



# The impact of health warnings for sugar-sweetened beverages on consumer perceptions of advertising

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## Abstract

**Objective:** In February 2020, San Francisco proposed mandatory health warnings for sugar-sweetened beverage (SSB) advertisements. Industry legal challenges stated that the warning would detract from advertisers' ability to convey their intended message and mislead consumers into believing that SSB cause weight gain regardless of consumption amount, lifestyle or intake of other energy-dense foods.

**Design:** Online between-group experiments tested the impact of SSB warnings on advertising outcomes and consumer perceptions. Respondents were randomised to view six SSB print advertisements with or without a health warning ('Warning' and 'No Warning' condition, respectively). Linear and binary logistic regression models tested differences between groups, including ad recall, brand perceptions and beliefs about SSB health effects.

**Setting:** Panelists from the US Nielsen Global Panel.

**Participants:** Sixteen to 65-year-old respondents ( $n$  1064).

**Results:** Overall, 69.2% of participants in the 'Warning' condition recalled seeing warnings on SSB ads. Compared with the 'No Warning' condition, participants in the 'Warning' condition who reported noticing the warnings were equally likely to recall the brands featured in the SSB ads and to recall specific attributes of the final ad they viewed. Similarly, no differences were observed between groups in perceptions of SSB, such as perceived taste, or in the prevalence of false beliefs regarding the health effects of SSB and intake of other sugary foods on weight gain.

**Conclusions:** Overall, there was no evidence that SSB health warnings detracted from attention to promotional elements in advertisements or that the warnings misled consumers into false beliefs about SSB as the exclusive cause of weight gain.

## Keywords

Sugar-sweetened beverages  
Health warnings  
Experiment

Sugar-sweetened beverages (SSB) are a public health concern given their contribution to energy intake and increased risk of diet-related non-communicable diseases such as obesity, diabetes, dental caries and heart disease<sup>(1–5)</sup>. An increasing number of jurisdictions are implementing population-level strategies to reduce SSB consumption, including more comprehensive nutrition labels<sup>(6)</sup>. For example, Chile, Mexico, Peru and other countries have mandated front-of-package labelling policies that require 'high in' symbols or other interpretive symbols on packaging of foods high in sugar, Na, saturated fats and energy, including SSB<sup>(7,8)</sup>. Countries such as Peru have also introduced measures to require similar warning messages on advertisements of foods high in these nutrients of concern<sup>(9)</sup>.

In the USA, SSB policies have largely been implemented at the sub-national level. In 2015, the City of San Francisco

created an ordinance that would require certain SSB advertisements to feature a text-based health warning covering 20% of the advertisement, similar in appearance to health warnings on tobacco advertisements in the USA<sup>(10)</sup>. Following litigation by the American Beverage Association and California Retailers Association, the original proposal was struck down, partly on the basis that the warnings may interfere with advertisers' ability to convey their intended message. In February 2020, the City of San Francisco amended the Ordinance by reducing the size of the health warning to 10% of the advertisement and revising the text statement to read, 'SAN FRANCISCO GOVERNMENT WARNING: Drinking beverages with added sugar(s) can cause weight gain, which increases the risk of obesity and type 2 diabetes<sup>(11)</sup>'. The warnings would apply to sodas and other SSB with exclusions for

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alcoholic beverages, milk and milk alternatives, 100 % fruit or vegetable juice, infant formula, meal replacements and medical foods<sup>(11)</sup>. Warnings would appear on a subset of advertisements, including any paper, poster or billboard in or on a stadium, arena, transit shelter, bus, train or other surface, but would not be required on advertisements in newspapers, television, Internet or other electronic media.

There is a large and growing evidence base on the effectiveness of health warnings across a range of consumer domains<sup>(12,13)</sup>. The ways in which health warnings can influence consumer behaviour have been described in several conceptual models<sup>(8,14)</sup>. These models highlight the primary importance of consumer attention, which is influenced by design features such as the size and content of the warning, as well as contextual factors, including the design of the advertisement or package on which warnings are displayed. The extent to which consumers cognitively process warnings is determined by the intrinsic properties of the warning and the medium in which they are conveyed, as well as extrinsic factors, such as a consumers' prior level of exposure to the warning, pre-existing beliefs and affective reactions. The ultimate impact of warnings on consumer behaviour is mediated by their effect on consumer perceptions of risk and consumer perceptions of the product, including the influence of warnings on promotional messages conveyed in the advertisement or on packaging<sup>(8,12,13)</sup>.

To date, a wide range of studies have tested the efficacy of SSB warnings similar to those proposed by San Francisco. Collectively, these studies suggest that SSB warnings can increase thoughts about the health effects of sugary drinks, leading to lower perceptions of healthiness and stronger disease likelihood perceptions. In addition, SSB warnings also significantly reduced both hypothetical and actual consumption and purchasing behaviour<sup>(8,15,16)</sup>. However, the beverage industry has challenged the revised San Francisco Ordinance based on whether the SSB warnings meet the 'Zauderer' legal standard in the USA, according to which governments can require health warnings and other product disclosures so long as the disclosure is related to a substantial government interest and the warning is '(1) purely factual, (2) noncontroversial and (3) not unjustified or unduly burdensome<sup>(17)</sup>.' In particular, the industry has argued that the warnings will 'severely detract from the advertiser's ability to convey its intended message' and will distort or weaken consumers' perceptions and recall of an advertisement<sup>(17)</sup>. Thus, although reductions in the impact of SSB advertisements may enhance the public health impact of health warnings, the industry has argued that the effect is sufficiently strong that the San Francisco ordinance is 'unduly burdensome' and should be struck down.

To date, several studies have examined how health warnings influence consumer attention to advertisements on which they appear. In one study, participants who viewed a cola can with a 20 % text warning were equally

as likely as those who did not see the warning to recall the 'Cola' brand and product information, such as the container size<sup>(18)</sup>. Participants who viewed the can with the 20 % warning were less likely to recall seeing a small text slogan vertically printed on the side of the container; however, perceptions of attractiveness, price, quality and taste did not differ between those viewing the can with and without the 20 % warning. The latter finding is consistent with a recent meta-analysis of SSB warnings, which found that warnings caused people to think more about the health effects of SSB consumption but did not diminish positive product attitudes, such as taste<sup>(19)</sup>.

Health warnings require the greatest level of cognitive processing upon initial exposure, which decreases over time due to familiarity with the warning<sup>(12,13,20)</sup>. As a result, experimental studies which test reactions to a 'new' warning are likely to overestimate a warning's impact on recall of advertising. Studies of 'real' mandated warnings that appear on actual advertisements are more indicative of whether warnings would detract from advertisements under non-experimental conditions. A series of eye-tracking studies conducted on mandated tobacco advertisements indicate that participants spend a small proportion of time viewing health warnings – approximately 10% of viewing time – relative to the time spent viewing branding and product information contained in advertisements<sup>(21–26)</sup>.

Beyond the impact on SSB advertisements, industry legal challenges also state that San Francisco's proposed warnings are misleading because they will lead to three types of false beliefs: (1) drinking SSB will cause weight gain regardless of the quantity of SSB consumed; (2) drinking SSB will cause weight gain regardless of lifestyle factors, such as exercise and (3) drinking SSB will cause weight gain to a greater extent than other energy-dense food and beverages which are not required to display health warnings. Although SSB warnings have been shown to increase consumer awareness of health risks<sup>(8)</sup>, we are unaware of any published studies that have examined the effect of warnings on consumer beliefs about weight gain and SSB quantity, lifestyle factors and other energy-dense foods.

The current study examined the impact of SSB health warnings proposed in San Francisco on attention to and recall of advertising content, brand perceptions and health beliefs about weight gain from SSB and other food and beverages.

## Methods

### *Study protocol*

A between-group experimental study was conducted via a web-based survey from 3 to 5 September 2020. Participants were randomised to view a series of print advertisements displayed according to one of two conditions: (1) advertisements without health warnings ('No Warning' control condition) and (2) advertisements that displayed a health



warning ('Warning' experimental condition). The study consisted of two experimental tasks, as described below. Participants completed survey items assessing recall of food and beverage advertisements with and without health warnings, as well as the perceived health risks of SSB and other high-energy food and beverage products.

### **Participants**

Individuals were eligible to participate if they resided in a US state, were English-speaking, were 16–65 years old at the time of recruitment and had access to the Internet. Respondents were drawn from a larger online survey assessing prevalence and patterns of cannabis use, recruited using the *Nielsen Consumer Insights Global Panel*, which maintains panels in the USA (<http://www.nielsen.com/ca/en/about-us.html>). The Nielsen panels are recruited using both probability and nonprobability sampling methods. A total of 1205 respondents completed the experiment, allowing for approximately 200 respondents in each experimental condition. Respondents who selected 'Refuse to answer' for all outcome variables were excluded. Time in seconds (s) spent viewing each of the nine beverage advertisements was recorded by the survey provider and summed. Respondents who spent a total of < 9 s across the nine ads were assumed to be 'speeders' and excluded. Respondents with extremely long viewing time for any ad (> 99th percentile) were also excluded. Values > 10 s and ≤ 99th percentile for viewing time of each ad were set to 10 s. Finally, as a data integrity measure, a question was included at the end of the survey in which respondents were asked to select the current month from a list. Those who did not select the current month (September) were excluded. This led to a total of 141 exclusions and a final sample of 1064 respondents.

### **Experimental task 1 – impact of health warnings on ad recall**

The survey text directed participants as follows: 'Next, we're going to do something a bit different. We'd like to show you some food and beverage advertisements. These are regular food and beverage products, NOT cannabis products. We'll show you one ad at a time. After you've seen all the ads, we'll ask you some questions about them.' Participants then viewed a series of nine advertisements: six for SSB and three for other products (chocolate milk, Oreos, McDonalds). All advertisements were 'real' advertisements selected from an online image search engine. The viewing time of each advertisement was not restricted: participants could proceed to the next ad when they were ready. However, after clicking 'next', participants could not go 'back' to view previous ads. The time spent viewing each advertisement was automatically recorded.

Participants randomised to the No Warning control condition viewed the original advertisements, which

were not modified in any way and did not display health warnings. Participants randomised to the Warning condition viewed advertisements that displayed a health warning for the six SSB products, but not for the three non-SSB products, in accordance with the proposed San Francisco Ordinance. The health warning displayed on the SSB advertisements was the same as San Francisco's amended warning in terms of size, location and wording. One modification was made to make the warning relevant to participants, who were drawn from across the USA: 'SAN FRANCISCO GOVERNMENT WARNING' was modified to read 'SURGEON GENERAL'S WARNING'. Images of the ads are provided in online Supplemental File 1.

The order of ads shown to participants was unrelated to experimental condition. The order of the first eight ads was determined using a random number generator: (1) Fanta, (2) McDonalds, (3) Chocolate milk, (4) Sprite, (5) Oreos, (6) Coca Cola or Pepsi, (7) Jones, (8) Mountain Dew and (9) Coca Cola or Pepsi. Participants were randomised to see either Coca Cola or Pepsi as the final ad; those who saw Coca Cola as the final ad saw Pepsi as the sixth ad, and vice versa. This was established to provide variability in the final warning shown to participants, for which additional questions were asked (described below).

After viewing all nine advertisements, participants were asked to recall as many advertising elements and brand attributes as they could from the last advertisement they viewed (Ad recall). Participants were then asked to recall as many brands from the other eight advertisements as possible using open-ended responses (Brand recall). As noted above, the order of the advertisements was set so that half of the sample viewed the Coca Cola Ad last, and the other half viewed the Pepsi Ad last.

#### *Ad recall*

Prior to the study, the ads were independently assessed by Research Assistants to identify key attributes of the Coca Cola and Pepsi ads, which were shown last in the series of the nine ads. These attributes and the corresponding categories are shown in online Supplemental File 2. After viewing the last advertisement (either the Coca Cola or Pepsi ad), participants were asked: 'Please describe all of the pictures and images you remember seeing in the last ad.'

#### *Brand recall*

Participants were asked two questions to assess brand recall: 'Please think about the LAST ADVERTISEMENT we showed you. What soda brand did you see in the last advertisement?', and 'In the OTHER ADVERTISEMENTS we showed you, what OTHER BRANDS do you remember seeing?'

### **Experimental task 2 – impact of health warnings on brand perceptions**

Participants were asked to view an additional advertisement ('We would like you to look at one more ad'), which



depicted a fictional SSB brand (online Supplemental File 3). A fictional brand was used to ensure that responses to the ad were not based on pre-existing associations. Participants viewed the advertisement according to their study condition: participants in the Warning condition viewed the advertisement with the health warning, whereas the advertisement in the No warning control condition did not display a warning. The advertisement remained on the screen while participants answered questions about their perceptions of the product featured in the advertisement (Brand perceptions).

#### *Brand perceptions*

While viewing the ad for 'Sam's soda' (fictional brand), participants were asked three questions to assess whether the presence of the health warning influenced their perceptions of the brand being advertised. The following target group characteristics were assessed gender ('Who does this ad target?' *Men, Women, Neither, Both, Don't know*) and age group ('What age group does this ad target? Select all that apply.' *Kids, Teenagers, Younger adults, Older adults, Seniors, Don't know*), as well as perceptions of taste ('How much do you think you would like or dislike the TASTE of this product?' *Dislike a lot, Dislike a little, Neither like nor dislike, Like a little, Like a lot, Don't know, Refuse*).

#### **Warning recall and perceived health risks**

Following the two experimental tasks, participants responded to several questions including recall of the health warning and beliefs about SSB and other high sugar or high-energy foods and beverages, as described below.

#### *Health warning recall*

All participants were asked, 'Did you notice a health warning message on any of the ads we showed you?' (*Yes, No, Don't know, Refuse*).

#### *Beliefs about the health risks of sugar-sweetened beverage consumption*

Participants were asked to respond to a question assessing their beliefs about the association between quantity of SSB consumed and weight gain: 'George drinks 1 can of sugary soda per day. Samuel drinks 5 cans of sugary soda per day. Which person is more likely to gain weight from drinking sodas?' (*George, Samuel, No difference, Don't know, Refuse*). Participants were also asked a question assessing their beliefs about the association of exercise and weight gain within the context of SSB consumption: 'Anna and Carmen both drink sugary sodas every day. Anna does not exercise at all. Carmen exercises a lot. Who is more likely to gain weight?' (*Anna, Carmen, No difference, Don't know, Refuse*).

#### *Beliefs about the health risks of other foods and beverages that do not display health warnings*

Participants were asked to indicate their level of agreement with three statements assessing beliefs about non-SSB

products that would not display warnings under the San Francisco Ordinance: (1) 'Foods high in sugar (e.g. cookies, doughnuts, flavored yogurts and ice cream) can lead to weight gain'; (2) 'Foods high in calories (e.g. pizza, hamburgers and burritos) can lead to weight gain' and (3) 'Milk drinks high in sugar (e.g. chocolate milk) can lead to weight gain.' The same response options were used for the three measures (*Strongly agree, Agree, Neither agree nor disagree, Disagree, Strongly disagree, Don't know, and Refuse*).

#### **Data analysis**

As a check on the experimental stimuli, a preliminary test was conducted to examine the percentage of participants in the Warning condition who noticed the warning on any of the six SSB advertisements. Participants who had missing data for this item or responded 'Don't know' or 'Refuse to answer' were categorised as 'No/Unstated'. As indicated below, 69.3% (362) of participants reported noticing 'any warnings'. The results in subsequent tables are stratified by noticing *v.* not noticing the warning within the experimental condition.

Open-text responses for the Ad recall task were coded by Research Assistants using the list of attribute codes identified prior to data collection (online Supplemental File 2). Research Assistants manually reviewed all responses to identify words or phrases corresponding to each attribute, based on pre-specified acceptable wording (e.g. 'building', 'tower', 'skyscraper', 'city' and 'skyline' were all acceptable responses for the 'Buildings/city' attribute). An initial 50 responses were coded independently by two Research Assistants, with a 96% inter-rater agreement rate. Discrepancies were discussed and resolved before all remaining open-text responses were coded. For the Brand recall tasks, open-text responses were reviewed by one Research Assistant and coded as 'recalled' if there was any mention of the brand name in the participant's response. In all cases, misspelled words were accepted, and Research Assistants were blinded to experimental condition.

Linear and binary logistic regression models were conducted to test differences between groups (Noticed the warning *v.* No Warning condition and Did not notice the warning *v.* No Warning condition) for continuous and binary outcomes of interest, respectively. For perceived target gender, the odds of responding 'Both' men and women (*v.* Other response/Don't know) were tested, and the odds of responding 'Like a little' or 'Like a lot' (*v.* Other response/Don't know) were tested for taste perceptions. For target age group, each response was tested separately because respondents could select all that applied. For beliefs about the health risks of SSB consumption, the responses 'Samuel' and 'Anna' were coded as 'Correct' for the two questions, respectively (*v.* Other response/Don't know). For beliefs about the health risks of other foods and beverages, the responses 'Strongly agree' and 'Agree' were combined for analysis (*v.* Other response/Don't know).



All regression models were adjusted for sex, age group, highest education level and race/ethnicity. Due to low cell counts, the following variable categories were merged for the purposes of the regression models: 'female' and 'inter-sex'; 'Less than high school' and 'Unstated' education; and 'American Indian', 'Native Hawaiian' and 'Other/> 1 race/Unstated'. Analyses were conducted using SPSS software (version 26.0; IBM Corp.).

## Results

### Sample characteristics

Table 1 displays the sample characteristics. The sample consisted of a greater proportion of females, a greater proportion of respondents identifying as  $\geq 1$  or an 'other' race and was slightly more highly educated compared with the broader US population. No significant differences were observed by sex, age group, education level or race/ethnicity between the No Warning and the Warning groups.

### Health warning recall

A total of 69.2% of participants in the Warning condition noticed health warnings on 'any of the ads' they viewed, while 6.5% of participants in the No Warning condition erroneously reported noticing a health warning on the ads.

### Ad viewing time

Compared with participants in the No Warning condition, participants in the Warning condition who noticed the warnings spent significantly longer viewing the ads on average (mean = 7.77 s (SD = 4.17; range = 1.80–21.10) *v.* mean = 9.81 s (SD = 5.09; range = 2.20–31.90), respectively;  $t(667.97) = -6.31, P < 0.001$ ). Viewing time was also greater for each of the individual ads among participants in the Warning condition who noticed the warnings compared with the No Warning condition, with the exception of the Coca Cola ad when it was viewed last in the list of ads (see online Supplemental File 4). In contrast, participants in the Warning condition who did not notice the warnings spent significantly less time viewing all of the advertisements, on average, compared those in the No Warning condition.

### Brand recall

As Table 2 indicates, the average number of brands recalled and likelihood of recalling of each of the nine brands were no different between participants in the No Warning condition and those in the Warning condition who noticed the warnings. In contrast, participants in the Warning condition who did not notice the warnings were significantly less likely to recall each of the nine brands and recalled fewer brands on average compared with those in the No Warning condition.

**Table 1** Sample characteristics table (n 1064)

	Overall (n 1064)		No warning condition (n 541)		Warning condition (n 523)		Statistical significance*
	%	n	%	n	%	n	
Sex							$\chi^2(2) = 3.51, P = 0.17$
Female	69.0	734	70.1	379	67.9	355	
Male	30.7	327	29.9	162	31.5	165	
Intersex	0.3	3	0	0	0.6	3	
Age							$\chi^2(2) = 2.07, P = 0.36$
16–35 years	40.3	429	39.4	213	41.3	216	
36–50 years	21.6	230	20.5	111	22.8	119	
51–65 years	38.1	405	40.1	217	35.9	188	
Education							$\chi^2(4) = 2.83, P = 0.59$
Less than high school	10.8	115	11.8	64	9.8	51	
High school diploma or equivalent	20.2	215	21.1	114	19.3	101	
Some college, no degree	29.1	310	28.7	155	29.6	155	
Bachelor's degree or higher	38.8	413	37.7	204	40.0	209	
Unstated†	1.0	11	0.7	4	1.3	7	
Race							$\chi^2(4) = 3.42, P = 0.49$
White	72.3	769	73.9	400	70.6	369	
Black or African American	9.4	100	9.1	49	9.8	51	
American Indian or Alaskan Native	0.8	8	0.7	4	0.8	4	
Native Hawaiian or Pacific Islander	0.2	2	0	0	0.4	2	
Other $\geq 1$ race/Unstated†	17.4	185	16.3	88	18.5	97	

\*Significance ( $P < 0.05$ ) between No warning and Warning condition based on  $\chi^2$  test of proportions.

†'Unstated' includes participants responding 'don't know' or 'refuse to answer'.

**Table 2** Brands recalled after exposure to advertisements\*

Brand recalled	Overall (n 1064)		No warning condition (n 541)		Warning condition				Participants in the Warning condition who noticed the warning v. No Warning Condition			Participants in the Warning condition who did not notice the warning v. No Warning Condition			
	%	n	%	n	Noticed warning (n 362)		Did not notice warning (n 161)		AOR <sup>a</sup>	95 % CI	P value	AOR <sup>a</sup>	95 % CI	P value	
					%	n	%	n							
Fanta	32.0	341	34.4	186	37.8	137	11.2	18	1.15	0.87, 1.52	0.333	0.25	0.15, 0.42	< 0.001	
MDonalds	23.2	247	24.8	134	26.2	95	11.2	18	1.07	0.78, 1.45	0.688	0.39	0.23, 0.66	< 0.001	
Chocolate milk	11.7	125	12.0	65	14.6	53	4.3	7	1.28	0.86, 1.89	0.227	0.35	0.16, 0.78	0.011	
Sprite	34.9	371	36.2	196	41.4	150	15.5	25	1.23	0.93, 1.62	0.147	0.32	0.20, 0.51	< 0.001	
Oreos	23.8	253	26.6	144	26.5	96	8.1	13	0.98	0.72, 1.33	0.897	0.25	0.14, 0.46	< 0.001	
Coca Cola	41.4	441	45.1	244	45.9	166	19.3	31	1.02	0.78, 1.33	0.905	0.30	0.19, 0.46	< 0.001	
Jones Soda	14.7	156	15.3	83	17.7	64	5.6	9	1.18	0.82, 1.69	0.374	0.35	0.17, 0.72	0.004	
Mountain Dew	33.5	356	37.0	200	37.3	135	13.0	21	1.00	0.76, 1.33	0.989	0.27	0.16, 0.44	< 0.001	
Pepsi	41.9	446	47.0	254	42.5	154	23.6	38	0.83	0.63, 1.09	0.829	0.37	0.24, 0.55	< 0.001	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD							
Total number of SSB brands recalled	1.98	1.92	2.15	1.97	2.23	1.86	0.88	1.42	0.06	-0.18, 0.31	0.622	-1.21	-1.53, -0.89	< 0.001	
Total number of 'other' brands	0.58	0.83	0.63	0.84	0.67	0.89	0.24	0.56	0.04	0.07, 0.15	0.518	-0.38	-0.52, -0.24	< 0.001	
Total number of all SSB and 'other' brands	2.57	2.50	2.78	2.55	2.90	2.47	1.12	1.82	0.10	-0.22, 0.42	0.550	-1.59	-2.01, -1.17	< 0.001	

\*Responses to the following two questions were coded for any mention of the brand: (1) 'Please think about the last advertisement we showed you. What soda brand did you see in the last advertisement?' and (2) 'In the other advertisements we showed you, what other brands do you remember seeing?' 'Don't know' or 'Refuse to answer' responses were coded as not identifying the brands. Logistic regression models testing for odds of recalling each brand; linear regression models testing mean number of brands recalled, adjusted for sex, age group, education and ethnicity. a Parameter estimates are betas for 'Total number of SSB brands recalled', 'Total number of 'other' brands' and 'Total number of all SSB & 'other' brands'.



### **Ad recall**

The proportion of participants who correctly recalled at least one key attribute from the Coca Cola or Pepsi advertisement was not significantly different between participants in the Warning condition who noticed the warnings (56.1%) and those in the No Warning condition (57.1%; AOR = .95, 95% CI = 0.72, 1.25,  $P = 0.710$ ). In contrast, participants in the Warning condition who did not notice the warnings were significantly less likely (66.5%) than those in the No Warning condition (57.1%) to recall at least one attribute (AOR = 0.40, 95% CI = 0.27, 0.58,  $P < 0.001$ ). Online Supplementary File 2 displays results for the recall of each individual ad attribute.

### **Brand perceptions**

Table 3 shows participants' perceptions of a novel brand that was displayed in an advertisement. Participants in the Warning condition who noticed the warnings were similarly likely as those in the No Warning condition to indicate that the advertisement was targeting 'Both' men and women, whereas participants in the Warning condition who did not notice the warnings were significantly less likely to select 'Both' compared with those in the No Warning condition.

Compared with the No Warning condition, participants in the Warning condition who noticed the warnings were more likely to indicate that the ad targeted 'Kids' and 'Older adults', while those in the Warning condition who did not notice the warnings were less likely to indicate that the ad targeted 'Kids' and more likely to select 'Don't know'.

In addition, there were no significant differences in the perceived taste of the product between those in the No Warning condition and those in the Warning condition who noticed the warnings (AOR 1.03; 95% CI = 0.77, 1.37;  $P = 0.856$ ), or between those in the No Warning condition and those in the Warning condition who did not notice the warnings (AOR 0.80; 95% CI = 0.55, 1.18;  $P = 0.265$ ).

### **Beliefs about the health risks of sugar-sweetened beverage consumption**

Table 4 shows beliefs about the association between quantity of SSB consumed and weight gain, as well as beliefs about physical activity and its potential to offset weight gain from SSB consumption. No significant differences were observed between participants in the Warning condition who noticed the warnings and those in the No Warning condition. Participants in the Warning condition who did not notice the warnings were less likely to select the correct responses of 'Samuel' and 'Anna' compared with those in the No Warning condition.

### **Beliefs about the health risks of other foods and beverages that do not display health warnings**

Table 5 shows beliefs about the potential health risks of high sugar foods, high-energy foods and non-SSB beverages (chocolate milk). As described above, participants had previously viewed advertisements for products in each of these categories earlier in the study (chocolate milk, Oreo cookies and McDonald's). None of the ads for these products displayed health warnings – including for participants in the Warning condition – as would be the case under the San Francisco Ordinance.

As Table 5 indicates, participants in the Warning condition who noticed the SSB warnings were significantly more likely than those in the No Warning condition to 'Strongly agree'/'Agree' (*v.* other responses) that foods high in sugar, food high in energy and milk drinks high in sugar can lead to weight gain. In contrast, participants in the Warning condition who did not notice the warnings were significantly less likely than those in the No Warning condition to 'Strongly agree'/'Agree' with the same statements.

### **Discussion**

Findings from the current study provide little or no evidence that health warnings on SSB advertisements overwhelm or distort the advertising messages. Indeed, approximately one-third of participants who viewed six separate advertisements on which the warnings were displayed reported not noticing any health warnings. Although noticing and familiarity with warnings would inevitably be higher under 'real world' implementation, the large number of participants who failed to notice the warnings upon initial exposure contradicts the industry's assertion that 10% warnings 'overwhelm' advertisements<sup>(27)</sup>.

Noticing the health warnings was also associated with greater overall viewing time of the ads, consistent with previous studies<sup>(22)</sup>. This suggests that consumers may spend additional time attending to and processing new health warnings, rather than simply taking away attention from the ad. These findings underscore the importance of allowing participants in experimental studies to view warnings for their desired amount of time, as would be the case in the 'real world', rather than constraining or standardising the duration of exposure to a novel health warning. Under 'real-world' conditions, the amount of cognitive processing and viewing time required to cognitively process the warning is likely to decrease with increasing exposure to warnings and familiarity with the content, as consumers will be able to recall the message based on visual recognition of the warning, rather than having to read and carefully process the text statements to extract the meaning.



**Table 3** Brand perceptions: perceived target group of advertisement\*

	Overall (n 1061)		Warning condition				Participants in the Warning condition who noticed the warning v. No Warning Condition			Participants in the Warning condition who did not notice the warning v. No Warning Condition				
	%	n	No warning condition (n 538)		Noticed warning (n 362)		Did not notice warning (n 161)		Odds of selecting 'Both' as target gender		Odds of selecting 'Both' as target gender			
'Who does this ad target?'	%	n	%	n	%	n	%	n	AOR	95 % CI	P-value	AOR	95 % CI	P-value
Target gender									0.95	0.73, 1.25	0.732	0.67	0.46, 0.97	0.036
Men	34.4	365	33.8	182	33.1	120	39.1	63						
Women	1.8	19	1.7	9	1.7	6	2.5	4						
Neither	14.3	152	14.1	76	16.6	60	9.9	16						
Both	42.2	448	44.1	237	43.1	156	34.2	55						
Don't know	7.3	77	6.3	34	5.5	20	14.3	23						
									Odds of selecting each age group		P-value	Odds of selecting each age group		P-value
'What age group does this ad target?'									AOR	95 % CI		AOR	95 % CI	
Select all that apply:														
Kids	51.8	551	50.5	273	59.7	216	38.5	62	1.51	1.15, 1.99	0.003	0.64	0.44, 0.92	0.015
Teenagers	47.8	509	47.9	259	50.3	182	42.2	68	1.07	0.81, 1.40	0.639	0.78	0.54, 1.12	0.173
Younger adults	42.9	456	43.4	235	43.9	159	38.5	62	0.96	0.73, 1.27	0.786	0.76	0.53, 1.10	0.151
Older adults	14.8	158	11.8	64	19.1	69	15.5	25	1.71	1.17, 2.49	0.005	1.29	0.78, 2.15	0.319
Seniors	5.6	60	5.7	31	6.6	24	3.1	5	1.14	0.65, 1.98	0.655	0.49	0.18, 1.28	0.140
Don't know	6.4	68	5.2	28	4.7	17	14.3	23	0.95	0.51, 1.76	0.864	3.14	1.74, 5.67	< 0.001

\*Sample size was 1061 for the 'target gender' question and 1064 for the 'target age group' question (n 3 and n 0 refused to answer, respectively). Sample sizes for 'No warning condition', 'Warning condition – noticed warning', and 'Warning condition – did not notice warning' for the 'target age group' question were n 541, n 321 and n 161, respectively. Logistic regression models testing for odds of selecting 'Both' v. All other responses for Target Gender, and odds of recalling each age group for Target Age, respectively, adjusted for sex, age group, education and ethnicity.



**Table 4** Consumer beliefs of SSB amount and exercise on weight gain\*

	Overall (n 1061)		Warning condition				Participants in the Warning condition who noticed the warning v. No Warning Condition			Participants in the Warning condition who did not notice the warning v. No Warning Condition				
	%	n	No warning condition (n 539)		Noticed warning (n 362)		Did not notice warning (n 160)		Odds of selecting correct response			Odds of selecting correct response		
			%	n	%	n	%	n	AOR	95 % CI	P-value	AOR	95 % CI	P-value
George drinks 1 can of sugary soda per day. Samuel drinks 5 cans of sugary soda per day. Which person is more likely to gain weight from drinking sodas?														
Response									1.02	0.68, 1.52	0.933	0.51	0.32, 0.79	0.003
Samuel ('correct' response) <sup>†</sup>	85.8	910	87.4	471	87.3	316	76.9	123						
George	2.7	29	1.7	9	4.1	15	3.1	5						
No difference	8.2	87	7.4	40	7.5	27	12.5	20						
Don't know	3.3	35	3.5	19	1.1	4	7.5	12						
Anna and Carmen both drink sugary sodas every day. Anna does not exercise at all. Carmen exercises a lot. Which person is more likely to gain weight?														
Response									1.09	0.77, 1.54	0.620	0.50	0.34, 0.74	0.001
Anna ('correct' response) <sup>†</sup>	78.8	836	80.5	434	81.5	295	66.9	107						
Carmen	7.0	74	5.4	29	7.2	26	11.9	19						
No difference	10.4	110	10.2	55	9.4	34	13.1	21						
Don't know	3.9	41	3.9	21	1.9	7	8.1	13						

\*Sample size was 1061 for the two questions (n 3 refused to answer each question). Logistic regression models testing odds of selecting Correct response v. All other responses, adjusted for sex, age group, education and ethnicity.

**Table 5** Consumer beliefs about food and drinks high in energy and sugar without warnings\*

Please indicate your level of agreement with the following statements:	Warning condition								Participants in the Warning condition who noticed the warning v. No Warning Condition			Participants in the Warning condition who did not notice the warning v. No Warning Condition		
	Overall (n 1060)		No warning condition (n 538)		Noticed warning (n 362)		Did not notice warning (n 160)		Odds of selecting 'Strongly agree/ Agree'			Odds of selecting 'Strongly agree/ Agree'		
	%	n	%	n	%	n	%	n	AOR	95 % CI	P-value	AOR	95 % CI	P-value
Foods high in sugar (e.g. cookies, doughnuts, flavoured yogurts and ice cream) can lead to weight gain									1.85	1.15, 2.96	0.011	0.40	0.26, 0.61	< 0.001
Strongly agree	55.6	589	55.6	299	62.7	227	39.4	63						
Agree	31.1	330	31.6	170	29.8	108	32.5	52						
Neither agree nor disagree	8.8	93	8.7	47	5.0	18	17.5	28						
Disagree	1.2	13	1.3	7	0.6	2	2.5	4						
Strongly disagree	0.7	7	0.4	2	0.6	2	1.9	3						
Don't know	2.6	28	2.4	13	1.4	5	6.3	10						
Foods high in calories (e.g. pizza, hamburgers and burritos) can lead to weight gain									1.63	1.05, 2.55	0.031	0.38	0.25, 0.58	< 0.001
Strongly agree	53.6	568	54.5	293	58.6	212	39.4	63						
Agree	31.9	338	32.0	172	32.6	118	30.0	48						
Neither agree nor disagree	9.8	104	9.9	53	6.4	23	17.5	28						
Disagree	1.6	17	1.1	6	1.4	5	3.8	6						
Strongly disagree	0.8	9	0.4	2	0.3	1	3.8	6						
Don't know	2.3	24	2.2	12	0.8	3	5.6	9						
Milk drinks high in sugar (e.g. chocolate milk) can lead to weight gain.									1.76	1.23, 2.53	0.002	0.49	0.33, 0.72	< 0.001
Strongly agree	41.5	439	40.6	218	47.5	172	30.6	49						
Agree	36.3	384	36.7	197	38.1	138	30.6	49						
Neither agree nor disagree	14.7	156	14.9	80	9.4	34	26.3	42						
Disagree	3.0	32	3.2	17	2.8	10	3.1	5						
Strongly disagree	1.2	13	1.1	6	0.6	2	3.1	5						
Don't know	3.3	35	3.5	19	1.7	6	6.3	10						

\*Sample size was 1060 for the 'foods high in sugar' and 'foods high in energy' questions and 1059 for the 'milk drinks high in sugar' question (n4 and n5 refused to answer, respectively). Sample sizes for 'No warning condition', 'Warning condition – noticed warning' and 'Warning condition – did not notice warning' for the 'milk drinks high in sugar' question were n 537, n 362 and n 160, respectively. Logistic regression models testing for odds of selecting 'Strongly agree/Agree' v. All other responses, adjusted for sex, age group, education and ethnicity.



Noticing warnings on advertisements had no impact on brand recall or recall of specific advertising elements. Participants noticing health warnings were equally as likely to recall the nine product brands and the elements of the last ad viewed compared with participants who saw the same advertisements with no warnings. The current study did not assess viewing time for specific elements of the ads; however, the findings are generally consistent with greater salience of advertising content compared with text-only health warnings<sup>(12,28–33)</sup>. For example, an analysis of more than a thousand print advertisements concluded: ‘The pictorial is superior in capturing attention, independent of its size. The text element best captures attention in direct proportion to its surface size<sup>(34)</sup>’. Collectively, these findings suggest that health warnings can be effective in communicating their message to consumers without ‘overwhelming’ the promotional information conveyed in advertisements.

Similarly, health warnings did not impact perceptions of SSB advertisements. Participants reported equally positive taste perceptions, and the ‘target’ groups of the advertisements were perceived similarly: in both the health warning and control condition participants perceived the ad as being targeted to younger males, consistent with the imagery featured in the advertisements. These findings suggest that presence of health warnings did not prevent or interfere with the brand imagery in regard to its ability to shape consumer perceptions regarding product attributes and the type of consumer targeted by the ad. Notably, these measures were assessed for a novel soda brand while the advertisement was displayed on the screen. Under experimental conditions, novel brands have an advantage in that consumers have no ‘pre-existing’ association with the product other than the information communicated in the advertisement. Future studies could consider also testing consumer perceptions of established brands, although the potential effects of warnings on familiar brands may be more resilient to change and require higher levels of exposure outside experimental settings. These findings are similar to other studies, which also demonstrate little impact of SSB warnings on perceived taste<sup>(18,19)</sup>.

There was no evidence that health warnings on advertisements had an effect on false health beliefs. Participants who noticed health warnings on the SSB ads were equally likely to report that greater SSB consumption would be associated with weight gain and to indicate that a person’s level of physical activity would affect weight gain regardless of their SSB consumption as were those shown ads with no warnings. This finding is particularly important in the context of health warnings on food products; in contrast to other consumer product categories, such as alcohol or tobacco, SSB warnings are only featured on a sub-category of products with a particular nutrient profile. In this case, it is important to ensure that warnings do not undermine health perceptions of unlabelled products, consistent with the findings from the current study.

Similarly, warnings did not undermine beliefs about weight gain and other sugary foods and beverages for which ads did not display warnings. In fact, participants who noticed warnings on SSB ads were *more* likely to agree that ‘other’ sugary and energy-dense foods and beverages can lead to weight gain compared with participants who saw no warnings on any of the ads. Overall, there was no evidence that viewing SSB advertisements with a health warning led to the belief that SSB are uniquely responsible for weight gain or are more likely to cause weight gain than other sugary or energy-dense foods and drinks that do not display warnings. This finding suggests that the phrasing used in the warning statement – ‘Drinking beverages with added sugar(s) can cause weight gain . . .’ appropriately conveys the association between SSB consumption and weight gain. Previous research has shown that consumers perceive words such as ‘can’ and ‘may’ as qualifying the causal statement to indicate the possibility, but not the certainty, of the outcome and recognise that other factors may moderate this relationship<sup>(12,35)</sup>.

### **Limitations and strengths**

Participants were able to complete the survey on a device of their choosing (laptop, desktop computer, smartphone and tablet), and therefore the size at which the advertisement images were viewed varied between participants. Similarly, viewing the ads on a web-based survey may not replicate how participants would encounter advertisements in the real world. However, as online advertisements have become increasingly common, consumers were likely familiar with viewing ads in this format, increasing the face validity of the study design. Additionally, while participants were shown a series of nine ads to account for potential novelty effects (i.e. paying more attention to the health warnings due to their novelty), the results may not reflect consumers’ reactions to health warnings after they have been implemented for an extended period of time. In the current study, the presentation order of most SSB advertisements was held constant, with the exception of the Coke and Pepsi ads. Randomising the presentation order of SSB ads would allow future studies to examine order effects, as well as potential interactions between health warnings and the characteristics of specific ads or brands. For example, health warnings may have differential effects on different sub-categories of SSB, including fruit drinks, which are often perceived as healthier than regular sodas. The current study is also subject to limitations common to survey research. Respondents were recruited using non-probability-based sampling for a study on cannabis use; however, the study participants represented a heterogeneous mix of respondents and were randomised across experimental conditions, which should improve generalisability. Finally, future studies could consider alternative approaches to assessing brand perceptions,

including qualitative measures, which can provide a more in-depth examination of consumer perceptions. Future studies could also examine individual-level attributes that may moderate the effect of health warnings and SSB advertisements.

## Conclusions

Health warnings have been shown to increase perceptions of health risk and to discourage consumption of SSB, consistent with public health objectives. However, the legal challenges have claimed that such warnings are misleading and associated with false health beliefs. Health warnings are an important regulatory measure for communicating the health risks of consumer products. The San Francisco ordinance represents a precedent for requiring health warnings on SSB products, which have been identified as an important public health issue. Despite considerable evidence that health warnings are an effective means of communicating the risks of high SSB consumption<sup>(8,13,15,18)</sup>, the food and beverage industry has argued that health warnings on SSB advertisements are unduly burdensome and promote false health beliefs. Indeed, the industry has argued that well-established design standards in regard to the use of a border, black and white text, and government attribution – design features that help to ensure warnings are noticeable, legible and credible<sup>(12,27–30)</sup> – are responsible for the ‘unduly burdensome’ aspects of the San Francisco ordinance<sup>(31)</sup>. The argument that these types of design features violate the Zauderer standard in the USA has potentially far-reaching consequences, especially considering that the same design features are widely used in product disclosures for other consumer products, including pharmaceutical products and health warnings on tobacco advertisements.

To our knowledge, the current study is among the first to empirically test these claims. The findings suggest that text-based health warnings similar in design to the San Francisco SSB warnings do not overwhelm the messages that advertisers seek to convey, nor do they lead to false beliefs about the health risks of SSB and other sugary or energy-dense foods and beverages.

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## Supplementary material

For supplementary material accompanying this paper visit <https://doi.org/10.1017/S1368980021001257>

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