

# Adverse effects of caffeinated energy drinks among youth and young adults in Canada

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# Disclosure Statement

- I have no affiliation (financial or otherwise) with a pharmaceutical, medical device or communications organization.

# Energy drinks suspected to have caused deaths of 3 Canadians

Three teens have died after drinking popular energy drinks like Red Bull, and dozens of other Canadians have suffered serious side effects, a Star investigation has found.



## Girl, 14, Died 'After Drinking Two Cans Of Monster Energy Drink'

Keith Kendrick Parentish UK



A 14-year-old girl collapsed and died after having two cans of a fashionable caffeine-rich drink, billed by the makers as a 'killer energy brew'.

Anais Fournier suffered a heart attack which her family claims was brought on by 'caffeine toxicity' after she drank the [Monster Energy](#) drinks.

The [teenager](#), who had a disorder that can weaken blood vessels, died two days before Christmas last year after the drink affected her heart's ability to pump blood.

Now her family is suing Monster Beverage Corp as the US Food and Drug

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## After Laval teen's death, Éduc'alcool calls for more regulations on alcoholic energy drinks

PRESSE CANADIENNE

Published on: March 3, 2018 | Last Updated: March 3, 2018 12:06 PM EST

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### BUSINESS DAY

## Monster Energy Drink Cited in Deaths

By BARRY MEIER OCT. 22, 2012

Five people may have died over the past three years after drinking Monster Energy, a popular energy drink that is high in caffeine, according to incident reports recently released by the [Food and Drug Administration](#).

The reports, like similar filings for other medical devices, do not provide details about the deaths or other health problems. The Freedom of Information Act records show that the girl who died in December had drunk two cans of Monster Energy on the day she died. Last week, Wendy Crossland filed a lawsuit against Monster Beverage, a company that used to be known as Hansen Natural. She said about the risk of caffeine in energy drinks last week that

## Coroner says South Carolina teenager died after drinking several high-caffeine drinks

'Energy drink was basically chugged,' coroner says of death of Davis Allen Cripe

Thomson Reuters - Posted: May 16, 2017 9:33 AM ET | Last Updated: May 16, 2017



Davis Allen Cripe, 16, died about an hour after collapsing in a high school near Columbia, S.C. (Davis Allen Cripe/Instagram)

A South Carolina teenager who collapsed in a high school classroom last month died because he drank several highly caffeinated drinks too quickly, a coroner says.

# Adverse effects of energy drinks

- ➔ Adverse effects of energy drink consumption reported in various sources: clinical trials, case reports, ER visits, poison center calls
- ➔ **US:** FDA identified **>30 deaths** linked to energy drinks, 2004-2012<sup>1,2</sup>
- ➔ **Canada:** 35 serious side effects of energy drinks and **3 deaths** reported to Health Canada, 2003-2012<sup>3</sup>
- ➔ Adverse event reporting may underestimate

## Sources:

1. US Food and Drug Administration. Adverse event reports allegedly related to RedBull. Available from: <http://www.fda.gov/downloads/AboutFDA/CentersOffices/OfficeofFoods/CFSAN/CFSANFOIAElectronicReadingRoom/UCM328525.pdf>
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3. Bruser D. Energy drinks suspected to have caused deaths of 3 Canadians. Toronto Star. 2012 Nov 18. Available from: [https://www.thestar.com/news/canada/2012/11/18/energy\\_drinks\\_suspected\\_to\\_have\\_caused\\_deaths\\_of\\_3\\_canadians.html](https://www.thestar.com/news/canada/2012/11/18/energy_drinks_suspected_to_have_caused_deaths_of_3_canadians.html)

# Caffeine

➔ **Caffeine generally safe**, but associated with **some adverse effects**<sup>1</sup>

- Common: anxiety, headache and insomnia<sup>2,3</sup>
- Rare: vomiting/abdominal pain, hypokalemia, hallucinations, seizures, arrhythmias, death<sup>2</sup>

➔ Youth may be more susceptible to caffeine<sup>4</sup>

➔ Health Canada **recommended maximum caffeine intake**:<sup>5</sup>

- 85 mg/day for children aged 10-12
- ≤2.5 mg/kg body weight for adolescents age 13+

## Sources:

1. IOM (Institute of Medicine). Caffeine in food and dietary supplements: Examining safety: Workshop summary. Washington, DC: The National Academies Press; 2014.

2. Seifert SM, Schaechter JL, Hershorin ER, Lipshultz SE. Health effects of energy drinks on children, adolescents, and young adults. *Pediatr*. 2011;127:511-28.

3. US Food and Drug Administration. Select Committee on GRAS Substances (SCOGS) Opinion: Caffeine; 1978. Available from: <http://www.fda.gov/Food/IngredientsPackagingLabeling/GRAS/SCOGS/ucm256650.htm>.

4. Nawrot P, Jordan S, Eastwood J, Rotstein J, Hugenholtz A, Feeley M. Effects of caffeine on human health. *Food Addit Contam*. 2003;20(1):1-30

5. Health Canada. Caffeine in Food. Available from: <http://www.hc-sc.gc.ca/fn-an/securit/addit/caf/food-caf-aliments-eng.php>.

# Energy Drinks

- ➔ **Energy drinks** contain **caffeine**, often **other stimulants**, sugars, vitamins, amino acids (e.g., taurine), various herbal supplements<sup>1</sup>
  - other stimulants may have independent physiological effects, may interact with caffeine
- ➔ Health Canada's Expert Panel (2010):
  - “stimulant drug containing drinks”
  - probability of serious adverse events low, but due to high volume of use, the **risk of adverse events “is considered to be a public health issue.”**<sup>2</sup>

Sources:

1. Higgins JP, Tuttle TD, Higgins CL. Energy beverages: content and safety. Mayo Clin Proc. 2010;85:1033-1041.
2. MacDonald N, Hamilton R, Malloy P, Moride Y, Shearer J. Report by the Expert Panel on Caffeinated Energy Drinks. Ottawa: Health Canada; 2010 [cited 2016 Aug 17]. Available from: [http://www.hc-sc.gc.ca/dhp-mps/alt\\_formats/pdf/prodnatur/activit/groupe-expert-panel/report\\_rapport-eng.pdf](http://www.hc-sc.gc.ca/dhp-mps/alt_formats/pdf/prodnatur/activit/groupe-expert-panel/report_rapport-eng.pdf).

## Energy drinks' non-caffeine ingredients may affect heart

Why the multiple ingredients in energy drinks may need more scrutiny when consumed in high volumes

CBC News - Posted: Apr 26, 2017 6:33 PM ET | Last Updated: May 1, 2017



The multiple ingredients in different energy drinks (CBC Press)

Concerns about energy drinks and other ingredients in the beverages

The findings, published Wednesday, were based on a small study of 18 healthy adolescents who drank an energy drink or a control drink.

## Energy drinks tied to dozens of adverse reactions in Canada

Doctors in Nova Scotia recommend ban on the sale of energy drinks to under-19s

CBC News - Posted: Nov 16, 2012 11:58 AM ET | Last Updated: November 16, 2012



## U of C researcher warns parents about dangers of high-caffeine energy drinks

Drinks are often marketed to children, says researcher

Jennifer Lee - CBC News - Posted: Feb 10, 2018 5:30 AM MT | Last Updated: February 10, 2018



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### HEALTH

## Energy drinks are all the buzz. But they may also be dangerous.

As young people consume more and more energy drinks, sometimes mixed with alcohol, new research shows they can raise blood pressure and stress levels

by Christopher Labos Jan 12, 2016



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POSITION STATEMENT

## Energy and sports drinks in children and adolescents

Posted: Oct 6 2017

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Paediatr Child Health, 2017;22(7):406-410

### Abstract

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1. Canadian Paediatric Society. Position Statement: Energy and sports drinks in children and adolescents. <https://www.cps.ca/en/documents/position/energy-and-sports-drinks>
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3. Office of the Chief Medical Officer of Health, New Brunswick. Position statement: energy drinks. Available from: <http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/HealthyPeople/Dialogue/PositionStatementEnergyDrinks.pdf>.
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5. Arria AM, O'Brien MC. The high risk of energy drinks. JAMA. 2011;305:600-601
6. Canadian Beverage Association. Energy drink information. 2015. Available from: <http://energydrinkinformation.ca/>

# Research Objectives

- ➔ Assess **adverse events from energy drinks** among a population-based sample of youth and young adults in Canada, including reports of seeking medical attention
- ➔ Assess **adverse events from coffee**, for comparison

# Methods

- ➔ **Online survey**
- ➔ November-December 2015
- ➔ National sample (N=2,055)
- ➔ Youth (age 12-17) & young adults (age 18-24)
- ➔ Recruited from consumer panel

# Adverse effects

➔ “Have you ever experienced any of the following after drinking [**an energy drink / COFFEE**]:”

- “Jolt and crash” episodes (feeling of increased alertness and energy followed by a sudden drop in energy)
- Headaches
- Jittery/shaking
- Difficulty sleeping
- Fast heart beat
- Chest pain
- Nausea/vomiting/diarrhea
- Seizures
- Decreased sexual performance
- Dental pain
- Other
- None of the above

➔ If “fast heart beat”, “chest pain”, or “seizures” selected, asked to confirm: “**How many times have you experienced [effect] after consuming [energy drinks / COFFEE]?**” (Never, Once, More than once)

- “Never” excluded from estimates

## Context for adverse effects

➔ “When you experienced side effects, **how many [energy drinks/ cups of coffee]** did you consume?”

- ➔ **For energy drinks:** Please enter the number of each type/size that you had in the boxes below.  
[Images of energy shot, 250mL can, 473mL can shown]
- ➔ **For coffee:** Please enter the number

➔ “When you experienced side effects after consuming **[energy drinks/COFFEE]**, were you also ...” (Select all that apply)

- Participating in sports or physical activity
- Drinking alcohol
- Taking recreational drugs (e.g., marijuana)
- Taking medication(s)
- Consuming other caffeinated products ([energy drinks/coffee], supplements, etc.)
- None of these

# Seeking medical attention

- ➔ “Did you seek medical help or talk to a health professional about any of these side effects?” (yes/no)
- ➔ “For what side-effect(s) did you seek medical help?”
- ➔ [If no:] “Did you consider seeking medical help?” (yes/no)

The DAWN Report  
January 10, 2013

### Update on Emergency Department Visits Involving Energy Drinks: A Continuing Public Health Concern

Energy drinks are flavored beverages containing high amounts of caffeine and typically other additives, such as vitamins, taurine, herbal supplements, creatine, sugars, and guarana, a plant product containing concentrated caffeine. These drinks are sold in cans and bottles and are readily available in grocery stores, vending machines, convenience stores, and bars and other venues where alcohol is sold. These beverages provide high doses of caffeine that stimulate the central nervous system and cardiovascular system. The total amount of caffeine in a can or bottle of an energy drink varies from about 80 to more than 500 milligrams (mg), compared with about 100 mg in a 5-ounce cup of coffee or 50 mg in a 12-ounce cola.<sup>1</sup> Research suggests that certain additives may compound the stimulant effects of caffeine. Some types of energy drinks may also contain alcohol, producing a hazardous combination; however, this report focuses only on the dangerous effects of energy drinks that do not have alcohol.

**IN BRIEF**

- The number of emergency department (ED) visits involving energy drinks doubled from 10,068 visits in 2007 to 20,783 visits in 2011
- Among energy drink-related ED visits, there were more male patients than female patients; visits doubled from 2007 to 2011 for both male and female patients

# Analysis

## ➔ **Weighted estimates**

- Based on 2011 National Household Survey weighted proportions for 40 demographic groups: age group (12-14, 15-17, 18-19, 20-24) by sex (male, female) by region (BC, Prairies, ON, QC, Atlantic)

## ➔ **Generalized Estimating Equations models:**

- To test differences in the prevalence of adverse events for energy drinks and coffee

# Sample Characteristics Unweighted (N=2,055)

Characteristic	% (n)
<b>Sex</b>	
Male	50.6 (1039)
Female	49.4 (1016)
<b>Age category</b>	
12-14	19.5 (401)
15-17	30.2 (621)
18-20	16.4 (335)
21-24	33.9 (697)
<b>Race/Ethnicity</b>	
White	73.6 (1513)
Chinese	4.5 (92)
South Asian	4.3 (88)
Black	3.2 (65)
Aboriginal	3.1 (63)
Other/Mixed	9.8 (202)
Don't know/Not stated	1.6 (32)

Characteristic	% (n)
<b>Language</b>	
English	60.3 (1240)
French	39.7 (815)
<b>Province</b>	
Alberta	9.0 (185)
British Columbia	7.3 (150)
Manitoba	3.0 (62)
New Brunswick	1.2 (25)
Newfoundland & Labrador	0.6 (12)
Nova Scotia	2.9 (59)
Ontario	30.9 (636)
Prince Edward Island	0.6 (12)
Quebec	43.2 (887)
Saskatchewan	1.3 (27)

# Sample Characteristics Unweighted (N=2,055)

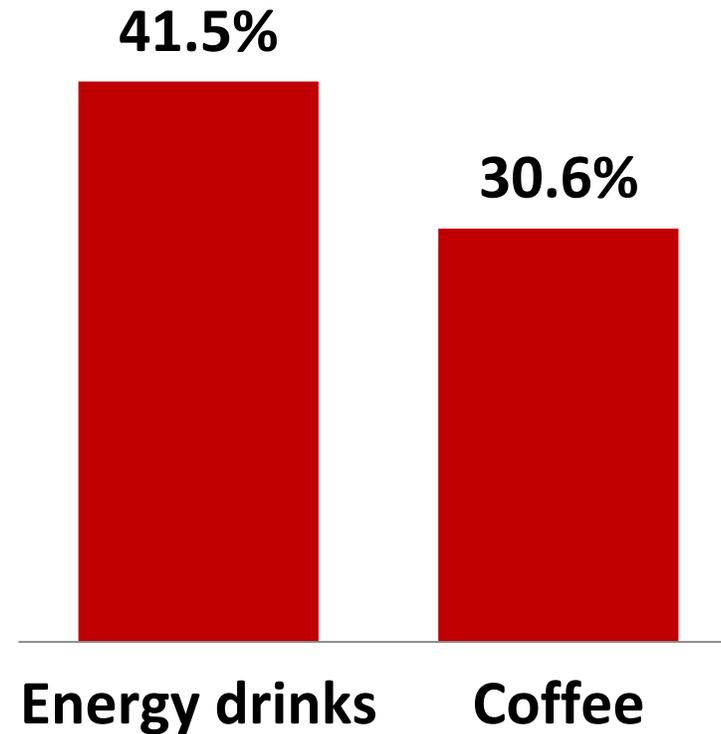


➔ 73.8% ever tried **energy drinks** (n=1516)



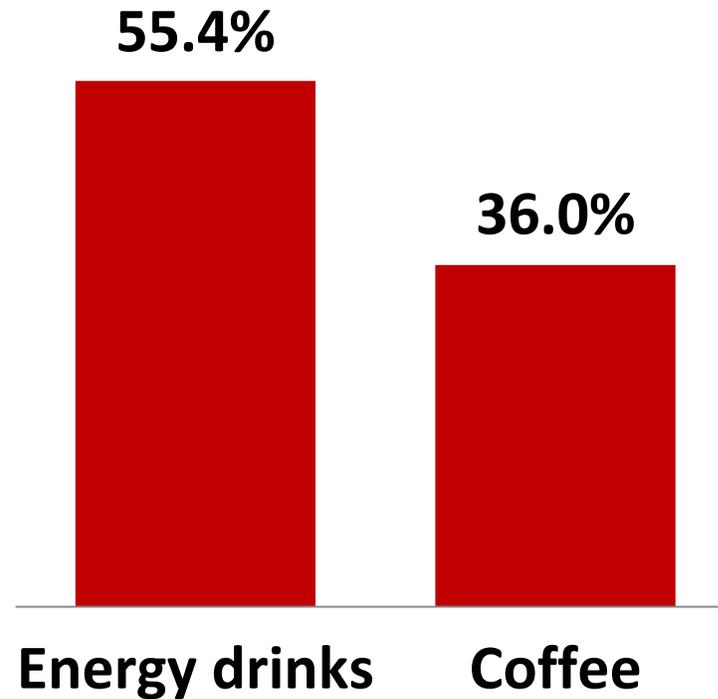
➔ 84.7% ever tried **coffee** (n=1741)

## Reported ANY adverse event, among **all respondents**



**OR=1.63** (95% CI: 1.46-1.81)

## Reported ANY adverse event, among 'ever' consumers



**OR=2.67** (95% CI: 2.01-2.56)

# Adverse effects Among ever-consumers

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## Energy drinks

(n=1516)

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Jittery/shaking	<b>26.5%</b>
Fast heart beat**	<b>24.7%</b>
Difficulty sleeping	<b>24.1%</b>
“Jolt and crash” episodes	<b>22.5%</b>
Headaches	<b>18.3%</b>
Nausea/vomiting/diarrhea	5.1%
Chest pain**	3.6%
Dental pain	1.8%
Decreased sexual performance	0.5%
Seizures**	0.2%
Other	0.8%
None of the above	<b>39.7%</b>
Don't know/Refuse to answer	4.3%

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\*\* Verified with follow-up question that asked about frequency of experiencing the effect; ‘never’ responses excluded from estimates

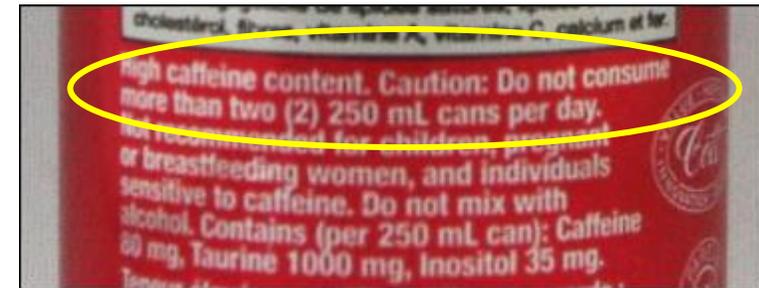
# Seeking medical attention Among ever-consumers

- ➔ **1.2%** (n=19) of **energy drink consumers** sought medical help or talked to a health professional about an adverse event(s)
  - + **1.8%** (n=28) considered it
- ➔ **0.7%** (n=12) of **coffee consumers** sought medical help or talked to a health professional about an adverse event(s)
  - + **0.7%** (n=12) considered it
- ➔ Significantly **greater proportion of energy drink consumers reported seeking or considering seeking medical help** for adverse events (vs. coffee): **OR=2.18** (95% CI: 1.39-3.41)

# Number of drinks Among those who reported adverse effects

➔ The **majority** of those who experienced adverse events from **energy drinks** had **consumed one or two** – i.e., **less than the recommended maximum**

- 50.8% (n=421) one or less
- 23.2% (n=181) two



➔ The **majority** of those who experienced adverse events from **coffee** had **consumed one or two**

- 43.0% (n=257) one or less
- 24.2% (n=152) two



# Concurrent activities Among those who reported adverse effects

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*“When you experienced side effects after consuming [energy drinks/COFFEE], were you also ...”* **Energy drinks**  
(n=865)

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Drinking alcohol **22.5%**

Participating in sports or physical activity **18.5%**

Consuming other caffeinated products 10.6%

Taking recreational drugs 8.3%

Taking medications 6.4%

None of these **48.6%**

Don't know/Refuse to answer 4.1%

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# Canada Vigilance adverse reaction online database

- ➔ Health Canada's post-market surveillance program; collects and assesses reports of suspected adverse reactions to health products marketed in Canada
  - ➔ reports submitted by health professionals and consumers on a voluntary basis, directly to Health Canada or via Market Authorization Holders
- ➔ Searched entries between 1999 and 2013 for reports of adverse reactions for energy drinks and coffee products
  - ➔ terms used for energy drinks (# number of reports retrieved): 'Energy' (n=99), 'Red bull' (n=30), 'Monster' (n=17), 'Rockstar' (n=16), '5-Hour Energy' (n=17), 'NOS' (n=7), 'Full throttle' (n=3), 'Rage' (n=1), 'Guru' (n=1), 'Xenergy/Xyience' (n=0), Amp (n=0)
  - ➔ terms used for coffee-related products: 'coffee' (n=20), 'caffeine' (n=52), 'espresso'/'expresso' (n=0), 'Starbucks' (n=0), 'Folger's' (n=0), 'Van Houtte' (n=0), 'Nestle' (n=0), 'Maxwell' (n=0), Nescafe (n=0), Second Cup (n=0), Tim Hortons (n=0)

# Results - Canada Vigilance adverse reaction online database

- ➔ 104 adverse reaction reports identified
  - ➔ 91 involving an energy drink (86.7%)
  - ➔ 14 involving a coffee beverage (13.3%)
  - ➔ 1 involved both (counted in each category)
- ➔ 4 brands (*Red Bull, 5-Hour Energy, Monster, Rockstar*) accounted for >80% of energy drink adverse reaction cases
- ➔ Majority (69.2%) of energy drink adverse reaction cases were NOT in combination with another substance
- ➔ Nearly all (92.9%) coffee adverse reaction cases were in combination with another substance (mostly Rx)

# Results - Canada Vigilance adverse reaction online database

- ➔ Across 91 cases involving energy drinks, n=350 adverse reactions reported
  - ➔ 56 (61.5% of cases) involved *increased or irregular heartbeat*
  - ➔ 15 (16.5% of cases) involved *malaise or feeling abnormal*
  - ➔ 14 (15.4% of cases) involved *vomiting*
  - ➔ Other reactions: *Psychomotor hyperactivity* (11); *Blood pressure increased or hypertension* (9); *Sleep disorder, initial insomnia or insomnia* (9); *Chest discomfort or pain* (8); *Nausea* (8); *Fatigue or lethargy* (8); *Disturbance in attention, disorientation or delirium* (8)
- ➔ Across 14 cases involving coffee, n=48 adverse reactions reported
  - ➔ *food interaction* (n=6; 42.5% of cases) and *psychomotor hyperactivity* (n=5; 35.7% of cases) most frequently reported

# Summary

- ➔ More than half of energy drink consumers reported an adverse event associated with energy drinks
  - More prevalent for energy drinks than for coffee
  - Some serious enough to seek/consider medical help (rare)
- ➔ Types of adverse events reported are consistent with data from the **Canada Vigilance Online Database** (Health Canada's post-market surveillance program that collects and assesses reports of suspected adverse reactions to health products marketed in Canada)
- ➔ Unclear to what extent adverse events from energy drinks are due to caffeine, other product constituents, or an interaction

# Strengths & Limitations

- ➔ Survey limitations: self-report, recall, attribution
- ➔ Population-based survey more inclusive than proactive event database reporting
- ➔ Unique measures: comparison product, amount, context
- ➔ Commercial panel sample

# Implications

- ➔ Evidence on energy drink use and adverse effects needed
- ➔ Reclassification of energy drinks under the Food and Drug Act (2013), ongoing monitoring of safety
- ➔ Additional regulations may be warranted (e.g., minimum age, enhanced health warnings)

## Adverse effects of caffeinated energy drinks among youth and young adults in Canada: a Web-based survey

David Hammond PhD, Jessica L. Reid MSc, Sara Zukowski BSc

### Abstract

**Background:** Energy drink consumption has increased dramatically among young Canadians, with anecdotal evidence of adverse health effects. There is a lack of population-based studies to examine the prevalence of adverse events from energy drinks, particularly among young people. The current study sought to assess adverse events from energy drinks among a population-based sample of youth and young adults in Canada.

**Methods:** An online survey was conducted in 2015 with a national sample of youth (aged 12–17 yr) and young adults (aged 18–24 yr) recruited from a consumer panel. Respondents reported prior consumption of energy drinks as well as adverse outcomes, concurrent activities associated with the outcomes and whether medical attention was sought or considered. Adverse events from coffee were also assessed for comparison. Weighted analyses are reported.

**Results:** Of the 2055 respondents, 1516 (73.8%) reported having ever consumed an energy drink, and 1741 (84.7%) reported having ever consumed coffee (unweighted). Overall, 55.4% of respondents who had ever consumed an energy drink reported that they had experienced at least 1 adverse event, including fast heartbeat (24.7%), difficulty sleeping (24.1%), headache (18.3%), nausea/vomiting/diarrhea (5.1%), chest pain (3.6%) and seizures (0.2%); 3.1% had sought or had considered seeking medical help for an adverse event. The prevalence of reported adverse events was significantly greater among energy drink consumers than among coffee consumers (36.0%) (odds ratio [OR] 2.67 [95% confidence interval (CI) 2.01–2.56]), as was the proportion who reported seeking or considering seeking medical help for adverse events (3.1% v. 1.4%) (OR 2.18 [95% CI 1.39–3.41]).

**Interpretation:** More than half of youth and young adults who had consumed energy drinks reported adverse outcomes, some serious enough to warrant seeking medical help. The adverse outcomes were consistent with the physiologic effects of caffeine but were significantly more prevalent than with other sources of caffeine such as coffee, consistent with data from national adverse event databases.

# Funding support

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**CIHR New Investigator Award** Hammond

**CIHR-PHAC Applied Chair in Public Health** Hammond



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