Preventive Medicine 111 (2018) 402–409

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Driving under the influence behaviours among high school students who mix alcohol with energy drinks

Maria N. Wilson[a,*], Tammy Cumming[b], Robin Burkhalter[b], Donald B. Langille[a], Rachel Ogilvie[a], Mark Asbridge[a]

[a] Department of Community Health and Epidemiology, Faculty of Medicine, Dalhousie University, 5790 University Avenue, Halifax, NS B3H 1V7, Canada
[b] Propel Centre for Population Health Impact, Faculty of Applied Health Sciences, University of Waterloo, 200 University Ave West, TechTown 2232, Waterloo, ON N2L 3G1, Canada

ARTICLE INFO

Keywords:
Alcohol
Energy drinks
Adolescents
Driving under the influence of alcohol
Driving under the influence of cannabis
Road safety

ABSTRACT

Alcohol and energy drinks are commonly used substances by youth in Canada, and are often mixed (AmED). While several studies have shown that AmED can have dangerous effects, less well understood is how AmED is associated with driving under the influence of either alcohol or drugs. This study sought to determine whether youth who use AmED were more likely to engage in driving, or being a passenger of a driver, under the influence of alcohol or cannabis compared to youth who use either alcohol or energy drinks alone.

This study used data from grade 10–12 students who took part in the 2014/2015 Canadian Student Tobacco, Alcohol and Drugs Survey (N = 17,450). The association of past-year AmED use with past-30 day: driving under the influence of alcohol or cannabis, and riding with an alcohol- or cannabis-influenced driver, was assessed using logistic regression.

One in four youth had consumed AmED in the previous 12 months. AmED users were more likely to engage in all risk behaviours except riding with a drinking driver, relative to youth who only consumed alcohol. No association was observed for youth who consumed alcohol and energy drinks on separate occasions.

Youth who use AmED demonstrate a higher risk profile for driving under the influence of alcohol or cannabis, than youth who use alcohol alone. Future research should explore the biopsychosocial pathways that may explain why using energy drinks enhances the already heightened risk posed by alcohol on other health-related behaviours such as driving under the influence.

1. Introduction

The term “energy drink” encompasses a variety of beverages with purported stimulant effects such as enhanced alertness and increased energy (Khan et al., 2016). These beverages are primarily composed of caffeine and sugars, and may include other ingredients such as L-carnitine, guarana, L-arginine, and taurine (Mcguinness, 2011). The U.S. Food and Drug Administration does not require that energy drink manufacturers label beverage containers with the amount of caffeine in each beverage (U.S. Food and Drug Administration, 2017). While caffeine levels in cola-type beverages are regulated to not exceed 0.02% (approximately 5.9 mg/oz), energy drinks sold in the United States are not strictly regulated, and have a wide range of caffeine contents from 1.5–32.5 mg/oz (Rosenfeld et al., 2014). According to Health Canada regulations, energy drinks cannot contain more than 180 mg of caffeine per 500 mL serving (10.6 mg/oz), and containers must display a warning of high caffeine content and a recommended maximum daily serving (Health Canada: Food Directorate - Health Products and Food Branch, 2013). Throughout North America, energy drinks are sold under a variety of different brand names, are easily available in grocery stores and gas stations, and are heavily marketed to youth (Harris et al., 2011; Emond et al., 2015; Costa et al., 2014). Reid et al., (2017a) found that 1 in 6 adolescents who consumed energy drinks had exceeded the usual guidance for maximum daily consumption. The use of energy drinks has risen steadily in the past decade, with around 30% of both American and Canadian junior and senior high school students reporting energy drink use (Government of Canada, 2016; Terry-McElrath et al., 2014).

Abbreviations: AmED, alcohol mixed with energy drinks; CSTADS, Canadian Student Tobacco Alcohol and Drugs Survey; DUIA, driving under the influence of alcohol; DUIC, driving under the influence of cannabis; RWDD, riding with a drunk driver; RWCD, riding with a cannabis-using driver; CMA, census metropolitan area; CA, census agglomerations

* Corresponding author at: Department of Community Health and Epidemiology, Dalhousie University, Clinical Research Centre, 5790 University Avenue, Halifax, NS B3H 1V7, Canada.
E-mail address: maria.wilson@dal.ca (M.N. Wilson).

https://doi.org/10.1016/j.ypmed.2017.11.035
Received 7 September 2017; Received in revised form 21 November 2017; Accepted 28 November 2017
Available online 29 November 2017
0091-7435/ © 2017 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/BY-NC-ND/4.0/).

Alcohol is the most commonly used substance by youth in North America, with around 75% of grade 12 students in both Canada and the United States reporting any alcohol consumption (Centers for Disease Control and Prevention, 2014; Asbridge and Langille, 2013). Despite warnings to the contrary, some young people consume alcohol mixed with energy drinks (AmED) (Reissig et al., 2009). While mixing alcohol with caffeinated beverages is not a new phenomenon (e.g. rum and cola), AmED use is particularly concerning due to high levels of caffeine and other plant-based stimulants (Centers for Disease Control and Prevention, 2017). Compared to using alcohol alone, several dangerous effects have been documented in relation to AmED use, including increased motivation to drink (Marczinski and Fillmore, 2014), reduced perception of motor control impairment (Ferreira et al., 2006), and reduced self-perceived levels of intoxication (Ferreira et al., 2006). Several studies have examined motivations for mixing alcohol with energy drinks among youth. While some reported motivations were unrelated to the purported effects of AmED, such as simply liking the taste (Verster et al., 2014), others consumed AmED to slow the onset of intoxication (Marczinski, 2011), to reduce the sedative effects of alcohol (Marczinski, 2011), to increase their ability to consume more alcohol (Pennay and Lubman, 2012), to increase sociability (Pennay and Lubman, 2012), and to sober up more quickly (Woolsey et al., 2010). The last motivation is particularly relevant for youth across North America, where many jurisdictions have a zero-tolerance policy for driving under the influence alcohol or drugs among young and novice drivers as part of their graduated drivers licensing programs (Asbridge et al., 2016; Royal Canadian Mounted Police, 2016). In Canada, for instance, a young person can obtain a learners permit at age 16 and will be under these restrictions until age 21. The consumption of energy drinks could mistakenly be viewed as a means to more quickly reduce blood alcohol concentration, or drug use biomarkers, in order to drive (Woolsey et al., 2010).

Correlates of AmED use among youth have been well documented and include: increasing age, smoking, binge drinking, cannabis use, participation in school sport, having more spending money, school truancy, lower school connectedness, and lower academic average (Khan et al., 2016; Reid et al., 2017a; Azagba et al., 2013; Martz et al., 2015). A growing body of literature has also found that AmED use is associated with increased risk-taking behaviours, injury, and harm (Roemer and Stockwell, 2017), such as heavy binge drinking (Woolsey et al., 2010), alcohol dependence (Snipes et al., 2015), more instances of negative alcohol-related consequences (de Haan et al., 2012; Patrick and Maggs, 2014), sexual risk taking (Miller, 2012), and drinking and driving behaviours (Woolsey et al., 2015); however, these studies are largely concentrated among American college students. One study of Dutch university students found that compared to those who consumed alcohol only, AmED was associated with lower odds of past-year consequences such as drinking and driving and alcohol-related injury, indicating the potential for variation in this association by geographic region (de Haan et al., 2012).

Given the disconnect between perceived level of intoxication and actual behavioural impairment among AmED users compared to alcohol-only users, driving under the influence is a risk behaviour of interest (Woolsey et al., 2015). Motor vehicle collisions produce substantial financial, healthcare, and social costs, with more than half of fatal collisions in Canada in 2012 involving a driver under the influence (MADD Canada, 2012a; MADD Canada, 2012b). There is significant interest in determining correlates of impaired driving in order to develop targeted prevention strategies (Chen et al., 2008; McDonald et al., 2014). Three studies have looked at high school students in the United States, and all found that AmED users were more likely to report unsafe drinking and driving behaviours (Martz et al., 2015; Tucker et al., 2016; Williams et al., 2017). However, the associations of AmED with other risky driving-related activities, including being a passenger of an alcohol or cannabis-influenced driver and driving under the influence of cannabis have yet to be investigated among high school students. Patterns of AmED use and associated harm may differ by country, and between high school students and college students due to differing substance using cultures in these settings (Tse and Tse, 2011; Bingham et al., 2005). Furthermore, driving under the influence of cannabis has equalled, and in some cases, surpassed rates of drinking and driving among high school students in many jurisdictions in recent years (O'Malley and Johnston, 2013).

The pathway by which AmED may be linked to driving under the influence is complex. The literature around injury and AmED use suggests that risk-taking tendencies may play an important role (Roemer and Stockwell, 2017). Berger et al. (2014) found that AmED use was associated with an increased engagement in high risk-taking activities, and O'Brien et al. (2013) noted that injury requiring medical treatment was associated with AmED use among college students, but that sensation-seeking moderated this outcome. The current state of the evidence leads to an important question: is it the direct effects of AmED consumption that produce risk-taking behaviours and associated adverse outcomes, or do AmED users have a higher risk behavioural profile compared to non-drinkers, those who only consume alcohol, those who only consume energy drinks, or those who use alcohol and energy drinks separately on different occasions? This study seeks to determine the associations of AmED with driving under the influence behaviours among a previously uninvestigated population: Canadian high school students. With the inclusion of driving under the influence and riding with a driver under the influence as potential outcomes, we aim to investigate propagating risk, and taking risks. Similarly, by examining alcohol- and cannabis-related driving behaviours, we seek to investigate risks that are directly and indirectly related to alcohol use.

2. Methods

2.1. Study design

The Canadian Student, Tobacco, Alcohol, and Drugs Survey (CSTADS) is a biennial self-reported paper-based survey administered to students in public, private, and Catholic schools across Canada (Propel Centre for Population Impact: University of Waterloo, n.d.). A total sample of 42,094 students in grades 6 to 12 completed the survey, with data collection between October 2014 and May 2015 in all Canadian provinces (territories were not included) (Reid et al., 2017b). This equated to a total of 128 school boards (49% participation rate), and 336 schools (47% participation rate) (Minaker et al., 2017).

The original survey employed a stratified single stage cluster design, with strata based on health region smoking rate and type of school (elementary and high school), and schools randomly selected within each stratum. A generalizable sample was achieved in all provinces with the exception of New Brunswick, due to a low response rate (Reid et al., 2017b).

CSTADS received ethical approval from the Health Canada Research Ethics Board, the Office of Research Ethics at the University of Waterloo, and from school boards and affiliated institutional ethics review boards in each province (Propel Centre for Population Impact: University of Waterloo, n.d.).

2.2. Study sample

This study draws upon data from grades 10–12 students, as most students in grades 6–9 were not old enough to operate most motor vehicles in any province. This represented a total of 17,450 students. Data for students from New Brunswick were included in overall estimates, but were not reported separately in provincial estimates due to restrictions for small cell sizes as established in research ethics applications.

2.3. Dependent variables

Study outcomes included past 30-day experiences of: 1) driving within 1 h of drinking alcohol (DUIA); 2) driving within 2 h of using cannabis (DUIC); 3) being a passenger in a vehicle driven by someone who consumed alcohol within the last hour (RWDD); and 4) being a passenger in a vehicle driven by someone who had used cannabis in the last 2 h (RWCD). Study outcomes were derived from survey responses to the following questions, "Have you driven a vehicle (e.g., car, snowmobile, motor boat, or all-terrain vehicle (ATV))…" a) within an hour of drinking one or more drinks of alcohol? and b) within 2 h of using marijuana?; and "Have you ever been a passenger in a vehicle (e.g., car, snowmobile, motor boat, or all-terrain vehicle (ATV))..." a) driven by someone who had one or more drinks of alcohol in the last hour? and b) driven by someone who had been using marijuana in the last 2 h?. Response options included "No, never", "Yes, in the last 30 days", "Yes, more than 30 days ago." All four outcomes of interest were dichotomized for analyses to reflect experiences over the past 30 days to reduce recall bias (i.e. yes over the past 30 days, or no over the past 30 days/ever).

2.4. Independent variables

The main exposure of interest was alcohol and energy drink use. Respondents were asked: "In the last 12 months, did you drink any of the following?" a) An energy drink (such as Red Bull®), b) Alcohol and an energy drink (such as Red Bull®) drank separately on one occasion, c) Alcohol and an energy drink (such as Red Bull®) hand-mixed together by you or someone else, and d) Store-bought pre-mixed alcoholic beverages with energy drink names (such as Rockstar® + Vodka)." Students were considered as having mixed alcohol and energy drinks if they indicated at least one of items b) (even though mixing was not necessarily deliberate), c) or d). Energy drink use was determined based on item a) listed above. Alcohol use was determined by responses to the following question: "In the last 12 months, how often did you have a drink of alcohol that was more than just a sip?" Answering "yes" to drinking alcohol at least once a month in the last 12 months was considered alcohol use. Five categories of alcohol and energy drink use were derived from the three variables described above:

- alcohol only (referent): mixed "no", energy drink "no", alcohol "yes"
- no alcohol or energy drinks: mixed "no", energy drink "no", alcohol "no"
- energy drinks only: mixed "no", energy drink "yes", alcohol "no"
- energy drinks and alcohol separately: mixed "no", energy drink "yes", alcohol "yes"
- energy drinks mixed with alcohol: mixed "yes" and any combination of the other two variables.

Individual-level covariates included respondents' sex (female, male); grade (Government of Canada, 2016; Terry-McElrath et al., 2014; Centers for Disease Control and Prevention, 2014); ethnicity (Aboriginal, Asian, Black, Latin, White, other); past-year frequency of binge drinking (none, ≤ once a month, ≥ 2–3 times a month); and province of residence. Two area-level covariates were also included in models: school-level socio-economic status (SES), and school urbanicity. Median family income of the school's forward sortation area was obtained from the 2011 Canadian Census, and was dichotomized within each province at the provincial median for use in models (high SES vs. low SES) (Statistics Canada, 2011). Schools in urban areas were those located in census metropolitan areas (CMA) or census agglomerations (CA), as determined by school postal code. CMAs have a total population of at least 100,000 of which 50,000 must live in the core; CAs must have a core population of at least 10,000. Rural areas were considered those not meeting the definition for CMAs or CAs (Statistics Canada, 2015).

Table 1
Descriptive characteristics of grade 10–12 students: 2014/2015 CSTADS (N = 17,450), unweighted frequency and weighted proportion with 99% confidence interval (CI).

	Unweighted frequency (n)	Weighted % (99% CI)
Sex		
Male	8563	51.4 (51.4–51.4)
Female	8887	48.6 (48.6–48.6)
Grade		
10	6986	33.8 (33.7–33.8)
11	6193	34.1 (34.1–34.1)
12	4271	32.1 (32.1–32.2)
Ethnicity		
White	12,071	61.5 (53.0–70.0)
Black	612	4.4 (3.1–5.6)
Asian	2518	23.0 (15.3–30.7)
Latin American	294	2.0 (1.2–2.8)
Aboriginal	1209	4.7 (2.9–6.6)
Other	650	4.4 (3.3–5.5)
Province		
ON	2589	48.0 (46.8–49.3)
NL	1878	1.4 (1.3–1.4)
PEI	1091	0.5 (0.5–0.5)
NS	2056	2.7 (2.7–2.8)
NB[a]	90	2.3 (–)
QC	1637	13.5 (13.2–13.9)
MB	1153	4.1 (4.0–4.2)
SK	1353	3.3 (3.2–3.4)
AB	2950	10.8 (10.5–11.1)
BC	2653	13.3 (13.0–13.7)
Median household income by FSA		
Low	8353	46.4 (29.6–63.1)
High	9097	53.6 (36.9–70.4)
Urban		
Yes	11,101	79.3 (68.1–90.5)
No	6349	20.7 (9.5–31.9)[b]
Frequency of binge drinking (past year)		
None	9561	61.9 (58.6–65.2)
Once a month or less	4529	25.2 (22.7–27.8)
2–3 times a month or more	2574	12.9 (11.0–14.8)
Alcohol and energy drink use		
Alcohol only	2292	13.6 (11.5–15.8)
No alcohol or energy drinks	6700	44.4 (41.4–47.4)
Energy drinks only	2249	13.4 (12.0–14.7)
Energy drinks & alcohol (separate occasions)	1029	5.5 (4.5–6.6)
Energy drinks mixed with alcohol	4205	23.0 (21.1–24.9)
Driving under the influence of alcohol (past 30 days)		
No	16,358	97.0 (96.3–97.6)
Yes	649	3.0 (2.4–3.7)
Driving under the influence of cannabis (past 30 days)		
No	15,961	96.2 (95.4–97.0)
Yes	878	3.8 (3.1–4.6)
Riding with a drunk driver (past 30 days)		
No	14,885	88.3 (87.1–89.6)
Yes	2092	11.7 (10.5–12.9)
Riding with a cannabis-using driver (past 30 days)		
No	14,661	89.3 (87.5–91.1)
Yes	2198	10.7 (8.9–12.6)

[a] Students from New Brunswick are included in overall analyses, but results are not reported separately for this province due to reporting requirements for small cell sizes.
[b] Moderate sampling variability, interpret with caution.

2.5. Statistical analyses

All analyses were conducted using SAS software (v. 9.4) (SAS Institute Inc., 2013). Survey weights adjusted for sampling methods, non-response (school, class, and student levels), and were used for calibrating the sample to the province, grade, and sex distribution of the

Table 2
Weighted prevalence (with 99% CI), and unadjusted and adjusted odds ratios of driving under the influence of alcohol (DUIA) by study covariates: grade 10–12 students, 2014/2015 CSTADS (N = 17,450).

	Weighted prevalence (99% CI)	Unadjusted OR (99% CI)	Adjusted OR (99% CI)
Alcohol and energy drink use			
Alcohol only	2.8 (1.7–3.9)	1.00 (–)	1.00 (–)
No alcohol or energy drinks	[a]	0.10 (0.04–0.26)	0.25 (0.08–0.79)
Energy drinks only	[a]	0.14 (0.04–0.53)	0.32 (0.07–1.37)
Energy drinks & alcohol (separate occasions)	5.7[b] (1.5–9.9)	2.19 (0.74–6.44)	2.00 (0.63–6.40)
Energy drinks mixed with alcohol	9.9 (7.3–12.4)	3.93 (2.36–6.55)	3.35 (2.03–5.53)
Sex			
Male	3.9 (2.8–5.0)	1.00 (–)	1.00 (–)
Female	2.1 (1.5–2.8)	0.52 (0.30–0.88)	0.54 (0.32–0.90)
Grade			
10	2.1 (1.4–2.8)	1.00 (–)	1.00 (–)
11	2.9 (1.9–3.9)	1.49 (0.77–2.91)	0.99 (0.61–1.60)
12	4.2 (2.9–5.4)	2.05 (1.19–3.54)	1.11 (0.65–1.90)
Ethnicity			
White	3.2 (2.3–4.2)	1.00 (–)	1.00 (–)
Black	[a]	1.35 (0.45–4.05)	1.93 (0.79–4.69)
Asian	1.2[b] (0.3–2.1)	0.42 (0.17–1.03)	1.24 (0.55–2.82)
Latin American	[a]	3.25 (0.54–19.72)	4.47 (0.54–36.67)
Aboriginal	5.5[b] (2.3–8.6)	2.08 (0.86–5.03)	1.15 (0.43–3.04)
Other	[a]	1.47 (0.51–4.23)	1.85 (0.69–4.95)
Province			
ON	2.1[b] (1.2–3.0)	1.00 (–)	1.00 (–)
NL	4.9 (3.5–6.3)	2.51 (1.46–4.30)	1.24 (0.69–2.23)
PEI	3.7 (2.5–4.8)	1.69 (0.92–3.09)	0.87 (0.50–1.51)
NS	3.5[b] (1.9–5.1)	1.70 (0.88–3.29)	1.03 (0.52–2.05)
QC	3.1[b] (0.7–5.5)	1.59 (0.59–4.28)	1.14 (0.58–2.23)
MB	2.7[b] (1.2–4.2)	1.25 (0.60–2.61)	0.68 (0.23–2.04)
SK	7.8[b] (2.9–12.8)	4.28 (1.41–12.96)	3.13 (1.43–6.81)
AB	2.8 (1.7–3.9)	1.40 (0.76–2.59)	1.33 (0.62–2.87)
BC	3.7 (2.3–5.2)	1.99 (1.07–3.71)	1.27 (0.69–2.36)
School SES			
Low	3.2 (2.2–4.2)	1.00 (–)	1.00 (–)
High	2.9 (1.9–3.8)	0.81 (0.42–1.55)	1.22 (0.73–2.02)
Urban			
Yes	2.2 (1.5–2.8)	1.00 (–)	1.00 (–)
No	6.3 (4.6–8.0)	2.61 (1.57–4.35)	2.13 (1.33–3.41)
Frequency of binge drinking (past year)			
None	0.6 (0.2–1.0)	1.00 (–)	1.00 (–)
Once a month or less	2.3 (1.6–3.1)	3.38 (1.23–9.24)	1.16 (0.40–3.39)
2–3 times a month or more	15.8 (11.8–19.8)	27.77 (12.27–62.84)	6.35 (2.62–15.40)

[a] High sampling variability/insufficient sample size; data suppressed.
[b] Moderate sampling variability; interpret with caution.

Table 3
Weighted prevalence (with 99% CI), and unadjusted and adjusted odds ratios of driving under the influence of cannabis (DUIC) by study covariates: grade 10–12 students, 2014/2015 CSTADS (N = 17,450).

	Weighted prevalence (99% CI)	Unadjusted OR (99% CI)	Adjusted OR (99% CI)
Alcohol and energy drink use			
Alcohol only	4.7[a] (2.3–7.1)	1.00 (–)	1.00 (–)
No alcohol or energy drinks	0.3[a] (0.1–0.4)	0.05 (0.02–0.11)	0.15 (0.06–0.36)
Energy drinks only	0.6[a] (0.2–1.0)	0.12 (0.05–0.31)	0.28 (0.11–0.72)
Energy drinks & alcohol (separate occasions)	4.4[a] (2.0–6.8)	0.89 (0.44–1.79)	0.81 (0.41–1.61)
Energy drinks mixed with alcohol	12.5 (9.7–15.3)	2.84 (1.41–5.75)	2.20 (1.03–4.71)
Sex			
Male	4.9 (3.8–6.0)	1.00 (–)	1.00 (–)
Female	2.7 (1.6–3.7)	0.52 (0.31–0.86)	0.49 (0.28–0.87)
Grade			
10	2.0 (1.4–2.7)	1.00 (–)	1.00 (–)
11	3.6 (2.6–4.6)	1.71 (1.04–2.80)	1.14 (0.64–2.02)
12	6.0 (4.0–7.9)	2.93 (1.76–4.90)	1.44 (0.79–2.62)
Ethnicity			
White	3.7 (2.7–4.7)	1.00 (–)	1.00 (–)
Black	5.8[a] (1.1–10.6)	1.84 (0.76–4.46)	2.73 (1.25–6.00)
Asian	1.8[a] (0.5–3.1)	0.52 (0.23–1.19)	1.34 (0.61–2.97)
Latin American	[b]	2.99 (0.52–17.14)	3.86 (0.47–31.66)
Aboriginal	11.8 (7.8–15.9)	3.64 (1.92–6.89)	2.42 (1.35–4.35)
Other	3.3[a] (0.5–6.2)	1.01 (0.40–2.56)	1.23 (0.51–1.76)
Province			
ON	3.0[a] (1.7–4.3)	1.00 (–)	1.00 (–)
NL	8.8 (6.4–11.1)	3.10 (1.75–5.47)	2.15 (1.23–3.56)
PEI	8.4 (6.7–10.1)	2.84 (1.65–4.90)	2.04 (1.14–3.67)
NS	6.1 (5.3–7.0)	2.10 (1.18–3.76)	1.74 (1.10–2.76)
QC	2.3[a] (1.1–3.5)	0.76 (0.35–1.65)	0.76 (0.33–1.76)
MB	5.1[a] (2.4–7.9)	1.62 (0.73–3.58)	1.09 (0.45–2.60)
SK	8.4[a] (2.5–14.4)	2.91 (1.19–7.15)	2.00 (1.03–3.88)
AB	2.9[a] (1.6–4.2)	0.95 (0.48–1.89)	1.00 (0.47–2.14)
BC	5.6 (3.4–7.9)	1.91 (0.95–3.81)	1.40 (0.67–2.91)
School SES			
Low	4.1 (2.6–5.6)	1.00 (–)	1.00 (–)
High	3.6 (2.7–4.5)	0.83 (0.40–1.70)	1.00 (0.50–2.03)
Urban			
Yes	3.5 (2.6–4.3)	1.00 (–)	1.00 (–)
No	5.1[a] (2.6–7.6)	1.29 (0.63–2.66)	0.94 (0.53–2.03)
Frequency of binge drinking (past year)			
None	0.7 (0.3–1.1)	1.00 (–)	1.00 (–)
Once a month or less	4.6 (3.0–6.2)	6.98 (2.70–18.03)	2.52 (0.93–6.84)
2–3 times a month or more	17.5 (13.8–21.3)	32.48 (15.61–67.57)	7.30 (2.89–18.47)

[a] Moderate sampling variability; interpret with caution.
[b] High sampling variability/insufficient sample size; data suppressed.

target population. Bootstrap weights were used for all analyses to account for survey design in the variances.

An initial descriptive analysis was conducted to determine the prevalence of driving and passenger outcomes of interest, as well as the distribution of variables in the study sample. Results are reported as unweighted frequencies and weighted prevalence with 99% confidence intervals (CIs). Unadjusted and adjusted logistic regression models were constructed to determine the association between the four driving outcomes and alcohol and energy drink use behaviours, reported as odds ratios (with 99% CIs).

3. Results

Table 1 describes the study sample by all variables of interest, using unweighted frequencies and weighted proportions (with 99% CI). The study sample was 51.4% male, with most of the study sample being of White ethnicity (61.5%), attending schools in urban areas (79.3%), and not reporting binge drinking in the past 12 months (61.9%). Almost half of the students surveyed had not consumed alcohol or energy drinks in the past 12 months (44.4%); however, almost one quarter had mixed energy drinks with alcohol in the same period (23.0%). Relatively equal proportions of the sample had consumed alcohol only (13.6%) or energy drinks only (13.4%), with 5.5% having consumed both, but on separate occasions over the past 12 months. Driving under the influence

Table 4
Weighted prevalence (with 99% CI), and unadjusted and adjusted odds ratios of riding with a drinking driver (RWDD) by study covariates: grade 10–12 students, 2014/2015 CSTADS (N = 17,450).

	Weighted prevalence (99% CI)	Unadjusted OR (99% CI)	Adjusted OR (99% CI)
Alcohol and energy drink use			
Alcohol only	19.8 (16.1–23.6)	1.00 (–)	1.00 (–)
No alcohol or energy drinks	4.9 (3.9–6.0)	0.22 (0.14–0.34)	0.39 (0.23–0.65)
Energy drinks only	5.5 (3.3–7.7)	0.25 (0.14–0.45)	0.46 (0.27–0.81)
Energy drinks & alcohol (separate occasions)	17.7 (13.2–22.2)	0.91 (0.58–1.40)	0.93 (0.58–1.50)
Energy drinks mixed with alcohol	22.8 (20.2–25.5)	1.25 (0.87–1.79)	1.31 (0.89–1.93)
Sex			
Male	10.4 (8.8–12.0)	1.00 (–)	1.00 (–)
Female	13.1 (11.3–14.8)	1.31 (1.04–1.66)	1.38 (1.10–1.74)
Grade			
10	11.1 (9.6–12.6)	1.00 (–)	1.00 (–)
11	12.4 (10.7–14.1)	1.18 (0.98–1.43)	0.98 (0.78–1.23)
12	11.6 (9.1–14.1)	1.09 (0.80–1.50)	0.81 (0.59–1.11)
Ethnicity			
White	13.9 (12.2–15.6)	1.00 (–)	1.00 (–)
Black	9.0[a] (4.7–13.3)	0.68 (0.36–1.28)	0.83 (0.49–1.43)
Asian	6.2 (4.5–7.9)	0.43 (0.30–0.60)	0.78 (0.52–1.17)
Latin American	[b]	0.56 (0.21–1.44)	0.48 (0.18–1.28)
Aboriginal	13.2 (8.9–17.5)	1.03 (0.66–1.60)	0.76 (0.48–1.20)
Other	12.1[a] (6.8–17.4)	0.97 (0.54–1.74)	1.07 (0.58–1.99)
Province			
ON	9.5 (7.6–11.3)	1.00 (–)	1.00 (–)
NL	11.0 (8.6–13.5)	1.19 (0.86–1.64)	0.81 (0.62–1.06)
PEI	11.6 (9.2–14.1)	1.24 (0.85–1.81)	0.87 (0.59–1.23)
NS	10.5 (8.1–13.0)	1.09 (0.77–1.55)	0.91 (0.68–1.22)
QC	18.4 (14.6–22.1)	2.08 (1.40–3.10)	1.68 (1.19–2.38)
MB	9.6 (6.7–12.6)	1.00 (0.62–1.60)	0.89 (0.57–1.40)
SK	16.2 (10.3–22.1)	1.87 (1.06–3.32)	1.50 (0.92–2.45)
AB	9.6 (5.8–13.4)	1.03 (0.60–1.77)	1.21 (0.73–1.98)
BC	12.0 (8.1–15.9)	1.34 (0.86–2.09)	1.22 (0.84–1.79)
School SES			
Low	13.0 (10.9–15.1)	1.00 (–)	1.00 (–)
High	10.6 (8.6–12.5)	0.74 (0.54–1.04)	0.92 (0.73–1.17)
Urban			
Yes	10.2 (8.7–11.8)	1.00 (–)	1.00 (–)
No	17.2 (13.9–20.5)	1.62 (1.14–2.31)	1.46 (0.79–2.68)
Frequency of binge drinking (past year)			
None	5.9 (4.6–7.1)	1.00 (–)	1.00 (–)
Once a month or less	15.4 (12.3–17.6)	2.87 (1.89–4.38)	1.46 (0.79–2.68)
2–3 times a month or more	31.5 (26.4–36.5)	7.03 (4.61–10.72)	3.02 (1.68–5.41)

[a] Moderate sampling variability; interpret with caution.
[b] High sampling variability/insufficient sample size; data suppressed.

of alcohol (DUIA) (3.0%) or cannabis (DUIC) (3.8%) were less prevalent behaviours than riding with a drinking driver (RWDD) (11.7%) or cannabis-using driver (RWCD) (10.7%) over the past 30 days.

Tables 2 and 3 present the weighted prevalence and odds ratios (unadjusted and adjusted) of DUIA and DUIC, respectively. In adjusted models, compared to those who consumed alcohol only, those who use AmED had an increased odds of DUIA (OR 3.35; 99% CI 2.03–5.53) and DUIC (OR 2.20; 99% CI 1.03–4.71). Respondents who consumed no alcohol or energy drinks, or energy drinks only over the past year, compared to alcohol-only drinkers, had a decreased odds of past 30-day DUIA and DUIC, and no difference was observed for those who consumed energy drinks and alcohol separately. As shown in Table 2 adjusted models, living in a rural area and binge drinking ≥ 2–3 times per month over the past year were positively associated with DUIA, while being female was negatively associated with DUIA. As shown in adjusted models in Table 3, binge drinking ≥ 2–3 times per month over the past year and identifying as Black or Aboriginal were positively associated with DUIC, while being female was negatively associated with DUIC.

Tables 4 and 5 present the weighted prevalence and odds ratios (unadjusted and adjusted) for RWDD and RWCD, respectively. Young people who use AmED had an increased odds of RWCD (OR 1.89; 99% CI 1.26–2.85), but not RWDD (OR 1.31; 99% CI 0.89–1.93) compared to those youth who only use alcohol. Respondents who did not consume alcohol or energy drinks had a decreased odds of RWDD and RWCD compared to alcohol only drinkers, as did those who consumed only energy drinks for RWDD only. No association was observed for those youth who consumed alcohol and energy drinks separately with RWDD and RWCD, and for youth who consumed only energy drinks with RWCD. In adjusted models presented in Table 4, being female and binge drinking 2–3 times per month or more over the past year were positively associated with RWDD. In adjusted models presented in Table 5, any past year binge drinking and identifying as Aboriginal were positively associated with RWCD. Province variation was also observed for DUIA, DUIC and RWDD in adjusted models shown in Tables 2–4.

4. Discussion

In a nationally representative sample of grade 10–12 students in Canada, youth who had mixed alcohol with energy drinks over the past year were more likely to report past 30-day DUIA, DUIC, and RWCD relative to youth who only used alcohol. Among youth who mixed alcohol with energy drinks, 9.9% reported DUIA, 12.5% reported DUIC, 22.8% reported RWDD, and 26.7% reported RWCD. The prevalence of these risky driving behaviours among youth engaged in AmED was between double and more than triple the prevalence among all youth in

Table 5
Weighted prevalence (with 99% CI), and unadjusted and adjusted odds ratios of riding with a cannabis-using driver (RWCD) by study covariates: grade 10–12 students, 2014/2015 CSTADS (N = 17,450).

	Weighted prevalence (99% CI)	Unadjusted OR (99% CI)	Adjusted OR (99% CI)
Alcohol and energy drink use			
Alcohol only	14.3 (10.4–18.3)	1.00 (–)	1.00 (–)
No alcohol or energy drinks	2.5 (1.6–3.4)	0.15 (0.10–0.23)	0.49 (0.26–0.94)
Energy drinks only	4.7[a] (2.5–7.0)	0.29 (0.18–0.45)	0.85 (0.53–1.37)
Energy drinks & alcohol (separate occasions)	17.9 (10.2–25.5)	1.27 (0.67–2.41)	1.35 (0.67–2.61)
Energy drinks mixed with alcohol	26.7 (23.0–30.3)	2.14 (1.53–3.01)	1.89 (1.26–2.85)
Sex			
Male	10.9 (8.4–13.5)	1.00 (–)	1.00 (–)
Female	10.5 (8.3–12.7)	0.92 (0.65–1.31)	0.97 (0.62–1.51)
Grade			
10	6.4 (4.9–7.8)	1.00 (–)	1.00 (–)
11	10.6 (8.8–12.4)	1.68 (1.22–2.32)	1.27 (0.97–1.67)
12	15.4 (10.5–20.3)	2.76 (1.74–4.40)	1.59 (0.96–2.65)
Ethnicity			
White	11.9 (9.2–14.7)	1.00 (–)	1.00 (–)
Black	11.2[a] (6.0–16.4)	0.99 (0.49–1.99)	1.33 (0.59–3.02)
Asian	5.4 (3.5–7.4)	0.43 (0.28–0.66)	0.84 (0.55–1.27)
Latin American	8.6[a] (2.5–14.6)	0.76 (0.30–1.94)	0.75 (0.27–2.09)
Aboriginal	23.0 (17.4–28.6)	2.54 (1.65–3.91)	1.93 (1.36–2.08)
Other	8.7[a] (3.6–13.8)	0.72 (0.27–1.90)	0.78 (0.27–2.39)
Province			
ON	9.4 (6.0–12.7)	1.00 (–)	1.00 (–)
NL	19.6 (14.0–25.3)	2.36 (1.35–4.13)	1.65 (0.83–3.27)
PEI	17.7 (15.1–20.3)	2.00 (1.26–3.17)	1.48 (0.87–2.53)
NS	16.7 (13.5–19.8)	1.84 (1.18–2.87)	1.55 (0.92–2.60)
QC	7.9[a] (4.5–11.3)	0.81 (0.44–1.48)	0.81 (0.49–1.33)
MB	11.1 (6.8–15.4)	1.18 (0.57–2.42)	0.89 (0.42–1.89)
SK	17.2[a] (8.4–25.9)	2.03 (0.94–4.37)	1.45 (0.80–2.64)
AB	9.3 (6.9–11.7)	0.98 (0.56–1.72)	1.20 (0.73–1.97)
BC	14.7 (10.0–19.3)	1.64 (0.95–2.83)	1.53 (0.91–2.57)
Median household income by FSA			
Low	11.3 (8.1–14.5)	1.00 (–)	1.00 (–)
High	10.2 (7.6–12.8)	0.87 (0.46–1.65)	1.13 (0.56–2.32)
Urban			
Yes	10.2 (8.0–12.4)	1.00 (–)	1.00 (–)
No	12.6 (8.8–16.4)	1.23 (0.73–2.04)	0.82 (0.59–1.51)
Frequency of binge drinking (past year)			
None	3.0 (1.9–4.1)	1.00 (–)	1.00 (–)
Once a month or less	15.3 (12.4–18.1)	5.60 (3.95–7.94)	3.12 (1.75–5.53)
2–3 times a month or more	39.1 (32.2–45.9)	19.89 (13.06–30.29)	8.19 (4.06–16.53)

[a] Moderate sampling variability; interpret with caution.

grades 10–12 included in our study sample. This is of concern given another of our findings: almost one quarter of youth in grades 10–12 reported engaging in AmED at least once in the past year. At the same time, no association with driving under the influence or being a passenger of a driver under the influence was observed for youth who consumed alcohol and energy drinks, but not on the same occasion.

Our finding that AmED users were more likely to DUIC and RWCD has not yet been reported among high school students prior to this study, and suggests that AmED users are more prone to overall risk-taking behaviours beyond the physiological mechanisms that may directly impact judgement related to drinking and driving. This is supported by findings in the literature on other types of risk taking and harm among AmED users such as heavy binge drinking (Woolsey et al., 2010) and sexual risk taking (Miller, 2012). As such, risky driving behaviours and AmED may be linked through a more complex risk-taking personality, emerging from one of several psychosocial theoretical models in the literature (e.g. low self-control, problem behaviour theory, development theory) that have been proposed to explain the cluster of risks in individuals (Gottfredson and Hirschi, 1990; Costa et al., 1999; Reyna and Rivers, 2008; Griffin et al., 2012). As such, engaging in AmED use represents a potentially useful marker of broader risk-taking behaviour among youth.

Our study also indicates that it is the group of youth who mix alcohol and energy drinks, rather than those who use both on different occasions that are more likely than alcohol-only users to engage in heightened risk behaviours. Equally important is the finding that AmED users exhibited significantly heightened risks relative to alcohol use alone, which represents an important contribution to our understanding of drinking and driving. In the driving literature, drinking and driving remains the most robust indicator for crash involvement leading to injury and death, with few additive effects from the combined use with other substances (Mayhew et al., 1986). While we cannot test this in the context of AmED use just prior to driving, our results suggest AmED use produces distinct harms above and beyond alcohol alone.

O'Brien et al. (2013) found that injury requiring medical treatment was associated with AmED use among college students, but that sensation seeking moderated the risk of this outcome. While we adjusted for many important covariates, the 2014–2015 CSTADS questionnaire did not assess sensation seeking tendencies. It is possible that youth who mix alcohol with energy drinks do so to satisfy sensation seeking tendencies. Future studies should aim to determine whether mixing alcohol with energy drinks has long-term impact on risk behaviours, and if so, through what mechanism, and whether sensation seeking impacts this relationship.

The present study has several limitations which should be considered when interpreting findings. First, survey items around driving under the influence are posed within an hour of consuming one or more drinks of alcohol or within 2 h of using cannabis. These questions do

not fully assess level of impairment, which depends on driver characteristics (i.e. weight, sex) and on the quantity of alcohol or cannabis consumed (Jones and Andersson, 1996; Watson et al., 1981). Second, driving under the influence and riding with a driver under the influence are both assessed over the past 30 days, while alcohol and energy drink use is assessed over the past year, and therefore no causative or temporal relationship can be established between the two. This measure may have missed students who have ever engaged in these behaviours, but not in the past 30 days. Third, limiting results to students with a driver's license would have likely increased rates of driving under the influence; however, CSTADS did not ask about licensed-driver status. Fourth, as this is a self-reported survey, the results are subject to several forms of potential bias, such as social desirability bias. Finally, generalizability to all youth in Canada could have been impacted by low participation of youth in New Brunswick, and by not including youth from the three territories, youth who were not at school on the designated day of the survey, youth from schools on reserves, and youth who had dropped out of school.

5. Conclusions

Driving under the influence of alcohol and cannabis, or being a passenger of a driver under the influence, puts youth at a higher risk for serious harm. After adjusting for covariates, youth who engaged in AmED in the past year were more likely to engage in a range of risky driving behaviours including DUIA, DUIC, and RWCD in the past 30 days. This is of great concern, given the fact that almost 1 in 4 youth in this study reported AmED use, and due to the potential for harm associated with driving under the influence of alcohol and drugs. While the exact mechanism of this association could not be determined with cross-sectional data, the literature suggests that AmED users have higher sensation seeking tendencies or an increased tendency to possess psychosocial markers for risk taking. Physiological mechanisms linked to drinking and driving, more specifically, could not be inferred from the current study; however, the literature suggests a combination of loss of psychomotor control, lower self-perceived levels of intoxication and increase motivation to drink. Future studies should seek to determine why youth who engaged in AmED have a higher risk profile, and to determine whether targeted prevention strategies can help to reduce harm and among this group.

Competing interests

The authors have no competing interests to report.

Conflicts of interest

None.

Acknowledgements

This manuscript was supported by the Canadian Cancer Society grant #2011-701019, through the Propel Centre for Population Health Impact. Data used for this research was taken from Health Canada's Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS; formerly Youth Smoking Survey), which was conducted for Health Canada by the Propel Centre at the University of Waterloo. Health Canada has not reviewed, approved, nor endorsed this research. Any views expressed or conclusions drawn herein do not necessarily represent those of Health Canada.

References

Asbridge, M., Langille, D.B., 2013. Nova Scotia Student Drug Use Survey: Technical Report. (Halifax, NS).

Asbridge, M., Wickens, C., Mann, R.E., Cartwright, J., 2016. Alcohol, cannabis, and new drivers. In: Fisher, D., Caird, J., Horrey, W.J., Trick, L. (Eds.), Handbook of Teen and Novice Drivers: Research, Practice, Policy, and Directions. CRC Press, Baco Raton, FL, pp. 150–168.

Azagba, S., Langille, D., Asbridge, M., 2013. The consumption of alcohol mixed with energy drinks: prevalence and key correlates among Canadian high school. C Open. E19–26.

Berger, L., Fendrich, M., Fuhrmann, D., 2014. Negative consequences beyond hazardous drinking in college. Addict. Behav. 38 (9), 2428–2432.

Bingham, C.R., Shope, J.T., Tang, X., 2005. Drinking behaviour from high school to young adulthood: differences by college education. Alcohol. Clin. Exp. Res. 29 (12), 2170–2180.

Centers for Disease Control and Prevention, 2014. Youth risk behavior surveillance — United States, 2013. Morb. Mortal. Wkly Rep. 63 (4).

Centers for Disease Control and Prevention, 2017. Fact Sheets - Alcohol and Caffeine. Available from: https://www.cdc.gov/alcohol/fact-sheets/caffeine-and-alcohol.htm (cited 2017 Aug 9).

Chen, M., Grube, J.W., Nygaard, P., Miller, B.A., 2008. Identifying social mechanisms for the prevention of adolescent drinking and driving. Accid. Ann. Prev. 40 (2), 576–585.

Costa, F.M., Ph, D., Jessor, R., Ph, D., Turbin, M.S., 1999. Transition into adolescent problem drinking: the role of psychosocial risk and protective factors. J. Stud. Alcohol 60, 480–490.

Costa, B.M., Hayley, A., Miller, P., 2014. Young adolescents' perceptions, patterns, and contexts of energy drink use. A focus group study. Appetite 80, 183–189. Available from: https://doi.org/10.1016/j.appet.2014.05.013.

Emond, J.A., Sargent, J.D., Gilbert-diamond, D., 2015. Patterns of energy drink advertising over US television networks. J. Nutr. Educ. Behav. 47, 120–126. Available from: https://doi.org/10.1016/j.jneb.2014.11.005.

Ferreira, S., De Mello, M., Pompeia, S., de Souza-Formigoni, M., 2006. Effects of energy drink ingestion on alcohol intoxication. Alcohol. Clin. Exp. Res. 30 (4), 598–605.

Gottfredson, M.R., Hirschi, T., 1990. A General Theory of Crime. Stanford University Press (297 pp.).

Government of Canada, 2016. Summary of Results: Canadian Student Tobacco, Alcohol and Drugs Survey 2014–2015. Available from: https://www.canada.ca/en/health-canada/services/canadian-student-tobacco-alcohol-drugs-survey/2014-2015-summary.html (cited 2017 Feb 1).

Griffin, K.W., Scheier, L.M., Acevedo, B., Grenard, J.L., 2012. Long-term effects of self-control on alcohol use and sexual behavior among urban minority young women. Int. J. Environ. Res. Public Health 9, 1–23.

de Haan, L., de Haan, H.A., van de Palen, J., Olivier, B., Verster, J.C., 2012. Effects of consuming alcohol mixed with energy drinks versus consuming alcohol only on overall alcohol consumption and negative alcohol-related consequences. Int. J. Gen. Med. 5, 953–960.

Harris, J.L., Schwartz, M.B., Brownell, K.D., 2011. Sugary Drink Food Advertising to Children and Teens Score (FACTS): Evaluating Sugary Drink Nutrition and Marketing to Youth. (New Haven, Connecticut).

Health Canada: Food Directorate - Health Products and Food Branch, 2013Health Canada: Food Directorate - Health Products and Food B. Category specific guidance for temporary marketing authorization - caffeinated energy drinks. Available from: https://www.canada.ca/en/health-canada/services/food-nutrition/legislation-guidelines/guidance-documents/category-specific-guidance-temporary-marketing-authorization-caffeinated-energy-drinks.html (cited 2017 Jun 28).

Jones, A.W., Andersson, L., 1996. Influence of age, gender, and blood-alcohol concentration on the disappearance rate of alcohol from blood in drinking drivers. J. Forensic Stud. 41 (6), 922–926.

Khan, S.R., Cottler, L.B., Striley, C.W., 2016. Correlates of use of alcohol mixed with energy drinks among youth across 10 US metropolitan areas. Drug Alcohol Depend. 163, 236–241. Available from: https://doi.org/10.1016/j.drugalcdep.2016.04.030.

MADD Canada, 2012a. The Financial Cost of Impaired Driving. Available from: http://madd.ca/pages/impaired-driving/overview/the-financial-cost-of-impaired-driving/ (cited 2017 Nov 1).

MADD Canada, 2012b. Statistics - Alcohol and Drug Presence in Fatal Motor Vehicle Crashes. Available from: http://madd.ca/pages/impaired-driving/overview/statistics/ (cited 2017 Nov 1).

Marczinski, C.A., 2011. Alcohol mixed with energy drinks: consumption patterns and motivations for use in U.S. college students. Int. J. Environ. Res. Public Health 8, 3232–3245.

Marczinski, C.A., Fillmore, M.T., 2014. Energy drinks mixed with alcohol: what are the risks? Nutr. Rev. 72 (S1), 98–107.

Martz, M.E., Patrick, M.E., Schulenberg, J.E., 2015. Alcohol mixed with energy drink use among U.S. 12th-grade students: prevalence, correlates, and associations with unsafe driving. J. Adolesc. Health 56 (5), 557–563.

Mayhew, D.R., Donelson, A.C., Beirness, D.J., Simpson, H.M., 1986. Youth, alcohol and relative risk of crash involvement. Accid. Anal. Prev. 18 (4), 273–287.

McDonald, C.C., Sommers, M.S., Fargo, J.D., 2014. Risky driving, mental health, and health-compromising behaviours: risk clustering in late adolescents and adults. Inj. Prev. 20 (6), 365–372. Available from: http://injuryprevention.bmj.com/cgi/doi/10.1136/injuryprev-2014-041150.

Mcguinness, T.M., 2011. Update on energy drinks and youth. J. Psychol. Nurs. 49 (12), 17–20.

Miller, K.E., 2012. Alcohol mixed with energy drink use and sexual risk-taking: casual, intoxicated, and unprotected sex. J. Caffeine Res. 2 (2), 62–69.

Minaker, L., Bonham, A., Elton-Marshall, T., Leos-Toro, C., Wild, C., Hammond, D., 2017. Under the influence: a cross-sectional examination of prevalence and correlates of alcohol and marijuana consumption in relation to youth driving and passenger behaviours in Canada from 2014/2015 CSTADS. Can. Med. Assoc. J. Open. 5 (2), E386–94.

O'Brien, M.C., Mccoy, T.P., Egan, K.L., Goldin, S., Rhodes, S.D., Wolfson, M., 2013. Caffeinated alcohol, sensation seeking, and injury risk. J. Caffeine Res. 3 (2), 59–66.
O'Malley, P.M., Johnston, L.D., 2013. Driving after drug or alcohol use by US high school seniors, 2001 – 2011. Am. J. Public Health 103 (11), 2027–2034.
Patrick, M., Maggs, J., 2014. Energy drinks and alcohol: links to alcohol behaviors and consequences across 56 days. J. Adolesc. Health 54 (4), 454–459.
Pennay, A., Lubman, D.I., 2012. Alcohol and energy drinks: a pilot study exploring patterns of consumption, social contexts, benefits and harms. BMC. Res. Notes 5, 369–379 (Available from: BMC Research Notes).
Propel Centre for Population Impact: University of Waterloo About the Canadian Student Tobacco, Alcohol and Drug Survey. Available from: https://uwaterloo.ca/canadian-student-tobacco-alcohol-drugs-survey/about (cited 2017 Jul 17).
Reid, J.L., Mccrory, C., White, C.M., Martineau, C., Vanderkooy, P., Fenton, N., et al., 2017a. Consumption of caffeinated energy drinks among youth and young adults in Canada. Prev. Med. Reports 5, 65–70. Available from: https://doi.org/10.1016/j.pmedr.2016.11.012.
Reid, J., Hammond, D., Raynard, V., Madill, C., Burkhalter, R., 2017b. Tobacco Use in Canada: Patterns and Trends. (Waterloo, ON).
Reissig, C.J., Strain, E.C., Griffiths, R.R., 2009. Caffeinated energy drinks — a growing problem. Drug Alcohol Depend. 99, 1–10.
Reyna, V.F., Rivers, S.E., 2008. Current theories of risk and rational decision making. Dev. Rev. 28 (1), 1–11.
Roemer, A., Stockwell, T.I.M., 2017. Alcohol mixed with energy drinks and risk of injury: a systematic review. J. Stud. Alcohol Drugs 78, 175–183.
Rosenfeld, L.S., Mihalov, J.J., Carlson, S.J., Mattia, A., 2014. Regulatory status of caffeine in the United States. Nutr. Rev. 72 (s1), 23–33.
Royal Canadian Mounted Police, 2016. Youth Impaired Driving. Available from: http://www.rcmp-grc.gc.ca/cycp-cpcj/id-cfa/index-eng.htm#laws (cited 2017 Nov 1).
SAS Institute Inc., 2013. SAS. SAS Institute Inc., Cary, NC, USA.
Snipes, D.J., Jeffers, A.J., Green, B.A., Benotsch, E.G., 2015. Addictive behaviors alcohol mixed with energy drinks are robustly associated with patterns of problematic alcohol consumption among young adult college students. Addict. Behav. 41, 136–141. Available from: https://doi.org/10.1016/j.addbeh.2014.10.010.
Statistics Canada, 2011. Census Profile. Available from: http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E (cited 2017 Jul 18).
Statistics Canada, 2015. Census Metropolitan Area (CMA) and Census Agglomeration (CA). Available from: http://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo009-eng.cfm (cited 2017 Jul 18).
Terry-McElrath, Y.M., O'Malley, P.M., Johnston, L.D., 2014. Energy drinks, soft drinks, and substance use among United States secondary school students. J. Addict. Med. 8 (1), 6–13.
Tse, E.C., Tse, E.C.A., 2011. comparative analysis of alcohol consumption pattern among global university students. In: ICHRIE Conference, pp. 12.
Tucker, J.S., Troxel, W.M., Ewing, B.A., D'Amico, E.J., 2016. Alcohol mixed with energy drinks: Associations with risky drinking and functioning in high school. Drug Alcohol Depend. 167, 36–41. Available from: https://doi.org/10.1016/j.drugalcdep.2016.07.016.
U.S. Food and Drug Administration, 2017. Why isn't the amount of caffeine a product contains required on a food label? Available from: https://www.fda.gov/aboutfda/transparency/basics/ucm194317.htm (cited 2017 Aug 2).
Verster, J.C., Benson, S., Scholey, A., 2014. Motives for mixing alcohol with energy drinks and other nonalcoholic beverages, and consequences for overall alcohol consumption. Int. J. Gen. Med. 7, 285–293.
Watson, P., Watson, I., Batt, R., 1981. Prediction of blood alcohol concentrationg in human subjects: updating the Widmark equation. J. Stud. Alcohol 42 (7), 547–556.
Williams, R.D., Housman, J.M., Woolsey, C.L., Sather, T.E., 2017. High-risk driving behaviors among 12th grade students: differences between alcohol-only and alcohol mixed with energy drink users. Subst. Use Misuse 0 (0), 1–6. Available from: https://doi.org/10.1080/10826084.2017.1327973.
Woolsey, C., Waigandt, A., Beck, N.C., 2010. Athletes and energy drinks: reported risk-taking and consequences from the combined use of alcohol and energy drinks. J. Appl. Sport Psychol. 22, 65–71.
Woolsey, C.L., Jacobson, B.H., Williams, R.D.J., Barry, A.E., Davidson, R.T., Evans, M.W.J., et al., 2015. A comparison of the combined-use of alcohol & energy drinks to alcohol-only on high-risk drinking and driving behaviors. Subst. Use Misuse 50 (1), 1–7.