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Sugar-sweetened beverage consumption, perceptions and disparities by race, ethnicity, and socioeconomic status in children and adolescents

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Abstract

Objective: To 1) examine the association between sugar-sweetened beverage (SSB) perceptions—knowledge, attitudes, and norms (KAN) and media literacy—and beverage consumption and 2) identify differences in beverage consumption and SSB perceptions by race/ethnicity and socioeconomic status.

Design: Cross-sectional.

Setting: Diverse California school district.

Participants: 992 5th (elementary) ,7th (middle), and 9th-12th (high school) grade students.

Main Outcome Measures: Questionnaire-assessed continuous beverage consumption and perceptions.

Analysis: Linear regression adjusting for school, grade, gender, race/ethnicity and free and reduced price meal (FRPM) eligibility.

Results: KAN and media literacy items were associated with SSB consumption in expected directions (Ps<0.05). Among elementary students, FRPM-eligible and Black students had higher SSB consumption (P<0.01). In middle/high school, non-Hispanic White students consumed fewer SSBs than all other racial/ethnic groups (Ps<0.01). There were differences in SSB-related perceptions by race/ethnicity and socioeconomic status; e.g., Black students perceived sugary drinks as less unhealthy; Black, Hispanic, and FRPM-eligible students expressed less distrust of food/beverage advertisements; and Black, Hispanic, Asian, multi-race, and FRPM-eligible students perceived more frequent SSB consumption among their peers (Ps<0.05).

Conclusions and implications: SSB perceptions were associated with SSB consumption. There were racial/ethnic and socioeconomic disparities in SSB consumption and perceptions. SSB

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perceptions and related social and commercial determinants like marketing may be useful targets for reducing SSB consumption.

Keywords

Sugar-sweetened beverages; knowledge; attitudes; norms; school

INTRODUCTION

Adolescent obesity remains a major public health concern, with 21% of U.S. adolescents classified as having obesity.[1] Although there are a myriad of contributors, sugar-sweetened beverages (SSBs) are one of the only dietary items causally linked to the development of obesity.[2,3] Of further concern are health inequities in obesity and SSB consumption. Black, Hispanic, and low-income individuals have a higher prevalence of obesity,[4] and disparities in adolescent obesity have only worsened over time.[5] Nationally, racial and ethnic minority groups[6] and low-income individuals[7] are also more likely to consume SSBs. Disparities in SSB consumption may reflect the disproportionate exposure by Black and Hispanic youth to SSB advertising on TV and in their neighborhoods.[8,9,10]

Currently, there is a growing interest among institutions and municipalities in investing in interventions, such as media campaigns and school education programs, to reduce SSB consumption and disparities in consumption.[11] The recent wave of soda taxes globally and across the U.S. is generating revenues that could fund SSB reduction programs.[12,13] However, to inform the development and targeting of SSB reduction programs, it is critical to understand the precursors to SSB consumption and differences in precursors by demographic and socioeconomic characteristics.

There are a number of potentially important precursors to SSB consumption, such as knowledge of health outcomes (similar to behavioral beliefs of Theory of Planned Behavior [TPB][14] and outcome expectations of Social Cognitive Theory[15]) as well as normative beliefs and attitudes toward SSBs (TPB). According to TPB, knowledge and behavioral beliefs determine attitudes, and normative beliefs determine subjective norms, which (together with perceived control) determine behavioral intention and behavior.[14] Thus far, there is preliminary evidence that knowledge, attitudes, and norms (KAN) predict intention to consume SSBs and that intention is significantly correlated with consumption.[16,17] However, more evidence is needed to substantiate this preliminary evidence and to understand the role KAN may play in racial/ethnic and socioeconomic disparities in SSB consumption. Additionally, few studies have examined how food and beverage media literacy are associated with SSB consumption.

Thus, the objective of this study was to examine the association of SSB KAN and food and beverage media literacy with SSB and water consumption among elementary, middle, and high school students in a diverse public school district in California. An additional objective was to examine the differences in SSB and water consumption, KAN, and food and beverage media literacy by race/ethnicity and socioeconomic status. This study examined both SSB and water consumption because water is the beverage recommended by the Dietary Guidelines for Americans[18] as a substitute for SSBs.

METHODS

Participants and Setting

Questionnaires were administered on beverage consumption and perceptions in public elementary (5th grade) and middle and high school (7th, and 9th-12th grade) classrooms during fall 2016 in a diverse school district in the San Francisco Bay Area's Alameda County. Nearly one-quarter of the district's student population was Hispanic and 16% Black in 2016.[19] Over a third of students were eligible for free or reduced price meals (FRPM).[19]

The survey was initially used to track SSB trends over time. Due to school district logistical constraints, a census was not feasible. Thus, purposive sampling was used to select the 5 out of 10 total elementary schools with the highest proportion of Black and Hispanic children and to select all of the middle and high schools with staff available to coordinate the survey, which was 2 of the 3 total middle schools and all of the district's 2 high schools. Because the district assigns students to schools to prioritize diversity, there was only modest between-school variability in race/ethnicity. Grades 5, 7, and 9-12th were surveyed to align with grades sampled for statewide assessments (e.g., physical fitness testing).

In all but 1 high school, all students present in the classroom (gardening for 5th grade, science for 7th grade, and English and science for high school) on the survey day were invited to participate. In the largest high school, a representative sample of science classes was selected for the survey. Of the 308 5th grade students present, 300 participated (97%). Of the 250 7th graders present, 248 (99%) participated, and of the 473 9-12th graders present in the sampled classes, 452 (96%) participated. Of all students enrolled in sampled schools (including high schoolers not in the sampled classes), the research sample represented 93%, 70%, and 15% of 5th, 7th, and 9-12th grade enrollment, respectively.

Parental consent for the survey was obtained through letters sent home, and researchers obtained student verbal assent before the questionnaire administration. All data collection procedures were approved by the school district's research department and the University's IRB.

Measures

Primary outcomes were self-reported beverage consumption and response to SSB-related KAN and food/beverage media literacy questionnaire items. The self-reported beverage questions for middle and high school students were adapted from the 2017 Center for Disease Control's Youth Behavioral Risk Survey (YRBS) questionnaire, a standardized tool used in grades 9-12 across the US.[20,21,22,23] Middle and high school students were asked, "During the past 7 days, how many times did you drink a can, bottle, or glass of…" for specific sugar-sweetened and non-sweetened beverage options. Items from the YRBS questionnaire included soda, sports drinks, water, milk, and 100% fruit juice with minor phrasing differences.[20] For example, the word "pop" for soda was removed as it is regionally specific. Additional items were added to comprehensively assess beverage consumption: "Diet soda, such as Diet Coke, Diet Pepsi, or Sprite Zero…", "Energy drinks, such as Red Bull or Monster (Do not count diet energy drinks)…", "Fruit-flavored drinks, such as Kool-Aid, Sunny Delight, lemonade, or Snapple (Do not count 100% juice)…", and "Any

other sugary drink like sweet tea, sweetened coffee, or Vitamin Water." Standard YRBS response options were used: "I did not drink … during the past 7 days", "1 to 3 times during the past 7 days", "4 to 6 times during the past 7 days", "1 time per day", "2 times per day", "3 times per day", and "4 or more times per day." Beverage intake responses for middle and high school were converted to continuous daily frequency in the past 7 days, and the midpoint of any range was assigned (e.g., "1-3 times" was assigned 2/7=0.29).

Fifth graders were asked about consumption of the same beverages as middle and high schoolers, but due to the inability of many 10 year-olds to report weekly consumption, 5th grade questions asked about "yesterday," consistent with the California Healthy Kids Survey (a different questionnaire designed for grades 5 and above).[24] Response options for "how many times did you drink a can, bottle, or glass of… yesterday" included "I did not drink it," "1," "2," "3," "4," and "5 or more." Responses were treated as continuous consumption yesterday. To calculate total SSB consumption, intake of soda; sports, energy, and fruit drinks; and sweetened water, coffee, and tea intake were summed.

Sugar-sweetened beverage-related KAN and food and beverage media literacy items were consistent for all grades. Knowledge items included: "drinking sugary drinks can cause cavities in teeth…", "foods with sugar in them make you feel full for a longer time than drinks with sugar in them…", and "drinking sugary drinks can lead to diabetes when you are older…" on a 5-point scale (1=strongly disagree, 2=sort of disagree, 3=neither, 4=sort of agree, 5=strongly agree). The attitude item, "in your opinion, drinking sugary drinks…" on a 4-point scale (1=has no effect on health, 2=is a little unhealthy, 3=is very unhealthy, 4=is extremely unhealthy), was based on literature exploring sugary drinks and the TPB.[25] The descriptive norm item, "most of your friends think sugary drinks…" on a 4-point scale (1=has no effect on health to 4=is extremely unhealthy) was also based on the same literature.[25] The other descriptive norm item "how often do you think most students at your school drink sugary drinks," was drawn from a study on peer norms that assessed how many "sweet drinks" per day students thought were most "typical for other students to consume…"[26] Response options included "never", "1-3 times a week", "4-6 times a week", "1 time per day", "2 times per day", and "3 or more times per day." Lastly, 3 novel media literacy questions were developed from themes explored in food and beverage marketing literature, consistent with other media literacy measures;[27,8] items included "a lot of sugary drink advertisements were designed for kids [and teens] your age…;" "advertisements for sugary drinks cause people to drink more sugary drinks…;" and "you can trust food and beverage advertisements…" on a 5-point scale (1=strongly disagree to 5=strongly agree). All KAN and media items were treated as continuous variables based on scale response, and the norm item on frequency of peer consumption was treated as continuous times per day. The questionnaire was pretested in 4-6th grade summer program for question comprehension and is included in the ancillary materials.

The school district provided student-level data on race and ethnicity (Hispanic any race and non-Hispanic: American Indian or Alaska Native, Asian, Filipino, Hawaiian, Black or African American, White, or two or more races), gender, and FRPM eligibility. Due to small sample size, Filipino and Hawaiian students were grouped with Asian students, creating

an Asian and Pacific Islander (API) classification. All district school enrollment data were accessed through DataQuest (dq.cde.ca.gov/dataquest/).[19]

Participants missing FRPM (n=3) and consumption data (n=1) were excluded. Due to insufficient sample size, American Indian participants (n=4) were not included in analyses. The analytic sample included 992 participants with complete beverage consumption and demographic data. Data on KAN and media items were available for 947 to 981 participants, depending on the item.

Analyses

All outcome variables were continuous. Thus, visual inspection of normal quantile plots was used to examine the distribution of outcome variables. Because SSB consumption was right-skewed, linear regression models in which SSB consumption was the outcome used a gamma distribution. All models in which SSB or water consumption were the outcomes used a log link, which allowed for coefficients to be interpreted as percent difference in consumption. To account for clustering by classroom and for the frequency of zeros for SSB consumption (n=148 and 82 for elementary and middle/high school, respectively), robust standard errors[28] were used for all regression analyses.

Multiple linear regression models with robust standard errors examined: 1) differences in SSB and water consumption by race/ethnicity and FRPM eligibility (Model 1); 2) the extent to which KAN and media items were associated with SSB and water consumption (Model 2); and 3) the extent to which race/ethnicity and FRPM eligibility were associated with differences in KAN (Model 3).

Model 1 regressed beverage consumption on race/ethnicity, FRPM eligibility, gender, grade (for middle/high), and school. Model 2 regressed beverage consumption on each KAN and media item as well as the independent variables in Model 1. Because beverage consumption response options differed between 5th and higher grades, for Model 1 and 2, separate models were run for elementary vs. middle and high school.

Lastly, Model 3 regressed each KAN and media item on race/ethnicity, FRPM eligibility, school, grade, and gender for all grades combined. All analyses were complete case analyses, used a two-sided alpha of 0.05 for statistical significance, and were run in Stata/IC v15.0 (StataCorp LLC, College Station,TX).

RESULTS

Table 1 presents participant characteristics. The demographics of students participating in the survey were similar to the district overall. Nearly one-quarter of survey participants were Hispanic, one-fifth Black, 7% API, and just over one-third Non-Hispanic White (hereafter, “White”). Over one-third of students were eligible for FRPM, which included 40% of API, 66% of Black, 52% of Hispanic, 29% of two or more race, and 11% of White students.

Table 2 shows the differences in beverage consumption by race/ethnicity and FRPM eligibility. Among elementary students, Black students consumed 209% (95CI: 72, 456; P<.001) more SSBs and Hispanic students consumed 18% (95CI: 4, 30; P=0.02) less water

than White students. There were no significant differences between White students and other racial/ethnic groups in beverage consumption in elementary students. FRPM-eligible elementary students consumed 86% (95CI: 18, 195; P=0.008) more SSBs than students not eligible for FRPM.

In middle and high school, compared to White students, all other racial and ethnic groups reported higher SSB consumption (67%, 214%, 68%, and 65% higher for API, Black, Hispanic, and two or more races, respectively; Ps<0.01). Additionally, Black and Hispanic middle and high school students reported lower water consumption than White students (17% and 10% lower [Ps<0.05], respectively). In contrast to elementary students, among middle and high school students, there were no significant differences in beverage consumption by FRPM eligibility.

Table 3 shows the association of KAN and media items with SSB consumption. In both elementary students and middle and high school students, knowledge that sugary drinks can lead to diabetes and cavities was associated with lower SSB consumption (Ps<0.01). Among middle and high school students, the attitude that sugary drinks are unhealthy was associated with lower SSB consumption (P<0.001). For media items, the belief that sugary drink advertisements were designed for youth and agreeing that advertisements cause people to drink more sugary drinks were each associated with lower SSB consumption (Ps<0.01) among elementary students. Belief that “you can trust food and beverage advertisements” was associated with higher SSB consumption in elementary students and middle/high school students (Ps<0.001). Among norms constructs, for each additional SSB per day that students thought their peers drank, their own consumption was higher by 24% (95CI: 1, 52; P=0.04) among elementary students and 21% (95CI: 9, 34; P<0.001) among middle and high school students.

Several KAN and media items were also associated with water consumption. The attitude that sugary drinks are unhealthy and knowledge about sugary drinks and diabetes risk were associated with higher water consumption in all grade levels (Ps<0.01). Among elementary students only, perceiving that friends think sugary drinks are unhealthy (norm) and knowledge about satiety and cavity risks of sugary drinks were associated with higher water consumption (Ps<0.05). Among middle and high school students only, perceiving that peers consume sugary drinks more frequently (norm) and the belief that advertisements for sugary drinks cause people to consume more were significantly associated with higher water consumption (Ps<0.01).

Table 4 shows the association of race/ethnicity and FRPM eligibility with KAN and media items, and Supplemental Table 1 shows the predicted means of each item by student characteristic. Compared to White students, Black students were significantly less likely to agree to the same extent that sugary drinks are unhealthy (attitude; P=0.04), their friends think sugary drinks are unhealthy (norm; P<0.001), foods with sugar are more satiating than drinks with sugar (knowledge; P=0.005), and sugary drinks can lead to diabetes and cavities (knowledge; Ps<0.01). Black students were also less likely to agree that many sugary drink advertisements were designed for youth (media; P<0.001) and that sugary drink advertisements cause people to drink more sugary drinks (media; P=0.01). Black, Hispanic,

and FRPM eligible students expressed less distrust of food and beverage advertisements (media; Ps<0.05). Additionally, compared to White students, all other racial and ethnic groups perceived that their peers consumed SSBs more frequently (norm; Ps<0.01). FRPM-eligible students also perceived that their peers consumed more SSBs than did non-eligible students (norm; P=0.007).

DISCUSSION

The study objectives were to 1) examine associations of SSB-related KAN and media literacy with beverage consumption and 2) identify differences in SSB perceptions and beverage consumption by race/ethnicity and socioeconomic status. The results showed that SSB KAN and media literacy items were associated with SSB consumption in expected directions. For example, distrust of food and beverage advertising and agreement that sugary drinks increase risk for diabetes were associated with lower SSB consumption. Furthermore, concerning disparities in consumption and responses to KAN and media items existed by race/ethnicity and socioeconomic status. Compared to non-Hispanic White students, all other racial/ethnic groups in middle and high school and Black 5th graders consumed more SSBs, as did FRPM-eligible 5th graders compared to their non-FRPM-eligible counterparts. Hispanic elementary and Black and Hispanic middle and high school students also reported lower water consumption. Findings regarding KAN and media literacy were a novel contribution of the study: Black, Hispanic, and students eligible for FRPM were less distrustful of food and beverage advertisements, and compared to White and non-FRPM-eligible students, all other racial/ethnic groups and FRPM-eligible students perceived that their peers consumed sugary drink more frequently, respectively. Across all other KAN and media items, there were significant differences between Black and White student responses that could potentially contribute to racial disparities in SSB consumption.

The observed differences in SSB consumption and related KAN and media items are consistent with documented disparities by race, ethnicity, and income in exposure to food and beverage marketing and other social and commercial determinants of health. First, research has shown that exposure to food advertising increases food intake in children[29] and that exposure to SSB promotions is associated with SSB consumption in adults.[30] In particular, the use of health-focused marketing for SSBs could influence KAN; experiments have found that messaging like “100% Vitamin C” on fruit-flavored SSBs increased consumers’ false beliefs that SSBs are healthful.[31] Second, Black, Latino, and low-income neighborhoods are exposed to more outdoor food and beverage advertisements and specifically ones for unhealthy food and drinks.[32,9] In particular, low income Black neighborhoods had the highest density of advertisements for sugary beverages.[32] Food and beverage TV ads make up roughly a quarter of the total ads directed at youth, with Black and lower-income youth having a higher risk of exposure to food and beverage ads.[33] A Rudd Center report detailed disparities in advertising exposure by race; in 2017, Black children and teens viewed 86% and 119% more food and beverage ads, respectively, than White children and teens.[8] The advertisements targeting Spanish language and Black audiences were almost exclusively for fast-food, candy, sugary drinks, and snacks, and non-nutritious products.

Findings of higher SSB consumption among Black and low-income elementary students and Black and Hispanic middle and high school students echo nationally-representative data.[34,6] Additionally, the result that SSB-related KAN were associated with SSB consumption is consistent with previous studies finding that several constructs of the TPB (attitudes and subjective norms) were significantly associated with SSB intake.[25,16] Previous research has also found that adult SSB health knowledge and youth peer norms were associated with SSB consumption.[16,26] In a pilot trial investigating a peer norms intervention for improving elementary students' water drinking behaviors, children who were exposed to the intervention reported an increase in water consumption and a decrease in SSB consumption.[35] Only recently, have studies of youth begun to incorporate constructs on food and beverage media literacy. In a feasibility study, after being exposed to an educational program grounded in the TPB, students significantly reduced SSB consumption and improved media and public health literacy.[36] Similarly, a qualitative study used focus groups to ask Black and Hispanic youth about their perceptions of targeted marketing; participants identified the strong appeal of non-traditional forms of marketing, such as in video games, YouTube, and social media.[37] The novel contributions to this literature of the study reported herein are quantitative estimates of differences in SSB-related KAN and media perceptions by race/ethnicity and socioeconomic status and quantitative estimates for the association of KAN and media items with SSB consumption.

Because of this study's cross-sectional design, the ability to make causal inferences is limited. Also, measures were self-reported and thus may be affected by random error, social desirability bias, and differences in social desirability by race/ethnicity and SES. Also, attitude was measured with just 1 item. The sample size was not based on a power calculation for the analyses reported. In particular, the analyses among elementary students may have been underpowered given that many non-significant coefficients for differences in consumption by race, SES, and KAN were similar in magnitude to those among middle and high school students. Although this study analyzed data from nearly 1,000 students from a diverse school district, data drawn from a single school district may not generalize more broadly.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This research found that SSB- and media-related perceptions were associated with SSB consumption, and that these perceptions differed by race/ethnicity and socioeconomic status in a manner consistent with prevailing disparities in SSB consumption. Thus, perceptions of SSBs and their upstream determinants (e.g., targeted marketing) may serve as important intervention targets in education and policy interventions. Furthermore, the observed disparities in SSB consumption and perceptions by socioeconomic status and race/ethnicity support prioritizing Black and lower-income youth when developing and implementing culturally responsive healthy beverage education interventions.

Future research should include longitudinal studies in larger geographic regions to confirm that SSB-related KAN and media awareness predict future SSB consumption. More broadly, however, is the need for research to identify and evaluate interventions that can reduce SSB consumption and disparities in SSB consumption. Authoritative groups have urged

for implementation of policies that are projected to reduce overall SSB consumption and disparities in SSB consumption in youth, including excise taxes and limits on marketing to youth.[38,39]

Sugar-sweetened beverage taxes have been implemented in 9 U.S. jurisdictions and have reduced SSB consumption and purchasing, especially in lower-income groups.[40,41] Taxes on SSBs have generated revenue that cities have used to fund healthy beverage media campaigns and school nutrition education. [12,13] Research on SSB-related KAN and advertising perceptions can inform the content of new healthy beverage campaigns. For instance, because more favorable perceptions of food and beverage ads were associated with higher SSB consumption, interventions could include content on media and marketing literacy. Future research could investigate if media literacy interventions or other specific KAN messaging reduce SSB consumption. Several communities have already created communication campaigns highlighting targeted SSB marketing. In San Francisco, The Bigger Picture uses youth-generated spoken-word messages to change the conversation around type 2 diabetes.[42] In collaboration with local health departments, The Bigger Picture has increased awareness about the negative health impacts of sugary drinks with the Open Truth Campaign.[42] Similarly, in Washington DC, the #Don'tMuteMyHealth campaign uses viral spoken-word videos and community-focused events to engage predominantly Black wards on the impact of sugar and chronic disease.[43] New York City's mass media series, "Pouring on the Pounds," focused on increasing knowledge of the sugar content in sugary drinks and associated weight gain, obesity, and diabetes.[44] Research evaluating the impact of media literacy and communications campaigns on SSB consumption could also assess and test for mediation through KAN and media literacy. However, the need for media literacy campaigns would be lessened if policies reduced youth-directed marketing and the disproportionate marketing of unhealthy products to communities of color and low-income neighborhoods. Lastly, findings that SSB knowledge (about satiety, diabetes, and cavities) was associated with lower SSB consumption support the inclusion of SSB knowledge topics in nutrition education interventions—either in curricula or policy approaches to education like warning labels.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Characteristics of the Analytic Sample of 5th, 7th, and 9th-12th Grade Participants Compared to Total Enrollment

	Elementary: 5th Grade n (%) or Mean±SD		Middle (7th Grade) and High School n (%) or Mean±SD		Total Grades 5,7,9-12th n (%) or Mean±SD	
Race	**Analytic Sample (n=297)**	**Enrollment Total[a] (N=319)**	**Analytic Sample (n=695)**	**Enrollment Total[a] (N=3,425)**	**Analytic Sample (n=992)**	**Enrollment Total[a] (N=3,744)**
Asian or Pacific Islander[b]	16 (5)	18 (6)	51 (7)	317 (9)	67 (7)	335 (9)
African American or Black[b]	48 (16)	54 (17)	157 (23)	627 (18)	205 (21)	681 (18)
Hispanic Any Race	81 (27)	79 (25)	158 (23)	762 (22)	239 (24)	841 (23)
Two or More Races[b]	44 (15)	47 (15)	76 (11)	392 (11)	120 (12)	439 (12)
White[b]	108 (36)	121 (38)	253 (36)	1,327 (39)	361 (37)	1,448 (39)
Free & Reduced Price Meal[c]						
Eligible	108 (36)	1,426 (34)	255 (37)	717 (38)	363 (37)	2,143 (35)
Ineligible	189 (64)	2,760 (66)	440 (63)	1,177(62)	629 (63)	3,937 (65)
Gender						
Female	142 (48)	154 (48)	370 (53)[d]	1664 (49)	512 (52)	1,818 (49)
Male	155 (52)	168 (52)	325 (47)[d]	1773 (52)	480 (48)	1930 (52)
Consumption[e]						
Total SSBs	1.6±2.8	n/a	1.2±1.7	n/a	n/a	n/a
Water	3.5±1.6	n/a	3.0±1.2	n/a	n/a	n/a
Total non-SSBs	6.0±3.0	n/a	4.5±2.0	n/a	n/a	n/a

Acronyms: SSBs—Sugar Sweetened Beverages, SD—standard deviation

[a]Total enrollment of sampled schools and grade(s) in the 2016-2017 school year (includes enrollment in classes not sampled)

[b]Non-Hispanic

[c]Data unavailable for 3 students, and enrollment data on free and reduced price meal is from the school-wide level

[d]Distribution of gender differed significantly between analytic sample and school enrollment data (Chi-square P=0.02). No other characteristic in table differed significantly.

[e]Units are in frequency of consuming a “can, bottle, or glass” “yesterday” for 5th grade and per day in the past week for 7-12th grades.

Table 2.

Mean Beverage Consumption and Percent Difference by Student Characteristics

	n	Unadjusted Mean (SD) SSB[a] Consumption[b]	Adjusted percent difference (95% CI); P-values[c] in beverage consumption compared to reference group	
			SSB	Water
Elementary (n=297)				
Race/Ethnicity				
White[d]	108	1.0 (2.2)	ref	ref
Asian or Pacific Islander[d]	16	1.3 (1.9)	42% (−43, 255); P=0.46	−8% (−30, 20); P=0.52
African American or Black[d]	48	3.8 (4.7)	209% (72, 456); P<0.001	−7% (−23, 11); P=0.42
Hispanic	81	1.7 (2.1)	32% (−19, 113); P=0.26	−18% (−30, −4); P=0.02
Two or More Races[d]	44	0.6 (1.4)	−52% (−78, 7); P=0.07	−2% (−15, 13); P=0.80
FRPM Not Eligible	108	1.0 (2.2)	ref	ref
FRPM Eligible	189	2.6 (3.4)	86% (18, 195); P=0.008	−3% (−15, 10); P=0.61
Middle and High (n=695)				
Race/Ethnicity				
White[c]	253	0.6 (0.7)	ref	ref
Asian Pacific Islander[c]	51	1.1 (1.7)	67% (17,138); P=0.004	4% (−5, 13); P=0.38
African American or Black[c]	157	2.1 (2.7)	214% (136, 316); P<0.001	−17% (−25, −8); P<0.001
Hispanic	158	1.1 (1.4)	68% (30, 117); P<0.001	−10% (−17, −2); P=0.02
Two or More Races[c]	76	1.1 (1.3)	65% (27, 116); P<0.001	−4% (−13, 6); P=0.42
FRPM Not Eligible	255	1.0 (1.6)	ref	ref
FRPM Eligible	440	1.5 (1.9)	10% (−11, 34); P=0.38	0% (−7, 8); P=0.93

Acronyms: SSB—sugar-sweetened beverage, FRPM—Free and reduced price meal, ref—reference group.

[a]SSBs include the sum of soda; fruit-flavored, energy, and sport drinks; and sweetened water, coffee, and tea

[b]Units of beverage consumption are in frequency of consuming a “can, bottle, or glass” “yesterday” for elementary and per day in the “past 7 days” for middle/high school.

[c]Estimates are from generalized linear regression models with a log link, gamma distribution, and robust standard errors, including the following independent variables: school, grade level, gender, race/ethnicity, and free and reduced price meal (FRPM) eligibility. Statistical significance is indicated by P-value<0.05.

[d]Non-Hispanic

Table 3.

Associations of Knowledge, Attitudes, and Norms (KAN) and media items with Sugar-Sweetened Beverage (SSB) Consumption

KAN and media items	Adjusted percent difference (95% CI); P-values[a] in beverage consumption according to KAN and media item response					
	Elementary			Middle and High		
	n	SSB[b]	Water	n	SSB[b]	Water
Response scale for below: 1=has no effect on health to 4=is extremely unhealthy[c]						
Attitude that sugary drink are unhealthy: *"…drinking sugary drinks…"*	291	−21% (−38, 0); P=0.05	12% (5, 20); P=0.001	686	−29% (−38, −18); P<0.001	10% (6, 15); P<0.001
Norm—friends think sugary drinks are unhealthy: *"…your friends think drinking sugary drinks…"*	273	−3% (−27, 29); P=0.84	18% (10, 26); P<0.001	674	−12% (−23, 1); P=0.07	1% (−3, 6); P=0.59
Norm—frequency of peer sugary drink consumption: *"How often do … most students…drink sugary drinks?* (response in times/day)	297	24% (1, 52); P=0.04	2% (−5, 9); P=0.68	691	21% (9, 34); P<0.001	6% (3, 10); P=0.001
Response scale for below: 1=strongly disagree to 5=strongly agree[d]						
Knowledge that liquid sugar is less satiating: *"Foods with sugar…make you feel full for a longer time than drinks with sugar in them"*	289	−14% (−27, 0); P=0.05	6% (1, 12); P=0.02	690	−9% (−16, −1); P=0.04	2% (−1, 5); P=0.13
Knowledge that sugary drinks increase diabetes risk: *"Drinking sugary drinks can lead to diabetes…"*	289	−17% (−28, −5); P=0.009	8% (3, 14); P=0.002	691	−17% (−24, −9); P<0.001	7% (3, 11); P=0.002
Knowledge that sugary drinks can cause cavities: *"Drinking sugary drinks can cause cavities…"*	290	−24% (−34, −12); P<0.001	7% (1, 13); P=0.03	689	−25% (−32, −17); P<0.001	4% (−1, 10); P=0.10
Media—belief that sugary drink ads target kids: *"…sugary drink [ads] were designed for kids and teens…"*	287	−23% (−33, −11); P<0.001	−1% (−5, 3); P=0.50	690	−6% (−16, 5); P=0.25	3% (0, 7); P=0.07
Media—belief that sugary drink ads "*cause people to drink more sugary drinks…"*	289	−21% (−31, −8); P=0.002	3% (−2, 8); P=0.21	688	2% (−10, 8); P=0.70	5% (1, 9); P=0.008
Media—belief that *"you can trust food and beverage advertisements"*	287	28% (11, 47); P<0.001	4% (0, 8); P=0.06	688	17% (8, 28); P<0.001	−1% (−5, 2); P=0.39

Acronyms: Ads—Advertisements, KAN—knowledge, attitudes, and norms, SSB—sugar-sweetened beverage

[a] Estimates are from generalized linear regression models with a log link, gamma distribution, and robust standard errors, including the following independent variables: school, grade level, gender, race/ethnicity, and FRPM eligibility. Statistical significance is indicated by P-value<0.05.

[b] SSBs include soda; fruit-flavored, energy, and sport drinks; and sweetened water, coffee, and tea

[c] 1=Has no effect on health, 2=Is a little unhealthy, 3=Is very unhealthy, 4=Is extremely unhealthy

[d] 1=Strongly Disagree, 2=Sort of Disagree, 3=Neither, 4=Sort of Agree, 5=Strongly Agree

Table 4.

Association Between Student Characteristics And Response To Knowledge, Attitude, And Norms (KAN) And Media Items

KAN and media items	Mean point difference in response (95% CI)[a] to KAN and media items by student characteristics; P-values (sample size)						
	Race/Ethnicity					FRPM Eligibility	
	White (ref)	Asian Pacific Islander[b]	Black or African American[b]	Hispanic	Two or More Races[b]	Not eligible (ref)	Eligible
Response scale for below: 1=has no effect on health to 4=is extremely unhealthy[c]							
Attitude that sugary drink are unhealthy: *"…drinking sugary drinks…"*	ref (n=355)	−0.07 (−0.24, 0.10); P=0.40 (n=66)	−0.15 (−0.30, −0.01); P=0.04 (n=201)	−0.05 (−0.17, 0.08); P=0.48 (n=236)	0.04 (−0.10, 0.17); P=0.60 (n=119)	ref (n=619)	−0.03 (−0.14, 0.07); P=0.54 (n=358)
Norm—friends think sugary drinks are unhealthy: *"…your friends think drinking sugary drinks…"*	ref (n=351)	−0.15 (−0.31, 0.02); P=0.08 (n=65)	−0.23 (−0.36, −0.11); P<0.001 (n=192)	−0.07 (−0.18, 0.05); P=0.24 (n=222)	0.07 (−0.07, 0.20); P=0.34 (n=117)	ref (n=610)	0.05 (−0.05, 0.16); P=0.30 (n=337)
Norm—frequency of peer sugary drink consumption: *"How often do … most students…drink sugary drinks?* (response in times/day)	ref (n=356)	0.4 (0.2, 0.7); P<0.001 (n=67)	0.6 (0.5, 0.8); P<0.001 (n=202)	0.2 (0.1, 0.4); P=0.002 (n=238)	0.3 (0.1, 0.4); P=0.004 (n=118)	ref (n=624)	0.2 (0.1, 0.3); P=0.007 (n=357)
Response scale for below: 1=strongly disagree to 5=strongly agree[d]							
Knowledge that liquid sugar is less satiating: *"Foods with sugar…make you feel full for a longer time than drinks with sugar in them"*	ref (n=353)	−0.17 (−0.45, 0.10); P=0.22 (n=67)	−0.32 (−0.55, −0.10); P=0.005 (n=203)	−0.18 (−0.36, 0.01); P=0.06 (n=238)	−0.09 (−0.29, 0.11); P=0.38 (n=118)	Ref (n=620)	−0.05 (−0.21, 0.11); P=0.51 (n=359)
Knowledge that sugary drinks increase diabetes risk: *"Drinking sugary drinks can lead to diabetes…"*	ref (n=358)	−0.15 (−0.39, 0.09); P=0.23 (n=66)	−0.34 (−0.56, −0.13); P=0.002 (n=201)	−0.14 (−0.31, 0.03); P=0.10 (n=238)	−0.10 (−0.29, 0.09); P=0.28 (n=117)	ref (n=623)	<−0.01 (−0.16, 0.15); P=0.98 (n=357)
Knowledge that sugary drinks can cause cavities: *"Drinking sugary drinks can cause cavities…"*	ref (n=357)	−0.19 (−0.45, 0.08); P=0.17 (n=67)	−0.42 (−0.62, −0.21); P<0.001(n=201)	−0.11 (−0.27, 0.04); P=0.14 (n=236)	−0.15 (−0.34, 0.03); P=0.10 (n=118)	ref (n=621)	0.07 (−0.08, 0.21); P=0.36 (n=358)
Media—belief that sugary drink ads target kids: *"…sugary drink [ads] were designed for kids [and teens]…"*	ref (n=353)	−0.29 (−0.59, <−.01); P=0.05 (n=67)	−0.42 (−0.63, −0.20) P<0.001 (n=204)	−0.10 (−0.27, 0.08); P=0.28 (n=236)	0.05 (−0.14, 0.24); P=0.61 (n=117)	ref (n=619)	−0.07 (−0.22, 0.09); P=0.41 (n=358)
Media—belief that sugary drink ads "*cause people to drink more sugary drinks…"*	ref (n=355)	−0.24 (−0.51, 0.03); P=0.09 (n=66)	−0.26 (−0.47, −0.05); P=0.01 (n=201)	−0.13 (−0.31, 0.04); P=0.13 (n=237)	−0.05 (−0.26, 0.15); P=0.62 (n=118)	ref (n=622)	0.07 (−0.08, 0.23); P=0.33 (n=355)
Media—belief that *"you can trust food and beverage advertisements"*	ref (n=355)	0.16 (−0.11, 0.43); P=0.24 (n=66)	0.39 (0.17, 0.60); P<0.001 (n=201)	0.40 (0.22, 0.58); P<0.001 (n=235)	0.09 (−0.10, 0.28); P=0.35 (n=118)	ref (n=619)	0.19 (0.03, 0.35); P=0.02 (n=356)

Acronyms: KAN—knowledge, attitudes, and norms, FRPM—Free and reduced price meal, ref—reference group.

[a] Estimates are linear regression models with robust standard errors, including the following independent variables: school, grade level, gender, race/ethnicity, and FRPM eligibility. Statistical significance is indicated by P-value<0.05.

[b] Non-Hispanic

[c] 1=Has no effect on health, 2=Is a little unhealthy, 3=Is very unhealthy, 4=Is extremely unhealthy

[d] 1=Strongly Disagree, 2=Sort of Disagree, 3=Neither, 4=Sort of Agree, 5=Strongly Agree