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Trends and sociodemographic disparities in sugary drink consumption among adults in New York City, 2009–2017

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A B S T R A C T

Despite efforts to decrease sugary drink consumption, sugary drinks remain the largest single source of added sugars in diets in the United States. This study aimed to examine trends in sugary drink consumption among adults in New York City (NYC) over the past decade by key sociodemographic factors. We used data from the 2009–2017 NYC Community Health Survey to examine trends in sugary drink consumption overall, and across different age, gender, and racial/ethnic subgroups. We conducted a test of trend to examine the significance of change in mean sugary drink consumption over time. We also conducted multiple zero-inflated negative binomial regression to identify the association between different sociodemographic and neighborhood factors and sugary drink consumption. Sugary drink consumption decreased from 2009 to 2014 from 0.97 to 0.69 servings per day ($p < 0.001$), but then plateaued from 2014 to 2017 ($p = 0.01$). Although decreases were observed across all age, gender and racial/ethnic subgroups, the largest decreases over this time period were observed among 18–24 year old (1.75 to 1.22 servings per day, $p < 0.001$); men (1.12 to 0.86 servings per day, $p < 0.001$); Blacks (1.45 to 1.14 servings per day, $p < 0.001$); and Hispanics (1.26 to 0.86 servings per day, $p < 0.001$). Despite these decreases, actual mean consumption remains highest in these same sociodemographic subgroups. Although overall sugary drink consumption has been declining, the decline has slowed in more recent years. Further, certain age, gender and racial/ethnic groups still consume disproportionately more sugary drinks than others. More research is needed to understand and address the root causes of disparities in sugary drink consumption.

1. Introduction

Despite efforts to decrease sugary drink consumption, sugary drinks remain the largest single source of added sugars in diets in the United States (US) (DeSalvo et al., 2016; NYC DOHMH, 2017a). Almost half of all added sugars in an average diet is from sugary drinks, with some 20-ounce drinks containing more added sugars than the recommended daily limit (DeSalvo et al., 2016). Strong evidence from randomized controlled trials and prospective and retrospective studies has implicated the consumption of sugary drinks in weight-gain and obesity (Te Morenga et al., 2013; Malik et al., 2010a; Vartanian et al., 2007); both of which have risen in recent years (Hales et al., 2017). Moreover, studies have shown that sugary drink consumption increases the risk of chronic diseases such as diabetes, hypertension, coronary heart disease, stroke and myocardial infarction (Te Morenga et al., 2013; Vartanian et al., 2007; Cheungpasitporn et al., 2015; Narain et al., 2016; Bechthold et al., 2017; Malik et al., 2013, 2010b; Te Morenga et al., 2014; Hu and Malik, 2010; Van Rompay et al., 2015).

Though prevalent in the general population, sugary drink consumption is disproportionately high among certain racial/ethnic groups in the US (Rehm et al., 2008; Park et al., 2012). A recent study using nationally-representative data showed that levels of sugary drink consumption was the highest among Blacks and Hispanics (Bleich et al., 2018). Over the past decade, New York City (NYC) has enacted legislation to restrict sugary drink sales in public schools, city agencies, and contracted service providers. The city has implemented public health campaigns focused on reducing sugary drink consumption in both adults and children (Kansagra et al., 2015). Despite an earlier study showing that sugary drink consumption declined across different age groups before 2015 (Elfassy et al., 2018); there is a need for accurately

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characterizing sugary drink consumption for more recent years across different sociodemographic groups. Understanding how the ongoing efforts have been associated with age, gender and racial/ethnic disparities in sugary drink consumption is critical to identify areas of improvement in public health interventions. In this study, we aim to provide the most recent picture of the trends of sugary drink consumption across different age, gender and racial/ethnic groups in NYC.

2. Methods

2.1. Study population

We used data from the 2009–2017 NYC Community Health Survey (CHS) (New York City Department of Health and Mental Hygiene, 2018). The NYC CHS is an annual population health survey conducted by the NYC Department of Health and Mental Hygiene (DOHMH). The survey uses stratified random sampling to provide a representative sample of NYC adults and generate neighborhood and citywide estimates of demographics, health behaviors, and chronic conditions. Our study sample included adults aged 18 years or older with self-reported information on demographics, socioeconomic status, and sugary drink consumption. Participants who did not report sugary drink consumption were excluded from this analysis (n = 1,229), resulting in a final analytic sample size of N = 80,085.

2.2. Measures

The NYC CHS examined sugary drink consumption via interviewer-administered surveys with a beverage frequency questionnaire. Participants were asked, “How often do you drink sugar-sweetened soda? Do not include diet soda or seltzer. Standardized to per day” and “How often do you drink other sweetened drinks like sweetened iced tea, sports drinks, fruit punch, or other fruit-flavored drinks?” The response was open ended and reflects the average number of drinks per day. One drink was equal to a 12-ounce can, bottle or glass, which was defined as one serving size in our analysis. To calculate the overall daily sugary drink consumption, we summed the responses from these two questions in the analysis.

We reported trends in sugary drink consumption for the following categories: overall NYC-wide; age (18–24, 25–44, 45–64, 65+ years); gender (male, female); and race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and non-Hispanic Asian American/Pacific Islander [hereafter, White, Black, Hispanic and AAPI]). We additionally present trends stratified by both age and race/ethnicity; and by both gender and race/ethnicity. We controlled for individual-level demographic and socioeconomic characteristics, including age, race/ethnicity, gender, educational attainment (less than high school, high school graduate, some college, college graduate), marital status (married/not married), and nativity (US born/Foreign born). Household income was categorized using the federal poverty level ([FPL], < 200% FPL, 200–399% FPL, > 400% FPL) (The United States Census Bureau, 2019). To adjust for potential neighborhood effects, we also controlled for neighborhood poverty status measured by the percentage of the population living below 100% FPL at the neighborhood (census tract) level. We used four categories to measure neighborhood poverty (i.e., 0– < 10%, 10– < 20%, 20– < 30%, 30– < 100%), with a higher percentage indicating more severe neighborhood poverty.

2.3. Statistical analysis

Results were weighted to be representative of the NYC adult population as a whole. We calculated weighted mean frequencies of sugary drink consumption per day in each survey year across different age, gender, and racial/ethnic subgroups. We conducted tests of linear trend and calculated p values to examine the significance of change in mean sugary drink consumption over time overall and then within each age, gender and racial/ethnic subgroup. P < 0.05 was considered statistically significant. We then created weight-adjusted multiple zero-inflated negative binomial regression (ZINB) models to identify the association between different sociodemographic and neighborhood factors (i.e., neighborhood poverty level) and sugary drink consumption. The zero-inflated negative binomial regression was used because the dependent variable was count data, contained an excessive number of zeros, and was non-normally distributed (Gaher et al., 2015; Rehder and Bowen, 2019). Year as a fixed effect was controlled in all estimations because data from multiple years were combined. Sampling weights were adjusted in the descriptive and regression analyses. To help with the interpretation of the results, we reported incidence rate ratios (IRRs) for each of the covariates (Rehder and Bowen, 2019). We finally performed a likelihood-ratio test to determine the model goodness of fit. All analyses were conducted using Stata software, version 15 (StataCorp LLC, College Station, Texas).

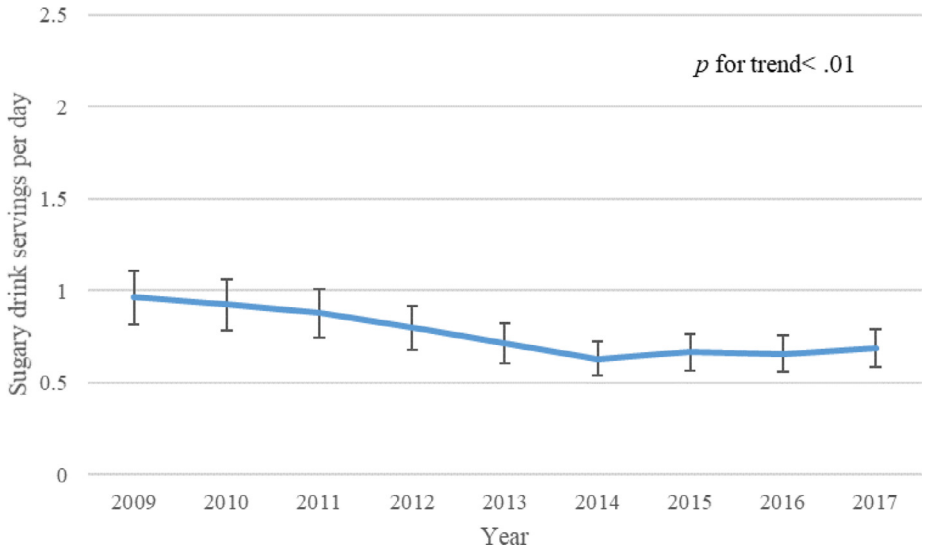

Fig. 1. Weight-adjusted mean of sugary drink consumption among NYC residents aged 18 and over from 2009 to 2017, overall.

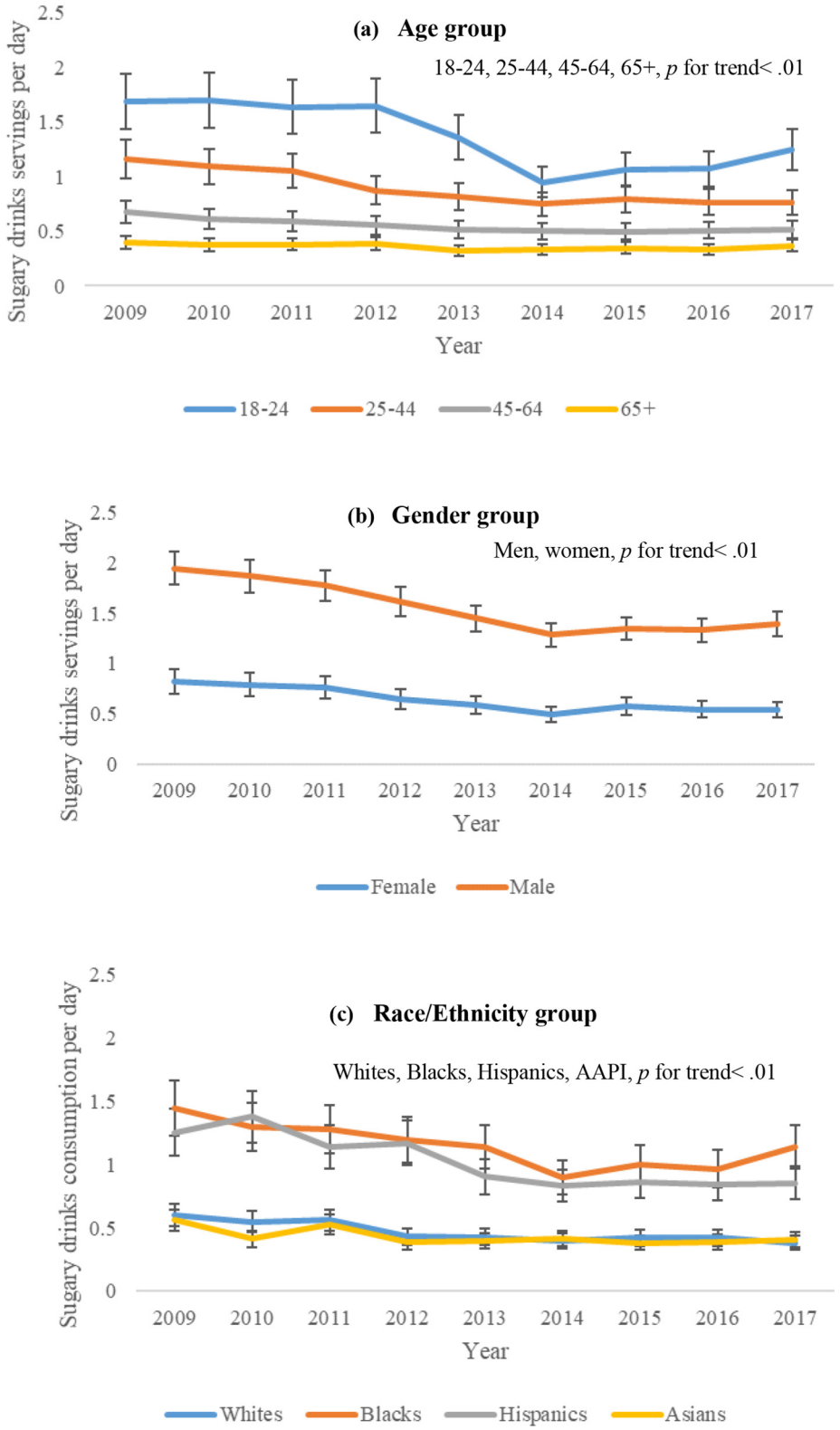

Fig. 2. Weight-adjusted mean of sugary drink consumption among NYC residents aged 18 and over from 2009 to 2017 * Gray bands are 95% confidence intervals.

3. Results

3.1. Temporal trends of sugary drink consumption

Fig. 1 displays the trend in daily sugary drink consumption in NYC adults overall. From 2009 to 2014, sugary drink consumption decreased from 0.97 to 0.69 servings per day ($p < 0.001$), then plateaued from 2014 to 2017 ($p = 0.01$). Fig. 2 demonstrates trends across age, gender and racial/ethnic subgroup. Young adults aged 18 to 24 years consumed the highest number of sugary drinks among all age groups. The consumption declined until 2014, and slowly increased from 2015 to 2017. Per capita sugary drink consumption decreased from 1.11 to 0.86

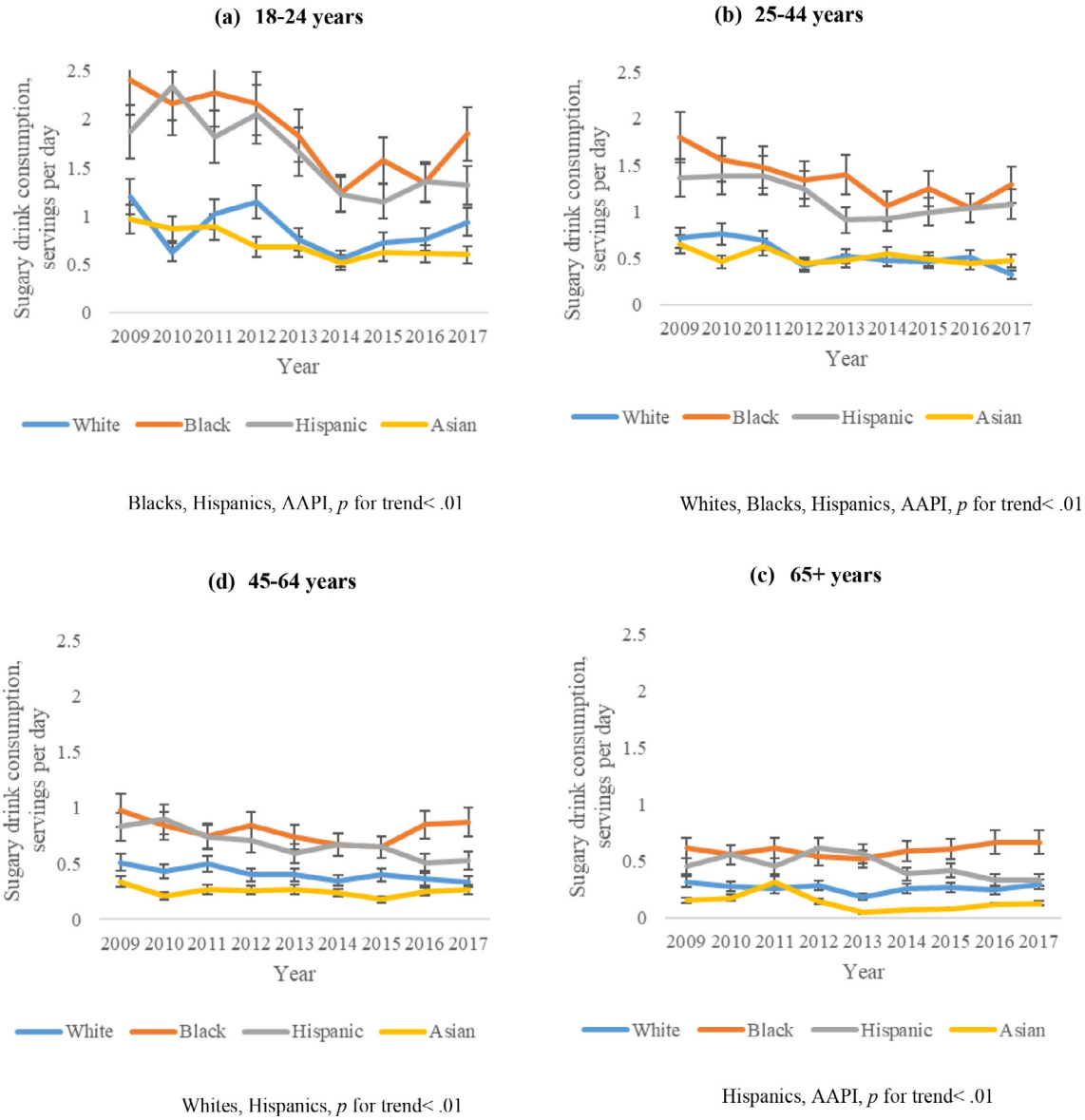

Fig. 3. Weight-adjusted mean of sugary drink consumption among NYC residents aged 18 and over from 2009 to 2017, by age group and race/ethnicity.

drinks/day for men ($p < 0.001$) and from 0.84 to 0.54 drinks/day for women ($p < 0.001$). Despite the significant declines overall, sugary drink consumption among Blacks and Hispanics were still higher than the other racial/ethnic groups. In 2017, mean intake was highest in 18–24 year old; men; and Blacks and Hispanics.

Fig. 3 displays the trend in daily sugary drink consumption within different racial/ethnic groups stratified by age group in NYC from 2009 to 2017. Sugary drink consumption decreased with age across all racial/ethnic categories. Among young adults aged 18 to 24 years, per capita sugary drink consumption decreased from 2.41 to 1.85 drinks/day for Blacks ($p < 0.001$) and from 1.87 to 1.32 drinks/day for Hispanics ($p < 0.001$). The sugary drink consumption among Whites young adults did not change significantly over time ($p > 0.05$). Among adults aged 25 to 64 years, daily sugary drink consumption declined significantly for each of the four racial/ethnic groups ($p < 0.001$). Among older adults aged 65 years or older, Hispanics had a significant decrease in sugary drink consumption ($p < 0.001$), while the other racial/ethnic groups did not change significantly over time ($p > 0.05$).

Fig. 4 shows the temporal trend of sugary drink consumption by race/ethnicity stratified by gender. Compared with men, women consumed fewer sugary drinks per day across all racial/ethnic groups. Daily sugary drink consumption declined significantly ($p < 0.001$) for all groups until 2014, when consumption increased among Black and Hispanic men and Black women. In addition, adults aged 18–24 had a significant increase in daily sugary drink consumption since 2014 (Fig. 2). Black and Hispanic men also had the highest sugary drink consumption among all racial/ethnic and gender groups from 2009 to 2017. Among Whites and AAPI, there were modest but significant declines in daily sugary drink consumption for both genders ($p < 0.001$).

3.2. Determinants of sugary drink consumption

Table 1 presents the incidence rate ratios (IRR) and 95% confidence intervals (CI) estimated from the weight-adjusted zero-inflated negative binomial regression. The results show that men reported a higher sugary drink consumption compared to women (*IRR* = 1.22, 95% CI 1.20–1.26). Compared with Whites, Hispanics (*IRR* = 1.11, 95% CI 1.06–1.15) and Blacks (*IRR* = 1.22, 95% CI 1.19–1.27) reported higher sugary drink consumption, whereas AAPI reported lower sugary drink consumption (*IRR* = 0.83, 95% CI 0.79–0.87). We also found that being foreign-born was a significant protective factor against sugary drink consumption (*IRR* = 1.45, 95% CI 1.40–1.48). Age was negatively

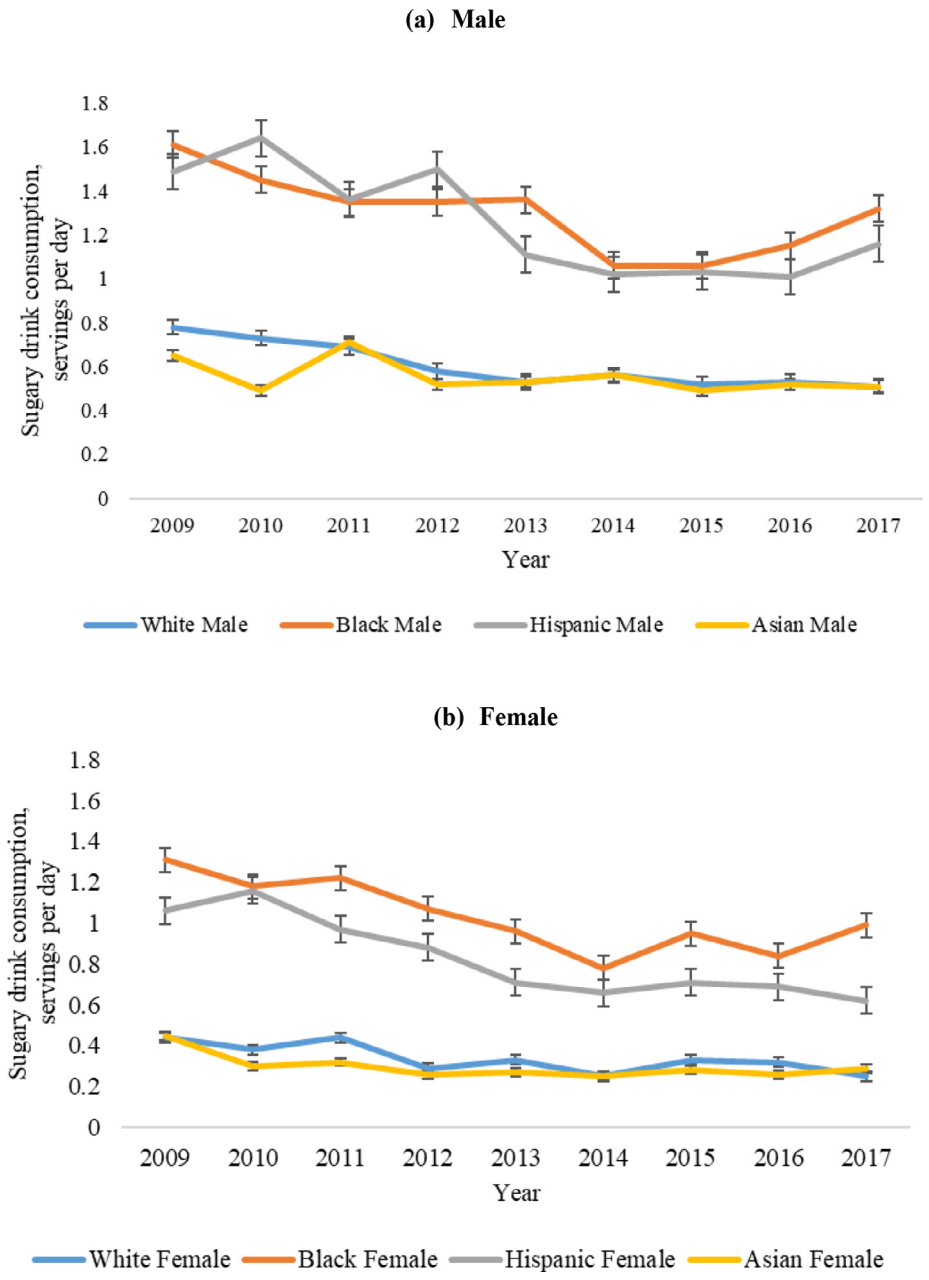

Fig. 4. Weight-adjusted mean of sugary drink consumption among NYC residents from 2009 to 2017, by gender and race/ethnicity.

associated with sugary drink consumption. Married individuals consumed fewer sugary drinks compared to those who were not married (*IRR* = 0.86, 95% CI 0.84–0.89). Low educational attainment was associated with a higher sugary drink consumption. Similarly, low- and middle-income individuals were more likely to consume more sugary drinks compared to high-income individuals. Living in a neighborhood with a high percentage of poverty (30–100%) was associated with higher sugary drink consumption (*IRR* = 1.07, 95% CI 1.03–1.13).

4. Discussion

The present study sought to understand the trends of sugary drink consumption over time in NYC considering age, gender and race/ethnicity. Consumption of sugary drinks declined from 2009 to 2014 in NYC across all groups, which was consistent with recent findings that SSB consumption has been declining nationally (Bleich et al., 2018; Beverage-Digest, 2020). The consumption of sugary drinks plateaued from 2014 to 2017 in this representative sample of NYC adults, while there is a lack of trend analysis for the national population. Decreases in consumption appear to primarily be driven by decreases observed in young and middle-aged adults; men; and Black and Hispanics. We found that there were differences in consumption level by age, gender and racial/ethnic subgroup. Regression analyses revealed that Hispanics and Blacks consumed the greatest amount of sugary drinks and AAPI consumed the least. Furthermore, persons who were male, younger, lower and middle-income and lived in an extremely poor neighborhood were more likely to consume sugary drinks. Foreign-born adults, married individuals and persons with high educational attainment were less likely to consume sugary drinks.

Our findings are consistent with prior research in that Hispanics and Blacks were the biggest consumers of sugary drinks and AAPI consumed the least (Elfassy et al., 2018; Rosinger et al., 2017). With regards to AAPI, however, consumption may be underestimated due to a potential lack of culturally salient beverage examples within current survey

Table 1
Weight-adjusted multiple zero-inflated negative binomial regression: consumption of SSB (servings per day) among adults in NYC (N = 80,085).

	IRR	*p*-value	[95% Conf.	Interval]
Male	1.22	0.000	1.19	1.25
Age group, years (ref. 18–24)				
25–44	0.93	0.000	0.89	0.96
45–64	0.80	0.000	0.76	0.83
65+	0.71	0.000	0.68	0.74
Race (ref. White)				
Black	1.22	0.000	1.18	1.27
Hispanic	1.10	0.000	1.07	1.14
AAPI	0.83	0.000	0.78	0.87
US born	1.44	0.000	1.40	1.48
Education (ref. Less than high school)				
High school grad	0.92	0.000	0.89	0.95
Some college	0.82	0.000	0.79	0.85
College graduate	0.66	0.000	0.64	0.69
Married	0.86	0.000	0.83	0.88
Individual poverty status (ref. < 200% FPL)				
200–399% FPL	0.90	0.000	0.88	0.94
> 400% FPL	0.82	0.000	0.79	0.84
Neighborhood poverty status (ref. 0– < 10%)				
10– < 20%	1.05	0.017	1.01	1.09
20– < 30%	1.03	0.213	0.99	1.07
30– < 100%	1.08	0.001	1.03	1.12
Year fixed effect	Yes			
Constant	1.62	0.000	1.50	1.73
LR test	3878.73			

Note: IRR indicates incidence rate ratio.

questions (Bragg et al., 2017; Yu et al., 2016; Min et al., 2017). One of the possible reasons for these racial/ethnic disparities is that marketing for unhealthy food is often targeted to Hispanic and Black communities (Harris et al., 2015, 2019).

Low- and middle-income status and living in a poor neighborhood were both predictors of sugary drink consumption. “Food swamps” are areas in which persons have high access to small food retailers, corner stores, fast food outlets and carryout restaurants, but limited access to supermarkets (Steeves et al., 2014; Walker et al., 2010). Neighborhoods with these qualities are more likely to be low-SES (Mui et al., 2017). The increased availability of unhealthful foods and beverages in impoverished neighborhoods may explain the finding of increased consumption among residents of these areas (Duran et al., 2016). Modifying the built environment to facilitate access to healthful options could improve the diets of these individuals (Li et al., 2018); though some studies failed to find a positive association (Allcott et al., 2019). In addition, racism and disinvestment in communities of color may also contribute to disparities at the neighborhood level (Schaff et al., 2013; Morello-Frosch and Lopez, 2006). Reducing marketing for unhealthy food in communities of color may also help improve dietary quality among their residents (Harris et al., 2015).

In 2009, NYC launched a financial incentive program, Food Retail Expansion to Support Health (FRESH), that provides real estate, state and mortgage recording tax deals to businesses that open or renovate grocery stores in underserved areas (Elbel et al., 2015). A 2017 study found that reductions in sugary drink consumption in the year following the opening of a new supermarket, which had received FRESH tax incentives (Elbel et al., 2017). Increased awareness and expansion of this program may lead to further reductions in consumption among these key populations.

The overall decline in sugary drink consumption over time coincide with the introduction of legislation in NYC to combat the rise of obesity and related health problems. In 2008, an executive order was signed that mandated all city agencies follow specific standards for foods purchased, prepared and/or served by the agency and/or contractors (NYC DOHMH, 2017b). A public health campaign initiated in 2009 advertised the harms of sugary drink intake (NYC DOHMH, 2019). A number of national policies have been implemented to reduce sugary drink consumption during this time period (Bleich et al., 2018). These policies may be associated with the declining trend in SSB consumption though more research is needed to examine the causation. The plateau of sugary drink consumption in 2014 may reflect multiple sociopolitical factors or other trends. For example, the slowing may be attributed to a reduced focus in health campaign messaging around sugary drinks around that time period in NYC. Alternatively, it may be that some of the public health strategies employed were particularly effective for the subgroups we found to have the most dramatic decreases over time. The plateau observed within some subgroups (Blacks and Hispanics) and not others (Whites) is somewhat troubling, however. Consumption has continued to decline for Whites over time. This indicates that while the public health campaigns initiated in 2009 may have had a sustained effect in some groups, other groups need continual and/or more tailored efforts for sugary drink consumption to continue to decline.

The current study is subject to some limitations. The NYC CHS is a cross-sectional survey and, thus, causality cannot be determined. In addition, sugary drink consumption was assessed using a beverage questionnaire rather than a 24-hour dietary recall which would capture more detailed information about foods and beverages consumed. Data from a dietary recall can be disaggregated by type of sugary drink, which would enable us to assess the trends in different types of sugary drinks over time. However, studies have shown that estimates of beverage intake from frequency questionnaires were similar to those derived from dietary recall methods (Hedrick et al., 2010; Segovia-Siapco et al., 2008). Finally, we do not have data on health beliefs and dietary preferences which may influence sugary drink consumption.

Despite progress in reducing consumption and a slightly narrowing racial/ethnic disparity, certain groups (e.g., young adults, Hispanics, Blacks) still are disproportionately affected and their sugary drink consumptions had a potentially increasing trend. Prior policy and programmatic efforts have been focused at creating city-wide changes. Findings from this study suggest that, though these initiatives were important and effective, more targeted approaches may be necessary to achieve healthy equity.

CRediT authorship contribution statement

Nan Jiang: Data curation, Formal analysis, Methodology, Writing - original draft. **Stella S. Yi:** Methodology, Funding acquisition, Writing - review & editing. **Rienna Russo:** Writing - original draft. **Daniel Bu:** Writing - original draft. **Donglan Zhang:** Methodology, Writing - review & editing. **Bart Ferket:** Writing - review & editing. **Fang Fang Zhang:** Methodology, Writing - review & editing. **José A. Pagán:** Writing - review & editing. **Y. Claire Wang:** Writing - review & editing. **Yan Li:** Conceptualization, Funding acquisition, Methodology, Supervision, Validation, Writing - original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2020.101162.

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