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Fast-Food and Full-service Restaurant Consumption among Children and Adolescents: Impact on Energy, Beverage and Nutrient Intake

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Abstract

Objective—To examine the impact of fast-food and full-service restaurant consumption on total energy intake, dietary indicators and beverage consumption.

Design—Individual-level fixed effects estimation based on two non-consecutive 24-hour dietary recalls.

Setting—Nationally representative data from the 2003–2004, 2005–2006, and 2007–2008 National Health and Nutrition Examination Survey.

Participants—Children aged 2 to 11 (N=4717) and adolescents aged 12 to 19 (N=4699)

Main Outcome Measures—Daily total energy intake in kilocalories, intakes of grams of sugar, fat, saturated fat and protein and milligrams of sodium and total grams of sugar-sweetened beverages (SSBs), regular soda and milk consumed.

Results—Fast-food and full-service restaurant consumption, respectively, was associated with a net increase in daily total energy intake of 126 kcal and 160 kcal for children and 310 kcal and 267 kcal for adolescents and higher intakes of regular soda (+74g and +88g for children and +163g and +107g for adolescents) and SSBs generally. Fast-food consumption increased intakes of total fat (+7–8g), saturated fat (+2–5g) and sugar (+6–16g) for both age groups and sodium (+396mg) and protein (+8g) for adolescents. Full-service restaurant consumption was associated with increases in all nutrients examined. Additional key findings were 1) adverse impacts on diet were larger for lower-income children and adolescents; and, 2) among adolescents, increased soda intake was twice as large when fast food was consumed away from home than at home.

Conclusions—Fast-food and full-service restaurant consumption is associated with higher net total energy intake and poorer diet quality.

Keywords

fast-food consumption; full-service restaurant consumption; energy intake; sugar-sweetened beverages; nutrition

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Introduction

Children and adolescents are increasingly consuming food away from home (FAFH), particularly from fast-food sources. From 1977–78 through 2003–06, among children aged 2 to 18, the contribution to total caloric intake from fast-food and full-service restaurant sources increased from 2% to 13% and from 1% to 5%, respectively.[1, 2] In particular, for adolescents, over this period, the percent of total energy from fast-food restaurants increased from 6.5% to 17%.[2, 3] From 1999 to 2004, frequent (≥ 3 times/week) fast-food consumption among adolescents increased from 19% to 27% for females and 24% to 30% for males.[4]

Upward trends in fast-food consumption have paralleled increasing obesity rates among children and adolescents, and consumption has been associated with greater total energy intake and poorer nutrient intakes.[5–9] Much of the existing literature focused on the association of fast-food but not full-service restaurant consumption with energy intake and diet and used older and/or non-nationally representative data and/or cross-sectional methods and those studies that did use within-person comparisons did not control for other forms of FAFH intake or the day of the week on which it was consumed.

This study built on the previous literature by examining the relationship between fast-food and full-service restaurant consumption and energy intake, diet quality and consumption of sugar-sweetened beverages (SSBs), particularly soda, controlling for consumption of other FAFH and the day of week. Analyses were undertaken for children and adolescents and by gender, ethnicity, and socioeconomic status. We provided new evidence examining differential effects according to whether the food was consumed away from home (AFH) or at home. To control for individual-level unobserved characteristics, we estimated multivariate individual-level fixed effects regression models using dietary recall data from the National Health and Nutrition Examination Survey (NHANES) 2003–08.

Methods

Data

We used dietary recall data from the participants in NHANES 2003–04, 2005–06 and 2007–08. NHANES is an ongoing survey based on a complex, multistage sampling design to be nationally representative of the civilian, non-institutionalized U.S. population. Data collection procedures and survey design are described elsewhere.[10] Our sample included children aged 2–11 years old and adolescents aged 12–19 year old who were not pregnant at the time of interview. We examined subpopulations by gender, race (non-Hispanic white, non-Hispanic black and Hispanic) and income (low-income defined as families with income <130% of the federal poverty level (FPL), middle income between 130% and 300% of the FPL, and high income ≥300% of the FPL).

The NHANES survey included two non-consecutive 24-hour dietary recalls for which respondents reported on all food and beverages consumed in the prior 24 hours. Day 1 interviews were conducted by trained dietary interviewers in a mobile examination center and day 2 interviews were collected by telephone 3–10 days later. Participants aged 12 years and older completed their own dietary interviews, children aged 6–11 completed proxy-assisted interviews, and proxy respondents reported for children younger than age 6. This study included 4717 observations for children aged 2 to 11 and 4699 observations for adolescents aged 12 to 19 for which there were complete dietary data for both day 1 and day 2 24-hour recalls.

Survey respondents were asked about the source from where each food and beverage item was obtained. Two key exposure indicators were constructed for whether on a given day any

food or beverage items were consumed from the following sources: 1) a fast-food restaurant (restaurant fast food/pizza) and 2) a full-service restaurant (restaurant with waiter/waitress, bar/tavern/lounge, and restaurant no additional information). Respondents were also asked whether they consumed the item at home or AFH. Therefore, we additionally differentiated the source and location of intake for each food or beverage item based on whether it was from a fast-food or full-service restaurant eaten at home (i.e. take out, drive thru, or delivery) or AFH (i.e. in restaurant). Our analyses controlled for non-restaurant FAFH which included all food and beverage items consumed AFH not from a fast-food or full-service restaurant. We examined outcomes including daily total kilocalories (kcal) of energy intake, nutrient intakes of grams of sugar, fat, saturated fat and protein and milligrams of sodium and total grams of SSBs and regular (non-diet) soda consumed.

Statistical Analyses

We estimated an individual-level fixed effects regression model based on the two different days of intake data, equivalent to a first-difference estimator based on only two observations per person. This model removed the effects of all standard time-invariant observed characteristics such as age, gender, and race and given the short time span between the day 1 and day 2 dietary recalls it also removed the effects of household/parental characteristics such as marital status, education, income etc. Importantly, the individual-level fixed effects model removed the time-invariant unobserved characteristics related to food and beverage preferences.[11] The regression model for outcome Y_i was specified as follows:

$$Y_i=\delta_0+\delta_1 FF_i+\delta_2 FS_i+\delta_3 NRFAFH_i+\delta_4 WD_i+\delta_5 D_i+v_i+w_i \quad (1)$$

where FF_i and FS_i indicated whether any food or beverages consumed came from a fast-food or full-service restaurant, respectively. $NRFAFH_i$ indicated whether there was any FAFH consumed from a non-restaurant source. Finally, WD_i and D_i, controlled for whether the recall day was on a weekday versus a weekend and whether it was on day 1 versus day 2, respectively. v_i was the constant individual-specific error and w_i was a standard error term. We estimated equation (1) separately for children aged 2 to 11 and adolescents aged 12 to 19 and by gender, ethnicity, and socioeconomic status for both age groups.

We further examined whether restaurant consumption AFH versus at home had differential effects specified as follows:

$$Y_i=\delta_0+\delta_1 FFAFH_i+\delta_2 FFAH_i+\delta_3 FSAFH_i+\delta_4 FSAH_i+\delta_5 NRFAFH_i+\delta_6 WD_i+\delta_7 D_i+v_i+w_i \quad (2)$$

where for fast-food ($FFAFH_i$ and $FFAH_i$) and full-service ($FSAFH_i$ and $FSAH_i$) restaurants the separate variable indicators distinguished whether items from these sources were consumed on the recall day AFH or at home. Estimation was undertaken using STATA 11.1 and accounted for the NHANES complex, multistage probability sampling design. This study was approved by the Institutional Review Board of the University of Illinois at Chicago.

Results

Summary statistics for all variables for both day 1 and day 2 dietary recalls are reported in Table 1. Tables 2 and 3 show the individual-level fixed effects regression estimates for the within-person daily changes in energy, beverage and nutrient intakes. Fast-food restaurant consumption was associated with an increase in total daily energy intake of 126 kcal for children and 310 kcal for adolescents. Consuming from a full-service restaurant also was associated with higher energy intake among children (+160 kcal) and adolescents (+267 kcal). Fast-food and full-service restaurant consumption, respectively, resulted in higher

intakes of SSBs (+91g and +143g for children and +162g and +126g for adolescents) in general, and regular soda (+74g and +88g for children and +163g and +107g for adolescents), in particular. Both fast food and full-service restaurant consumption reduced milk intake by approximately 30g for children and 50g for adolescents.

For children, both fast-food and full-service consumption were associated with higher intakes of sugar (+6g and +15g), total fat (+7g and +6g) and saturated fat (both +2g). However, only full-service restaurant consumption was associated with sodium intake (+226mg) and it was associated with higher protein intake (+3 g). Fast-food and full service restaurant consumption among adolescents significantly affected all of the nutrients examined. Whereas for children, additional sugar intake was lower for fast-food compared to full-service restaurant consumption, the opposite was found for teens – fast-food and full-service restaurant consumption was associated with an additional 16g and 7g of sugar intake, respectively. Fast-food and full-service restaurant consumption similarly increased total fat (+14 g) and had similar effects on saturated fat (+4–5g) intake for adolescents. Fast-food and full-service restaurant consumption increased sodium intake by 396mg and 625mg, respectively. Protein intake was also higher for teens on days that they consumed from fast food (+8g) or full-service restaurants (+13g).

There were a number of differences found by subpopulations – we focus the discussion in the text on fast-food consumption. Compared to females, male children and adolescents consumed more additional total calories on days that they consumed fast food (157 versus 90 kcal for children and 389 versus 231 kcal for adolescents). Fast-food consumption was associated with higher additional intake of SSBs, soda, protein, total fat, saturated fat, and sodium but not sugar for male compared to female teens. There were generally few differences by race in intake patterns associated with fast-food consumption among children, although it was associated with higher additional intakes of soda and sodium among Hispanic children. Among adolescents, fast-food consumption was associated with substantially higher intakes of soda for white compared to black and Hispanic teens (+196g compared to +89g and +95g) and correspondingly higher additional intakes of sugar. However, fast-food consumption was associated with higher additional total fat intake for black (+20g) compared to white (+12g) and Hispanic (+15g) youths. Fast-food consumption also increased sodium intake to a greater extent for black youths (+592mg) compared to white (+366mg) and Hispanic (+319mg) youths.

Numerous differential effects emerged by income. Among children, fast-food consumption resulted in fewer additional calories consumed in high-income (+68kcal) compared to low-income (+159 kcal) and middle-income (+175 kcal) families. Increased intakes of SSBs and soda were also lower for children in high-income families, as was additional fat intake. Fast-food consumption had no significant effects on higher-income children's intake of sugar, protein and sodium. Among adolescents, those from lower-income families had larger increases in caloric intake when they consumed fast food (+384 kcal) compared to teens from middle-income (+290 kcal) and high-income (+294 kcal) families. Fast-food consumption was associated with higher additional intakes of sugar, fat, saturated fat and sodium for low-income youths compared to their high-income counterparts. At the same time, fast-food consumption was also a greater source of increased protein for low- compared to middle- and high-income youths.

Table 4 reports on the differential effects of consuming from restaurant sources AFH compared to at home (again, in text discussion is focused on fast food). Fast food consumption at home increased children's total caloric intake by 147 kcal, compared to 77 kcal from consumption AFH. For children, consuming fast food at home compared to AFH was associated with higher additional intakes of all total fat (+7g), saturated fat (+2g), sugar

(+8g), protein (+2g), and sodium (134g), whereas fast-food consumption AFH was not significantly associated with these nutrient measures. Fast-food consumption was associated with greater SSB and soda consumption to a slightly higher extent when consumed AFH. However, consumption AFH but not at home was significantly associated with less milk intake (−42g).

For teens, overall additional caloric intake was similar when fast food was consumed AFH versus at home. Both total and saturated fat and sodium were higher when fast food was consumed at home. However, additional SSB and soda intakes were twice as high when fast food was consumed AFH compared to at home: 226g compared to 81g higher SSB intake and 200g compared to 99g higher soda intake.

Discussion

Based on multivariate individual-level fixed effects models of within person differences, the study results show that consuming from a fast-food restaurant was associated with a net increase in total daily energy intake of 126 kcal for children and 310 kcal for adolescents. Consuming from a full-service restaurant also was associated with higher energy intake among children (+160 kcal) and adolescents (+267 kcal). Thus, the evidence clearly suggests that non-restaurant caloric intake is not sufficiently reduced to compensate for additional calories obtained on days when consuming from restaurants. Further, restaurant consumption among children and adolescents was significantly related to higher nutrient intakes of sugar, total fat, saturated fat and sodium. In particular, for example, fast-food consumption among adolescents increased sugar, fat, saturated fat, and sodium intake by approximately 13%, 22%, 25% and 17% of the daily reference levels of these respective nutrients.[12–14] Soda and SSB intake was significantly higher on days that children and adolescents consumed from restaurants, particularly for adolescents. However, positive associations were found for protein intake for full-service restaurant consumption among children and both fast-food and full-service consumption among adolescents.

Our results are generally consistent with the previous literature that examined fast-food consumption. For example, earlier evidence from the 1994–96 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII) comparing within-person means dietary recalls showed that children and adolescents who ate fast food had higher energy, fat, saturated fat, and sodium intakes and lower intakes of vitamin C, beta carotene and protein.[6] However, we found that fast-food consumption had no association with protein intake for children and was associated with higher intake of protein for adolescents which may have important implications since although most age/sex groups have sufficient levels of protein in their diet a significant percentage of adolescent females were shown to have inadequate protein intake.[15] Another study using the CSFII found cross-sectional and within-person mean associations of fast-food consumption with higher energy intake, higher intakes of fat, carbohydrates, added sugars, sugar-sweetened beverages, and less fiber, milk and fruits and vegetables for children aged 4 to 19.[7] A 1987 10-year longitudinal study that followed 9 and 10 year old girls found a positive age gradient of fast-food consumption and that higher frequency of consumption was associated with higher energy intake and higher intakes of sodium, fat and saturated fat.[9] Cross-sectional analyses of frequency of fast-food use among a sample of students in grades 7–12 in Minnesota found associations with higher energy, fat and soda intake and lower fruit, vegetable and milk intake.[5] Cross-sectional analyses based on more recent 2003–04 NHANES data found that fast-food consumption was negatively associated with meeting MyPyramid recommended intakes of fruits, vegetables, and milk and positively associated with discretionary energy and intakes of fat.[8] Finally, our results are also consistent with a recent USDA study that used CSFII and NHANES data and first differencing regression analyses to examine how consumption of food prepared AFH,

controlling for FAFH from schools, affects school-aged children's diet quality.[16] The study found that each FAFH meal was associated with lower diet quality and increased caloric intake by 108 kcal and the effects similarly were larger for older children but overall smaller in magnitude than our study results that specified fast-food and full-service restaurant sources and used more recent waves of NHANES data.[16]

This study was subject to two key limitations. First, the 24-hour dietary recall data were obtained via self-report and are subject to error; such data have been shown to under-report.[17, 18] Second, although we estimated multivariate models to adjust for time-varying variables such as weekday versus weekend to account for differential preferences across the week and day 1 versus day 2 of the recall to account for potential bias based on recall conducted in person versus by phone, due to data limitations our analyses did not account other time-varying confounders such as physical activity or other unobserved factors that might affect food preferences day to day. Nonetheless, all time-constant confounders were accounted for in the fixed effects regression. Finally, this study did not differentiate restaurant consumption by meal occasions. To better understand the impacts of fast-food consumption by race/ethnicity and income levels, future research should investigate the extent to which different sub-populations have differential patterns of fast-food restaurant use across meals. In addition, future analyses should examine how fast-food consumption across different meal occasions may differentially impact caloric and nutrient intakes.

Given the adverse effects of restaurant consumption and its high prevalence, particularly for fast food, policies aimed at reducing consumption and improving diet are increasingly being assessed and considered. Several studies found that lower fast-food prices are associated with higher consumption and weight outcomes, particularly for middle- and high-school youths suggesting that policies that increase the relative prices of such meals may be effective instruments.[19] In particular, low-income populations tend to be more price sensitive; analyses herein revealed greater adverse effects from fast-food consumption among lower-income populations suggesting an important need for effective policies among this group.

Analyses that accounted for place of consumption had potentially important policy implications. Adolescents consumed twice as many additional grams of soda and SSBs when they consumed fast food AFH versus at home which is a major public health concern given that soda consumption constitutes empty calories and has been related to higher risk of type-2 diabetes and obesity.[20, 21] Soda excise taxes based on per unit volume would particularly impact quantity discounts and free refills or limits on SSB portion sizes such as the recently proposed policy in New York City may be effective at curbing excessive SSB consumption in restaurants.[22, 23]

Fast-food restaurants are clustered around schools, particularly high schools and those in low-income neighborhoods,[24–26] and availability around schools has been associated with higher consumption and weight.[27] Indeed, policies that limit the spatial presence of fast food restaurants around schools have been suggested[28] and, in fact, bans on fast-food outlets were implemented more broadly in some cities.[29]

Fast-food advertising on television is the most frequently seen category of food-related product advertisements by children and teens, exposure has trended upwards substantially,[30] and greater exposure has been associated with higher frequency of consumption and higher body weight.[31, 32] Further, research shows significant differences by race in exposure to fast-food advertising across brands.[33] Indeed, this study found additional fat intake from fast-food consumption was twice as large among black compared to white adolescents which was similarly observed in a study by Schmidt et al.[9] Only two fast-food companies

are members of the self-regulatory Children's Food and Beverage Advertising Initiative (CFBAI) and despite this initiative the poor nutritional content of fast-food advertising has been well-documented.[34] Further consideration should be given to improve the initiative's nutritional guidelines and apply it to teens.

Overall, the higher caloric and SSB intake and poorer nutrient intake found associated with consuming from restaurants suggest that public policies that aim to reduce restaurant consumption such as increasing the relative costs of these purchases, limiting access through zoning, particularly around schools, limiting portion sizes, and limiting exposure to marketing deserve serious consideration. At the same time, regulatory[35, 36] and voluntary[37, 38] policies that aim to set standards for the nutritional content of meals obtained from restaurants are increasingly being implemented and continued efforts are needed to improve and promote healthy food options in restaurants.

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TABLE 1

Summary Statistics for Day 1 and Day 2 Dietary Recalls: Restaurant Consumption Prevalence, Energy and Beverage Intake, and Nutrient Intake, for Children and Adolescents

	Ages 2 – 11 (N=4717)		Ages 12 – 19 (N=4699)	
	Day 1	**Day 2**	**Day 1**	**Day 2**
Prevalence of consumption				
Fast food	36%	24%	42%	35%
By Location				
Fast food away from home	18%	11%	25%	20%
Fast food at home	20%	14%	21%	18%
Full-service	15%	7%	18%	12%
By Location				
Full-service away from home	11%	6%	15%	9%
Full-service at home	5%	2%	4%	3%
Non-restaurant food away from home	66%	63%	62%	60%
Consumption on weekday	58%	79%	55%	80%
Energy and Beverage Intake				
Energy (kcal)	1843 (15.50)	1798 (13.58)	2267 (18.89)	2078 (19.92)
Sugar sweetened beverage (grams)	349 (10.58)	268 (9.08)	699 (17.47)	559 (15.33)
Regular soda (grams)	164 (7.93)	109 (5.64)	433 (13.98)	338 (13.98)
Milk (grams)	325 (8.59)	370 (9.4)	238 (9.60)	266 (11.40)
Nutrient Intake				
Sugar (grams)	130 (1.42)	121 (1.29)	148 (1.55)	132 (1.77)
Total protein (grams)	62 (0.68)	65 (0.54)	81 (0.96)	78 (0.78)
Total fat (grams)	68 (0.8)	66 (0.72)	85 (0.89)	77 (0.80)
Saturated fat (grams)	24 (0.31)	24 (0.3)	29 (0.35)	27 (0.30)
Sodium (milligrams)	2771 (30.82)	2774 (34.32)	3551 (43.27)	3319 (34.07)

Note: All analyses are weighted using NHANES examination weight. Standard errors are in parentheses.

TABLE 2

Regression Estimates of Impact of Fast-food and Full-service Restaurant Consumption on Energy, Beverage and Nutrient Intake for Children Aged 2 to 11, by Gender, Race/Ethnicity and Income.

	Total Energy Intake	Beverage intake			Nutrient intake				
	Energy (kcal)	SSB (gm)	Regular soda (gm)	Milk (gm)	Sugar (gm)	Protein (gm)	Total fat (gm)	Saturated fat (gm)	Sodium (mg)
All (N=4717)									
Fast food	126.29*** (22.35)	91.41*** (14.03)	73.77*** (9.68)	−27.01*** (9.83)	5.71*** (2.09)	1.26 (1.04)	7.03*** (1.15)	1.99*** (0.46)	34.48 (46.72)
Full-service	160.49*** (36.43)	143.97*** (21.97)	88.28*** (15.91)	−31.25** (13.94)	15.43*** (3.44)	3.24** (1.57)	6.09*** (1.69)	1.52** (0.70)	225.71*** (73.05)
Girl (N=2388)									
Fast food	89.88*** (29.34)	75.59*** (17.96)	78.38*** (12.52)	−23.51** (11.05)	3.42 (2.74)	0.44 (1.27)	5.46*** (1.42)	1.57*** (0.55)	43.02 (63.69)
Full-service	214.79*** (50.63)	128.63*** (31.37)	81.69*** (21.27)	−25.56 (17.84)	16.00*** (4.59)	5.08** (2.07)	8.32*** (2.36)	2.31** (0.97)	317.59*** (109.95)
Boy (N=2329)									
Fast food	157.03*** (33.31)	109.73*** (21.27)	71.62*** (14.56)	−31.32* (16.04)	8.03** (3.13)	1.92 (1.62)	8.28*** (1.79)	2.32*** (0.73)	18.69 (68.00)
Full-service	104.80** (51.78)	161.42*** (30.28)	95.20*** (23.61)	−38.31* (21.63)	15.05*** (5.14)	1.31 (2.37)	3.78 (2.41)	0.69 (1.01)	127.20 (93.62)
White (N=1408)									
Fast food	122.89*** (33)	86.34*** (21.18)	66.64*** (14.51)	−24.82* (14.99)	7.05** (3.10)	−0.16 (1.55)	6.54*** (1.72)	2.01*** (0.69)	−33.58 (68.48)
Full-service	174.15*** (49.56)	164.65*** (30.52)	95.32*** (21.80)	−21.52 (19.00)	18.16*** (4.76)	3.71* (2.12)	5.44** (2.30)	1.48 (0.96)	249.75** (98.69)
Black (N=1282)									
Fast food	108.77*** (37.1)	116.51*** (20.37)	59.83*** (12.79)	−34.96*** (12.61)	1.28 (3.39)	2.16 (1.43)	6.19*** (1.68)	1.50** (0.61)	94.20 (69.75)
Full-service	173.08*** (63.8)	173.40*** (36.50)	113.25*** (23.66)	−49.06** (19.81)	13.00** (5.74)	3.05 (2.86)	7.29** (3.23)	0.78 (1.27)	201.44* (122.13)
Hispanic (N=1763)									
Fast food	103.49*** (32.13)	86.53*** (17.41)	93.79*** (12.62)	−24.47* (12.67)	2.25 (2.90)	2.68** (1.35)	7.27*** (1.61)	1.74*** (0.61)	161.79** (63.56)
Full-service	101.73* (58.8)	70.77** (29.49)	53.95** (27.04)	−39.13 (25.43)	5.48 (4.50)	2.98 (2.32)	7.77*** (2.78)	2.18** (1.08)	112.16 (128.06)
Low income (N=2045)									
Fast food	159.02*** (38.75)	136.14*** (27.07)	93.09*** (16.16)	− 39.95*** (14.86)	4.18 (3.64)	2.92** (1.46)	8.10*** (1.89)	2.04*** (0.70)	153.98** (68.63)
Full-service	33.83 (78.97)	87.18 (53.43)	14.06 (32.33)	−42.19* (22.21)	0.87 (6.12)	3.41 (2.74)	6.34* (3.55)	1.77 (1.29)	−10.80 (179.44)

	Total Energy Intake	Beverage intake			Nutrient intake				
	Energy (kcal)	SSB (gm)	Regular soda (gm)	Milk (gm)	Sugar (gm)	Protein (gm)	Total fat (gm)	Saturated fat (gm)	Sodium (mg)
Middle income (N=1360)									
Fast food	175.34*** (42.66)	91.00*** (25.81)	77.89*** (18.30)	−24.28 (18.77)	8.99** (3.80)	3.33* (2.01)	10.20*** (2.15)	3.03*** (0.89)	28.13 (91.25)
Full-service	206.37*** (56.86)	129.26*** (32.25)	83.64*** (24.81)	−24.05 (27.93)	18.18*** (5.33)	3.65 (2.68)	7.19*** (2.75)	1.85 (1.17)	225.92* (116.52)
High income (N=1090)									
Fast food	68.03* (36.06)	64.76*** (22.45)	59.19*** (16.96)	−17.48 (17.60)	4.72 (3.48)	−1.25 (1.80)	3.94** (1.99)	1.39* (0.81)	−62.58 (81.48)
Full-service	183.71*** (59.12)	178.00*** (35.31)	119.98*** (25.50)	−21.25 (21.41)	20.92*** (5.92)	2.66 (2.55)	5.10* (2.77)	1.15 (1.17)	306.27*** (110.58)

Notes: All analyses are weighted using NHANES examination weight. Standard errors are reported in parentheses and are robust.

*Significant at 10%,

**significant at 5%,

***significant at 1%. Control variables include indicators for non-restaurant food away from home consumption, whether the recall was on a week day versus the weekend and whether it was on day 1 versus day 2.

SSB: sugar sweetened beverage.

Table 3

Regression Estimates of Impact of Fast-food and Full-service Restaurant Consumption on Energy, Beverage and Nutrient Intake for Adolescents Aged 1 2 to 19, by Gender, Race/Ethnicity and Income.

	Total Energy Intake	Beverage Intake			Nutrient Intake				
	Energy (kcal)	SSB (gm)	Regular soda (gm)	Milk (gm)	Sugar (gm)	Protein (gm)	Total fat (gm)	Saturated fat (gm)	Sodium (mg)
All (N=4699)									
Fast food	309.53*** (34.27)	162.40*** (21.72)	163.67*** (17.60)	−52.29*** (12.04)	16.24*** (2.82)	7.94*** (1.50)	14.36*** (1.66)	4.64*** (0.64)	396.28*** (70.73)
Full-service	267.30*** (46.61)	126.10*** (33.10)	107.25*** (28.86)	−50.65** (19.82)	7.28* (4.01)	12.93*** (2.14)	14.49*** (2.22)	3.99*** (0.85)	624.90*** (102.08)
Girl (N=2332)									
Fast food	231.49*** (39.29)	147.87*** (24.36)	136.25*** (20.82)	−27.58* (14.79)	16.23*** (3.29)	5.83*** (1.71)	9.46*** (2.10)	2.77*** (0.76)	197.13** (89.02)
Full-service	246.33*** (57.01)	140.40*** (39.80)	72.38** (34.38)	−41.89** (19.50)	10.38** (4.76)	9.22*** (2.58)	13.00*** (2.90)	3.63*** (1.10)	534.41*** (130.97)
Boy (N=2367)									
Fast food	389.46*** (55.15)	177.65*** (35.75)	190.56*** (28.14)	−75.69*** (18.78)	16.39*** (4.57)	10.15*** (2.42)	19.27*** (2.50)	6.52*** (1.00)	599.62*** (107.41)
Full-service	286.75*** (75.15)	109.58** (54.59)	147.21*** (48.01)	−60.21* (36.23)	3.62 (6.67)	17.14*** (3.49)	15.97*** (3.37)	4.32*** (1.30)	718.01*** (157.08)
White (N=1306)									
Fast food	314.14*** (50.18)	200.63*** (32.31)	196.33*** (26.18)	−60.91*** (18.00)	20.78*** (4.06)	7.08*** (2.20)	12.11*** (2.44)	4.07*** (0.95)	366.40*** (104.86)
Full-service	300.52*** (61.30)	142.96*** (44.59)	120.23*** (38.84)	−59.50** (27.08)	10.55** (5.27)	13.14*** (2.74)	14.55*** (2.87)	4.02*** (1.07)	643.76*** (132.02)
Black (N=1554)									
Fast food	376.12*** (53.30)	96.59*** (30.11)	88.88*** (22.45)	−23.66* (12.10)	11.28*** (4.36)	13.17*** (2.13)	20.43*** (2.57)	6.66*** (0.85)	591.80*** (92.14)
Full-service	242.74*** (84.78)	92.91 (59.39)	46.81 (38.59)	−10.61 (18.87)	6.75 (7.00)	13.49*** (3.90)	12.47*** (4.01)	1.97 (1.36)	592.36*** (177.65)
Hispanic (N=1636)									
Fast food	215.87*** (55.86)	69.30* (36.23)	95.30*** (25.44)	−58.25*** (19.52)	4.63 (4.34)	5.72** (2.57)	15.39*** (2.63)	4.82*** (0.97)	319.40*** (107.11)
Full-service	213.31*** (79.38)	134.12*** (49.53)	144.68*** (33.71)	−33.82 (29.75)	5.38 (5.87)	11.80** (4.79)	13.67*** (4.17)	4.10** (1.99)	699.42*** (224.81)
Low income (N=1817)									
Fast food	383.73*** (54.26)	193.76*** (40.54)	142.77*** (29.25)	−34.50** (16.16)	18.64*** (4.64)	9.65*** (2.38)	18.84*** (2.61)	5.68*** (0.95)	535.95*** (104.59)
Full-service	243.03*** (83.84)	133.07** (67.67)	67.41 (52.95)	−38.46 (24.40)	2.49 (7.76)	15.06*** (3.97)	15.57*** (4.03)	4.72*** (1.41)	677.84*** (198.13)

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	Total Energy Intake	Beverage Intake			Nutrient Intake				
	Energy (kcal)	SSB (gm)	Regular soda (gm)	Milk (gm)	Sugar (gm)	Protein (gm)	Total fat (gm)	Saturated fat (gm)	Sodium (mg)
Middle income (N=1385)									
Fast food	289.52*** (59.01)	128.59*** (42.31)	170.49*** (35.93)	−52.50** (21.96)	14.45*** (5.00)	7.86*** (2.66)	12.90*** (2.92)	4.88*** (1.05)	431.57*** (129.67)
Full-service	232.51*** (81.03)	64.72 (58.83)	53.46 (52.92)	−16.50 (31.39)	10.16 (7.11)	12.22*** (3.38)	10.89*** (3.93)	2.05 (1.38)	504.52*** (180.98)
High income (N=1259)									
Fast food	293.62*** (61.13)	164.17*** (34.92)	169.51*** (28.88)	−58.05*** (22.44)	16.58*** (4.93)	7.35*** (2.68)	13.31*** (2.93)	4.02*** (1.18)	302.13** (127.05)
Full-service	291.13*** (75.61)	144.30*** (50.44)	148.50*** (45.12)	−71.21** (34.70)	7.94 (6.26)	12.66*** (3.55)	15.74*** (3.60)	4.51*** (1.41)	658.09*** (161.96)

Notes: All analyses are weighted using NHANES examination weight. Standard errors are reported in parentheses and are robust.

* Significant at 10%,

** significant at 5%,

*** significant at 1%. Control variables include indicators for non-restaurant food away from home consumption, whether the recall was on a week day versus the weekend and whether it was on day 1 versus day 2.

SSB: sugar sweetened beverage.

Table 4

Regression Estimates of Impact of Fast-food and Full-service Restaurant Consumption At Home and Away from Home on Energy, Beverage and Nutrient Intake for Children and Adolescents.

	Total Energy Intake	Beverage Intake			Nutrient Intake				
	Energy (kcal)	SSB (gm)	Regular soda (gm)	Milk (gm)	Sugar (gm)	Protein (gm)	Total fat (gm)	Saturated fat (gm)	Sodium (mg)
Panel A: Age 2 – 11 (N=4717)									
Fast food away from home	77.31*** (28.61)	91.36*** (18.42)	76.40*** (13.61)	−41.5*** (12.62)	4.00 (2.63)	−0.30 (1.41)	4.74*** (1.49)	1.09* (0.61)	−78.61 (60.52)
Fast food at home	146.72*** (26.18)	83.48*** (17.27)	64.55*** (11.45)	−11.34 (11.24)	7.78*** (2.51)	2.37** (1.11)	7.38*** (1.34)	2.25*** (0.51)	133.62*** (50.71)
Full-service away from home	200.24*** (41.91)	172.57*** (25.17)	114.47*** (18.72)	−30.16** (14.65)	18.44*** (3.95)	5.18*** (1.79)	8.12*** (1.92)	2.08** (0.82)	239.45*** (86.24)
Full-service at home	68.62 (55.76)	49.35 (30.45)	26.55 (20.13)	−23.54 (26.58)	7.66 (4.70)	−1.99 (2.39)	1.35 (2.75)	0.24 (1.17)	176.50 (111.13)
Panel B: Age 12 – 19 (N=4699)									
Fast food away from home	285.2*** (44.19)	226.02*** (26.39)	200.20*** (22.30)	−65.02*** (14.79)	18.86*** (3.52)	6.89*** (1.94)	12.29*** (2.14)	3.7*** (0.86)	339.18*** (88.68)
Fast food at home	297.82*** (43.34)	80.93*** (26.87)	98.73*** (20.72)	−11.59 (11.90)	13.05*** (3.52)	8.37*** (1.81)	14.58*** (1.95)	5.06*** (0.85)	365.77*** (89.42)
Full-service away from home	273.84*** (53.06)	142.52*** (36.71)	131.49*** (32.47)	−60.42*** (22.44)	10.32** (4.42)	12.68*** (2.45)	14.1*** (2.59)	4.07*** (0.96)	617.14*** (118.35)
Full-service at home	238.89*** (74.34)	98.15** (48.55)	46.50 (39.02)	−12.29 (26.14)	1.41 (6.93)	12.71*** (3.47)	14.62*** (4.15)	3.26** (1.40)	584.74*** (149.61)

Notes: All analyses are weighted using NHANES examination weight. Standard errors are reported in parentheses and are robust.

*Significant at 10%,

**significant at 5%,

***significant at 1%. Control variables include indicators for non-restaurant food away from home consumption, whether the recall was on a week day versus the weekend and whether it was on day 1 versus day 2.

SSB: sugar sweetened beverage.