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Sodium, calorie, and sugary drink purchasing patterns in chain restaurants: Findings from NYC

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ABSTRACT

To understand how consumer purchases in chain restaurants relate to nutrients of public health concern, sodium, calories and sugary drinks purchased for personal consumption were assessed through a customer intercept receipt study at a sample of New York City quick- and full-service chain restaurants (QSR and FSR) in 2015. The percentages of respondents purchasing ≥2,300 mg sodium, ≥2,000 calories, and a sugary drink, respectively, were 14%, 3% and 32% at QSR, and 56%, 23%, and 22% at FSR. Sodium content of purchases averaged 1,260 mg at QSR and 2,897 mg at FSR and calories averaged 770 at QSR and 1,456 at FSR. 71% of QSR sugary drink purchases contained at least 200 calories. Purchasing patterns that are exceptionally high in sodium and calories, and that include sugary drinks, are common in chain restaurants. Because restaurant-sourced foods are a cornerstone of the American diet, fostering conditions that support healthful purchases is essential to reduce preventable disease and advance health.

1. Introduction

Restaurant foods are a cornerstone of the American diet, with an estimated 35% of United States (US) adults consuming food from fast-food restaurants and 28% from full-service restaurants on a given day (Nguyen and Powell, 2014). Yet, menu offerings are often high in sodium and calories (Wu and Sturm, 2013) and include an array of sugary drinks in large portions. Excess sodium intake increases hypertension risk (Stamler, 1997), overconsumption of calories is a cause of overweight and obesity (U.S. Department of Health and Human Services, 2010), and daily consumption of sugary drinks can lead to type 2 diabetes, heart disease, and weight gain (Malik et al., 2010). Restaurant food is a substantial source of sodium and calories in US adult diets, contributing to approximately 29 percent of total dietary sodium intake among those aged 20 and up (Quader et al., 2017) and 24 percent of total caloric intake in those aged 20–64 years (Powell et al., 2012).

To understand how consumer purchases in restaurants relate to nutrients of public health concern, sodium, calories and sugary drinks purchased at a sample of New York City (NYC) chain restaurants were assessed through a customer-intercept receipt study. The evaluation included fast-food, also known as quick-service restaurants (QSR), which are "limited service" restaurants where customers pay before eating, and full-service restaurants (FSR), which provide wait service (Okrent and Alston, 2012). Previous customer-intercept studies of the NYC chain restaurant environment have reported on caloric content of fast-food purchases with respect to the implementation of calorie labeling (Elbel et al., 2009; Cantor et al., 2015; Dumanovsky et al., 2009; Dumanovsky et al., 2011). In NYC, sodium (Johnson et al., 2010) and sugary drinks (Taskler et al., 2016) purchased at fast-food chain restaurants have also been reported on, to a lesser extent. Elsewhere, two studies assessed calories and sodium, among other nutrients, in purchases at chain (Auchincloss et al., 2013) and non-chain (Pulos and Leng, 2010) FSR. Our study adds to the current body of research by collectively assessing sodium, calories and sugary drinks in both QSR and FSR.

We aimed to determine the following: 1) the amount of sodium and calories purchased for personal consumption by patrons, and the extent to which these purchases exceeded national daily recommendations and reference amounts, and 2) sugary drink purchase frequency and contribution to total calories purchased.

Abbreviations: US, United States; NYC, New York City; QSR, Quick-service restaurants; FSR, Full-service restaurants; DGA, Dietary Guidelines for Americans

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2. Methods

2.1. Sampling frame

The sample of restaurants surveyed was drawn from a list of all food service establishments with permits issued by the NYC Department of Health and Mental Hygiene (Health Department) as of June 2015, and that have 15 or more locations nationally (i.e., chains). The list was then limited to the 4 QSR (Burger King, McDonald's, Popeyes and Subway) and 3 FSR (IHOP, TGI Friday's and Applebee's) chains with the greatest number of NYC locations and at least one location in a) 3 out of the 5 NYC boroughs and b) Yonkers, NY, the comparison city for a future evaluation. These chains comprised 28% of QSR and FSR chain locations in NYC (unpublished data, Health Department). In order to focus on purchases in NYC, Yonkers locations were removed from the analytic sample.

While there was no pre-determined goal for the total number of restaurants in each sample, at least one QSR and one FSR location in each borough was required. Separately, QSR and FSR were proportionally sampled by NYC borough, so the borough-specific surveyed QSR and FSR locations would reflect the real proportion of each type of establishment within the sampling frame. Following proportional sampling, restaurant locations were selected with consideration of including sites from different neighborhoods in each borough, in an attempt to reflect the geographic and socioeconomic diversity of NYC. Restaurant locations were deemed ineligible if they were located on private property that prohibited soliciting, such as malls and airports. However, this was uncommon, and did not impact ability to sample. Out of 857 NYC QSR locations, 17 (2%) were ineligible for this reason, and out of 59 NYC FSR locations, 3 (5%) were ineligible. Additionally, restaurants were assessed to determine that they had not yet implemented the sodium warning rule, an NYC policy mandating that chain restaurants place a warning icon next to high sodium items and educate consumers of the health risks of excess dietary sodium at the point of purchase (Anekwe et al., 2019), as baseline data collection was timed to occur before policy implementation. Although the study was conducted prior to policy enforcement, Applebee's locations implemented sodium warning icons before data collection completion and were therefore excluded, since respondents would have had differential exposure than respondents at other chains. The final sample included 19 QSR locations (3 Burger King, 8 McDonald's, 3 Popeyes and 5 Subway) and 13 FSR locations (9 IHOP, 4 TGI Friday's).

2.2. Customer receipt collection and survey

Data collection occurred between October-December 2015. Teams of 2 to 4 interviewers visited QSR locations between 12 and 3 pm on weekdays, and FSR locations between 5 and 9 pm on weekdays and weekends; these times of data collection are similar to other customer-intercept studies in each environment (Dumanovsky et al., 2009; Auchincloss et al., 2013). Interviewers received training from senior study team members, and supervision included random quality assurance monitoring. Interviewers approached all adult patrons leaving site locations, with the exception of drive-through customers at the 3 QSR locations that had these, and invited them to participate in a survey in exchange for a $5 incentive. Patrons without an itemized receipt were ineligible. If interviewers were asked by restaurant management to leave, they relocated to different sites.

The target was 1,000 completed surveys each at NYC QSR and FSR locations, in order to have sufficient power to detect changes in key outcomes for the future evaluation. The 16-item survey asked participants to identify receipt purchases for their own consumption, if they modified default menu items (e.g., extra cheese, diet beverage, turkey bacon instead of pork), if they refilled a beverage, and the number of refills. Respondents were asked the number of meals in the past week that were prepared away from home (i.e., at restaurants, food stands, convenience/grocery stores or vending machines). The survey also collected respondents' demographic characteristics, including gender, age group, race/ethnicity, educational level, and home ZIP code. The Health Department's Institutional Review Board reviewed the study protocol and determined it to be exempt human subjects' research.

2.3. Data entry and analysis

Receipt items and corresponding calorie and sodium information were entered into a database. Nutrition information was obtained from MenuStat.org (MenuStat), a free, public database that annually aggregates nutrition information from websites of the largest US restaurant chains; a list of publications that have utilized MenuStat are available on the website (MenuStat Methods, 2019). This study used nutrition data collected in January 2015. Only items listed on the receipt that the respondent indicated were for their own consumption were included. If a respondent indicated that just a portion of a shareable item was for them (e.g. 3 pieces of chicken from a 16-piece family meal), then only the portion that they consumed was included.

A 2,300 mg sodium benchmark was used to evaluate respondents' purchases for their own consumption; the Dietary Guidelines for Americans (DGA) recommend consuming less than this amount (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015), and recently-updated Dietary Reference Intakes state that reducing sodium intake to below this level can reduce chronic disease risk (National Academies of Sciences, Engineering, and Medicine, 2019). Two calorie benchmarks were used in analyses; the 2,000 calorie (kcal) reference amount used on the Food and Drug Administration nutrition labels and the 750 kcal-per-meal target used by the Healthy Dining Finder, a repository of dietician-recommended menu items offered at chain restaurants (Healthy Dining Finder).

Sugary drinks were defined as beverages with added caloric sweetener and more than 25 kcal per 8 oz, excluding beverages prepared with milk, such as hot chocolate and flavored lattes, blended beverages such as smoothies, and alcoholic beverages. This is consistent with the definition used for sugary drink -related legislation previously proposed in NYC (NYC Department of Health and Mental Hygiene and NYC Board of Health, 2012). At Popeyes and Subway, fountain and bottled carbonated beverages were not specifically named on receipts. If the participant verbally specified their beverage, corresponding nutrition information was entered. Otherwise, an average of the fountain (Popeyes: $n = 6$; Subway $n = 53$) or bottled (Subway: $n = 19$) beverage nutrition information was applied, and the beverage was counted as a sugary drink, since participants were separately asked if they purchased diet drinks. QSR receipts typically indicated beverage size, and the nutrition information for the corresponding item was entered. If beverage size was not specified on the receipt, then nutrition information for the smallest, non-children's sized beverage was entered. Beverage sizes were uniform at each FSR. Nutrition information was only available for the smallest-sized beverages at Popeyes and Subway. For larger fountain beverages, calories- and sodium-per-ounce were calculated from available information, and per-ounce values were multiplied by beverage size specified on the receipt. If a participant refilled their beverage, nutrition values were multiplied by the number of refills and added to the nutrition values of a single beverage. The percentage of respondents ordering 200 kcal or more of sugary drinks was calculated; this caloric threshold aligns with the DGA's recommended limit for added sugar consumption, approximating 10% of total energy intake (using a 2,000 kcal diet as a reference) (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

Self-reported home ZIP codes were used to assess neighborhood-level poverty, defined as the percent of residents within the corresponding ZIP Code Tabulation Area (ZCTA) with incomes below 100% of the Federal Poverty Level, as per 2011–2015 American Community Survey 5-year estimates (Toprani and Hadler, 2013; U.S. Census

Bureau). In cases where the reported ZIP did not exist (n = 65), or a valid ZIP did not match to a ZCTA (n = 5), neighborhood-level poverty could not be determined.

Purchases made at each location on each day were examined for systematic aberrations (e.g., a high rate of outlier transactions). We identified one day at one Subway location where over 70% of purchases were only a side item; however, a sensitivity analysis showed no significant differences in the mean calories and sodium of purchases upon excluding this cohort (n = 35), and they therefore were not excluded from analyses.

Two-tailed t-tests ($\alpha < 0.05$) were used to evaluate differences in mean nutrient values between pairs of restaurant chains (e.g., Burger King vs. McDonald's). Medians and interquartile ranges were calculated to ensure that mean values were not unduly skewed by outlier values. Linear regression models including fixed effects for covariates were used to assess least squares means for nutrient values and differences by participant characteristics; independent variables with 3 or more levels were compared to an assigned reference group. Data were analyzed in SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1. Participants

The sample included 1,924 total receipts, with 989 from QSR and 935 from FSR. Respondents whose purchase could not be determined (n = 117) or with missing nutrition information for all items purchased (n = 48) were excluded (Fig. 1). Participants with missing nutrition information for some, but not all, items were included in the analyses (QSR n = 77; FSR n = 190). Following exclusions, 11% of QSR participants were from Burger King (n = 104), 47% from McDonald's (n = 440), 12% from Popeyes (n = 108), and 30% from Subway (n = 283). At FSR, 87% of participants were from IHOP (n = 715) and 13% were from TGI Friday's (n = 109) (Table 1). The majority (87%) of eligible respondents were NYC residents (n = 1524). Participant characteristics are shown in Tables 2 and 3.

3.2. Sodium

QSR purchases averaged 1,260 ± 1,217 mg sodium, and mean sodium ranged from 815 ± 757 mg (McDonald's) to 2,646 ± 1,685 mg (Popeyes). Sodium was significantly different between each QSR pair ($p < 0.001$ for all), except for the difference between Burger King and Subway ($p = 0.067$). At FSR, purchases averaged 2,897 ± 2,183 mg sodium, with TGI Friday's respondents purchasing significantly more sodium (3,444 ± 2,191 mg) than IHOP

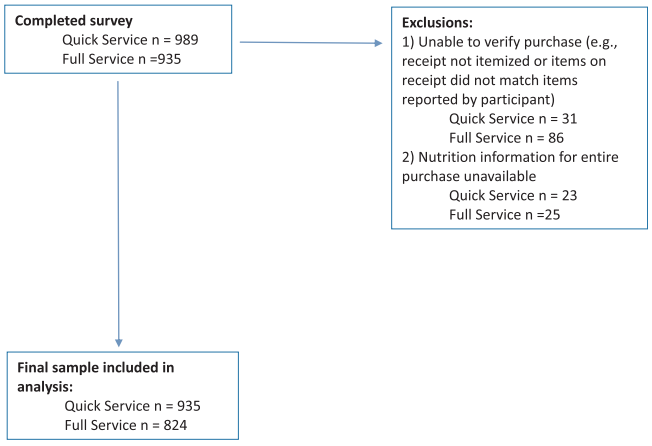

Fig. 1. Flow chart of participant inclusions and exclusions following completion of survey at quick- and full-service chain restaurants, NYC 2015.

Table 1
Summary of sodium and calories in daytime (12-3 pm) purchases at quick-service and evening (5-9 pm) purchases at full-service chain restaurants, NYC 2015.

Restaurant	No. Sites	Valid Receipts[a], N (%)	Sodium (mg)					Calories (kcal)					
			Mean	SD	Median	IQR	≥ 2300 mg in purchase, N (%)	Mean	SD	Median	IQR	≥ 2000 kcal in purchase, N (%)	≥ 750 kcal in purchase, N (%)
Quick-Service, Overall	19	935 (100)	1260.0	(1216.7)	1020.0	(390.0, 1746.0)	134 (14.3)	769.7	(570.9)	650.0	(370.0, 1070.0)	32 (3.4)	384 (41.1)
Burger King	3	104 (11.1)	1544.1	(1607.5)	1235.0	(765.0, 1857.5)	13 (12.5)	991.7	(772.6)	890.0	(495.0, 1270.0)	9 (8.7)	58 (55.8)
McDonald's	8	440 (47.1)	815.3	(757.4)	680.0	(165.0, 1175.0)	20 (4.6)	623.6	(503.0)	510.0	(240.0, 835.0)	11 (2.5)	122 (27.7)
Popeyes	3	108 (11.6)	2646.0	(1684.6)	2780.5	(1265.0, 3500.0)	65 (60.2)	1132.0	(679.1)	1140.0	(574.5, 1420.0)	6 (5.6)	73 (67.6)
Subway	5	283 (30.3)	1318.1	(955.0)	1220.0	(670.0, 1790.0)	36 (12.7)	776.9	(436.6)	740.0	(480.0, 1000.0)	6 (2.1)	131 (46.3)
Full-Service, Overall	13	824 (100)	2896.5	(2182.7)	2475.0	(1617.5, 3730.0)	465 (56.4)	1455.6	(1051.7)	1240.0	(787.5, 1915.0)	188 (22.8)	625 (75.9)
IHOP	9	715 (86.8)	2813.0	(2170.9)	2435.0	(1585.0, 3660.0)	383 (53.6)	1462.5	(1072.8)	1250.0	(785.0, 1930.0)	166 (23.2)	543 (75.9)
TGI Friday's	4	109 (13.2)	3444.4	(2190.7)	2940.0	(2350.0, 4140.0)	82 (75.2)	1410.1	(904.4)	1190.0	(800.0, 1830.0)	22 (20.2)	82 (75.2)

[a] The final sample excluded participants who only purchased alcohol and those whose entire purchase did not have nutrition information available.

Table 2
Participant characteristics and regression-adjusted nutritional content of daytime (12-3pm) purchases at quick service chain restaurants, NYC 2015.

Variable	N (%) N = 935	Sodium (mg)			Calories (kcal)		
		Mean	95% CI	p-value*	Mean	95% CI	p-value*
Gender (by observation)							
Male	530 (56.7)	1528.4	(1352.9, 1703.9)	**0.043**	813.2	(725.4, 901.1)	0.069
Female	404 (43.3)	1377.4	(1181.8, 1573.0)		745.3	(647.4, 843.2)	
Age (years)							
18–24	236 (25.5)	1640.0	(1432.3, 1847.7)	0.117	899.4	(795.4, 1003.4)	**0.018**
25–34	213 (23.0)	1436.3	(1230.7, 1641.8)	0.690	785.3	(682.4, 888.2)	0.288
35–44	174 (18.8)	1391.6	(1166.3, 1616.8)	0.885	752.2	(639.4, 865.0)	0.495
45–64	254 (27.4)	1431.1	(1230.0, 1632.3)	0.704	768.7	(668.0, 869.4)	0.368
65 +	49 (5.3)	1365.5	(1021.8, 1709.3)	ref	690.8	(518.6, 862.9)	ref
Race/Ethnicity[a]							
Asian/Pacific Islander	36 (3.9)	1176.9	(797.1, 1556.7)	0.120	625.3	(435.1, 815.5)	0.055
Black	385 (41.8)	1457.6	(1280.0, 1635.2)	0.768	811.4	(722.5, 900.4)	0.888
Latino	291 (31.6)	1575.1	(1384.4, 1765.8)	0.469	868.5	(773.0, 963.9)	0.401
White	152 (16.5)	1490.2	(1269.2, 1711.2)	ref	819.2	(708.5, 929.9)	ref
Other	58 (6.3)	1564.7	(1244.2, 1885.1)	0.660	772.0	(611.5, 932.4)	0.577
Educational attainment							
Less than High School	107 (11.5)	1334.0	(1067.0, 1601.0)	0.175	706.8	(573.1, 840.4)	0.074
High School Graduate	331 (35.4)	1420.9	(1224.5, 1617.4)	0.330	764.4	(666.1, 862.8)	0.200
Some College	238 (25.5)	1542.3	(1335.6, 1748.9)	0.782	819.9	(716.4, 923.3)	0.903
College Graduate	258 (27.6)	1514.4	(1314.9, 1714.0)	ref	826.0	(726.1, 926.0)	ref
Neighborhood poverty, % below federal poverty line[b]							
0– < 10%	118 (12.6)	1434.7	(1189.8, 1679.6)	ref	770.2	(647.6, 892.9)	ref
10– < 20%	387 (41.4)	1534.1	(1367.8, 1700.4)	0.404	827.7	(744.5, 911.0)	0.335
20– < 30%	160 (17.1)	1487.9	(1271.8, 1704.0)	0.701	797.6	(689.4, 905.8)	0.694
30–100%	249 (26.7)	1415.7	(1210.4, 1620.9)	0.887	772.7	(669.9, 875.4)	0.971
Not available	20 (2.1)	1392.2	(902.7, 1881.7)	0.873	728.1	(483.0, 973.2)	0.752
Meals prepared away from home							
< 1 per day	558 (59.7)	1488.7	(1328.5, 1648.9)	ref	793.7	(713.5, 873.9)	ref
1– < 2 per day	202 (21.6)	1548.7	(1342.2, 1755.3)	0.511	835.6	(732.2, 939.0)	0.359
2– < 3 per day	112 (12.0)	1436.5	(1181.8, 1691.2)	0.655	796.5	(669.0, 924.0)	0.962
3 + per day	62 (6.6)	1337.7	(1023.3, 1652.0)	0.315	691.4	(534.0, 848.7)	0.174

Missing responses were not included; therefore, not all subgroups sum to 935. Sodium and calorie values were assessed as least squares means from regression models with fixed effects for restaurant chain and all other covariates presented in the table.

[a] For the purpose of this publication, Latino includes persons of Hispanic or Latino origin, as identified by the survey question "Are you Hispanic or Latino?" and regardless of reported race. Those included in the Black, White, Asian/Pacific Islander and other race categories did not identify as Latino.

[b] Self-reported home ZIP codes were used to assess neighborhood-level poverty rate, defined as the percent of residents within the corresponding ZIP Code Tabulation Area (ZCTA) with incomes below 100% of the Federal Poverty Level, as per 2011–2015 American Community Survey 5-year estimates. Neighborhood poverty rate could not be determined in cases where the reported ZIP did not exist (n = 17), or where a valid ZIP code did not match to a ZCTA (n = 3).

* Bolded value indicates statistically significant difference from reference group at $\alpha = 0.05$.

respondents (2,813 ± 2,171 mg, p = 0.005). (Table 1, between-chain p-values not shown).

Fourteen percent of QSR and 56% of FSR respondents purchased at least 2,300 mg of sodium (Table 1).

Among QSR respondents, males purchased significantly more sodium than females, following adjustment for covariates (1,528 mg vs 1,377 mg, p = 0.043) (Table 2). At FSR, those with less than a high-school education purchased significantly less sodium than college graduates (adjusted means: 2,555 mg vs 3,378 mg, p = 0.022), and those who reported consuming at least 2, but < 3 meals per day prepared away from home purchased more sodium than those consuming < 1 per day (adjusted means: 3,591 vs 2,938 mg, p = 0.015).

3.3. Calories

QSR purchases averaged 770 ± 571 kcal, and mean calories by chain ranged from 624 ± 503 kcal (McDonald's) to 1,132 ± 679 kcal (Popeyes). Mean calories were significantly different between each pair of QSR (p < 0.001 for all), except for the difference between Popeyes and Burger King (p = 0.061). At FSR, purchases averaged 1,456 ± 1,052 kcal, with no significant differences between chains (p = 0.584). (Table 1, p-values not shown).

Three percent of QSR and 23% of FSR respondents purchased at least 2,000 kcal, and 41% percent of QSR and 76% of FSR respondents exceeded 750 kcal (Table 1).

Among QSR respondents, participants aged 18–24 purchased significantly more calories than those aged 65 or older (adjusted means: 899 kcal vs 691 kcal, p = 0.018). (Table 2). Among FSR respondents, college graduates purchased more calories than those with less than a high school education (adjusted means: 1,583 vs 1,219 kcal, p = 0.036), and those who reported eating at least 2, but < 3 meals prepared away from home per day purchased more calories than those who consumed < 1 per day (adjusted means: 1,707 vs 1,343 kcal, p = 0.005) (Table 3).

3.4. Sugary drinks

Thirty-two percent of QSR respondents and 21% of FSR respondents ordered sugary drinks. At QSR, among those who did so, mean sugary drink caloric contribution was 262 ± 145 kcal, and 71% purchased at least 200 kcal worth of sugary drinks. At FSR, mean sugary drink calories amounted to 133 ± 81 kcal, and 10% of respondents had ≥200 kcal from sugary drinks (among those who purchased them). (Table 4).

Table 3
Participant characteristics and regression-adjusted nutritional content of evening (5-9 pm) purchases at full-service chain restaurants, NYC 2015.

Variable	N (%) N = 824	Sodium (mg)			Calories (kcal)		
		Mean	95% CI	p-value[c]	Mean	95% CI	p-value[c]
Gender (by observation)							
Male	416 (50.5)	3245.7	(2805.9, 3685.5)	**0.043**	1522.1	(1309.3, 1734.9)	0.069
Female	408 (49.5)	2947.2	(2480.5, 3413.9)		1383.1	(1157.2, 1608.9)	
Age (years)							
18-24	196 (23.8)	3349.0	(2890.3, 3807.6)	0.117	1567.1	(1345.2, 1789.0)	**0.018**
25-34	223 (27.1)	2853.8	(2400.4, 3307.1)	0.690	1351.7	(1132.3, 1571.0)	0.288
35-44	220 (26.7)	3199.4	(2728.5, 3670.3)	0.885	1527.9	(1300.0, 1755.7)	0.495
45-64	160 (19.4)	3227.4	(2714.9, 3739.8)	0.704	1497.7	(1249.8, 1745.7)	0.368
65+	24 (2.9)	2852.7	(1876.2, 3829.3)	ref	1318.5	(846.0, 1791.0)	ref
Race/Ethnicity[a]							
Asian/Pacific Islander	49 (6.0)	2971.7	(2256.1, 3687.3)	0.120	1369.9	(1023.7, 1716.1)	0.055
Black	269 (32.8)	3033.9	(2555.9, 3511.9)	0.768	1443.7	(1212.5, 1675.0)	0.888
Latino	299 (36.4)	2832.1	(2383.2, 3281.0)	0.469	1293.3	(1076.1, 1510.5)	0.401
White	165(20.1)	2816.1	(2346.5, 3285.6)	ref	1307.4	(1080.2, 1534.6)	ref
Other	39 (4.8)	3828.5	(3039.6, 4617.3)	0.660	1848.5	(1466.9, 2230.2)	0.577
Educational attainment							
Less than High School	46 (5.6)	2554.6	(1804.5, 3304.6)	0.175	1218.6	(855.7, 1581.5)	0.074
High School Graduate	257 (31.2)	3377.7	(2901.1, 3854.3)	0.330	1573.5	(1342.9, 1804.1)	0.200
Some College	290 (35.2)	3075.8	(2621.1, 3530.5)	0.782	1434.8	(1214.8, 1654.8)	0.903
College Graduate	231 (28.0)	3377.7	(2922.9, 3832.4)	ref	1583.4	(1363.4, 1803.4)	ref
Neighborhood poverty, % below federal poverty line[b]							
0– < 10%	131 (15.9)	3454.5	(2934.0, 3975.0)	ref	1628.7	(1376.9, 1880.6)	ref
10– < 20%	369 (44.8)	3185.2	(2732.1, 3638.3)	0.404	1479.8	(1260.6, 1699.0)	0.335
20– < 30%	90 (10.9)	2998.6	(2423.4, 3573.9)	0.701	1421.5	(1143.1, 1699.8)	0.694
30–100%	184 (22.3)	3140.5	(2632.1, 3648.9)	0.887	1507.1	(1261.1, 1753.1)	0.971
Not available	50 (6.1)	2703.4	(1953.4, 3453.4)	0.873	1225.8	(862.9, 1588.6)	0.752
Meals prepared away from home							
< 1 per day	565 (68.6)	2938.2	(2578.1, 3298.2)	ref	1343.0	(1168.8, 1517.2)	ref
1– < 2 per day	158 (19.2)	3014.1	(2534.9, 3493.2)	0.511	1398.5	(1166.7, 1630.3)	0.359
2– < 3 per day	75 (9.1)	3591.0	(2992.4, 4189.6)	0.655	1707.4	(1417.7, 1997.0)	0.962
3+ per day	26 (3.2)	2842.6	(1923.0, 3762.1)	0.315	1361.4	(916.5, 1806.3)	0.174

Missing responses were not included; therefore, not all subgroups sum to 824. Sodium and calorie values were assessed as least squares means from regression models with fixed effects for restaurant chain and all other covariates presented in the table.

[a] For the purpose of this publication, Latino includes persons of Hispanic or Latino origin, as identified by the survey question "Are you Hispanic or Latino?" and regardless of reported race. Those included in the Black, White, Asian/Pacific Islander and other race categories did not identify as Latino.

[b] Self-reported home ZIP codes were used to assess neighborhood-level poverty rate, defined as the percent of residents within the corresponding ZIP Code Tabulation Area (ZCTA) with incomes below 100% of the Federal Poverty Level, as per 2011-2015 American Community Survey 5-year estimates. Neighborhood poverty rate could not be determined in cases where the reported ZIP did not exist (n = 48), or where a valid ZIP code did not match to a ZCTA (n = 2).

[c] Bolded value indicates statistically significant difference from reference group at $\alpha = 0.05$.

3.5. Purchases exceeding daily thresholds

Thirty-two percent (n = 303) of QSR and 57% (n = 472) of FSR respondents purchased at least 2,300 mg sodium, 2,000 kcal, or 200 kcal from sugary drinks. Among QSR respondents, 7% (n = 61) exceeded two of these three thresholds, and 1% (n = 14) exceeded all. Twenty-three percent (n = 189) and 1% (n = 9) of FSR respondents exceeded two and all thresholds, respectively.

4. Discussion

Chain restaurant purchases that exceed total daily recommended limits for sodium and calories and that include sugary drink purchases are common in NYC. When considering sodium, more than 50% of FSR respondents surpassed the recommended daily limit. At QSR, purchased sodium amounts varied widely across chains. This is consistent with previous QSR findings, which assessed sodium content of purchases at different types of chains (Johnson et al., 2010).

At both QSR and FSR, the percentage of respondents purchasing at least 2,300 mg of sodium was more than twice than the percentage of those who purchased at least 2,000 kcal, suggesting that even if individuals' menu selections are within daily caloric recommendations, these selections likely do not align with sodium intake recommendations. At Subway, for example, mean calories purchased (777 kcal) were roughly one-third of the 2,000 daily calorie benchmark, but the mean sodium purchased (1,318 mg) was more than half the daily sodium limit of < 2,300 mg. In short, the potential to consume excess sodium is especially high in the chain restaurant environment, independent of calories. This, coupled with documented underestimation of sodium content in restaurant meals (Moran et al., 2017), supports the need for additional mechanisms to reduce high sodium purchases in restaurants.

At FSR, 23% of respondents purchased at least 2,000 kcal for themselves in a single visit, and 76% exceeded the 750 kcal suggested by the Healthy Dining Finder. Although only 3% of the QSR sample purchased at least 2,000 kcal, 41% still exceeded 750 kcal, demonstrating that patrons may be consuming an excess of calories for a single eating occasion in these establishments. Like sodium, calories varied widely across surveyed QSR, consistent with previous QSR studies (Dumanovsky et al., 2009, 2011). These variations may speak to common offerings at each chain. McDonald's offers a large number of à la carte items and café style beverages (e.g., coffee, lattes, etc.) which

Table 4
Summary of sugary drinks purchased during daytime (12-3 pm) at quick- and evening (5-9 pm) at full-service chain restaurants, NYC 2015.

Restaurant	Ordered sugary drink, n (%)	Sugary drink calories*					Calories in total order, among those who purchased a sugary drink				Sugary drink refills		
		Mean	SD	Median	IQR	≥ 200 sugary drink calories, n(%)‡	Mean	SD	Median	IQR	Got a refill*, n (%)	Mean**	SD**
Quick-Service, Overall	299 (32.0)	261.5	(144.9)	215.0	(190.0, 290.0)	212 (70.9)	1044.4	(537.3)	1010.0	(690.0, 1370.0)	37 (12.7)	1.4	(0.7)
Burger King	44 (42.3)	265.2	(110.3)	280.0	(190.0, 325.0)	26 (59.1)	1099.2	(552.0)	1070.0	(670.0, 1395.0)	4 (9.1)	1.0	(0.0)
McDonald's	122 (27.3)	221.5	(94.6)	200.0	(160.0, 230.0)	84 (70.0)	971.2	(613.9)	905.0	(530.0, 1365.0)	4 (3.3)	1.2	(0.4)
Popeyes	39 (36.1)	235.4	(74.1)	210.0	(209.0, 230.0)	28 (71.8)	1265.5	(408.3)	1291.0	(964.0, 1570.0)	2 (5.1)	1.0	(0.0)
S ubway	96 (33.9)	318.2	(201.1)	215.0	(215.0, 430.0)	74 (77.1)	1020.8	(447.4)	947.5	(747.5,1252.5)	27 (28.1)	1.6	(0.8)
Full-Service, Overall	177 (21.5)	132.7	(80.8)	100.0	(80.0, 150.0)	17 (9.6)	1858.3	(1309.4)	1510.0	(1050.0, 2585.0)	18 (10.2)	1.8	(0.9)
IHOP	150 (21.0)	123.2	(74.2)	80.0	(80.0, 140.0)	10 (6.7)	1858.3	(1327.4)	1475.0	(1070.0, 2575.0)	16 (10.7)	1.9	(1.0)
TGI Friday's	27 (24.8)	189.7	(96.0)	150.0	(140.0, 230.0)	7 (25.9)	1858.3	(1228.5)	1690.0	(740.0, 2830.0)	2 (7.4)	1.5	(0.7)

*These analyses were restricted to those who purchased a sugary drink for individual consumption.
‡ Beverage nutrition information has not been adjusted for ice. With the exception of Subway, the source information from each restaurant did not state if ice was factored into nutrition calculations. Subway stated that beverage nutrition values were without ice. Therefore, estimates of caloric content of beverages at Subway may be overestimated.
**The number of sugary drink refills was restricted to those who got a refill for individual consumption.

have lower sodium and calories than combination meals, while many signature menu items at Popeyes, including fried chicken and side dishes, are salty and highly caloric.

Excess intake of added sugars is a feature of the US diet, the majority of which are from sugary drinks (National Cancer Institute, 2018) laden in calories with negligible nutritional value. Concerningly, our study found that about one-third of QSR patrons purchased a sugary drink; by contrast, Taksler et al. reported that only about 20% of fast food patrons in a similar market region did so (Taskler et al., 2016). Additionally, at QSR chains in our study, the majority of patrons who purchased a sugary drink had at least 200 kcals, or 50 g, of added sugar in their drink purchase alone. While local data have shown a decreasing trend in self-reported sugary drink consumption more generally (Kansagra et al., 2015; Elfassy et al., 2019), our data cannot be used to determine whether these trends are applicable to the QSR environment specifically.

Our findings indicate that QSR and FSR chains present a risk for unhealthy meal purchases, as evidenced by the 32% of QSR respondents and 57% of FSR respondents who exceeded at least one of the daily sodium, calorie or added sugar thresholds in their purchase.

4.1. Limitations

This study has some limitations. Because MenuStat captures restaurant nutrition information in January, and the study was conducted October-December, nutrition information for items introduced after January 2015 was not included. Because participants with missing nutrition information for at least one, but not all, items were included in the analyses, we have likely presented a conservative summary of sodium and calories purchased in the chain restaurant environment. Although we used a reference point of 2,000 kcal, daily calorie recommendations vary by age and sex. Additionally, these data may not accurately represent one daily meal. Because this survey was not a 24-hour dietary recall, we are unable to draw conclusions about how this eating occasion may have related to participants' overall dietary intake that day. While only included items that respondents reported as for their individual consumption were included, we do not know if the entire purchase was consumed.

Because QSR and FSR data collection occurred during different times (QSR on weekdays between 12 and 3 pm, and FSR daily between 5 and 9 pm), data from these two categories of restaurants cannot be combined or directly compared.

Like most other restaurant nutrition studies, feasibility required that we limit this study to chain restaurants that have consistent menus across all venues and provide nutrition information online. We also only surveyed two FSR chains. Additionally, we surveyed a convenience sample which is not representative of any population. Our findings cannot be generalized to all restaurant dining patrons or the general population. Finally, if a restaurant patron lacked an itemized receipt, they were ineligible. To address this, interviewers intercepted consumers before they entered the restaurant to inform them that an itemized receipt was required to complete the survey; there may have been variation in the information given at that time regarding the $5 incentive and the Health Department's involvement in the study, which may have influenced participation or purchasing decisions. We identified one systematic anomaly that could have resulted from this or other factors, but this did not significantly influence findings. Future studies of this kind should take into consideration the rapid obsolescence of paper receipts.

5. Conclusions

Here, we examine purchasing behaviors at both QSR and FSR, and in particular contribute to the understanding of the less-studied FSR environment. Despite efforts to improve the restaurant food environment through policy and voluntary industry action, we find that

sodium, calories and sugary drinks abound in chain restaurant purchases. We also learned that nutritional quality of purchases did not greatly differ across demographic groups, including race/ethnicity and neighborhood poverty, emphasizing that an unhealthy restaurant environment is a shared exposure for people who dine out.

In recognition of the important role that restaurants play in the diets of many Americans, jurisdictions nationwide have sought to introduce polices intended to achieve meaningful public health impacts in restaurants. Mandatory calorie labeling (Farley et al., 2009) in chain restaurants and trans fat restrictions (Angell et al., 2009) at all restaurants have been in effect in NYC for over a decade, and similar federal policies now apply nationwide. Elsewhere in the US, sugary drink taxes and kids meal policies that impact restaurant settings have been implemented. Most recently, NYC and Philadelphia require sodium warnings on menus. Restaurants nationwide have also engaged in both large- and small-scale voluntary efforts to improve nutrition (Newswire, 2011; Food Fit Philly, 2018), with mixed results (Moran et al., 2017; Ma et al., 2018). Studies of changes in newly-introduced chain restaurant menu items showed decreases in calories between 2012 and 2013, and sodium from 2012 to 2016, possibly as a response to policy efforts and consumer demand; however, overall calories and sodium in core offerings have remained high in chains (Bleich et al., 2016; Wolfson et al., 2018).

Because restaurants are a common source of food, fostering conditions that support more healthful purchasing is essential to reduce diet-related disease and advance health. Beyond consumers, many stakeholders have a role to play in supporting healthier dietary intake in restaurants, including researchers, health systems, employers, and, importantly, government and the food industry. Broader, more aggressive efforts are needed to identify tools and incentives to support more healthful decision making. Purchases are influenced by a variety of aspects including, but not limited to, product formulation and availability, individual taste and habits, pricing, packaging, promotion, menu placement, and social marketing. Opportunities for targeted action across this spectrum of influence should be pursued and evaluated rapidly, to allow all stakeholders to learn from, and implement, best practices.

CRediT authorship contribution statement

Divya Prasad: Formal analysis, Writing - original draft, Writing - review & editing, Visualization. **Tamar Adjoian Mezzacca:** Conceptualization, Methodology, Formal analysis, Writing - review & editing, Visualization, Project administration. **Amaka V. Anekwe:** Writing - review & editing. **Megan Lent:** Conceptualization, Writing - review & editing. **Shannon M. Farley:** Conceptualization, Methodology, Writing - review & editing, Supervision. **Kimberly Kessler:** Writing - review & editing, Supervision. **Sonia Y. Angell:** Conceptualization, Methodology, Writing - review & editing, Supervision.

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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References

National Academies of Sciences, Engineering, and Medicine, 2019. In: Dietary Reference Intakes for Sodium and Potassium. The National Academies Press, Washington, DC. https://doi.org/10.17226/25353.

Nguyen, B.T., Powell, L.M., 2014. The impact of restaurant consumption among US adults: effects on energy and nutrient intakes. Public Health Nutr. 17 (11), 2445–2452. https://doi.org/10.1017/s1368980014001153.

Wu, H.W., Sturm, R., 2013. What's on the menu? A review of the energy and nutritional content of US chain restaurant menus. Public Health Nutr. 16 (1), 87–96. https://doi.org/10.1017/s136898001200122x.

Stamler, J., 1997. The INTERSALT Study: background, methods, findings, and implications. Am. J. Clin. Nutr. 65 (2 Suppl), 626S–642S. https://doi.org/10.1093/ajcn/65.2.626s.

Malik, V.S., Popkin, B.M., Bray, G.A., Jean-Pierre, Després, Hu, F.B., 2010. Sugar-Sweetened Beverages, Obesity, Type 2 Diabetes Mellitus, and Cardiovascular Disease Risk. Circulation 121 (11), 1356–1364. https://doi.org/10.1161/circulationaha.109.876185.

Quader, Z.S., Zhao, L., Gillespie, C., et al., 2017. Sodium Intake Among Persons Aged ≥2 Years — United States, 2013–2014. MMWR Morb. Mortal. Wkly Rep. 66 (12), 324–1238. https://doi.org/10.15585/mmwr.mm6612a3.

Powell, L.M., Nguyen, B.T., Han, E., 2012. Energy intake from restaurants: demographics and socioeconomics, 2003–2008. Am. J. Prev. Med. 43 (5), 498–504. https://doi.org/10.1016/j.amepre.2012.07.041.

Okrent, A.M., Alston, J.M. The Demand for Disaggregated Food-Away-from-Home and Food-at-Home Products in the United States. ERR-139. Washington, D.C.: U.S. Dept. of Agriculture, Economic Research Service; 2012.

Elbel, B., Kersh, R., Brescoll, V.L., Dixon, L.B. Calorie Labeling And Food Choices: A First Look At The Effects On Low-Income People In New York City. Health Aff (Milwood) 2009; 28(6): w1110-21. doi: 10.1377/hlthaff.28.6.w1110 10.2105/AJPH.2019.305228.

Cantor, J., Torres, A., Abrams, C., Elbel, B., 2015. Five years later: awareness of New York City's calorie labels declined, with no changes in calories purchased. Health Aff (Milwood) 34 (11), 1893–1900. https://doi.org/10.1377/hlthaff.2015.0623.

Dumanovsky, T., Nonas, C.A., Huang, C.Y., Silver, L.D., Bassett, M.T., 2009. What people buy from fast-food restaurants: caloric content and menu item selection, New York City 2007. Obesity. 17 (7), 1369–1374. https://doi.org/10.1038/oby.2009.90.

Dumanovsky, T., Huang, C.Y., Nonas, C.A., Matte, T.D., Bassett, M.T., Silver, L.D., 2011. Changes in energy content of lunchtime purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys. BMJ 343, d4464. https://doi.org/10.1136/bmj.d4464.

Johnson, C.M., Angell, S.Y., Lederer, A., Dumanovsky, T., Bassett, M.T., Silver, L.D., 2010. Sodium Content of Lunchtime Fast Food Purchases at Major US Chains. Arch Inten Med. 170 (8), 732–734. https://doi.org/10.1001/archinternmed.2010.72.

Taskler, G.B., Kiszko, K., Abrams, C., Elbel, B., 2016. Adults who order sugar-sweetened beverages: sociodemographics and meal patterns at fast food chains. Am. J. Prev. Med. 51 (6), 890–897. https://doi.org/10.1016/j.amepre.2016.07.038.

Auchincloss, A.H., Mallya, G.G., Leonberg, B.L., Ricchezza, A., Glanz, K., Schwarz, D.F., 2013. Customer responses to mandatory menu labeling at full-service restaurants. Am. J. Prev. Med. 45 (6), 710–719. https://doi.org/10.1016/j.amepre.2013.07.014.

Pulos, E., Leng, K., 2010. Evaluation of a voluntary menu-labeling program in full-service restaurants. Am. J. Public Health 100 (6), 1035–1039. https://doi.org/10.2105/AJPH.2009.174839.

Anekwe, A.V., Lent, M., Farley, S.M., Kessler, K., Kennelly, M.O., Angell, S.Y., 2019. New York City's sodium warning regulation: from conception to enforcement. Am. J. Public Health 109 (9), 1191–1192. https://doi.org/10.2105/AJPH.2019.305228.

National Cancer Institute, 2018. Sources of Calories from Added Sugars among the U.S. Population, 2005–06. Epidemiology and Genomics Research Program website. http://epi.grants.cancer.gov/diet/foodsources/added_sugars. Accessed 11 April, 2019.

MenuStat Methods, 2019. http://menustat.org/Content/assets/pdfFile/MenuStat%20Data%20Completeness%20Documentation.pdf. Accessed 18 June, 2019.

Toprani, A., Hadler, J.L., 2013. Selecting and Applying a Standard Area-based Socioeconomic Status Measure for Public Health Data: Analysis for New York City. New York City Department of Health and Mental Hygiene:Epi Research Report, pp. 1–11.

PR Newswire, 2011. National Restaurant Association's First-of-its-Kind "Kids LiveWell" Initiative Showcases Restaurants' Healthful Menu Options for Children. https://www.prnewswire.com/news-releases/national-restaurant-associations-first-of-its-kind-kids-livewell-initiative-showcases-restaurants-healthful-menu-options-for-children-125465208.html. Accessed 19 June, 2019.

NYC Department of Health and Mental Hygiene and NYC Board of Health, 2012. Notice of Adoption of an Amendment to Article 81 of the New York City Health Code. http://rules.cityofnewyork.us/sites/default/files/adopted_rules_pdf/maximum_sugary_drink_sizes-f-dohmh-09-13-12-a.pdf. Accessed 15 November, 2019.

Moran, A.J., Ramirez, M., Block, J.P., 2017. Consumer underestimation of sodium in fast food restaurant meals: results from a cross-sectional observational study. Appetite 113, 155–161. https://doi.org/10.1016/j.appet.2017.02.028.

Kansagra, S.M., Kennelly, M.O., Nonas, C.A., et al., 2015. Reducing sugary drink consumption: New York City's approach. Am. J. Public Health 105 (4), e61–e64. https://doi.org/10.2105/AJPH.2014.302497.

Elfassy, T., Adjoian, T., Lent, M., 2019. Sugary Drink Consumption Among NYC Children, Youth, and Adults: Disparities Persist Over Time, 2007–2015. J. Community Health 44 (2), 297–306. https://doi.org/10.1007/s10900-018-0587-9.

Farley, T.A., Caffarelli, A., Bassett, M.T., Silver, L., Frieden, T.R., 2009. New York Citys

Fight Over Calorie Labeling. Health Aff (Milwood). 28 (Supplement 1), w1098–w1109. https://doi.org/10.1377/hlthaff.28.6.w1098.
Angell, S.Y., Silver, L.D., Goldstein, G.P., et al., 2009. Cholesterol Control Beyond the Clinic: New York City's Trans Fat Restriction. Ann. Intern. Med. 151 (2), 129–135. https://doi.org/10.7326/0003-4819-151-2-200907210-00010.
Moran, A.J., Block, J.P., Goshev, S.G., Bleich, S.N., Roberto, C.A., 2017. Trends in Nutrient Content of Children's Menu Items in U.S. Chain Restaurants. Am. J. Prev. Med. 52 (3), 284–291. https://doi.org/10.1016/j.amepre.2016.11.007.
Ma, G.X., Shive, S.E., Zhang, G., et al., 2018. Evaluation of a Healthy Chinese Take-Out Sodium-Reduction Initiative in Philadelphia Low-Income Communities and Neighborhoods. Public Health Rep. 133 (4), 472–480. https://doi.org/10.1177/0033354918773747.
Bleich, S.N., Wolfson, J.A., Jarlenski, M.P., 2016. Calorie Changes in Large Chain Restaurants: Declines in New Menu Items but Room for Improvement. Am. J. Prev. Med. 50 (1), e1–e8. https://doi.org/10.1016/j.amepre.2015.05.007.
U.S. Department of Health and Human Services, 2010. The Surgeon General's Vision for a Healthy and Fit Nation. Office of the Surgeon General, Rockville, MD.
U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015. Dietary Guidelines for Americans: 2015-2020, 8th Edition. U.S. Government Printing Office, Washington, DC.
Wolfson, J.A., Moran, A.J., Jarlenski, M.P., 2018. Bleich SN. Trends in Sodium Content of Menu Items in Large Chain Restaurants in the U.S. Am. J. Prev. Med. 54 (1), 28–36. https://doi.org/10.1016/j.amepre.2017.08.018.
Food Fit Philly, 2018. Less Salt, Healthier Life: Unique Partnership Strives for a Healthier Community. http://foodfitphilly.org/less-salt-healthier-life-unique-partnership-strives-healthier-community/. Accessed 19 June, 2019.
Healthy Dining Finder, n.d. Nutrition Criteria. https://www.healthydiningfinder.com/Nutrition-Criteria/. Accessed 22 August 2018.
U.S. Census Bureau, 2015. 2011-2015 American Community Survey 5-year Estimates, Table DP-03: Selected Economic Characteristics. http://factfinder.census.gov. Accessed 29 October 2019.