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Short Communication

Trends and patterns in sugar-sweetened beverage consumption among children and adults by race and/or ethnicity, 2003–2018

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Abstract

Objective: Sugar-sweetened beverage (SSB) consumption has declined steadily. This study uses the latest national data to examine trends in SSB consumption among children and adults by race and/or ethnicity and to document whether long-standing disparities in intake remain.
Design: Trend analyses of demographic and dietary data measured by 24-h dietary recall from the National Health and Nutrition Examination Survey (NHANES).
Setting: Data from the 2003–2004 through 2017–2018 NHANES survey cycles were analysed in 2020.
Participants: The study sample included 21 156 children aged 2–19 years and 32 631 adults aged 20+ years.
Results: From 2003–2004 to 2017–2018, the prevalence of drinking any amount of SSB on a given day declined significantly among all race and/or ethnicity groups for children (non-Hispanic (NH) White: 81·6 % to 72·7 %; NH Black: 83·2 % to 74·8 %, Hispanic: 86·9 % to 77·2 %) and most race and/or ethnicity groups for adults (NH White: 72·3 % to 65·3 %; Hispanic: 84·6 % to 77·8 %). Consumption declined at a higher rate among NH Black and Hispanic children aged 12–19 years compared with their NH White peers; among NH Black children aged 6–11 years, the rate of decline was lower. Despite significant declines in per capita SSB energy consumption from soda and fruit drinks, consumption of sweetened coffee/tea beverages increased among older children and nearly all adults and consumption of sweetened milk beverages increased among NH White and Hispanic children.
Conclusions: SSB consumption has declined steadily for children and adults of all race and/or ethnicity groups, but disparities persist, and overall intake remains high.

Keywords
Trends
Sugar-sweetened beverages
Disparities
National Health and Nutrition Examination Survey

There is clear evidence that consuming sugar-sweetened beverages (SSB) increases risk for obesity, diabetes, CVD and dental caries – diseases that cluster among racial and ethnic minorities[1–7]. Because SSB have been a leading source of added sugars in the American diet, particularly in non-Hispanic (NH) Black children and adults[8,9], continued surveillance of SSB trends by race and/or ethnicity is critical.

While prior research documents persistent racial and/or ethnic disparities in SSB intake[10–13], none use the most recent data. In addition, there have been a number of policies in the US to reduce SSB consumption that have passed in recent years; these may have influenced consumption trends[14]. We address this research gap by using the most current data from the National Health and Nutrition Examination Survey (NHANES) to examine trends in SSB consumption among children and adults by race and/or ethnicity and to document whether long-standing disparities in intake have been attenuated.

Methods

Study population

We used nationally representative cross-sectional data from eight cycles of the NHANES for 2003–2004 to 2017–2018.

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Data collection procedures and analytic guidelines for study populations selected through a multistage, clustered probability sampling strategy are available through the Centers for Disease and Control and Prevention[15]. Data were taken from the dietary recall section of the NHANES[16], which used consistent dietary recall methods for two non-consecutive 24-h periods (day 1 and day 2 recall). Similar to other studies[13], this analysis used day 1 recall because it: (1) has a higher response rate and (2) uses a more reliable data collection method (in person *v.* by telephone).

Study sample and measures

Our study sample consisted of children aged 2–19 years old and adults aged 20 years and older with a reliable 24-h dietary recall and complete data on covariates[15]. Consistent with NCHS analytic guidelines[15] and previous work[13,17–19], we divided children (2–5 years; 6–11 years; 12–19 years) and adults (20–39 years; 40–59 years; 60 years and older) into age sub-groups.

Each cycle of NHANES dietary recall was matched to the USDA's Food and Nutrient Database for Dietary Studies[16]. Similar to prior research[13], we defined SSB as either ready-to-drink or in combination with food items (e.g. coffee sweetened with chocolate syrup) and further hand-coded into mutually exclusive subcategories: soda, fruit drinks, sports and energy drinks, sweetened coffee and tea drinks, sweetened milk and milk-alternative drinks, low-energy drinks and other sweetened drinks (see Supplementary Note for details of our SSB categorisation scheme). Total energies from SSB, overall and by subcategory, were generated for each participant. The distinction of a category for sweetened coffee/tea and milk drinks differs from some previous analyses[17] but was included here given recent trends promoting these drinks as healthier alternatives to traditional SSB (e.g. soda)[20].

Statistical analysis

All models account for the complex, multistage sampling design of the NHANES and are weighted for non-response to the dietary recall. We estimated (1) the prevalence of drinking any amount of SSB per day and (2) mean SSB energetic intake overall and by subcategory.

To estimate the prevalence and per capita intake of SSB, we fitted separate multivariable logistic and linear regression models within each racial and/or ethnic and age group adjusted for total energetic intake, gender, income and weight status. Stata's margins command was used post-estimation to determine the prevalence of SSB consumption and per capita mean energetic intake from SSB at each survey year. We report these results as data were available for NH White, NH Black and Hispanic (defined by Mexican American or Other Hispanic) participants due to small sample size in the Other race category[15]. We also report results from a supplemental analysis among NH Asians using data available from 2011 and onwards.

To analyse the statistical significance of trends over time, models were fit using survey year as a continuous variable. To assess potential non-linearity in trends, we also included quadratic and cubic year terms as covariates and then performed a joint Wald test of the quadratic and cubic terms. If the test was statistically significant, we reported the results from this model. If not, we concluded there was no evidence of non-linearity and fitted a model using only a linear term and reported the results from this model. To statistically compare linear trends across groups, we fit a model within each age group, allowing for interactions between the continuous survey year term and indicators for each racial and/or ethnic group. We used the largest weighted subgroup (NH White) as the reference group for all comparisons.

All results were weighted to be representative of the non-institutionalised US population and considered significant at $P < 0{\cdot}05$. Analyses were completed in 2020 using Stata/MP version 15.1 (StataCorp LLC) and replicated by a second analyst.

Results

The analytic sample included 21 156 children aged 2–19 years and 32 631 adults aged 20+ years. Supplemental Table 1 reports unweighted descriptive statistics of the sample.

The percentage of the total population consuming any amount of SSB on a given day declined significantly from 2003 to 2018 for all race and/or ethnicity groups among children (NH White: 81·6 % to 72·7 %, $P_{trend} < 0{\cdot}001$; NH Black: 83·2 % to 74·8 %, $P_{trend} = 0{\cdot}001$; Hispanic: 86·9 % to 77·2 %, $P_{trend} < 0{\cdot}001$) (Table 1). When further stratified by age, significant declines were observed in NH White children aged 6–11 years (90·6 % to 72·4 %, $P_{trend} < 0{\cdot}001$), NH Black children aged 12–19 (88·7 % to 76·2 %, $P_{trend} < 0{\cdot}001$) and some Hispanic children (6–11 years: 92·4 % to 85·2 %, $P_{trend} = 0{\cdot}007$; 12–19 years: 87·7 % to 75·1 %, $P_{trend} < 0{\cdot}001$). The rate of decline in SSB consumption was significantly higher among NH Black ($P = 0{\cdot}017$) and Hispanic children aged 12–19 years ($P = 0{\cdot}031$) compared with the rate of change among NH White children aged 12–19 years, while declines among NH Black children aged 6–11 years were significantly lower than their NH White counterparts ($P = 0{\cdot}017$).

Among adults, we also observed significant declines in SSB consumption from 2003 to 2018 among NH White adults (72·3 % to 65·3 %, $P_{trend} = 0{\cdot}020$) and Hispanic adults (84·6 % to 77·8 %, $P_{trend} = 0{\cdot}001$) (Table 2). When further stratified by age, significant declines were observed only in some adults aged 20–39 years (NH White: 79·1 % to 67·2 %, $P_{trend} < 0{\cdot}001$; Hispanic: 87·8 % to 74·8 %, $P_{trend} = 0{\cdot}001$). There were no statistically significant differences in the rates of decline among Hispanic adults when compared with NH White adults. We found evidence of non-linearity in the perceived decline in SSB consumption among

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Table 1 Race and/or ethnicity- and age-specific trends in the percentage of children (aged 2 to 19 years) consuming at least some sugar-sweetened beverage (SSB) on a given day from 2003 to 2018

	All (aged 2–19 years)		Aged 2–5 years		Aged 6–11 years		Aged 12–19 years	
Survey year	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
NH White								
2003–2004	81·6	77·0, 86·3	66·3	57·4, 75·2	90·6	87·6, 93·7	82·1	76·0, 88·3
2005–2006	73·8	69·0, 78·5	61·5	54·3, 68·6	78·1	72·0, 84·1	76·3	69·7, 82·9
2007–2008	79·2	75·8, 82·6	72·5	66·5, 78·6	83·4	78·8, 88·1	79·2	73·5, 84·8
2009–2010	74·8	71·0, 78·6	63·3	57·9, 68·7	80·2	75·6, 84·8	75·7	70·5, 80·9
2011–2012	76·7	70·5, 83·0	56·3	41·0, 71·7	83·9	79·5, 88·3	80·8	72·0, 89·7
2013–2014	72·2	69·7, 74·8	59·2	53·4, 65·0	74·9	68·3, 81·4	75·5	70·9, 80·1
2015–2016	67·4	64·3, 70·5	47·9	36·9, 58·9	71·8	65·0, 78·6	72·9	64·6, 81·2
2017–2018	72·7	68·8, 76·7	64·2	52·6, 75·9	72·4	66·3, 78·5	76·8	71·5, 82·0
P-value for linear trend	< 0·001		0·044		< 0·001		0·147	
P-value for change	0·007		0·773		< 0·001		0·206	
NH Black								
2003–2004	83·2	79·7, 86·7	75·6	67·4, 83·8	81·2	76·7, 85·8	88·7	85·6, 91·8
2005–2006	82·2	78·9, 85·5	68·2	55·4, 80·9	83·7	78·5, 88·8	87·8	84·6, 91·0
2007–2008	82·7	79·3, 86·0	68·7	60·2, 77·3	90·9	86·9, 94·9	83·4	77·5, 89·4
2009–2010	79·4	76·0, 82·9	69·6	62·3, 77·0	81·1	76·0, 86·1	83·1	77·4, 88·7
2011–2012	79·5	76·2, 82·8	71·4	65·8, 77·1	83·7	76·2, 91·2	80·4	76·4, 84·4
2013–2014	80·1	76·2, 84·0	68·5	60·2, 76·9	82·0	76·6, 87·4	82·8	77·8, 87·8
2015–2016	77·9	74·3, 81·6	69·5	59·4, 79·6	84·8	79·4, 90·2	77·0	70·6, 83·4
2017–2018	74·8	69·7, 80·0	64·6	52·9, 76·4	79·1	70·3, 87·9	76·2	69·6, 82·8
P-value for linear trend	0·001		0·389		0·493*		< 0·001*	
P-value for change	0·008		0·133		0·662		< 0·001	
Hispanic								
2003–2004	86·9	83·6, 90·2	77·9	71·8, 84·1	92·4	88·6, 96·1	87·7	82·1, 93·3
2005–2006	82·0	79·0, 85·1	75·2	69·0, 81·4	81·1	73·1, 89·2	87·3	84·2, 90·4
2007–2008	81·7	79·7, 83·6	76·3	69·7, 82·9	86·5	81·9, 91·1	80·6	75·5, 85·8
2009–2010	84·4	80·5, 88·2	76·4	70·3, 82·5	89·7	85·8, 93·5	84·3	79·8, 88·8
2011–2012	80·9	75·1, 86·7	78·8	71·6, 86·1	85·6	80·1, 91·1	78·2	70·0, 86·4
2013–2014	76·6	74·2, 78·9	63·1	57·2, 68·9	82·2	77·1, 87·2	78·9	75·4, 82·5
2015–2016	74·0	69·3, 78·8	73·0	65·7, 80·2	73·3	65·7, 80·9	75·6	68·6, 82·7
2017–2018	77·2	71·6, 82·9	70·7	49·6, 91·7	85·2	80·1, 90·3	75·1	68·2, 82·1
P-value for linear trend	< 0·001		0·215		0·007		< 0·001*	
P-value for change	0·002		0·480		0·029		0·009	

To obtain yearly estimates, separate models were fitted within each race and/or ethnicity and age subgroup; all estimates were adjusted for total energetic intake and whether the participant was someone female, of lower-income status, and with obesity. Participants missing values for income (*n* 4395) or weight (*n* 680) were excluded. Negative predicted values were truncated at 0. To obtain linear trend estimates, separate models were fitted within each age subgroup using survey year as a continuous indicator, adjusting for all other covariates.

*Evidence of a statistically significant different rate of change in the proportion of SSB drinkers among children compared with the rate of change among NH White counterparts ($P < 0·05$).

NH Black adults of all ages and NH Black adults aged 20–39 years.

Per capita consumption of overall SSB energies declined significantly from 2003 to 2018 among all NH White and Hispanic children, as well as NH Black children aged 6–19 years, which were primarily driven by declines in soda and fruit drinks (see online supplementary material, Supplemental Table 2). Rates of decline in per capita soda energies were significantly lower for NH Black children aged 6–11 years ($P = 0·046$) and 12–19 years ($P = 0·004$) compared with their NH White peers. With respect to fruit juice, NH Black children aged 12–19 years had a significantly lower rate of decline in per capita energies ($P < 0·001$). Most notably, we observed significant increases in per capita energies from sweetened coffee/tea and milk beverages among some children. Among adults, we observed similar trends in declining per capita consumption of overall SSB energies that were driven by declines in soda and fruit drinks, as well as significant increases in consumption of sweetened coffee/tea beverages in nearly all adults (see online supplementary material, Supplemental Table 3).

When examining trends among NH Asians (data only available from 2011 to 2018), the prevalence of SSB consumption (see online supplementary material, Supplemental Table 4) and per capita consumption of overall SSB (see online supplementary material, Supplemental Table 5) declined significantly only among children aged 2–11 years.

Discussion

From 2003 to 2018, the percentage of children and adults consuming SSB on a given day declined significantly for most race and/or ethnicity groups. These results are consistent with previous research on SSB consumption in the US, showing relatively consistent declines in SSB consumption overall[21], by race and/or ethnicity[22], and among heavy SSB drinkers (defined as those who consume 500+ kcal daily from SSB)[13]. In addition, global estimates of SSB

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Table 2 Race and/or ethnicity- and age-specific trends in the percentage of adults (aged 20+ years) consuming at least some sugar-sweetened beverage (SSB) on a given day from 2003 to 2018

	All (aged 20+ years)		Aged 20–39 years		Aged 40–59 years		Aged 60+ years	
Survey year	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
NH White								
2003–2004	72·3	69·7, 74·8	79·1	74·8, 83·3	74·3	70·8, 77·8	61·0	56·4, 65·7
2005–2006	69·5	65·5, 73·5	74·6	70·1, 79·0	71·0	65·2, 76·9	61·3	57·7, 64·9
2007–2008	71·6	69·2, 74·0	74·9	69·9, 79·9	75·6	71·9, 79·2	61·4	57·7, 65·1
2009–2010	67·5	62·6, 72·4	74·2	69·0, 79·5	67·4	60·5, 74·4	60·1	54·0, 66·1
2011–2012	70·8	67·4, 74·1	74·9	68·2, 81·6	73·4	66·4, 80·5	62·7	55·8, 69·6
2013–2014	67·3	63·8, 70·8	72·8	68·0, 77·5	70·6	63·9, 77·3	57·3	53·5, 61·2
2015–2016	67·5	63·5, 71·5	67·6	61·4, 73·9	74·7	69·1, 80·2	58·6	51·6, 65·5
2017–2018	65·3	60·2, 70·5	67·2	62·3, 72·1	69·0	60·2, 77·8	59·9	53·3, 66·5
P-value for linear trend	0·020		< 0·001		0·537		0·401	
P-value for change	0·013		< 0·001		0·258		0·772	
NH Black								
2003–2004	86·0	83·1, 88·9	89·1	84·6, 93·7	85·3	81·2, 89·4	78·6	74·7, 82·4
2005–2006	79·2	75·3, 83·1	78·8	72·4, 85·2	79·2	73·5, 84·9	79·8	75·7, 84·0
2007–2008	80·0	77·6, 82·4	80·3	75·3, 85·3	81·0	76·0, 86·0	76·9	72·2, 81·6
2009–2010	79·6	77·4, 81·8	79·3	76·2, 82·4	79·5	75·7, 83·3	81·0	77·8, 84·2
2011–2012	79·8	76·7, 82·8	78·9	75·9, 82·0	79·0	73·4, 84·5	82·6	78·3, 86·9
2013–2014	80·0	78·0, 82·0	83·1	78·6, 87·6	78·4	73·8, 83·0	76·8	70·8, 82·8
2015–2016	77·6	74·3, 81·0	79·7	74·0, 85·3	78·6	72·6, 84·7	71·0	65·3, 76·7
2017–2018	77·9	74·1, 81·6	75·8	69·2, 82·4	81·5	75·7, 87·3	76·7	71·8, 81·6
P-value for linear trend	Nonlinear*		Nonlinear†		0·272		0·074	
P-value for change	0·001		0·002		0·280		0·554	
Hispanic								
2003–2004	84·6	81·6, 87·5	87·8	84·2, 91·4	80·0	73·2, 86·8	82·7	77·6, 87·9
2005–2006	85·7	82·2, 89·2	87·0	82·9, 91·1	88·6	83·3, 93·9	73·9	69·0, 78·8
2007–2008	84·5	83·0, 86·1	86·9	83·7, 90·0	83·3	79·2, 87·4	77·6	72·5, 82·6
2009–2010	81·9	78·2, 85·5	81·7	76·3, 87·0	84·5	80·9, 88·0	76·1	69·0, 83·2
2011–2012	82·0	78·6, 85·4	84·4	80·7, 88·0	78·0	69·5, 86·5	82·5	78·5, 86·5
2013–2014	82·6	78·3, 87·0	82·6	75·6, 89·5	84·7	80·0, 89·4	78·1	73·2, 83·1
2015–2016	82·3	79·8, 84·7	85·2	81·2, 89·3	80·7	77·1, 84·2	75·4	71·9, 79·0
2017–2018	77·8	74·2, 81·4	74·8	69·3, 80·4	81·4	76·0, 86·8	78·3	72·4, 84·1
P-value for linear trend	0·001		0·001		0·403		0·679	
P-value for change	0·004		0·000		0·742		0·260	

To obtain yearly estimates, separate models were fitted within each race and/or ethnicity and age subgroup; all estimates were adjusted for total energetic intake and whether the participant was someone female, of lower-income status, and with obesity. Participants missing values for income (*n* 4395) or weight (*n* 680) were excluded. Negative predicted values were truncated at 0. To obtain linear trend estimates, separate models were fitted within each age subgroup using survey year as a continuous indicator, adjusting for all other covariates.

*Evidence of a nonlinear trend in SSB consumption over time, as indicated by a statistically significant joint Wald test of the quadratic and cubic terms for survey year ($P = 0·033$).

†Evidence of a nonlinear trend in SSB consumption over time, as indicated by a statistically significant joint Wald test of the quadratic and cubic terms for survey year ($P = 0·015$).

consumption are similar to our findings: soda and fruit drinks are the main drivers of SSB consumption[23].

Within the apparent declines in SSB consumption by overall age and race and/or ethnicity, we note that NH Black and Hispanic teenagers appear to have closed the gap in overall SSB consumption. This suggests that broad-based public health efforts to reduce SSB consumption in the US may be helping to equitably reduce consumption[14], but important disparities remain. Among NH Black children aged 6–11 years, consumption has fallen at a lower rate compared with their NH White peers. These findings demonstrate that targeted efforts are needed to continue addressing disparities in SSB consumption throughout the life course, especially among NH Black children aged 6–11 years.

Regarding per capita consumption of SSB energies, we observed that while declines were primarily driven by reduced consumption of soda and fruit drinks, there was a significant upward trend in consumption of non-traditional SSB. Among NH White and Hispanic children, sweetened milk beverages are the second-highest source of SSB energies after soda. Among adults, sweetened coffee/tea beverages are also high sources of SSB energies. These shifts coincide with secular trends in policy, systems and environment approaches to promoting alternative beverage choices. For example, more than one-third of SSB are consumed at food-service establishments[24], which in cities like New York City and Wilmington have been policy targets of beverage ordinances that may nudge children away from soda consumption and towards non-traditional SSB (e.g. chocolate milk). Excise taxes on SSB (currently implemented in seven US localities) and availability of reduced-sugar beverages may also nudge both children and adults away from consuming traditional SSB. Due to the limited scope of this study, we did not further explore the self-reported sources of SSB consumption (e.g. soda

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consumed at a fast-food restaurant) and cannot conclude that these policy, systems and environment changes are directly impacting SSB consumption. Moving forward, ongoing evaluations assessing the association between policy, systems and environment strategies and SSB consumption will be important.

This study has several limitations. First, when stratified by both race and/or ethnicity and age, yearly estimates were less stable due to smaller subgroup size. We combined the Mexican American and other Hispanic race and/or ethnicity groups to a single Hispanic group to address this concern as per Centers for Disease and Control and Prevention analysis guidelines[15], but this limits the generalisability of our findings to these sub-groups. Second, dietary recalls are self-reported and subject to measurement error, even more so given that adults self-report on behalf of their children. Also, our reliance on a single day of dietary recall can unreliably estimate episodically consumed beverages. However, our estimates are in line with similar studies that do incorporate a second day of dietary recall[1].

Conclusions

SSB consumption has continued to decline for children and adults of most race and/or ethnicity groups, primarily driven by reductions among older children and adults, but levels remain unacceptably high[25]. Moreover, disparities between NH Black and White children aged 6–11 years remain. Continued surveillance of trends in consumption of both traditional and non-traditional SSB using de-aggregated race and/or ethnicity data, along with targeted efforts to reduce persistent disparities in consumption, is critical.

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Supplementary material

For supplementary material accompanying this paper, visit https://doi.org/10.1017/S1368980021001580

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