

Letters

RESEARCH LETTER

Association of Caloric Intake From Sugar-Sweetened Beverages With Water Intake Among US Children and Young Adults in the 2011-2016 National Health and Nutrition Examination Survey

Sugar-sweetened beverages (SSBs) add empty calories to children's diets¹ and may increase the risk of weight gain, obesity, and diabetes.² Substituting water for SSBs may reduce total energy intake.³ Furthermore, school-based interventions to displace SSBs by increasing water access were associated with decreased body mass index.⁴ However, how water consumption in daily life is associated with

children's caloric intake from SSBs is unclear. We examined whether the number of calories and percentage of total energy intake from SSBs differs among US children by water intake status on a given day.

Methods | The National Health and Nutrition Examination Survey (NHANES) uses a complex, multistage probability design to obtain representative samples of the noninstitutionalized civilian US population. This analysis used data from the 2011 to 2016 NHANES cross-sectional survey waves. Response rates ranged from 77.0% (2011-2012) to 64.6% (2015-2016). NHANES is approved by the research ethics review board of the National Center for Health Statistics. Parents provided written in-

Table. Sample Size and Descriptive Characteristics of SSB Intake on a Given Day Overall and by Water Intake Status^a

Participant Group	Overall		Any Water Intake				No Water Intake			
	No. of Participants ^c	SSB, Mean (SE) ^b		No. of Participants ^c	SSB, Mean (SE) ^b		No. of Participants ^c	SSB, Mean (SE) ^b		
		kcal	TEI, %		kcal	TEI, %		kcal	TEI, %	
All	8400	132.1 (3.9)	6.8 (0.21)	6561	112.3 (3.9)	5.8 (0.21)	1839	210.2 (8.4)	10.6 (0.33)	
Male	4234	148.7 (5.1)	6.9 (0.2)	3278	124.1 (5.2)	5.8 (0.2)	956	236.9 (13.0)	10.9 (0.5)	
Female	4166	114.8 (4.5)	6.7 (0.3)	3283	100.4 (4.7)	5.9 (0.3)	883	177.5 (8.4)	10.2 (0.4)	
Aged 2-5 y	2025	56.2 (3.7)	3.7 (0.2)	1602	46.4 (3.5)	3.1 (0.2)	423	92.8 (10.3)	6.0 (0.5)	
Non-Hispanic white	527	47.0 (4.6)	3.2 (0.3)	421	37.6 (5.2)	2.6 (0.4)	106	84.8 (16.6)	5.5 (1.0)	
Non-Hispanic black	510	85.3 (6.9)	5.4 (0.3)	380	73.3 (5.0)	4.7 (0.4)	130	121.5 (22.5)	7.3 (0.8)	
Non-Hispanic Asian	183	24.0 (6.0)	1.6 (0.4)	168	23.3 (5.9)	1.5 (0.3)	15	32.7 (19.8)	2.2 (1.4)	
Hispanic	652	67.0 (5.6)	4.3 (0.3)	520	56.4 (4.6)	3.7 (0.3)	132	104.9 (16.3)	6.8 (1.0)	
Aged 6-11 y	3044	112.9 (3.9)	5.9 (0.2)	2394	95.4 (4.0)	5.0 (0.2)	650	183.3 (10.3)	9.7 (0.6)	
Non-Hispanic white	843	111.7 (6.3)	5.8 (0.3)	673	91.8 (5.5)	4.7 (0.3)	170	202.3 (18.5)	11.0 (1.1)	
Non-Hispanic black	794	128.4 (6.6)	6.8 (0.3)	597	112.4 (6.1)	6.0 (0.3)	197	173.9 (14.4)	9.1 (0.7)	
Non-Hispanic Asian	232	52.3 (5.5)	2.8 (0.3)	204	45.3 (5.5)	2.5 (0.3)	28	113.7 (32.2)	6.1 (1.7)	
Hispanic	976	121.6 (7.4)	6.4 (0.3)	761	108.5 (7.8)	5.9 (0.4)	215	165.9 (16.1)	8.3 (0.6)	
Aged 12-19 y	3331	182.1 (5.8)	8.9 (0.3)	2565	155.4 (7.1)	7.7 (0.4)	766	288.4 (16.8)	13.5 (0.6)	
Non-Hispanic white	883	196.0 (11.0)	9.3 (0.6)	693	165.0 (11.7)	8.1 (0.6)	190	338.2 (29.4)	14.8 (1.2)	
Non-Hispanic black	845	197.5 (12.0)	10.0 (0.6)	586	160.5 (13.6)	8.4 (0.7)	259	284.5 (20.0)	13.7 (0.8)	
Non-Hispanic Asian	366	81.5 (10.2)	3.9 (0.5)	327	77.8 (10.9)	3.6 (0.4)	39	120.3 (26.2)	6.7 (1.7)	
Hispanic	1047	167.1 (8.8)	8.3 (0.4)	805	151.7 (9.6)	7.2 (0.4)	242	219.2 (16.3)	11.8 (0.8)	

Abbreviations: SSB, sugar-sweetened beverage; TEI, total energy intake. ^a

Includes US children and young adults aged 2 to 19 years from the 2011 through 2016 waves of the National Health and Nutrition Examination Survey. Participants of other race/ethnicity were included in analyses but were not shown separately.

^b Indicates weighted means and Taylor series linearized SEs.

^c Indicates unweighted sample size with valid dietary recall data and complete covariate data (652 children had missing family income to poverty ratio data; no differences were found in SSB intake among those with missing data).

^c Indicates weighted means and Taylor series linearized SEs.

formed consent, and children aged 7 to 17 years provided written assent.

An in-person 24-hour dietary recall was assessed using the automated multiple-pass method in the mobile examination center by trained interviewers with the assistance of caretakers for children 11 years or younger.⁵ A single 24-hour recall allowed estimates of population means and differences between groups⁶ on a given day. Methods to classify SSBs (sodas, fruit drinks, sports and energy drinks, sweetened coffees and teas, and other) followed those of previous analyses.⁷ Calories were summed to estimate total energy intake from SSBs and divided by total caloric intake to estimate the contribution of SSBs to daily total energy intake. Plain water was defined as tap or nonsweetened, noncarbonated bottled water. Children with water intake of more than 0 mL were categorized as drinking water; those with 0 mL, as not.

Linear regression models estimated associations between water intake status and the number of calories and percentage of total daily energy intake from SSBs across race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, or Hispanic) and age (2-5, 6-11, or 12-19 years; categorized based on NHANES sample selection) adjusted for sex and federal income to poverty ratio $\leq 130\%$, 131%-350%, or $>350\%$. Interactions between these covariates and water intake status were tested. Regressions were plotted using marginal standardization. Statistical significance was set at 2-sided $P < .05$. Dietary day 1 sample weights were used to adjust for day of week, oversampling, nonresponse, noncoverage, and loss of participants from being screened, to the interview, to the examination component. Survey analyses were conducted in Stata software, version 15.1 (StataCorp).

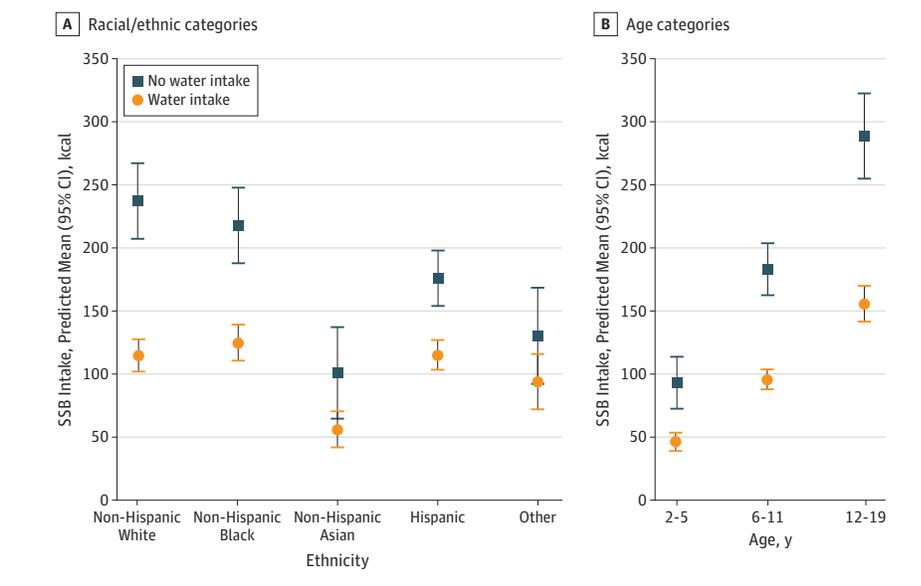
Results | Data from 8400 children and young adults (51.1% male [standard error (SE), 0.8%] and 48.9% female [SE, 0.8%]; mean [SE] age, 10.6 [0.1] years) with complete valid dietary and

covariate data were analyzed. Number of total kilocalories and percentage of total energy intake from SSBs varied by water intake status within all age and racial/ethnic groups (Table). On a given day, 79.7% (SE, 1.0%) of children reported drinking plain water. Adjusting for sociodemographic variables, no water intake was associated with intake of 92.9 kcal (SE, 8.3 kcal [$P < .001$]) and 4.5% (SE, 0.3% [$P < .001$]) more calories from SSBs among participants aged 2 to 19 years.

Interactions of water intake status with race/ethnicity and age, but not sex or federal income to poverty ratio, were statistically significant. Among non-Hispanic white (237.4 [SE, 14.8] vs 114.9 [SE, 6.3] kcal), non-Hispanic black (218.1 [SE, 15.5] vs 124.9 [SE, 7.2] kcal), and Hispanic (176.1 [SE, 10.8] vs 115.3 [SE, 5.9] kcal) children and among all age categories (2-5 years, 92.8 [SE, 10.3] vs 46.4 [SE, 3.5] kcal; 6-11 years, 183.3 [SE, 10.3] vs 95.4 [SE, 4.0] kcal; 12-19 years, 288.4 [SE, 16.8] vs 155.4 [SE, 7.1] kcal), caloric intake from SSBs was significantly higher if no water intake was reported (all $P < .001$) (Figure). The magnitude of these differences varied by group. For example, non-Hispanic white children consumed an additional 122.5 kcal from SSBs if they did not drink water, whereas Hispanic children consumed an additional 60.7 kcal from SSBs.

Discussion | From 2011 through 2016, one-fifth of US children and young adults reported no water intake on a given day; they consumed nearly twice the calories from SSBs as those with water intake, exceeding the recommended 10% of total calories from added sugar.¹ Although water and SSB intake were assessed for the same 24-hour period, NHANES is cross-sectional and therefore results cannot infer causality. In addition, although we assessed water intake from tap and bottled sources, NHANES does not collect data on perception of water safety or trust, which may affect the propensity to drink SSBs and plain water. Increasing access to safe, free

Figure. Sugar-Sweetened Beverage (SSB) Intake by Water Intake Status on a Given Day Among Respondents



water is critical for childhood health, because daily water intake may help reduce SSB consumption and curb childhood obesity.⁴ Our study demonstrates that US children and young adults should drink water every day to help avoid excess caloric and sugar intake.

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Concept and design: Rosinger.

Acquisition, analysis, or interpretation of data: All authors.

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