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Sugary Drink Consumption Among NYC Children, Youth, and Adults: Disparities Persist Over Time, 2007–2015

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Abstract

Sugary drink consumption is associated with many adverse health outcomes, including weight gain, diabetes, and other chronic conditions. These beverages are widely marketed and ubiquitously available. This analysis explores sugary drink consumption across all age groups among New York City (NYC) residents using representative survey data. Three population-based representative surveys of NYC residents of different age groups were analyzed. Adult participants, youth participants, and caregivers of child participants self-reported the number of sugary drinks they consumed per day. Mean sugary drink intake per day was estimated overall and by demographic characteristics, for the 2015 cycle of each survey and the 2007–2015 cycles of the adult survey. T tests were used to determine whether means differed by demographics. Long-term trends in mean sugary drink consumption among adult participants were conducted to examine changes over time overall and by demographic characteristics. In 2015, the mean daily number of sugary drinks consumed was 0.53 (95% CI 0.45, 0.61) among children 0–5 years old, 1.05 (95% CI 0.90, 1.21) among children 6–12 years old, and 1.16 (95% CI 1.09, 1.29) among NYC high school students. Among all NYC adults, sugary drink intake decreased 36% from 1.03 (95% CI 0.99, 1.08) in 2007 to 0.66 (95% CI 0.62, 0.70) drinks per day in 2015, $p < 0.01$. However, at each age level, there were persistent disparities in sugary drink consumption by sex, race/ethnicity, educational attainment, and poverty level. Decreasing overall rates of sugary drink consumption are promising; however, disparities by socio-demographics are a concern. Reducing sugary drink consumption across all ages is recommended as is minimizing the introduction at an early age. Reduction of sugary drink consumption will require a collaborative, multi-sectoral approach.

Keywords Sugary drinks · Sugar-sweetened beverages · SSBs

Introduction

There are many adverse health consequences associated with sugary drink consumption, including weight gain, cavities, and increased risk of chronic diseases, such as type 2 diabetes and heart disease [1–4]. The 2015–2020 Dietary Guidelines for Americans recommend limiting consumption of added sugars to less than 10% of daily calorie intake [5]; however, a single 20-ounce sugary drink can contain up to 350 calories of added sugars [6], well-exceeding the recommended daily limit for a 2000 calorie diet. Despite nationally-representative data showing declines in sugary drink consumption during the 2000s [7, 8], beverages remain the largest single source of added sugar in the diets of US children and adults 18 years and older, contributing 47% of daily added sugars consumed [5].

Sugary drinks are both widely available and heavily promoted. Studies indicate that in food retail settings, sugary drinks are the most prominent beverage offering [9] and sugary drinks are also available widely in many non-food retail stores, such as big box stores, pharmacies, clothing stores, office supply stores, etc. [10, 11]. There is also evidence that sugary drink advertising varies by community characteristics, with increased outdoor advertising in low-income

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communities [12] and greater exposure to television advertising for both children of color and children in low-income communities [13]. In addition to television, youth are heavily exposed to sugary drink marketing through advertising on websites and social media, as well as through use of strategies that appeal to children, including cartoon characters, cross-promotions, giveaways, and celebrity endorsements [6, 14].

This analysis explores sugary drink consumption among children, youth, and adults in New York City (NYC) over time using population-based surveillance data collected by the NYC Department of Health and Mental Hygiene (Health Department). In addition to age, we examine sugary drink consumption according to socio-demographic variables including race/ethnicity and poverty.

Methods

Study Sample

We used data from three cross-sectional, population-based representative samples of NYC residents of different age groups (children, adolescents, and adults): the Child Health, Emotional Wellness, and Development Survey (CHEWDS), the NYC Youth Risk Behavior Survey (YRBS), and the NYC Community Health Survey (CHS).

Children

Conducted in 2015, CHEWDS is a random-digit-dial dual-frame cell phone and landline telephone survey conducted by the Health Department that included families eligible based on a randomized sampling design [15]. Approximately 3000 families were surveyed. For each child surveyed, a proxy was identified to answer questions on the child's behalf. The proxy was an adult from each household who knew the child well enough to provide information regarding the child's health and general activities including their consumption of sugary drinks. The survey was designed to provide representative estimates of two age groups of NYC children: 0–5 and 6–12 year-olds.

Adolescents

The NYC YRBS is a biennial survey administered to NYC public high school students aimed at monitoring health risk behaviors. It is based on the national YRBS protocol and is representative of NYC public high school students in grades 9–12, between 12 and 18 years of age [16]. Data from the 2015 YRBS cycle was used in the current analysis. The NYC YRBS is conducted by the NYC Health Department, the

NYC Department of Education, and the Centers for Disease Control and Prevention (CDC).

Adults

The NYC CHS is a population-based representative study of non-institutionalized adult NYC residents 18 years or older. Based on the CDC's Behavioral Risk Factor Surveillance System (BRFSS) [17], CHS is a random-digit-dial telephone survey of approximately 9000 participants conducted annually since 2002 [18]. CHS is used as a surveillance tool to monitor health trends among NYC adult residents. To obtain a representative sample of adult New Yorkers, CHS uses a dual frame sample design consisting of random-digit-dial landline telephone exchanges and a second frame (beginning in 2010) of cellular telephone exchanges that cover NYC. CHS also incorporates a disproportionate stratified random sample design. Data from 9 CHS cycles were used in the current analysis (2007–2015). Study methods for each of the above-listed surveys were approved by the NYC Health Department's Institutional Review Board.

Defining Sugary Drink Consumption

Sugary drink consumption was assessed slightly differently for each of the three surveys. From the CHEWDS survey, respondents were asked, "How often does (child) usually drink sugar-sweetened soda? Do not include diet soda or seltzer." and "How often does (child) usually drink other sweetened drinks like sweetened iced tea, sports drinks, fruit punch, or other fruit-flavored drinks? Do not include diet soda, sugar free drinks, or 100% juice." Response options were open ended and were combined for both questions to derive total sugary drinks per day.

From the YRBS survey, participants were asked two questions pertaining to their sugary drink consumption, "During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite? (Do not count diet soda or diet pop.)" and "During the past 7 days, how many times did you drink other sugar-sweetened drinks such as sports drinks, energy drinks, fruit punch, fruit-flavored drinks, or sugar-sweetened teas? (Do not count diet or sugar-free drinks.)". Response options for both questions were: I did not drink [soda or pop/other sugar-sweetened drinks] during the past 7 days, 1–3 times during the past 7 days, 4–6 times during the past 7 days, 1 time per day, 2 times per day, 3 times per day, or 4 or more times per day. Response options were assigned the following concrete range midpoint values, respectively: 0, 2/7, 5/7, 1, 2, 3, or 4 drinks per day. Midpoint values for sodas per day and other sugary drinks per day were combined to calculate values for total sugary drinks per day.

From the CHS survey, starting in 2007, participants were asked, "How often do you drink sugar-sweetened soda?" and "How often do you drink other sweetened drinks like sweetened iced tea, sports drinks, fruit punch, or other fruit-flavored drinks?" Response options for both questions were open ended and were combined to derive values for overall sugary drinks per day.

Defining Other Variables

For all three surveys (CHEWDS, YRBS, and CHS) age, sex, and race/ethnicity were self-reported by either the proxy (CHEWDS) or study participant (YRBS and CHS). Race/ethnicity was combined into mutually exclusive categories corresponding to: White non-Latino, Black non-Latino, Latino, Asian or Asian/Pacific Islander non-Latino, or Other non-Latino. For the current study, Latino includes persons of Hispanic or Latino origin, as identified by the survey question "Are you Hispanic or Latino?" and regardless of reported race. Black, White and Asian or Asian/Pacific Islander race categories exclude those who identified as Latino. Respondents of the CHEWDS and CHS (but not YRBS) also reported information on income and educational attainment. CHEWDS and CHS respondents reported their household income in ranges based on the percentage of the federal poverty level (FPL): < 200% FPL, 200% to < 400% FPL, or 400% FPL ≤. Among CHEWDS and CHS participants, neighborhood poverty was also assessed as a percentage of the population in the respondent's ZIP code living below 100% of the FPL. Based on NYC Health Department administrative guidelines, [19] neighborhood poverty was collapsed into the following categories: < 10%, 10% to < 20%, 20% to < 30%, and ≥ 30% corresponding to low-, medium-, high- and very high-neighborhood poverty level. CHEWDS and CHS respondents were also asked to report their highest level of educational attainment (less than high school (HS), HS graduate, some college, or college graduate). For CHEWDS respondents (i.e. child proxies), educational attainment corresponded to highest level in the household.

Statistical Analyses

We described the age, sex, race/ethnicity, education, poverty status, and neighborhood poverty status (when available) breakdown for the 2015 cycle of each survey. Next, we estimated mean sugary drinks consumed per day in 2015 by demographic characteristics for each survey. We used t-tests to determine whether means differed by demographic characteristics. Finally, for the CHS survey, we estimated the mean sugary drinks consumed from 2007 to 2015, testing for long term trends or changes over time overall and by

demographic characteristics. We considered reporting medians (rather than means) as our main end point to provide a more stable estimate of sugary drink consumption. However, median values were not as informative as means, given that medians were often zero, and did not describe consumption well. Therefore, we included an analysis of medians, as a sensitivity analysis, and described median consumption for children, adolescents, and adults overall and among only those who reported consuming any sugary beverages. Analyses were conducted using SUDAAN version 11.0.1 (Research Triangle Park, NC) to take into account the complex survey design and reflect estimates representative of the populations described.

Results

Demographic characteristics of each sample are described for the 2015 survey year in Table 1. In all surveys, the populations represented were approximately evenly split by sex. The distribution of socio-demographic factors for each survey differed slightly due to differences in the underlying demographic of the population represented by each survey. For example, the distribution of race/ethnicity in each population varied somewhat depending on the age group of the population represented, with Whites ranging from 13 to 36%, Blacks from 22 to 30%, Latinos from 27 to 38%, and Asian or Asian/Pacific Islanders from 11 to 17%.

Sugary Drink Consumption Among Children 0–5 Years Old

In 2015, children aged 0–5 years old consumed an average of 0.53 sugary drinks per day (Table 2). Sugary drink consumption was higher among children who were Black (0.89, 95% CI 0.63, 1.15) or Latino (0.68, 95% CI 0.56, 0.80) compared to children who were White (0.18, 95% CI 0.12, 1.24). Sugary drink consumption was also higher among children of caretakers reporting less than HS vs. college graduate education levels (1.19 vs. 0.28, p < 0.01) and among those living in households < 200% FPL vs. 400+% FPL (0.70 vs. 0.23, p < 0.01).

Sugary Drink Consumption Among Children 6–12 Years Old

In 2015, children 6–12 years old consumed an average of 1.05 (95% CI 0.90, 1.21) sugary drinks per day, with males consuming more than females (1.22, 95% CI 0.99, 1.21 vs. 0.88, 95% CI 0.68, 1.09, p = 0.04). Sugary drink consumption was higher among children who were Black (1.55, 95% CI 1.16, 1.95) or Latino (1.06, 95% CI 0.89,

Table 1 Demographic Characteristics of the Study Sample, CHEWDS, YRBS, and CHS, 2015

	CHEWDS		YRBS		CHS	
	N = 3,031		N = 8,486		N = 10,172	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Age group						
0–5	49.4	(46.4, 52.3)				
6–12	50.6	(47.7, 53.6)				
12–18			100.0			
18–24					13.1	12.0, 14.2
25–44					40.1	38.7, 41.4
45–64					31.5	30.4, 32.8
65+					15.3	14.5, 16.1
Sex						
Male	51.1	(48.2, 54.0)	50.9	(47.1, 54.6)	46.3	44.9, 47.7
Female	48.9	(46.0, 51.8)	49.1	(45.4, 52.9)	53.7	52.3, 55.1
Race/ethnicity						
White	26.4	(24.1, 28.9)	13.4	(9.9, 18.0)	35.5	34.2, 36.8
Black	23.4	(20.9, 26.0)	29.9	(24.5, 36.0)	22.0	20.9, 23.1
Latino	35.3	(32.6, 38.1)	37.8	(32.5, 43.4)	26.9	25.8, 28.1
Asian/PI	11.4	(9.3, 13.9)	16.8	(14.1, 19.8)	13.6	12.6, 14.6
Other	3.5	(2.7, 4.6)	2.1	(1.7, 2.5)	2.1	1.7, 2.5
Education[a]						
Less than HS	11.3	(9.3, 13.6)			20.1	19.0, 21.3
HS grad	20.6	(18.4, 23.0)			23.3	22.1, 24.6
Some college	29.0	(26.2, 31.9)			20.8	19.6, 22.0
College grad+	39.2	(36.5, 41.9)			35.8	34.5, 37.1
Poverty						
< 200% FPL	60.5	(57.5, 63.5)			50.3	49.0, 51.7
200 to < 400% FPL	15.1	(13.1, 17.4)			19.4	18.3, 20..6
400+	24.4	(21.9, 27.0)			30.2	29.0, 31.5
Neighborhood poverty						
Low	15.2	(13.2, 17.3)			17.6	16.6, 18.6
Medium	27.1	(24.5, 29.8)			37.2	35.8, 38.6
High	28.9	(26.4, 31.6)			24.6	23.5, 25.8
Very high	28.8	(26.1, 31.6)			20.6	19.6, 21.6

All race/ethnicity groups are non-Latino unless otherwise specified; poverty status is based on household poverty; YRBS Asian category does not include PI

Education, poverty, and neighborhood poverty were not assessed in the YRBS survey, hence estimates are blank

CHEWDS Child Health, Emotional Wellness, and Development Survey, *CHS* Community Health Survey, *FPL* federal poverty level, *HS* high school, *PI* Pacific Islander, *YRBS* Youth Risk Behavior Survey

[a]Among children 0–12, education refers to the highest level of educational attainment in the household; Education is restricted to adults aged 25+

1.23) compared to children who were White (0.49, 95% CI 0.37, 0.60). Sugary drink consumption per day was higher among children of caretakers reporting less than HS vs. college graduate education levels (1.66 vs. 0.63, p < 0.01) and among those living in neighborhoods of very high vs. low poverty (1.61 vs. 0.55, p < 0.01).

Sugary Drink Consumption Among Public HS Students 12–18 Years Old

In 2015, mean sugary drink consumption per day was 1.21 (95% CI 1.09, 1.23). Mean sugary drink consumption was greater among males (1.22, 95% CI 1.15, 1.29) compared to females (1.10, 95% CI 1.00, 1.20), and greater among

Table 2 Mean sugary drinks per day among NYC children, Child Health, Emotional Wellness, and Development Survey, 2015

	All Children		0–5 years old		6–12 years old	
	Mean	95% CI	Mean	95% CI	Mean	95% CI
OVERALL	0.80	0.71, 0.89	0.53	0.45, 0.61	1.05	0.90, 1.21
Sex						
Male (ref)	0.89	0.75, 1.02	0.55	0.44, 0.67	1.22	0.99, 1.45
Female	0.70*	0.58, 0.82	0.50	0.40, 0.61	0.88*	0.68, 1.09
Race/ethnicity						
White (ref)	0.32	0.26, 0.38	0.18	0.12, 0.24	0.49	0.37, 0.60
Black	1.27*	1.01, 1.53	0.89*	0.63, 1.15	1.55*	1.16, 1.95
Latino	0.87*	0.77, 0.98	0.68*	0.56, 0.80	1.06*	0.89, 1.23
Asian/PI	0.67	0.26, 1.08	0.27	0.12, 0.41	1.4	0.31, 1.77
Education						
College+ (ref)	0.46	0.39, 0.53	0.28	0.21, 0.36	0.63	0.52, 0.74
Some college	0.91*	0.71, 1.11	0.55*	0.42, 0.67	1.28*	0.92, 1.63
HS grad	0.92*	0.75, 1.09	0.70*	0.53, 0.88	1.19*	0.88, 1.49
< HS	1.48*	1.03, 1.93	1.19*	0.72, 1.65	1.66*	1.00, 2.31
Poverty						
400%+ FPL (ref)	0.39	0.30, 0.47	0.23	0.15, 0.31	0.53	0.40, 0.66
200–400% FPL	0.40	0.31, 0.48	0.32	0.20, 0.45	0.48	0.37, 0.60
< 200% FPL	1.08*	0.93, 1.24	0.70*	0.57, 0.82	1.43*	1.17, 1.69
Neighborhood poverty						
Low (ref)	0.44	0.34, 0.54	0.32	0.19, 0.45	0.55	0.40, 0.70
Medium	0.70*	0.57, 0.83	0.52	0.36, 0.67	0.84*	0.65, 1.03
High	0.77*	0.64, 0.90	0.59*	0.44, 0.75	0.97	0.76, 1.18
Very high	1.08*	0.83, 1.33	0.58	0.43, 0.72	1.61*	1.15, 2.07

All race/ethnicity groups are non-Latino unless otherwise specified; household education refers to the highest level of educational attainment in the household; poverty status is based on household poverty

FPL federal poverty level, *HS* high school, *PI* Pacific Islander

*Indicates mean is significantly different from the noted reference category, p < 0.05

Blacks (1.45, 95% CI 1.31, 1.58) or Latinos (1.24, 95% CI 1.11, 1.37) compared to Whites (0.83, 95% CI 0.71, 1.29).

Sugary Drink Consumption Among all Adults

In 2015, mean sugary drink consumption was 0.66 (95% CI 0.62, 0.70) among all adults (Table 3). Sugary drink consumption was higher among Blacks (0.99, 95% CI 0.88, 1.10) and Latinos (0.81, 95% CI 0.74, 0.88) compared with Whites (0.45, 95% CI 0.39, 0.51). Likewise, mean sugary drink consumption was higher among adults with less education, higher poverty levels, and adults residing in neighborhoods of higher poverty. These patterns were consistent across all adult age groups, though mean sugary drink consumption was higher among younger adults. For example, mean sugary drink intake was 1.09 (95% CI 0.90, 1.27) among adults aged 18–24, 0.78 (95% CI 0.71, 0.85) among adults aged 25–44, 0.50 (95% CI 0.45, 0.55) among adults aged 45–64, and 0.34 (95% CI 0.30, 0.39) among adults aged 65 or older.

Nine Year Trends in Sugary Drink Consumption Among all Adults

Between 2007 and 2015, sugary drink consumption among all NYC adults decreased 36% from 1.03 (95% CI 0.99, 1.08) to 0.66 (95% CI 0.62, 0.70), p < 0.01 (Fig. 1). This decline was seen across all sex, age, race/ethnicity, education, poverty, and neighborhood poverty groups, p < 0.05 for all. Despite these declines, disparities in sugary drink consumption persisted in 2015 (as noted above). Results from our sensitivity analyses, showed that median sugary drink intake, though lower than mean sugary drink intake, mirrored all patterns found with means, and also decreased over time among all adults and among adults who reported any sugary drink consumption (data not shown).

Table 3 Mean sugary drinks per day among NYC adults, Community Health Survey, 2015

	All Adults		18–24 years old		25–44 years old		45–64 years old		≥ 65 years old	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Overall	0.66	0.62, 0.70	1.09	0.90, 1.27	0.78	0.71, 0.85	0.50	0.45, 0.55	0.34	0.30, 0.39
Sex										
Male (ref)	0.75	0.68, 0.81	1.25	0.94, 1.56	0.91	0.80, 1.02	0.54	0.47, 0.61	0.35	0.28, 0.41
Female	0.58*	0.54, 0.63	0.93	0.73, 1.12	0.66*	0.58, 0.75	0.60	0.40, 0.53	0.34	0.29, 0.40
Race/ethnicity										
White (ref)	0.45	0.39, 0.51	0.73	0.47, 0.99	0.46	0.6, 0.57	0.40	0.32, 0.48	0.27	0.21, 0.34
Black	0.99*	0.88, 1.10	1.61*	1.04, 2.18	1.20*	1.01, 1.38	0.66*	0.57, 0.76	0.61*	0.49, 0.73
Latino	0.81*	0.74, 0.88	1.15*	0.87, 1.43	0.99*	0.86, 1.12	0.65*	0.55, 0.75	0.42*	0.34, 0.50
Asian/PI	0.35*	0.29, 0.41	0.62	0.43, 0.81	0.51	0.39, 0.62	0.18*	0.11, 0.25	0.08*	0.04, 0.11
Education										
College+ (ref)	0.37	0.33, 0.41	–	–	0.44	0.36, 0.52	0.34	0.28, 0.40	0.25	0.18, 0.32
Some college	0.65*	0.58, 0.73	–	–	0.87*	0.74, 1.00	0.53*	0.43, 0.62	0.37	0.27, 0.48
HS grad	0.82*	0.73, 0.91	–	–	1.10*	0.93, 1.27	0.63*	0.53, 0.73	0.49*	0.39, 0.59
< HS	0.76*	0.65, 0.87	–	–	1.09*	0.87, 1.31	0.56*	0.45, 0.68	0.31	0.24, 0.38
Poverty										
400%+ FPL (ref)	0.48	0.41, 0.54	0.90	0.54, 1.27	0.50	0.41, 0.59	0.37	0.30, 0.44	0.27	0.20, 0.35
200–400% FPL	0.70*	0.61, 0.80	1.25	0.75, 1.75	0.74*	0.60, 0.88	0.57*	0.45, 0.69	0.43*	0.33, 0.52
< 200% FPL	0.76*	0.70, 0.82	1.07	0.88, 1.25	0.98*	0.87, 1.09	0.57*	0.50, 0.63	0.35	0.29, 0.41
Neigh poverty										
Low (ref)	0.54	0.44, 0.64	1.44	0.84, 2.05	0.48	0.34, 0.62	0.38	0.28, 0.48	0.29	0.20, 0.38
Medium	0.56	0.51, 061	0.70*	0.75, 0.84	0.73*	0.62, 0.83	0.41	0.34, 0.48	0.34	0.26, 0.42
High	0.73*	0.63, 0.83	1.35	0.75, 1.94	0.79*	0.67, 0.91	0.60*	0.50, 0.71	0.34	0.26, 0.42
Very high	0.85*	0.76, 0.94	1.30	0.97, 1.63	0.98*	0.81, 1.15	0.70*	0.59, 0.81	0.47*	0.37, 0.57

All race/ethnicity groups are non-Latino unless otherwise specified; education is restricted to adults aged 25+; poverty status is based on household poverty

FPL federal poverty level, *HS* high school, *PI* Pacific Islander

*Indicates mean is significantly different from the noted reference category, p < 0.05

Education was categories were only estimated among adults ≥ 25 years of age, hence categories are blank

Discussion

Consumption of sugary drinks is an unhealthy habit at any age; it can lead to weight gain and is associated with other adverse health effects [1–4]. In response to the current obesity crisis, several organizations, including local governments, have focused their efforts on reducing sugary drink consumption. Likely, the 36% decrease in sugary drink consumption among NYC adults from 1.03 drinks/day in 2007 to 0.66 drinks/day in 2015 is partially a result of these efforts. The local NYC government attempted to limit sugary drink portion sizes offered or sold at chain food service establishments in 2012 [20]. Though this policy was not implemented, it generated media coverage and may have increased public awareness about the harms of sugary drinks [21]. Additionally, beginning in 2007, policies which changed nutritional regulations in NYC agencies and in child care settings [21], and mass media educational campaigns were launched and continued to present date. While these

declines are promising, sugary drink consumption remains too high and continues to present a challenge as even the youngest New Yorkers consume too many harmful beverages. Additionally, despite the declines among all groups, little progress has been made in closing relative disparities in sugary drink consumption by race/ethnicity and other sociodemographic characteristics. For example, in most cases, Black New Yorkers consume at least double the amount of sugary drinks as White New Yorkers. Also troubling is the existence of these disparities throughout all age groups—suggestive of pervasive health inequities that emerge very early and present throughout adulthood.

The formation of habits often happens at a young age [22–24] and can lead to lifelong practices which can be difficult to overcome in later years [25]. For example, several life course models hypothesize that there are critical periods and sensitive time points at which exposures may have deeper and lasting impacts [26]. The current study data show that NYC residents start consuming sugary drinks at a young
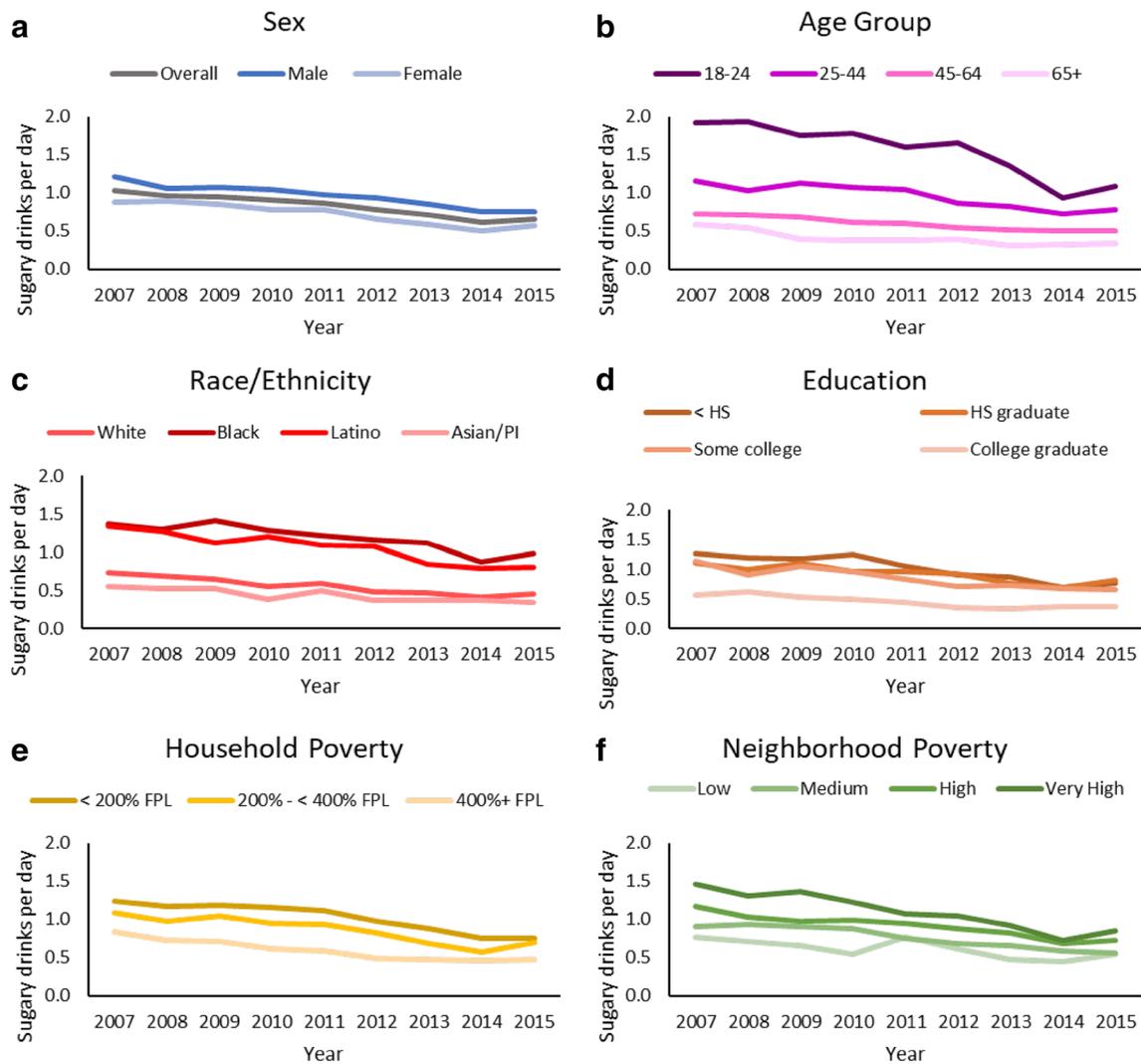
Fig. 1 Mean sugary drinks per day among NYC adults, Community Health Survey, 2007–2015. *FPL* federal poverty level, *HS* high school, *PI* Pacific Islander. All race/ethnicity groups are non-Latino unless otherwise specified; education is restricted to adults aged 25+

age, and consumption is highest among adolescents and young adults and is lowest among older adults. The youngest NYC residents (aged 0–5) consumed an average of 0.53 sugary drinks per day—a number almost on par with what the average adult reports in 2015 (0.66 per day). The survey questions include soda, sweetened iced tea, sports drinks, fruit punch, and other fruit-flavored drinks. Among these drink types, sports drinks are typically lower in calories, at around 6.5 calories/ounce, and fruit drinks and energy drinks are on the higher end, some with 17 calories/ounce or more [6]. This means that even half of a 12-ounce sugary drink could contribute an additional 108 calories per day, when the total daily recommended intake for this age group is only 1000–1600 [27]. Among older children, aged 6–12, sugary drink consumption is even higher; on average, children in this age group consume just over one sugary drink

daily— potentially translating to 215 or more extra calories per day, with a recommended daily intake of 1200–2400 calories total [27]. Sugary drinks can contribute significantly to the consumption of added sugars. For a 2,000 calorie diet, the recommended 10% maximum from added sugars would equate to 200 calories, or 50 g of sugar [5]. One 12-oz Coca-Cola has 39 g of sugar [28], almost 80% of the recommendation for the entire day contained in one beverage. For a child with a 1600 calorie diet, 39 g of sugar is almost 100% of their maximum allotment. Overconsumption of added sugars can make it difficult to consume a diet within recommended calorie needs.

Sugary drink consumption also differed by socio-economic factors. For example, children and adults in the lowest income groups (highest poverty) reported drinking more sugary drinks than their higher income counterparts.

It is unlikely that children under the age of five have full autonomy in determining their beverage intakes [24], suggesting that sugary drink consumption may be related to practices in the home, neighborhood environment, and early childhood settings. Other studies emphasize similar findings. For example, parental cooking [29] and a health promoting home environment [30] have been shown to be associated with lower sugary drink consumption among children. Likewise, numerous studies have shown that the neighborhood environment is associated with diet [31] and, in particular, sugary drink intake [9, 32]. We found that children from households with lowest vs. highest educational attainment consumed four times as many sugary drinks. Among adults, we found a very clear socio-economic gradient, with lower sugary drink consumption at higher levels of education. These trends have also been observed in national data from the National Health and Nutrition Examination Survey, showing that lower income and lower educational attainment are associated with greater consumption of sugary drinks [33].

Perhaps most striking in our findings were the large disparities in sugary drink consumption by race/ethnicity, which, among adults, has been shown to persist even within income strata [34]. There is evidence that corporations target sugary drink ads toward communities of color, resulting in increased exposure to such imagery compared to White populations [12, 35, 36]. This practice is not without consequence; research indicates that exposure to consumption cues (i.e., advertisements) can both trigger consumption and induce habit formation [37]. This may explain why our analysis found that, even among children 5 and under, we found a large disparity in sugary drink consumption, with Black and Latino children consuming four and three times as many sugary drinks compared to White children, respectively. This trend persisted in every age group, suggesting that habits likely begin early and present throughout life.

This study is not without limitations. First, these data are derived from cross-sectional surveys of overlapping years but different study age groups. Therefore, we were unable to determine how trends changed from youth to adulthood. Rather, we were able to characterize a cross-section of the population at the same point in time. Further, our definition of sugary drinks differed slightly among surveys, limiting the comparability of our estimates across populations. The YRBS survey also lacked information about neighborhood or household poverty of students, so we were unable to analyze consumption with respect to these measures. Additionally, our definition of sugary drinks throughout all surveys excluded blended beverages and sweet coffee drinks, which can be very high in sugar; therefore the data presented may be a conservative estimate of sweet beverages consumed. Finally, due to methodological differences in the survey instruments, we were unable to determine whether declines were specific to NYC or in line with national trends showing declines in sugary drink consumption among children and adults [8]. However, a recent study using national dietary recall data showed almost no significant changes between 2003 and 2014 among Latinos and Blacks across almost all age groups [8] while our findings specific to NYC showed significant declines among all race/ethnic groups at each adult age group. Despite such limitations, our findings were notable for many reasons. First, our large robust samples were representative of NYC as a whole and allowed for stratification by key socio-demographic characteristics. Additionally, with 9 years of systematically-collected data available, we were able to test for trends among NYC adults overall and by key socio-demographic characteristics. Our large representative samples also enabled us to characterize sugary drink consumption in NYC over a wide spread of age groups which included those as young as infants. Finally, though we were unable to attribute any decline in sugary drinks to specific interventions, these data are informative as they correspond with targeted public health efforts aimed at reducing sugary drink consumption.

Public Policy Implications/Conclusions

High rates of sugary drink consumption in NYC, particularly among young children, as well as the disparities by race/ethnicity across all age groups, are troubling and require a multi-sectoral approach to achieve further progress. Government efforts are needed to ensure that community and institutional environments are supportive of healthy beverage choices. For instance, the US Food and Drug Administration's proposed, but delayed, updated nutrition facts label will for the first time display calories from added sugars and added sugar content in comparison with the recommended daily limit. In addition to government efforts, industry action is needed to reduce the ubiquity of unhealthy beverages and pervasiveness of unhealthy food and beverage marketing in communities and directed toward children. Community groups and health care organizations can create healthy environments by removing sugary drinks from their facilities and events, and health care providers can talk to patients and caregivers, especially those caring for young children, about reducing or never starting sugary drink consumption. Non-governmental organizations also have tremendous power to push the local and national discussion on sugary drinks by engaging in advocacy efforts. Lastly, we encourage local and state health departments to collect similar surveillance data on sugary drink consumption to guide their programmatic, policy, and educational efforts to reduce sugary drink consumption.

Compliance with Ethical Standards

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