Nutrition-related claims lead parents to choose less healthy drinks for young children: a randomized trial in a virtual convenience store

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ABSTRACT

Background: Consumption of sugar-sweetened beverages, including fruit drinks (i.e., fruit-flavored drinks containing added sugar), contributes to childhood obesity.

Objectives: We aimed to examine whether nutrition-related claims on fruit drinks influence purchasing among parents and lead to misperceptions of healthfulness.

Methods: We conducted an experiment in a virtual convenience store with 2219 parents of children ages 1–5 y. Parents were randomly assigned to view fruit drinks displaying 1 of 3 claims ("No artificial sweeteners," "100% Vitamin C," and "100% All Natural") or no claim (i.e., control group). Parents selected among each of 2 drinks for their young child: *1*) a fruit drink or 100% juice (primary outcome), and *2*) a fruit drink or water.

Results: When choosing between a fruit drink and 100% juice, 45% of parents who viewed the fruit drink with the "No artificial sweeteners" claim, 51% who viewed the "100% Vitamin C" claim, and 54% who viewed the "100% All Natural" claim selected the fruit drink, compared with 32% in the no-claim control group (all $P < 0.001$). "No artificial sweeteners" (Cohen's $d = 0.13$, $P < 0.05$) and "100% All Natural" ($d = 0.15$, $P < 0.05$) claims increased the likelihood of parents choosing the fruit drink instead of water but "100% Vitamin C" did not ($P = 0.06$). All claims made parents more likely to incorrectly believe that the fruit drinks contained no added sugar and were 100% juice than the control (d ranged from 0.26 to 0.84, all $P < 0.001$), as assessed in a posttest survey. The impact of claims on selection of the fruit drink (compared with 100% juice) did not vary by any of the moderators examined (e.g., race/ethnicity, income; all moderation $P > 0.05$).

Conclusions: Nutrition-related claims led parents to choose less healthy beverages for their children and misled them about the healthfulness of fruit drinks. Labeling regulations could mitigate misleading marketing of fruit drinks. This trial was registered at clinicaltrials.gov as NCT04381481. *Am J Clin Nutr* 2022;115:1144–1154.

Keywords: sugar-sweetened beverages, childhood obesity, randomized controlled trial, front-of-package labels, nutrition-related claims, marketing

Introduction

Sugar-sweetened beverage consumption in childhood is a major contributor to diet-related diseases (1). Fruit drinks (defined herein as fruit-flavored drinks containing added sugar) are the most common type of sugar-sweetened beverage consumed by young children ages 0–5 y (2, 3). Thus, strategies to reduce fruit drink intake in young children may help to prevent diet-related diseases.

One potential strategy for reducing children's fruit drink intake is to regulate marketing elements on fruit drink packaging, including statements about the nutritional content of, healthfulness of, or ingredients in a product (hereinafter referred to as

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Supplemental Figures 1–2 and Supplemental Tables 1–2 are available from the "Supplementary data" link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/ajcn/.

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"nutrition-related claims"). Prior research found that nutrition-related claims were nearly universal on labels of fruit drinks purchased by households with young children (4, 5), but fruit drinks with prevalent claims did not have healthier nutritional profiles (4). Public health advocates and legal scholars have raised concerns that these claims, even when technically truthful, may be misleading, deceive consumers into thinking products are healthier than they really are, and drive consumption of unhealthy foods (6–8). Indeed, prior studies have documented parents' misperceptions about the healthfulness of fruit drinks (9, 10) and experiments have found that claims make people think products are healthier (11, 12) and increase selection of products (13).

The US FDA has the authority to regulate false and misleading claims on food and beverage labels (14). To determine how it should exercise this authority with respect to nutrition-related claims, the FDA needs to understand whether and how these claims affect consumer behavior or cause misperceptions about the nutritional quality of foods and beverages. Despite concerns about the potentially deceptive nature of claims, studies have not assessed the causal impact of claims on beverage selection and misperceptions about the nutritional content of products. Moreover, studies have not explored whether nutrition-related claims have stronger effects in certain population subgroups, which could shed light on whether claims may contribute to higher fruit drink consumption among children who are black or Latino, or higher sugar-sweetened beverage consumption among children from lower-income families (3, 15–17).

This study aims to address these research gaps by examining the impact of nutrition-related claims on parents' behavior and potential misperceptions, as assessed in a naturalistic experimental setting that mimics the appearance of a real-world convenience store. Specifically, we aimed to determine whether nutrition-related claims increased parents' selection of fruit drinks for their young children when presented with a choice of a fruit drink as opposed to 100% juice or water. We also examined whether nutrition-related claims caused misperceptions about product nutritional quality and changed parents' attitudes and intentions. Finally, we explored whether participant characteristics moderated the impact of claims on selection of drinks for young children.

Methods

Participants

From May through July 2020, we recruited a national convenience sample of 2219 US parents to participate in an experiment. Recruitment occurred through 2 panel research companies (Kantar and CloudResearch's Prime Panels, which recruit panelists via Internet/online channels and by aggregating from other panels). Inclusion criteria, assessed via an online eligibility screener, were currently residing in the United States, being ≥18 y old, and being a parent or guardian of ≥1 young child (i.e., ages 1–5 y). In addition, for the parent to be eligible, the young child who most recently had a birthday must have consumed ≥1 fruit drink in the previous week. The panel companies specifically aimed to enroll parents identifying as black or Latino, given that these groups are often underrepresented in research studies (18, 19) yet have higher rates of fruit drink consumption than non-Latino white populations (2, 3). Using a z test model for the difference between 2 independent proportions in G.Power version 3.1.9.4 (Foshan G-power Technology Co., LTD), we estimated that with a sample of ∼525/group, α of 0.05, and 80% power, we could detect a difference between ∼54% selection of fruit juice in the control and ∼45% in each claim arm.

Stimuli development

In order to determine which nutrition-related claims to test in this experiment, we developed an initial list of claims based on the front-of-package claims most prevalent on fruit drinks purchased by households with young children in the United States (4). We then obtained feedback from persons with expertise in nutrition regulations to select 8 claims to further evaluate, based on policy relevance. We conducted a pretest with a national convenience sample of 1002 US adults ages 18 y and older recruited through Amazon Mechanical Turk. Participants randomly viewed 1 of 9 fruit drinks (8 claims and a no-claim control) paired with 100% juice. The main purpose of this pretest was to select the 3 fruit drink claims, out of 8 possible claims, that, compared with a control, had the largest impact on participants' perceptions and intentions to buy fruit drinks for themselves and young children. The 3 fruit drink claims we selected for the experiment were "No artificial sweeteners," "100% Vitamin C daily value," and "100% All Natural." In the same sample, we also pretested mock fruit drink brands created by a professional designer; we chose to use mock brands to control for established brand preferences (22). Participants rated 7 drink brands on product appeal and perceived product healthfulness, and we selected 4 brands that were not statistically significantly different from one another for the experiment.

A team of nutritionists modeled the nutritional profiles after commonly purchased beverages in the United States within the corresponding beverage categories (23–25). The Nutrition Facts Labels used realistic quantities of nutrients based off of the team's review of top-purchased products in US households (26). The fruit drinks and the 100% juices had similar nutritional profiles for all ingredients except added sugar. Fruit drinks contained 39 g added sugar, with 44 g total sugar. In contrast, the 100% juice contained 0 g added sugar and 38 grams total sugar (1 teaspoon is equivalent to 4 g added sugar). The water contained no amounts of any nutrients listed on the label. Owing to the higher amounts of added sugar in the fruit drinks, and similar amounts of other macro- and micronutrients between the fruit drinks and 100% juice, we conceptualized the fruit drink as the less healthy choice than both the 100% juice and the water. The final experimental stimuli appear in **Figure 1**.

Procedures

After participants provided electronic written informed consent, we randomly assigned participants using simple randomization in Qualtrics to 1 of 4 between-subjects experimental arms (1:1:1:1), in which a virtual convenience store (described in what follows) contained grape-flavored fruit drinks and apple-flavored fruit drinks with either no claim (control), or 1 of the 3 claims [see **Figure 2** for a Consolidated Standards of Reporting Trials (CONSORT) diagram], as well as 100% juice

FIGURE 1 Stimuli used in experiment. (A) Fronts of stimuli and (B) Nutrition Facts Panels on stimuli. Participants could make selections in either order.

and water. After completing a shopping trip, as described in what follows, participants took an online survey and received incentives in a type and amount set by the survey vendor. The University of North Carolina Institutional Review Board approved the study. Before data collection, we preregistered the study procedures, hypotheses, and analytic plan on clinicaltrials.gov (NCT04381481).

Virtual convenience store.

The virtual convenience store (i.e., iShoppe) was developed by a team of researchers and graphic designers from RTI International using Unity, a 3D game engine and development environment (27). The store was designed to replicate a real-world convenience store, and included features such as a fountain drink station, 4 gondola units with snack items, restrooms, a refrigerated section, and a checkout counter with a store clerk. The iShoppe convenience store has been used in previous research to examine tobacco purchasing behavior (28, 29) and a larger-format supermarket version has been used to examine front-of-package nutrition labels (27). Participants experienced the store from a first-person perspective, as if they were in the store completing the shopping task themselves. No prices were displayed in the store.

Shopping task.

Upon entering the virtual convenience store, participants were directed to the beverage coolers and instructed to select 2 beverages for their young child. Both beverages were located in the refrigerated section of the store (see **Supplemental Figure 1** for full instructions and screenshots from iShoppe). A shopping list remained in the upper right-hand corner of the screen, along with a help button, in case the participant needed further instructions about how to navigate the store.

Once parents were in the refrigerated section of the store, they were instructed to make 2 drink choices. In 1 selection task, parents chose between 2 grape beverages: a grape-flavored fruit drink, labeled per their randomly assigned arm, or a 100% grape juice with no claim. At the time of registering the trial, this selection task was conceptualized as a "within-category" choice between a less healthy fruit-flavored beverage (the fruit drink)

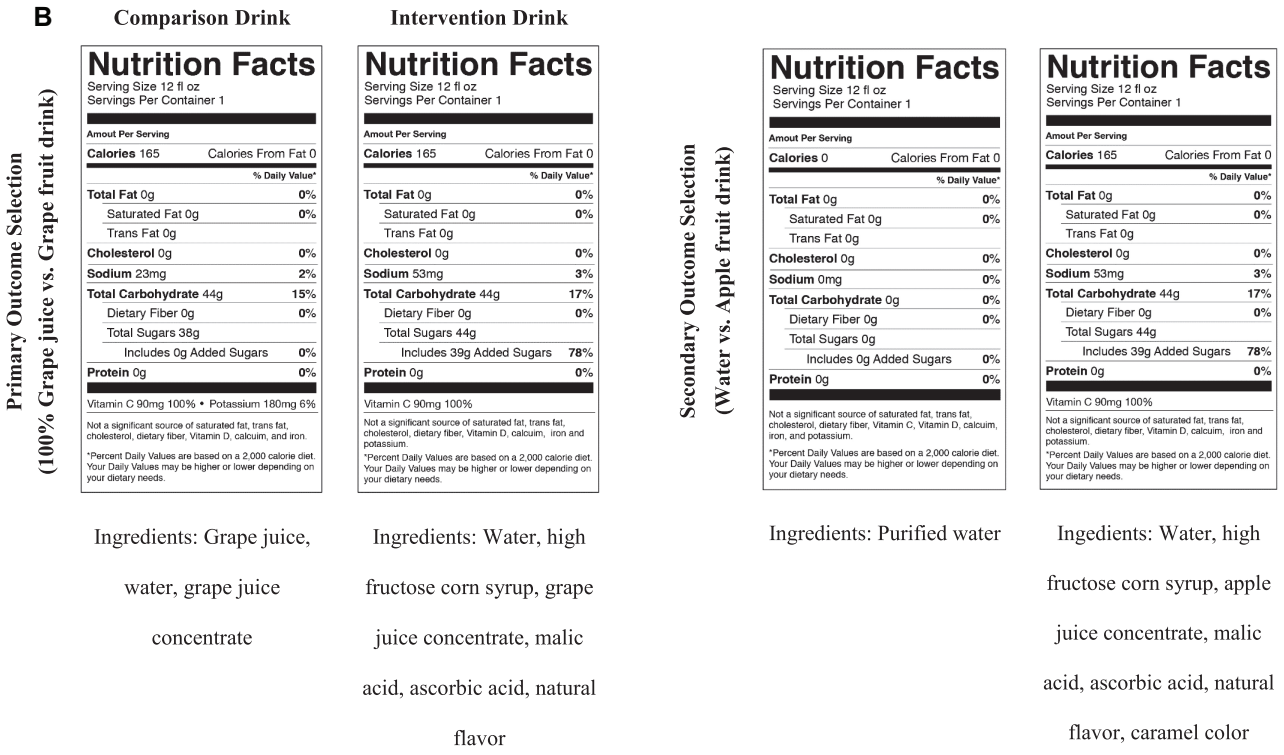

FIGURE 1 Continued.

and a healthier fruit-flavored beverage (the 100% juice). For the other selection task, parents chose between an apple-flavored fruit drink, labeled per their randomly assigned arm, and plain water with no claims. This selection task was conceptualized as an "across-category" choice between 2 products from distinct beverage categories. Participants were able to see all sides of the 3-dimensional drinks and could view the Nutrition Facts Label (**Supplemental Figure 2**) on the back of the beverage if they desired, by rotating the image of the product. Participants could complete the 2 selection tasks in any order but could only select a beverage if they had viewed both options within the comparison task. After selecting the 2 beverages, participants were directed to the checkout counter, where they were instructed to select a granola snack in order to help mask the purpose of the study. Participants were not permitted to select the snack until after they had completed their drink purchases. The granola choice involved an auxiliary experiment about front-of-package "high sugar" warning labels. These data will be reported in a separate article given that the 2 experiments were conceptually distinct. Participants were required to select both drinks before selecting the granola snack; thus, the drink choices were not influenced by the snack experiment. The preregistered data analytic plan involved analyzing these 2 tasks independently because they occurred sequentially.

Measures

The study assessed 3 behavioral measures within the virtual convenience store. The primary outcome was whether the participant selected the grape-flavored fruit drink instead of the 100% grape juice, coded as 1 if the parent selected the fruit drink and 0 if the parent selected the 100% juice. We selected this within-category selection task as the primary outcome instead of the across-category choice because consumers are more likely to choose substitutes that are similar to their original choice, rather than choosing from a different product category altogether (30). A secondary outcome was whether the participant selected the apple-flavored fruit drink instead of the plain water, coded as 1 if the parent selected the fruit drink and 0 if the parent selected the water. The iShoppe software also captured whether the participant viewed the Nutrition Facts Label for the within-category beverage choice, which we conceptualized as a potential moderator.

An online survey then assessed participants' reactions to the grape-flavored or apple-flavored fruit drink (randomly assigned), displayed with the label to which they were assigned in the virtual convenience store. Exact survey items and response options appear in Supplementary Table 1. The survey assessed the belief that the fruit drink was 100% juice (yes/no), the belief that the fruit drink did not contain added sugar (yes/no), the estimated amount of added sugar in 1 serving of the fruit drink (in teaspoons), and the estimated percentage of fruit juice in the fruit drink (in percentage points). We created these items for the current study in consultation with experts in nutrition labeling regulation and policy. The survey also assessed several outcomes with Likert-style response options ranging from 1 (low) to 5 (high), adapted from prior studies about sugar-sweetened beverages (11, 31, 32). These measures included perceived product healthfulness, perceived healthfulness of the fruit drink compared with soda, perceived healthfulness of the fruit drink compared with 100% juice, how appealing their child would find the fruit drink, interest in giving the fruit drink to their child,

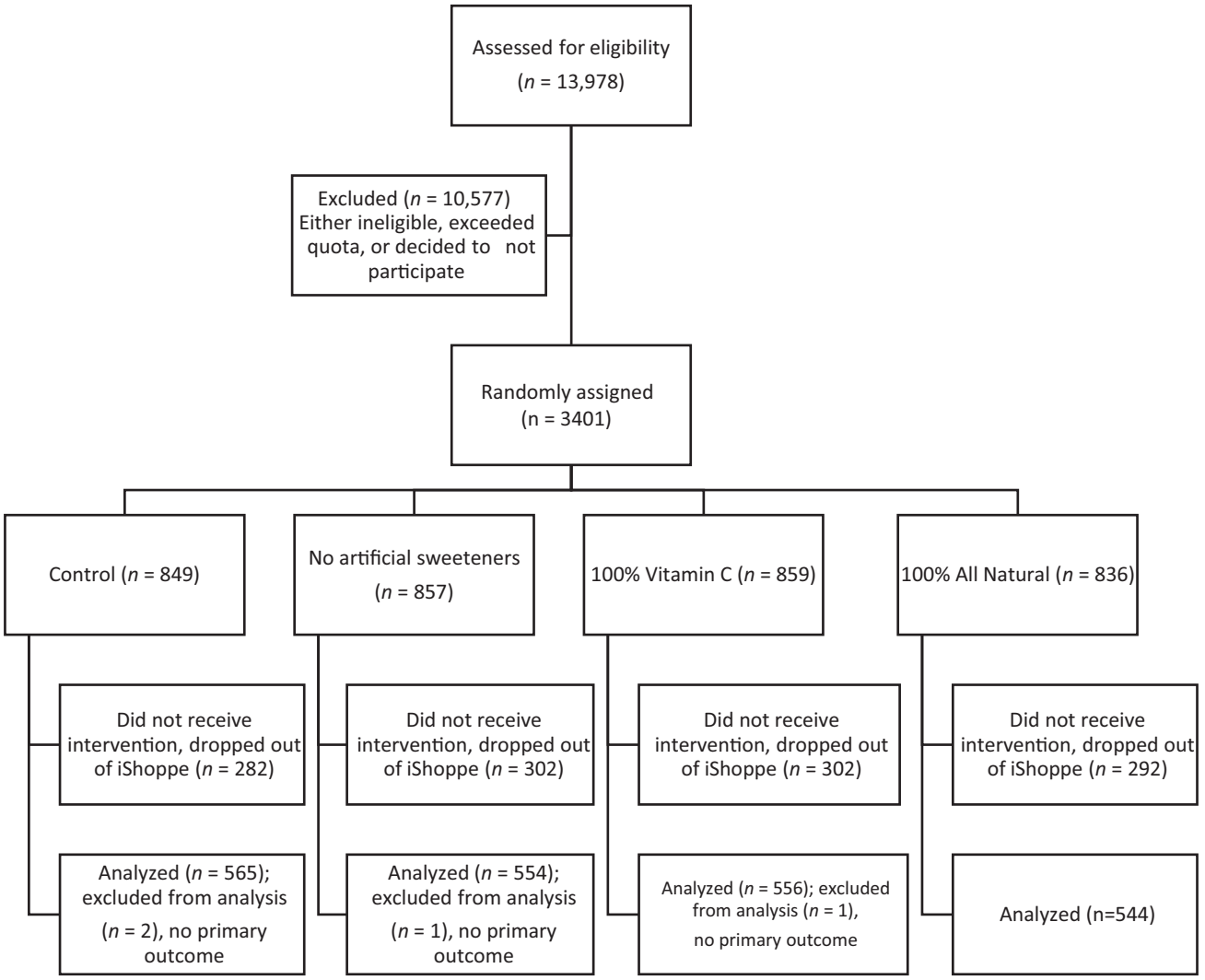

FIGURE 2 Consolidated Standards of Reporting Trials (CONSORT) diagram.

parents' interest in consuming the fruit drink themselves, and how misleading parents thought the information on the product was after learning about the nutritional content. The survey also assessed questions about other nutrition topics including 2 auxiliary experiments, process measures about the realism of the virtual store (33), and participants' demographic characteristics. If participants skipped questions, the survey requested but did not require a response. Exact item wording appears in **Supplemental Table 1**.

We preregistered several hypotheses before collecting data, based on prior literature on claims (11–13, 34–38). We hypothesized that the claims would lead to a greater percentage of parents selecting fruit drinks for their child, relative to the no-claim control group. We also hypothesized that participants who viewed a claim would be more likely to believe the fruit drink did not contain added sugar and was 100% juice. We predicted that parents who saw a claim would have lower estimates of the amount of added sugar and higher estimates of the percentage of fruit juice in the fruit drinks. We also hypothesized that claims would lead to greater perceived product healthfulness, greater perceived healthfulness of fruit drinks for their child than of both soda and 100% juice, greater appeal of fruit drinks for their child, greater misleadingness of information on the fruit drink package, greater interest in giving the fruit drink to their child, and greater interest in consuming the fruit drink.

Analysis

Analyses used Stata/SE version 16 (StataCorp) with a critical α of 0.05 and casewise deletion for missing data. We first checked for duplicate participant IDs and identified several instances in which participants had needed to restart the shopping task, likely owing to connectivity issues, resulting in multiple records with the same IDs. However, for these participants, only 1 of their records contained data (product selections and survey responses). In these cases, we retained only the record which had data points. In addition, 1 participant completed the shopping task

and the survey twice; for this participant, we retained only the first shopping task data and survey record and deleted the other shopping task data and survey record. We then examined whether randomization had created equivalent groups using chi-square tests for categorical variables and 1-factor ANOVA *F* tests for continuous variables, examining all variables in **Table 1** as well as random assignment to the 2 auxiliary experiments in the posttest survey.

We reported descriptive results for all outcomes by experimental arm. For significance testing, we ran a separate logistic regression model for each dichotomous outcome which included the primary outcome (selection of the grape-flavored fruit drink instead of 100% grape juice), selection of the apple-flavored fruit drink instead of water, incorrectly believing the fruit drink did not contain added sugar, and incorrectly believing the fruit drink was 100% juice. The only predictor in these models was a 4-level categorical variable for claims (3 unique) or control trial arm with the control as the reference group. All other outcomes were measured continuously. For these outcomes, we ran a separate linear regression model for each outcome. As with the logistic models, the only predictor was a 4-level categorical variable for trial arm with the control as the reference group. For each model, we examined the statistical significance of each claim compared with the control. Although we preregistered that we would compare each claim with each other, before analyzing the data we decided not to conduct these comparisons to reduce the number of tests run. For continuous outcomes, we examined skewness of the residuals and ran ordinal models in sensitivity analyses for outcomes if residuals were skewed. We retained the linear models because the pattern of results did not change in terms of direction of effect and statistical significance.

We explored whether participant and child characteristics moderated the impact of claims on the primary outcome of selecting the grape-flavored fruit drink, in unadjusted analyses. In these analyses, we collapsed across claim types to increase statistical power for moderation; these exploratory moderation analyses corrected for multiple comparisons using the Holm method (39). Moderators (described further in **Supplemental Table 2**) included parent's race/ethnicity measured using self-classification (40) (white non-Latino/Hispanic participants compared with black non-Latino/Hispanic participants compared with Latino/Hispanic participants), highest educational attainment (high school or less compared with 4-y college degree or more), and household income (<$75,000 compared with ≥$75,000); gender (boy compared with girl, man compared with woman; we dropped "other gender identity" from this model owing to small cell sizes) of both the parent and the child the participant shopped for; child's age (y) and frequency of consuming fruit drinks (<7 times/wk compared with ≥7 times/wk); whether the participant looked at the fruit drink Nutrition Facts Label during the shopping task; and how much the participant had sought vitamin C since the COVID-19 pandemic began ("Not at all," "Very little," "Somewhat" compared with "Quite a bit," "A great deal"). To test these interactions, we ran separate logistic regression models for each moderator. The dependent variable in the models was the primary outcome: selecting the grape-flavored fruit drink instead of 100% grape juice. Predictors in the moderation models were randomization to any claim (collapsed across arm) compared

TABLE 1 Participant characteristics[1]

Characteristic	Value
Age, y	34.8 ± 7.6
18–29	540 (24)
30–39	1176 (53)
40–54	452 (20)
≥55	51 (2)
Gender	
Man	768 (35)
Woman	1402 (65)
Transgender or other gender identity	1 (0)
Sexual orientation	
Straight or heterosexual	1997 (92)
Gay or lesbian	32 (1)
Bisexual	129 (6)
Another sexual orientation	12 (1)
Latino ethnicity	735 (33)
Race	
White	1571 (71)
Black or African American	472 (21)
Other/multiracial	176 (8)
Education	
Less than a high school diploma	25 (1)
High school diploma	718 (33)
Four-year college degree	956 (44)
Graduate degree	472 (22)
Employment status	
Employed part-time	433 (20)
Employed full-time	1212 (56)
Unemployed (able to work)	424 (20)
Other	103 (5)
Annual household income, $	
0–24,999	254 (12)
25,000–49,999	459 (21)
50,000–74,999	460 (21)
≥75,000	990 (46)
Children in household (0–18), *n*	
1	827 (38)
2	799 (37)
3	355 (16)
≥4	186 (9)
Used SNAP in the last year	445 (21)
Used WIC in the last year	293 (14)
BMI, kg/m^2	27.2 ± 7.5
Underweight (<18.5)	100 (5)
Normal weight (18.5–24.9)	894 (42)
Overweight (25.0–29.9)	576 (27)
Obesity (>29.9)	565 (26)
Age of child for whom the parent shopped, y	
1	183 (8)
2	338 (15)
3	458 (21)
4	594 (27)
5	626 (28)
Gender of child for whom the parent shopped	
Boy	1201 (55)
Girl	996 (45)
Other gender identity	1 (0)
Frequency of child ages 1–5 y consuming fruit drinks	
0–1 times/wk	487 (22)
2 to <7 times/wk	1191 (55)
1–2 times/d	371 (17)
>2 times/d	122 (6)

(*Continued*)

TABLE 1 (*Continued*)

Characteristic	Value
Experimental arm	
Control	565 (25)
"No artificial sweeteners" claim	555 (25)
"100% Vitamin C" claim	556 (25)
"100% All Natural" claim	544 (25)

[1] $n = 2218$. Values are n (%) or mean ± SD. Missing demographic data ranged from 0.0% to 3.7%. Characteristics including assignment to 2 auxiliary posttest experiments did not differ by trial arm (all $P > 0.05$ for comparisons of characteristics by trial arm). SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

with no claim, the moderator variable, and the interaction term between claim (compared with control) and the moderator. We then examined the statistical significance of the interaction term.

Results

Participants' mean age was 35 y, most (65%) identified as women, 33% identified as Latino/a or Hispanic, and 21% identified as black or African American (Table 1) (characteristics did not differ by trial arm, all $P > 0.05$). A majority of participants (54%) had an annual household income <$75,000/y, 21% had used Supplemental Nutrition Assistance Program (SNAP) in the last year, and 14% had used Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in the last year. The child for whom the parent shopped was most commonly a boy (55%) and consumed between 2 and 6 fruit drinks per week (55%). Most parents (87%) said that they could imagine doing their real-life shopping in the virtual store, and 88% said the virtual store reminded them of convenience stores they had visited. Most (82%) said that the drinks they chose in the virtual store were similar to choices they would make for their child in real life. Eleven percent of participants viewed the Nutrition Facts Label.

When presented with the choice between a grape-flavored fruit drink and 100% grape fruit juice, parents exposed to any of the 3 claims on the fruit drink were more likely to select the fruit drink than parents in the no-claim control condition (all $P < 0.001$) (**Figure 3**A). Nearly half (45%) of parents who viewed a "No artificial sweeteners" claim (Cohen's $d = 0.27$), 51% who viewed a "100% Vitamin C" claim ($d = 0.41$), and 54% who viewed a "100% All Natural" claim ($d = 0.46$) selected the fruit drink, compared with 32% in the control group. In the second choice task, parents were more likely to select the apple-flavored fruit drink instead of water when viewing an apple-flavored fruit drink with a "No artificial sweeteners" claim (61%, $P < 0.05$; $d = 0.13$) (Figure 3B) or a "100% All Natural" claim (62%, $P < 0.05$; $d = 0.15$), than in the no-claim control (55%). The difference between the "100% Vitamin C" claim (60%) and the control (55%) was not statistically significant ($P = 0.06$; $d = 0.11$).

Parents who viewed nutrition-related claims on fruit drinks were more likely to hold misperceptions about the nutritional quality of the fruit drinks than were parents in the control group. As described in the Methods section, the fruit drink had 39 g added sugar shown on the Nutrition Facts Label. However, 22%–47% of parents who viewed a claim incorrectly believed the fruit drink did not contain any added sugar, compared with only 12% in the control group ($P < 0.001$ for each claim compared with control) (**Table 2**). Similarly, 35%–56% of parents who viewed a claim believed the fruit drink was 100% juice, compared with 22% in the control group ($P < 0.001$ for each claim compared with control). Even when parents correctly stated that the fruit drink contained added sugar, 2 of the 3 claims led to a lower estimated amount of added sugar in the fruit drink ($P < 0.05$ for "No artificial sweetener" compared with control, $P < 0.01$ for "100% Vitamin C" compared with control). Among parents who correctly understood the drink was not 100% juice, all 3 claims led to higher estimations of the percentage of the drink that was juice ($P < 0.01$ for "100% Vitamin C" compared with control, $P < 0.001$ for "No artificial sweeteners" and "100% All Natural" compared with control). In other words, even when parents understood that the fruit drinks contained added sugars and were not 100% juice, the claims led parents to believe the fruit drinks had less added sugar and a higher proportion of fruit juice.

Exposure to nutrition-related claims on fruit drinks also changed attitudes and intentions related to fruit drink consumption (Table 2). Parents who viewed any of the claims gave higher ratings of healthfulness of the fruit drink ($P < 0.001$ for each claim compared with control for all healthfulness-related outcomes). Two of the claims led to greater perceived appeal of the fruit drink for parents' young child ($P < 0.01$ for "100% Vitamin C" compared with control, $P < 0.05$ for "100% All Natural" compared with control). All 3 claims led parents to have greater interest in giving the fruit drink to their young child ($P < 0.001$ for each claim compared with control) and greater interest in consuming the fruit drink themselves ($P < 0.01$ for "100% Vitamin C" and "No artificial sweeteners" compared with control, $P < 0.001$ for "100% All Natural" compared with control). The survey told parents, "This beverage is 20% fruit juice and contains 39 grams (about 9 teaspoons) of added sugar." After viewing this statement, parents exposed to a claim considered the information on the product more misleading than did those who viewed the control ($P < 0.001$ for each claim compared with control).

None of the participant characteristics moderated the impact of exposure to claims on fruit drink selection (compared with 100% juice), which included race/ethnicity, age and gender of the child the parent shopped for, frequency of fruit drink consumption of the child, parents' gender, highest educational attainment, household income, viewing the Nutrition Facts Label, and seeking vitamin C (all $P > 0.05$).

Discussion

In this randomized experimental study with a diverse sample of US parents, exposure to a nutrition-related claim ("No artificial sweeteners," "100% Vitamin C daily value," or "100% All Natural") increased the likelihood that parents selected a fruit drink that was high in added sugar for their young child, instead of 100% juice. Parents who viewed fruit drinks with "No artificial sweeteners" and "100% All Natural" claims were also more likely to choose the fruit drink for their child instead of water,

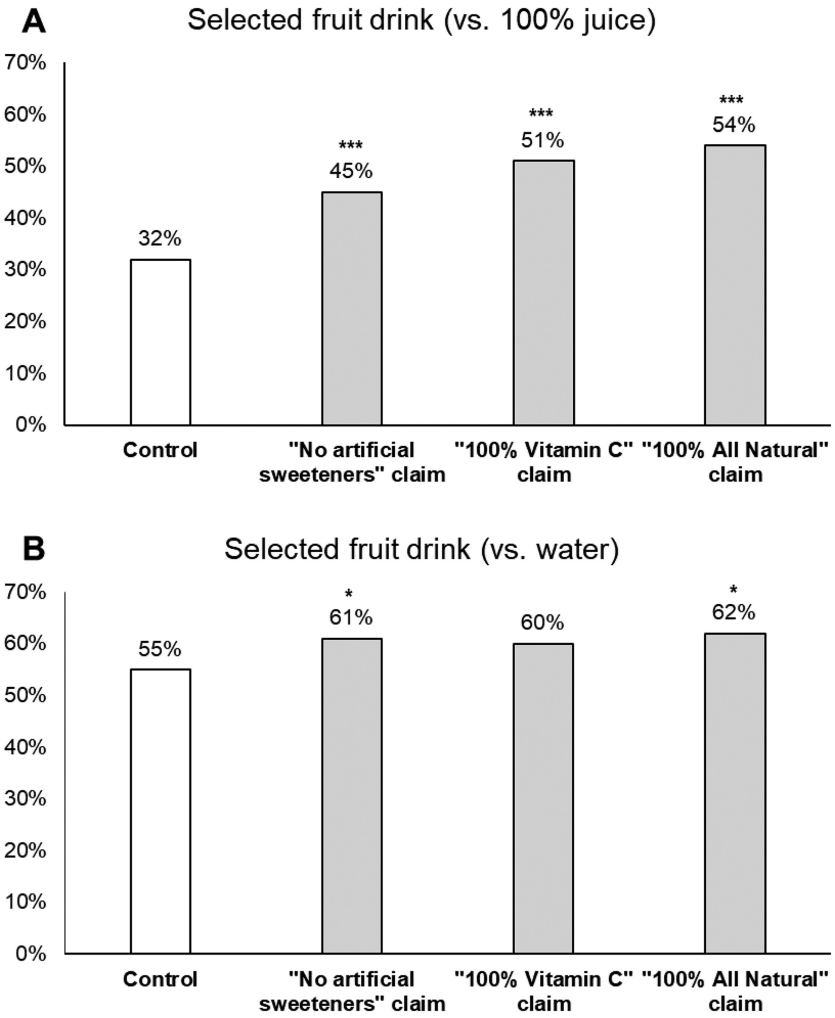

FIGURE 3 Impact of claims on parents' selection of fruit drinks for their children ages 1–5 y, compared with 100% juice ($n = 2219$) (A) and water ($n = 2219$) (B). *,***Significant difference compared with control: $^{*}P < 0.05$, $^{***}P < 0.001$; P values from a logistic regression model regressing claim type (compared with control) on selection of a fruit drink (yes/no).

than were parents who viewed a fruit drink with no claim. These findings build on prior research that has found that health-related and nutrient content claims increase intentions to purchase and consume foods and beverages, as well as selection of products (11–13, 34–38). The current study extends this research by demonstrating that nutrition-related claims influenced parents' beverage selection for their young children in a realistic virtual convenience store setting. The magnitude of the effect of claims in the "across-category" beverage choice (between the fruit drink and water) was smaller than that for the "within-category" choice (between the fruit drink and 100% juice). The difference in magnitude appears to be driven by a lower interest in water than in 100% juice among participants in our sample. Although exploring parents' lower interest in water fell outside the scope of the current study, future intervention and communications approaches could consider how to simultaneously encourage water consumption while reducing sugary drink consumption in children (41, 42).

All 3 claims led to misperceptions about the nutritional quality of the fruit drinks. Although the fruit drink's Nutrition Facts Label stated that it contained 39 g added sugar and only 20% fruit juice, parents who viewed a claim were more likely than those who did not view a claim to incorrectly believe that the fruit drink contained no added sugar and that the fruit drink was 100% juice. All 3 claims also led to greater perceived healthfulness of fruit drinks, more interest in serving fruit drinks to their child, and more interest in consuming fruit drinks themselves. This suggests that nutrition-related claims on fruit drinks can be misleading for parents. These findings are especially problematic given high rates of consumption of fruit drinks among US children (2, 3). Potential regulatory actions could include prohibiting the use of nutrient content claims on products that are high in added sugar, similar to a ban of the use of terms such as "light" on cigarette packaging. Another promising regulatory action could be to require front-of-package warnings or disclosures on products high in added sugar, based on evidence that warnings help communicate risk to consumers and may shift people toward healthier food choices (43, 44). For instance, several countries including Chile, Mexico, and Peru have required "high in sugar" warnings to appear on the front of foods and beverages that

TABLE 2 Impact of claims on parents' misperceptions, attitudes, and intentions[1]

			"No artificial sweeteners" claim		"100% Vitamin C" claim		"100% All Natural" claim	
	n	Control		Cohen's *d*		Cohen's *d*		Cohen's *d*
Misperceptions								
Incorrectly believe fruit drink does not contain added sugar	2181	12% (66)	42%*** (229)	0.74	22%*** (117)	0.26	47%*** (252)	0.84
Incorrectly believe fruit drink is 100% juice	2182	22% (124)	36%*** (195)	0.31	35%*** (189)	0.28	56%*** (300)	0.74
Amount of added sugar estimated in fruit drink,[2] teaspoons	1515	6.4 ± 3.8	5.8 ± 3.4*	−0.16	5.7 ± 3.8**	−0.18	5.9 ± 4.4	−0.11
Percentage of the fruit drink estimated to be fruit juice[3]	1372	35.4 ± 23.0	46.3 ± 24.4***	0.46	40.8 ± 24.7**	0.23	43.9 ± 25.4***	0.36
Attitudes and intentions								
Perceived healthfulness of fruit drink for their child	2192	3.3 ± 1.3	3.6 ± 1.2***	0.29	3.7 ± 1.2***	0.33	3.8 ± 1.1***	0.48
Perceived healthfulness of fruit drink, compared with soda	2181	3.6 ± 0.9	3.9 ± 0.8***	0.36	3.9 ± 0.9***	0.35	4.0 ± 0.9***	0.49
Perceived healthfulness of fruit drink, compared with 100% juice	2181	2.3 ± 1.3	2.8 ± 1.2***	0.32	2.8 ± 1.4***	0.34	3.2 ± 1.3***	0.65
Perceived appeal of fruit drink for child	2192	4.1 ± 1.0	4.2 ± 0.9	0.10	4.3 ± 0.8**	0.18	4.2 ± 0.9*	0.12
Interest in giving fruit drink to child	2192	3.4 ± 1.2	3.7 ± 1.1***	0.22	3.7 ± 1.2***	0.23	3.8 ± 1.1***	0.33
Interest in consuming fruit drink	2191	3.3 ± 1.4	3.5 ± 1.3**	0.17	3.5 ± 1.3**	0.18	3.6 ± 1.3***	0.27
Perceived misleadingness of information on the fruit drink	2181	3.3 ± 1.3	3.7 ± 1.3***	0.32	3.7 ± 1.2***	0.34	3.9 ± 1.2***	0.47

[1]Values are % (*n*) or mean ± SD unless otherwise indicated. *,**,***Significant difference compared with control: *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$; *P* values from logistic regression models for dichotomous outcomes and linear regression for continuous outcomes. Cohen's *d* is the standardized effect size of the experimental arm compared with the control. One teaspoon is equivalent to 4 g added sugar. Response options for attitudes and intentions variables ranged from 1 to 5.

[2]Among those who correctly stated the fruit drink contained added sugar.

[3]Among those who correctly stated the fruit drink was not 100% juice.

exceed thresholds for added sugar. Future studies could examine the potential for warnings to correct or minimize misperceptions, especially around added sugar content, caused by claims.

It is worth noting that in our study, only 11% of consumers opted to view the Nutrition Facts Label, substantially lower than estimates from prior studies showing rates of regular self-reported use of the Nutrition Facts Label of 35%–62% (45–47). However, the lower rates in our study are unsurprising given that nutrition label use assessed via more objective methods such as eye tracking or "think aloud" shopping tasks tends to be substantially lower than self-reported use (48, 49). Taken together, the low Nutrition Facts Label use in our study and in other studies (45), coupled with prior research showing stronger impacts of nutrition-related claims among people who did not view the Nutrition Facts Panel (38), highlights the need to make nutrition information more salient to consumers, for example through front-of-package labeling.

Finally, in our study, nutrition-related claims had similar effects across all groups of parents analyzed, including by race/ethnicity, household income, and education. In other words, the claims were equally misleading and led to less healthy choices across all population groups. Thus, regulation of claims could reduce consumption of fruit drinks across the population (3, 15, 16, 50, 51). However, these findings suggest that regulation of claims is unlikely to be a sufficient approach to addressing the disproportionately higher consumption of fruit drinks among children who are black, Latino, or from lower-income families, which may be largely driven by other causes. Factors not examined in this study such as targeted marketing, limited availability of healthy alternatives, or price may instead be contributing to observed disparities. Future studies should continue to examine how claims affect consumers' perceptions and purchases of less healthy options and evaluate interventions and policies that address root causes of disparities in diet and health. Future studies could also explore other potential moderators of the impact of claims, such as level of nutrition knowledge.

Strengths of this study include preregistration of predictions and the analytic plan and stimuli that were pretested and professionally designed. The use of a naturalistic virtual store environment allowed participants to view a 3D rendering of products including marketing elements on the front of the package and the Nutrition Facts Label on the back of the package. One study has found that purchases in virtual food retailer environments are comparable with those in real life (52). However, further validation work would be useful for understanding the extent to which behavior in the virtual store reflects real-world behavior. Other limitations include the brief, one-time exposure to claims, which could have limited the impact of the intervention on the outcomes. The use of a convenience sample means the generalizability of findings has yet to be established. However, convenience samples tend to accurately estimate the impact of randomized experiments, at least in the context of tobacco (53). The study measured selection of a small subset of product types, without monetary value attached. Future studies could examine the impact of claims on real-world purchases and on a wider range of products. Finally, the selection of 100% fruit juice as a healthier beverage choice was determined based on clinical recommendations that allow for modest amounts of 100% fruit juice in young children (54,

55). Because 100% fruit juice is fruit-flavored, such beverages may present a more feasible healthy substitution for fruit drinks than water or milk. However, it is worth noting that excessive consumption of 100% fruit juice can also lead to health problems in children (55) and public health efforts should be made to promote whole fruit consumption among young children.

In conclusion, our study found that parents were more likely to choose a fruit drink with added sugar for their young child (than a healthier alternative) when the drink packaging included nutrition-related claims. Parents who viewed claims on fruit drinks were also more likely to incorrectly believe that the fruit drinks did not contain added sugar and were 100% juice. These findings point toward the need for stronger regulation of marketing claims on fruit drinks. Future studies should evaluate the effects of claims on additional outcomes including real-world purchasing or consumption behavior.

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Data Availability

Data described in the article, code book, and analytic code will be made available upon request pending approval from the study principal investigators.

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