

The Influence of Sugar-Sweetened Beverage Health Warning Labels on Parents' Choices

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abstract

BACKGROUND AND OBJECTIVES: US states have introduced bills requiring sugar-sweetened beverages (SSBs) to display health warning labels. This study examined how such labels may influence parents and which labels are most impactful.

METHODS: In this study, 2381 demographically and educationally diverse parents participated in an online survey. Parents were randomly assigned to 1 of 6 conditions: (1) no warning label (control); (2) calorie label; or (3–6) 1 of 4 text versions of a warning label (eg, Safety Warning: Drinking beverages with added sugar[s] contributes to obesity, diabetes, and tooth decay). Parents chose a beverage for their child in a vending machine choice task, rated perceptions of different beverages, and indicated interest in receiving beverage coupons.

RESULTS: Regression analyses controlling for frequency of beverage purchases were used to compare the no warning label group, calorie label group, and all warning label groups combined. Significantly fewer parents chose an SSB for their child in the warning label condition (40%) versus the no label (60%) and calorie label conditions (53%). Parents in the warning label condition also chose significantly fewer SSB coupons, believed that SSBs were less healthy for their child, and were less likely to intend to purchase SSBs. All *P* values <.05 after correcting for multiple comparisons. There were no consistent differences among different versions of the warning labels.

CONCLUSIONS: Health warning labels on SSBs improved parents' understanding of health harms associated with overconsumption of such beverages and may reduce parents' purchase of SSBs for their children.



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WHAT'S KNOWN ON THIS SUBJECT: Research finds that large tobacco text warnings are associated with increased risk perceptions of the health harms of using tobacco products. Although this suggests sugar-sweetened beverage (SSB) warning labels will help educate consumers, few studies have investigated SSB warning labels.

WHAT THIS STUDY ADDS: In an online study of 2381 demographically and educationally diverse parents, SSB health warning labels improved parents' understanding of health harms associated with overconsumption of SSBs. The warning labels also lowered parents' intentions to purchase SSBs for their children.

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National US surveys have revealed that 66% of children 2 to 11 years old drink sugar-sweetened beverages (SSBs) daily.¹ One study estimated that these beverages contribute 69 kcal (calories) and 118 calories daily to the diets of children 2 to 5 and 6 to 11 years old, respectively.² Relative to white children ages 2 to 5, African American children consume almost twice as many calories from SSBs.² Research has linked children's consumption of SSBs with weight gain and risk of obesity in adulthood, as well as dental caries.³⁻⁵ Further, 60% of sodas are estimated to contain caffeine, a known addictive substance.⁶

Growing concern about the health harms associated with SSB intake has prompted policies and interventions to try to reduce their consumption. Most recently, San Francisco passed a law (although due to an ongoing lawsuit it has not yet been implemented) requiring SSB advertisements to include a conspicuous and legible warning label.⁷ The health warnings would be required to take up at least 20% of print advertisements on billboards, walls, taxis, and buses within city limits, but would not apply to advertisements in newspapers, on broadcast outlets, or on the Internet. Legislative bills have also been introduced in California and New York State, which would require SSBs to display health warning labels on product containers, much like tobacco warning labels.^{8,9}

From a public health perspective, the first goal of a warning label is to educate consumers about the potential health harms of a product. In the case of SSBs, such education may be particularly needed for certain beverages. For example, 1 study of 982 parents revealed that many believed some SSBs, including flavored waters and fruit and sports drinks, were healthy options for children.¹⁰ The second goal of a warning is to reduce

consumption by making salient the long-term consequences of drinking SSBs at moments of purchase and consumption.

Research has revealed that large tobacco text warnings are associated with greater knowledge and increased risk perceptions of the health harms of using tobacco products.¹¹ Although this evidence suggests SSB warning labels will help educate consumers, there is a lack of data on the influence of SSB warning labels. Therefore, the current study addressed the following research questions:

1. Do warning labels educate parents' about the health harms associated with SSB intake above and beyond current beverage industry standards of placing calorie information on beverages?
2. Do warning labels influence parents' intentions to buy SSBs for their children and is this effect moderated by education level?
3. Do warning labels influence parents' perceptions and intentions toward nonlabeled beverages?
4. Do the effects of warning labels differ across different label phrasings?
5. What are parents' beliefs about proposals to put warning labels on SSBs?

Overall, we hypothesized that a warning label would be more likely to increase perceptions of the health harms of SSBs and reduce purchase intentions for SSBs relative to calorie labels or no labels. This research has the potential to inform regulatory efforts in states and municipalities considering SSB warning label policies.

METHODS

Participants

We recruited 3136 primary caregivers of a child aged 6 to 11

years old through Survey Sampling International (SSI), a firm that recruits research participants through their online panels and other online communities, social networks, and Web sites by using banner advertisements, SMS and text messaging, and telephone alerts. SSI uses a 3-stage randomization process in matching participants with surveys they are likely to be eligible for and complete. First, randomly selected participants from SSI's panels are combined with people entering the sample who have responded to other SSI recruitment advertisements. An invitation is sent asking them to "take a survey." To reduce selection bias, no specific details of the survey are included in the invitation. After recruitment, potential participants complete proprietary quality control questions before inclusion in a study sample. Participants are then randomly assigned to surveys they are likely to be able to take. There are also quality controls to ensure participants do not take the same survey twice. Based on the target population being recruited, SSI offers a diversity of incentives, including cash, points, prizes, sweepstakes, or being able to donate to charity. For the current study, SSI determined whether a 6- to 11-year-old resided in the household and then randomly selected caregivers in those households to participate. The survey had to be completed on a computer size screen; smart phones or tablets were not permitted. Recruitment efforts were targeted so that the sample reflected the educational make-up of the United States on the basis of 2010 census data. We also oversampled Hispanics and African Americans because they have the highest obesity prevalence in the United States (Table 1).¹² Of the 3136 participants who started the survey, 2492 completed it, and 2381 accurately answered the data integrity check question described below; these participants composed the final sample.

Label Development and Randomization

After agreeing to participate, child caregivers were randomly assigned to 1 of 6 label conditions. The conditions did not significantly differ on sociodemographic variables. The first condition (No Label Control) was a no health warning label control group in which participants viewed beverages without any label. The second condition (Calorie Label) displayed a “Calories per Bottle” label that appeared on all beverages, not just SSBs, which were identical to the American Beverage Association’s “Clear on Calories” labels.¹³ Conditions 3 to 6 displayed warning labels. The first warning label condition (California Label) included the text proposed in the California bill (Safety Warning: Drinking beverages with added sugar[s] contributes to obesity, diabetes, and tooth decay). We then tested 3 modifications of that text designed to make aspects of the warning more salient. A scientific advisory board and legal team reviewed all labels to ensure they accurately reflected current scientific evidence and would be legally viable.

The second warning label condition (Weight Gain Label) modified the California label by changing “obesity” to “weight gain.” The rationale was that obesity might seem like a distant problem affecting older adults and may therefore be less salient to parents making decisions for children. Because people tend to focus on the present rather than the future, we hypothesized that the phrase “weight gain” would be more influential than “obesity.” For the third warning label condition (Preventable Label), the words “preventable diseases like” were inserted before “obesity.” We hypothesized this would be more effective than the California label because it makes salient that these diseases could be prevented. Finally,

TABLE 1 Sociodemographic Characteristics of Sample

Demographic Characteristic	Sample
<i>N</i>	2381
Women, %	70.4
Average age, y	36.2
Median BMI	25.8
Average number of children	2.3
Hispanic, %	31.0
Race, %	
White	67.5
African American	28.2
Asian	1.0
Native American	1.7
Hawaiian	0.2
Other	4.7
Education, %	
Less than high school	4.7
High school degree	31.9
Associate’s degree	9.1
Some college	24.5
College degree	19.3
At least some graduate school	10.5
Household income, %	
Less than \$25 000	17.4
\$25 001–\$50 000	30.2
\$50 001–\$75 000	23.3
\$75 001–\$100 000	14.7
\$100 001–\$125 000	6.2
\$125 001–\$150 000	4.6
More than \$150 000	3.8
Marital status, %	
Never married	15.1
Married	66.1
Living with significant other	9.9
Separated	2.5
Divorced/widowed	6.3
Political party, %	
Republican	21.4
Democrat	43.7
Independent	34.9
Relationship with weight, %	
Trying to lose weight	48.3
Trying to maintain weight	31.3
Trying to gain weight	4.7
Not trying to gain or lose weight	15.8
Has a doctor ever said your child is overweight, %	
No	80.6
Currently	16.7
Not currently, but in the past	2.7
Has a doctor ever said your child has type 2 diabetes, %	
No	93.7
Currently	5.0
Not currently, but in the past	1.3

to respond to concerns that the labels are misleading because the messaging does not apply to type 1 diabetes, we tested a fourth label condition (Type 2 Diabetes Label) that includes the words “type 2” before diabetes. See Fig 1 for label images. We hypothesized that the

Type 2 Diabetes Label would not differ from the California Label.

Warning Label Criteria

We used the criteria in the proposed California legislation to determine which beverages qualified for a

warning label. These criteria were as follows: any sweetened nonalcoholic beverages with added sweeteners that contain 75 or more calories per 12 fluid ounces qualified for a label.⁸ Beverages containing 100% natural fruit juice or natural vegetable juice with no added caloric sweeteners, liquid products used as “dietary aid,” products used for oral nutritional therapy and/or a source of necessary nutrition as a result of a medical condition, oral electrolyte solutions, infant formula, and milk were excluded.

Survey Procedures

This study was approved by the Harvard T.H. Chan School of Public Health Institutional Review Board. After providing informed consent, caregivers took a 20-minute survey (median completion time was 23 minutes). At the beginning of the survey, they were asked if they had more than 1 child between the ages of 6 and 11 years old, and if so, to answer the questions on the basis of their youngest child within that age range.

Outcomes

Vending Machine Choice

The first task required parents to imagine they were looking at a vending machine while shopping because they wanted to purchase a beverage for their child. They were asked to scroll down on 1 screen to view 20 popular, 20-ounce beverages (12 of which were SSBs) presented in 2 columns and then select 1. Beverages were presented in random order. Participants had to view all the beverages before they could advance to the next question. We included beverages with a wide range of added sugar content. Participants were told to select the beverage brand they wanted even if they typically buy a different flavor. Those in a warning label condition were also told that, “drinks with a lot of added sugar have a safety warning label on them.” When a calorie or warning label appeared

A Calorie label



B California label

SAFETY WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay.

C Weight gain label

SAFETY WARNING: Drinking beverages with added sugar(s) contributes to weight gain, diabetes, and tooth decay.

D Preventable label

SAFETY WARNING: Drinking beverages with added sugar(s) contributes to preventable diseases like obesity, diabetes, and tooth decay.

E Type 2 diabetes label

SAFETY WARNING: Drinking beverages with added sugar(s) contributes to obesity, type 2 diabetes, and tooth decay.

FIGURE 1

Different label conditions. A, Calorie label; B, California label; C, Weight gain label; D, Preventable label; E, Type 2 diabetes label.

on a product, it was enlarged and displayed above the beverage image (Fig 2). Because this is among the first studies on SSB warning labels, we tested labels under conditions when they were highly visible and salient. If no effects are detected, there is little reason to think warning labels would work better in the real world.

Beverage Perceptions and Intentions

After completing the vending machine task, participants answered questions about 14 of the twenty,

20-ounce beverages used in the vending machine task (9 of which were SSBs). After pilot testing the survey, we only included a subset of beverages from the vending machine task so the survey did not take too long. Beverages were shown in random order displaying labels on the basis of study condition (see Table 2 for survey questions).

Coupon Choice

After the perceptions and intentions task, participants scrolled down on 1

SAFETY WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay.



FIGURE 2

Sample beverage image with warning label. Color pictures of actual branded beverages were used in the survey.

screen to view the same 20 beverages in random order that were presented in the vending machine task. They were asked to indicate all beverages

they would buy for their child for which they would like to receive a coupon.

Health and Sociodemographic Information

After the coupon task, we asked several health-related questions, including a question asking participants to indicate their relationship with their weight. Participants also provided information about health conditions and whether their doctor ever told them their child is overweight or obese or has type 2 diabetes. Finally, participants indicated their age, gender, height, weight, number of children, ethnicity, race, educational level, marital status, household income, political party affiliation, and the US state or territory they reside in.

Label Recall

As a manipulation check, participants were asked whether they saw a warning label on any of the beverages (choosing among: yes, no, and I don't know).

Support for Warning Label Policy

At the end of the survey, participants were presented with either the California warning label if they were in the control, calorie label, or California condition or a picture of the warning label they were assigned to for the other conditions (see Table 2 for survey questions).

Data Integrity Check

The last question asked people to indicate how many days are in a

TABLE 2 Survey Items for Beverage Perceptions and Intentions and Support for Warning Label Policy

Construct	Survey Question	Scale
Child would find delicious	How delicious would your child think this product is?	1 = Not at all; 7 = Extremely
Healthy	How healthy do you think this product is for your child?	1 = Not at all; 7 = Extremely
Purchase intentions	How likely are you to buy this product for your child in the next 4 wk?	1 = Not at all; 7 = Extremely
Willingness to pay	If you were buying this 20-ounce beverage for your child, what is the most you would be willing to pay?	Range was capped at \$10
Allow child to drink	How likely are you to allow your child to drink this product in the next 4 wk?	1 = Not at all; 7 = Extremely
Make child feel energized	Drinking this product often would make my child feel energized.	1 = Not at all; 7 = Extremely
Help child focus	Drinking this product often would help my child focus at school.	1 = Strongly disagree; 7 = Strongly agree
Amount of added sugar	How much added sugar do you think is in this 20-ounce bottle?	1 = None; 2 = A little; 3 = Some; 4 = A lot
Calorie estimates	How many calories do you think are in this 20-ounce bottle?	Open-ended
SSB disease risk ^a	Drinking this product often would...	1 = Strongly disagree; 7 = Strongly agree
Weight gain	...lead my child to gain weight	
Heart disease	...increase my child's risk of heart disease	
Diabetes	...increase my child's risk of diabetes	
Healthy life (reverse coded)	...help my child live a healthier life	
Purchase frequency	How often have you bought this beverage for your child in the last month?	1 = 0 times; 2 = 1 time; 3 = 2–6 times; 4 = 7–11 times; 5 = 12–16 times; 6 = 17–21 times; 7 = 22–26 times; 8 = 27–31 times; 9 = more than 31 times
Support for warning label policy	If this government safety warning label were on a beverage, how much would it change your thoughts about the healthfulness of that beverage for your child?	1 = Not at all; 5 = A lot
	If this government safety warning label were on beverages with a lot of added sugars, would the label encourage you to give fewer of those beverages to your child?	1 = Definitely no; 5 = Definitely yes
	Would you favor or oppose a government policy requiring a government safety warning label to be placed on beverages with added sugars?	–2 = Strongly oppose; +2 = strongly favor

^a Items adapted from scale used in Andrew et al.¹⁴

week (options ranged from 1–7). Those answering incorrectly were excluded from the analyses ($N = 111$).

Statistical Analyses

First, we assessed differences across the 4 warning label conditions by using logistic regression for categorical outcomes and ordinary least squares regression for continuous outcomes. We regressed each dependent variable on label condition, controlling for self-reported frequency of purchasing SSBs and beverages that would not qualify for a warning label over the past month. Controlling for past behavior is important because people's perceptions, beliefs, intentions, and behavior are partially a product of people's past behavior. We ran all pairwise comparisons by varying which condition was the reference group.

We then collapsed across all warning label conditions and repeated these analyses, running all pairwise comparisons to assess differences among the No Label Control condition, The Calorie Label condition and the Warning Label condition. For this analysis, we examined label effects on both SSBs and beverages that would not qualify for a warning label to see if the labels had spillover effects on beverages that did not have a warning label.

To determine whether the effects of warning labels were similar across the education spectrum, we regressed each of the outcome variables on (1) a dummy variable for Warning Label condition, (2) a dummy variable for Calorie Label condition, (3) mean-centered level of education, (4) the interaction between the Warning Label condition and level of education, (5) the interaction between the Calorie Label condition and level of education, and (6) the self-reported average frequency of purchasing

SSBs and beverages that did not qualify for a warning label. For each of these 3 sets of analyses, we used a $P < .05$ significance threshold and the Bonferroni-Holm procedure to correct for multiple comparisons.¹⁵

RESULTS

Do Different Warning Labels Exert Different Effects?

Our first set of analyses explored whether the 4 warning label conditions exerted different effects on the outcome measures. As shown in Table 3, the differences were minimal. Among the 16 measures analyzed, only estimated calories differed, whereby those who saw the California Label estimated that the SSBs contained fewer calories than those who saw the Preventable Label. However, the California Label group performed better, although not significantly so, on most other measures. These results suggest that the label modifications did not detectably affect our primary outcome measures, and thus are unlikely to be consequential. As a result, the warning label conditions were collapsed for the main analyses, described below.

Do Warning Labels Affect Choices, Perceptions, and Intentions?

As shown in Table 4, putting warning labels on the 9 qualifying SSBs exerted powerful effects relative to both the No Label and Calorie Label conditions. In the vending machine choice task, those in the Warning Label group were significantly less likely than The Calorie Label or No Label groups to choose an SSB for their child. Calorie labels did not have a significant effect compared with the control condition.

Second, warning labels led parents to believe that SSBs were significantly less healthy, less likely to make their child feel energized, less likely to help their child to focus, and more

likely to increase their child's risk of weight gain, heart disease, and diabetes relative to both the Calorie Label and control groups. Although calorie labels significantly increased parents' estimates of the calorie content of SSBs, warning labels did so as well, but to a lesser extent. Participants in the warning label condition judged SSBs to have more added sugar, and they indicated they were less likely to purchase them for their child. Willingness to pay did not significantly differ across groups. Finally, participants in The Warning Label condition chose significantly fewer SSB coupons than did those in The Calorie Label and No Label conditions.

Analyses of beverages that did not qualify for a warning label (averaged across the 5 beverages without warning labels) revealed only a few significant effects of warning label on disease risk and calorie estimation, all of which were very small, and possibly caused by anchoring on the values participants had given for SSBs (see Supplemental Table 5). Judgments of healthfulness and purchase intentions were unaffected.

Do the Effects Vary Across Levels of Education?

The Education \times Warning Label interaction was barely significant for only 2 of the 16 outcomes, indicating that the warning label increased calorie estimates for SSBs ($P = .02$) and perceived diabetes risk ($P = .05$) more for those who were less educated. Education level did not moderate the effect of warning labels on other outcomes, including vending machine beverage choice ($P = .93$), number of SSB coupons chosen ($P = .34$), SSB purchase intentions ($P = .32$), and perceptions of SSB healthfulness ($P = .950$). The Calorie Label \times Education

TABLE 3 SSB Outcomes by Warning Label Condition

	California Warning	Weight Gain Warning	Preventable Warning	Type 2 Diabetes Warning
Vending machine choice				
Choosing an SSB, % ^a	35.7 _a (2.4)	42.3 _a (2.5)	43.6 _a (2.5)	40.0 _a (2.5)
SSB perceptions and intentions ^b				
Child would find delicious (1–7)	4.5 _a (0.07)	4.6 _a (0.06)	4.5 _a (0.07)	4.6 _a (0.07)
Healthy (1–7)	3.2 _a (0.08)	3.4 _a (0.08)	3.3 _a (0.08)	3.4 _a (0.08)
Purchase intention (1–7)	3.3 _a (0.08)	3.5 _a (0.08)	3.4 _a (0.08)	3.5 _a (0.08)
Willingness to pay	\$1.87 _a (0.08)	\$2.01 _a (0.08)	\$2.01 _a (0.08)	\$1.91 _a (0.08)
Allow child to drink (1–7)	3.5 _a (0.08)	3.7 _a (0.08)	3.6 _a (0.08)	3.7 _a (0.08)
Make child feel energized (1–7)	4.2 _a (0.07)	4.4 _a (0.07)	4.3 _a (0.08)	4.3 _a (0.07)
Help child focus (1–7) ^c	3.2 _a (0.08)	3.4 _a (0.08)	3.4 _a (0.08)	3.3 _a (0.08)
Amount of added sugar (1–4)	3.1 _a (0.03)	3.1 _a (0.03)	3.1 _a (0.03)	3.1 _a (0.03)
Estimated calories ^d	101.6 _b (5.97)	109.1 _{ab} (6.95)	128.1 _a (6.96)	113.6 _{ab} (6.87)
SSB disease risk				
Weight gain (1–7)	4.6 _a (0.07)	4.6 _a (0.07)	4.5 _a (0.07)	4.7 _a (0.07)
Heart disease (1–7)	4.4 _a (0.07)	4.4 _a (0.07)	4.3 _a (0.07)	4.5 _a (0.07)
Diabetes (1–7)	4.5 _a (0.07)	4.6 _a (0.07)	4.5 _a (0.07)	4.7 _a (0.07)
Healthy life (1–7)	3.4 _a (0.07)	3.5 _a (0.07)	3.5 _a (0.07)	3.4 _a (0.08)
Coupon choice				
Number of SSB coupons (0–12)	2.3 _a (0.13)	2.5 _a (0.12)	2.4 _a (0.13)	2.2 _a (0.12)
Number of non-SSB coupons (0–8)	3.3 _a (0.10)	3.1 _a (0.09)	3.1 _a (0.09)	3.2 _a (0.09)

N = 2381. Raw statistics are displayed. Data are presented as percentages and means (and SEs). The “perceptions and intentions” and “disease risk” means are averages across 9 SSBs. Within each row, percentages or means with different subscripts differ at *P* < .05 (after correcting for multiple comparisons using the Bonferroni-Holm procedure; Holm¹⁵). After applying this correction, the only statistically significant *P* value in this table is the comparison between the California and preventable labels for estimated calories (*P* = .001). Statistical tests were regressions controlling for the self-reported frequency of purchasing SSB and non-labeled beverages. Analyses of “estimated calories” were conducted on log-transformed estimates (ie, log₁₀[Calories+1]); the table converts the log means and SEs into calories (ie, using 10^{0.8} to calculate the mean).

^a The 12 SSBs were Pom Coconut, Nestea, 7Up, Canada Dry Ginger Ale, Tropicana Lemonade, Coca Cola, Arizona Green Tea, Mountain Dew, Purity Organic: Peach Paradise, Minute Maid Lemonade, Old Orchard Ruby Red Grapefruit Juice, and Mountain Berry Blast Powerade. The 8 non-SSBs were Dasani Water, Simply Orange, Schweppes Seltzer Water, Diet Coca Cola, Honest Green Tea, Tropicana Orange Juice, Polar Seltzer Water, and Power-C Dragonfruit Vitamin Water.

^b The 9 SSBs were Coca Cola, Arizona Green Tea, Mountain Dew, Minute Maid Lemonade, Mountain Berry Blast Powerade, Pom Coconut, Nestea Iced Tea, Purity Organic: Peach Paradise, and Schweppes Ginger Ale. The 5 nonlabeled beverages were Tropicana Orange Juice, Diet Coca Cola, Dasani Water, Honest Green Tea, and Power-C Dragonfruit Vitamin Water.

^c For 1 beverage, Minute Maid Lemonade, we unintentionally omitted the help child focus question from the control condition. Therefore, this item was removed from all analyses of the help child focus variable.

^d Differs significantly across conditions.

interaction was nonsignificant for all outcomes.

Do People Support Warning Label Policies?

Most participants reported that a warning label would change their beliefs about a beverage’s healthfulness (mean = 3.8 ± 1.2 on 5-point scale) and that a label would encourage them to purchase fewer of the beverages for their child (mean = 4.1 ± 1.1 on 5-point scale). Second, 73.3% of participants were in favor of an SSB warning label policy, with only 5.7% opposed (the average support was +1.1 ± 1.0 on a scale from –2 to +2). This did not differ across experimental conditions. Although Republicans (72.9%) and Independents (66.0%) favored the policy less than Democrats (79.2%), the policy had strong majority support among all 3 parties.

DISCUSSION

The first aim of this study was to test whether warning labels can effectively educate consumers about the health harms associated with SSB intake more so than current industry practices of printing calorie labels on beverages. The study also aimed to evaluate how warning labels influence parents’ intentions to buy SSBs, as well as beverages that would not qualify for a label, whether these effects were moderated by education level, and whether the different label phrasings would be more or less effective. Finally, we assessed support for SSB warning labels.

We found that SSB warning labels may be an important way to educate parents about the health harms of SSBs and encourage them to purchase fewer of these beverages. Warning labels reduced parents’

perceptions that SSBs are healthy beverages and that SSBs can increase their child’s energy or ability to focus. We also found that the labels increased parents’ perceptions of the child’s risk of weight gain, heart disease, and diabetes from consuming SSBs. As predicted, calorie labels increased parents’ ability to estimate the calories in SSBs as did warning labels, but to a lesser extent. However, warning labels led parents to judge SSBs to have more added sugar. Analyses of beverages that did not qualify for a warning label suggested that SSB warning labels are unlikely to have spillover effects, either positively or negatively, on judgments of nonlabeled drinks.

Three outcomes measured in this study indicated that warning labels may influence behavior. When asked to make an in-the-moment

TABLE 4 SSB Outcomes. Control Versus Calorie Label Versus Warning Label Conditions

	Percentages and Means (SEs)			Control Versus Calorie	Calorie Versus Warning	Control Versus Warning
	Control	Calorie Label	Warning Label			
Vending machine choice						
Choosing an SSB, % ^{a,b}	59.9 _a (2.4)	53.3 _a (2.5)	40.4 _b (1.2)	.07	<.001	<.001
SSB perceptions and intentions ^c						
Child would find delicious (1–7)	4.6 _a (0.06)	4.6 _a (0.07)	4.6 _a (0.03)	.46	.22	.78
Healthy (1–7) ^a	3.8 _a (0.07)	3.7 _a (0.07)	3.4 _b (0.04)	.68	<.001	<.001
Purchase intention (1–7) ^a	3.8 _a (0.07)	3.8 _a (0.07)	3.4 _b (0.04)	.27	<.001	<.001
Willingness to pay	\$2.09 _a (0.09)	\$1.93 _a (0.07)	\$1.95 _a (0.04)	.35	.78	.37
Allow child to drink (1–7) ^a	4.1 _a (0.07)	4.1 _a (0.07)	3.6 _b (0.04)	.49	<.001	<.001
Make child feel energized (1–7) ^a	4.7 _a (0.06)	4.4 _b (0.07)	4.3 _c (0.04)	.003	.04	<.001
Help child focus (1–7) ^{a,d}	4.3 _a (0.06)	3.6 _b (0.07)	3.3 _c (0.04)	<.001	<.001	<.001
Amount of added sugar (1–4) ^a	2.8 _b (0.03)	2.9 _b (0.03)	3.1 _a (0.01)	.16	<.001	<.001
Estimated calories ^a	91.7 _c (5.41)	148.3 _a (5.84)	112.8 _b (3.35)	<.001	<.001	.005
SSB disease risk						
Weight gain (1–7) ^a	4.5 _b (0.06)	4.2 _c (0.06)	4.6 _a (0.03)	.03	<.001	.02
Heart disease (1–7) ^a	4.2 _b (0.07)	4.0 _b (0.06)	4.4 _a (0.03)	.09	<.001	.003
Diabetes (1–7) ^a	4.3 _b (0.07)	4.2 _b (0.06)	4.6 _a (0.03)	.26	<.001	<.001
Healthy life (1–7) ^a	4.4 _a (0.06)	3.7 _b (0.07)	3.4 _c (0.04)	<.001	<.001	<.001
Coupon choice						
Number of SSB coupons (0–12) ^a	3.3 _a (0.13)	3.0 _a (0.12)	2.4 _b (0.06)	.28	<.001	<.001
Number of non-SSB coupons (0–8)	3.2 _a (0.09)	2.9 _a (0.09)	3.2 _a (0.05)	.07	.011	.51

N = 2381. Raw statistics are displayed. The “perceptions and intentions” and “disease risk” means are averages across 9 SSBs. Within each row, percentages or means with different subscripts differ at *P* < .05 (after correcting for multiple comparisons by using the Bonferroni-Holm procedure; Holm¹⁵). Statistical tests were regressions controlling for the self-reported frequency of purchasing SSB and non-labeled beverages. Analyses of “estimated calories” were conducted on log-transformed estimates (ie, log₁₀[Calories+1]); the table converts the log means and SEs into calories (ie, using 10^{log} to calculate the mean).

^a Differs significantly across conditions.

^b The 12 SSBs were Pom Coconut, Nestea, 7Up, Canada Dry Ginger Ale, Tropicana Lemonade, Coca Cola, Arizona Green Tea, Mountain Dew, Purity Organic: Peach Paradise, Minute Maid Lemonade, Old Orchard Ruby Red Grapefruit Juice, and Mountain Berry Blast Powerade. The 8 non-SSBs were Dasani Water, Simply Orange, Schweppes Seltzer Water, Diet Coca Cola, Honest Green Tea, Tropicana Orange Juice, Polar Seltzer Water, and Power-C Dragonfruit Vitamin Water.

^c The 9 SSBs were Coca Cola, Arizona Green Tea, Mountain Dew, Minute Maid Lemonade, Mountain Berry Blast Powerade, Pom Coconut, Nestea Iced Tea, Purity Organic: Peach Paradise, and Schweppes Ginger Ale. The 5 non-labeled beverages were Tropicana Orange Juice, Diet Coca Cola, Dasani Water, Honest Green Tea, and Power-C Dragonfruit Vitamin Water.

^d For 1 beverage, Minute Maid Lemonade, we unintentionally omitted the help child focus question from the control condition. Therefore, this item was removed from all analyses of the help child focus variable.

hypothetical purchasing decision for their child, caregivers who saw SSBs with warning labels were significantly less likely to choose an SSB relative to those who saw calorie or no labels on beverages. When parents’ were asked to select beverages for which they would want to receive coupons, those who saw warning labels chose significantly fewer coupons for SSBs than the control and calorie label conditions. Finally, warning labels led parents to report being less likely to purchase SSBs for their child in the future. These results suggest that when noticed, warning labels may encourage parents’ to purchase healthier beverages for their children, while current efforts to place calories per bottle information may have little influence. However, research examining SSB

purchases among low-income adolescents revealed that brightly colored signs displaying calorie-related information was associated with a decrease in purchases of these beverages over 6 months,¹⁶ but we do not know whether such decreases would be more dramatic if the signs had included warning labels.

The influence of warning labels on the vast majority of outcomes did not vary based on education level, suggesting they may be helpful for people across the education spectrum. However, the impact of more traditional nutrition labeling strategies tends to vary based on demographic subgroups. For example, research on posting calorie information on restaurant menus finds that those who are more educated or have higher incomes are more likely to use the

information when make purchasing decisions.^{17,18} Although we are not seeing meaningful differences in this study on the basis of education level, our results might be unique to lower education populations in online samples.

Contrary to our hypotheses, we did not find that modified label phrasings differentially impacted the outcomes of interest. This provides support for keeping the proposed California text in future bills, but future research should continue to explore whether other types of label phrasings can increase the influence of text warnings and whether different phrasings resonate with different populations (eg, parents versus teenagers).

Finally, participants strongly believed labels would help change their beliefs about a beverages’

healthfulness and would encourage them to purchase fewer SSBs for their children. The majority of respondents favored a policy to place warning labels on SSBs and although there were differences across political parties, the policy had strong majority support among all 3 parties, suggesting that SSB warning label proposals are unlikely to be met with strong constituent opposition. Labeling strategies typically garner more public support than more controversial food policies such as taxing SSBs or limiting their portion size.¹⁹

This study has several limitations. First, we studied the influence of warning labels via an online survey, not in the real world. However, given that such SSB labels do not exist in the real world, this is 1 of the first studies to look at the potential effect of such a policy. In addition, tobacco research suggests that labels are most likely to influence consumers if they are visible and salient, whereas more obscure text warning are less likely to have an impact.¹¹ Therefore, we wanted to study warning labels under conditions where they are highly visible and salient to understand how they may impact consumers who see them. This means the study may have overestimated the effect of the warning label, but if we had found no effect, it would suggest that such labels would not be influential in real-world settings. The survey is also limited because of potential desirability bias. Consumers may be inclined to indicate they would not want to purchase an

SSB because it is the desirable answer. However, consumers were completing the survey online and anonymously, likely reducing the desire to please the researcher. In addition, if there was a strong social desirability bias, we would expect to also see strong effects from exposure to salient calorie labels, but this did not happen. Although we have a large racially and ethnically diverse sample and we recruited so that our sample reflects the educational make-up of the United States, this does not mean we have a nationally representative sample. Therefore, these results may not generalize to other populations. In addition, we do not know how our study sample differs from those who opted not to take the survey. This study is also limited to parents making purchasing decisions for their children. Future research should assess the influence of warning labels on adults and adolescents. Finally, we tested the warning label guidelines on the basis of the California law so that the study could inform current policy debates. However, other laws might seek to include 100% fruit juices in labeling requirements, making it important to understand how warning labels would affect perceptions of those beverages.

This study has a number of strengths, including a large sample size, a randomized-controlled design with both a no label control group and a calorie label group, and a sample that included a range of education levels, as well as a large proportion of racial and ethnic minority participants. This study

is among the first to examine the potential influence of SSB warning labels and provides timely data on the potential for such labels to educate consumers and reduce SSB intake. Although this study provides preliminary support for placing warning labels on SSBs, more research is needed to understand how they would influence a range of consumers and whether they would impact overall dietary choices. For example, 1 concern is that warning labels on SSBs would be ineffective at reducing overconsumption of calories and sugar because people would simply compensate by buying other high sugar foods that are unlabeled.

CONCLUSIONS

These results suggest that SSB warning labels are likely to reduce parents' perceptions of SSBs' healthfulness, increase perceptions of the health risks posed by SSBs, and decrease parents' likelihood of buying SSBs for their children.

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ABBREVIATIONS

SSB: sugar-sweetened beverage
SSI: Survey Sampling
International

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