

Efficacy of Canadian health warning statements on caffeinated energy drinks: an experimental study among young Canadians

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Abstract

The current study examined the efficacy of health warnings on caffeinated energy drinks (CEDs). Participants aged 12–24 years ($n = 2040$) completed an online survey where they were asked to recall any existing warning statements on CED products and were randomized to one of 29 experimental warning conditions. Regression models were fitted to examine differences between conditions in product appeal, perceived safety and message recall. Overall, fewer than 30% of participants were able to accurately describe an existing CED product warning. Experimental findings indicated that exposure to CEDs with warning labels resulted in greater recall. Warnings on the back of CED cans featuring large font, a border, and a ‘caution’ heading resulted in significantly greater recall ($P < 0.05$ for all). Front-of-package ‘High source of caffeine’ labels resulted in greater recall than a quantitative description ($P < 0.001$); caffeine labels generally elicited lower product appeal ($P < 0.001$) and perceived safety ($P = 0.002$) ratings vs. no caffeine labels, and the qualitative caffeine statement elicited lower perceived safety ratings than the quantitative statement ($P = 0.02$). Existing warning statements in Canada have low levels of awareness. Warnings on CEDs could be enhanced to increase the salience of messages, with greater impact from clear, descriptive, front-of-package ‘High source of caffeine’ labels.

Introduction

The increased popularity of caffeinated energy drinks (CEDs) has been associated with a range of adverse health effects, particularly among young people [1, 2]. More than half of young people who have consumed a CED have reported experiencing an adverse event, such as fast heartbeat, difficulty sleeping, headache, nausea/vomiting/diarrhoea, chest pain or seizures [1]. Due to the elevated health risks, regulatory authorities such as Health Canada have cautioned against the use of CEDs among children, pregnant or breastfeeding women, and individuals sensitive to caffeine, as well as the use of CEDs in certain contexts, such as during sports and with alcohol [3]. Despite these recommendations, research has shown that CEDs are marketed to and used by young people in ways that run counter to these recommendations [4–11]. For example, recent studies indicate that approximately half of young adults aged 18–30 in the United States reported consuming alcohol mixed with energy drinks in the past year [10], as did almost 15% of Canadian youth in grades 9 through 12 [9]. CEDs are also popular among athletes: a study conducted in Poland found that approximately two-thirds of young athletes consumed CEDs, with 15% and 13% consuming CEDs before and after physical effort, respectively [8].

In 2012, Health Canada transitioned CEDs from the natural health products regulatory framework to the food regulatory framework, in response to recommendations of their expert advisory panel [3, 12]. As part of this transition, CEDs were granted

a Temporary Marketing Authorization [3]. Under the food regulatory framework, CEDs must adhere to maximum limits on caffeine content, marketing restrictions and the use of ‘cautionary statements’ (i.e. health warnings) on packaging. Health Canada also requires that CED labels include a quantitative declaration of the caffeine content, in addition to a ‘High caffeine content’ statement [3]. In addition, CEDs are required to include a set of warning statements on product packaging. These four statements must be grouped together, under a standardized bold heading (e.g. ‘Caution/Mise en garde’ or ‘Caution/Attention’) or presented in bold text: ‘Do not consume more than (X) container(s)/servings(s) daily’ or ‘Usage: (X) container(s)/serving(s) maximum daily’; ‘Not recommended for children, pregnant or breastfeeding women and individuals sensitive to caffeine’; and, ‘Do not mix with alcohol’ [3]. In practice, the statements are usually displayed on the back of CED cans in small font (typically 2 mm).

There is a vast literature on the impact of product health warnings on consumer perceptions and behaviour. In particular, findings from tobacco and alcohol warning label research indicate support of warning labels and their potential to contribute to positive outcomes [13–17]. Design characteristics and message content can influence salience, and in turn the effectiveness of a warning label, with the ultimate objective of changing behaviour. Collectively, the evidence indicates that small, text-only warnings have little or no impact; in contrast, large pictorial warnings that are prominently displayed can have a significant impact on consumer perceptions of risk and behaviour [13, 18–20]. Alongside large pictorial warnings, research has generally found that warnings that have contrasting borders and text (including the use of bold typeface) [20–22], signal words such as ‘Caution’ [20], and reference to a credible source of the warning [23, 24] are more effective.

To date, very little research has evaluated warnings for CEDs. Focus groups conducted with youth aged 12–18 in two Canadian cities found that most youth had never noticed the existing warnings on CED cans [25]. Further, when participants were presented with CED cans, many had difficulty locating

the warnings, and they agreed that several design characteristics, including font size, colour, contrast, and language complexity, were barriers to noticing and reading the labels [25]. Another study evaluated the impact of CED labels on purchasing behaviour of participants aged 15–30 years in the US, using an experimental marketplace with products in one of three labelling conditions: no label, a label with the caffeine content in milligrams, or a warning label listing potential negative effects of consuming excess caffeine [26]. Results showed both caffeine content and warning labels (vs. no label) significantly decreased energy drink purchasing in adolescents, but not in adults [26].

The current study sought to expand the evidence base on product warnings for CEDs, with two primary objectives. First, the study assessed awareness of existing warning statements on products among youth and young adults, the age group most likely to consume energy drinks. Second, the study also tested the efficacy of potential design changes to the warnings, with respect to their location, font size, use of headings, and use of borders, using an experimental task to assess the impact on consumer perceptions.

Methods

Data were collected via self-completed online surveys, between 3 and 22 October 2014. A full description of the study methods and sample characteristics can be found in the Technical Report (available at <http://davidhammond.ca/wp-content/uploads/2015/11/2014-CED-Technical-Report.pdf>).

Sample and recruitment

Respondents across Canada were recruited via email through the Légerweb consumer panel, which has over 400 000 active members, half of them sampled using probability-based methods [27]. Respondents aged 18–24 were recruited directly. Respondents aged 12–17 were recruited through their parents, and parental consent was obtained prior to youth accessing the survey. All respondents were provided with information about the study and

asked to give consent before participating. The survey was available in English or French, and took approximately 20 min to complete. Respondents received remuneration from Léger in accordance with their usual incentive structure, which allows respondents to earn points or monetary rewards (redeemed as cash or donated), as well as chances to win monthly prizes.

A total of 2055 respondents completed the survey. Records were deleted due to missing data on variables used for weighting (age, sex, or province; $n = 7$); respondents from the territories were also excluded ($n = 8$). Thus, a total of 2040 were retained for analysis: 1013 youth aged 12–17 and 1027 young adults aged 18–24. Sample weights were constructed based on population estimates from the 2011 National Household Survey (NHS) [28]. Sample probabilities were created for 40 demographic groups (age group by sex by region) based on weighted NHS proportions, and applied to the data set. The study was reviewed by and received ethics clearance from the Office of Research Ethics at the University of Waterloo. No personal identifiers were collected as part of the study.

Measures

Sample characteristics

Participants were asked about the following demographic characteristics: sex, age, race/ethnicity (12 categories; re-coded as white [only], mixed/other/don't know/refused or Aboriginal [any]), and province of residence (re-coded into region: British Columbia, Prairies, Ontario, Quebec or Atlantic). Participants were also asked, 'Have you ever tried an energy drink, even a few sips? (Yes/No/Don't know/Refuse to answer)'. If participants indicated 'yes', they were asked, 'How many energy drinks have you consumed in your life? (None/1 drink or less/2–5 drinks/6–10 drinks/11–20 drinks/21–50 drinks/51–100 drinks/More than 100 drinks/Don't know/Refuse to answer)'. Responses from these two questions were re-coded as never consumed/none, >0–20 drinks, 21–100 drinks, >100 drinks; 'Don't know' responses were coded as never

consumed/none, and 'Refuse to answer' responses were excluded.

Awareness and recall of required warning statements on products

Participants were asked, 'As far as you know, are there any warning statements on cans or bottles of energy drinks? (Yes/No/Don't know/Refuse to answer)'. Those indicating 'yes' were asked to 'describe the warning messages or statements' using an open-ended text box; the prompt included, 'If you have seen more than one warning, please describe as many as possible.' Responses were coded for correspondence with six components of the required statements: (i) Caffeine content (qualitative and quantitative statements were coded as correct [e.g. high in caffeine, contains caffeine, or X mg caffeine]; general statements mentioning caffeine were also included as correct, even if the details were not necessarily displayed on cans [e.g. 'caffeine isn't good for your heart']); (ii) Maximum servings per day (statements that indicated a maximum of 1 per day, 2 per day, 500 ml, or even reference to a general limit were coded as correct; statements referring to a maximum of 3 or more per day were coded as incorrect); (iii) Not for pregnant and/or breastfeeding women (mentioning pregnancy and/or breastfeeding was coded as correct); (iv) Not for children; (v) Not for individuals sensitive to caffeine; and, (vi) Do not mix with alcohol. An index was created to indicate the number of required components recalled by each participant (range from 0–6). Responses were coded independently by two research assistants, with any differences resolved through discussion.

Experimental manipulation of warnings

Participants were randomized to one of 29 experimental conditions, representing various combinations of six label attributes, as illustrated in [Supplementary Appendices SA and SB](#): (i) presence or absence of the existing warning statements ('Do not consume more than 2 containers/servings daily. Not recommended for children, pregnant or breastfeeding women and individuals sensitive to

caffeine. Do not mix with alcohol’); (ii) font size (small vs. large); (iii) presence of a border on the warning (vs. absence); (iv) use of the signal word ‘CAUTION’ on the warning (vs. absence); (v) caffeine content label (none, ‘High source of caffeine’, or ‘160 mg of caffeine’); and, (vi) presence of a border on the caffeine content label (vs. absence). Participants viewed images of both the front and back of an energy drink can (Red Bull) displaying the warning label(s) corresponding to the condition to which they were assigned. The images shown on the screen corresponded to the actual size of cans. While the product images were displayed on screen, respondents used 1–10 scales to rate perceived safety (‘Is this product safe for people your age to drink?’), where 1 = Not at all safe and 10 = Extremely safe and product appeal (‘Would you be interested in trying this product?’), where 1 = Not at all interested and 10 = Extremely interested). Afterwards, respondents were asked to ‘describe any health warnings or statements that appeared on the energy drink on the previous screen’, using open-ended fields, and were not permitted to go back to the previous screen. An index was created to indicate the number of warning components recalled (range 0–6), by coding responses for the six content themes of the warnings: caffeine content, maximum servings per day, not for pregnant and/or breastfeeding women, not for children, not for individuals sensitive to caffeine, and do not mix with alcohol. Recall of caffeine content information was also assessed as a separate measure (coded yes/no).

Analysis

Descriptive statistics were used to determine awareness and recall of existing warning statements. A logistic regression model was fitted to examine correlates of recalling any warnings on CEDs (0 = no warnings recalled [including participants who indicated ‘don’t know’], 1 = one or more warnings recalled). The model included lifetime consumption of CEDs, sex, age category, survey language, race/ethnicity, and region. Chi-square tests were used to check randomization to

experimental conditions, for sex, age category, and ever consuming CEDs. The proportion of males and females was significantly different across conditions ($P = 0.047$). Therefore, regression models described below were adjusted for sex and age category in all cases. Regression models testing the experimental task were conducted in two steps: first, models including all respondents were fitted to test exposure to a warning/front-of-package caffeine label on the energy drink can (separate models for front and/or back); second, models were fitted among those who were exposed to products with warnings, to test specific attributes (font size, presence of a border, presence of a ‘CAUTION’ heading, type of caffeine statement) of the manipulated warnings (separate models for front and/or back). Prevalence estimates related to recall of existing warning statements are weighted; however, results from the experimental component are unweighted, as per standard practice. Analyses were conducted using IBM SPSS version 24.

Warning recall

Poisson regression models were fitted to test differences in the number of warning components recalled between experimental conditions, for the back-of-package warnings: first, for the presence or absence of a warning; second, whether the warning on the back of the can featured large or small font, the presence of a border, and the presence of a ‘CAUTION’ heading.

Front-of-package caffeine label recall

Binary logistic regression models were fitted to test differences in the recall of a caffeine label between experimental conditions, for the front-of-package caffeine labels: first, for the presence or absence of a label; second, for the caffeine content label (‘160 mg of caffeine’ vs. ‘High source of caffeine’), and the presence of a border.

Product appeal and perceived safety

Linear regression models were fitted to examine differences in mean rating of product appeal and

product safety between experimental conditions: for the presence or absence of a warning on the back and subsequently, whether the warning featured large or small font, the presence of a border, and the presence of a 'CAUTION' heading; and, for the presence of a caffeine label on the front and subsequently, for the caffeine content label ('160 mg of caffeine' vs. 'High source of caffeine'), and presence of a border.

Results

Sample characteristics

Table I shows the characteristics of respondents in the analytic sample, by age category, unweighted, and overall, unweighted and weighted.

Awareness and recall of existing warnings on CEDs

Overall, 53.0% of participants ($n = 1081$) indicated they were aware of the existing warnings on CED cans, whereas 29.6% ($n = 604$) reported 'Don't know', 17.2% ($n = 351$) reported 'No' and 0.2% ($n = 4$) refused to answer. When prompted to describe the warning(s), 28.4% of all respondents (including those who were not aware of the warnings) could recall any of the six statement components, and less than 10% recalled more than one statement component. As shown in Table II, the most commonly recalled warning statement was maximum number of servings per day (20.1%), followed by not mixing with alcohol (5.0%), caffeine content (5.0%) and not for pregnant and/or

Table I. Characteristics of respondents in the analytic sample

Characteristic	Age 12–14 ($n = 393$) unweighted % (n)	Age 15–17 ($n = 620$) unweighted % (n)	Age 18–19 ($n = 208$) unweighted % (n)	Age 20–24 ($n = 819$) unweighted % (n)	Total sample ($n = 2040$) unweighted % (n)	Total sample weighted%
Sex						
Male	51.7 (203)	52.6 (326)	34.1 (71)	39.1 (320)	45.1 (920)	51.1
Female	48.3 (190)	47.4 (294)	65.9 (137)	60.9 (499)	54.9 (1120)	48.9
Age (mean; SD)	—	—	—	—	18.3; 3.7	18.3; 3.7
Language of survey						
English	57.5 (226)	63.9 (396)	59.1 (123)	71.3 (584)	65.1 (1329)	79.0
French	42.5 (167)	36.1 (224)	40.9 (85)	28.7 (235)	34.9 (711)	21.0
Race/Ethnicity						
White (only)	79.4 (312)	78.5 (487)	65.4 (136)	70.0 (573)	73.9 (1508)	67.5
Mixed/other/do not know/refused	17.3 (68)	17.3 (107)	30.3 (63)	26.7 (219)	22.4 (457)	28.2
Aboriginal (any)	3.3 (13)	4.2 (26)	4.3 (9)	3.3 (27)	3.7 (75)	4.3
Region						
British Columbia	9.7 (38)	11.1 (69)	9.6 (20)	11.7 (96)	10.9 (223)	12.8
Prairies (AB, SK, MB)	8.4 (33)	13.9 (86)	12.0 (25)	14.2 (116)	12.8 (260)	18.6
Ontario	32.8 (129)	32.4 (201)	22.1 (46)	31.0 (254)	30.9 (630)	40.0
Quebec	43.0 (169)	36.8 (228)	51.5 (107)	38.5 (315)	40.1 (819)	22.6
Atlantic (NB, NL, NS, PEI)	6.1 (24)	5.8 (36)	4.8 (10)	4.6 (38)	5.3 (108)	6.0
Lifetime consumption of CEDs ^a						
Never/none	49.1 (193)	36.2 (224)	25.7 (53)	20.5 (168)	31.3 (638)	31.0
>0–20 drinks	44.8 (176)	51.4 (318)	59.2 (122)	53.3 (436)	51.7 (1052)	51.6
21–100 drinks	5.6 (22)	9.8 (61)	12.2 (25)	18.2 (149)	12.6 (257)	12.9
>100 drinks	0.5 (2)	2.6 (16)	2.9 (6)	8.0 (65)	4.4 (89)	4.5

AB, Alberta; SK, Saskatchewan; MB, Manitoba; NB, New Brunswick; NL, Newfoundland; NS, Nova Scotia; PEI, Prince Edward Island.

CED, caffeinated energy drink.

^a $n = 4$ missing.

Table II. Recall of warning statements on CED products

Frequency of statements recalled	% (n) (n = 2040)
Maximum servings per day	20.1% (410)
Do not mix with alcohol	5.0% (101)
Caffeine content ^a	5.0% (101)
Not for pregnant and/or breastfeeding women	4.9% (99)
Not for children	3.8% (78)
Not for individuals sensitive to caffeine	0.6% (13)
Total number of statements recalled	
0	71.6% (1461)
1	20.0% (408)
2	6.5% (133)
3	1.3% (26)
4	0.5% (11)
5	0.1% (1)
6	0.0% (0)
Mean (SD)	0.39 (0.72)

^a Qualitative or quantitative, includes general mention of caffeine or implicit.

breastfeeding women (4.9%). Lifetime consumption of CEDs was significantly associated with recall of warning messages: respondents who reported consuming more than 100 drinks (61.5%, AOR = 5.82, 95% CI = 3.54–9.58, $P < 0.001$), 21–100 drinks (46.4%, AOR = 3.59, 95% CI = 2.55–5.05, $P < 0.001$), and >0–20 drinks (29.3%, AOR = 1.97, 95% CI = 1.51–2.58, $P < 0.001$) had significantly higher odds of recalling at least one of the six components of the required statements, compared with those who reported never consuming CEDs (14.7%) See [Supplementary Table SI](#).

Experimental manipulation of warnings

Warning recall. Participants who were exposed to a warning on the back of the energy drink recalled seeing significantly more warning statements compared with those who were not exposed to a back-of-product warning (0.43 [SD = 0.97] vs. 0.23 [SD = 0.61], $\beta = 0.63$, $P < 0.001$). Significantly more warning statements were recalled by respondents who were exposed to warnings with larger font (0.56 [SD = 1.10] vs. 0.31 [SD = 0.80], $\beta = 0.63$,

$P < 0.001$), a border (0.47 [SD = 0.99] vs. 0.40 [SD = 0.95], $\beta = 0.16$, $P = 0.03$) and a ‘CAUTION’ heading (0.48 [SD = 1.02] vs. 0.39 [SD = 0.92], $\beta = 0.21$, $P = 0.01$). See [Supplementary Table SII](#).

Front-of-package caffeine label recall. Participants who were exposed to a caffeine content label (‘160 mg of caffeine’ or ‘High source of caffeine’) on the front of the energy drink can were significantly more likely to recall seeing a caffeine content message than those who were not exposed to a front-of-package label (8.1% vs. 2.5%, OR = 3.58, 95% CI = 2.10–6.10, $P < 0.001$). Those who were exposed to the ‘High source of caffeine’ label were more likely to recall seeing a statement describing the product’s caffeine content than those exposed to the ‘160 mg of caffeine’ label (11.6% vs. 4.8%, OR = 2.59, 95% CI = 1.71–3.94, $P < 0.001$). The presence of a border around the label had a marginal effect on participants’ recall of a caffeine statement (9.6% for border vs. 6.8% for no border, $P = 0.07$). See [Supplementary Table SIII](#).

Product appeal. The presence of a warning on the back of the energy drink can had no significant effect on participants’ interest in trying the energy drink (3.81 [SD = 3.00] for warning vs. 3.65 [SD = 2.99] for no warning, $P = 0.43$). See [Supplementary Table SIV](#).

Participants who were exposed to a caffeine content label on the front of the can rated their interest in trying the product as significantly lower than those who were not exposed to a caffeine label (3.61 [SD = 2.92] vs. 4.14 [SD = 3.12], $\beta = -0.51$, $P < 0.001$). The specific caffeine content label (‘160 mg of caffeine’ or ‘High source of caffeine’) had no significant effect on participants’ ratings of interest in trying the energy drink (3.73 [SD = 3.00] for ‘160 mg of caffeine’ label vs. 3.48 [SD = 2.83] for ‘High source of caffeine’ label, $P = 0.12$), nor did the presence of a border around the label (3.64 [SD = 2.89] for border vs. 3.58 [SD = 2.96] for no border, $P = 0.65$). See [Supplementary Table SV](#).

Perceived safety. The presence of a warning on the back of the energy drink can had no significant effect on the participants' ratings of the safety of the product for use by their peers (3.93 [SD = 2.59] for warning vs. 3.91 [SD = 2.61] for no warning, $P = 0.86$). See [Supplementary Table SVI](#).

Participants who were exposed to a front-of-package caffeine content label rated the product safety as significantly lower than those who were not exposed to a label (3.82 [SD = 2.56] vs. 4.18 [SD = 2.65], $\beta = -0.39$, $P = 0.002$). Those who were exposed to the 'High source of caffeine' label rated the product safety significantly lower than those exposed to the label '160 mg of caffeine' (3.65 [SD = 2.47] vs. 3.98 [SD = 2.63], $\beta = -0.31$, $P = 0.02$). The presence of a border around the label had no significant effect on product safety ratings (3.80 [SD = 2.59] for border vs. 3.83 [SD = 2.53] for no border, $P = 0.89$). See [Supplementary Table SVII](#).

Discussion

The current study indicates that approximately half of young Canadians reported seeing warning statements on energy drinks, and less than one-third were able to correctly recall any of the six message components. Indeed, 95% of respondents were unable to recall statements warning against CED consumption with alcohol, during pregnancy or by children. Although awareness of warnings was greater among participants with greater reported lifetime consumption of CEDs, which was expected given greater exposure, recall of specific statements remained low. Collectively, these findings suggest that the existing warnings mandated in Canada have little impact among youth and young adults—arguably the primary target group for the warnings. This is unsurprising given the obscure nature of the warnings, which are typically printed in extremely small font that is usually at or below the standards for legibility. This is consistent with the scientific literature on warning design, which indicates very low levels of awareness and recall for small, text-only warnings [13, 18, 20].

Results from the experiment demonstrate that enhancements in the size and prominence of warnings increased recall of messages. In particular, for warnings on the back of cans, those who were exposed to cans featuring warnings with large font, a border, and a caution heading recalled seeing more warning statements. This finding was expected, given that these design features have been shown to be effective in other domains [13, 20–22]. Still, even the larger font warnings that were tested in the current study were still very small by the standards of most warning labels. For caffeine content labels on the front of cans, participants were more likely to recall the 'High source of caffeine' label than the '160 mg of caffeine' label. Signal words such as 'Caution', or 'High in' attract attention, and so therefore the 'High source of caffeine' label may have been more salient, resulting in greater recall [20]. Furthermore, participants may be unfamiliar with what constitutes a high level of caffeine in milligrams, and therefore this quantitative description of caffeine content may not be effectively communicating any level of risk. Previous research has shown that young people are unfamiliar with caffeine intake recommendations in terms of milligrams, suggesting that when caffeine is presented this way, it may be too complex and not resonate with consumers, similar to the challenges consumers face in interpreting quantitative nutrient information on nutrition labels [29–32]. The presence of a border around the caffeine statements had no effect on participant recall, which contrasts previous research showing the use of borders to be effective [21]. The caffeine statement may have been just as salient without the border because it was presented on the front of the can, where there is a larger amount of open space, in addition to a contrasting label-background colour, thus increasing noticeability and legibility.

In terms of product ratings, the presence of a warning on the back of the can had no significant effect on product appeal or perceived safety. However, the presence of a front-of-package caffeine content label elicited lower product appeal and perceived safety ratings. This finding is consistent with previous research demonstrating that caffeine

labels, showing content in milligrams or listing potential negative effects of consuming excess caffeine, reduced demand for energy drinks among adolescents [26]. Products with the ‘High source of caffeine’ label received lower safety ratings in comparison to the ‘160mg of caffeine’ label. As mentioned previously, the use of the word ‘High in’ as a signal word may more effectively communicate risk than numbers, as has been demonstrated for nutrition labelling [33].

Limitations

This study was not without limitations. The sample was recruited through a web panel, and therefore was not probability-based, which may limit generalizability for questions related to general recall of existing warnings. However, the sample included respondents in all provinces, and survey weights were applied for questions related to general recall, to match national estimates for age, sex and geographic region. The experimental manipulation of the warning components, along with the use of real Red Bull cans, were strengths of the study. Recall of warning messages may have been overestimated, as respondents may have been cued to report some statements based on earlier questions in the survey related to safety and adverse effects. Also, the protocol may have underestimated differences attributable to the design features: design features such as size and location are most effective in attracting greater attention, but attention to the warnings was essentially forced through the experimental design. Therefore, the effects of font size, location, border, and signal word may be underestimated under study conditions compared with naturalistic exposure in the marketplace. While the purpose of this study was not to capture the impact of warnings on consumption, the association between lifetime consumption and recall should not be misinterpreted. Efforts to assess the impact of warnings on consumption are best done in longitudinal studies that use ‘pre-post’ measures before and after warnings are implemented. In addition, the message content tested in the current study reflected the existing content in mandatory statements for energy drinks in

Canada, as well as some variations suggested by Health Canada. Future research should evaluate more tailored message content to help inform warning label research.

Conclusion

The current findings suggest that the mandated warning statements on caffeinated energy drinks in Canada are largely ineffective and could be improved. Given that the labelling regulations for CEDs in Canada exceed those of most other jurisdictions, the current findings suggest that existing industry practices may have little or no impact in conveying information about product risk. Findings from the current study also indicate that warnings on energy drink cans could be enhanced to increase salience and effectiveness, using design features that have been shown to be effective in other domains.

Supplementary data

Supplementary data are available at *HEAL* online.

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Conflict of interest statement

None declared.

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