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Research

Under the influence: examination of prevalence and correlates of alcohol and marijuana consumption in relation to youth driving and passenger behaviours in Canada. A cross-sectional study

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Abstract

Background: Consequences of alcohol- and drug-impaired driving affect youth disproportionately. We describe individual- and area-level characteristics associated with risky driving and passenger behaviours among grade 9–12 students in Canada.

Methods: The 2014–2015 Canadian Student Tobacco, Alcohol and Drug Survey was administered to 24 650 students in provincially generalizable samples. Dichotomous outcomes included ever and last-30-day driving after drinking alcohol, ever and last-30-day driving after using marijuana, and ever and last-30-day reporting of being a passenger with a driver who had been drinking or using marijuana.

Results: A total of 9.1% (99% confidence interval 7.9–10.3) of grade 11–12 students reported ever driving after drinking, and 9.4% (99% confidence interval 8.3–10.4) reported ever driving after using marijuana. Almost half (48%) of grade 11–12 students reported ever participating in any risky driving or passenger behaviour. Over one-third (35%) of grade 9–12 students reported ever riding with a driver who had been drinking, and 20% reported ever riding with a driver who had been using marijuana. Logistic regression models showed that boys had higher odds of risky driving behaviours relative to girls, whereas girls had higher odds of risky passenger behaviours relative to boys. Students from rural schools had higher odds of drinking and driving and of riding with a driver who had drunk relative to students from urban schools. There were significant differences in risky driving and passenger behaviours by province.

Interpretation: A substantial number of Canadian youth reported risky driving and passenger behaviours, which varied by individual and area-level characteristics. Federal marijuana policy should aim to reduce the prevalence of drug-impaired driving. Additional provincial policies to prevent impaired driving are needed.

Unintentional injuries are the leading cause of death among Canadians aged 1–24 years, being responsible for 35% of deaths in this age group.[1–3] Traffic collisions account for a high proportion of accident-related deaths and injuries and place a substantial burden on the health care system.[4] Young drivers are at higher risk for collision-related mortality than drivers in other age groups,[5] and 39% of car-crash deaths among 16- to 19-year-olds were related to alcohol in 2012.[6]

Alcohol is the most common intoxicant in Canada,[7] and the link between alcohol-impaired driving and high collision rates is well recognized.[8,9] Less frequently studied are adolescents' decisions to ride with impaired drivers. In 2008, 15% of Canadians aged 15–17 years rode with an alcohol-impaired driver, and 19% rode with a cannabis-impaired driver.[10] In 2009–2010, about 20% of grade 6–10 Canadian students rode with a driver who had consumed alcohol, cannabis or other drugs in the previous 30 days.[11] Younger age (9–15 yr), male sex, heavy drinking, lower socioeconomic status and rural residence are associated with riding with an impaired driver.[10–13]

Cannabis is second most commonly used intoxicant in Canada:[14] 17% of Canadian youth reported cannabis use in 2014–2015.[7] Cannabis-impaired driving has recently come to the fore given the Canadian government's plan to legalize the possession and sale of marijuana to adults. Proposed legislation to reduce drug-impaired driving was tabled in October 2016 in the Canadian Senate,[15] and, in the absence of current federal law, Canadian provinces have begun to introduce leg-

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islation to address drug-impaired driving and create heavier sanctions.[16] Debate exists regarding the extent to which driving under the influence of cannabis causes motor vehicle fatalities.[17–21] In Ontario in 2015, 12% of grade 7–12 students rode with a driver who had used drugs, including cannabis, at least once in the previous year.[22]

In light of the impending legalization of cannabis in Canada, we aimed to determine what individual and area-level characteristics are associated with risky driving and passenger behaviours among grade 9–12 students in Canada.

Methods

Design

The Canadian Student Tobacco, Alcohol and Drugs Survey is a biennial, provincially generalizable, paper-and-pencil, school-based survey administered to students across Canada.[7] The survey uses a stratified single-stage cluster design; strata are based on the rate of cigarette smoking in the health region and type of school. In each province, 2 or 3 smoking rate strata and 2 school-level strata (elementary and high school) are defined. Schools are randomly selected within each stratum to ensure a generalizable sample within each province. The 2014–2015 survey wave did not include a generalizable sample of students in New Brunswick owing to a low response rate. National estimates include data from the 3 New Brunswick schools that participated.

Setting

The survey was conducted in private, public and Catholic schools attended by grade 6–12 students (6 to secondary V in Quebec) in all 10 provinces. Data were collected between October 2014 and May 2015.

Participants

Within each participating school, all students in eligible grades (6–12) were invited to participate in the survey. Schools and school boards determined permission protocols. About 66% of students participated with active information–passive permission, and 34% participated with active parental permission. Sample size was based on the ability of the sample to provide generalizable estimates at the provincial level.

Measures

Dichotomous outcomes from the survey included ever and previous-30-day experiences of 1) driving within 1 hour of drinking alcohol, 2) driving within 2 hours of using marijuana, 3) being a passenger in a vehicle driven by someone who had consumed alcohol within the previous hour and 4) being a passenger in a vehicle driven by someone who had used marijuana in the previous 2 hours. The first 2 outcomes were derived from survey responses to the question "Have you driven a vehicle (e.g., car, snowmobile, motor boat or all-terrain vehicle) within an hour of drinking one or more drinks of alcohol, or within 2 hours of using marijuana?" Response options included "No, never," "Yes, in the last 30 days" and "Yes, more than 30 days ago." Outcomes 3 and 4 were derived from survey responses to the question "Have you ever been a passenger in a vehicle (e.g., car, snowmobile, motor boat, or all-terrain vehicle) a) driven by someone who had 1 or more drinks of alcohol in the last hour? and b) driven by someone who had been using marijuana in the last 2 hours?," with the same response options as above. For all 4 outcomes of interest, we created dichotomous variables to assess "Ever" (those responding with either "yes" option) and "Last 30 days" (those responding "Yes, in the last 30 days") driving and passenger behaviours.

Independent variables included respondents' sex (female, male), grade (9–12 [age 13–18 yr in Canada]), province of residence (with Ontario as the reference province, given that it is the most populous province in Canada), binge drinking behaviours among students who reported consuming alcohol (drinking but never binge drinking [drinking at least 5 drinks on 1 occasion] and ever binge drinking) and race/ethnicity (white, black, Asian, Aboriginal, Latin American or other).

We examined 2 area-level independent variables: school-region socioeconomic status and rural versus urban school location. The median family income of the school's forward sortation area (first 3 digits of the postal code) from the 2011 census was dichotomized at the provincial median and was treated as a dichotomous variable (high and low socioeconomic status). Urban and rural categories were based on Statistics Canada's Statistical Area Classification system and were derived from school postal codes. Urban areas were considered census metropolitan areas (total population of at least 100 000, of whom 50 000 live in the core) or census agglomerations (core population of at least 10 000), which are areas consisting of at least 1 neighbouring municipality situated around a core.[23] Rural areas were considered noncensus metropolitan areas or census agglomerations. We adopted these definitions of socioeconomic status and urban versus rural locale since they are in the survey's public use microdata file (Vicki Rynard, Propel Centre for Population Health Impact, Waterloo, Ont.: personal communication, 2015).

Statistical analysis

In Canada, adolescents can operate a motor vehicle on their own between 16 and 17 years of age (Appendix 1, available at www.cmajopen.ca/content/5/2/E386/suppl/DC1), which generally corresponds to the age of grade 11 students. Therefore, in the absence of drivers' licence data, we restricted analyses to grade 11–12 students for driving outcomes and included grade 9–12 students in analyses examining passenger outcomes.

We used survey weights to adjust for sample selection, nonresponse (school, grade and student levels) and calibration of the sample to the grade and sex distribution of the target population. We used bootstrap weights for all analyses to account for survey design effects on variance estimates. One important effect of using the bootstrap weights is the adjustment of estimate and model variances for clustering within schools. Consequently, similar adjustment of models by entering schools as random effects is not necessary.

We used descriptive statistics to show the weighted prevalence of driving and passenger outcomes of interest according to the independent variables listed above. We produced weighted logistic regression models to examine independent variables associated with ever and last-30-day driving after

drinking, driving after using marijuana, riding with a driver who had drunk and riding with a driver who had used marijuana. Covariates for each model included respondents' sex, grade, ethnicity, drinking behaviours, school-level socioeconomic status and school-level urban versus rural locale. We conducted logistic regression analyses with bootstrap weight adjustment for clustering within schools using PROC SURVEYLOGISTIC in SAS version 9.4 (SAS Institute).

Ethics approval

The study received ethics approval from the Health Canada Research Ethics Board, the Office of Research Ethics at the University of Waterloo and ethics review boards located at the institutions and school boards in each province.

Results

A total of 177 school boards (68% of those approached), 336 schools (47% of those approached) and 24 650 grade 9–12 students (66% recruitment rate) participated in the Canadian Student Tobacco, Alcohol and Drugs Survey. Although reasons for nonparticipation varied, school boards reported participation in other research as their primary reason not to participate in the survey, and schools reported being "too busy" to participate as their primary reason for nonresponse. Student nonparticipation is primarily influenced by the parental permission protocol used at the school. There is a higher nonparticipation rate in schools requiring active permission methods in comparison to active information–passive permission methods. For each outcome variable, less than 5% of data were missing (range 2.6% [driving after drinking] to 3.6% [driving after cannabis use]).

Table 1 presents sample characteristics. Overall, 9.1% of Canadian grade 11–12 students reported ever driving within an hour of drinking at least 1 drink (Table 2). A similar proportion (9.4%) reported ever driving within 2 hours of using marijuana (Table 3). A total of 34.6% of grade 9–12 students reported ever being passengers of a driver who had had at least 1 drink within the previous hour (Table 4), and 19.8% reported ever riding with a driver who had used marijuana within the previous 2 hours (Table 5). The prevalence of ever driving after drinking ranged from a low of 6.3% in Ontario to a high of 18.5% in Saskatchewan, and the prevalence of ever driving after using marijuana ranged from a low of 6.9% in Quebec to 20.0% in Saskatchewan.

In the overall sample, 48.1% of grade 11–12 students (representing 351 900 students [weighted Canadian population estimate]) reported ever engaging in any risky driving or passenger behaviours: 25.5% (representing 186 400 students) reported engaging in 1 behaviour, and 22.6% (representing 165 600 students) reported engaging in more than 1 behaviour.

Girls had lower odds than boys of ever driving after drinking (odds ratio [OR] 0.477, 99% confidence interval [CI] 0.290–0.786) or after using marijuana (last 30 days OR 0.448, 99% CI 0.240–0.834; ever OR 0.517, 99% CI 0.333–0.805). Conversely, compared to boys, girls had higher odds of ever riding with a driver who had drunk in the previous hour (OR 1.337, 99% CI 1.159–1.543).

Table 1: Characteristics of grade 9–12 students who participated in the 2014–2015 Canadian Student Tobacco, Alcohol and Drugs Survey

Characteristic	Sample size	Weighted %* (99% CI)
Canada (total)	24 650	
Sex		
Female	12 514	48.6 (48.6–48.6)
Male	12 136	51.4 (51.4–51.5)
Grade		
9	7200	25.2 (25.2–25.2)
10	6986	25.3 (25.2–5.3)
11	6193	25.5 (25.5–25.5)
12	4271	24.0 (24.0–24.1)
Ethnicity		
White	16 970	60.9 (52.3–69.4)
Black	859	4.7 (3.0–6.3)
Asian	3597	22.7 (14.6–30.9)
Latin American	434	2.3 (1.2–3.3)
Aboriginal	1684	4.7 (3.0–6.3)
Other	955	4.8 (3.5–6.0)
Missing values	151	
Province		
British Columbia	3862	12.9 (12.6–13.3)
Alberta	3957	10.8 (10.5–11.1)
Saskatchewan	1895	3.2 (3.1–3.3)
Manitoba	1863	4.0 (3.9–4.1)
Ontario	3657	46.3 (45.1–47.6)
Quebec	2608	15.9 (15.5–16.3)
Nova Scotia	2778	2.7 (2.6–2.7)
Prince Edward Island	1446	0.5 (0.5–0.5)
Newfoundland and Labrador	2458	1.4 (1.3–1.4)
School socioeconomic status		
Low median	12 066	44.9 (28.6–61.1)
High median	12 584	55.1 (38.9–71.4)
Urban		
Yes	15 801	79.5 (68.1–90.9)
No	8849	20.5 (9.1–31.9)*
Ever binge drink		
Does not drink	8316	38.8 (34.4–43.2)
Drinks but no binging	4052	18.1 (16.2–20.1)
Binge drinks	10 955	43.1 (39.6–46.5)
Missing values	1327	

Note: CI = confidence interval.
*Presented as a proportion of complete data (i.e., does not include missing values).

Relative to grade 11 students, grade 12 students had higher odds of ever driving after drinking (OR 1.642, 99% CI 1.115–2.417) or using marijuana (OR 1.584, 99% CI 1.072–2.339). Drinking and driving did not vary by ethnicity. Relative to those identifying as white, students identifying as Aboriginal had higher odds of driving after using marijuana (OR 2.005, 99% CI 1.140–3.526) and of being a passenger of a driver who had used marijuana within the previous 2 hours (OR 1.938, 99% CI 1.364–2.755). Students who reported binge drinking had higher odds of engaging in each risky driving and passenger behaviour.

Table 2: Weighted prevalence and logistic regression analysis* of variables related to the odds of driving within an hour of drinking at least 1 drink among 10 411 grade 11–12 students

	In last 30 d		Ever	
Variable	Weighted prevalence (95% CI), %	Odds ratio (99% CI)	Weighted prevalence (95% CI), %	Odds ratio (99% CI)
Canada (total)	3.5 (2.8–4.2)		9.1 (7.9–10.3)	
Sex				
Female	2.7 (1.8–3.5)	0.516 (0.264–1.011)	6.8 (5.3–8.2)	0.477 (0.290–0.786)
Male	4.3 (3.2–5.4)	Reference	11.4 (9.4–13.4)	Reference
Grade				
11	2.9 (2.2–3.6)	Reference	7.1 (6.1–8.1)	Reference
12	4.2 (3.2–5. 1)	1.406 (0.883–2.240)	11.3 (9.2–13.4)	1.642 (1.115–2.417)
Ethnicity				
White	3.7 (2.7–4.6)	Reference	10.4 (8.5–12.3)	Reference
Black	†	2.645 (0.730–9.584)	7.1(2.6–11.5)‡	1.096 (0.409–2.940)
Asian	1.6 (0.7–2.5)‡	1.000 (0.417–2.399)	4.4(2.8–5.9)‡	0.850 (0.440–1.643)
Latin American	†	5.238 (0.278–98.553)	16.7(6.5–27.0)‡	2.658 (0.405–17.433)
Aboriginal	5.8 (2.6–9.1)‡	1.441 (0.518–4.007)	14.7 (9.5–19.9)‡	1.031 (0.529–2.008)
Other	†	2.433 (0.743–7.968)	10.3(4.7–15.3)‡	1.694 (0.549–5.234)
Province				
British Columbia	4.5 (3.1–6.0)	1.583 (0.681–3.677)	12.4 (9.4–15.4)	2.065 (1.125–3.791)
Alberta	3.4 (2.2–4.5)‡	1.339 (0.558–3.214)	9.5 (7.2–11.8)	1.699 (1.033–2.795)
Saskatchewan	9.8 (4.9–14.8)‡	3.679 (1.472–9.194)	18.5 (11.4–25.6)‡	2.926 (1.510–5.670)
Manitoba	2.4 (1.5–3.4)‡	0.630 (0.254–1.564)	11.1(5.8–16.4)‡	1.474 (0.625–3.477)
Ontario	2.3 (1.5–3.3)‡	Reference	6.3 (4.4–8.2)	Reference
Quebec	†	1.007 (0.367–2.764)	9.0 (7.0–11.0)	1.213 (0.656–2.243)
Nova Scotia	4.0 (2.3–5.6)‡	1.109 (0.433–2.839)	10.0 (7.9–12.1)	1.299 (0.796–2.120)
Prince Edward Island	3.8 (2.7–4.9)	1.174 (0.562–2.458)	11.7 (8.3–15.0)	1.462 (0.799–2.674)
Newfoundland and Labrador	5.5 (4.4–6.5)	1.716 (0.827–3.563)	13.9(9.2–18.6)‡	1.828 (1.042–3.208)
School socioeconomic status				
Low median	3.6 (2.6–4.6)	Reference	10.5(8.0–13.0)	Reference
High median	3.5 (2.5–4.4)	1.219 (0.605–2.457)	8.0 (6.7–9.4)	0.889 (0.518–1.526)
Urban				
Yes	2.6 (1.9–3.3)	Reference	7.2 (5.9–8.5)	Reference
No	7.6 (5.9–9.4)	2.326 (1.312–4.125)	17.6 (13.7–21.4)	1.712 (1.163–2.520)
Drinking behaviour				
Does not drink	†	Reference	†	Reference
Drinks but no binging	0.7 (0.4–1.0)‡	1.113 (0.146–8.470)	2.9 (1.6–4.2)‡	2.391 (0.527–10.839)
Binge drinks	5.9 (4.9–7.0)	8.559 (1.188–61.655)	15.1 (13.0–17.1)	12.725 (3.284–49.308)

Note: CI = confidence interval.
*All logistic regressions were conducted with the use of a complete-case methods approach, so the results presented here are among all cases with complete data.
†High sampling variability/insufficient sample size; data suppressed.
‡Moderate sampling variability; interpret with caution.

No differences by school region socioeconomic status were observed. Relative to urban students, students from rural schools had higher odds of driving after drinking (OR 1.712, 99% CI 1.163–2.520) and of ever riding with a driver who had drunk in the previous hour (OR 1.394, 99% CI 1.128–1.723).

Interpretation

In Canada in 2014–2015, 9% of grade 11–12 students reported ever driving within an hour of drinking alcohol or within 2 hours of using marijuana. Almost half (48%) of grade 11–12

Table 3: Weighted prevalence and logistic regression analysis* of variables related to the odds of driving within 2 hours of using marijuana among 10 411 grade 11–12 students

	In last 30 d		Ever	
Variable	Weighted prevalence (95% CI), %	Odds ratio (99% CI)	Weighted prevalence (95% CI), %	Odds ratio (99% CI)
Canada (total)	4.7 (3.9–5.5)		9.4 (8.3–10.4)	
Sex				
Female	3.2 (2.1–4.3)†	0.448 (0.240–0.834)	7.1 (5.6–8.6)	0.517 (0.333–0.805)
Male	6.1 (4.9–7.3)	Reference	11.5 (10.0–13.0)	Reference
Grade				
11	3.6 (2.8–4.3)	Reference	7.2 (6.1–8.4)	Reference
12	6.0 (4.5–7.4)	1.533 (0.959–2.452)	11.6 (9.8–13.5)	1.584 (1.072–2.339)
Ethnicity				
White	4.7 (3.7–5.8)	Reference	10.2 (8.9–11.4)	Reference
Black	‡	2.610 (0.823–8.274)	8.4 (3.5–13.3)†	1.337 (0.465–3.842)
Asian	2.3 (1.0–3.6)†	0.982 (0.438–2.198)	4.0 (2.6–5.4)†	0.733 (0.393–1.369)
Latin American	‡	4.189 (0.273–64.273)	‡	3.698 (0.722–18.934)
Aboriginal	13.2 (9.1–17.2)	2.529 (1.244–5.143)	23.0 (16.9–29.2)	2.005 (1.140–3.526)
Other	‡	1.126 (0.308–4.114)	10.0 (4.4–15.5)†	1.692 (0.690–4.146)
Province				
British Columbia	6.9 (4.8–9.0)‡	1.849 (0.676–5.062)	12.5 (8.6–16.4)	1.757 (0.815–3.787)
Alberta	3.5 (2.0–5.0)‡	0.992 (0.400–2.459)	8.0 (6.2–9.8)	1.241 (0.782–1.970)
Saskatchewan	10.5 (6.0–14.9)‡	2.428 (1.135–5.194)	20.0 (11.7–28.3)‡	2.665 (1.519–4.677)
Manitoba	4.8 (3.0–6.7)‡	1.050 (0.435–2.534)	14.1 (8.3–20.0)‡	1.757 (0.832–3.710)
Ontario	3.5 (2.1–4.9)‡	Reference	7.2 (5.8–8.6)	Reference
Quebec	3.5 (2.2–4.7)‡	0.850 (0.348–2.075)	6.9 (4.7–9.0)	0.773 (0.450–1.327)
Nova Scotia	7.6 (6.5–8.6)	1.842 (1.092–3.107)	15.2 (13.0–17.3)	1.867 (1.329–2.621)
Prince Edward Island	10.9 (9.1–12.6)	2.892 (1.478–5.656)	16.3 (14.0–18.6)	1.993 (1.375–2.888)
Newfoundland and Labrador	10.1 (8.1–12.2)	2.723 (1.476–5.023)	18.9 (16.6–21.3)	2.394 (1.582–3.625)
School socioeconomic status				
Low median	5.0 (3.4–6.6)	Reference	10.3 (8.2–12.4)	Reference
High median	4.4 (3.4–5.4)	0.989 (0.479–2.043)	8.6 (7.3–9.9)	1.037 (0.619–1.738)
Urban				
Yes	4.2 (3.3–5.1)	Reference	8.2 (7.0–9.4)	Reference
No	6.8 (4.0–9.6)‡	1.029 (0.537–1.974)	14.5 (11.5–17.4)	1.228 (0.891–1.693)
Drinking behaviour				
Does not drink	†	Reference	†	Reference
Drinks but no binging	0.7 (0.4–1.0)‡	0.879 (0.175–4.428)	1.5 (0.8–2.2)‡	1.089 (0.366–3.244)
Binge drinks	8.0 (6.7–9.2)	10.128 (2.283–44.940)	16.0 (14.4–17.6)	12.934 (4.360–38.366)

Note: CI = confidence interval.
*All logistic regressions were conducted with the use of a complete-case methods approach, so the results presented here are among all cases with complete data.
†Moderate sampling variability; interpret with caution.
‡High sampling variability/insufficient sample size; data suppressed.

students reported having ever engaged in at least 1 risky driving or passenger behaviour. Significant differences in unsafe driving and passenger behaviours existed by individual characteristics such as sex, grade and binge drinking behaviours, but fewer differences in unsafe driving or passenger behaviours existed by area-level factors.

Table 4: Logistic regression analysis* of variables related to the odds of riding with a driver who had had at least 1 drink within the previous hour among 22 684 grade 9–12 students

	In last 30 d		Ever	
Variable	Weighted prevalence (95% CI), %	Odds ratio (99% CI)	Weighted prevalence (95% CI), %	Odds ratio (99% CI)
Canada (total)	11.0 (10.2–11.9)		34.6 (32.4–36.9)	
Sex				
Female	12.2 (10.9–13.6)	1.233 (0.990–1.536)	38.2 (35.5–41.0)	1.337 (1.159–1.543)
Male	9.9 (8.9–10.9)	Reference	31.2 (29.1–33.3)	Reference
Grade				
9	9.1 (7.6–10.6)	Reference	29.8 (27.1–32.5)	Reference
10	11.1 (9.9–12.2)	0.952 (0.698–1.301)	34.5 (31.9–37.2)	1.006 (0.847–1.196)
11	12.4 (11.1–13.7)	0.995 (0.737–1.344)	36.9 (34.7–39.1)	1.045 (0.869–1.257)
12	11.6 (9.7–13.5)	0.879 (0.652–1.186)	37.3 (32.9–41.7)	1.008 (0.809–1.255)
Ethnicity				
White	13.4 (12.2–14.6)	Reference	39.6 (36.8–42.5)	Reference
Black	7.9 (4.3–11.5)†	0.806 (0.428–1.519)	24.4 (16.6–32.2)	0.691 (0.441–1.084)
Asian	5.5 (4.6–6.5)	0.682 (0.492–0.946)	22.4 (20.5–24.3)	0.798 (0.626–1.017)
Latin American	7.7 (4.8–10.7)†	0.604 (0.342–1.066)	39.7 (32.4–47.0)	1.112 (0.697–1.774)
Aboriginal	12.4 (9.8–15.0)	0.860 (0.564–1.312)	42.7 (37.6–47.8)	1.014 (0.740–1.389)
Other	11.0 (8.1–13.9)	1.051 (0.662–1.667)	30.1 (22.3–37.9)	0.874 (0.568–1.344)
Province				
British Columbia	11.4 (8.8–13.9)	1.237 (0.860–1.780)	34.9 (28.7–41.1)	1.059 (0.773–1.452)
Alberta	9.9 (7.6–12.1)	1.200 (0.808–1.781)	31.3 (28.7–33.8)	1.009 (0.740–1.376)
Saskatchewan	14.7 (11.3–18.1)	1.444 (1.029–2.026)	38.7 (29.1–48.2)	1.070 (0.702–1.630)
Manitoba	9.1 (7.0–11.1)	0.888 (0.578–1.366)	30.5 (24.4–36.6)	0.790 (0.516–1.210)
Ontario	9.1 (7.8–10.3)	Reference	30.9 (26.7–35.1)	Reference
Quebec	15.4 (12.4–18.5)	1.309 (0.881–1.946)	43.8 (40.0–47.5)	1.204 (0.855–1.694)
Nova Scotia	9.2 (7.8–10.7)	0.807 (0.615–1.060)	30.6 (27.8–33.3)	0.799 (0.588–1.087)
Prince Edward Island	10.6 (9.0–12.2)	0.939 (0.646–1.365)	34.8 (31.9–37.8)	0.895 (0.648–1.236)
Newfoundland and Labrador	10.0 (8.3–11.7)	0.864 (0.684–1.090)	31.4 (26.2–36.7)	0.789 (0.579–1.076)
School socioeconomic status				
Low median	12.2 (10.9–13.6)	Reference	40.0 (37.0–43.0)	Reference
High median	10.1 (8.8–11.4)	0.997 (0.807–1.231)	30.3 (27.1–33.4)	0.789 (0.620–1.004)
Urban				
Yes	9.6 (8.6–10.7)	Reference	30.7 (28.3–33.3)	Reference
No	16.4 (14.1–18.6)	1.094 (0.841–1.425)	49.5 (46.2–52.8)	1.394 (1.128–1.723)
Drinking behaviour				
Does not drink	3.5 (2.8–4.1)	Reference	17.0 (14.8–19.2)	Reference
Drinks but no binging	8.5 (6.8–9.5)	2.259 (1.432–3.561)	32.9 (29.1–36.8)	2.072 (1.600–2.685)
Binge drinks	18.5 (17.1–20.0)	5.425 (3.681–7.995)	49.8 (47.1–52.6)	3.893 (3.138–4.829)

Note: CI = confidence interval.
*All logistic regressions were conducted with the use of a complete-case methods approach, so the results presented here are among all cases with complete data.
†Moderate sampling variability; interpret with caution.

Almost 1 in 10 grade 11–12 students reported ever driving after using alcohol or marijuana, which is comparable to the 2010 finding that 10% of Canadian 11- to 15-year-olds reported drinking and driving in the previous 30 days.[11] However, it is higher than the rates found for Ontario, where 5% of grade 10–12 students with a driver's licence reported driv-

Table 5: Logistic regression analysis* of variables related to the odds of riding with a driver who had used marijuana within 2 hours of driving among 22 504 grade 9–12 students

	In last 30 d		Ever	
Variable	Weighted prevalence (95% CI), %	Odds ratio (99% CI)	Weighted prevalence (95% CI), %	Odds ratio (99% CI)
Canada (total)	9.0 (7.9–10.1)		19.8 (18.0–21.6)	
Sex				
Female	8.9 (7.7–10.2)	0.892 (0.627–1.269)	19.9 (18.0–21.8)	0.909 (0.705–1.171)
Male	9.1 (7.6–10.7)	Reference	19.6 (17.4–21.8)	Reference
Grade				
9	4.0 (2.9–5.0)	Reference	9.1 (6.9–11.3)	Reference
10	6.4 (5.3–7.5)	1.325 (0.946–1.856)	15.5 (13.0–18.0)	1.338 (0.942–1.900)
11	10.6 (9.2–11.9)	1.872 (1.196–2.929)	22.5 (20.5–24.4)	1.893 (1.310–2.735)
12	15.4 (11.8–19.1)	2.546 (1.452–4.463)	32.4 (27.4–37.4)	2.947 (1.873–4.638)
Ethnicity				
White	10.3 (8.6–11.9)	Reference	22.9 (20.0–25.8)	Reference
Black	8.2 (4.4–12.1)†	1.278 (0.605–2.702)	17.0 (11.7–22.2)	1.097 (0.599–2.011)
Asian	4.3 (3.1–5.5)	0.730 (0.499–1.069)	8.3 (7.0–9.5)	0.540 (0.338–0.863)
Latin American	6.6 (3.5–9.8)†	0.817 (0.336–1.987)	23.9 (17.5–30.3)	1.397 (0.625–3.124)
Aboriginal	20.1 (16.5–23.7)	2.068 (1.453–2.942)	38.8 (33.0–44.6)	1.938 (1.364–2.755)
Other	7.3 (4.1–10.4)†	0.986 (0.441–2.206)	17.5 (11.6–23.5)†	1.055 (0.518–2.150)
Province				
British Columbia	12.8 (9.7–15.9)	1.807 (1.054–3.098)	24.9 (19.6–30.3)	1.722 (1.119–2.650)
Alberta	8.1 (6.6–9.6)	1.204 (0.760–1.907)	18.5 (16.9–20.1)	1.336 (0.946–1.885)
Saskatchewan	14.3 (8.6–20.0)†	1.452 (0.876–2.407)	27.1 (15.9–38.4)†	1.319 (0.755–2.305)
Manitoba	10.0 (7.2–12.9)	1.015 (0.587–1.755)	22.5 (16.7–28.2)	1.139 (0.644–2.013)
Ontario	7.8 (5.7–9.8)	Reference	17.2 (14.2–20.1)	Reference
Quebec	6.7 (4.5–9.0)†	0.824 (0.503–1.351)	17.9 (12.5–23.4)†	0.942 (0.546–1.625)
Nova Scotia	13.8 (11.9–15.7)	1.612 (1.008–2.576)	27.8 (25.4–30.3)	1.706 (1.142–2.548)
Prince Edward Island	15.3 (13.6–17.1)	1.863 (1.192–2.912)	29.2 (26.9–31.6)	1.743 (1.181–2.571)
Newfoundland and Labrador	15.9 (12.6–19.3)	1.945 (1.104–3.427)	31.3 (28.1–34.5)	1.942 (1.265–2.980)
School socioeconomic status				
Low median	10.1 (8.0–12.2)	Reference	22.9 (19.2–26.6)	Reference
High median	8.2 (6.7–9.6)	1.038 (0.561–1.918)	17.2 (14.9–19.5)	0.948 (0.611–1.472)
Urban				
Yes	8.5 (7.2–9.8)	Reference	18.2 (16.1–20.4)	Reference
No	11.1 (8.7–13.5)	0.854 (0.607–1.202)	25.5 (21.9–29.2)	0.888 (0.635–1.244)
Drinking behaviour				
Does not drink	1.2 (0.8–1.7)†	Reference	3.2 (2.6–3.8)	Reference
Drinks but no binging	3.3 (2.5–4.0)	2.320 (1.451–3.710)	9.4 (8.1–10.7)	2.608 (1.945–3.497)
Binge drinks	18.1 (16.1–20.1)	14.173 (8.335–24.099)	37.5 (34.5–40.5)	13.693 (10.300–18.203)

Note: CI = confidence interval.
*All logistic regressions were conducted with the use of a complete-case methods approach, so the results presented here are among all cases with complete data.
†Moderate sampling variability; interpret with caution.

ing after drinking and 10% reported driving after cannabis use.[22] In the current survey, just over one-third (35%) of grade 9–12 students reported being passengers of a driver who had drunk in the previous hour, and 20% reported riding with a driver who had used marijuana within the previous 2 hours. These rates are higher than those found in a 2008 survey: 14.6% of 15- to 17-year-olds rode as a passenger of a driver who had drunk, and 19.3% rode as a passenger of a driver who had used marijuana.[10] Our estimates are also higher than the 2010 finding that 21% of 11- to 15-year-olds reported riding with a driver who had been using alcohol or marijuana or other illegal drugs in the previous 30 days.[11] These differences are likely a function of survey methods, populations or survey instruments.

We found that, while boys had higher odds of driving after drinking or using marijuana, girls had higher odds of ever riding with drivers who had drunk. Males typically have higher odds of driving while impaired.[11,13,24] Findings around the sex-related nature of risky passenger behaviours are inconsistent: studies have shown no sex differences,[24] that males are at higher risk[10,11,13] and that females are at higher risk.[25] Consistent with past research, in the current study, older adolescents[11,13,25] and those who reported binge drinking[10,24,25] had higher odds of driving after drinking and riding with potentially impaired drivers. Few differences existed by school-region socioeconomic status. Compared with urban students, rural students had higher odds of reporting alcohol-related risky driving and passenger behaviours, consistent with previous research.[11,13,25] Although there were few differences in alcohol-related risky behaviours, students from the 3 East Coast provinces for which generalizable data were available (Nova Scotia, Prince Edward Island and Newfoundland and Labrador) had higher odds of risky marijuana-related behaviours relative to Ontario students. Therefore, irrespective of the forthcoming federal approach to legalizing and regulating cannabis, it is within provincial jurisdiction to enact stricter provincial policies to reduce cannabis-impaired driving.

Limitations and strengths

Our study is subject to several limitations. First, outcome data were based on self-report rather than objective measures. Despite efforts to establish the validity and reliability of questionnaire items,[26] some underreporting is likely. However, whereas objective data can measure the number of collisions related to impaired driving, no objective data exist on drinking or marijuana use before driving among youth. Furthermore, self-reported data are commonly used in similar studies.[10,11,13,17] Second, survey items asked about driving within an hour of consuming 1 or more drinks of alcohol or within 2 hours of using marijuana. Although cognitive interviewing showed that these questions were easy for the target population to answer, they do not assess level of impairment, which depends on driver characteristics and on the amount of alcohol or marijuana consumed. Third, the survey did not include participants from Canada's territories, where the prevalence of impaired driving is high.[27] However, the nonincluded populations represent only a small fraction of the Canadian population. Fourth, given the survey's focus on tobacco, alcohol and drug use and not driving behaviours per se, we were unable to determine whether students had driver's licences.[25] Prevalence estimates of risky driving behaviours would likely have been higher had we restricted analyses to licensed youth. Despite these limitations, distinguishing between alcohol use and marijuana use before driving is a strength of the current study, particularly in light of the impending marijuana legalization in Canada. In addition, the comprehensive measures we used included risky driving of all types. The survey's national scope and provincially generalizable estimates are strengths.

Conclusion

A high proportion of Canadian youth reported engaging in risky driving and passenger behaviours. The impending legalization of marijuana necessitates further interventions to reduce impaired driving. Provincial policies can be implemented in the absence of federal legislation to achieve this end. Such policies may be particularly important for the Atlantic provinces, which had the highest prevalence of marijuana-related risky driving and passenger behaviours. Future research should continue to monitor the prevalence of alcohol- and marijuana-related risky driving and passenger behaviours and should leverage surveillance data to conduct natural experiments on the impact of provincial policies as they are implemented.

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