students in grades 6- 12 reported ever using e-cigarettes, which represents approximately 441,900 students (Table 2). Past 30-day use was reported by 5.7% of these students (142,900). Ever and past 30-day e-cigarette use was higher among males than females, and among grades 10-12. Reports of ever use and past 30-day use were the highest among students self-identifying as Aboriginal and the lowest among those identifying as Asian. Ever e-cigarette use was higher among rural than urban students but no geographic differences were observed for past 30-day use. The rate of ever and past 30-day use was higher in schools located in lower than middle income neighbourhoods.

Regionally, ever and past 30-day use of e-cigarettes varied considerably across provinces, with the highest rates of ever use observed in Newfoundland and Labrador (26.3%) and Quebec (24.1%), and the lowest rates in Ontario (14.1%) and Alberta (15.1%). Past 30-day use was also highest in Newfoundland and Labrador (13.3%), although the next highest rates were found in Prince Edward Island (9.8%). Similar to ever use, Ontario and Alberta had the lowest rates of past 30-day use at 4.3% and 4.8% respectively.

A majority of current (75.7%) and former cigarette smokers (77.6%) reported ever use of e-cigarettes while ever use was lower among susceptible never smokers (16%) and among non-susceptible never smokers (5.1%). Whereas current and former smokers reported similar rates of ever use, a different pattern was found for past 30-day use; former smokers (20.4%) reported lower rates of past 30-day e-cigarette use than current smokers (46.6%). Among susceptible non-cigarette smokers, only 3.6% reported past 30-day e-cigarette use, while only 0.9% of non-susceptible non-smokers had used e-cigarettes in the past 30 days; however, susceptible never smokers were more likely to have used e-cigarettes in their lifetime and in the past 30 days than non-susceptible never smokers.

E-cigarette use was also common among users of other tobacco products (61.5% ever use; 27.7% past 30-day use). Respondents who perceived access to e-cigarettes to be fairly easy or very easy reported higher rates of use compared to those who felt access was fairly difficult or very difficult. Perceptions that e-cigarettes are easy to obtain increased by student grade, with 11.5% of grade 6 students perceiving e-cigarettes as easy to obtain compared to 70.2% in grade 12 (data not shown). Finally, ever use of e-cigarettes was inversely related to perceived risk of harm from regular e-cigarette use. More than 40% of those perceiving no risk reported e-cigarette ever use while only 6.7% of those perceiving great risk reported ever use. A similar pattern of results for past 30-day use was found with respect to perceived ease of access and perceptions of harm.

Table 2. Use of e-cigarettes by sociodemographic variables among Canadian students, by province and smoking status, 2014/2015 CSTADS

	Ever used e-cigarettes	Used e-cigarettes in the past 30 days
	% (95% CI)	% (95% CI)

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	Ever used e-cigarettes	Used e-cigarettes in the past 30 days
	% (95% CI)	% (95% CI)
Canada	17.7 (16.4, 18.9)	5.7 (5.2, 6.3)
Gender		
Female	14.7 (13.5, 16.0)	4.4 (3.8, 5.1)
Male	20.4 (18.8, 22.0)	7.0 (6.1, 7.8)
Grade		
6	2.5 (1.8, 3.3)	#
7	6.3 (5.1, 7.6)	1.7 (1.1, 2.3) †
8	12.6 (10.6, 14.6)	4.2 (3.0, 5.3)
9	17.6 (15.1, 20.0)	5.7 (4.4, 7.0)
10	22.8 (19.4, 26.3)	8.1 (6.5, 9.8)
11	28.8 (26.2, 31.4)	9.9 (8.2, 11.7)
12	29.7 (26.4, 33.1)	8.7 (7.0, 10.3)
6-9	10.1 (8.9, 11.2)	3.2 (2.5, 3.8)
10-12	27.1 (24.8, 29.3)	8.9 (7.9, 9.9)
Ethnicity		
White	19.6 (17.8, 21.4)	6.2 (5.5, 7.0)
Black	18.2 (14.8, 21.5)	6.6 (4.5, 8.7)
Asian	10.2 (8.3, 12.1)	3.3 (2.5, 4.1)
Aboriginal	30.4 (27.4, 33.4)	11.7 (9.4, 14.1)
Latin	22.2 (16.9, 27.5)	8.1 (5.8, 10.5)
Other	15.9 (13.6, 18.2)	4.6 (3.4, 5.9)
Urban Location of School		
Yes	16.4 (14.7, 18.2)	5.4 (4.7, 6.2)
No	22.4 (18.8, 26.1)	7.0 (5.5, 8.4)
SES of school neighbourhood		
Low	20.2 (17.0, 23.3)	6.7 (5.0, 8.3)
Middle	15.2 (12.4, 18.0)	4.5 (3.4, 5.5)
High	18.0 (15.0, 20.9)	6.2 (5.2, 7.1)
Province[1]		
NL	26.3 (23.6, 29.1)	13.3 (9.9, 16.7)
PE	21.7 (19.5, 23.9)	9.8 (8.3, 11.3)
NS	20.0 (18.3, 21.7)	8.2 (6.7, 9.7)
QC	24.1 (20.8, 27.4)	6.8 (4.8, 8.9)
ON	14.1 (11.9, 16.3)	4.3 (3.4, 5.1)
MB	18.5 (16.2, 20.8)	9.2 (6.8, 11.7)

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	Ever used e-cigarettes	Used e-cigarettes in the past 30 days
	% (95% CI)	% (95% CI)
SK	20.3 (16.0, 24.5)	8.2 (6.2, 10.1)
AB	15.1 (12.6, 17.5)	4.8 (3.4, 6.1)
BC	19.2 (16.2, 22.2)	7.1 (5.8, 8.4)
Smoking Status		
Current Smoker	75.7 (70.7, 80.8)	46.6 (39.3, 53.9)
Former Smoker	77.6 (68.7, 86.5)	20.4 (11.8, 28.9)
Never smoker - susceptible	15.9 (14.2, 17.6)	3.6 (3.0, 4.3)
Never smoker – not susceptible	5.1 (4.5, 5.6)	0.9 (0.7, 1.1)
Tried other tobacco products		
Little cigars or cigarillos	69.0 (66.4, 71.6)	28.9 (26.2, 31.7)
Water-pipe	67.5 (63.7, 71.4)	29.6 (26.6, 32.7)
Smokeless	73.8 (70.5, 77.2)	36.4 (32.8, 40.1)
Any tobacco product other than cigarettes	61.5 (59.0, 63.8)	23.7 (21.6, 25.8)
Perceived ease of access to e-cigs		
Very or fairly easy	32.9 (30.9, 34.9)	10.8 (9.8, 11.9)
Very or fairly difficult	5.2 (4.6, 5.9)	1.2 (1.0, 1.5)
Perceived risk of harm from using an e-cigarette on a regular basis		
Great risk	6.7 (5.9, 7.6)	1.9 (1.5, 2.4)
Moderate risk	15.4 (13.8, 17.0)	4.1 (3.5, 4.8)
Slight risk	31.3 (29.0, 33.5)	9.6 (8.3, 10.8)
No risk	40.5 (37.4, 43.5)	15.9 (14.1, 17.7)
Don't know	6.3 (5.1, 7.5)	2.2 (1.6, 2.9)

Data are suppressed due to unacceptable data quality due to high variability or low numbers.

† Moderate sampling variability, interpret with caution.

[1] *The 2014/2015 CSTADS does not include a generalizable sample of students in the province of New Brunswick. As a result, New Brunswick student data cannot be used to produce provincial estimates for New Brunswick*

Table 3. Bivariate logistic regression of ever use and past 30-day use of e-cigarettes on sociodemographic and smoking related indicators among Canadian students, 2014/2015 CSTADS

	Ever use of e-cigarettes		Past 30-day use of e-cigarettes	
	OR and 95% CI	P	OR and 95% CI	P
Sex				
Male (reference)	1.00	-	1.00	-
Female	0.67 (0.58- 0.79)	<0.001*	0.62 (0.51-0.76)	<0.001*
Grade				
6 to 9 (reference)	1.00	-	1.00	-

10 to 12	3.31 (2.78-3.95)	<0.001*	3.00 (2.20-4.07)	<0.001*
Ethnicity				
White (reference)	1.00	-	1.00	-
Black	0.91 (0.71, 1.18)	0.474	1.06 (0.75, 1.51)	0.730
Asian	0.47 (0.36, 0.61)	<0.001*	0.51 (0.38, 0.69)	<0.001*
Aboriginal	1.79 (1.49, 2.15)	<0.001*	2.01 (1.58, 2.57)	<0.001*
Latin	1.17 (0.82, 1.68)	0.386	1.34 (0.97, 1.84)	0.075
Other	0.78 (0.61, 1.00)	0.048*	0.74 (0.53, 1.02)	0.069
Urban v. Rural				
Urban (reference)	1.00	-	1.00	-
Rural	1.47 (1.06-2.04)	0.023*	1.31 (0.94-1.82)	0.112
Income				
Middle (reference)	1.00	-	1.00	-
Low	1.41 (1.02-1.95)	0.035*	1.53 (1.07-2.19)	0.021*
High	1.22 (0.76-1.98)	0.408	1.41 (0.96-2.08)	0.078
Province				
ON (reference)	1.00	-	1.00	-
AB	1.08 (0.81-1.44)	0.592	1.13 (0.74-1.71)	0.575
BC	1.45 (1.08-1.95)	0.014*	1.72 (1.27-2.32)	<0.001*
MB	1.38 (1.03-1.86)	0.032*	2.29 (1.49-3.53)	<0.001*
NL	2.18 (1.72-2.75)	<0.001*	3.45 (2.40-4.97)	<0.001*
NS	1.52 (1.21-1.91)	<0.001*	2.00 (1.51-2.65)	<0.001*
PE	1.69 (1.33-2.14)	<0.001*	2.44 (1.85-3.22)	<0.001*
QC	1.93 (1.42-2.64)	<0.001*	1.65 (1.02-2.66)	0.040*
SK	1.55 (1.07-2.25)	0.022*	2.00 (1.40-2.87)	<0.001*
Smoker status/susceptibility				
Not susceptible (reference)	1.00	-	1.00	-
Never smoked susceptible	3.55 (3.04-4.15)	<0.001*	4.09 (3.09-5.41)	<0.001*
Former smoker	64.9 (37.8-111.4)	<0.001*	27.7 (13.6-56.3)	<0.001*
Current smoker	57.4 (43.8-77.9)	<0.001*	94.3 (66.8-133.1)	<0.001*
Tried other tobacco products				
No (reference)	1.00	-	1.00	-
Yes	20.0 (17.4-23.0)	<0.001*	19.57 (16.2-23.6)	<0.001*
Perceived easy access to e-cig				
No (reference)	1.00	-	1.00	-
Yes	8.93 (7.67-10.4)	<0.001*	9.99 (7.93-12.6)	<0.001*
Perceived Risk (regular use)				
No risk (reference)	1.00	-	1.00	-
Slight risk	0.67 (0.59-0.76)	<0.001*	0.56 (0.46-0.68)	<0.001*
Moderate risk	0.27 (0.23-0.31)	<0.001*	0.23 (0.19-0.28)	<0.001*
Great risk	0.11 (0.09-0.13)	<0.001*	0.10 (0.07-0.15)	<0.001*
Don't know	0.10 (0.08-0.13)	<0.001*	0.12 (0.09-0.17)	<0.001*

*statistically significant p<0.05

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Factors associated with ever use and past 30-day use of e-cigarettes

Table 4 presents results of multivariable logistic regression analyses of socio-demographic and smoking related indicators on ever use and past 30-day use of e-cigarettes. When other predictors are considered, female students were less likely to use e-cigarettes than males. The odds of ever use was significantly higher among students in grades 10-12 compared to those in grades 6-9. Students identifying as Asian origin were less likely than White students to report ever use. As with the descriptive findings, there is considerable variation in the use of e-cigarettes among provinces. Relative to students in Ontario, the odds of e-cigarette ever use was significantly higher in British Columbia, Newfoundland and Labrador, Quebec, and Saskatchewan. For past 30-day e-cigarette use, the odds of use were significantly higher among students in British Columbia, Manitoba, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and Quebec. Ever use and past 30-day use was higher among students attending schools located in high SES areas compared to medium SES areas. No significant differences were observed for rural-urban school settings.

Compared with not susceptible never smokers, susceptible never smokers had double the odds of having ever used e-cigarettes or to have used them in the past 30 days; former smokers were 13 times more likely to have tried e-cigarettes and had a three-fold increased odds of past 30-day use; current smokers were seven times more likely to have ever tried e-cigarettes, and 13 times more likely to have used them in the past 30 days. Students who perceive that regular use of e-cigarette comes with moderate or great risk were less likely to use e-cigarettes than students who perceive no risk. Students who tried other tobacco products were more likely to have ever used e-cigarettes or to have used them in the past 30 days than students who did not try other tobacco products. Finally, the perception that it is easy to obtain e-cigarettes is associated with a higher likelihood of having tried e-cigarettes or having used them in the past 30 days.

Table 4. Multivariable logistic regression of ever use and past 30-day use of e-cigarettes on sociodemographic and smoking related indicators among Canadian students, 2014/2015 CSTADS

Variables	Ever use of e-cigarettes		Past 30-day use of e-cigarettes	
	OR and 95% CI	P	OR and 95% CI	P
Sex				
Male (reference)	1.00		1.00	
Female	0.73 (0.60-0.89)	0.002*	0.65 (0.51-0.84)	0.001*
Grade				
6 to 9 (reference)	1.00		1.00	
10 to 12	1.25 (1.03-1.51)	0.022*	0.87 (0.64-1.18)	0.371
Ethnicity				
White (reference)	1.00	-	1.00	-
Black	1.01 (0.62-1.65)	0.960	0.95 (0.50-1.81)	0.884
Asian	0.64 (0.48-0.85)	0.002*	0.74 (0.41-1.35)	0.329
Aboriginal	1.07 (0.74-1.54)	0.724	0.93 (0.50-1.71)	0.812
Latin	0.76 (0.36-1.63)	0.483	0.69 (0.22-2.16)	0.523
Other	1.22 (0.87-1.73)	0.251	1.08 (0.54-2.14)	0.832
Urban v. Rural				
Urban (reference)	1.00	-	1.00	-
Rural	0.85 (0.63-1.13)	0.255	0.80 (0.47-1.37)	0.413

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Income				
Middle (reference)	1.00	-	1.00	-
Low	1.25 (0.99-1.59)	0.066	1.09 (0.67-1.77)	0.737
High	1.24 (1.04-1.49)	0.019*	1.63 (1.19-2.23)	0.002*
Province				
ON (reference)	1.00		1.00	-
AB	1.31 (0.97-1.77)	0.082	1.36 (0.78-2.37)	0.283
BC	1.67 (1.30-2.14)	<0.001*	2.49 (1.62-3.83)	<0.001*
MB	1.21 (0.87-1.69)	0.264	2.62 (1.58-4.34)	0.002
NL	2.17 (1.59-2.98)	<0.001*	3.77 (2.15-6.62)	<0.001*
NS	1.23 (0.96-1.58)	0.103	1.78 (1.16-2.74)	0.009*
PE	1.24 (0.89-1.74)	0.203	1.86 (1.11-3.10)	0.018*
QC	2.77 (2.12-3.61)	<0.001*	1.98 (0.99-3.97)	0.053
SK	1.36 (1.01-1.82)	0.040*	1.68 (0.82-3.43)	0.158
Smoker status/susceptibility				
Not susceptible (reference)	1.00	-	1.00	-
Never smoked susceptible	2.14 (1.75-2.61)	<0.001*	2.28 (1.65-3.16)	<0.001*
Former smoker	13.2 (4.64-37.5)	<0.001*	3.36 (1.32-8.52)	0.011*
Current smoker	6.57 (3.99-10.8)	<0.001*	13.2 (7.21-24.3)	<0.001*
Tried other tobacco products				
No (reference)	1.00	-	1.00	-
Yes	5.94 (4.27-8.26)	<0.001*	4.35 (2.63-7.20)	<0.001*
Perceived easy access to e-cig				
No (reference)	1.00	-	1.00	-
Yes	5.24 (4.24-6.20)	<0.001*	5.28 (3.82-7.28)	<0.001*
Perceived Risk (regular use)				
No risk (reference)	1.00	-	1.00	-
Slight risk	0.63 (0.49-0.80)	0.002*	0.70 (0.46-1.06)	0.091
Moderate risk	0.31 (0.24-0.40)	<0.001*	0.48 (0.33-0.71)	<0.001*
Great risk	0.15 (0.09-0.23)	<0.001*	0.26 (0.16-0.40)	<0.001*
Don't know	0.16 (0.12-0.23)	<0.001*	0.22 (0.11-0.44)	<0.001*

*statistically significant p<0.05

Discussion

This study provides the first national estimates of the prevalence of e-cigarette use among grade 6-12 students in Canada. It reveals that 18% of students have ever tried an e-cigarette and 6% used it in the past 30 days, corresponding respectively to approximately 441,900 and 142,900 students. These rates are similar to the proportion of students who report smoking cigarettes in their lifetime (17.6%, 447 000) or in the past 30 days (6.3%; 158 900). The Canadian Tobacco, Alcohol and Drugs Survey, based on telephone interviews among participants 15 years and older, is the only other national level data against which to compare these results[25]. E-cigarette prevalence among CTADS participants aged 15-19 in 2015 was 26% for ever use and 6% for past 30-day use, an increase from 2013 (respectively 20% and 3%). The rate observed in our study among the same age range students (grades 10-12) is similar for ever use (27%) but slightly higher for past 30-day use at 9%. Rates of past 30-day use are higher in the US (16% of high school students and 5% of middle school students in 2015)[1] and lower in the UK (2% of 11-18 years old in 2014[15] and 3% of 15-year-olds in Scotland[21]). International comparisons should be made with

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caution because timing of surveys may vary, age range may differ, and different designs may not allow comparisons, but overall e-cigarette use among students in Canada appears to be higher than in the UK and lower than in the US.

Substantial variations were observed across provinces, with the lowest rate found in Ontario. Reasons for these provincial differences are unknown. Consistent with the literature, use of e-cigarettes is much higher among current and former smokers than among never smokers[26], although young smokers are less likely than older smokers to report using e-cigarettes to quit smoking[13, 27-28]. A recent study in Ontario's Niagara region found that only 6% of adolescents reported using them for reduction or cessation of smoking[20]. Ever use among never smokers is not marginal, with 16% of susceptible never smokers and 5% of non-susceptible never smokers reporting ever use of e-cigarettes while past 30-day use is considerably lower among never smokers. Consistent with other studies, use is more prevalent among males[1, 13-14, 20], users of other tobacco products such as little cigars, water-pipes and smokeless tobacco[16, 29], users of alcohol and marijuana[10], and students who perceive access is easy[13]. Use is less prevalent among students who perceive they risk harming themselves by using e-cigarettes[13].

This study has several limitations. First, results do not indicate the proportions of students who used e-cigarettes with and without nicotine. This was not assessed in the questionnaire because: (1) at the time of data collection, e-cigarettes with nicotine, although widely available, had not been approved to be legally sold on the Canadian market; (2) labelling of nicotine content on e-cigarettes has been shown to be inaccurate[30-31]. Second, our results are not representative of young people who do not attend school, live in institutions, attend school on First Nations reserves, or who attend special schools or schools located on military bases. These young people may be more likely to smoke cigarettes, use other tobacco products and possibly e-cigarettes than students sampled for CSTADS. Finally, cross-sectional results do not allow the inference of causal relationships between e-cigarette use and factors associated with use.

In conclusion, there is still debate and uncertainty surrounding the role of e-cigarettes as a gateway to smoking; our cross-sectional study cannot be used to inform this debate. However, the first representative data on e-cigarette use among students collected across Canada suggests that many young people, smokers and non-smokers, are trying e-cigarettes despite the fact that e-cigarettes containing nicotine are not approved for sale in Canada. Since these data were collected in 2014-15, e-cigarette legislation has been implemented in many provinces, banning sales to minors, promotion and advertising, and use where smoking is prohibited. Such legislation is likely to decrease perceptions that e-cigarettes are easily accessible. Announced upcoming changes in Canadian legislation, such as regulation of e-cigarette products, plain packaging of tobacco products and marijuana legalization are also likely to change perception of risk associated with e-cigarette use. Biennial CSTADS will be a useful tool to monitor e-cigarette use, access and perception among students across Canada in the coming years as major changes are expected in the regulation of psychoactive substances that appeal to youth.

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