

The Influence of Sugar-Sweetened Beverage Warnings

A Randomized Trial of Adolescents' Choices and Beliefs

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Introduction: California, New York, and the cities of San Francisco and Baltimore have introduced bills requiring health-related warning labels for sugar-sweetened beverages. This study measures the extent to which these warning labels influence adolescents' beliefs and hypothetical choices.

Design: Participants completed an online survey in which they chose a beverage in a hypothetical vending machine task, rated perceptions of different beverages, and indicated interest in coupons for beverages. Data were collected and analyzed in 2015.

Setting/participants: A total of 2,202 demographically diverse adolescents aged 12–18 years completed the online survey.

Intervention: Participants were randomly assigned to one of six conditions: (1) no warning label; (2) calorie label; (3–6) one of four text versions of a warning label (e.g., *SAFETY WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay*).

Main outcome measures: Hypothetical choices, perceptions of beverages, interest in coupons, and endorsement of warning label policies were assessed.

Results: Controlling for frequency of beverage purchases, significantly fewer adolescents chose a sugar-sweetened beverage in three of the four warning label conditions (65%, 63%, and 61%) than in the no label (77%) condition. Adolescents in the four warning label conditions chose fewer sugar-sweetened beverage coupons and believed that sugar-sweetened beverages were less likely to help them lead a healthy life and had more added sugar compared with the no label condition.

Conclusions: Health-related warning labels on sugar-sweetened beverages improved adolescents' recognition of the sugar content of such beverages and reduced hypothetical choices to buy sugar-sweetened beverages.

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Introduction

Recent surveys have found that 77% of American adolescents drink sugar-sweetened beverages (SSBs) daily.¹ Although soda consumption among adolescents has decreased over the last 15 years,

the consumption of other SSBs like sports/energy drinks has simultaneously increased.¹ According to one study, SSBs contribute approximately 225 kilocalories daily to the diets of adolescents aged 12–19 years, comprising approximately 10% of calorie intake.² Research has linked children's SSB consumption with weight gain and risk of obesity in adulthood, as well as dental caries.^{3–5}

In response to high levels of SSB consumption and the health concerns associated with overconsumption, legislative bills introduced in California, New York, Vermont, Hawaii, and Washington would require health-related warning labels to be displayed on individual beverage packaging.^{6–11} Similarly, San Francisco passed a law in

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2015 (still yet to be implemented at the time of this writing) requiring SSB advertisements to include a warning label that informs consumers of the potential health harms associated with drinking SSBs,¹² and an ordinance introduced in the city of Baltimore would require health-related warnings on certain SSB advertisements, menus, and signs in locations where SSBs are sold.¹³ Studies of text warnings for tobacco products show improved consumer education, greater knowledge of health harms, and increased perceived risk of tobacco use.¹⁴ Combined with a recent study of the impact of SSB warning labels on parents' decisions and judgments,¹⁵ this suggests SSB warning labels would similarly educate adult consumers, but there is a lack of research on how these labels would influence adolescents. Therefore, the present study aimed to answer the following questions:

1. Do warning labels educate adolescents about the health concerns associated with SSB intake, and do these warning labels outperform front-of-package calorie labels?
2. Do warning and calorie labels influence adolescents' intentions to buy SSBs?
3. Do warning and calorie labels change adolescents' perceptions and purchase intentions of non-labeled beverages?
4. Do the effects of warning labels differ depending on label phrasing?
5. Are the effects of warning labels moderated by parent education, age, or whether one is overweight?
6. What are adolescents' beliefs regarding policies requiring warning labels on SSBs?

It was hypothesized that exposure to a warning label would increase adolescents' perceptions of SSB-related health problems and reduce purchase intentions for SSBs relative to exposure to calorie labels or no labels. The authors additionally generated different warning label phrasings, and hypothesized that two of these phrasings would have a greater impact on adolescents' perceptions and intentions than the label phrasing recently proposed in California. Finally, the authors hypothesized that the effect of warning labels would be moderated by the education level of adolescents' parents.

This research provides the first evidence regarding how adolescent beliefs and intentions can be influenced by SSB warning labels, and can inform regulatory efforts at both the local and state level where such labeling policies are being considered.

Methods

Participants

The authors recruited 2,495 adolescents aged 12–18 years to complete an online survey. Participants were recruited through

Survey Sampling International, which maintains online panels and recruits from other online networks and websites. Recruitment materials invited individuals to “take a survey” without including additional details, thus minimizing selection bias. Once recruited, potential participants passed quality control questions and were then randomly assigned to surveys for which they likely qualify. Based on the recruited population, Survey Sampling International offers a variety of incentives, including cash, lotteries, and donations to charity.

For this study, the authors worked with Survey Sampling International to recruit families with an adolescent aged 12–18 years residing in the household, specifically seeking to oversample Hispanics and African Americans (Table 1) because they have higher obesity prevalence than other groups.¹⁶ Adolescents were recruited such that their parents' education level was representative of the U.S. population according to 2010 Census data.

Overall, 2,495 participants started the survey, 2,282 completed it, and 2,202 correctly answered the data integrity question (described below); these 2,202 adolescents made up the final sample.

Label Development and Randomization

Adolescent participants were randomized to one of six label conditions. The first condition was a control group in which participants were shown beverages without any health-related warning label (no label control). Participants in the second condition viewed a “calories per bottle” label on all beverages, not only SSBs (calorie label). These labels were identical to the American Beverage Association's “Clear on Calories” labels.¹⁷ Although calorie labels may influence choices and perceptions, it was hypothesized that these labels would be less influential than labels that explicitly include a safety warning. Conditions 3–6 featured SSB warning labels. The first warning label read: *SAFETY WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay* (California label). The text in this warning is the same text proposed in the California bill^{6,7}; the remaining three experimental conditions were modifications of that text. All labels were reviewed for accuracy by a scientific advisory board and a legal team to ensure legally permissible claims were tested.

The first warning label modification altered the original text by changing “obesity” to “weight gain” (weight gain label) because obesity might seem like a distant, abstract problem, whereas weight gain might feel more immediate and tangible. For the second label, the phrase “preventable diseases like” was inserted before “obesity, diabetes, and tooth decay” (preventable label) to highlight that disease risk could be modified by one's behavior. Finally, a label that added the words “type 2” before “diabetes” (Type 2 diabetes label) was tested to address concerns that the California label is misleading because SSB intake does not impact development of Type 1 diabetes. Figure 1 displays all label images. The authors hypothesized that the “weight gain” and “preventable” labels would be more effective than the other warning labels, and that all four warning labels would be more influential than the no label and calorie label conditions because those groups did not view explicit safety warnings or descriptions of health problems.

Study beverages qualified for a warning label based on criteria set by the proposed California legislation, which

Table 1. Socio-demographic Characteristics of Sample

Demographic characteristic	Sample
N	2,202
Female, %	50.3
Average age (years)	15.0
Median BMI	22.1
Hispanic, %	31.6
Race, %	
White	62.9
Black	33.6
Asian	1.8
Native American	2.1
Hawaiian	0.3
Other	4.5
Grade in school, %	
5th	1.5
6th	6.3
7th	10.4
8th	13.9
9th	17.8
10th	18.4
11th	16.9
12th	14.9
Mother's education, %	
Less than high school	9.6
High school degree	18.6
Associate's degree	10.6
Some college	20.6
College degree	25.2
At least some graduate school	14.0
Don't know	1.4
Father's education, %	
Less than high school	6.8
High school degree	24.5
Associate's degree	7.7
Some college	16.1
College degree	23.3
At least some graduate school	16.0

*(continued)***Table 1.** (continued)

Demographic characteristic	Sample
Don't know	5.6
Relationship with weight, %	
Trying to lose weight	30.0
Trying to maintain weight	33.7
Trying to gain weight	4.9
Not trying to gain or lose weight	31.4
Has a doctor ever said you are overweight?, %	
No	74.6
Currently	21.2
Not currently, but in the past	4.2
Has a doctor ever said you have type 2 diabetes?, %	
No	94.4
Currently	5.3
Not currently, but in the past	0.3

mandates a label for any nonalcoholic beverage with added sweeteners that contains ≥ 75 calories per 12 fluid ounces.^{6,7}

Survey Procedures

Upon meeting recruitment criteria and providing informed consent, adolescents completed the survey online (median completion time was 16 minutes). The survey was administered via Qualtrics and could only be completed on a computer-size screen; mobile devices or tablets were not permitted because their small screens would make it difficult to read labels and complete the survey. All data were collected and analyzed in 2015. The Harvard T. H. Chan School of Public Health IRB approved this study (Figure 2).

Primary Outcomes

Adolescents were asked to imagine they wanted to purchase a beverage from a vending machine, viewed 20 popular 20-ounce beverages (12 SSBs) presented in random order in two columns on the computer screen, and selected one for hypothetical purchase. Beverages that spanned a range of added sugar content were included. An effort was made to include beverages that consumers likely know are high in added sugar content (e.g., Coca Cola) or low in added sugar content (e.g., Dasani bottled water) as well as drinks that many consumers likely do not realize are high in added sugar (e.g., Arizona Green Iced Tea, Powerade). Study beverages consisted of sodas, juices, iced teas, still and seltzer waters, lemonade, and sports drinks. Energy drinks, such as Red Bull or Monster, were not included, nor were coffee or iced coffee beverages. Participants were required to view all beverages and were told to select the product they wanted even if they typically

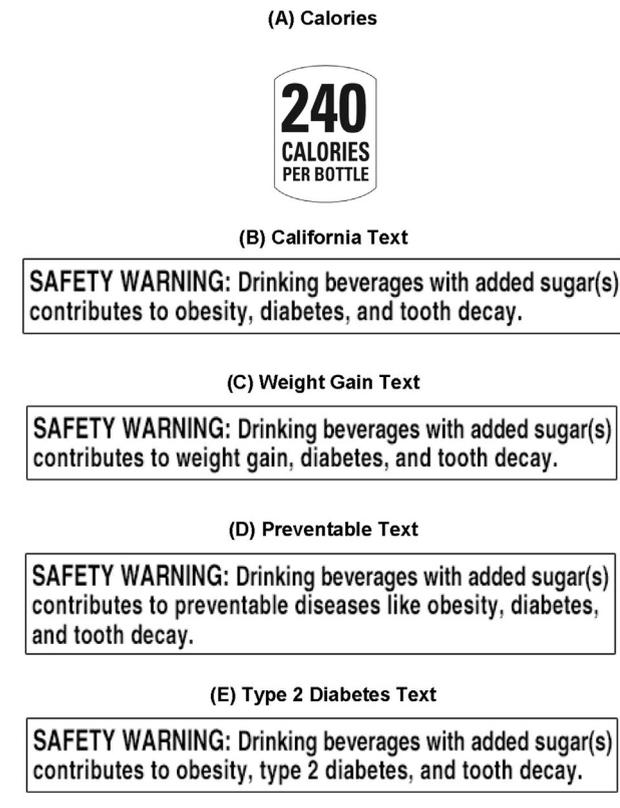


Figure 1. Different label conditions.

buy a different flavor (e.g., they should choose Fruit Punch Powerade even if they normally purchase Lemon Lime Powerade). Because consumers would have never previously encountered warning labels and might not realize why some beverages had them whereas others did not, the authors included a sentence in the instructional paragraph for the vending machine task that read: *Drinks with a lot of added sugar have a safety warning label on them.*

Beverages displayed labels based on study condition and eligibility for SSB warning labels. Calorie or warning labels were enlarged and displayed above beverage images to make these labels legible on a computer screen (Appendix Figure 1, available online).

Next, participants answered questions about their perceptions of and intentions regarding ten randomly ordered 20-ounce beverages, of which six were SSBs. Responses to these questions were averaged across beverages for analyses. Appendix Table 1 (available online) lists the survey questions.

Participants viewed the same 20 randomly ordered beverages as in the vending machine task and selected each beverage for which they would be interested in receiving a discount coupon.

Secondary Outcomes

At the end of the survey, participants in the control, calorie label, or California warning label conditions were presented with the California warning label, whereas those in the other conditions saw their assigned warning label. All participants were asked whether such a label would change their health beliefs about SSBs, willingness to buy SSBs, and whether they would favor a government policy requiring this label on SSBs (Appendix Table 1, available online).

Additional Measures

Participants indicated whether their doctor has told them they are currently overweight or have Type 2 diabetes, and whether they are currently trying to lose, gain, or maintain weight. Participants also stated their age, gender, height, weight, ethnicity, race, grade in school, parents' educational level, and their U.S. state or territory of residence.

As a manipulation check, participants indicated whether they saw a warning label on any beverage (choosing among *yes*, *no*, and *I don't know*). As expected, those in each of the warning label conditions were significantly more likely to report seeing a warning label (range, 70%–75%) than those in the calorie label condition (6%) or those in the no label condition (6%), ($\chi^2_{(10)}=895.14, p<0.001$).

The final question asked participants the number of days in a week (multiple choice, options ranged from 5 to 25 days). Those answering incorrectly were excluded from analyses ($n=80$).

Statistical Analysis

There were no observed differences across conditions with regard to gender, age, respondent BMI, respondent education, parents' education, relationship with weight, or overweight status (all $p>0.15$), suggesting that randomization to condition successfully balanced the groups.

To assess differences in the outcome variables across conditions, the authors regressed each dependent variable on label condition, controlling for self-reported frequency of both SSB and non-SSB purchases over the past month, and using a $p<0.05$ significance threshold. ANCOVAs were used to analyze continuous outcomes and logistic regressions to analyze categorical outcomes. For the ANCOVAs, pairwise comparisons were conducted with Tukey post hoc corrections; for the logistic regressions, the authors varied which condition was the reference group and used the Bonferroni–Holm procedure to correct for multiple comparisons.¹⁸

To determine whether the effects of calorie and warning labels differed by parent education level, each outcome variable was regressed on

1. a categorical variable for experimental condition, with no label as the reference group;
2. a binary variable for whether at least one parent received education beyond high school;
3. the interaction between experimental condition and parent education; and
4. the self-reported average frequency of SSB and non-SSB purchases.

The authors hypothesized that warning labels would be more influential for children of parents with a higher education level.

As exploratory analyses, the authors also examined whether participant age or being overweight moderated the effects of warning labels, replacing the binary variable for parent education with either mean-centered participant age or a binary variable for doctor-diagnosed current overweight status (as reported by participants; combining *no* and *in the past* responses). For all interaction analyses, the Bonferroni–Holm procedure was used to correct for multiple comparisons.

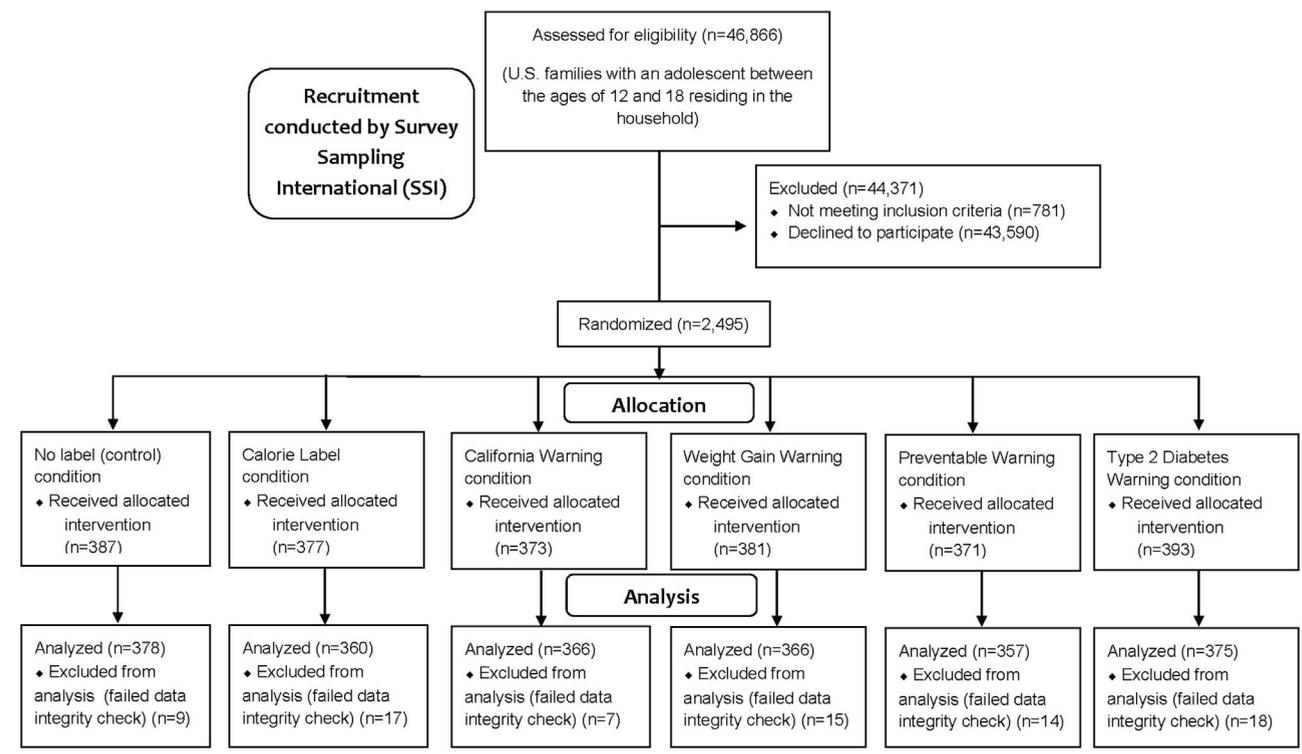


Figure 2. CONSORT flow diagram.

Results

Among the six label conditions, there were differences in 13 of 15 analyzed measures (Table 2). Compared with the control condition, three of four warning labels reduced vending machine selection of SSBs. All four warning labels reduced the number of selected SSB coupons. They also increased subjective perceptions of added sugar in SSBs, and led to lower subjective perceptions of SSBs promoting a healthy life, helping one feel energized, or helping one focus at school. Calorie labels did not reduce selection of SSBs or SSB coupons compared to the control condition, and led to significantly more SSB coupons being selected than in any warning label condition. Relative to the control condition, calorie labels increased perceptions of added sugar in SSBs and reduced perceptions of SSBs promoting a healthy life or helping one focus at school, though not to the same extent as warning labels (Table 2). Finally, compared with all other conditions, calorie labels significantly increased the estimated calories in SSBs, which were underestimated on average in all conditions.

Among the warning label conditions, there were significant differences on three of 15 measures, although none of these differences followed ex ante predictions regarding the intended effects of these labels’ phrasings. Those exposed to the California label were more likely to select an SSB in the vending machine task than those

shown the Type 2 diabetes label, and, curiously, rated the risk of diabetes as lower than in any other condition. Those who saw type 2 diabetes labels rated SSBs as less delicious than those shown the weight gain label.

Analyses of non-labeled beverages revealed significant effects of label condition on seven of eight perceptions and intentions measures, but only one of four disease risk measures (risk of weight gain). Most of these differences appear to be driven by the calorie label condition, as participants exposed to calorie labels rated these beverages as less healthy and having more added sugar than participants in other conditions (Appendix Table 2, available online).

There were significant interactions of the weight gain warning label and overweight status ($p=0.004$) and the “preventable” warning label and overweight status ($p=0.001$) on vending machine choice. In both cases, overweight adolescents exposed to the warning label were less likely to choose SSBs than non-overweight adolescents shown the same labels. No other interactions (e.g., by parent education or age) emerged as statistically significant.

On average, participants reported that a warning label would change their beliefs about a beverage’s healthfulness ($M=3.51$ [$SD=1.34$] on a 5-point scale) and that a label would encourage them to purchase fewer SSBs ($M=3.65$ [$SD=1.25$] on a 5-point scale). Additionally,

Table 2. Sugar-Sweetened Beverage (SSB) Outcomes by Study Condition, Percentages and Means (and SEs)

	Control	Calorie label	California warning	Weight gain warning	Preventable warning	Type 2 diabetes warning
Vending machine choice						
% Choosing an SSB	77.2% ^{d,e,f} (2.2%)	72.5% ^f (2.4%)	69.1% (2.4%)	64.5% ^a (2.5%)	63.0% ^a (2.6%)	60.8% ^{a,b} (2.5%)
SSB perceptions and intentions						
Delicious (1–7)	4.87 (0.06)	4.97 ^f (0.07)	4.90 (0.06)	4.97 ^f (0.07)	4.82 (0.06)	4.69 ^{b,d} (0.07)
Healthy (1–7)	3.90 ^{e,f} (0.06)	3.95 ^{e,f} (0.07)	3.77 (0.08)	3.79 (0.08)	3.61 ^{a,b} (0.08)	3.61 ^{a,b} (0.08)
Purchase intention (1–7)	4.13 (0.07)	4.21 ^{e,f} (0.08)	4.08 (0.08)	4.07 (0.08)	3.93 ^b (0.08)	3.92 ^b (0.08)
Likely to drink (1–7)	4.15 (0.07)	4.25 ^{e,f} (0.08)	4.08 (0.08)	4.15 (0.08)	3.96 ^b (0.08)	3.95 ^b (0.08)
Energized (1–7)	5.02 ^{c,d,e,f} (0.06)	4.80 ^f (0.06)	4.72 ^a (0.06)	4.70 ^a (0.07)	4.69 ^a (0.07)	4.52 ^{a,b} (0.07)
Focus (1–7)	4.51 ^{b,c,d,e,f} (0.06)	4.09 ^a (0.08)	4.07 ^a (0.07)	4.07 ^a (0.08)	3.93 ^a (0.08)	3.90 ^a (0.08)
Amount of added sugar (1–4)	2.88 ^{b,c,d,e,f} (0.03)	3.01 ^a (0.03)	3.05 ^a (0.03)	3.05 ^a (0.03)	3.06 ^a (0.03)	3.07 ^a (0.03)
Estimated calories	91.22 ^{b,e,f} (4.96)	180.62 ^{a,c,d,e,f} (6.35)	102.61 ^b (5.33)	104.30 ^b (5.86)	114.61 ^{a,b} (5.88)	111.53 ^{a,b} (5.46)
SSB disease risk						
Weight gain (1–7)	4.65 (0.06)	4.57 (0.06)	4.51 (0.07)	4.66 (0.06)	4.76 (0.06)	4.56 (0.07)
Heart disease (1–7)	4.23 (0.06)	4.22 (0.06)	4.31 (0.07)	4.28 (0.07)	4.36 (0.07)	4.28 (0.07)
Diabetes (1–7)	4.44 ^{c,e} (0.06)	4.43 ^{c,e} (0.06)	4.05 ^{a,b,d,e,f} (0.07)	4.57 ^c (0.07)	4.71 ^{a,b,c} (0.07)	4.58 ^c (0.07)
Healthy life (1–7)	4.57 ^{b,c,d,e,f} (0.05)	3.90 ^{a,f} (0.07)	3.83 ^a (0.07)	3.76 ^a (0.07)	3.70 ^a (0.07)	3.67 ^{a,b} (0.07)
Coupon choice						
Number of SSB coupons (0–12)	3.64 ^{c,d,e,f} (0.14)	3.66 ^{c,d,e,f} (0.13)	3.00 ^{a,b} (0.13)	2.92 ^{a,b} (0.13)	2.85 ^{a,b} (0.14)	2.70 ^{a,b} (0.13)
Number of non-SSB coupons (0–8)	2.70 (0.10)	2.88 ^d (0.10)	2.57 (0.10)	2.47 ^b (0.10)	2.58 (0.10)	2.65 (0.10)

Note: N = 2,202. Raw statistics are displayed. The “Perceptions and Intentions” means are averages across beverages. Within each row, boldface percentages or means with different superscripts differ at $p < 0.05$ (after correcting for multiple comparisons using Tukey post hoc tests), compared to the number of the corresponding column:

^aSignificantly different from control condition.

^bSignificantly different from calorie label condition.

^cSignificantly different from California warning.

^dSignificantly different from weight gain warning.

^eSignificantly different from preventable warning.

^fSignificantly different from Type 2 diabetes warning.

For the vending machine choice, a Bonferroni-Holm correction rather than the Tukey post hoc test was applied because data were analyzed using logistic regression. All statistical tests controlled for the self-reported frequency of purchasing beverages that qualified for a warning label and ones that did not. Analyses of “Estimated Calories” were conducted on log-transformed estimates (i.e., $\log_{10}[\text{Calories} + 1]$); the table converts the log means and SEs into calories (i.e., using 10^{log} to calculate the mean). Non-SSB refers to those beverages that did not qualify for an SSB warning label.

For analyses related to vending machine choice and coupon choice, 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 eight non-SSBs (those beverages that did not qualify for an SSB warning label) 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.

For analyses related to SSB perceptions and intentions and disease risk, the six SSBs were Coca Cola, Arizona Green Tea, Mountain Dew, Minute Maid Lemonade, Mountain Berry Blast Powerade, and Purity Organic: Peach Paradise. The four non-SSBs were Tropicana Orange Juice, Diet Coca Cola, Dasani Water, and Power-C Dragonfruit Vitamin Water.

62.7% of participants favored an SSB warning label policy, whereas only 7.8% were opposed (the average support was +0.85 [SD=1.06] on a scale from -2 to +2). These beliefs did not differ across experimental conditions.

Discussion

Warning labels reduced adolescents' perceptions that SSBs contribute to a healthy life and reduced beliefs that SSBs can increase their energy and help them focus. Calorie labels increased adolescents' estimates of the calories in SSBs, as did two of four warning labels. Both calorie and warning labels led participants to subjectively evaluate SSBs to have more added sugar.

Although shifts in perceptions are important, this study also provides preliminary evidence that SSB warning labels may affect behavior. In the vending machine task, participants who saw SSBs with warning labels were less likely to hypothetically purchase an SSB relative to those who saw no labels, an effect that was statistically significant for three of four warning label conditions. When selecting hypothetical beverage coupons, adolescents who saw warning labels chose significantly fewer SSB coupons than the control and calorie label conditions, suggesting that the warning labels reduced desire for a range of SSB options. Additionally, when stating perceptions and intentions, two of the warning label conditions led participants to report lower intentions to purchase SSBs in the future than those exposed to calorie labels. Overall, it appears that warning labels may encourage adolescents to purchase healthier beverages, whereas "calories per bottle" labels had no such impact on behavioral intentions. Whether this diminished impact of calorie labels is due to the safety and health information included in the health-related warning labels, greater novelty of warning labels, or consumer difficulty in interpreting calorie labels is a question for future research. It is possible that additional interpretative information, such as a clearly communicated threshold for high calorie content, could facilitate greater impact of calorie labels on behavioral intentions.

By analyzing responses to both SSBs and beverages that did not qualify for a warning label, the authors were able to assess potential spillover effects of SSB warning labels. The results suggest that SSB warning labels have little impact, either positively or negatively, on judgments of non-labeled beverages. This stands in contrast to the influence of calorie labels, which decreased perceptions of the healthfulness of non-labeled beverages and increased their perceived sugar content. These differences between calorie labels and warning labels may exist because calorie labels were posted on all beverages

(even ones that contain some sugar, but would not qualify for a warning label), whereas warning labels only appeared on SSBs meeting a certain added sugar threshold.

The influence of warning labels on measured outcomes did not vary based on parent education, suggesting SSB warning labels may be helpful for adolescents regardless of their parents' education level. This suggests that factors related to SES may have less impact on adolescents' ability to use these labels relative to other types of nutrition labels, whereas research on restaurant menu calorie labeling has found that higher-income and higher-educated individuals are more likely to use menu calorie labels to make purchasing decisions.^{19,20} Future research could investigate whether SSB warning labels are categorically different from (and perhaps more universally understood than) other labels, or whether the hypothetical setting contributed to the uniqueness of the present results.

Overall, there was little support for hypotheses that modified label phrasings would differentially impact outcomes of interest, although alternative phrasings were directionally more effective than the California label on several outcomes. Combined with past research regarding parents' decisions,¹⁵ these data suggest the California text is a reasonable baseline standard for improving consumer knowledge of SSBs, but future research could further examine whether alternative phrasing, design, or placement of warning labels can improve their impact.

Finally, adolescents expressed that government-sponsored SSB warning labels would shift their beliefs about a beverage's healthfulness and would motivate them to consume fewer SSBs. In addition, the majority of respondents favored a policy to place warning labels on SSBs.

Limitations

This study has several limitations concerning generalizability. First, decisions were hypothetical. However, given that SSB labels do not yet exist in stores or other actual decision contexts, this hypothetical context enabled the authors to investigate the potential effect of a labeling policy. In line with research suggesting that tobacco labels have the largest impact when clearly legible and prominently displayed,¹⁴ the present work studied warning labels under conditions where labels were highly visible to identify how they could impact consumers who see them. Although such a design may overestimate the effect of a warning label, such research is important because the absence of an effect would suggest that labels would not influence actual decisions. It is also possible that the inclusion of an instructional sentence informing participants that warning labels appeared on

drinks with a lot of added sugar could have increased the labels' impact. Additionally, although this study had a large sample size, it may have lacked adequate statistical power to detect significant differences between different label phrasings. The survey is also limited because of potential desirability bias. Consumers may realize that the authors are testing responses to labels and infer that they should indicate that they would not purchase an SSB. However, survey responses were anonymous and respondents had little incentive to please the researcher. Further, a strong social desirability bias would predict more significant effects from exposure to the equally salient calorie labels, but such effects were not detected. The authors also did not recruit a nationally representative sample. However, the sample was large, racially and ethnically diverse, and recruited so that parent education level reflected the educational makeup of the U.S. Finally, the warning label was tested using the inclusion criteria set by California legislation so that this study might inform current policy debates. However, different labeling requirements could include additional beverages, such as 100% fruit juices, and the present study does not address 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 no label control and calorie label groups, a sample of adolescents ranging in age from 12 to 18 years, and a large proportion of racial and ethnic minority participants with a range of parental education levels. The present research is among the first to examine the influence of SSB warning labels and provides timely data on the potential for such labels to educate adolescents and reduce SSB intake. This study provides preliminary support for placing warning labels on SSBs, setting the stage for future research to identify their impact on overall dietary choices in different settings.

Conclusions

These results suggest that SSB warning labels are a promising strategy to reduce adolescents' perceptions of SSBs' healthfulness and decrease adolescents' likelihood of buying SSBs.

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analyzed the data and drafted the initial manuscript. Dr. Roberto conceptualized and designed the study, critically reviewed the manuscript, and approved the final manuscript as submitted.

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Appendix

Supplementary data

Supplementary data associated with this article can be found at <http://dx.doi.org/10.1016/j.amepre.2016.07.010>.