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Characterizing Sugar-Sweetened Beverage Consumption for US Children and Adolescents by Race/Ethnicity

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Abstract

Objectives: To examine racial/ethnic differences in type of SSB most frequently consumed and in correlates of youth sugar-sweetened beverage (SSB) intake.

Methods: Data were obtained from the National Health and Nutrition Examination Survey (NHANES), 2011–2016, for children and adolescents aged 5–17 years (n=6,507). The main outcome was SSB consumption (i.e., sodas, sweetened fruit drinks, nectars, sports and energy drinks, sweetened coffees and teas, enhanced waters). Mean and proportions of SSB intake were estimated accounting for complex sampling strategy and weighting. Multivariable regression models were developed for each race/ethnicity and age group.

Results: Two-thirds of children and adolescents reported consuming SSB on a given day. Among consumers, mean SSB consumption was greatest for Black children and White adolescents and lowest for Asian American children and adolescents. The most popular type of SSB consumed was sweetened fruit drinks among children and soda among adolescents, except among White and Mexican American children for whom soda and Black adolescents for whom sweetened fruit drinks were most popular. Female sex and water intake were negatively associated with SSB consumption across most races/ethnicities. Screen time, dentist visits, nativity, and guardian education were associated with SSB intake among a subset of races/ethnicities.

Conclusions: Associations between covariates and SSB intake as well as types of beverages preferred vary by race/ethnicity, as such chronic disease policies should not be ‘one size fits all’. Targeted interventions for specific groups of vulnerable youths hold promise for further reducing SSB consumption, including directing efforts towards reducing sweetened fruit drinks for Black children.

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Keywords

dietary behaviors; racial disparities; children; adolescents

INTRODUCTION

Youth consumption of sugar-sweetened beverages (SSB) in the United States remains a major public health challenge, as SSB are among the leading sources of added sugars and calories in children's diets.[1] Sugary drinks are associated with adverse health outcomes, including high blood pressure, increased waist-circumference, and overweight/obesity, [2–8] as well as long-term cardiometabolic and dental caries risk. [3, 9] Promisingly, SSB intake among adolescents and children has decreased over the past 2 decades, [10] likely due to the introduction of school-based policies[11–13] and intensified messaging around the health effects of SSB.[14–18] A systematic review of school food environment changes found that product-specific restrictions and standards on nutrients, calories, or portion sizes led to a 0.18 servings/day decrease in habitual intake.[13]

Previously, factors at multiple levels have been identified as determinants of consumption. Demographic characteristics, such as sex,[19] income,[20] and age,[21, 22] as well as parental factors, such as education,[20] have been studied. Health conditions and behaviors have also been associated with consumption, with higher consumption among those with poor oral health,[19, 23] higher BMIs,[24] and increased sedentary behavior.[25] Nativity has also been found to influence SSB consumption.[26, 27]

Despite overall reductions, racial/ethnic disparities persist in SSB consumption, with non-Hispanic Blacks consuming the most, and Asian Americans consuming the least,[20, 28, 29] though consumption patterns may differ in community-based or non-English-speaking samples. Yet, limited research has been conducted on the determinants of SSB consumption and preferred types of SSB *within* racial/ethnic minority groups, due to small sample sizes, lack of Asian American inclusion, or failure to stratify by race/ethnicity.[19, 28, 30–35] To our knowledge, only one paper has previously examined consumption patterns and associations by race/ethnicity among a sample of low-income youth from a single state.[19]

This study builds on prior research that has identified individual-level associations for children and adolescents of all racial/ethnic groups, and determine whether these associations exist within specific racial/ethnic groups.[19, 20] Further, it addresses gaps in the literature by using a US nationally representative sample to: 1) describe SSB consumption patterns by racial/ethnic subgroups among children and adolescents; and 2) determine the most popular types of SSB across race/ethnicities and 3) examine relationships between selected sociodemographic and behavioral characteristics and SSB intake by race/ethnicity subgroup.

PATIENTS AND METHODS

Study Design and Population

The National Health and Nutrition Examination Survey (NHANES) includes a series of 2-year health and nutrition surveys conducted by the National Center for Health Statistics (NCHS). NHANES is a stratified, multistage probability sample of the civilian noninstitutionalized population in the US. The technical details of the survey, including its content and operations, are publicly available (<https://www.cdc.gov/nchs/nhanes/index.htm>). All participants provided written informed consent and the data collection procedures were approved by the NCHS Institutional / Ethics Review Board to ensure human subject protection and confidentiality.

For the present study, data from 2011–2016 were used, as Asian Americans were oversampled during this time period. Participants were included in the analyses if they were 5–17 years of age and had one reliable, complete 24-hour recall dietary interview.

Measures

Sociodemographic Characteristics and Covariates of Interest—Covariates of interest were determined based on a review of the extant literature that identified factors associated with SSB consumption at the individual and parental levels.

Sociodemographic characteristics were self-reported and collected through in-home interviews, including age, race/ethnicity [(Mexican American, other Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian American, and non-Hispanic other (hereafter White, Black, Asian American, and other)], sex, poverty index ratio (< 130%, 130–185%, > 185%), health insurance, last dental visit (within the past year, more than a year ago, never) and nativity (US- or foreign-born). To determine screen-time, responses to the following questions were used: “Over the past 30 days, on average how many hours per day did you sit and watch TV or videos?” and “Over the past 30 days, on average how many hours per day did you use a computer or play computer games outside of school?” Consistent with previous research,[36–38] responses were categorized into more or less than 2 hours a day for television and videos, and more or less than 1 hour a day for computer use. The following information on the household reference person (hereafter, guardian) was also of interest: nativity and education level (less than high school education, high school graduate or GED, some college or associates degree, college graduate).

Body mass index (BMI) was calculated using height and weight measurements from the physical examination. BMI-for-age growth charts were used to categorize the participants as underweight (<5th percentile), normal weight (5th-84th percentile), overweight (85th-94th percentile), or obese (> 95th percentile).

As we combined three waves of NHANES data, we also assessed a variable to represent the years during which the data were collected, corresponding to 2011–2012, 2013–2014, and 2015–2016.

Dietary Intake—Water and SSB consumption were estimated using the first day of dietary recall, collected during an in person interview where all food/beverage items that each participant consumed during the prior 24-hour period were recorded. Individual food and beverage items were linked with What We Eat in America (WWEIA) categories, which are released every 2 years to coincide with the release of NHANES data, to classify beverages. [39] To account for changes in the classification scheme over time, the coding of categories in the 2011–2012 and 2013–2014 waves were aligned with the most recently available 2015–2016 wave. The United States Department of Agriculture (USDA) Food Patterns Equivalents Database (FPED), which translates food and beverage items into the 37 USDA Food Patterns components, was used to obtain the values of added sugars for reported beverages.[40]

Bottled and tap water were aggregated to represent total water consumption, and dichotomized into greater or less than one serving (250 grams) per day.[41] SSB was defined as regular soda, sweetened bottled waters, sweetened fruit drinks, sports and energy drinks, sweetened coffees and teas, smoothies and grain drinks, and nutritional beverages. When investigating most common type of SSB consumed, smoothies and grain drinks, nutritional beverages, and sweetened bottled waters were aggregated into other SSB. For estimation of mean intake and the linear regression analyses, total SSB consumed per day was reported in grams; amounts also presented in approximate ounces by dividing the gram amount by 28.35.

Statistical Analyses—All analyses were stratified by race/ethnicity and age (children = 5–11 years; adolescents = 12–17 years). Means (M) and standard error (SE) for SSB consumption per day were estimated. Population proportions of SSB consumed by type and race/ethnicity were calculated by summing the grams consumed within each type for all participants within each racial/ethnic group and dividing the sum by the total grams of SSB consumed for all persons within that racial/ethnic group, multiplied by 100%. Frequencies of sociodemographic, behavioral, and guardian characteristics of youths were calculated and compared across racial/ethnic subgroups using the design-based F statistic, which accounts for sample weighting. Factors of interest were examined for missing data and collinearity. Variables with 5% or more missing values were not included in the study, including language spoken at home and fast food consumption. A variance inflation factor (VIF) of 5 was used as the cutoff to determine collinearity, and all variables in the final model had a VIF<5.

A two-step analysis was conducted to examine the relationships between the dependent variable, SSB consumption, and the factors of interest. First, to measure factors associated with consumption on a given day, a binary variable of any vs. none was used in multivariable logistic regression models. Next, to measure factors associated with varying amounts of SSB consumption among consumers, a continuous variable was used in multivariable linear regression models. Place of birth for child and guardian were not included in the models for Whites, Blacks, and Other races/ethnicities, due to the high proportions of youths who were US-born (95–98%). Regression coefficients (β s) representing differences in intake and corresponding 95% confidence intervals (CIs) were obtained.

Separate linear regression models were used to determine whether there was a change in mean SSB consumption among consumers or in the proportion of SSB consumers across the three waves. The binary outcome of non-consumers vs. consumers was scaled to 0 and 100 when assessing the changes in percent of consumers. Annual absolute change and corresponding p-values are presented. The trend in mean consumption for the Other racial/ethnic group should be interpreted with caution due to small sample sizes when disaggregated by year.

All analyses accounted for the complex sampling design and weighting. Three cycles of data (2011–2012, 2013–2014, 2015–2016) were combined. A 6-year dietary weight was generated using one-third of the 1-day dietary weight for each 2-year cycle. Analyses were conducted using svy commands in Stata, version 15 (StataCorp LLC, College Station, TX) and SAS-callable SUDAAN version 11. Data are not presented for the Other racial/ethnic group

A sensitivity analysis was conducted using 2 alternative definitions of SSB consumption to estimate intake. One definition was broader (i.e., regular soda, sweetened bottled waters, sweetened fruit juices and nectars, sports and energy drinks, sweetened coffees and teas, and flavored milk) and the other was narrower (i.e., regular soda, sweetened fruit juices and nectars, sports and energy drinks)[42] than the SSB definition used in the main analyses.

RESULTS

The study population characteristics for children and adolescents, respectively, are presented in Table 1.

In total, 6,507 individuals included in the sample: 3,697 children, ages 5–11 years, and 2,810 adolescents, ages 12–17 years. Overall, the vast majority of participants (96% children; 93% adolescents) and their guardians (78% children and adolescents) were US-born. Over one third of children (34%) and adolescents (37%) were overweight or obese, and most had health insurance (94% children, 92% adolescents). Asian American children were less likely to be US-born (77%) than Mexican American (94%), other Hispanic (92%), White (99%), Black (98%), and Other (96%). Among adolescents, Asian American (65%), Mexican American (81%), and other Hispanic (79%) participants were less likely to be US-born compared to White (99%), Black (97%), and Other (98%). Overweight and obesity were especially prevalent among Mexican Americans (47% children and adolescents), other Hispanics (42% children and adolescents), Blacks (35% children, 43% adolescents) and Others (37% children, 53% adolescents). Almost two-thirds of children (62%) and adolescents (61%) reported consuming any SSB on a given day.

SSB Intake among Consumers

Among children who reported consuming any SSB on a given day, mean consumption was 419.93 grams (approximately 15 ounces, SE=11.28). Results by racial/ethnic subgroup were that SSB intake was greatest among Black (M=444.63 grams [approximately 16 ounces], SE=19.03) and Other (M=455.95 grams [approximately 16 ounces], SE=45.53) children.

Asian American youths consumed the least amount of SSB (M=297.17 grams [approximately 10 ounces]; SE=19.03) (Table 2).

Among adolescents, mean consumption was 600.73 grams [(approximately 21 ounces), SE=18.82]. White [M=647.31 (approximately 23 ounces); SE=33.75] and Other [M=612.38 (approximately 22 ounces); SE=69.71] adolescents consumed the greatest amount of SSB whereas Asian Americans consumed the least [M=381.67 (approximately 13 ounces), SE=26.46] (Table 2).

The greatest source of SSB intake for children of most races/ethnicities was sweetened fruit drinks, except for Mexican Americans and White youths, for whom soft drinks were the greatest source (Figure 1a). For Black children, sweetened fruit drinks comprised over half (58%) of total SSB consumption. Similarly, Black adolescents consumed more sweetened fruit drinks than any other type of SSB. In contrast, for adolescents of all other race/ethnicities, the greatest source of SSB intake was soft drinks (Figure 1b).

Factors Associated with Any SSB Consumption

Tables 3, 4, 5, and 6 present the multivariable logistic regression results of factors associated with SSB intake on a given day among children and adolescents by race/ethnicity.

Among children (Tables 3 and 4), water consumption was associated with lower odds of SSB consumption among Mexican American (aOR 0.47; 95% CI 0.30, 0.73), White (aOR 0.59; 95% CI 0.38, 0.91), and Black (aOR 0.44; 95% CI 0.32, 0.62) children. Asian American (aOR 4.05; 95% CI 1.01, 16.21) and Other (aOR 4.05; 95% CI 1.08, 5.32) children who lived in households above 185% of the poverty line had increased odds of consuming any SSB on a given day. For Mexican American and White children, older children (Mexican American - aOR 1.10; 95% CI 1.01, 1.20; White - aOR 0.71; 95% CI 0.51, 0.97) and males (Mexican American - aOR 0.70; 95% CI 0.49, 0.99; White - aOR 0.71; 95% CI 0.51, 0.97) had increased likelihood of SSB consumption. Increased screen time was associated with greater likelihood of SSB consumption among Mexican American (aOR 1.85; 95% CI 1.14, 3.00) and other Hispanic (aOR 2.95; 95% CI 1.43, 6.10) children.

Among adolescents (Tables 5 and 6), water consumption was associated with decreased odds of consuming SSB for most race/ethnicities: Asian American (aOR 0.43; 95% CI 0.20, 0.93), Mexican American (aOR 0.39; 95% CI 0.22, 0.69), other Hispanic (aOR 0.38; 95% CI 0.17, 0.82), White (aOR 0.59; 95% CI 0.37, 0.93), and Black (aOR 0.57; 95% CI 0.39, 0.81) adolescents. Asian American adolescents who lived in households above 185% of the poverty line (aOR 4.05; 95% CI 1.01, 16.21) and had never had a dental visit (aOR 25.62; 95% CI 1.20, 545.36) were more likely to consume SSB. Among Mexican American adolescents, the more education their guardian had the less likely adolescents were to consume SSB (some college: aOR 0.36; 95% CI 0.18, 0.72; college graduate: aOR 0.29; 95% CI 0.09, 0.94), whereas the more screen time they had, the more likely they were to consume SSB (aOR 1.75; 1.07, 2.99). Obesity was associated with increased odds of consuming SSB among White adolescents (aOR 1.86; 95% CI 1.03, 3.38), and females were less likely to consume SSB among Black adolescents (aOR 0.60; 95% CI 0.43, 0.83).

Sample Restricted to SSB Drinkers

Tables 7, 8, 9, and 10 present multivariable linear regression results of factors associated with SSB consumption among children and adolescents who consumed SSB on a given day.

Among children (Tables 7 and 8), Asian American (−84.77 grams; 95% CI −160.52, −9.03) and Mexican American (−103.15 grams; 95% CI −165.50, −40.79) females consumed less SSB than males on a given day. Older Mexican American (21.42 grams; 95% CI 6.69, 36.14), White (26.60 grams; 95% CI 16.53, 36.68), Black (11.57 grams; 95% CI 44.83), and Other (46.99 grams; 95% CI 18.33, 75.65) children consumed more SSB. Children who consumed at least one serving of water consumed less SSB among Asian Americans (−115.86 grams; 95% CI −182.24, −49.49), Whites (−115.04; 95% CI −174.56, −55.53), and Other races/ethnicities (−219.11 grams; 95% CI −329.95, −108.27). Among Mexican Americans (105.25 grams; 95% CI 33.02, 177.47) and Blacks (80.63 grams; 95% CI 18.72, 142.53), children who reported higher screen times consumed more SSB. Mexican American foreign-born children (152.94 grams; 95% CI 17.02, 288.86) consumed more SSB. Children who had a guardian who was foreign-born consumed more SSB (−110.19 grams; 95% CI −187.98, −32.41) among Mexican Americans (110.19 grams; 95% CI −187.98, −32.41) and other Hispanics (−160.46 grams; 95% CI −244.92, −76.00). Overweight White (−119.46 grams; 95% CI −166.68, −72.23) and Other (130.08 grams; 95% CI 13.56, 246.59) children consumed more SSB than normal weight children. Visiting the dentist more than a year ago compared to within the past year was associated with consuming more SSB among Other children (216.52 grams; 95% CI 4.12, 428.92).

Among adolescents (Tables 9 and 10), females consumed less SSB on a given day among Asian American (−118.27 grams; 95% CI −225.46, −11.08), White (−194.73 grams; 95% CI −315.67, −73.79), and Other (−194.83 grams; 95% CI −362.95, −26.71) adolescents. Among Asian Americans, adolescents who reported never visiting the dentist compared within the past year consumed less SSB (−151.54 grams; 95% CI −268.24, −34.85), whereas those who had a guardian who was foreign-born consumed more SSB (203.85 grams; 95% CI 132.25, 275.45). Adolescents who reported higher screen times consumed more SSB among Asian Americans (72.39 grams; 95% CI 4.18, 140.59) and other Hispanics (72.39 grams; 95% CI 4.18, 140.59), but less among Whites (−145.07 grams; 95% CI −247.99, −42.19). Mexican American (−99.36; 95% CI −192.45, −6.26) and Black (−138.95; 95% CI −221.80, −56.11) adolescents who consumed at least one serving of water consumed less SSB. Among White (60.52 grams; 95% CI 24.35, 96.70), other Hispanic (42.96 grams; 95% CI 9.33, 76.60), and Other (61.23 grams; 95% CI 5.90, 116.56) adolescents, older adolescents consumed more SSB. Overweight adolescents consumed less SSB than normal weight adolescents among Whites only (−137.92 grams; 95% CI −255.99, −19.84).

Trend in SSB Consumption

Over the three two-year cycles, overall, there was a significant decrease in the percent of children (Annual Absolute Change [AAC] −0.04; $p=0.021$) and adolescents (AAC −0.05; $p=0.003$) consuming any SSB on a given day (Figures 2a–b). Among children, this decline appeared to be driven by decreases in consumption among Mexican American children (AAC −0.07; $p=0.015$), given that the percent of SSB consumers did not significantly

change over time for children or adolescents of other racial/ethnic groups. Among adolescents, this decline appeared to be driven by decreases in the percentage of White (AAC -0.07 ; $p=0.030$) and Other (AAC -0.15 ; $p=0.017$) adolescents consuming SSB. (Supplemental Table 1) There was a significant decrease in mean consumption over time among adolescents (AAC -59.22 ; $p=0.017$) but not among children (Figures 2c–d). There were significant declines in mean SSB consumption for Other Hispanic (AAC -82.42 ; $p=0.022$) and White adolescents (AAC -96.53 ; $p=0.001$), and Black children (AAC -32.20 ; $p=0.012$), but no significant trends for any other racial/ethnic group. (Supplemental Table 2)

Sensitivity Analyses

Modifying the definition of SSB resulted in differences in estimated intakes. Among children, average SSB consumption increased from 419.93 grams (approximately 15 ounces; $SE=11.28$) to 517.17 grams (approximately 18 ounces; $SE=13.87$) using the broader definition; using the narrower definition, intake decreased to 404.76 grams (approximately 14 ounces; $SD=11.13$). Among adolescents, average SSB consumption increased from 600.73 grams (approximately 21 ounces; $SE=18.82$) to 691.01 grams (approximately 24 ounces; $SE=21.32$) using the broader definition; using the narrower definition, intake decreased to 575.15 grams (approximately 20 ounces; $SE=18.04$). Across all 3 definitions, SSB consumption remained highest for Black children and lowest for Asian American children; similarly, SSB consumption remained highest among White adolescents and lowest among Asian American adolescents (Supplemental Table 3).

DISCUSSION

This study investigated differences in factors associated with and types of youth SSB consumption by race/ethnicity in a US national sample of children and adolescents. Findings were that almost two-thirds of children and adolescents reported any SSB consumption on a given day. Among those reporting SSB consumption, children and adolescents consumed more than a serving of SSB per day and consumption was lowest among Asian Americans. Consumption of SSB was highest among Black and Other children and White and Other adolescents. Sweetened fruit drinks were the most popular source of SSB intake for most children, whereas soft drinks were the most common type of SSB consumed for most adolescents. Age was positively associated and female sex and water intake were negatively associated with SSB consumption across most races/ethnicities, whereas associations of other potential determinants and SSB consumption were only found in certain racial/ethnic subgroups.

The finding that Asian American youths had the lowest consumption of SSB, regardless of how SSB was defined, is consistent with previous studies.[20, 43] A limitation is that current dietary recall methods may not accurately capture SSB intake in Asian Americans, as they fail to explicitly record culturally relevant beverages, such as boba and aloe drinks.[44] Such beverages ought to be included in future nutritional surveys that include Asian Americans. More research is also needed to investigate how acculturation and dietary norms affect youth SSB consumption.

A systematic review of the literature on youth beverage consumption in the United States found that only 4% of published articles included Asian or Asian American children.[45] Even as recent NHANES surveys oversample Asian American participants, they tend to have higher education, English proficiency, and income levels than Asian Americans sampled at the community level.[46–48] Thus, the SSB consumption patterns reported here may only represent more acculturated and higher socioeconomic status Asian American youths. Moreover, Asian Americans are a heterogeneous population.[43, 48, 49] Future studies ought to examine differences within the Asian American population using innovative data collection methods to reach diverse communities and subgroups of Asian Americans (e.g., Asian Indian, Chinese, Filipino).

Previous studies have examined determinants of SSB consumption among youths and concluded that factors at multiple levels are important, including child, parent, and environmental characteristics.[28, 30–35] Only one previous study assessed such associations by race/ethnicity, for Hispanics, Whites, Blacks, and Other races/ethnicities. [19] Findings were that screen time had a moderate effect on SSB consumption among Hispanic children, and that youths of parents of Black and Hispanic children with at least a college education had less frequent youth SSB consumption than youths of parents with less education.

Screen time was associated with SSB intake among Hispanic children and adolescents and Asian American adolescents; guardian education level was statistically significantly associated with SSB intake among Mexican American adolescents. This is interesting, given the limited autonomy younger children, especially, have on their screen time and diets, and the considerable influence of their caretakers on these behaviors. Intergenerational influences, including caregivers' attributes, attitudes, and knowledge, may be viewed as intermediary mechanisms through which societal and community influences affect children's health behaviors.[49]

Other studies have investigated the types of SSB consumed among youths,[20, 22, 29, 31, 50] but only one previous study stratified results by race/ethnicity.[31] The present study assessed a wider variety of SSB types, including sweetened coffee and tea, fruit drinks, nutritional beverages, smoothies and grain drinks, and sweetened water, in addition to soda, sports and energy drinks, and included Asian Americans in the sample. Differences emerged by age group and race. While regular soda was the most commonly consumed SSB type among adolescents of most racial/ethnic subgroups, sweetened fruit drinks were the most commonly consumed SSB type among Black adolescents. Conversely, sweetened fruit drinks were the most commonly consumed SSB type among most children, whereas soft drinks were most popular among Mexican American and White children. Sweetened fruit drinks appear to be particularly relevant in the diets of Black youth, whereas soft drinks are more important for White and Hispanic youth. Future research should investigate sociocultural reasons for differences in SSB type preferences and how best to decrease fruit drink consumption while preventing its replacement with other types of SSB.

Prior studies have described promoting plain water to replace SSB thereby reducing energy intake, weight gain, and chronic disease risk.[51–53] A modeling study predicted that

replacing SSB with water could significantly reduce the prevalence of obesity.[54] Yet, the relationship between promotion of water and replacement of SSB is unclear. Youths who were exposed to a combined school- and community-based social marketing campaign for water promotion had lower average SSB consumption.[55] Yet, youths attending a school in which environmental changes were made to support water consumption reduced SSB consumption, but did not replace SSB with water.[56] In the multivariable analyses, drinking at least one serving of water was associated with decreased SSB consumption for the majority of racial/ethnic subgroups in both age groups. Hence, encouraging water consumption may decrease SSB intake; more research is needed to determine the mechanism whereby this occurs.

Finally, the decreasing trend in percent of consumers among Mexican American children and White and Other adolescents has both positive and negative implications. While this finding points to the success of increased messaging, education and, therefore, awareness with regards to the harms of sugary drink consumption, it also provides support for the notion that health messaging or policies are not ‘one size fits all’[57] as has been demonstrated with other chronic disease related behaviors.[58] Bearing in mind the potential for these policies to widen disparities between population subgroups is also critical.[59]

This is the first US national study to assess determinants of SSB intake by racial/ethnic subgroup. A strength is the inclusion of Asian Americans and Other Hispanics as separate categories. Presenting data in their most disaggregated form can help in identifying disparities to target, thereby promoting health equity. Another strength is the continuous measure of SSB consumption used, as recorded through a reliable and complete 24-hour dietary recall. This facilitated the identification of factors that might influence SSB consumption, including factors with more modest effects. It also permitted the examination of various types of SSB and their contributions to overall consumption.

Important limitations also deserve mention beyond the need to include Asian American culturally relevant beverages, such as boba tea and aloe drinks, in future nutritional surveys that was previously discussed. Since NHANES is cross-sectional study, causality cannot be determined from the reported associations. Moreover, averaging 24-hour recalls may not represent usual consumption patterns, due to over-inflated zeros. Rather, the results here should be interpreted as intake on a given day. Dietary data may also be subject to under- or over-reporting. Finally, a parent, caregiver, or proxy of children reported food intake for children less than 6 years of age, and the accuracy of these reports is unknown.

Conclusion

SSB consumption among children and adolescents is a risk factor for general health conditions such as obesity and oral health conditions such as dental caries. While determinants of youth SSB intake vary by race/ethnicity, water consumption was associated with decreased SSB intake and screen time was associated with increased SSB intake for many groups, but the mechanisms through which this occurs remain unknown. Certain findings presented here may help target interventions to decrease SSB consumption among specific vulnerable groups. In particular, directing efforts towards reducing sweetened fruit

juice consumption among children and Black adolescents may foster increased water intake and decreased SSB intake.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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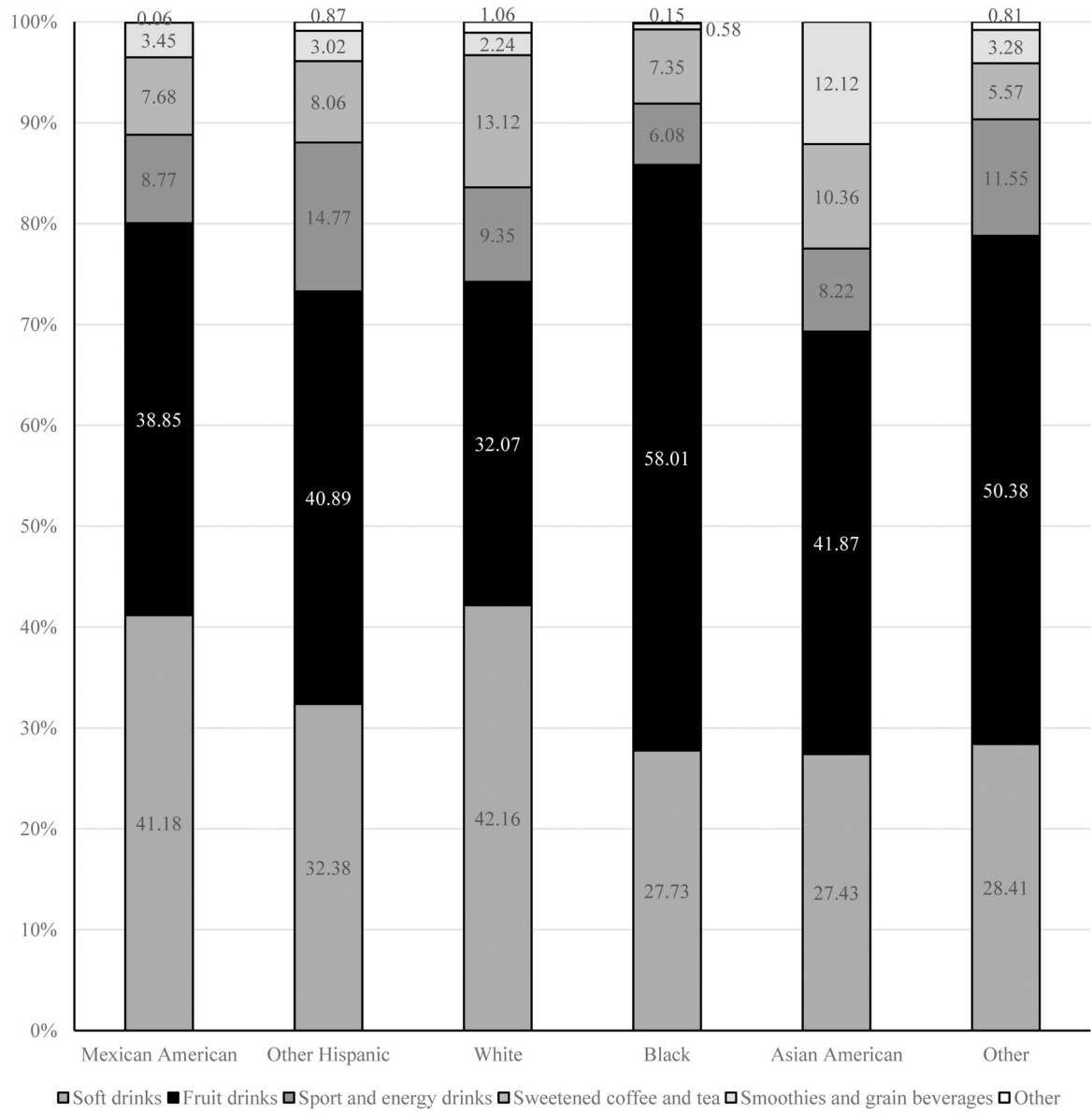
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a) Children, ages 5-11



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b) Adolescents, 12-17

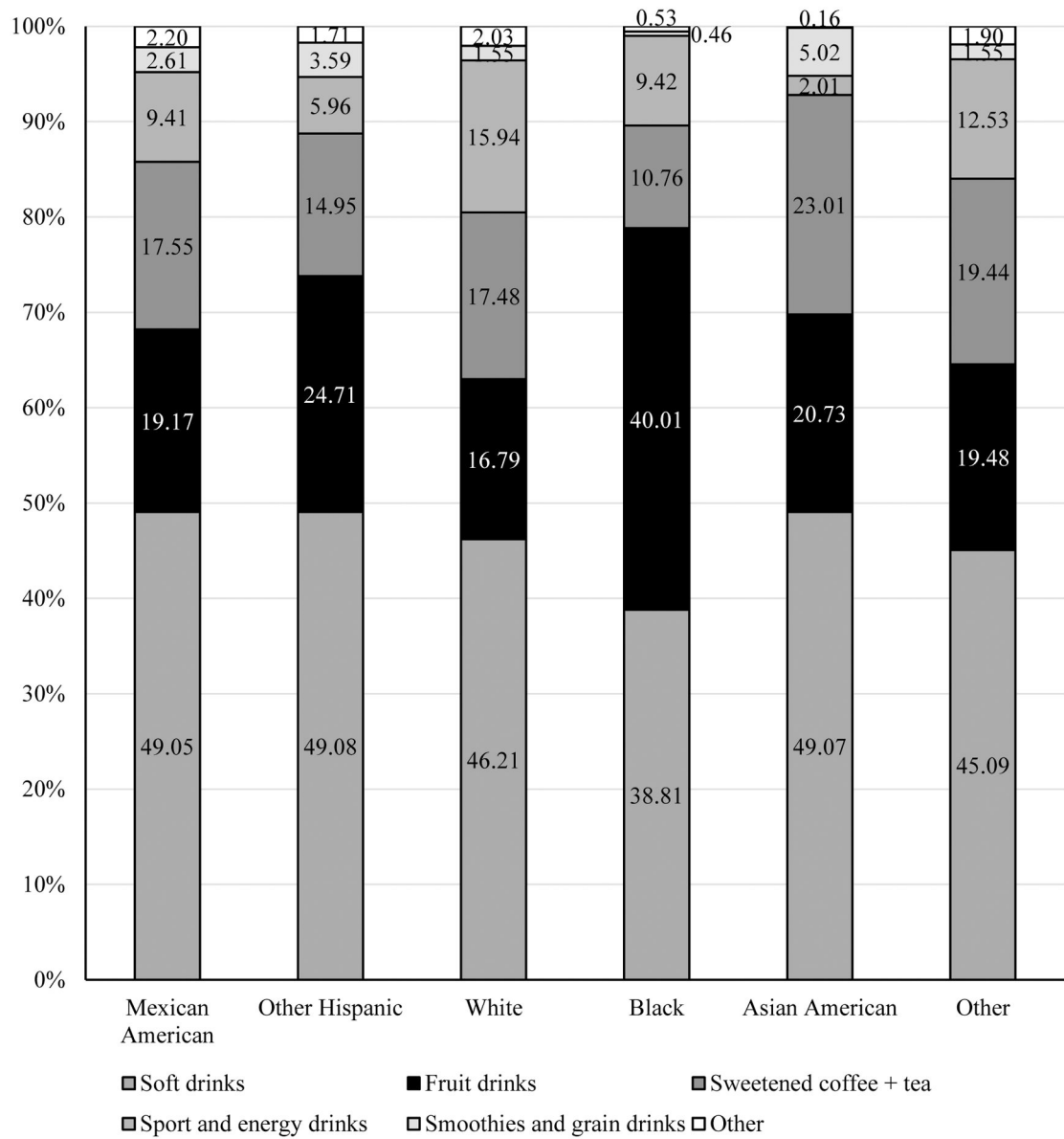


Figure 1.
 Proportion of SSB consumption by category and race/ethnicity, NHANES 2011–2016
 a) Children, ages 5–11
 b) Adolescents, ages 12–17

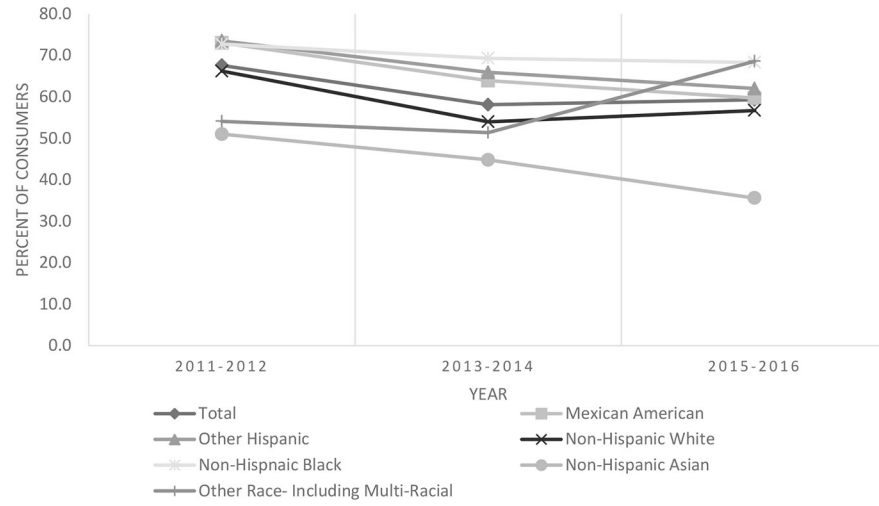
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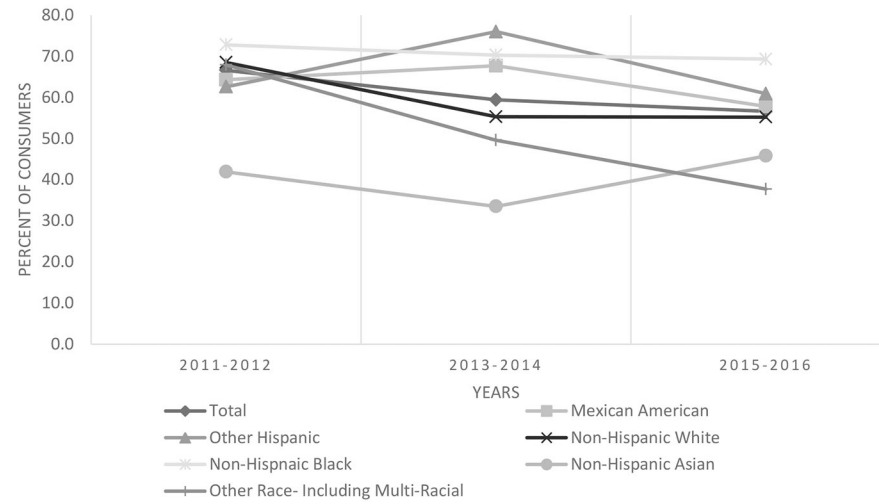
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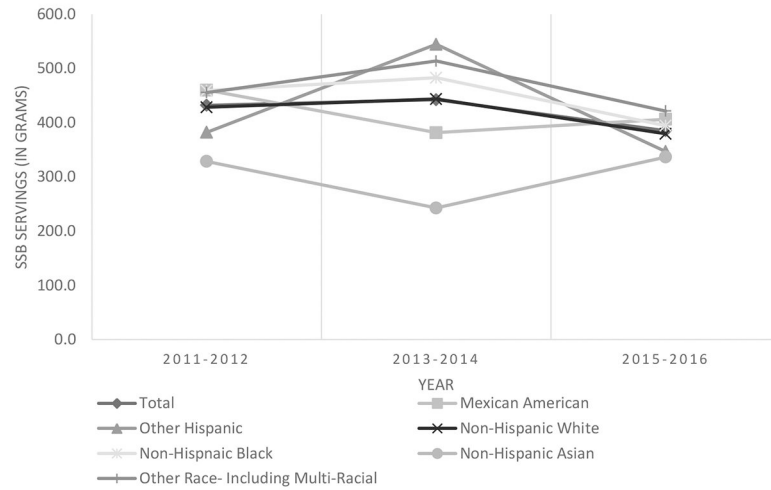
A) CHILDREN



B) ADOLESCENTS



C) CHILDREN



D) ADOLESCENTS

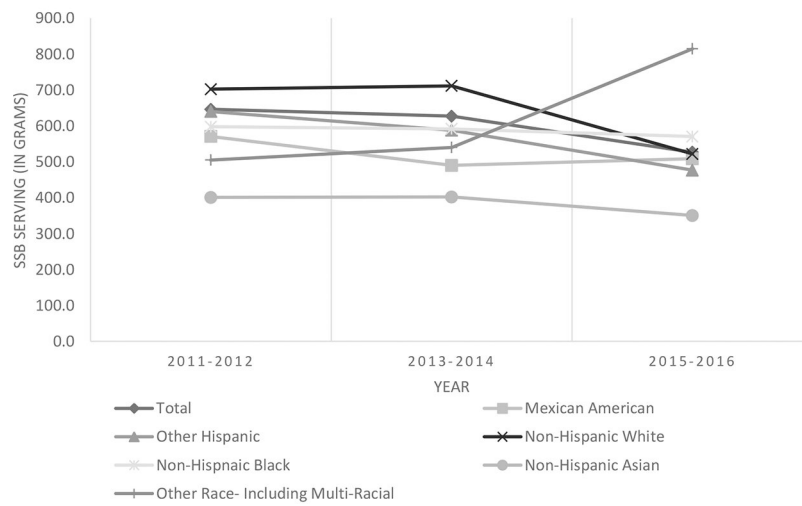


Figure 2.

Trend in SSB consumption among children and adolescents from 2011–2016.

- A) Percent of children, ages 5–11, consuming any SSB on a given day
- B) Percent of adolescents, s 12–17, consuming any SSB on a given day
- C) Mean SSB consumption on a given day among children, ages 5–11.
- D) Mean SSB consumption on a given day among adolescents, ages 12–17

Table 1.

Demographic characteristics of children ages 5–11 years, NHANES 2011–2016

	Mexican American	Other Hispanic	White	Black	Asian American	Other	p-value	Total
	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	SE	% (SE)
CHILDREN	N=802	N=431	N=977	N=949	N=293	N=245		N=3697
Male	48.71 (2.71)	56.92 (2.79)	54.18 (2.41)	51.44 (1.86)	54.08 (3.92)	45.94 (5.35)		52.70 (1.51)
BMI							0.000	
Normal	51.66 (1.74)	53.04 (3.11)	65.57 (2.01)	62.92 (2.27)	65.20 (3.59)	60.63 (4.98)		61.62 (1.25)
Overweight	19.48 (2.07)	21.07 (2.49)	14.7 (1.22)	15.41 (1.76)	15.06 (2.58)	18.47 (4.13)		16.32 (0.73)
Obese	27.03 (1.98)	21.32 (2.63)	14.51 (1.86)	19.58 (1.44)	12.28 (2.85)	18.52 (2.54)		17.94 (1.23)
Poverty ratio							0.000	
> 130% and < 185%	14.51 (1.69)	12.00 (2.27)	13.38 (2.10)	13.14 (1.31)	17.73 (5.00)	16.10 (4.13)		13.74 (1.26)
>= 185%	22.79 (2.61)	33.56 (3.30)	61.60 (3.44)	21.67 (2.37)	62.65 (6.23)	38.15 (5.34)		46.25 (2.61)
Child born in the US	93.50 (1.43)	92.19 (1.33)	99.14 (0.39)	97.83 (0.75)	77.91 (2.44)	96.4 (1.90)	0.000	96.39 (0.46)
Has health insurance	88.39 (1.96)	90.33 (1.72)	95.40 (1.07)	95.60 (0.80)	94.90 (2.25)	97.63 (0.83)	0.000	93.96 (0.79)
Guardian born in US	35.00 (3.56)	50.97 (4.39)	95.83 (1.56)	90.48 (2.92)	20.38 (4.46)	87.41 (3.10)	0.000	77.79 (2.02)
Guardian education							0.000	
Less than high school education	48.40 (3.05)	31.52 (4.08)	9.96 (1.70)	18.01 (1.91)	8.26 (2.30)	6.53 (2.25)		18.83 (1.71)
High school	21.10 (2.19)	20.96 (3.70)	17.13 (2.34)	26.92 (2.48)	13.88 (3.67)	29.60 (5.32)		19.98 (1.37)
Some college	22.46 (2.86)	28.66 (3.41)	32.43 (2.60)	41.18 (2.67)	16.27 (3.05)	27.16 (3.70)		30.76 (1.52)
College graduate or more	8.03 (1.78)	18.85 (3.48)	40.48 (2.96)	13.89 (1.80)	61.59 (4.49)	36.7 (6.12)		30.42 (2.33)
Consumed any SSB	65.43 (2.43)	66.94 (3.08)	59.07 (2.49)	70.08 (2.51)	44.20 (3.68)	59.07 (5.05)	0.000	61.66 (1.36)
ADOLESCENTS	N=598	N=309	N=721	N=708	N=323	N=151		N=2810
Male	51.78 (2.41)	49.68 (2.98)	48.10 (2.16)	51.39 (2.17)	46.69 (4.96)	51.72 (7.64)	0.765	49.32 (1.38)
BMI							0.000	
Normal	51.22 (2.84)	57.47 (3.89)	64.95 (1.98)	55.14 (2.87)	71.10 (3.63)	46.60 (5.93)		60.43 (1.59)
Overweight	20.09 (2.33)	18.18 (2.94)	14.62 (1.19)	19.03 (0.87)	12.36 (2.74)	16.69 (3.61)		16.32 (0.93)
Obese	26.51 (2.01)	23.42 (2.25)	17.68 (1.71)	23.86 (5.87)	12.50 (3.06)	36.05 (6.31)		20.87 (1.28)
Poverty ratio							0.000	
> 130% and < 185%	20.22 (2.67)	19.43 (4.12)	11.19 (1.59)	14.36 (2.87)	16.75 (3.25)	27.43 (9.86)		14.54 (1.36)

	Mexican American % (SE)	Other Hispanic % (SE)	White % (SE)	Black % (SE)	Asian American % (SE)	Other % (SE)	p-value SE	Total % (SE)
>= 185%	22.51 (3.75)	28.97 (4.22)	66.21 (3.44)	31.40 (5.87)	57.44 (4.96)	39.19 (7.36)		50.65 (2.82)
Child born in the US	81.43 (3.78)	78.66 (3.95)	98.78 (0.54)	96.71 (4.87)	65.55 (4.94)	97.65 (1.13)	0.000	92.56 (0.89)
Has health insurance	77.90 (3.50)	84.14 (3.33)	96.25 (0.87)	94.01 (9.87)	95.85 (1.46)	83.32 (6.49)	0.000	91.64 (0.98)
Guardian born in US	38.37 (4.16)	45.96 (5.62)	95.04 (1.20)	89.99 (3.87)	15.13 (2.47)	87.76 (3.18)	0.000	77.90 (1.56)
Guardian education							0.000	
Less than high school education	49.40 (3.78)	29.33 (3.55)	13.22 (2.00)	17.51 (4.87)	15.05 (2.82)	18.31 (5.57)		20.81 (1.66)
High school	23.82 (2.32)	27.79 (5.17)	19.96 (2.90)	29.73 (8.87)	13.42 (3.12)	15.25 (4.42)		22.01 (1.71)
Some college	19.09 (2.45)	25.99 (5.01)	34.74 (2.54)	35.91 (0.87)	20.65 (3.26)	36.54 (5.78)		31.29 (1.73)
College graduate or more	7.68 (1.94)	16.89 (3.85)	32.09 (2.73)	16.85 (6.87)	50.88 (4.08)	29.90 (5.99)		25.89 (1.94)
Consumed any SSB	62.99 (2.99)	65.97 (4.02)	59.59 (2.43)	70.76 (2.22)	40.52 (3.92)	49.70 (6.44)	0.000	60.77 (1.34)

Table 2. Mean sugar-sweetened beverage consumption among children (ages 5–11) and adolescents (ages 12–17) NHANES 2011–2016

	Total SSB		Soft drinks		Fruit drinks		Sports and energy drinks		Nutritional beverages		Enhanced water		Sweetened teas and coffee		Smoothies and grain beverages	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Children																
Mexican American	416.89	19.99	185.97	11.03	175.45	17.66	39.61	7.59	0.00	0.00	0.27	0.28	17.83	5.25	15.59	5.32
Other Hispanic	418.90	30.69	147.55	15.57	186.32	15.93	67.30	21.95	1.17	0.84	2.77	2.71	26.70	10.84	13.78	3.82
White	417.31	21.19	199.76	15.55	156.03	9.85	45.47	9.24	0.27	0.28	4.88	2.89	30.19	6.78	10.90	6.32
Black	444.63	14.62	133.10	11.61	278.42	15.85	29.16	6.75	0.41	0.31	0.74	0.61	22.28	5.45	2.80	1.38
Asian American	297.17	19.03	90.93	10.83	138.80	17.96	27.25	13.47	0.00	0.00	0.00	0.00	21.43	13.89	40.19	15.22
Other	455.95	45.53	137.17	25.10	243.25	36.81	55.76	23.05	0.00	0.00	3.90	2.96	14.94	6.58	15.86	4.44
Total	419.93	11.28	175.46	8.13	185.54	8.16	43.77	5.34	0.31	0.16	3.03	1.43	25.45	3.58	11.83	3.34
Adolescent																
Mexican American	522.21	25.89	310.68	20.92	121.41	14.66	59.63	10.79	1.45	1.19	12.48	11	45.45	14.05	16.55	4.78
Other Hispanic	565.19	29.9	326.14	30.23	164.21	29.21	39.58	9.99	0.34	0.34	11.04	8.45	42.38	12.19	23.88	6.85
White	647.31	33.75	359.96	30.88	132.9	20.65	126.12	23.84	4.23	3.59	11.84	3.35	72.61	14.67	12.25	4.85
Black	586.61	21.24	255.13	20.16	263	15.24	61.93	12.22	0.99	0.98	2.52	1.68	33.79	4.05	3.04	1.42
Asian American	381.67	26.46	243.25	31.97	102.75	19.51	9.99	4.46	0	0.00	0.8	0.61	57.13	21.44	24.89	7.91
Other	612.38	69.71	342.76	48.06	148.1	38.66	95.28	43.24	0	0.00	14.47	10.52	19.52	11.49	11.76	7.87
Total	600.73	18.82	327.86	17.25	154.42	10.97	92.88	13.65	2.64	1.94	10.08	2.66	57.07	8.46	12.85	2.71

Table 3.

Multivariable logistic regression models of factors associated with any sugar-sweetened beverage (SSB) intake among children, ages 5–11, by race/ethnicity, NHANES 2011–2016

	Asian American		Mexican-American		Other Hispanic	
	aOR [†]	95% CI	aOR	95% CI	aOR	95% CI
Age	1.22	[0.99,1.50]	1.10*	[1.01,1.20]	1.02	[0.88,1.18]
Gender	1.32	[0.66,2.66]	0.70*	[0.49,0.99]	1.09	[0.65,1.81]
Poverty ratio						
130%	REF		REF		REF	
>130% and <185%	2.96	[0.73,11.99]	0.57	[0.32,1.04]	0.89	[0.31,2.51]
185%	4.05*	[1.01,16.21]	0.57	[0.28,1.19]	1.29	[0.59,2.80]
BMI category						
Normal weight	REF		REF		REF	
Overweight	0.91	[0.34,2.38]	1.37	[0.90,2.09]	1.69	[0.74,3.91]
Obese	0.94	[0.27,3.23]	1.37	[0.82,2.30]	0.91	[0.40,2.08]
Drink >1 cup of water/day	0.93	[0.53,1.61]	0.47**	[0.30,0.73]	0.54	[0.27,1.07]
TV screen time >2 hours/day	1.88	[0.90,3.95]	1.85*	[1.14,3.00]	2.95**	[1.43,6.10]
Computer screen time >1 hour/day	0.78	[0.39,1.57]	0.64	[0.38,1.10]	0.97	[0.50,1.88]
Youth foreign-born	0.87	[0.29,2.56]	0.41	[0.14,1.16]	0.97	[0.35,2.67]
Health insurance	1.80	[0.23,14.08]	0.66	[0.30,1.46]	2.02	[0.66,6.22]
Last dental visit						
Within past year	REF		REF		REF	
More than a year ago	1.13	[0.32,3.93]	0.85	[0.45,1.59]	1.96	[0.77,5.00]
Never	2.21	[0.35,13.75]	0.48	[0.11,2.07]	1.41	[0.36,5.55]
Guardian education						
Less than high school	REF		REF		REF	
High school grad/GED or equivalent	0.82	[0.26,2.57]	0.92	[0.54,1.55]	0.91	[0.38,2.16]
Some college or AA degree	0.67	[0.11,4.14]	0.97	[0.55,1.74]	0.82	[0.37,1.85]
College graduate or above	0.47	[0.13,1.71]	2.50	[0.98,6.41]	0.75	[0.28,2.04]
Guardian foreign-born	0.45	[0.18,1.13]	1.15	[0.83,1.59]	1.32	[0.63,2.79]

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

Table 4.

Multivariable logistic regression models of factors associated with any sugar-sweetened beverage (SSB) intake among children, ages 5–11, by race/ethnicity, NHANES 2011–2016

	White		Black		Other	
	aOR ¹	95% CI	aOR ¹	95% CI	aOR ¹	95% CI
Age	1.11 *	[1.00,1.23]	1.07	[0.99,1.17]	1.09	[0.90,1.32]
Gender	0.71 *	[0.51,0.97]	1.02	[0.73,1.42]	0.84	[0.44,1.59]
Poverty ratio						
130%	REF		REF		REF	
>130% and <185%	0.73	[0.39,1.36]	0.81	[0.39,1.67]	2.35	[0.78,7.08]
>=185%	0.69	[0.43,1.11]	0.81	[0.51,1.28]	2.40 *	[1.08,5.32]
BMI category						
Normal weight	REF		REF		REF	
Overweight	1.42	[0.78,2.57]	0.68	[0.43,1.07]	0.41	[0.13,1.27]
Obese	1.14	[0.66,1.98]	0.99	[0.59,1.67]	1.30	[0.39,4.30]
Drink >1 cup of water/day	0.59 *	[0.38,0.91]	0.44 ***	[0.32,0.62]	0.37 *	[0.17,0.80]
TV screen time >2 hours/day	1.16	[0.74,1.82]	0.95	[0.55,1.64]	0.59	[0.24,1.45]
Computer screen time >1 hour/day	1.40	[0.92,2.13]	1.21	[0.77,1.91]	2.08	[0.82,5.29]
Health insurance	0.98	[0.31,3.16]	1.70	[0.60,4.85]	1.24	[0.23,6.75]
Last dental visit						
Within past year	REF		REF		REF	
More than a year ago	0.61	[0.32,1.18]	0.82	[0.38,1.81]	2.05	[0.61,6.85]
Never	0.65	[0.30,1.42]	1.15	[0.30,4.39]	0.53	[0.05,5.04]
Guardian education						
Less than high school	REF		REF		REF	
High school grad/GED or equivalent	1.02	[0.58,1.79]	1.05	[0.53,2.08]	0.48	[0.06,3.88]
Some college or AA degree	1.08	[0.58,2.02]	1.44	[0.89,2.34]	0.64	[0.09,4.39]
College graduate or above	0.97	[0.47,1.98]	0.94	[0.53,1.67]	0.30	[0.04,2.12]

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

Table 5.

Multivariable logistic regression models of factors associated with any sugar-sweetened beverage (SSB) intake among adolescents, ages 12–17, by race/ethnicity, NHANES 2011–2016

	Asian American		Mexican-American		Other Hispanic	
	aOR ¹	95% CI	aOR	95% CI	aOR	95% CI
Age	0.96	[0.78,1.18]	1.16	[0.97,1.40]	0.92	[0.76,1.10]
Gender	0.74	[0.39,1.41]	0.84	[0.53,1.34]	0.96	[0.48,1.95]
Poverty ratio						
130%	REF		REF		REF	
>130% and <185%	2.96	[0.73,11.99]	0.57	[0.32,1.04]	0.89	[0.31,2.51]
185%	4.05*	[1.01,16.21]	0.57	[0.28,1.19]	1.29	[0.59,2.80]
BMI category						
Normal weight	REF		REF		REF	
Overweight	1.71	[0.56,5.24]	0.89	[0.50,1.57]	0.77	[0.28,2.08]
Obese	2.05	[0.54,7.81]	0.83	[0.45,1.53]	1.06	[0.41,2.72]
Drink >1 cup of water/day	0.43*	[0.20,0.93]	0.39**	[0.22,0.69]	0.38*	[0.17,0.82]
TV screen time >2 hours/day	1.11	[0.53,2.36]	1.75*	[1.07,2.88]	0.87	[0.43,1.75]
Computer screen time >1 hour/day	0.37	[0.13,1.03]	0.92	[0.57,1.49]	1.16	[0.55,2.44]
Youth foreign-born	0.58	[0.24,1.42]	0.99	[0.38,2.54]	1.04	[0.37,2.88]
Health insurance	0.45	[0.11,1.85]	0.75	[0.42,1.32]	0.79	[0.30,2.07]
Last dental visit						
Within past year	REF		REF		REF	
More than a year ago	0.84	[0.26,2.76]	0.83	[0.43,1.59]	1.75	[0.84,3.64]
Never	25.62*	[1.20,545.36]	0.71	[0.16,3.27]	1.00	[1.00,1.00]
Guardian education						
Less than high school	REF		REF		REF	
High school grad/GED or equivalent	0.41	[0.16,1.07]	0.63	[0.28,1.40]	0.64	[0.25,1.64]
Some college or AA degree	0.62	[0.20,1.92]	0.36**	[0.18,0.72]	0.61	[0.24,1.55]
College graduate or above	0.66	[0.26,1.64]	0.29*	[0.09,0.94]	0.87	[0.26,2.89]
Guardian foreign-born	0.57	[0.19,1.75]	0.54	[0.26,1.12]	0.96	[0.46,1.97]

Table 6.

Multivariable logistic regression models of factors associated with any sugar-sweetened beverage (SSB) intake among adolescent, ages 12–17, by race/ethnicity, NHANES 2011–2016

	White		Black		Other	
	aOR ¹	95% CI	aOR ¹	95% CI	aOR ¹	95% CI
Age	0.99	[0.90,1.10]	1.10	[0.96,1.25]	0.90	[0.65,1.22]
Gender	0.71	[0.49,1.05]	0.60**	[0.43,0.83]	1.00	[0.36,2.79]
Poverty ratio						
130%	REF		REF		REF	
>130% and <185%	1.60	[0.84,3.05]	0.54	[0.25,1.17]	52.66***	[8.89,311.86]
185%	1.30	[0.69,2.42]	0.58	[0.31,1.10]	1.57	[0.47,5.27]
BMI category						
Normal weight	REF		REF		REF	
Overweight	0.92	[0.50,1.68]	1.03	[0.53,2.01]	0.37	[0.08,1.78]
Obese	1.86*	[1.03,3.38]	1.00	[0.50,2.01]	1.11	[0.25,4.99]
Drink >1 cup of water/day	0.59*	[0.37,0.93]	0.57**	[0.39,0.81]	0.91	[0.17,4.76]
TV screen time >2 hours/day	1.17	[0.75,1.82]	1.21	[0.71,2.04]	0.38*	[0.15,0.93]
Computer screen time >1 hour/day	0.98	[0.63,1.52]	0.93	[0.56,1.55]	3.40	[0.53,21.68]
Health insurance	2.07	[0.73,5.89]	0.31	[0.10,1.02]	23.67**	[3.77,148.57]
Last dental visit						
Within past year	REF		REF		REF	
More than a year ago	0.64	[0.37,1.09]	1.09	[0.58,2.07]	0.55	[0.09,3.20]
Never	3.06	[0.15,64.12]	1.43	[0.20,10.33]	1.00	[1.00,1.00]
Guardian education						
Less than high school	REF		REF		REF	
High schoolgrad/GED orequivalent	0.76	[0.37,1.57]	0.74	[0.39,1.41]	9.80**	[1.88,51.03]
Some college or AA degree	0.81	[0.40,1.64]	0.72	[0.36,1.45]	14.81***	[3.18,69.02]
College graduate or Above	0.68	[0.30,1.57]	0.72	[0.30,1.72]	3.87	[0.54,27.78]

Table 7.

Multilevel linear regression models among children, ages 5–11, who consumed sugar-sweetened beverages (SSB) by race/ethnicity, NHANES 2011–2016

	Asian American		Mexican-American		Other Hispanic	
	β	95% CI	β	95% CI	β	95% CI
Age	4.33	[-20.76,29.41]	21.42**	[6.69,36.14]	5.60	[-19.54,30.74]
Gender	-84.77*	[-160.52,-9.03]	-103.15**	[-165.50,-40.79]	-101.53	[-218.87,15.81]
Poverty ratio						
130%	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
>130% and <185%	-66.60	[-264.31,131.11]	-24.81	[-156.86,107.24]	145.09	[-90.86,381.04]
185%	-65.01	[-175.64,45.62]	61.70	[-59.15,182.55]	14.93	[-175.62,205.48]
BMI category						
Normal weight	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
Overweight	-5.73	[-108.70,97.25]	-23.99	[-97.06,49.08]	-21.56	[-131.23,88.11]
Obese	40.82	[-141.27,222.92]	-10.17	[-95.79,75.46]	42.64	[-66.57,151.85]
Drink >1 cup water/day	-115.86**	[-182.24,-49.49]	-42.01	[-137.58,53.55]	-112.54	[-225.79,0.71]
TV screen time >2 hours/day	46.29	[-46.91,139.50]	105.25**	[33.02,177.47]	77.89	[-2.80,158.58]
Computer screen time >1 hour/day	18.80	[-90.25,127.85]	62.85	[-5.82,131.51]	-58.23	[-227.41,110.94]
Youth foreign-born	93.83	[-10.77,198.43]	152.94*	[17.02,288.86]	52.87	[-64.56,170.30]
Health insurance	-70.06	[-253.44,113.33]	-34.40	[-204.59,135.78]	101.49	[-19.77,222.74]
Last dental visit						
Within past year	REF		REF		REF	
More than a year ago	10.23	[-181.69,202.14]	61.94	[-73.16,197.03]	-85.11	[-233.52,63.29]
Never	125.87	[-64.99,316.74]	-145.51	[-320.40,29.38]	-12.19	[-174.84,150.46]
Guardian education						
Less than high school	REF		REF		REF	
High school grad/GED or equivalent	110.75	[-0.91,222.42]	-73.63	[-151.89,4.62]	32.66	[-81.51,146.83]
Some college or AA degree	75.58	[-59.68,210.84]	-7.06	[-91.30,77.17]	61.81	[-50.17,173.78]
College graduate or above	13.25	[-96.18,122.68]	20.14	[-203.93,244.21]	-94.63	[-292.28,103.02]
Guardian foreign-born	35.82	[-63.54,135.18]	-110.19**	[-187.98,-32.41]	-160.46***	[-244.92,-76.00]

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

Table 8.

Multilevel linear regression models among children, ages 5–11, who consumed sugar-sweetened beverages (SSB) by race/ethnicity, NHANES 2011–2016

	Non-Hispanic White		Non-Hispanic Black		Other Races/Ethnicities	
	β	95% CI	β	95% CI	β	95% CI
Age	26.60***	[16.53,36.68]	28.20**	[11.57,44.83]	46.99**	[18.33,75.65]
Gender	-61.30	[-132.62,10.02]	25.85	[-30.29,81.98]	-109.76	[-225.64,6.12]
Poverty ratio						
130%	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
>130% and <185%	-36.37	[-125.30,52.56]	42.24	[-35.13,119.61]	52.12	[-79.04,183.29]
185%	-28.02	[-104.78,48.75]	24.80	[-43.37,92.97]	-78.33	[-267.57,110.90]
BMI category						
Normal weight	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
Overweight	-119.46***	[-166.68,-72.23]	-40.28	[-111.17,30.62]	130.08*	[13.56,246.59]
Obese	45.18	[-26.75,117.10]	91.14	[-24.74,207.02]	117.96	[-67.93,303.85]
Drink >1 cup water/day	-115.04***	[-174.56,-55.53]	-53.86	[-126.27,18.56]	-219.11***	[-329.95,-108.27]
TV screen time >2 hours/day	6.21	[-63.02,75.43]	51.87	[-10.32,114.06]	112.71	[-7.27,232.69]
Computer screen time >1 hour/day	-36.44	[-97.29,24.42]	80.63*	[18.72,142.53]	-115.45	[-279.83,48.94]
Health insurance	-57.19	[-212.98,98.61]	31.83	[-102.01,165.68]	161.81	[-64.43,388.04]
Last dental visit						
Within past year	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
More than a year ago	129.81	[-35.66,295.27]	-87.77	[-178.91,3.38]	216.52*	[4.12,428.92]
Never	97.53	[-114.81,309.88]	40.43	[-66.05,146.92]	35.12	[-125.96,196.20]
Guardian education						
Less than high school	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
High school grad/GED or equivalent	-47.35	[-174.61,79.92]	9.06	[-39.93,58.05]	-71.42	[-213.59,70.74]
Some college or AA degree	-21.90	[-138.88,95.09]	31.55	[-47.81,110.92]	86.79	[-69.31,242.90]
College graduate or above	-36.25	[-160.04,87.55]	16.36	[-107.32,140.04]	186.12	[-48.27,420.50]

Table 9.

Multilevel linear regression models among adolescents, ages 12–17, who consumed sugar-sweetened beverages (SSB) by race/ethnicity, NHANES 2011–2016

	Asian American		Mexican-American		Other Hispanic	
	β	95% CI	β	95% CI	β	95% CI
Age	-1.20	[-26.46,24.05]	10.49	[-12.46,33.44]	42.96*	[9.33,76.60]
Gender	-118.27*	[-225.46,-11.08]	-71.06	[-184.35,42.23]	-93.62	[-239.20,51.96]
Poverty ratio						
\leq 130%	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
>130% and <185%	61.27	[-57.07,179.61]	67.00	[-121.64,255.64]	193.33	[-7.44,394.11]
\geq 185%	19.14	[-91.85,130.14]	-30.47	[-156.00,95.05]	71.33	[-97.60,240.25]
BMI category						
Normal weight	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
Overweight	-48.25	[-174.86,78.35]	-10.59	[-92.94,71.76]	-143.09	[-289.96,3.77]
Obese	46.87	[-38.98,132.73]	21.31	[-115.95,158.58]	-149.11	[-309.78,11.56]
Drink >1 cup water/day	-55.12	[-166.69,56.45]	-99.36*	[-192.45,-6.26]	-59.31	[-211.69,93.06]
TV screen time >2 hours/day	72.39*	[4.18,140.59]	80.06	[-7.83,167.94]	188.20*	[36.56,339.84]
Computer screen time >1 hour/day	47.06	[-16.40,110.51]	46.13	[-56.77,149.02]	-100.68	[-296.04,94.68]
Youth foreign-born	49.84	[-30.29,129.96]	-41.77	[-232.01,148.47]	88.28	[-145.99,322.55]
Health insurance	22.75	[-144.93,190.42]	10.82	[-112.26,133.90]	-41.66	[-290.56,207.24]
Last dental visit						
Within past year	REF		REF		REF	
More than a year ago	119.05	[-51.95,290.05]	125.03	[-8.13,258.18]	-35.33	[-217.62,146.96]
Never	-151.54*	[-268.24,-34.85]	365.22	[-43.66,774.11]	-112.19	[-324.12,99.75]
Guardian education						
Less than high school	REF		REF		REF	
High school grad/GED or equivalent	-4.26	[-237.41,228.89]	-77.52	[-185.73,30.70]	-116.95	[-241.27,7.38]
Some college or AA degree	-6.53	[-123.50,110.43]	70.25	[-82.15,222.64]	84.67	[-103.92,273.25]
College graduate or above	-12.52	[-119.89,94.84]	354.42	[-73.57,782.40]	26.60	[-159.38,212.58]
Guardian foreign-born	203.85***	[132.25,275.45]	94.59	[-39.08,228.27]	-101.51	[-240.16,37.14]

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$

Table 10.

Multilevel linear regression models among adolescents, ages 12–17, who consumed sugar-sweetened beverages (SSB) by race/ethnicity, NHANES 2011–2016

	Non-Hispanic White		Non-Hispanic Black		Other Races/Ethnicities	
	β	95% CI	β	95% CI	β	95% CI
Age	60.52**	[24.35,96.70]	24.87	[-4.67,54.41]	61.23*	[5.90,116.56]
Gender	-194.73**	[-315.67,-73.79]	-5.63	[-122.52,111.27]	-194.83*	[-362.95,-26.71]
Poverty ratio						
≤130%	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
>130% and <185%	-162.97	[-359.09,33.16]	108.47	[-50.24,267.17]	-56.02	[-321.78,209.75]
≥185%	-84.63	[-273.79,104.53]	-15.28	[-109.73,79.18]	126.47	[-104.02,356.96]
BMI category						
Normal weight	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
Overweight	-137.92*	[-255.99,-19.84]	-84.24	[-221.63,53.16]	-112.96	[-402.23,176.31]
Obese	-100.09	[-243.16,42.97]	-65.87	[-158.65,26.90]	-10.49	[-188.41,167.43]
Drink >1 cup water/day	-96.28	[-344.92,152.36]	-138.95**	[-221.80,-56.11]	-28.34	[-239.37,182.70]
TV screen time >2 hours/day	76.17	[-25.41,177.75]	32.91	[-73.74,139.55]	-76.17	[-255.85,103.51]
Computer screen time >1 hour/day	-145.07**	[-247.99,-42.16]	-10.19	[-142.76,122.39]	-10.78	[-182.73,161.16]
Health insurance	-318.01	[-649.99,13.96]	102.31	[-23.36,227.98]	221.41	[-121.24,564.06]
Last dental visit						
Within past year	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
More than a year ago	-75.74	[-252.16,100.68]	111.49	[-45.00,267.98]	-294.04***	[-422.45,-165.63]
Never	-194.51	[-447.29,58.27]	453.16	[-393.23,1299.54]		
Guardian education						
Less than high school	0.00	[0.00,0.00]	0.00	[0.00,0.00]	0.00	[0.00,0.00]
High school grad/GED or equivalent	82.59	[-117.66,282.85]	-27.72	[-149.61,94.17]	70.69	[-437.22,578.59]
Some college or AA degree	65.73	[-143.88,275.35]	-19.60	[-143.52,104.31]	-18.31	[-395.85,359.23]
College graduate or above	30.62	[-229.92,291.16]	-16.59	[-171.61,138.43]	-222.82	[-572.20,126.56]

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$