Demographic and Behavioral Factors Associated with Daily Sugar-sweetened Soda Consumption in New York City Adults

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ABSTRACT *The objective of the study was to assess the relations of socioeconomic and behavioral factors to frequent consumption of sugar-sweetened soda among New York City (NYC) adults and the relation of frequent consumption to body mass index (BMI; kg/m²). Data from the 2005 NYC Community Health Survey, a population-based telephone survey, were analyzed. Frequent consumption was defined as drinking one or more 12-oz servings of sugar-sweetened soda on an average day; 9,865 adults, aged 18 years and older, provided valid responses. Logistic regression was used to identify factors associated with frequent consumption, and linear regression models were used to assess the relation of frequent consumption to BMI. An estimated 27.5% of NYC adults are frequent sugar-sweetened soda consumers. Frequent consumption is independently associated with low household income (odds ratio [OR]=1.7, 95% confidence interval [CI] 1.4–2.1 for <200% vs. ≥600% federal poverty level) and with ethnic group and nativity (e.g., OR=3.1, 95% CI 2.6–3.7 for U.S.-born blacks vs. whites). Men report more consumption than women, but an association of less education with frequent consumption is stronger among women. Adjusting for demographics, frequent consumption is associated with more television viewing and with less physical activity. Adjusting for demographics and behaviors, frequent consumption was associated with higher BMI among women (0.7 BMI units, 95% CI 0.1–1.2) but not among men. Disparities in sugar-sweetened soda consumption mirror obesity disparities. Improved surveillance and interventions are needed to better quantify and reduce consumption of sugar-sweetened beverages, especially in groups most impacted by obesity.*

KEYWORDS *Obesity, Epidemiology, Carbonated beverages/adverse effects, Cross-sectional studies, Health disparities.*

INTRODUCTION

The prevalence of obesity (defined as BMI ≥ 30 kg/m²) in the U.S. nearly doubled from 12.0% in 1991 to 20.9% in 2001.^{1,2} In 2004, 21.7% of the New York City

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population was obese, compared to 18.2% in 2002.³ Obesity and excess weight are clear contributors to diabetes, stroke, heart disease, and excess mortality.⁴⁻⁶ One study estimated that obesity leads to excess medical costs of \$295/per person per year, similar to the individual contributions of smoking or alcohol consumption to medical costs.⁷

Obesity is a complex public health problem, with numerous contributing factors. One potential pathway to weight gain is increased energy intake from the consumption of sugar-sweetened soda. The past 30 years has been marked by increased consumption of sugar-sweetened soda among both children and adults. In the late 1970s, 2.8% of energy intake for Americans was from sugar-sweetened soda. By 2001, this proportion had risen to more than 7.0%, accounting for one third of the 16% increase in total daily calorie intake during the same period.⁸ Energy consumption from soda increased among all age groups and from all sources, including vending machines, restaurants, fast food establishments, and grocery stores and supermarkets.⁸ Notably, the increase in soda consumption has mirrored the emergence of obesity as a major public health threat in the U.S.⁹

Obesity disproportionately affects the poor and certain race/ethnicity groups, both nationally and within New York City. In New York City, obesity is 1.8 times as prevalent in the non-Hispanic black population compared to the white population. Those living below 100% of the federal poverty level in New York City are nearly twice as likely to be obese compared to those with incomes greater than 600% of the federal poverty level. The prevalence of obesity in some low-income New York City neighborhoods approaches 30%, compared to less than 15% in some of New York City's more affluent neighborhoods.³

Despite disparities in obesity, to our knowledge, only one study has assessed variation in sugar-sweetened beverage and soda consumption in relation to demographic or socio-demographic factors associated with obesity.¹⁰ We analyzed data from a 2005 population-based telephone survey of adult New York City residents to identify individual characteristics of frequent consumers of sugar-sweetened soda, and to assess the association between sugar-sweetened soda consumption and body mass index (BMI).

MATERIALS AND METHODS

Data Source

The New York City Department of Health and Mental Hygiene (DOHMH) Community Health Survey (CHS) is an annual, stratified random digit-dialed phone survey of approximately 10,000 adult New York City residents, based on the nationwide Behavioral Risk Factor Surveillance System survey. The CHS is described in detail elsewhere.¹¹ Data for the CHS are collected through computer-assisted telephone interviews of noninstitutionalized New York City residents age 18 and older. The CHS sampling frame is designed to provide neighborhood estimates of health outcomes and health-related behaviors. Data were collected in 2005 and analyzed in the summer of 2006. The CHS protocol is reviewed and approved annually by the DOHMH Institutional Review Board.

Variables

The question assessing soda consumption in the 2005 CHS asked respondents, "On an average day, how many sodas do you drink? One drink of soda would equal a 12

ounce can, bottle or glass. Do not include diet soda or seltzer.” The question was developed specifically for the 2005 CHS and underwent cognitive testing and development. Available response categories were zero or a positive integer. For analyses presented in this paper, we used a dichotomous variable for sugar-sweetened soda consumption: one or more sugar-sweetened sodas on an average day vs. no sugar-sweetened sodas on an average day. Analyses were also conducted using cans of sugar-sweetened soda in an average day as a continuous variable. Findings of these alternative analyses were similar in terms of demographic and behavioral factors associated with higher consumption and the association between sugar-sweetened soda consumption and BMI and are not presented in this paper.

Other variables used in this analysis included gender and age. A composite race/ethnicity and foreign-born/U.S.-born variable was used because frequent soda consumption varied dramatically within certain populations, specifically within the Hispanic and black populations. Ten race/ethnicity/nativity categories were created: white, U.S.-born black, foreign-born black, Asian/Pacific Islander, Dominican, Puerto Rican, Mexican/Mexican-American, other Hispanic/Latino (U.S. born), other Hispanic/Latino (foreign born), and other. The Mexican and Mexican-American populations were combined because there were too few Mexican-American (U.S.-born) individuals for statistical analysis. In addition, the percent of frequent soda consumers did not differ between foreign- and U.S.-born Mexicans.

The income-to-poverty ratio in each respondent's household was classified as an income of less than 200% of the federal poverty level, between 200% and 599% of the federal poverty level, greater than 600% of the federal poverty level, and unknown. We used less than 200% of the federal poverty group to define the low-income group to account for the relatively high cost of living in New York City. Education was classified as less than a high school education, high school graduate, some college or technical school, and college graduate.

Behavioral factors were also included in the analysis. Frequency of television viewing was classified as less than or equal to 1 h per day, between 2 and 4 h per day, and 5 or more hours per day. Physical activity was classified into three categories according to the Healthy People 2010 guidelines for physical activity: (1) meeting the Healthy People goals for moderate or vigorous physical activity (corresponding to 30 min/day of moderate activity 5 days per week or 20 min/day of vigorous activity 3 days per week), (2) not meeting the Healthy People 2010 goals for physical activity but still reporting some moderate and vigorous physical activity, and (3) no moderate or vigorous physical activity.¹² Smoking status classified as former, never, and current was included in models with BMI because of the association between being a current smoker and having a lower BMI.

Statistical Analysis

Data were weighted to account for unequal selection probabilities and nonresponse. Primary weights consisted of the number of adults in each household divided by the number of residential telephone lines with an adjustment for households reporting interrupted phone service. Post-stratification weights were used to adjust the sample estimates to the age, race/ethnicity, and gender composition of each United Hospital Fund (UHF) neighborhood, as per the 2000 Census.

We estimated the prevalence and 95% confidence intervals (CIs) of frequent soda consumption in SUDAAN to account for the sampling scheme used in the CHS. In addition, because age was a strong predictor of soda consumption, we evaluated the age-adjusted prevalence of daily soda consumption within each covariate group. The

method of age adjustment was direct standardization using age weights from the U.S. Standard Million population.

To assess independent predictors of soda consumption, two multivariate logistic regression models were constructed, with soda consumption as the primary outcome of interest. The first model was intended to identify independent demographic predictors of soda consumption and included age group, gender, race/ethnicity, income-to-poverty ratio, and educational attainment. The second model added the behavioral measures of physical activity and television viewing to evaluate associations of soda consumption with sedentary behaviors.

To determine the association between soda consumption and BMI, three linear regression models were developed with BMI as the outcome of interest and soda consumption as the predictor of interest. The first model adjusted only for age group. The second model included covariates for age group, gender, race/ethnicity, income-to-poverty ratio, and educational attainment. The third model added the behavioral covariates of television viewing, physical activity, and smoking status (current vs. former/never). Prior studies have shown disparities in obesity to vary by gender, so in both the soda consumption and BMI analyses, relevant two-way statistical interactions were tested for gender with education, race, and income.^{13,14} In addition, an interaction between gender and soda consumption in relation to BMI was also evaluated.

All *p* values presented are two tailed, and $p < 0.05$ was considered statistically significant. The Wald test was used to evaluate the overall significance of categorical covariates. All statistical analyses were performed using SAS¹⁵ and SUDAAN.¹⁶

RESULTS

Twenty-seven percent of New York City adults or 1.66 million adults reported consuming one or more 12-oz servings of sugar-sweetened soda per day. Among these frequent consumers, 59% consumed one soda on an average day; the average was 1.9 sodas per day. There are large differences in self-reported soda consumption by gender, age group, race/ethnicity, socioeconomic status, and weight status (Table 1).

The proportions of U.S.-born blacks, Puerto Ricans, and Mexicans/Mexican-Americans who reported consuming more than one soda per day was more than twice that of whites. Individuals aged 18–24, men, and those with less than a college education were also more likely to be frequent soda consumers. In addition, those living in households with an income of 200% of the poverty level or less were more likely to be frequent soda consumers than those from higher income households. The prevalence of frequent soda consumption was highest among obese and overweight individuals, compared to normal weight individuals. Soda consumption was also associated with sedentary behaviors. Among those watching 5 or more hours of television per day, the prevalence of frequent soda consumption was 38%, compared to 21% among those watching an hour or less per day. Individuals not reporting any moderate or vigorous physical activity were also more likely to be frequent soda consumers than those reporting at least some moderate physical activity.

In a logistic regression model with frequent sugar-sweetened soda consumption as the outcome, age, gender, income-to-poverty ratio, and educational attainment were significant independent demographic predictors of frequent soda consumption after adjustment; a significant two-way interaction between gender and educational attainment was also observed (Table 2, model 1). Young adults were more likely than older adults to be frequent consumers. With whites as the reference group, the

TABLE 1 Description of 2005 NYC Community Health Survey sample and prevalence of frequent sugar-sweetened soda consumption

Variable	N ^a	Weighted <i>n</i>	Frequent sugar-sweetened soda consumption	
			Crude prevalence	Age-adjusted prevalence (95% CI)
All participants	9,916	6,068,000		
Soda consumption	9,865			
Frequent—1+ soda per day	2,566	1,659,000	27.5	27.1 (26.0–28.2)
<1 soda per day	7,299	4,380,000		
Weight status	9,192			
Underweight	192	138,000	23.7	22.0 (15.8–29.8)
Normal weight	3,728	2,435,000	25.3	23.8 (22.1–25.5)
Overweight	3,198	1,957,000	28.5	28.8 (26.7–30.9)
Obese	2,074	1,110,000	32.0	33.3 (30.7–36.2)
Age group (years)	9,843			
18–24	762	779,000	43.2	
25–44	3,910	2,627,000	31.2	
45–64	3,322	1,686,000	21.7	
65+	1,849	932,000	14.3	
Gender	9,865			
Male	3,920	2,785,000	34.0	32.8 (31.0–34.6)
Female	5,945	3,254,000	21.9	22.0 (20.7–23.4)
Race/ethnicity/birthplace	9,732			
White	3,755	2,327,000	17.2	18.0 (16.4–19.7)
Black (U.S. born)	1,665	841,000	43.6	42.5 (39.5–45.5)
Black (Foreign born)	902	532,000	28.3	27.2 (23.9–30.9)
Asian/Pacific Islander	656	613,000	24.3	22.0 (18.6–25.8)
Puerto Rican	898	436,000	39.7	38.1 (34.3–42.1)
Dominican	576	350,000	29.2	26.9 (22.1–32.2)
Mexican/ Mexican-American	222	174,000	56.4	49.0 (39.1–59.0)
Other Hispanic/Latino (U.S. born)	143	99,000	30.6	29.1 (20.1–40.2)
Other Hispanic/Latino (Foreign born)	564	361,000	28.4	27.6 (22.9–33.0)
Other	351	236,000	29.1	27.5 (22.2–33.6)
Income-to-poverty ratio	9,008			
<200% poverty level	3,456	2,093,000	34.0	33.4 (31.4–35.5)
200–599% poverty level	3,036	1,802,000	26.8	26.6 (24.7–28.6)
600%+ poverty level	1,635	1,031,000	17.3	17.8 (15.3–20.6)
Do not know	881	609,000	30.1	27.4 (23.9–31.3)
Educational attainment	9,725			
Less than high school	1,717	1,023,000	34.4	35.8 (33.0–38.7)
High school graduate	2,428	1,455,000	33.4	32.8 (30.5–35.3)
Some college/tech school	2,081	1,263,000	29.4	27.5 (25.2–29.9)
College graduate	3,499	2,224,000	19.7	19.3 (17.5–21.2)
TV viewing (hours per day)	9,442			
≤1 h	2,592	1,664,000	21.0	20.3 (18.4–22.4)
2–4 h	5,516	3,370,000	29.3	29.3 (27.8–30.8)
5+ h	1,334	736,000	37.6	39.1 (35.8–42.6)

TABLE 1 (continued)

Variable	N ^a	Weighted <i>n</i>	Frequent sugar-sweetened soda consumption	
			Crude prevalence	Age-adjusted prevalence (95% CI)
Physical activity (PA)	9,367			
Meets HP 2010 PA recommendations	3,139	2,067,000	24.1	22.1 (20.3–23.9)
Some PA, does not meet HP2010	2,688	1,661,000	27.0	26.4 (24.3–28.5)
No moderate/vigorous PA	3,540	2,029,000	32.0	33.3 (31.3–35.4)

^aNumber of participants with nonmissing data for each measure.

odds of consuming soda was 3.1 times higher for U.S.-born blacks (95% CI 2.6–3.7), 2.4 times higher for Puerto Ricans (95% CI 1.9–3.0), and 2.9 times higher for Mexican/Mexican-Americans (95% CI 2.0–4.1). Those living in households with income less than 200% of the federal poverty level were more likely (odds ratio [OR] = 1.7, 95% CI 1.4–2.1) to be frequent soda consumers than those in households earning 600% or more of the poverty level. The joint effect of educational attainment and gender showed that, independent of age, race, and income, men and the less educated participants were more likely to be frequent soda consumers. The increase in the odds of frequent soda consumption with less education was greater among women.

Independent of demographic factors, those reporting 5 or more hours of TV watching daily were more likely to be frequent soda consumers than those reporting 1 h or less of TV viewing per day (OR=1.8, 95% CI 1.4–2.3; Table 2, model 2). Similarly, adults who reported no moderate or vigorous physical activity were more frequent soda consumers than those meeting Healthy People 2010 physical activity recommendations (OR=1.7, 95% CI 1.4–2.0). Demographic associations with frequent soda consumption were little changed by adjustment for these behaviors.

In linear regression models with BMI as the outcome, gender was found to modify the association between soda consumption and weight (Table 3). Adjusting for age only, women consuming one or more 12-oz servings of sugar-sweetened soda per day had mean BMI 1.8 units higher than those consuming less than one can per day, while the association of soda consumption with BMI was much weaker for men (model 1). Adjustment for other demographic factors eliminated the BMI–soda consumption association for men and attenuated it for women (model 2). Further adjustment for frequency of television watching, physical activity, and smoking had little additional impact on the relation of BMI to soda consumption and gender; women who were frequent soda consumers were an average of 0.7 BMI units heavier (95% CI 0.1–1.2).

DISCUSSION

More than one in four adult New York City residents consumes one or more cans of sugar-sweetened soda per day. Consumption varies widely among demographic groups, with socially disadvantaged populations, who are most impacted by obesity, having the highest prevalence of frequent consumption. Frequent soda consumption is strongly associated with sedentary behaviors, including not participating in any moderate or vigorous physical activity and watching 2 or more hours of television per

TABLE 2 Logistic regression models—daily soda consumption as outcome

	Model 1 (n=8,312) ^a	Model 2 (n=7,688) ^b
Covariate	aOR (95% CI)	aOR (95% CI)
Age group (years)		
18–24	1.4 (1.1–1.8)	1.5 (1.2–1.9)
25–44	Ref	Ref
45–65	0.6 (0.6–0.7)	0.6 (0.5–0.7)
65+	0.4 (0.3–0.5)	0.3 (0.3–0.4)
p value	p<0.001	p<0.001
Race/ethnicity		
White	Ref	Ref
Black (U.S. born)	3.1 (2.6–3.7)	2.8 (2.3–3.4)
Black (Foreign born)	1.5 (1.2–1.9)	1.4 (1.1–1.8)
Asian/Pac Islander	1.1 (0.8–1.4)	1.0 (0.8–1.4)
Puerto Rican	2.4 (1.9–3.0)	2.2 (1.8–2.8)
Dominican	1.3 (0.9–1.7)	1.2 (0.9–1.7)
Mexican/Mexican-American	2.9 (2.0–4.1)	3.0 (2.0–4.4)
Other Hispanic (U.S. born)	1.3 (0.7–2.3)	1.1 (0.6–1.9)
Other Hispanic (Foreign born)	1.3 (0.9–1.7)	1.2 (0.9–1.6)
Other	1.7 (1.2–2.5)	1.8 (1.3–2.6)
p value	p<0.001	p<0.001
Income-to-poverty ratio		
<200% poverty level	1.7 (1.4–2.1)	1.6 (1.3–2.0)
200–599% poverty level	1.4 (1.2–1.8)	1.4 (1.1–1.7)
600%+ poverty level	Ref	Ref
Do not know	1.4 (1.1–1.9)	1.3 (1.0–1.7)
p value	p<0.001	p<0.001
Educational attainment×gender (interaction)		
Less than high school (male)	3.6 (2.7–4.9)	3.6 (2.7–4.9)
High school graduate (male)	3.1 (2.3–4.0)	2.9 (2.2–3.8)
Some college/tech school (male)	2.9 (2.2–3.8)	2.8 (2.1–3.7)
College graduate (male)	2.7 (2.2–3.4)	2.7 (2.1–3.5)
Less than high school (female)	1.9 (1.4–2.5)	1.7 (1.3–2.3)
High school graduate (female)	2.1 (1.7–2.7)	2.0 (1.5–2.5)
Some college/tech school (female)	1.7 (1.3–2.2)	1.5 (1.1–2.0)
College graduate (female)	Ref	Ref
Test for interaction	p<0.05	p<0.05
TV viewing (hours per day)		
≤1 h		Ref
2–4 h		1.5 (1.3–1.8)
5+ h		1.8 (1.4–2.3)
p value		p<0.001
Physical activity (PA)		
Meets Healthy People 2010 PA recommendations		Ref
Some PA but does not meet 2010 recommendations		1.3 (1.1–1.5)
No moderate/vigorous PA		1.7 (1.4–2.0)
p value		p<0.001

^aAdjusted for age group, gender, race/ethnicity, income to poverty ratio, and education/gender interaction.
^bAdjusted for age group, gender, race/ethnicity, income to poverty ratio, education/gender interaction, frequency of television viewing, and physical activity.

TABLE 3 Linear regression models—BMI as outcome

	Model 1 ^a	Model 2 ^b	Model 3 ^c
	Beta (95% CI)	Beta (95% CI)	Beta (95% CI)
Soda consumption × gender (interaction)			
>1 soda per day (male)	0.9 (0.6–1.2)	1.9 (1.4–2.4)	2.1 (1.6–2.7)
Frequent—1+ soda per day (Male)	1.3 (0.9–1.7)	1.8 (1.2–2.4)	2.0 (1.3–2.6)
>1 soda per day (Female)	Ref	Ref	Ref
Frequent—1+ soda per day (Female)	1.8 (1.3–2.4)	0.8 (0.3–1.3)	0.7 (0.1–1.2)
Test for interaction	<i>p</i> <0.01	<i>p</i> <0.05	<i>p</i> <0.05
Model multiple <i>r</i> ²	0.04	0.10	0.11

^aAdjusted for age group.
^bAdjusted for age group, gender, race/ethnicity, income to poverty ratio, education/gender interaction.
^cAdjusted for age group, gender, race/ethnicity, income to poverty ratio, education/gender interaction, frequency of television viewing, physical activity, and smoking status (current, former, and never).

day. Men are more likely than women to be frequent soda consumers; however, only among women is soda consumption associated with increased BMI in this study. Limitations of our study, including its cross-sectional nature and unmeasured nutritional behaviors, preclude strong inference about a causal link of sugar-sweetened soda consumption to obesity among New York City adults. However, the strong associations we found of frequent consumption of sugar-sweetened soda with demographic and behavioral risk factors for obesity have important implications for addressing the obesity epidemic and health disparities in New York City.

We identified differences in soda consumption that mirror disparities in obesity and other chronic diseases in New York City. Frequent soda consumption is more common among U.S.-born blacks and Hispanics as well as those with less household income and less education compared with whites and more affluent and educated New Yorkers. Other health-related behaviors, including physical activity and nutrition, show similar differences in other populations.^{17–19} Why socially disadvantaged populations are more likely to drink sugar-sweetened soda is not clear, but the low cost and marketing in convenience stores that are common in low-income New York City neighborhoods²⁰ may play a role. The fact that income-to-poverty ratio, educational attainment, and race/ethnicity/birthplace were all independent predictors of frequent soda consumption suggest that a combination of factors related to economic resources, health literacy, and culture may contribute to these differences.

The association between frequent soda consumption and higher BMI among New York City women is consistent with the evidence from other studies. One cross-sectional study, in the rural west, determined that soda consumption was significantly associated with increased odds of being overweight or obese among both men and women.²¹ However, this study defined soda consumption as one or more per week and analyzed weight as a categorical rather than continuous variable, making comparison with our results difficult. Another study determined that consuming one or more sodas per week was associated with increased weight in women. Men who drank soda tended to weigh more, but the difference was not significant.²²

While a BMI difference of less than one unit may seem small, it can be important at the population level. For example, we estimate that if the BMI of all New York City women who are frequent consumers of sugar-sweetened soda (approximately 700,000 women) was decreased by 0.7 units, approximately 20,000 fewer would be

classified as obese and approximately 30,000 fewer would be classified as overweight. Nonetheless, it should be noted only a limited amount of the individual level variation in BMI ($r^2=11\%$) is explained by all of the limited set of demographic and behavioral variables available to us.

Because weight gain may lead to changes in sugar-sweetened beverage consumption, prospective studies provide more useful evidence on the relationship between consumption and subsequent weight gain. An analysis of data from the Nurse's Health Study determined that women who increased their soda consumption from less than one per week, to one or more per day had significantly greater weight gain than women who did not increase their soda intake or who reduced their soda consumption during an 8-year follow-up period.²³ However, the group that increased their soda consumption was very small, and women who maintained frequent soda consumption from baseline did not experience weight gain compared to women who were infrequent soda consumers. This study also reported that the consumption of soda and sweetened fruit drink consumption was also associated with an increased incidence of type-2 diabetes.

Experimental studies have supported a role of the consumption of caloric sweeteners in soda in weight gain, at least over the short term. Unlike prospective observational studies, experimental trials tend to be feeding studies with limited follow-up and smaller sample sizes. One study randomized participants to sucrose or artificially sweetened beverages. Individuals randomized to the sucrose treatment had an increased BMI and fat mass compared to individuals in the artificially sweetened treatment group.²⁴ A crossover trial determined that the consumption of 1,150 g of high-fructose corn syrup-sweetened soda over a 3-week period led to increased weight in women (0.97 kg weight gain relative to no soda treatment group; $p<0.01$) but not men.²⁵

Important limitations of our findings include the lack of measures of some important potential confounders, self-reported behavior and BMI measures, the cross-sectional design of our study, and our measure of sugar-sweetened soda consumption.

The observed association of soda consumption with physical inactivity and television viewing, two sedentary behaviors linked with obesity, are consistent with other studies showing that unhealthy and healthy lifestyle behaviors tend to cluster but also implies that confounding by unmeasured lifestyle factors may explain the association between soda consumption and BMI among women observed in this analysis.¹⁹ A recent study determined that high-caloric beverage consumers were more likely to be frequent fast food consumers and less likely to be vegetable consumers, both factors being linked to BMI and unmeasured in our study.¹⁰

Another limitation of the present study is the self-reported measures of both soda consumption and BMI and possible differential reporting of soda consumption by race, age, gender, or even by BMI class. While self-reported height and weight are used to track obesity at the state level,^{1,2} both men and women underreport weight, and men may overreport height in telephone surveys.²⁶ However, the resulting downward bias in the population distribution of BMI seems unlikely to explain the association we observed between soda consumption and BMI in New York City women; the random component of error from a self-report of height and weight may have biased this observed association toward the null.

Some individuals may be more likely to underreport their soda consumption due to social desirability factors, while some may be more likely to report soda intake accurately. In addition, when faced with weight gain, many individuals may reduce or eliminate soda from their diet, making the relationship between soda consumption

and weight difficult to evaluate in a cross-sectional study. Finally, our measure of sugar-sweetened soda consumption—drinking one or more sugar-sweetened sodas per day—did not include less frequent consumption of noncarbonated beverages sweetened with sugar, including sweetened ice tea, sports drinks, and fruit drinks. We were also unable to evaluate diet soda consumption in this analysis. It is notable that sales of traditional soft drinks and soda have stabilized, while sales for sports drinks, sweetened iced tea and coffee drinks, and energy drinks increased more than 30% in 2005.²⁷

While the focus of our study was sociodemographic disparities in sugar-sweetened soda consumption among individuals, neighborhood contextual factors, such as advertising and shelf placement in local markets,²⁰ might contribute to the disparities we observed. Systematic data needed to study such neighborhood environmental factors are not available across the city. Additional analyses we conducted, however, did not support the hypothesis that our findings are substantially explained by clustering based on neighborhood of residence. A fixed effect class variable for UHF neighborhood was not significant when added to the fully adjusted model with frequent sugar-sweetened soda consumption as the outcome, while the associations of individual demographic predictors were not meaningfully attenuated (data not shown).

Whatever mechanisms explain the individual sociodemographic disparities in sugar-sweetened soda consumption, their existence suggests that sugar-sweetened soda consumption may be contributing to the overall high prevalence of obesity, especially among socially disadvantaged women in New York City. Improved surveillance of consumption and relevant environmental factors as well as individual- and community-level interventions are urgently needed to better quantify and reduce the impact of sugar-sweetened soda on obesity.

ACKNOWLEDGMENTS

The authors thank Dr. Bonnie Kerker for her thoughtful review of the manuscript. The authors are also grateful to Ms. Donna Eisenhower and Chitra Ramsaswamy for oversight of the collection and management of the Community Health Survey data. The authors have no competing interests related to this work. The Community Health Survey data collection and this analysis were solely funded internally by the Department of Health and Mental Hygiene.

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