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The impact of exposure to sugary drink marketing on youth brand preference and recall: a cross-sectional and multi-country analysis

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Abstract

Background Consumption of sugary drinks (SD) among children and adolescents is a prevalent public health issue both within Canada and worldwide. This problem is exacerbated by the powerful marketing of such beverages to youth, which is known to influence a wide range of dietary behaviours.

Methods A cross-sectional, secondary analysis of the International Food Policy Survey Youth Wave 2019 was conducted to assess the relationship between self-reported exposure to SD marketing within the past 30 days or SD brand advertisements and brand preference and brand recall among youth aged 10–17 from Australia, Canada, Chile, Mexico, the United Kingdom, and the United States. Ordinal, multinomial, and binary logistic regression were used as appropriate to examine these associations.

Results Youth brand preference and recall was positively associated with self-reported exposure to general and brand-specific SD marketing across all countries. No statistical interaction was observed between youth age and SD marketing overall or within countries. Soft drinks, sports drinks, and fruit juice brands were most commonly recalled by all youth.

Conclusion Similar results were observed among children and adolescents within all countries. Global marketing policies should consider older children and adolescents to adequately protect and support child health.

Keywords Child, Youth, Food marketing

Background

Non-communicable diseases (NCD) are responsible for millions of deaths among adults worldwide and are considered a critical global public health issue [1]. Childhood obesity is a significant risk factor for a number of NCDs including diabetes and cardiovascular disease, and also poses a risk for several physical and mental health consequences in the short-term [2–4]. While the prevalence of obesity among children 5 to 19 years old has plateaued in high-income Western and Latin American countries between 1975–2016, overweight and obesity levels

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remain high and reducing excess weight in children is considered a global priority by the World Health Organization (WHO) [5]. The key drivers of childhood obesity stem from a wealth of individual, social, environmental, and physical factors. In particular, the food environment is instrumental in shaping youth eating behaviours, which can carry into adulthood [6].

Globally, sugary drinks (SDs) represent the greatest source of free sugar intake in children and adolescents' diets [7–9]. These types of drinks, defined as beverages containing added or natural sugars (i.e., free sugars), encompass sugar-sweetened beverages (SSB) such as soft drinks, energy drinks, sports drinks, or sweetened coffees and teas, as well as 100% fruit juices, sweetened drinkable yogurts, and flavoured water or milk beverages [8]. Excessive sugar consumption from a young age drives lifelong sugar cravings, making it more difficult to transition children to healthier beverage options [10, 11]. In Canada, children and adolescents are known to consume a daily average of 578 ml SDs [8]. The consumption of free sugars is greatest among youth (9–18 years) [12] and SDs, particularly soft drinks and fruit juices, are among the top sources of free sugar consumption in this age group [8]. Consumption rates of SDs are as equally alarming internationally, including in South America and Europe, where SSBs represent a significant share of children and adolescents' sugar intake [13–15].

Youth are a valuable demographic market to food and beverage companies due to their influence over family purchases and future as adult consumers [16]. Companies aim to develop positive brand relationships with their youth consumers by targeting children and adolescents through multiple channels and settings, but primarily on television and digital media [17, 18]. Few studies have compared exposure to food and beverage marketing (hereafter referred to as food marketing) among youth globally. However, one study found that youth aged 10 to 17 in Canada, Australia, Mexico, United Kingdom (UK), United States (US), and Chile, frequently reported exposure to SDs and fast food, particularly on television, in which between 43–69% of youth reported seeing advertisements for unhealthy foods/drinks within the past month [19].

Sugary drinks are heavily advertised to children and adolescents and the marketing of such products contributes to unhealthy food consumption [20]. Under the hierarchical framework of food marketing effects developed by Kelly et al., exposure to unhealthy food marketing is causally linked to post-consumption effects such as weight gain, through proximal and intermediate outcomes including children's eating preferences and attitudes. [21] Both short and regular exposure to food marketing are a cause for concern as exposure acts as a cue for consumption responses [22, 23]. For instance, American and Australian children exposed to food advertisements on television more frequently chose advertised and unhealthier foods compared to those who were not exposed [24, 25]. Of equal concern is the influence of food advertisements on memory, whereby exposure to advertisements leads to an explicit or implicit cognitive processing and prompts easier recall of advertised brands [26]. Empirical evidence from one Australian study demonstrated that children most often recalled one particular savoury snack brand and that advertisements for this brand featured promotional characters such as celebrities [27]. The effects of food marketing may also operate differently depending on age groups, however, the evidence is mixed. Adolescents (defined by the WHO as children aged 10 to 19) [28] are particularly sensitive to the power of food marketing due to their developmental stage, susceptibility to peer influence, and high levels of advertising exposure [16]. Despite these vulnerabilities, older children and adolescents are rarely examined as a unique population in the food marketing literature [29].

The WHO has specifically identified SD marketing as an area requiring policy action [30]. Most countries currently rely on self-regulatory models established by the food and beverage industry to monitor and control SD marketing; however, research has demonstrated that these policies are inadequate at protecting children from exposure to marketing [31–33]. Moreover, most self-regulatory policies only protect children up to 13 years old. Further research examining the effects of SD marketing on youth outcomes is needed to inform global policy efforts. To help fill this gap, this study aimed to explore the association between self-reported exposure to SD marketing on youth (10–17 years old) SD preferences and recall and to examine whether this association differed in six countries (Canada, Australia, UK, US, Mexico, and Chile). A secondary objective included examining whether these associations differed by youth age groups (children 10–12 years versus adolescents 13–17 years). It was predicted that youth brand preference and recall would be positively associated with self-reported SD marketing and that these associations would differ across countries, particularly in the UK where extensive restrictions have been implemented since 2011. It was also predicted that differences in the associations would be observed by child age group (10–12 years old versus 13–17 years old), as older children will have a greater duration and accumulation of exposure to SD marketing due to their age.

Methods

Data were from the 2019 International Food Policy Study (IFPS) Youth Survey, an annual repeat cross-sectional survey conducted in Australia, Canada, Chile, Mexico, the UK, and the US [34]. Data were collected via self-completed web-based surveys conducted in November–December 2019 with youth aged 10 –17 years. Respondents were recruited through parents/guardians enrolled in the Nielsen Consumer Insights Global Panel and their partners' panels. Email invitations with unique survey links were sent to adult panelists within each country. Those who confirmed they had a child aged 10 –17 living in their household were asked for permission for their child to complete the survey (only one child per household was invited). Children aged 10 –17 years were eligible to participate, with quotas for age and sex groups in the UK and US. After eligibility screening, all potential respondents were provided with information about the study and asked to provide assent. Surveys were conducted in English in Australia and the UK; Spanish in Chile and Mexico; English or French in Canada; and English or Spanish in the US. Members of the research team who were native in each language reviewed the French and Spanish translations independently. The median survey time was 24 min.

The child's parent/guardian received remuneration in accordance with their panel's usual incentive structure (e.g., points-based or monetary rewards, chances to win prizes). The IFPS was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#41,477) and this study received ethics approval through the University of Ottawa Research Ethics Board (H-06–20–5908). A full description of the study methods can be found in the International Food Policy Study: Technical Report – 2019 Youth Survey [35].

Measures

Youth sugary drink brand recall and brand preference

The main outcomes of interest of this study were youth brand preference and youth brand recall. These outcomes were selected as they are the first steps within the hierarchical framework of food marketing effects [21]. One-hundred percent fruit juices are included as part of this study's definition of sugary drinks as they are metabolized similarly to added sugars, contributing to overall energy density of diets [36], and is supported by evidence which observed an association between 1 serving of 100% fruit juice and weight gain in children [37].

Brand preference was assessed as a self-reported emoji scale using the question: *How much would you like to have this drink?* Participants were asked to rate their preference to either Coca-Cola, Red Bull, or a country-specific 100% juice brand from a 7-point Likert-type emoji scale which ranged from "strongly dislike" to "strongly prefer", "don't know", and "refuse to answer" (Fig. 1). Brand preference was recoded as a categorical variable with three levels, where "strongly dislike", "dislike", and "somewhat dislike" were combined as "dislike"; "neutral" and "somewhat prefer" combined as "neutral"; and "prefer" and "strongly prefer" combined as "prefer".

Youth SD brand recall was examined using the following question: *An example of a candy brand is Skittles. An example of a chip brand is Pringles. Please name up to 5 drink brands.* Participants could also select "don't know" or "refuse to answer". All open text responses were reviewed and coded to determine if the response was a valid SD brand. A summary variable was created for the analyses, to count the number of legitimate brands recalled per participant, ranging from 0 to 5 brands. The number of brands recalled was then recoded as a binary variable with 0–3 brands recalled grouped together and 4–5 brands recalled grouped to minimize small cell sizes. A recall of 0 brands meant that either the participant had selected "don't know" or the responses provided were considered to be invalid SD brands (e.g., a generic drink such as "milk" or "cola", food product, etc.).

Self-reported exposure to sugary drink marketing frequency

Self-reported exposure to SD marketing was assessed based on the following question: *In the last 30 days, how often did you see or hear advertisements for these kinds of food or drinks? Ads for sugary drinks.* Response options were "never", "less than once a week", "once a week", "a few times a week", "every day", "more than once a day", "don't know", or "refuse to answer". The variable was collapsed into 2 categories of "low exposure" ("never", "less than once a week", and "once a week") and "medium–high exposure" ("a few times a week", "every day", "more than once a day") to minimize small cell sizes. Respondents who selected "don't know" or "refuse to answer" were excluded from analyses.

Fig. 1 IFPS emoji-scale measure of youth brand preference

Self-reported exposure to sugary drink brand advertisements

Participants reported exposure to three major SD brands: Coca-Cola, Red Bull, and/or country-specific 100% juice brand advertisements in a randomized order. These brands were selected as they represented major brands in all IFPS countries based on Euromonitor data [38]. Respondents reported whether they had seen or heard advertisements in the past 30 days for each brand (response options: "yes", "no", "don't know", or "refuse to answer"). An aggregate variable of brand advertising exposure was constructed by summing the number of brands viewed by a participant, ranging from 0 (participant reported "no" to exposure to all three brand advertisements) to 3 (participant reported "yes" to exposure to all three brand advertisements). This aggregate variable was only used in analyses involving the brand recall outcome. Responses of "don't know" and "refuse to answer" were considered missing and excluded from all analyses.

Sociodemographics

Sociodemographic characteristics included as covariates were age, sex-at-birth, ethnicity, perceived income adequacy, and country. Age was modelled as a continuous variable in all overall models but was collapsed into two categories (10–12 years old and 13–17 years old) for subgroup analysis as described below. Sex was included as a binary variable with response options of "male" or "female". Race/ethnicity was assessed as a binary variable, "majority" or "minority" and was derived from measures adapted from census methods from each country. Perceived income adequacy based on self-reported responses to the question "*Does your family have enough money to pay for things your family needs*" (response options: "not enough money", "barely enough money", "enough money", "more than enough money", "don't know", and "refuse to answer"). Categories were collapsed to create a binary variable, where "inadequate" included "not enough money" and "barely enough money" and "adequate" included "enough money" and "more than enough money". Responses of "don't know" and "refuse to answer" were excluded.

Data analysis

A total of 11,491 children completed the survey. Respondents were excluded for the following reasons: region was missing, ineligible or had an inadequate sample size (i.e., Canadian territories); invalid response to a data quality question; and/or survey completion time under 10 min ($n=383$). The analytic sample included 11,108 respondents (Australia: $n=1,435$; Canada: $n=3,682$; Chile: $n=1,252$; Mexico: $n=1,616$; UK: $n=1,520$; US: $n=1,603$). A sub-sample ($n=8,502$) were included in the current analysis after excluding respondents with missing data (including do not know and refuse to answer) for all covariates and main predictors and outcomes of interest. Data were weighted with post-stratification sample weights constructed using a raking algorithm with population estimates from the census in each country based on age group, sex, region, and ethnicity (except in Canada). Estimates reported are weighted unless otherwise specified. All models were adjusted for age, sex, ethnicity, perceived income adequacy, and country however the regression results for these variables are not presented. Analyses were conducted using survey analysis procedures in SAS version 9.4 and data graphs were produced using R v.4.2.1 in RStudio and the dyplr, ggplot2, and patchwork packages [39–42].

The association between self-reported SD marketing frequency or brand advertising and brand preference was modelled using proportional odds logistic regression. The proportionality assumption was assessed using the score test for all models. In cases where the proportionality assumption was not met (i.e., score test p-value < 0.05), the results of a multinomial logistic regression are presented. Binary logistic regression models were constructed to examine the association between self-reported SD marketing frequency or brand advertising and beverage brand recall. Regression results are presented overall for all models. A likelihood ratio test was used to compare models with and without interaction between country and the exposures of interest. For simplicity, all models were stratified by country if at least one statistically significant interaction between country and the predictor of interest (p-value < 0.05) was detected. Similarly, the likelihood ratio test was used to test for interaction between child age (children 10–12 years old versus adolescents 13–17 years old), and exposure of interest. The test for interaction was not significant ($p > 0.05$) and thus an exploratory subgroup analysis was performed to achieve the research objective of examining differences in the associations by child age group.

Results

Study characteristics

The weighted sample characteristics of youth participants are presented in Table 1. Differences in the proportion of sociodemographics by country were observed, consistent with different population distributions in each country.

Brand preference and association with sugary drink marketing

Overall, between 10–34% of youth reported a strong preference for either Coca-Cola, Red Bull, or juice (Table 1). Results from proportional odds regression examining the association between self-reported

Table 1 Sample characteristics of youth aged 10–17 in the 2019 IFPS Youth Study ($n = 8,502$)

	Canada	Australia	United Kingdom	United States	Mexico	Chile	Total
	(*n* = 2,674)	(*n* = 1,047)	(*n* = 1,082)	(*n* = 1,217)	(*n* = 1,399)	(*n* = 1,083)	(*n* = 8,502)
Variable	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**
Sex							
Male	51% (1363)	50% (521)	51% (550)	51% (625)	50% (706)	51% (550)	51% (4315)
Female	49% (1312)	50% (526)	49% (532)	49% (591)	50% (693)	49% (533)	49% (4187)
Age (years) mean (SE)	13.6 (0)	13.4 (0.1)	13.5 (0.1)	13.5 (0.1)	13.5 (0.1)	13.6 (0.1)	13.5 (0)
Ethnicity							
Majority	73% (1948)	77% (805)	83% (897)	52% (630)	78% (1093)	86% (933)	74% (6306)
Minority	27% (727)	23% (242)	17% (185)	48% (587)	22% (306)	14% (150)	26% (2196)
Perceived income adequacy							
Not or barely enough money	17% (457)	25% (261)	26% (280)	29% (356)	27% (382)	30% (330)	24% (2065)
Enough or more than enough money	83% (2218)	75% (786)	74% (802)	71% (860)	73% (1018)	70% (753)	76% (6437)
Self-reported exposure to sugary drink food marketing							
Never to once per week	45% (1213)	48% (500)	56% (605)	36% (442)	18% (249)	21% (226)	38% (3236)
A few times per week to more than once per day	55% (1461)	52% (547)	44% (477)	64% (775)	82% (1150)	79% (856)	62% (5266)
Self-reported exposure to Coca-Cola brand ads							
Yes	78% (2095)	71% (743)	72% (784)	81% (991)	98% (1369)	97% (1050)	83% (7032)
No	22% (579)	29% (304)	28% (298)	19% (225)	2% (31)	3% (33)	17% (1470)
Self-reported exposure to Red Bull brand ads							
Yes	52% (1379)	37% (386)	36% (394)	61% (744)	56% (783)	72% (780)	53% (4466)
No	48% (1296)	63% (661)	64% (688)	39% (472)	44% (616)	28% (303)	47% (4036)
Self-reported exposure to juice brand ads							
Yes	50% (1344)	28% (295)	34% (363)	37% (456)	93% (1298)	85% (925)	55% (4680)
No	50% (1330)	72% (752)	66% (719)	63% (761)	7% (101)	15% (158)	45% (3822)
Preference for Coca-Cola							
Strong dislike, dislike, somewhat dislike	37% (353)	26% (93)	24% (86)	23% (97)	19% (88)	26% (90)	28% (806)
Neutral preference	43% (410)	45% (159)	47% (166)	40% (169)	43% (206)	43% (147)	43% (1257)
Strong preference	21% (199)	29% (104)	29% (104)	37% (157)	38% (181)	31% (104)	29% (850)
Total	100% (962)	100% (356)	100% (356)	100% (423)	100% (475)	100% (341)	100% (2913)
Preference for Red Bull							
Strong dislike, dislike, somewhat dislike	63% (529)	66% (245)	57% (209)	56% (245)	63% (279)	61% (221)	61% (1729)
Neutral preference	29% (238)	25% (92)	30% (111)	28% (123)	31% (135)	27% (98)	28% (798)
Strong preference	8% (67)	9% (32)	13% (47)	16% (71)	6% (28)	13% (46)	10% (291)
Total	100% (834)	100% (369)	100% (367)	100% (439)	100% (443)	100% (365)	100% (2817)
Preference for Juice							
Strong dislike, dislike, somewhat dislike	11% (99)	10% (33)	13% (47)	7% (23)	8% (37)	15% (58)	11% (297)
Neutral preference	55% (486)	65% (211)	52% (187)	56% (198)	50% (241)	52% (198)	55% (1521)
Strong preference	33% (294)	24% (78)	35% (126)	38% (133)	42% (203)	32% (121)	34% (956)
Total	100% (879)	100% (323)	100% (361)	100% (354)	100% (481)	100% (376)	100% (2774)
Recall of drink brands							
No brands	38% (1015)	40% (422)	33% (355)	33% (401)	19% (263)	16% (179)	31% (2634)
1–5 brands	62% (1659)	60% (625)	67% (727)	67% (816)	81% (1137)	83% (904)	69% (5868)

exposure to SD and brand advertising and brand preference are shown in Figs. 1, 2, 3 and 4. Across all countries, youth who reported frequent exposure to SD marketing were more likely to prefer Coca-Cola, Red Bull, and juice compared to those who did not report frequent exposure; however this association was not statistically significant for Coca-Cola preference (Fig. 1). Similarly, youth who reported viewing brand advertisements for either Coca-Cola or juice were more likely to prefer the corresponding SD brand compared to those not exposed to brand advertisements. A strong association across all countries (OR = 2.3, 95% CI = 1.9, 2.73) was observed between exposure to juice brand advertisements and preference for juice.

Note: All models adjusted for sex, age, race/ethnicity, and perceived income adequacy. No statistical interaction between country and either exposure predictor was detected (p>0.05). Results from overall models should be interpreted.

Note: Multinomial overall estimates and estimates for the UK and US (where the score test was significant ($p > 0.05$)) are shown in Fig. 4. All models adjusted for sex,

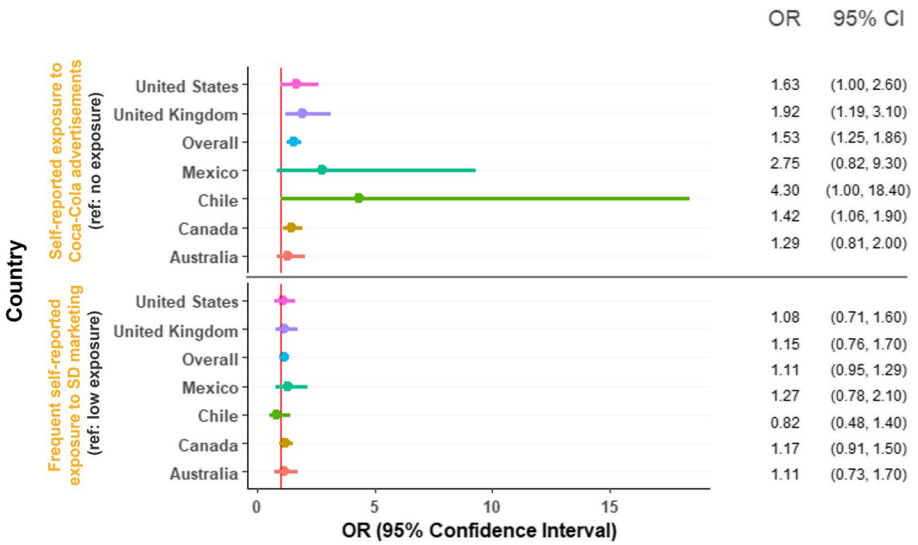

Fig. 2 Estimates from separate adjusted proportional odds logistic regression models examining the association between exposure to SD marketing and Coca-Cola ads and Coca-Cola brand preference among youth in six countries ($n = 2,913$)

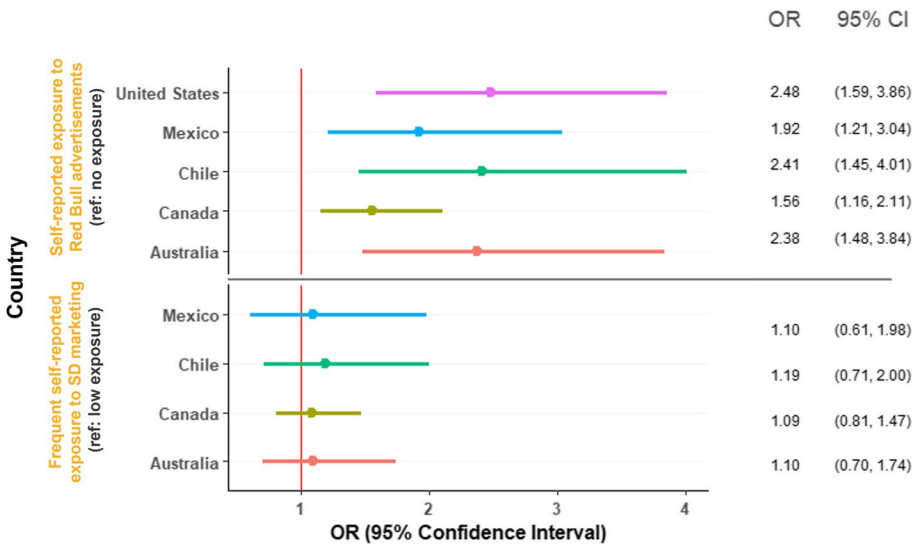

Fig. 3 Estimates from separate adjusted proportional odds logistic regression models examining the association between exposure to SD marketing and Red Bull ads and Red Bull brand preference among youth in six countries ($n = 2,817$)

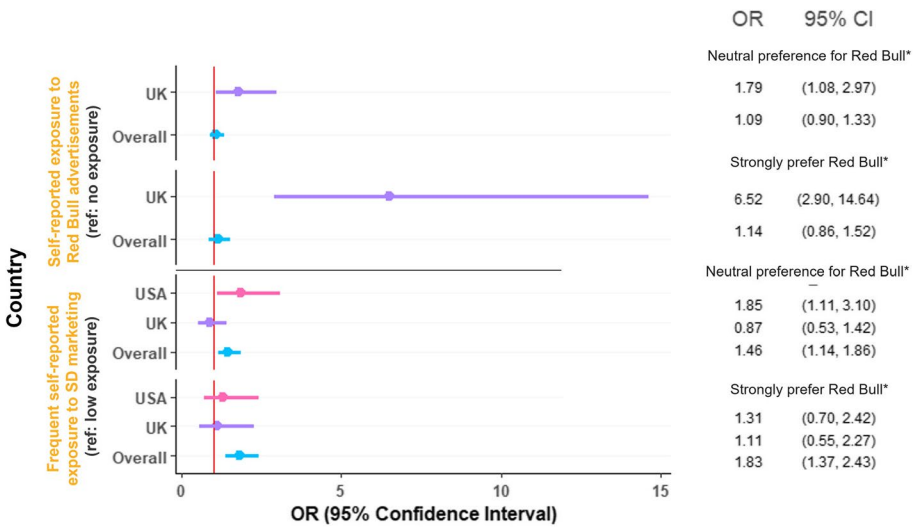

Fig. 4 Estimates from separate adjusted multinomial logistic regression models examining the association between exposure to SD marketing and Red Bull ads and Red Bull brand preference among youth in six countries (n = 2,817)

age, race/ethnicity, and perceived income adequacy. No statistical interaction between country and either exposure predictor was detected ($p > 0.05$). Results from overall models should be interpreted and are presented in Fig. 4.

*ref: Strongly or somewhat dislike Red Bull

Note: All models adjusted for sex, age, race/ethnicity, and perceived income adequacy. No statistical interaction between country and either exposure predictor was detected (p>0.05). Results from overall models should be interpreted.

Brand recall and association with sugary drink marketing

The top three most frequently recalled SD brands overall included Coca-Cola (75%, n=6,379), Pepsi (52%, n=4,463), and Sprite (30%, n=2,516) (Table 2). Both Coca-Cola and Pepsi were the most commonly recalled brands within all countries, with an exception being

Table 2 Top 10 most frequently recalled sugary drink brands in among youth in six countries (n=8,502)

	Canada	Australia	United Kingdom	United States	Mexico	Chile	Total
	Weighted %(n)	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**	**Weighted %(n)**
1	Coca Cola 68% (1803)	Coca Cola 86% (900)	Coca Cola 78% (839)	Coca Cola 62% (753)	Coca Cola 78% (1094)	Coca Cola 91% (991)	Coca Cola 75% (6379)
2	Pepsi 57% (1501)	Pepsi 47% (494)	Pepsi 54% (583)	Pepsi 53% (650)	Pepsi 46% (644)	Fanta 64% (689)	Pepsi 52% (4463)
3	Gatorade 25% (655)	Fanta 45% (466)	Fanta 39% (423)	Sprite 33% (407)	Jumex 34% (482)	Sprite 62% (669)	Sprite 30% (2516)
4	Sprite 22% (572)	Sprite 30% (312)	Sprite 24% (258)	Gatorade 32%(395)	Del Valle 23% (318)	Pepsi 55% (591)	Fanta 26% (2199)
5	Seven Up 15% (390)	Schweppes 15% (155)	Lucozade 19% (204)	Dr Pepper 24% (289)	Fanta 23% (319)	Bilz Y Pap 44% (473)	Gatorade 18% (1501)
6	Nestea 11% (300)	Solo 11% (113)	Seven Up 18% (195)	Mountain Dew 20% (245)	Gatorade 23% (325)	Canada Dry 23% (248)	Seven Up 11% (899)
7	Oasis 9% (232)	Kirks 9% (96)	Dr Pepper 16% (177)	Powerade 13% (161)	Sprite 21% (297)	Kem 22% (240)	Dr Pepper 8% (655)
8	Crush 10% (256)	Gatorade 9% (91)	Tango 15% (167)	Fanta 10% (119)	Bonafont 19% (271)	Seven Up 10% (113)	Powerade 7% (585)
9	Tropicana 9% (239)	Powerade 9% (91)	Ribena 11% (117)	Kool Aid 5% (65)	Boing 13% (189)	Crush 9% (94)	Mountain Dew 6% (506)
10	Minute Maid 9% (235)	Mountain Dew 8% (84)	Vimto 8% (89)	Sunny D 5% (62)	Ciel 13% (181)	Cachantun 6% (60)	Bilz Y Pap 6% (473)

Percentages do not add up to 100 as each respondent could name up to 5 SD brands

Chile, where Fanta was the second most frequently recalled brand. Sports drink brands such as Lucozade in the UK (19%, $n=204$), Powerade in Australia (9%, $n=91$), or Gatorade in Canada (25%, $n=655$), Australia (9%, $n=91$), and the US (32%, n=395) were also frequently recalled. Fruit juice brands including Jumex (34%, $n=482$) and Del Valle (23%, $n=318$) were commonly recalled in Mexico.

Higher levels of SD marketing and self-reported exposure to SD brand-specific advertising (compared to low levels of exposure) was strongly and statistically associated with a greater odds of brand recall overall and within almost all countries (Figs. 5 and 6). In particular, a greater recall for SD brands was most likely among youth in Canada (OR=2, 95%CI=1.70–2.36) and Mexico (OR=2.54, 95%CI=1.76–3.67) who reported frequent exposure to SD marketing in general compared to those who reported less frequent exposure. Youth in Mexico (OR=6.02, 95% CI=1.95–18.56), Australia (OR=2.09, 95%CI=1.56–2.8), and Canada (OR=2.32, 95%CI=1.87–2.88) who viewed at least one or more advertisements for Coca-Cola, Red Bull, and/or juice were more likely to recall SD brands compared to youth who did not see these advertisements, although the country and SD marketing exposure interaction term was not statistically significant.

Note: All models adjusted for sex, age, race/ethnicity, and perceived income adequacy. Statistically significant interactions between country and self-reported exposure to juice brand advertisements were detected ($p = 0.001$), thus country stratified results should be interpreted for these associations.

Age group differences in associations

An exploratory subgroup analysis was performed to further examine differences in the associations between SD marketing and brand preference and recall among child populations (Figs. 7, 8, 9 and 10). No statistical difference was detected by age group across all countries or when stratified by country, however notable trends observed in these subgroup results included a greater preference for Red Bull among adolescents (Fig. 10).

*Brand-specific ads refers to self-reported exposure to at least one Coca-Cola, Red Bull, or juice brand ad.

Note: All models adjusted for sex, age, race/ethnicity, and perceived income adequacy. Statistically significant interactions between country and self-reported exposure to SD marketing were detected (p =0.005), thus country stratified results should be interpreted for these associations.Note: Extremely large confidence intervals for Chile (95%CI: 1.90, 128.63) and Mexico (95%CI: 1.56, 30.51) under 13-17 year old subgroup are not presented. No statistically significant interactions were detected between youth age group, country, and the predictors of interest (i.e., self-reported exposure to Coca-Cola ads or SD marketing).

Note: Extremely large confidence intervals for UK (95%CI: 3.12, 19.34) and US (95%CI: 2.25, 13.60) under 10–12-year-old subgroup are not shown. No statistically significant interactions were detected between youth age group, country, and the predictors of interest (i.e., self-reported exposure to juice ads or SD marketing).

Note: Extremely large confidence intervals for Mexico (95%CI: 4.77, 63.84) under 13–17-year-old subgroup are not shown. No statistically significant interactions were

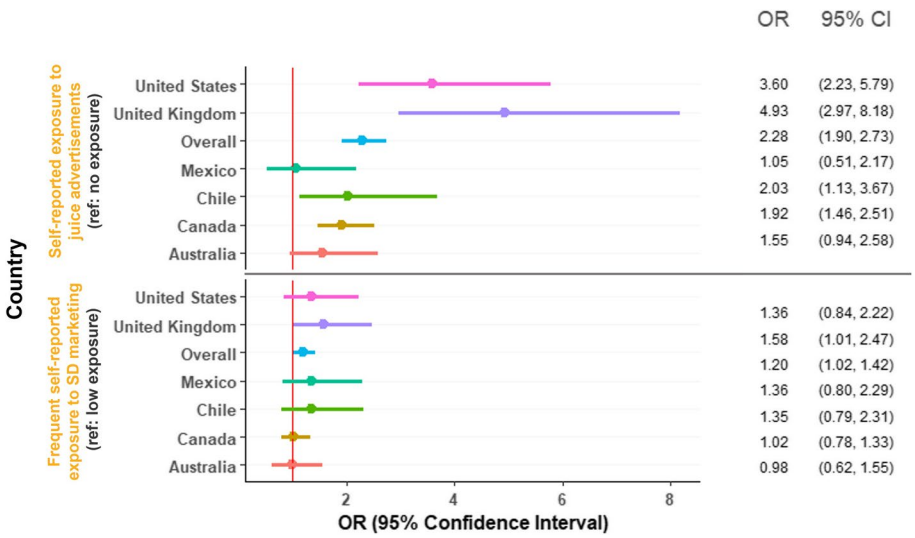

Fig. 5 Estimates from separate adjusted proportional odds logistic regression models examining the association between exposure to SD marketing and juice ads and juice brand preference among youth in six countries ($n = 2,774$)

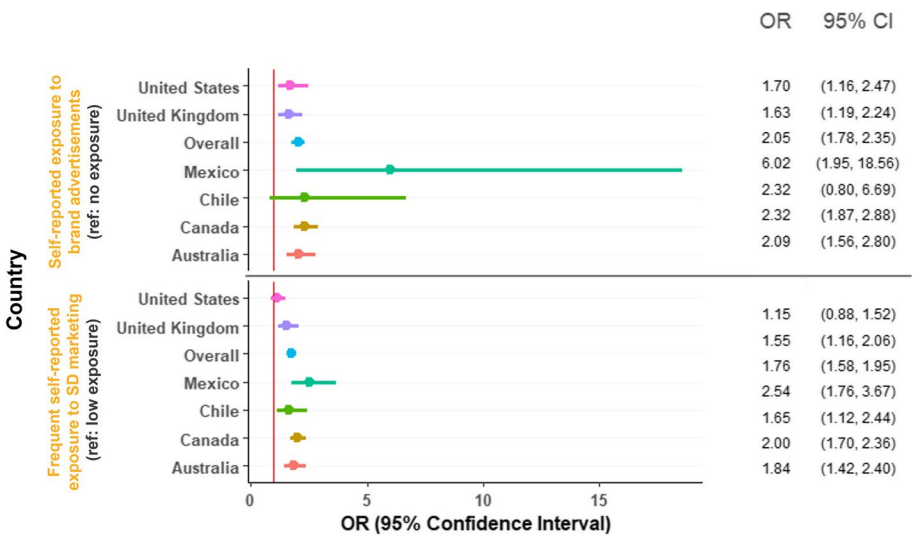

Fig. 6 Estimates from separate adjusted binary logistic regression models examining the association between exposure to SD marketing and brand-specific ads* and brand recall among youth in six countries ($n = 8,502$)

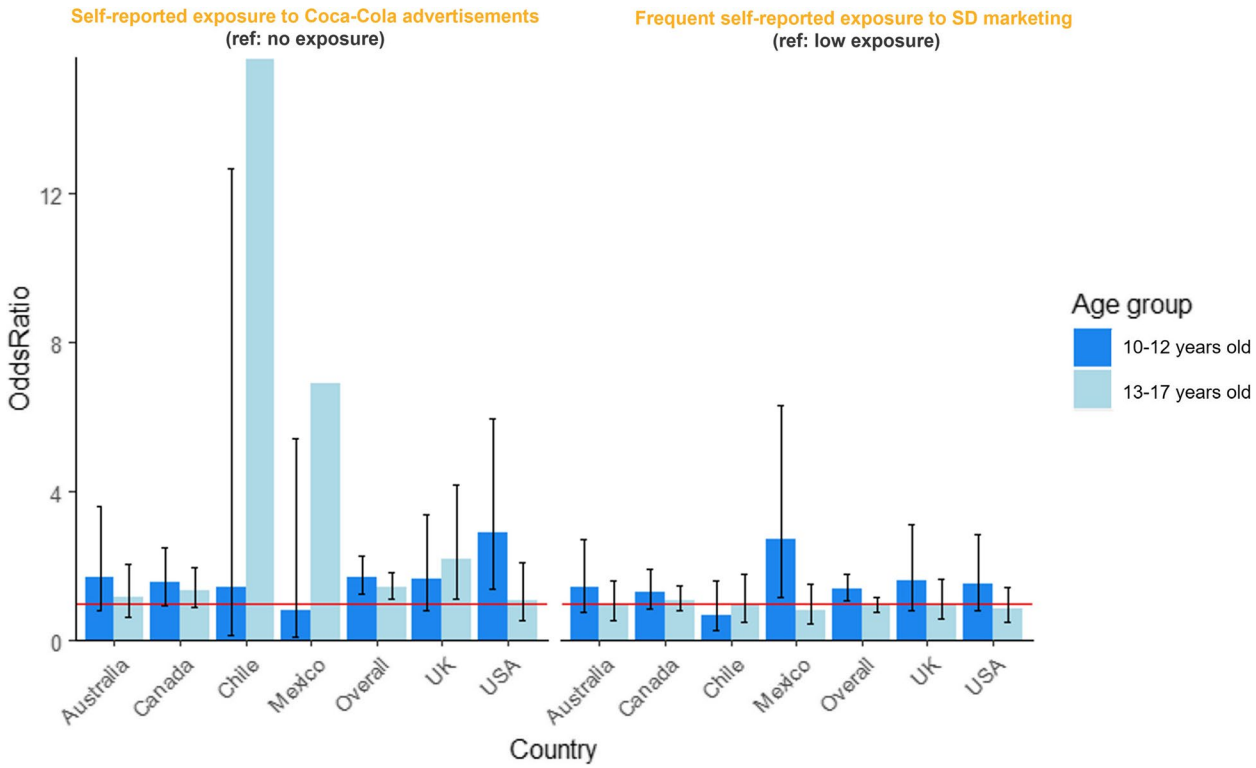

Fig. 7 Estimates from separate adjusted proportional odds logistic regression models examining the association between exposure to SD marketing and Coca-Cola ads and Coca-Cola brand preference, by age group, among youth in six countries ($n = 2,913$)

detected between youth age group, country, and the predictors of interest (i.e., self-reported exposure to brand ads or SD marketing).

Discussion

This study found that more frequent exposure to both general and brand-specific SD marketing were associated with positive attitudes towards SD brands and a greater

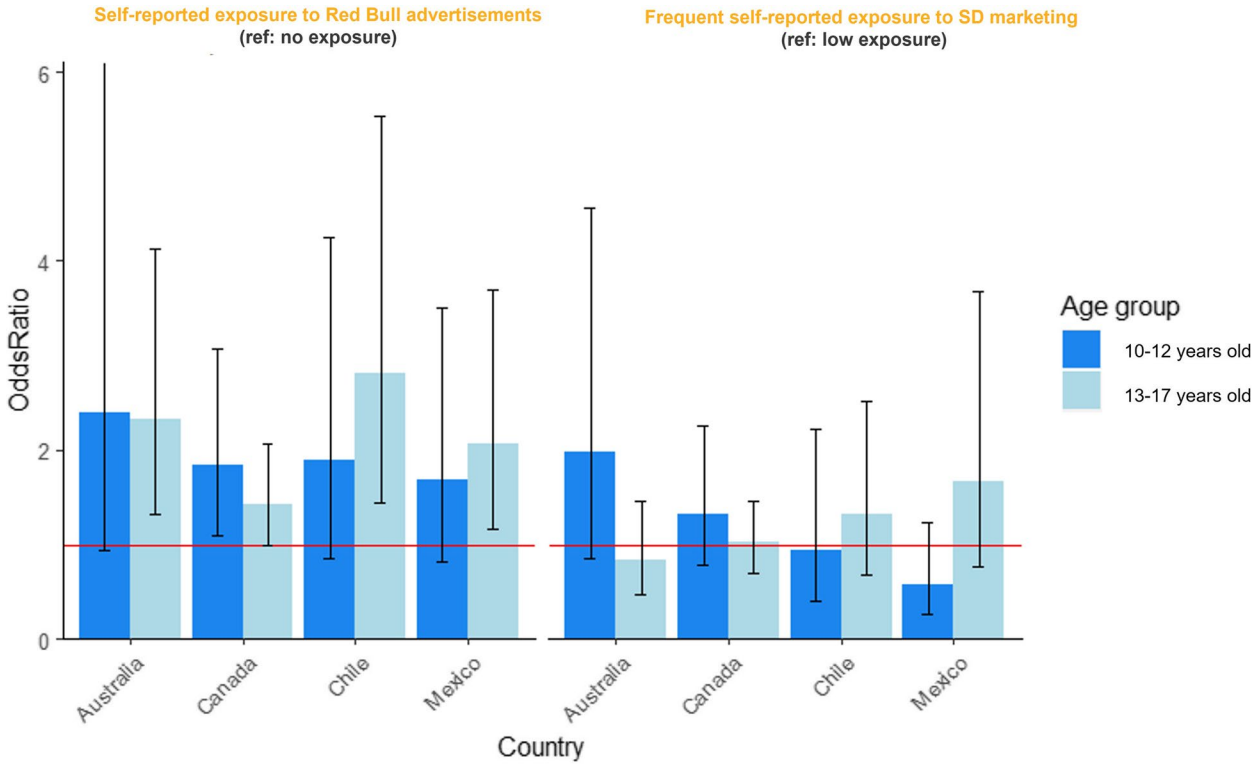

Fig. 8 Estimates from separate adjusted proportional odds logistic regression models examining the association between exposure to SD marketing and Red Bull ads and Red Bull brand preference, by age group, among youth in six countries (n = 2,817)

recall of such brands among youth in six middle- to high-income countries. Most notably, exposure to juice or Coca-Cola brand advertisements was strongly related to a greater preference for juice and Coca-Cola, respectively. Greater SD brand recall was significantly associated with greater exposure to SD marketing overall and particularly in Mexico and Chile. Effects of the associations on brand preference and recall were similar across age groups.

Brand preference

In this study, youth reporting frequent exposure to SD marketing exhibited a greater preference for juice and these associations were statistically significant across all countries. These findings are unsurprising as exposure to food marketing is known to impact children's health in multiple capacities [21]. Preference for advertised food products has been observed among children post exposure across a number of media, including television [43–45], digital media [45–47], and food packaging [48, 49]. Most studies related to brand preference to date are experimental and measure preference after exposure to brand specific advertisements [44]. Research indicates that food marketing influences youth dietary preferences through psychological and neurobiological mechanisms. In one study involving children aged 8 to 14, exposure to food commercials was found to stimulate increased activity in the reward regions of the brain, altering children's taste perceptions and increasing the potential for children to make food decisions driven by taste as a result of such advertisements [50]. Indeed, this notion is well recognized in the advertising community. Advertisers may target consumers subconsciously and through behaviour modification to develop brand preference for advertised products [51]. The average intake of fruit juices among children and youth aged 9 to 19 years old varies substantially by country, however higher consumption of fruit juices are noted in the UK (between 83–93 g/day) and the US (65–73 g/day) [52, 53]. The observed preference for juice in this study may be concerning within the overall context of youth diets as excessive consumption can provide a substantial source of free sugar and calories in youth diets [54]. This is compounded by research which demonstrates that youth often choose fruit juices over water or as a substitution for whole fruits or vegetables [55].

This study also observed strong positive associations between self-reported exposure to brand advertisements (e.g., Coca-Cola or juice) and brand preference. Brand marketing plays an important role in children's eating and brand preferences [21]. Children as young as

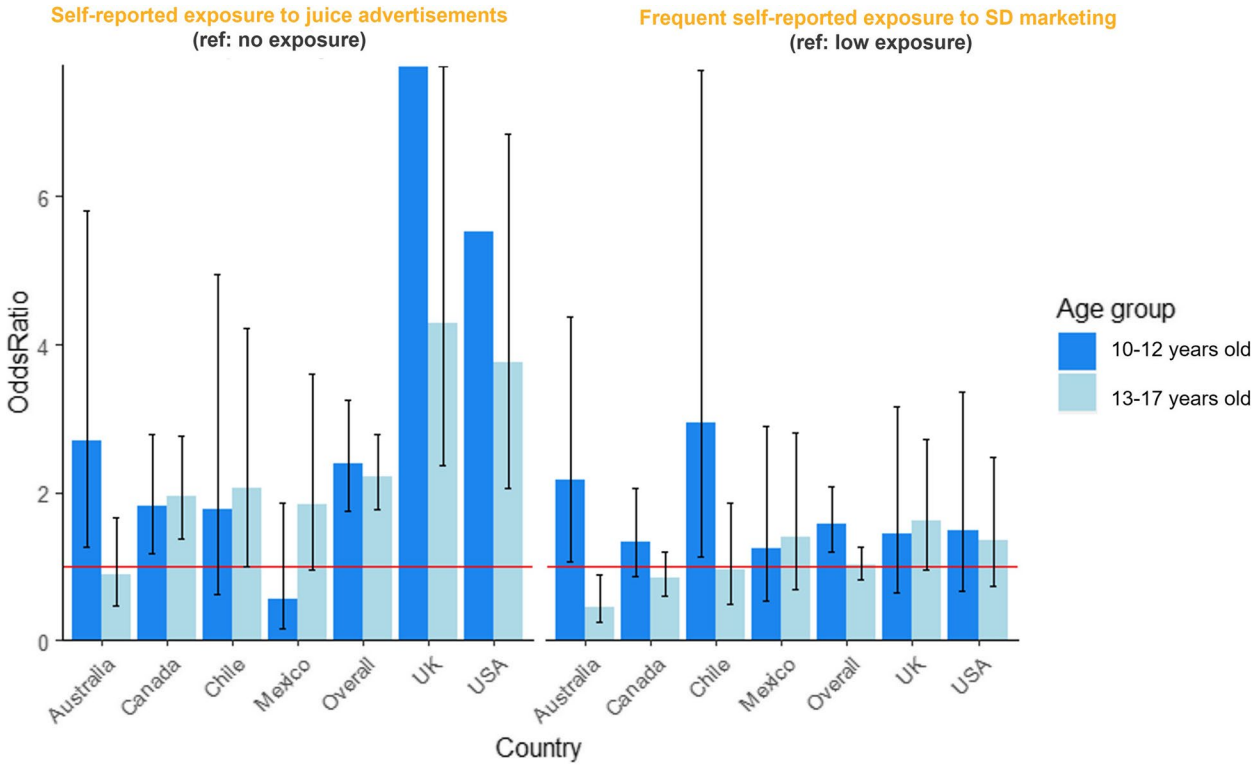

Fig. 9 Estimates from separate adjusted proportional odds logistic regression models examining the association between exposure to SD marketing and juice ads and juice brand preference, by age group, among youth in six countries (n = 2,774)

3 years old are capable of recognizing brand logos and both children and adolescents have been found to prefer branded food and beverage items over plain/non-branded items [56]. An earlier study demonstrated that preschool children preferred familiar branded food and beverages compared to plain packaged items [56]. However, the quantitative research supporting this association specifically in adolescent populations is sparse and existing evidence is mixed. In one experimental study involving pre-adolescents (8–12 years old) in the US, no statistically significant association was found between exposure to a soft drink brand advertisement and drink preference or choice, while in another study among Australian children 10 to 11 years old, increased positive attitudes towards advertised food and beverage products were observed post acute exposure to television brand advertisements [57, 58]. Coca-Cola is recognized as a popular beverage advertiser globally and is responsible for some of the largest beverage marketing campaigns [59]. The majority of sugary drink marketing expenditures on American television in 2018 were driven by PepsiCo and Coca-Cola. Moreover, increased spending by these companies is indicative of the beverage industry's efforts to counteract declining soft drink consumption among youth [60]. Content analyses of major sugary drink brands indicate that companies are exploiting both traditional and new forms of media to target youth. One such study revealed that the marketing content of major soft drink brands, including Coca-Cola, is heavily dominated by themes considered important to youth, such as themes of happiness, sports, or social enhancement/fun [61]. Of equal concern is that an analysis of Coca-Cola's PR practices revealed that Coca-Cola explicitly intended to target youth with some marketing campaigns to build their youth consumer base [62]. Taken together, these results may point to the targeting of youth by major beverage companies in order to build a loyal adult consumer base in the future [63].

Brand recall

Children and adolescents who reported viewing SD marketing or at least one or more brand advertisements in this study were also more likely to recall at least four SD brands compared to those who did not report any SD marketing exposure. A similar trend was observed within country-specific results; however, these results should be cautiously interpreted due to a lack of statistically significant interaction between country and the predictors of interest. This finding is supported by evidence from the literature, which demonstrated increased

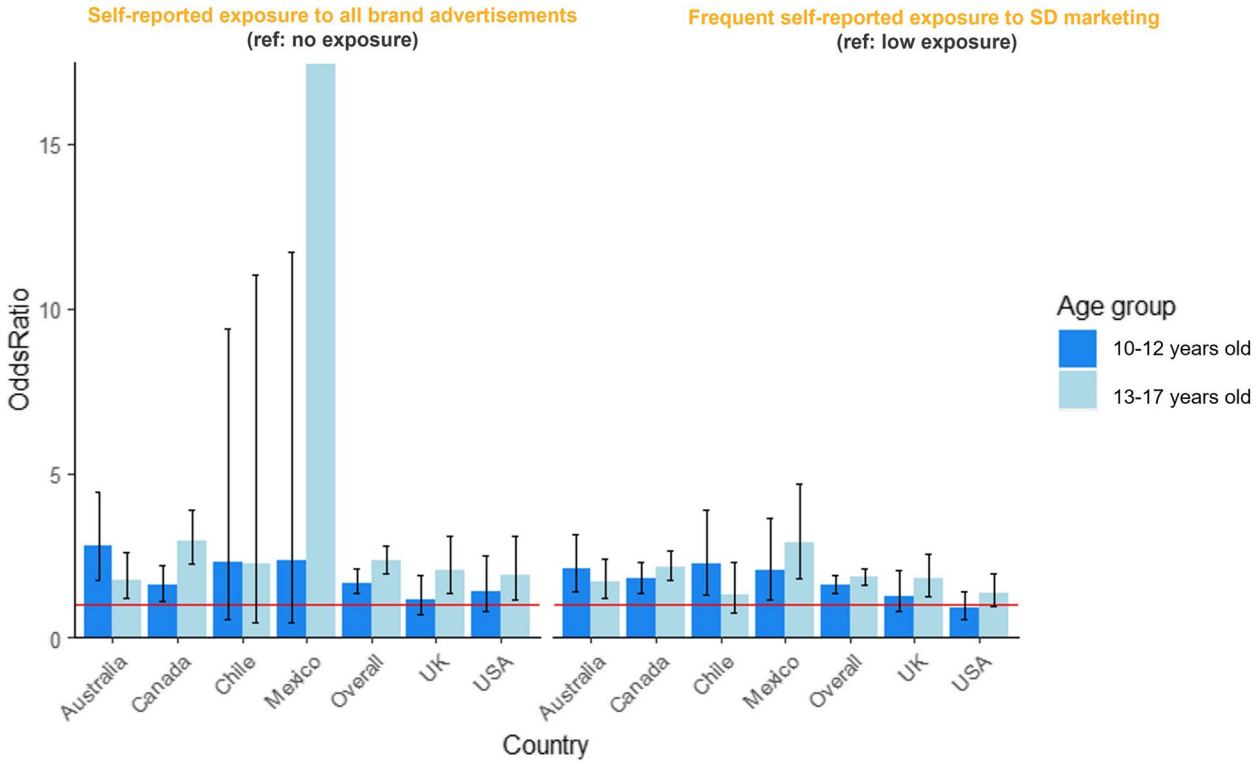

Fig. 10 Estimates from separate adjusted binary logistic regression models examining the association between exposure to SD marketing and brand-specific ads* and brand recall, by age group, among youth in six countries (n = 8,502)

free brand recall among children and adolescents post exposure to food marketing on traditional platforms, such as television [43] and in print [64], as well as on newer media such as social and digital media [65] in Chile and the UK. Soft drink brands were the most frequently recalled responses both overall and across all countries in this study. In this study, large global companies (e.g., Coca-Cola and Pepsi) made up the majority of free recall responses. This was often followed by sports drinks or fruit juice brands. Brand recall is an important attitudinal response as it serves as stimulus for beverage purchases [21]. As with this study, other studies have found that unhealthy food and beverage brands are the more often recalled compared to healthier brands. This may be due to the frequent use of marketing techniques by such brands to appeal to young consumers. Children's positive attitudes towards brands have been observed to be more pronounced when the advertisement features child-appealing elements such as celebrity endorsements [24]. The influence of food marketing, particularly on an implicit level such as with recall, is concerning as it is the first step along the hierarchical pathway of food promotion effects and poses a risk to children's downstream health [21].

Differences between age groups

Although these results must be cautiously interpreted given the exploratory nature of this analysis, the results of the subgroup analysis suggest that preference for some brands, particularly Red Bull, may differ between children and adolescents. A study examining energy drink marketing on television suggested that Red Bull advertisements are the one of the most heavily advertised energy drinks on adolescent-targeted television stations [66]. This is unsurprising as other studies have found that energy drink advertisements on social media largely feature adolescent-targeted techniques including promoting themes of cool or extreme sports that appeal to youth [67]. Few studies have examined child and adolescent populations together. One study found that food product preference was similar among children (aged 5 to 11) in the UK, regardless of age [68]. Moreover, similar to this current study, the interaction between advertisement exposure and age was not significant and that younger and older children were similarly influenced by food commercials [68]. Other research also failed to detect significant differences between child age groups (9 to 15 years old) when examining Chilean children's free recall and brand attitudes after exposure to McDonald's television advertisements [69]. Taken together, the findings of this

study in conjunction with the current body of literature may lend credence to adolescents being as vulnerable as children to the impacts of unhealthy food marketing. Future research should further pursue the inclusion of adolescents as a subgroup within the investigation of the impacts of SD marketing due to their unique vulnerabilities and to further delineate these effects.

Policy implications

Overall, the findings of this study reinforce the importance of food marketing regulations to protect children and adolescents globally. The observed associations suggest that greater exposure to SD marketing and branded advertisements influence the likelihood of brand preference and recall among youth. These associations were particularly salient in Mexico and Chile, where statutory food marketing regulations have been in place since 2016 and 2018, respectively. In Chile in particular, while consumption of foods high in sugar, fat, or sodium decreased significantly among preschoolers post implementation of food marketing policies, evidence supporting a similar trend in adolescents (who would not have been captured by some marketing restrictions) was not observed [70, 71]. Further research exploring the impact of food marketing policies specifically in youth populations is warranted to inform and lend support for the inclusion of older adolescents as part of global food marketing policies.

Popular brands recalled by youth in this study seemingly parallel trends documented in other beverage marketing research whereby Pepsi and Coca-Cola are primarily responsible for most of the SD advertisements viewed by youth. Given the increasingly diverse range of platforms where youth may be exposed to SD marketing, further research is needed to monitor priority areas of SD marketing exposure to better inform policies.

Strengths and limitations

The strengths of this study include its large and diverse sample size and use of consistent measures across countries. Moreover, a key strength includes that this study demonstrated consistent findings six different countries. The use of an emoji scale as a measure of brand preference has been validated in the literature and has been demonstrated to be a more accurate means of reflecting food/beverage preference in youth populations compared to traditional methods such as a Likert scale [72–74]. This study is subject to limitations common to survey research. Respondents were recruited using non-probability-based sampling. Therefore, although the data were weighted by age group, sex, region, and ethnicity (except in Canada), the findings do not necessarily provide nationally representative estimates. Exposure to SD marketing and branded advertisements may be underestimated due to self-reported measures which do not capture all avenues and methods of actual exposure to beverage marketing including marketing that is less visible and recognizable (e.g., through social media influencers) as well as subject to recall errors. However, self-reported exposure is highly correlated with objective exposure data [75–77]. The cross-sectional nature of this study does not permit causal conclusions such as whether exposure leads to brand preference and recall or vice versa. Moreover, given that this study explored proximal outcomes along the causal pathway of food marketing effects [21], such as brand preference and recall, the results observed cannot be directly applied to more distal outcomes such as consumption or post-consumption effects. Estimates with large confidence intervals should be interpreted with caution due to small cell sample sizes. The lack of significant interaction between age and exposure to SD marketing may also be underpowered due to small subgroup sample sizes. Nevertheless, these findings may add to the current body of food marketing literature, in which adolescents are often excluded from analyses or are examined within the broader definition of children.

Conclusion

This study examined the relationship between exposure to general and brand-specific SD marketing and SD brand preference and recall among youth in six countries. Minimal differences in the patterns of these associations were observed across countries and age groups, which may suggest gaps in current policies to protect youth. The results of this study may be used as a justification for future research examining the impact of food and beverage marketing in adolescent populations and to help inform international policy efforts to reduce youth exposure to SD marketing in order to protect child health.

Abbreviations

SDs	Sugary drinks
NCDs	Non-communicable diseases
WHO	World Health Organization
SSBs	Sugar-sweetened beverages
IFPS	International Food Policy Study
OR	Odds Ratio
CI	Confidence interval
ref	Reference

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Author's contributions

LR and MPK designed the study and MRG, MPK, LV, and DH oversaw the analysis. LR conducted the analysis and drafted the manuscript. All authors read and approved the final manuscript.

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Data availability
The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The IFPS received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 41477) prior to data collection. This study received additional clearance for secondary analyses through a University of Ottawa Research Ethics Committee (H-06–20-5908).
Informed consent was obtained from all respondents and their parent/guardian. Only one child per household was invited to participate.

Consent for publication
Not applicable.

Competing Interests
The authors declare no competing interests.

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