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RESEARCH ARTICLE

Online RCT of Icon Added-Sugar Warning Labels for Restaurant Menus

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Introduction: To reduce added-sugar consumption, jurisdictions are considering requiring restaurant menu labels to identify high-added-sugar items. This study examined the impacts of added-sugar warning labels on hypothetical choices, knowledge of items' added-sugar content, and perceptions of high-added-sugar items.

Study design: The design was an online RCT.

Setting/participants: National sample of adults (N=15,496) was recruited to approximate the U.S. distribution of sex, age, race, ethnicity, and education.

Intervention: Participants viewed fast-food and full-service restaurant menus displaying no warning labels (control) or icon-only added-sugar warning labels next to high-added-sugar items (containing >50% of the daily recommended limit).

Main outcome measures: The main outcome measures were hypothetical ordering of ≥1 high-added-sugar item, grams of added sugar ordered, and knowledge of items' added-sugar content assessed in 2021 and analyzed in 2021−2022.

Results: Warning labels reduced the relative probability of ordering ≥1 high-added-sugar item by 2.2% (probability ratio=0.978, 95% CI=0.964, 0.992; p=0.002); improved knowledge of added-sugar content (p<0.001); and led to a nonstatistically significant reduction of 1.5 grams of added sugar ordered, averaged across menus (p=0.07). The label modestly reduced the appeal of high-added-sugar items, increased perceptions that consuming such items often will increase Type 2 diabetes risk, increased perceived control over eating decisions, and increased injunctive norms about limiting consumption of high-added-sugar items (ps<0.001). However, in the warning condition, only 47% noticed nutrition labels, and 21% recalled seeing added-sugar labels. When restricting the warning condition to those who noticed the label, the result for grams of added sugar ordered was significant, with the warning condition ordering 4.9 fewer grams than the controls (95% CI= −7.3, −2.5; p<0.001).

Conclusions: Added-sugar warning labels reduced the probability of ordering a high-added-sugar menu item and increased participants' knowledge of whether items contained >50% of the daily value for added sugar. The modest magnitudes of effects may be due to low label noticeability. Menu warning labels should be designed for noticeability.

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INTRODUCTION

Most U.S. children and adults consume added sugar in excess of the Dietary Guidelines for Americans' recommended limit of 10% of daily calories,[1] increasing the population's risk for cardiometabolic diseases.[2−4] Governing bodies worldwide—including U.S. federal agencies and the WHO—have identified reducing added-sugar consumption as a public health priority.[1,5,6]

Individuals' ability to reduce added-sugar intake relies largely on the environment in which they make food decisions.[1,7,8] A total of 21% of calories consumed in the U.S. come from restaurants,[9,10] and the nutritional quality of restaurant food is lower than that of foods consumed from schools, workplaces, and grocery stores,[10] making restaurants an important target for public health intervention. One barrier to informed choice in restaurants is the lack of added-sugar information.[11−14] Although the U.S. mandates added-sugar labeling on packaged foods, calorie labeling on chain-restaurant menus, and disclosure of several nutrients upon request in chain restaurants, chain restaurants are not required to disclose added sugar let alone label high-added-sugar items. Therefore, the New York City (NYC) Council passed a bill in 2021 requiring added-sugar menu labels in chain restaurants to indicate prepackaged items that exceed the daily recommended limit.[15] This policy is similar to NYC and Philadelphia laws requiring sodium labeling in chain restaurants.[16,17]

Online experiments have found that restaurant menu sodium warnings and multinutrient warnings (such as Chile's octagonal nutrient labels) on food-ordering websites reduced hypothetical ordering of labeled items,[18,19] but there is a lack of research on added-sugar menu warning labels. The only study to examine such warnings found that compared with a control label, icon-only and icon-plus-text added-sugar warning labels were perceived as more effective and increased knowledge about items' added-sugar content, with both label types performing similarly.[20] However, research with behavioral outcomes is needed to better understand the potential effectiveness of added-sugar menu labels. The goal of this study was to examine the effect of icon-only added-sugar warning labels displayed next to restaurant menu items high in added sugar on (1) ordering ≥1 high-added-sugar item in a menu ordering task, (2) grams of added sugar ordered in that task, and (3) knowledge about menu items' added-sugar content. A secondary objective was to examine warning-label effects on perceptions predictive of behavior.

METHODS

Study Sample

A national sample of 15,496 U.S. adults (Figure 1) was recruited to match the 2018 American Community Survey (ACS) 5-year estimates[21] for age (18−34, 35−54, ≥55 years), sex, race/ethnicity (Hispanic [any race], non-Hispanic Asian, non-Hispanic Black, non-Hispanic White, and non-Hispanic Multiracial), and education (lower than some college, some college, bachelor's degree or higher) from Dynata's panels.[22] Participants were told that restaurant menus were the study topic; neither warnings nor sugar were mentioned. After participants provided informed consent, a screener assessed eligibility: English speaking, living in the U.S., aged 18−99 years, purchasing from restaurants ≥1 time/month before the pandemic, and passing a task distinguishing humans from bots. Participants received incentives worth ∼$1.25−$1.50 for the 10−15 minute Qualtrics questionnaire (the questionnaire is provided in Appendix, available online) and an extra $1 to incentivize real-world behavior.

Data were collected in May−June 2021 and analyzed in July 2021−February 2022. This study was approved by the University of California Davis IRB and preregistered with AsPredicted.org (Appendix, available online).

Intervention

In a between-subjects RCT, a simple allocation ratio was used to assign participants (through Qualtrics randomizer) to view restaurant menus containing either (1) no added-sugar warning labels (control) or (2) icon-only added-sugar warning labels (upside−down triangle with an exclamation mark over a spoon) next to high-added-sugar items (i.e., containing >50% daily recommended limit [>25 grams]) (Figure 2). The label design was based on the results of an online randomized experiment[20] that used a validated scale of perceived message effectiveness[23] (but not behavioral outcomes) to test 6 icons against one another and a control label. The icons

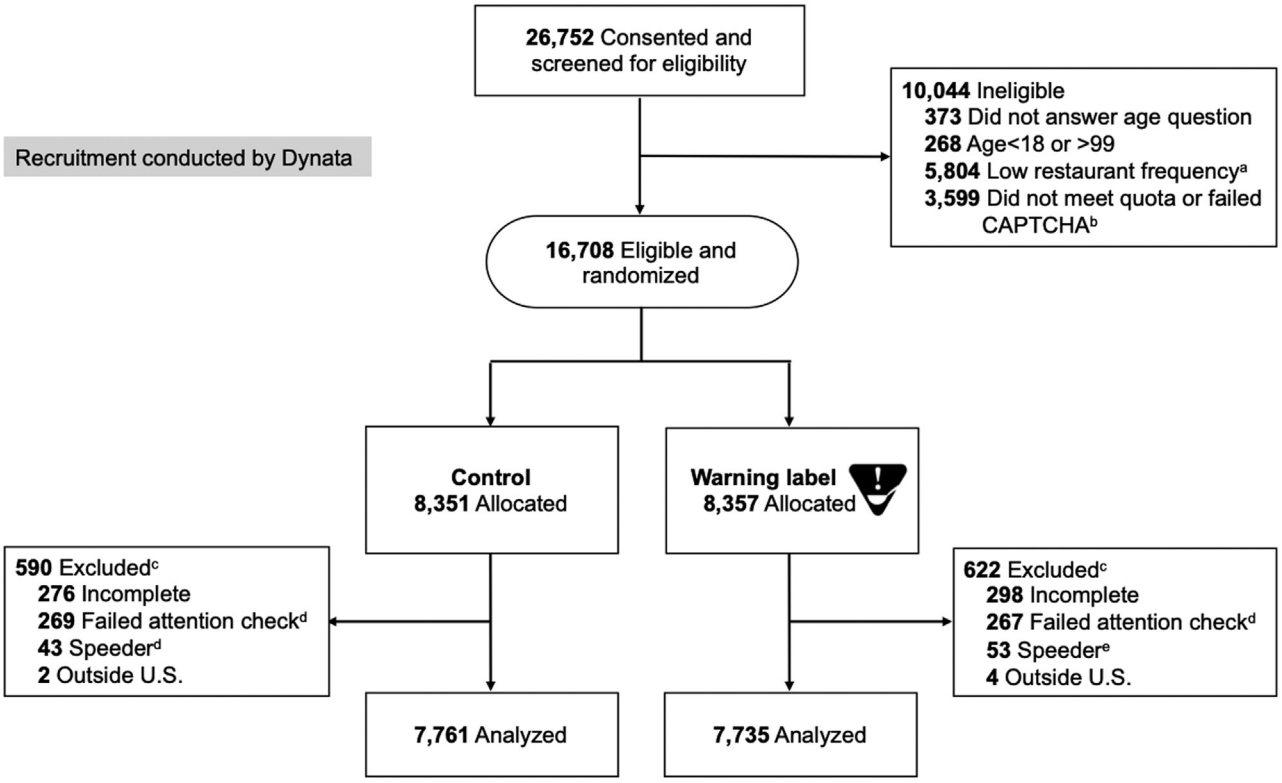

Figure 1. CONSORT diagram.
[a]Reported purchasing from restaurants <1 time/month before the pandemic.
[b]A challenge−response test to determine a human user.
[c]The 1,212 (7% of eligible individuals) excluded were more likely than the analytic sample to be aged 18−34 years (37% vs 29%), to have a bachelor's degree (25% vs 19%), and to identify as non-Hispanic Black (22% vs 14%) and were less likely to be aged 55+ years (30% vs 40%), to have attained some college (28% vs 32%), and to identify as non-Hispanic White (chi-square *p*s<0.001).
[d]Attention check question assessed the current month.
[e]Completion time <30% of the median completion time.
CAPTCHA, Completely Automated Public Turing test to tell Computers and Humans Apart.

were perceived as significantly more effective than the control label and increased the knowledge about items' added-sugar content. Because the 6 icons performed similarly,[20] this study tested the icon most complementary to but also distinguishable from NYC and Philadelphia's sodium warning label (triangle with salt shaker).[16,17] All menus contained prices and calorie information as mandated by federal law for chain restaurants (P.L 111−148). Prices and calories were obtained from the chains' websites and apps. In the warning condition, the top of the menus displayed a disclosure statement: "[icon] SUGAR WARNING: Item exceeds half the Daily Value for added sugars based on a 2,000 calorie diet. The U.S. Dietary Guidelines advises limiting added sugars." The icon size and placement in this study were consistent with NYC's sodium labeling requirements[16] because if adopted, an added-sugar warning policy would likely be similar (e.g., icon height equaled the height of the largest letter in an item's name; combo meals were labeled if any combo option was high in added sugar).

Measures

In a menu ordering task, all participants were asked to imagine that they were ordering dinner for themselves from a fast-food menu and full-service restaurant menu, labeled according to condition and shown in random order. For each menu, participants clicked on the items they wanted to order (up to 4 food/combo items and 2 beverages per menu). Menus included a variety of items available at the U.S.' highest-grossing fast-food chain and second-highest-grossing full-service chain owing to its high number of locations and wide geographic distribution.[24] To incentivize the selection of items participants would actually purchase, participants were told that they would receive a $1 coupon for an item selected. In reality, they received an additional Dynata incentive worth $1.

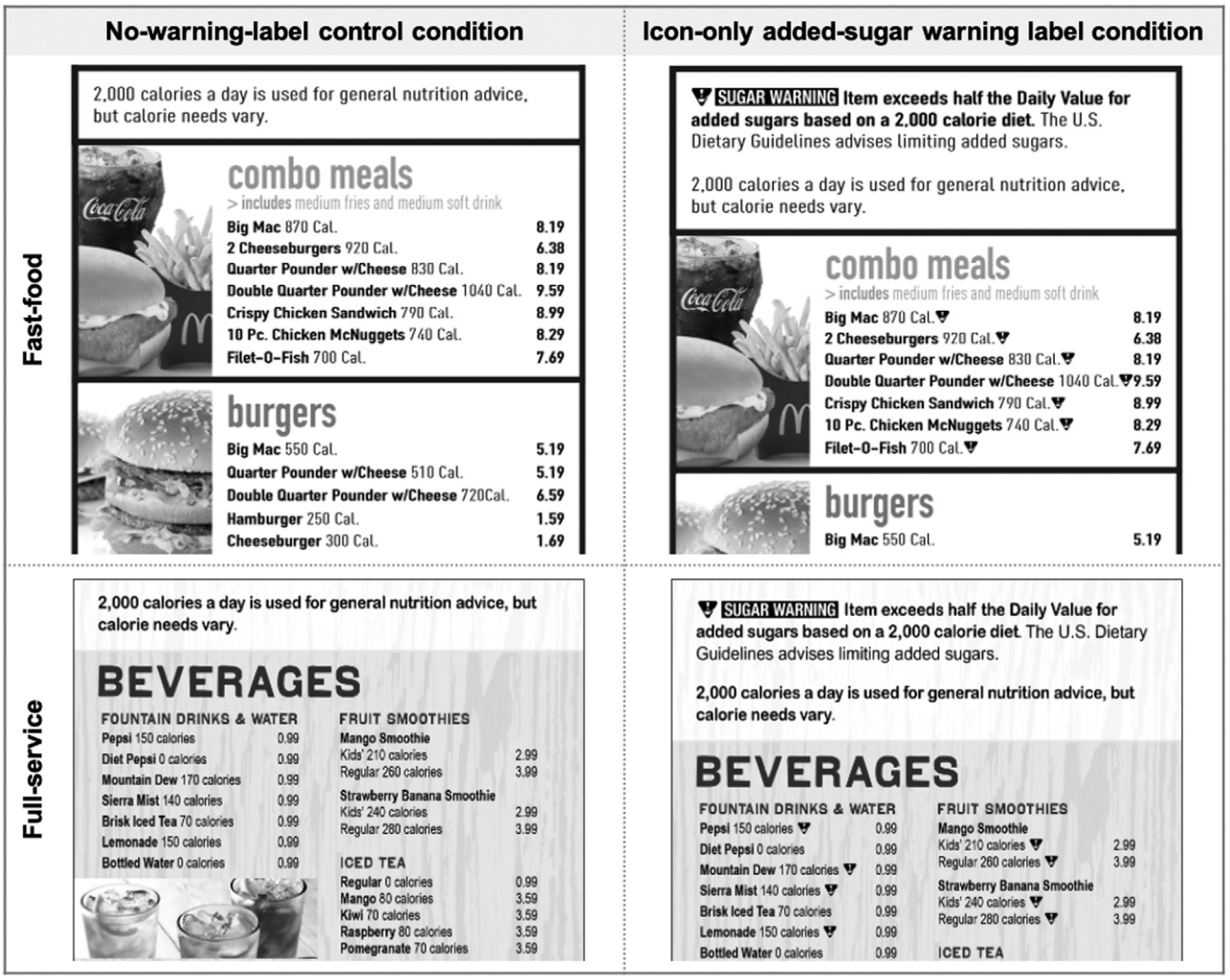

Figure 2. Excerpts of restaurant menus viewed in the control and added-sugar warning label conditions. The menus were designed by the reserach team and based on restaurant websites and apps.

The first primary outcome from the menu ordering task was ordering ≥1 high-added-sugar item from either menu. Note that all combo meals on the fast-food menu were labeled in the warning condition because some combo beverage options (but not mains or fries) were high in added sugar. However, a combo meal was only classified as high in added sugar if the version ordered met that criterion (e.g., regular soda). Thus, a combo meal without a high-added-sugar beverage was not classified as high in added sugar.

The second primary outcome from the menu ordering task was grams of added sugar ordered, averaged across menus. Grams of added sugar were approximated for items containing naturally occurring sugars because the Food and Drug Administration does not require restaurants to disclose added sugar. For these items, added-sugar content was estimated on the basis of items' total-sugar content, items' ingredients, and the added-sugar content of similar packaged foods and foods listed in the National Cancer Institute's Automated Self-Administered 24-hour Dietary Assessment Tool database (Appendix, available online). Because warning efficacy may vary by restaurant type, ordering outcomes were examined by menu. We also explored differences by item category (i.e., beverage, main, dessert), which was not preregistered but provided upon reviewer request.

The other primary outcome was *knowledge about menu items' added-sugar content*, defined as the percentage of items participants correctly classified as high in added sugar. Knowledge was measured because the stated goal of governmental labeling policies is typically to promote public understanding and knowledge.[25] Participants were shown 4 pairs of items: entrées, beverages, desserts, and combo meals (1 with an SSB, which was labeled, and 1 with a non-SSB, which was not labeled). Five of the 8 items were high in added sugar and labeled

in the warning condition: 1 entrée, 1 dessert, 1 combo meal, and both beverages. Participants were asked to indicate the item(s) that had "more than half of the daily value for added sugars" and could select either item, both, or neither. Knowledge was operationalized as the percentage of the 5 high-added-sugar items correctly identified. However, because warnings can also help consumers to identify items not high in added sugar, this study also examined (not preregistered) the percentage of the 3 not-high-added-sugar items correctly identified and the percentage of all the 8 items correctly classified.

To assess the secondary outcomes of perceptions and behavioral intention, participants were shown 3 high-added-sugar items (soda, chicken salad, and fudge sundae) one at a time and rated each product on perceived healthfulness (response options: 1−7), appeal (1−7), risk perceptions regarding Type 2 diabetes (1−5), and injunctive norms (1−5) (Appendix, available online, contains items and response scales). For each construct, a continuous composite score was created by averaging individuals' responses for the 3 menu items. To assess perceived control over eating decisions, participants were asked, *Did the information on the menu make you feel..." ("Less in control of making eating decisions," "Neither less nor more in control of making eating decisions," or "More in control of making eating decisions?* (dichotomized into 1=more or 0=less/neither).[26] Intention was assessed by, *I intend to reduce my consumption of added sugars in the next month* (1−5),[27] treated as a continuous variable.

To assess whether participants noticed the labels (a process measure), participants were asked, *Think back to the beginning of this survey when you imagined you were ordering from a menu. Did you notice any nutrition labels (other than the calories) next to the menu items?* (dichotomized: 1=*yes* or 0=*no/don't know*). Those in the warning condition who answered *yes* were asked, *What did the nutrition label tell you about?* (*sodium, added sugars, trans fats, fiber, calcium, healthy items, none of these options*, or *I don't know*). The other process measures—perceived knowledge gain[28] and label use (yes or no)—were also assessed among those who noticed added-sugar labels.

Participants in the warning condition were shown the labels again in the context of a menu excerpt and asked:... *How much does this label grab your attention*? (1−5),[29] *How likely are you to talk about this label with others?* (1−5),[30] *How much does this label make you think about added sugars?* (1−5).[31]

To assess support for an added-sugar warning label policy, both conditions were shown the warning and asked, *Some cities are considering a law that requires that chain restaurants display this label next to items that are high in added sugars. Would you...?* (1=*Strongly support this law* to 5=*Strongly oppose this law*).

Other measures included an attention check item asking participants to select the current month and items assessing sociodemographic characteristics (e.g., household income), height and weight, and health behaviors and conditions. Total dollar amounts of menu orders were calculated (not preregistered but provided upon reviewer request).

The a priori planned sample size of 15,500 was estimated to provide 90% power to detect a very small effect size (Cohen's d=0.024). Of 16,708 eligible participants, 16,134 provided complete data on primary outcomes. According to the preregistered analysis plan, participants who failed the attention check (n=536) or completed the survey in <30% of the median time[20] (n=96; i.e., speeders) were excluded from the main analysis. Although all panelists were prescreened as living in the U.S., 6 reported living elsewhere and were excluded, yielding an analytic sample of n=15,496 (Figure 1). The differences between the analytic sample and excluded eligible participants are described in the Figure 1 footnote.

Statistical Analysis

Chi-square and independent t-tests were used to compare differences in participant characteristics between conditions. Bivariate linear models regressed continuous outcomes on a warning label indicator. For dichotomous outcomes, bivariate Poisson regression with a robust error variance[32] was used to estimate the probability ratio (PR) comparing the warning with the control condition, and the number needed to treat (NNT)[33] was calculated. Analyses were not adjusted for covariates per CONSORT guidelines.[34] Percentages and mean responses were calculated for process measures.

The Holm−Bonferroni procedure[35] was used to adjust for multiple comparisons within 2 families of outcomes: primary menu ordering outcomes (≥1 high-added-sugar item selected and grams of added sugar ordered) and secondary perception and behavioral intention outcomes. Results include unadjusted p-values and specify when statistical significance changed after the Holm−Bonferroni procedure.

Nonpreregistered sensitivity analyses were conducted. First, for grams of added sugar, 47 outliers with studentized residuals >|3| were excluded. Second, for all primary outcomes, effects were examined among those who noticed the warning by restricting the sample to those in the warning condition who reported noticing an added-sugar warning (n=1,603 [21%]) and comparing them with all controls (n=7,761). In these analyses, the following variables that were significantly (p<0.05) and meaningfully (PR>1.01 or PR<0.99) associated with

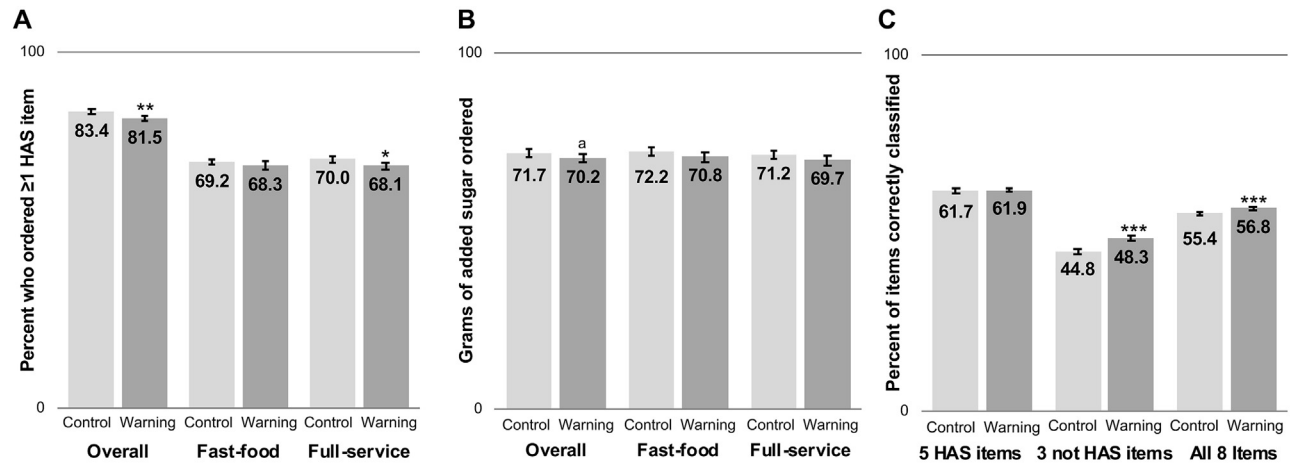

Figure 3. (A) Percentage of participants who ordered ≥1 HAS item, (B) added sugar ordered, and (C) the percentage of items correctly classified as HAS or not.

Note: Sample size=15,496 (control=7,761, warning label=7,735).

***$p<0.001$, **$p<0.01$, *$p<0.05$, and [a]$p<0.10$ from (A) Poisson regression models with robust SEs and (B, C) linear regression models in which the outcome was regressed on an indicator for the warning label condition. Means and 95% CIs (indicated by error bars) were generated using the Stata margins command.

HAS, high-added-sugar.

both noticing the label in the warning group (Appendix Table 1, available online) and with the primary outcomes were included as covariates: age, ordering frequency from full-service restaurants, household income, and dietary restrictions. Although trying to reduce added-sugar consumption was also associated with noticing, it was not included owing to the uncertain direction of causality. Third, analyses included speeders and those who failed the attention check. Fourth, analyses additionally included those with incomplete ordering outcomes with zeros imputed. Fifth, additional ordering thresholds were examined as dichotomous outcomes (i.e., ≥2 and ≥3 high-added-sugar items ordered).

Although this study was not powered to assess moderation, potential differences in label effects were explored by income and education. These moderating variables were selected given the higher prevalence of diet-related diseases in lower SES groups.[36] The goal was to understand whether this labeling approach would produce equitable outcomes. Because labels could have a bigger impact among those trying to reduce added-sugar consumption, moderation by this variable was also examined (not preregistered). The same models for the primary outcomes were used with the addition of a(n) indicator(s) for the level of a potential moderator and a (n) interaction term(s) between the warning condition and the level of a moderator. Separate models were run for each moderation analysis. All tests (2-sided alpha=0.05) were conducted using Stata/MPv15.1 (StataCorp LLC, College Station, TX).

RESULTS

Appendix Table 2 (available online) shows the participant characteristics. The distribution of race, Hispanic ethnicity, sex (measured in this study vs. sex measured by the ACS), and education were similar to the 2018 ACS estimates. For annual household income before taxes, 27% reported ≤$35,000; 27% reported $35,001−$65,000; 18% reported $65,001−$95,000; and 28% reported >$95,000. There were no significant differences by condition.

Appendix Table 3 (available online) shows the number of items ordered by restaurant and item category. Figure 3A and B and Appendix Table 4 (available online) show primary ordering outcomes. In total, 81.5% in the warning condition ordered ≥1 high-added-sugar item from either menu, compared with 83.4% in the control condition, for an absolute difference of −1.9 percentage points (pps) and relative difference of −2.2% (PR=0.978, 95% CI=0.964, 0.992; p=0.002; NNT=53). Effects were larger for the full-service than for the fast-food menu (−2.7% vs −1.3%; PR=0.973, 95% CI=0.953, 0.994 vs PR=0.987, 95% CI=0.966, 1.008; NNT=53 vs NNT=112).

Although not a statistically significant difference, the amount of added sugar ordered, averaged across menus, was lower in the warning condition by 1.5 grams (95% CI= −3.0, 0.1; p=0.07), a relative difference of 2.1%. Although also not significant, label effect sizes for grams of added sugar ordered were similar by restaurant menu

(fast food= −1.4 grams vs −1.5 grams for full service) and larger for beverages than for mains or desserts when averaged across menus (−0.7 vs −0.3 and −0.4 grams) (Appendix Table 4, available online).

In the sensitivity analysis excluding 47 outliers for grams of added sugar ordered (Appendix Table 5, available online), results were statistically significant: the warning group ordered 1.6 fewer average grams of added sugar than the controls (95% CI= −3.1, −0.03; p=0.046). Second, in adjusted analyses that restricted the warning group to participants who reported noticing added-sugar warnings (Appendix Table 6, available online), effect sizes for ordering outcomes were stronger than in the full sample, and results for grams of added sugar ordered were statistically significant. The relative percentage of participants who ordered ≥1 high-added-sugar item was lower by 4.1% (3.4 pp) among those who noticed the warning than for controls (PR=0.959, 95% CI=0.935, 0.984; p=0.001), and the amount of added sugar ordered was significantly lower by 4.9 grams (6.8%) among those who noticed the warning than among the controls (95% CI= −7.3, −2.5 grams; p<0.001). Results for both ordering outcomes were robust to the inclusion of speeders, those who failed the attention check, and those without complete ordering data (Appendix Table 7, available online). Finally, there were no significant warning effects when examining other dichotomous ordering thresholds for high-added-sugar items (Appendix Table 8, available online).

For the knowledge outcomes, participants' ability to correctly identify the 5 high-added-sugar items did not differ between conditions (Figure 3C). However, warning group participants correctly classified a significantly higher percentage of the 3 not-high-added-sugar items (3.5 pp [95% CI=2.5, 4.5; p<0.001]) and all the 8 menu items by their added-sugar content (1.4 pp [95% CI=0.8, 2.1; p<0.001]) than the controls. In sensitivity analyses restricting warning group participants to those who noticed the added-sugar warnings (Appendix Table 6, available online), associations were stronger. For example, warning group participants who noticed warnings correctly classified 6.9 pp more of the 8 items by added-sugar content than the controls (95% CI=5.8, 8.0 pp; p<0.001). Warning effects on knowledge were also robust to the inclusion of speeders and those who failed the attention check or did not complete the ordering task (Appendix Table 7, available online).

Table 1 displays the perception and behavioral intention results. Warnings modestly reduced perceived healthfulness and appeal of high-added-sugar items (ps<0.001) and increased the relative probability of feeling more in control of eating decisions by 6% (PR=1.06, 95% CI=1.03, 1.10; p<0.001). The warnings did not significantly affect intentions to reduce added-sugar consumption in the next month. The warning group was also modestly more likely to agree that people who are important to them would want them to limit consumption of high-added-sugar items (i.e., injunctive norm) and that consuming such items often would increase Type 2 diabetes risk (ps<0.001).

Table 1 shows process outcomes. A total of 47% of participants in the warning condition (n=3,617) reported noticing nutrition labels other than calories, and 21% of the warning group (44% of the 47% who noticed nutrition labels, n=1,603) correctly recalled that the labels were for added sugar. Among those who noticed added-sugar warnings, 79% (n=1,265) reported perceived knowledge gain, and 55% (n=877) reported using the labels when ordering. Upon viewing the label again, 51% of the warning group (n=3,923) perceived that the label grabbed their attention and caused them to think about added sugar quite a bit or a great deal. A total of 38% (n=2,889) reported being very or extremely likely to talk about the labels with others.

Upon viewing the warning, the majority (72%) of participants supported a law requiring warning labels on chain-restaurant menus (39% strongly and 33% somewhat supported), whereas 19% had no opinion, and 9% opposed the law (4% strongly and 5% somewhat opposed). Finally, there were no significant differences between control and warning groups in dollar amounts of orders (i.e., amount of money hypothetically spent) from fast-food ($12.78 vs $12.64; p=0.16) or full-service ($25.21 vs $25.19; p=0.93) menus.

The only outcome for which there was significant moderation was knowledge: the warning was more effective in helping lower-income (≤$35,000 and >$35,000 −65,000/year) than high-income (>$95K/year) participants to correctly classify high-added-sugar items (ps=0.02) (Appendix Table 9, available online).

DISCUSSION

To the authors' knowledge, this is the first study to test the effect of restaurant menu added-sugar warning labels on hypothetical orders. This online RCT found that added-sugar warnings significantly reduced the relative probability of ordering ≥1 high-added-sugar item by 2.2% (absolute difference: 1.9 pps [control=83.4% vs warning=81.5%]). Warnings also led to a nonsignificant 1.5-gram (2%) reduction in average added sugar ordered across both menus and a statistically significant 1.6-gram reduction after excluding outliers. Given the frequency of restaurant food consumption, these relatively small effects may lead to meaningful changes in intake

Table 1. Perception, Intention, and Process Outcomes From a Randomized Experiment of Added-Sugar Menu Warning Labels

Outcomes	Control group (*n*=7,761), mean (SE) or *n* (%)	Added-sugar warning label group (*n*=7,735), mean (SE) or *n* (%)	Difference or PR comparing the warning group with the control group (95% CI)
Perception and behavioral intention outcomes[a]			
Perceived healthfulness of HAS menu items[b] (1=very unhealthy to 7=very healthy)	3.75 (0.02)	3.63 (0.02)	**−0.12 (−0.16, −0.08)**
Perceived appeal of HAS menu items[b] (1=very unappealing to 7=very appealing)	5.23 (0.01)	5.15 (0.01)	**−0.08 (−0.12, −0.04)**
Injunctive norm regarding HAS menu items[b] (1=strongly disagree to 5=strongly agree)	3.42 (0.01)	3.50 (0.01)	**0.08 (0.05, 0.10)**
Perceived risk of Type 2 diabetes associated with HAS menu items[b] (1=strongly disagree to 5=strongly agree)	3.43 (0.01)	3.53 (0.01)	**0.09 (0.07, 0.12)**
Intention to reduce added-sugar consumption (1=strongly disagree to 5=strongly agree)	3.69 (0.01)	3.71 (0.01)	0.01 (−0.02, 0.05)
Increased feeling in control over eating decisions	3,650 (47%)	3,872 (50%)	**PR=1.06 (1.03, 1.10)[c]**
Process outcomes			
Reported noticing nutrition labels other than calories	2,616 (34%)[d]	3,617 (47%)[e]	**PR=1.39 (1.33, 1.44)[c]**
Recalled that the label was for added sugars[f,g]	—	1,603 (21%)[e]	—
Perceived knowledge gain from warning labels[f,g]	—	1,265 (79%)[h]	—
Reported use of warning labels[f,g]	—	877 (55%)[h]	
Reported that warning label grabbed attention quite a bit or a great deal[f]	—	3,923 (51%)[e]	—
Anticipated social interaction about warning label: Very or extremely likely to talk about it with others[f]	—	2,889 (38%)[e]	—
Reported that warning label caused one to think about added sugars quite a bit or a great deal[f]	—	3,942 (51%)[e]	

Note: Boldface indicates statistical significance ($p<0.001$).
The *p*-values show statistical significance, including after the Holm–Bonferroni correction.
[a]Holm–Bonferroni correction was used for determining significance among the 6 perception outcomes.
[b]Individuals' average across all the 3 high-added-sugar items, used as a continuous outcome in OLS regression.
[c]PR of Poisson regression with robust SEs.
[d]Control participants were not shown any nutrition labels other than calories, so these participants erroneously reported noticing nutrition labels.
[e]Denominator is all participants in the warning condition who answered the noticed question and did not have missing data for the process outcome (7,660 to 7,682).
[f]Assessed only in the warning condition.
[g]Indented items indicate a skip pattern in which the question was only asked of those who correctly answered the previous question.
[h]Denominator is the 1,603 warning group participants who recalled seeing a label for added sugars.
HAS, high-added-sugar; OLS, ordinary least squares; PR, probability ratio.

at the population level. Such warnings might also motivate restaurants to reduce the added-sugar content of menu items.[37,38] These effect sizes are within the range of those for calorie labeling,[38–40] and the directions of effects are consistent with those of other experiments testing sugar-related warnings on packages and signage.[41–46] These results are also consistent with those of experiments testing sodium and multinutrient warnings

on food-ordering websites.[18,19] For instance, Musicus et al.[18] found that icon-only sodium warnings reduced the percentage of participants ordering ≥1 high-sodium item by 2.4 pp and reduced sodium ordered by 25 mg or 2%, although effects were not statistically significant, potentially owing to sample size. However, the icon-plus-text sodium warnings examined in that study resulted in larger and statistically significant results compared to the icon-only label: 4.1−6.4 pp reduction in ordering ≥1 high-sodium item and 46−68 fewer mg (3%−5%) of sodium ordered.[18] Thus, it is possible that icon-plus-text added-sugar warnings could result in larger effects than observed in this study for icon-only added-sugar warnings.

Results also found that added-sugar warnings increased participants' knowledge of whether menu items contained >50% of the added-sugar daily recommended limit and modestly reduced perceptions of healthfulness and appeal for high-added-sugar items. They also increased perceptions that eating such items frequently would increase Type 2 diabetes risk, and they shifted norms about consuming high-added-sugar items. Support was high (72%) for a law that would require chain restaurants to display added-sugar warnings on menus. Finally, there were no warning effects on (hypothetical) dollar amounts of orders.

The observed effects on primary outcomes may be modest because only 47% of the warning group reported noticing a nutrition label (similar to a previous finding for sodium icons),[18] and only 21% of the warning group reported noticing an added-sugar warning. When analyses were restricted to those who noticed the added-sugar warning, the adjusted effect sizes were significant and larger than in the full sample. The relative probability of ordering ≥1 high-added-sugar item was lower by 4.1%; average added sugar ordered was lower by 4.9 grams; and the percentage of items correctly classified by added-sugar intake was higher by 6.9 pp. The icon-only label that was tested was black, the same size as the menu-item text, and not the more commonly used warning triangle shape. Larger warning size, bright and contrasting colors,[47−50] and icon-plus-text warnings[18] could increase noticeability and efficacy.

The icon-only warning in this study had a much smaller effect on knowledge than that of a previous study that examined 6 icon-only added-sugar warnings, including the icon in this study. This may be because the previous study[20] first assessed perceived message effectiveness,[23] which drew attention to the labels, or because the knowledge tasks differed. In the previous study, participants were presented with 8 items on a single menu and asked to click the items that had more than half the daily added-sugar limit. In this study, only 2 items were presented at a time, and there may have been more items that participants typically associate with high-added-sugar content.

Future research should explore whether the effectiveness of added-sugar warnings can be increased by including bright colors, making the warning larger than the menu text, changing the label text (e.g., added-sugar warning versus sugar warning), and adding text next-to icons. It is also worth exploring whether the placement of labels (e.g., on the left side of item names) or grouping labeled items together or near an unlabeled counterpart to increase salience and attract attention[51] could boost label effectiveness. It would also be valuable to investigate the effects of different added-sugar warning thresholds; alternative labeling approaches for combo meals; and the potential interactive effects of added-sugar warnings, sodium warnings, and calorie labels. Real-world policy evaluations should also examine whether added-sugar warnings spur reformulation. Furthermore, requiring chain restaurants to disclose added-sugar content would facilitate the implementation and enforcement of added-sugar labeling policies. Study strengths include recruiting a large national sample, basing the label design on results of a previous experiment testing multiple warning designs,[20] and examining warnings on fast-food and full-service menus.

Limitations

Limitations include measuring hypothetical, not actual, behavior (although incentives were offered to try to increase realistic decision making); the possibility for social desirability bias (which was likely small given participant anonymity); and the potential that although the sample was recruited to match the U.S. distribution of sex, age, race, Hispanic ethnicity, and education, there may have been differences in other characteristics that limit generalizability. However, online convenience samples do typically produce internally valid experimental results.[52−54] In addition, because the Food and Drug Administration does not require restaurants to disclose added sugar, the added-sugar content of many items had to be estimated. Finally, the study examined only 1-time label exposure. Research on repeated exposures, especially in real-world settings, is needed to understand long-term impacts.

CONCLUSIONS

Added-sugar warnings on restaurant menus modestly reduced the probability of ordering a high-added-sugar item, increased the knowledge of whether items contained more than half the daily value for added sugar, and influenced perceptions that precede behavior change. Furthermore, label effects were larger among the one fifth of participants who noticed the warnings.

Research is needed to design and test the impacts of more noticeable restaurant menu added-sugar warnings.

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