ARTICLE

Increasing Caloric Contribution From Sugar-Sweetened Beverages and 100% Fruit Juices Among US Children and Adolescents, 1988–2004

Y. Claire Wang, MD, ScD[a,b], Sara N. Bleich, PhD[c], Steven L. Gortmaker, PhD[b]

[a]Department of Health Policy and Management, Columbia Mallman School of Public Health Health, New York, New York; [b]Society, Human Development, and Health, Harvard School of Public Health, Boston, Massachusetts; [c]Department of Health Policy and Management, Johns Hopkins School of Public Health, Baltimore, Maryland

The authors have indicated they have no financial relationships relevant to this article to disclose.

What's Known on This Subject

Consumption of sugar-sweetened beverages and 100% fruit juices has been linked to excess weight gain in US children and adults.

What This Study Adds

Our study provides a timely update on the pattern of beverage consumption (caloric contribution, amount, consumption location, source, and type of beverages) among US children and adolescents.

ABSTRACT

OBJECTIVE. We sought to document increases in caloric contributions from sugar-sweetened beverages and 100% fruit juice among US youth during 1988–2004.

PATIENTS AND METHODS. We analyzed 24-hour dietary recalls from children and adolescents (aged 2–19) in 2 nationally representative population surveys: National Health and Nutrition Examination Survey III (1988–1994, $N = 9882$) and National Health and Nutrition Examination Survey 1999–2004 ($N = 10\,962$). We estimated trends in caloric contribution, type, and location of sugar-sweetened beverages and 100% fruit juice consumed.

RESULTS. Per-capita daily caloric contribution from sugar-sweetened beverages and 100% fruit juice increased from 242 kcal/day (1 kcal = 4.2 kJ) in 1988–1994 to 270 kcal/day in 1999–2004; sugar-sweetened beverage intake increased from 204 to 224 kcal/day and 100% fruit juice increased from 38 to 48 kcal/day. The largest increases occurred among children aged 6 to 11 years (~20% increase). There was no change in per-capita consumption among white adolescents but significant increases among black and Mexican American youths. On average, respondents aged 2 to 5, 6 to 11, and 12 to 19 years who had sugar-sweetened beverages on the surveyed day in 1999–2004 consumed 176, 229, and 356 kcal/day, respectively. Soda contributed ~67% of all sugar-sweetened beverage calories among the adolescents, whereas fruit drinks provided more than half of the sugar-sweetened beverage calories consumed by preschool-aged children. Fruit juice drinkers consumed, on average, 148 (ages 2–5), 136 (ages 6–11), and 184 (ages 12–19) kcal/day. On a typical weekday, 55% to 70% of all sugar-sweetened beverage calories were consumed in the home environment, and 7% to 15% occurred in schools.

CONCLUSIONS. Children and adolescents today derive 10% to 15% of total calories from sugar-sweetened beverages and 100% fruit juice. Our analysis indicates increasing consumption in all ages. Schools are a limited source for sugar-sweetened beverages, suggesting that initiatives to restrict sugar-sweetened beverage sales in schools may have an only marginal impact on overall consumption. Pediatricians' awareness of these trends is critical for helping children and parents target suboptimal dietary patterns that may contribute to excess calories and obesity. *Pediatrics* 2008;121:e1604–e1614

www.pediatrics.org/cgi/doi/10.1542/peds.2007-2834

doi:10.1542/peds.2007-2834

This work is solely the responsibility of the authors and does not represent official views of the Centers for Disease Control and Prevention.

Key Words
soft drinks, fruit juice, weight management

Abbreviations
SSB—sugar-sweetened beverage
FJ—100% fruit juice
NHANES—National Health and Nutrition Examination Survey
CDC—Centers for Disease Control and Prevention
CI—confidence interval

Accepted for publication Nov 30, 2007

Address correspondence to Y. Claire Wang, MD, ScD, Columbia Mailman School of Public Health, Department of Health Policy and Management, 600 West 168th St, 6th Floor, New York, NY 10032. E-mail: ycw2102@columbia.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

THE OBESITY EPIDEMIC among children and youth continues to grow in the United States,[1] heightening the need to identify modifiable drivers of energy imbalance. Although promoting more active lifestyles remains crucial, improving food and beverage choices is of top priority. Consumption of sugar-sweetened beverages (SSBs), including soda, sports drinks, energy drinks, lemonade, and other fruit drinks, has been linked to excess weight gain in children and adults.[2–5] Although widely marketed as healthy,[6] 100% fruit juices (FJs) contain similar caloric content as SSBs, contain limited nutrients, and have been associated with increased risks of weight gain.[7,8] Mounting evidence strongly supports the role of limiting intake of these sweet beverages in promoting energy balance, mainly because liquid carbohydrates from sweet, energy-dense beverages seem to be poorly compensated by reduction of dietary intake elsewhere.[9–11]

In 1996–1997, ~85% of all children drank SSBs on any given day, and the average serving size had increased by 46% since 1977.[12,13] From 1977–1978 to 1999–2001, the percentage of total energy intake from SSBs among children and adolescents aged 2 to 18 years more than doubled, from 4.8% to 10.3%.[12] National data consistently document that adolescents and older children consume more SSBs than younger children.[14] A number of regional studies have indicated that average consumption levels might be higher among children from lower-income households[15] or children from Native American,[16,17] rural white,[17] or Latino families.[18] Paralleling the rise in SSB consumption has been a decline in milk consumption.[12]

In 2005, the American Heart Association[19] and the US Department of Agriculture[20] published dietary guidelines for children and adolescents and reiterated their recommendation that "sweetened beverages and naturally sweet beverages, such as fruit juice, should be limited to 4 to 6 oz per day for children 1 to 6 years old, and to 8 to 12 oz per day for children 7 to 18 years old." The American Academy of Pediatrics has also stated that the pediatric population commonly overconsumes FJ, which "offer no nutrition advantage over whole fruit for children over 6 months of age."[19,21]

More recently, legislative and regulatory actions targeting beverages consumed in schools have taken center stage.[22] A recent landmark agreement between major US beverage manufacturers, the American Heart Association, and the Clinton Foundation that established voluntary guidelines for beverages sold in schools is an indication that manufacturers may begin restricting availability of sodas, limiting serving sizes, capping sugar and caloric density, and only offering low-fat/fat-free milk in schools. Such initiatives have been embraced by parents and health professionals and are representative of the growing support for environmental and policy initiatives aimed at improving dietary choices among children and youth.

In this study we aimed to provide a timely update on the current pattern of beverage consumption among US youth. We first characterize national trends from 1988 to 2004 on the amount, consumption location, source, and type of beverages consumed by preschool-aged children (aged 2–5 years), older children (aged 6–11 years), and adolescents (aged 12–19 years). We specifically focus on calories from SSBs and FJs to identify opportunities for removing sources of excess calories (the "energy gap")[23] that contribute to excess weight gain among US children. We also examine the extent to which these national trends differ according to age, gender, race/ethnicity, income, and overweight status.

METHODS

Subjects

We included children and adolescents from 2 nationally representative population studies: National Health and Nutrition Examination Survey III (NHANES III, 1988–1994) and the NHANES 1999–2004. The NHANES is an ongoing series of nationwide surveys and clinical examinations conducted by the National Center for Health Statistics. The surveys use a multistage, clustered, probability sampling strategy to select households and individuals to provide national estimates representative of the civilian noninstitutionalized US population. Beginning in 1999, the NHANES began collecting data every year. This analysis is based on the first 6 years of continuous NHANES data collection (1999–2004) and the NHANES III (1988–1994). A complete description of data-collection procedures and analytic guidelines are on the National Center for Health Statistics Web site (www.cdc.gov/nchs/nhanes.htm).

We included children and adolescents with completed 24-hour dietary recalls from the 2 cross-sectional surveys. Respondents with incomplete or unreliable dietary recall status (coded by the NHANES staff) or those who were being breastfed or pregnant at the time of the survey were excluded from our analysis. Sample size for the "other race" category was small; therefore, our trend analyses were only conducted for non-Hispanic white, non-Hispanic black (hereafter referred to as "white" and "black"), and Mexican American youth. Three age categories were defined to approximately characterize their pattern of time spent between home and school environments: preschool-aged children (aged 2–5 years), primary school–aged or older children (aged 6–11 years), and adolescents (aged 12–19 years).

Beverage-Consumption Data

Information on beverage consumption was based on standardized 24-hour dietary recalls in the NHANES. Survey respondents reported all food and beverages consumed in a previous 24-hour period (midnight to midnight). Respondents reported type, quantity, time, and location of each food- and beverage-consumption occasion. Proxy respondents were used for survey examinees who were <6 years of age, and children aged 6 to 11 years underwent assisted interviews. In the NHANES 1999–2004, a computer-assisted system was used to automate the data-collection process. However, the 2 surveys collected dietary information with similar, standardized protocols and coding schemes. After the completion of interviews, all reported food and beverage items were systemically coded by using the US Department of Agriculture Food and Nutrient Database. Caloric content and other nutrients derived from each consumed food or beverage item were calculated on the basis of the quantity of food and beverages reported and corresponding nutrient contents.

From 485 nonalcoholic beverage items reported by NHANES III respondents and 453 items by NHANES 1999–2004 respondents, we identified 6 mutually exclusive, nonalcoholic beverage categories: SSBs (including soda, sport drinks, fruit drinks and punches, low-calorie drinks, sweetened tea, and other sweetened beverages), diet beverages, milk (including flavored milk), FJs (including all unsweetened FJs [eg, apple and orange juices), and (unsweetened) coffee/tea. Reported alcohol consumption was negligible in the study population and was not included in the analysis. The identification and categorization of beverage items followed recently proposed guidelines.[24] We used kilocalories (1 kcal = 4.2 kJ) and fluid ounces (1 oz = 28.35 g) as 2 primary measures for evaluating consumption patterns in an effort to make direct linkages to dietary guidelines and to inform preventive strategies for energy imbalance. Information on location (where the beverage was consumed) was only available in 1999–2000, whereas source (where purchased) was only available in the 2003–2004 surveys.

Assessment of Weight Status and Income

In both surveys, weight and height were objectively measured by using standard procedures in the mobile examination center. Overweight was defined as having a BMI (weight in kilograms divided by height in meters squared) that is greater than or equal to the age- and gender-specific 95th percentile on the Centers for Disease Control and Prevention (CDC) growth charts. Based on self-reported or proxy-reported annual family income, (household income levels) dichotomized to "higher income" or "lower income" by using the 130% poverty level, which defines eligibility for food-stamp programs.

Statistical Analysis

All statistical procedures were conducted by using SAS 9.1 (SAS Institute, Inc, Cary, NC) and SUDAAN 9.0.1 (RTI, Research Triangle Park, NC) software. All statistics were weighted to adjust for unequal probabilities of sampling. Variance estimates from the NHANES analyses were adjusted for the complex sample structure including stratification and clustering by using the robust variance estimation method.[25] Multivariate regressions were used to adjust for differences in population composition across the 2 survey periods including race/ethnicity, gender, income, age, and weekday versus weekend diet recall.

RESULTS

We included 9882 children and adolescents (aged 2–19 years) from the NHANES III and 10 962 from the NHANES 1999–2004. Table 1 summarizes the characteristics of the 2 NHANES samples and the population distributions after weighting. The weighted estimates show comparable race/ethnicity, gender, and age distributions in the NHANES III compared with the NHANES 1999–2004. However, a larger portion of the NHANES 1999–2004 dietary recalls were on weekends than those of the NHANES III sample, which represents an operational imbalance that cannot be fully adjusted for by applying sample weights alone. Because dietary patterns for children substantially vary from weekdays to weekends, we controlled for this variable in addition to race/ethnicity, gender, and age enhance comparability between the 2 time periods.

Percentage of Youth Consuming SSBs, Fruit Juices, and Other Beverages on a Typical Day

As shown in Table 2, in 1988–1994, 79% of all US youth (adjusted for race, gender, age, and weekend versus weekdays) consumed SSBs on a typical day; this percentage was virtually unchanged (80%) in 1999–2004. Approximately 30% of the youth population consumed FJs in 1999–2004, compared with 27% (P = .07) in the NHANES III. Taking SSBs and FJs together, the percentage of US youth who consumed either drink on any given day also remained stable (88%–89%; P = .11) during this period. There was a small decline in the percentage of youth who consumed milk (from 74% to 71%; P = .057). Table 3 summarizes the percentage of children and adolescents who reported consumption of each beverage category according to age group. The decline in milk consumption is statistically significant among children aged 2 to 5 years (−3%; $P < .05$). The increase in FJ drinkers between the 2 time periods is significant among adolescents (5%; $P < .05$).

TABLE 1 **Characteristics of US Children and Adolescents Aged 2 to 19 Years: NHANES III (1988–1994) and NHANES 1999–2004 Dietary Sample**

	n (%)[a]	
	1988–1994	1999–2004
Total	9882 (100)	10962 (100)
Boys	4843 (51)	5560 (51)
Girls	5039 (49)	5402 (49)
Race/ethnicity		
Non-Hispanic white	2812 (73)	3276 (70)
Non-Hispanic black	3433 (17)	3745 (17)
Mexican American	3637 (10)	3941 (14)
Age, y		
2–5	3918 (22)	2083 (21)
6–11	3027 (34)	2792 (34)
12–19	2937 (43)	6087 (46)
Lower income	4521 (30)	4522 (33)
Higher income	4522 (70)	5550 (67)
Recalled day was weekend (Saturday and Sunday)	1776 (22)	4175 (38)
Recalled day was weekday (Monday through Friday)	8106 (78)	6787 (62)
BMI, percentile[b]		
<85th	7257 (76)	7075 (69)
85th–95th	1266 (13)	1673 (15)
≥95th	1146 (10)	1955 (16)

[a] Percentage of US population was estimated by using weights to adjust for unequal probability of sampling.
[b] A BMI greater than or equal to the gender- and age-specific 95th percentile on the CDC growth charts is usually defined as "overweight," and BMI between the 85th and the 95th percentiles is defined as "at risk for overweight."

Per-Capita Caloric Contribution From SSBs and FJs

Across all youth, SSBs contributed, on average, 204 kcal/day in 1988–1994 (95% confidence interval [CI]: 190–213) and 224 kcal/day in 1999–2004 (95% CI: 214–233; P for trend = .006), after adjusting for compositional differences according to age, gender, race/ethnicity, and weekend versus weekday recall (Table 2). The increase during the past 10 years was statistically significant in boys (from 228 to 259 kcal/day; P = .002) but not in girls (177 to 186 kcal/day; P = .2). This increase in per-capita SSB calories corresponded to a change from 9.8% (95% CI: 9.3%–10.3%) to 10.7%

TABLE 2 **Percentage of Children and Youth (Aged 2–19 Years) Who Consumed Beverages and Per-Capita Kilocalories From SSBs on the Surveyed Day, According to Beverage: NHANES III (1988–1994) Versus NHANES 1999–2004**

	1988–1994		1999–2004		Adjusted Mean Difference[a]	*P* (for Trend)
	Crude Mean, %	Adjusted Mean, %[a]	Crude Mean, %	Adjusted Mean, %[a]		
Consumed beverages on the surveyed day						
Had SSB	79	80	81	80	0	.63
Had diet beverage	7	8	5	5	−3	.01
Had milk	75	74	70	71	−3	.06
Had FJ	27	27	30	30	3	.07
Had coffee/tea	4	4	6	5	1	.009
Had SSB or FJ	88	88	90	89	1	.2
Per-capita caloric contribution, kcal/d[b]						
From SSBs	199	204	228	224	20	.006
From FJs	38	38	48	47	8	.008
From SSBs and FJs combined	238	242	276	271	28	.0002
Daily caloric contribution among drinkers, kcal/d[b]						
From SSBs	252	255	282	278	22	.002
From FJs	142	144	158	154	10	.17
From SSBs and FJs combined	271	275	307	302	27	.0001

[a] Adjusted for age, race/ethnicity, gender, household income, and weekend versus weekday consumption.
[b] 1 kcal = 4.2 kJ.

(95% CI: 10.2%–11.1%) (*P* for trend = .02) daily energy intake.

Table 4 shows corresponding per-capita caloric contribution from SSBs and percent total daily energy according to age and demographic groups. In 1999–2004, daily SSB calories averaged 124 kcal (7% total daily energy), 184 kcal (9% total daily energy), and 301 kcal (13% total daily energy) among youths aged 2 to 5, 6 to 11, and 12 to 19 years, respectively. The largest increase from the NHANES III took place among older children (aged 6–11 years), who increased their SSB calories by 20% or 31 kcal ($P < .0001$). Within the group of 6- to

TABLE 3 **Percentage of Respondents to Report at Least 1 Consumption Occasion of Beverages on the Surveyed Day, According to Category and Age: NHANES III (1988–1994) Versus NHANES 1999–2004**

	Ages 2–5 y		Ages 6–11 y		Ages 12–19 y	
	1988–1994	1999–2004	1988–1994	1999–2004	1988–1994	1999–2004
Overall[a]						
Had SSB	72	70	79	81	84	84
Had diet beverage	5	4	9	5[b]	8	6
Had milk	89	86[b]	81	77	60	58
Had FJ	41	46	29	30	18	23[b]
Had coffee/tea	1	2	1	3[b]	6	9
Had SSB or FJ	90	90	86	89	89	90
Weekdays (Monday through Friday)						
Had SSB	72	71	78	80	82	83
Had diet beverage	4	4	8	5[b]	8	6
Had milk	90	87[b]	84	80	63	60
Had FJ	42	46	29	30	17	23[b]
Had coffee/tea	1	2	1	3[b]	7	8
Had SSB or FJ	90	90	85	88	87	88
Weekends (Saturday and Sunday)						
Had SSB	74	71	81	85	88	88
Had diet beverage	8	3	9	6	8	6
Had milk	86	84	73	69	54	53
Had FJ	40	44	30	26	22	24
Had coffee/tea	3	3	2	3	4	11[b]
Had SSB or FJ	89	89	88	92	93	93

[a] Adjusted for race, gender, income, and weekend versus weekdays.
[b] *P* for trend <.05

TABLE 4 **Per-Capita Consumption of SSBs Measured in Caloric Contributions: NHANES III (1988–1994) Versus NHANES 1999–2004**

	Per-Capita Kilocalories[a] From SSBs (% Contribution to Daily Energy Intake)					
	Age 2–5 y		Age 6–11 y		Age 12–19 y	
	1988–1994	1999–2004	1988–1994	1999–2004	1988–1994	1999–2004
Overall	107 (7)	124[b] (7)	153 (8)	184[b] (9)	287 (12)	301 (13)
Male	113 (7)	133[b] (8)	161 (8)	208[b] (10)	333 (12)	357 (14)
Female	101 (7)	115 (7)	145 (8)	159 (9)	238 (13)	242 (13)
Race/ethnicity						
White	102 (7)	120 (7)	154 (8)	184[b] (9)	297 (13)	302 (13)
Black	122 (8)	139 (8)	161 (9)	190[b] (10)	268 (12)	297[b] (14)
Mexican American	113 (8)	127 (8)	134 (7)	181[b] (9)	248 (12)	305[b] (14)
Lower income[c]	127 (8)	141 (8)	154 (8)	187 (9)	283 (13)	325 (15)
Higher income[c]	103 (7)	118 (7)	155 (8)	186[b] (9)	292 (13)	297 (13)
BMI, percentile[d]						
<85th	107 (7)	122 (7)	150 (8)	178[b] (9)	285 (12)	297 (13)
85th–95th	98 (7)	125 (7)	155 (8)	209[b] (10)	280 (13)	304 (14)
≥95th	135 (8)	137 (8)	177 (9)	185 (9)	313 (14)	320 (16)
On weekdays	108 (7)	124 (7)	147 (8)	172[b] (9)	269 (12)	286 (13)
On weekends	106 (7)	126 (8)	168 (9)	214[b] (11)	325 (13)	334 (15)

[a] 1 kcal = 4.2 kJ.
[b] *P* for trend <.05.
[c] Income level was dichotomized on the basis of poverty index ratio (the ratio of annual family income to the federal poverty line, accounting for calendar year of interview). The lower-income level was defined as a poverty index ratio of <130%, reflecting eligibility for the federal food-stamp program.
[d] A BMI greater than or equal to the gender- and age-specific 95th percentile on the CDC growth charts is usually defined as "overweight," and BMI between the 85th and the 95th percentiles is defined as "at risk for overweight."

11-year-olds, boys showed a larger increase (47 kcal; $P = .0002$). In all age groups, the increase in SSB calories per capita was larger among black and Mexican American adolescents than white adolescents. Although overweight children and adolescents generally consume more SSBs than their nonoverweight peers, we found that the trends suggest more substantial increases in SSB consumption among the nonoverweight.

Our results also indicate that consumption of FJs per capita has risen. Between the 2 survey periods, the over-

TABLE 5 **Per-Capita Consumption of FJs Measured in Caloric Contributions: NHANES III (1988–1994) Versus NHANES 1999–2004**

	Per-Capita Kilocalories[a] From FJs (% Contribution to Daily Energy Intake)					
	Age 2–5 y		Age 6–11 y		Age 12–19 y	
	1988–1994	1999–2004	1988–1994	1999–2004	1988–1994	1999–2004
Overall	55 (4)	69 (4)[b]	34 (2)	41 (2)[b]	33 (2)	43 (2)
Male	53 (4)	71 (4)[b]	34 (2)	43 (2)	44 (2)	47 (2)
Female	58 (4)	68 (4)	34 (2)	38 (2)	22 (1)	39 (2)[b]
Race/ethnicity						
White	58 (4)	68 (5)	34 (2)	36 (2)	35 (2)	42 (2)
Black	49 (3)	76 (6)[b]	41 (2)	52 (3)[b]	33 (1)	48 (2)[b]
Mexican American	48 (4)	66 (6)[b]	26 (1)	52 (3)[b]	24 (1)	42 (2)[b]
Lower income[c]	38 (3)	66 (4)[b]	26 (1)	45 (2)	27 (1)	40 (2)
Higher income[c]	61 (4)	67 (4)	36 (2)	38 (2)	34 (2)	43 (2)
BMI, percentile[d]						
<85th	56 (4)	72 (5)[b]	32 (2)	40 (2)[b]	36 (2)	45 (2)
85th–95th	54 (4)	56 (4)	30 (2)	44 (2)	32 (1)	39 (2)
≥95th	44 (3)	62 (4)	46 (2)	38 (2)	15 (1)	39 (2)[b]
On weekdays	58 (4)	67 (4)	34 (2)	41 (2)	28 (1)	41 (2)[b]
On weekends	48 (3)	74 (5)[b]	35 (2)	40 (2)	44 (2)	46 (2)

[a] 1 kcal = 4.2 kJ.
[b] *P* for trend <.05
[c] Income level was dichotomized on the basis of poverty index ratio (the ratio of annual family income to the federal poverty line, accounting for calendar year of interview). The lower-income level was defined as a poverty index ratio of <130%, reflecting eligibility for the federal food-stamp program.
[d] A BMI greater than or equal to the gender- and age-specific 95th percentile on the CDC growth charts is usually defined as "overweight," and BMI between the 85th and the 95th percentiles is defined as "at risk for overweight."

TABLE 6 **Average Quantity and Caloric Contributions From SSBs and FJs Among Children Who Had at Least 1 Consumption Occasion on the Surveyed Day: NHANES III (1988–1994) Versus NHANES 1999–2004**

	SSBs				FJs			
	Mean, oz		kcal[a] (% Total Energy)		Mean, oz		kcal[a] (% Total Energy)	
	1988–1994	1999–2004	1988–1994	1999–2004	1988–1994	1999–2004	1988–1994	1999–2004
Overall								
Aged 2–5 y	13.2	15.5[b]	150 (10)	176[b] (11)	9.9	11.1[c]	135 (9)	148 (9)
Aged 6–11 y	17.4	20.5[b]	196 (10)	229[b] (11)	9.0	10.4[b]	118 (6)	136[b] (7)
Aged 12–19 y	30.3	32.7[b]	340 (15)	356 (16)	13.4	14.6	178 (8)	184 (8)
Boys								
Aged 2–5 y	14.0	16.4[b]	159 (10)	187[b] (11)	9.8	11.0	135 (9)	147 (9)
Aged 6–11 y	18.5	22.9[b]	208 (10)	253[b] (12)	9.5	11.0[c]	125 (6)	144 (7)
Aged 12–19 y	34.4	38.1[b]	388 (14)	409 (16)	15.6	16.2	208 (8)	202 (8)
Girls								
Aged 2–5 y	12.4	14.6[b]	139 (10)	164[b] (10)	10.0	11.2	134 (10)	149 (8)
Aged 6–11 y	16.2	18.0	183 (10)	199 (11)	8.4	9.9[c]	111 (7)	128[c] (7)
Aged 12–19 y	25.8	27.0	289 (16)	300 (16)	11.2	12.9[c]	145 (9)	165[c] (9)
White								
Aged 2–5 y	13.3	15.9[b]	149 (10)	176[b] (11)	9.8	10.8	134 (9)	145 (9)
Aged 6–11 y	17.9	21.0[c]	200 (11)	228[c] (11)	8.7	10.1[c]	114 (6)	132[c] (7)
Aged 12–19 y	31.8	33.8	354 (15)	363 (16)	13.6	14.7	181 (9)	185 (8)
Black								
Aged 2–5 y	13.0	14.5[c]	150 (10)	178[b] (10)	9.5	11.9[b]	130 (8)	160[b] (10)
Aged 6–11 y	16.7	19.7[b]	193 (10)	226[b] (12)	9.6	11.2[c]	126 (7)	146[c] (7)
Aged 12–19 y	26.9	29.4[b]	310 (14)	333[c] (16)	13.7	14.2	179 (7)	183 (9)
Mexican American								
Aged 2–5 y	12.7	14.8[c]	151 (10)	173 (10)	10.6	11.1	145 (10)	145 (9)
Aged 6–11 y	15.4	19.3[b]	179 (10)	220[b] (11)	10.1	11.6[c]	134 (7)	148 (7)
Aged 12–19 y	25.4	30.9[b]	293 (14)	347[b] (16)	12.3	14.3	156 (7)	178 (9)

[a] 1 kcal = 4.2 kJ.
[b] *P* for trend <.01.
[c] *P* for trend <.05.

all caloric contribution from these beverages increased from 38 to 48 kcal/day (*P* = .001), with the largest changes occurring among black and Hispanic children and adolescents (Table 5). We observed the greatest increase over the period among children aged 2 to 11 years from lower income families, bringing their consumption level similar to that of higher-income families. After adjusting for race/ethnicity, gender, age, and weekday versus weekend, the combined total of daily calories from SSBs and FJs in 1999–2004 was 193, 225, and 344 kcal among children aged 2 to 5, 6 to 11, and 12 to 19 years, respectively, which was an increase from 162, 187, and 321 kcal/day in the NHANES III.

Daily Intake Among Children Who Consumed SSBs or FJs

Among children and adolescents who reported at least 1 SSB consumption occasion on the recalled day, they consumed an average of 273 kcal/day in 1999–2004 (adjusted for age, race/ethnicity, gender, income, and weekend versus weekdays, 95% CI: 265–282), which was up from the average of 250 kcal/day (95% CI: 240–261) in 1988–1994. The corresponding daily consumption averages to 22 oz/day in 1988–1994 and 25 oz/day in 1999–2004 (*P* for trend = .0001). Among all children who had at least 1 FJ drink on the surveyed day, their average daily consumption increased from 148 kcal/day in 1999–2004 (95% CI: 134–162) to 160 kcal/day (95% CI: 154–166) in 1988–1994. The average daily consumption level across all children and adolescents who consumed FJ amounted to 12.4 oz/day in 1999–2004, an increase from 11.2 oz/day in the NHANES III (*P* for trend = .011).

Table 6 shows the consumption level reported by respondents who had at least 1 SSB or FJ consumption occasion within each age group. In almost all groups, the average SSB consumption level showed significant increase over time. Not only did more children and adolescents consume FJ (Table 1), but the average daily intake also increased during this period. Approximately half of all children aged 2 to 5 years consumed FJ, for an average of 11.1 oz (up from 9.9 oz in the NHANES III) and 148 kcal (up from 135 kcal in the NHANES III) per day. This increase in the contribution of FJ to total daily energy is highly significant among younger black children (from 130 to 160 kcal/day; *P* = .003). The upward trend in serving size was significant in girls aged 6 to 19 but not in boys.

Location and Sources of SSB and FJ Consumption

Figure 1 describes the relative contributions of calories from SSBs and FJs combined (per capita) according to location of consumption among children and adolescents. For children and adolescents in 1999–2004, 60% to 80% of these calories were consumed in the home environment (home or other people's house). Although

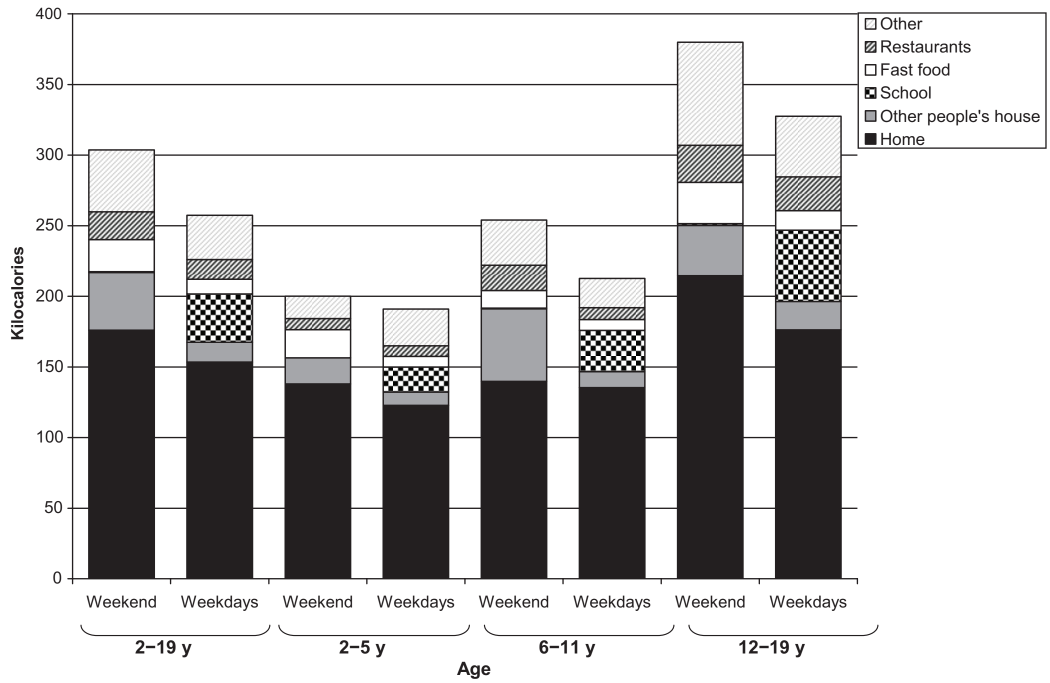

FIGURE 1
Per-capita kilocalories from SSBs and FJs combined according to location of consumption: 1999–2004. "Restaurants" includes self-serve buffets, cafeterias, delicatessens, restaurants, stores, and take-out restaurants; "other" includes in transit (boats, cars, planes), community-feeding programs, work, day camp, day care, and other.

this proportion decreased with age, home consumption remained the main location of SSB and FJ intake even among adolescents on weekdays. SSB and FJ consumption at school represented 14% of all SSB and FJ consumption on a typical weekday for older children (aged 6–11 years) and 15% for adolescents (aged 12–19 years). The in-school intake of SSB and FJ calories seems to be similar between income groups (data not shown). Our findings also indicate that restaurants were an environment in which children frequently consumed SSBs, especially on weekends; fast-food and other types of restaurants seem equally important on the basis of per-capita calories.

In 2003–2004, 1735 children and adolescents who reported SSB consumption in the 24-hour recall also provided the source of the beverage ("Where did you get [food name]?"). Table 7 presents the contribution to all SSB calories from each source category on a typical weekday (Monday to Friday). Note that the contribution from fast-food/pizza restaurants in this table is much higher than that shown in Fig 1, because these estimates include take-out meals. Generally speaking, 71% of all SSB purchases were made in stores. Among adolescents (aged 12–19 years), the points of purchase shift to restaurants and vending machines (~5%). Even if we assume all vending purchases occur in school, the in-school contribution seems small.

Type of Beverages

Figure 2 illustrates the relative contribution of various types of beverages to overall SSB consumption according to age group. Soda contributed 55% of all calories from SSBs among children and adolescents (aged 2–19 years). The remaining SSB calories came from fruit drinks (37%), sports drinks (3%), low-caloric drinks, and other sugar-sweetened drinks (6%). Soda represented ~50% of all SSB calories among older children, and became the predominant SSB consumed by teens. For preschool-aged children, on the other hand, more than half of all SSB calories came from fruit punch. Between 1988–1994 and 1999–2004, consumption of fruit punch and FJs increased among young children (aged 2–5 years). During the same period, the share of SSB consumption

TABLE 7 Sources of SSB Calories on a Typical Weekday: NHANES 2003–2004

	n	% (SE) of All SSB Calories According to Source						
		Store	Restaurant Fast-Food/ Pizza	Restaurant Other	School Cafeteria	Vending Machine	Recreational/Sports Facilities	Other Sources
Overall	1735	70.6 (2.3)	13.4 (1.7)	3.7 (0.4)	0.2 (0.1)	2.6 (0.5)	1.7 (0.7)	7.9 (1.3)
Ages 2–5 y	323	80.4 (3.2)	8.5 (1.8)	1.8 (0.8)	0.1 (0.1)	0.8 (0.6)	0.1 (0.1)	8.2 (2.5)
Ages 6–11 y	397	67.6 (5.0)	15.9 (4.2)	3.4 (0.9)	0.0 (0.0)	0.7 (0.5)	2.7 (2.0)	9.6 (2.6)
Ages 12–19 y	1015	69 (2.2)	13.4 (1.4)	4.6 (0.6)	0.3 (0.1)	4.6 (1.4)	1.7 (0.5)	6.5 (1.4)

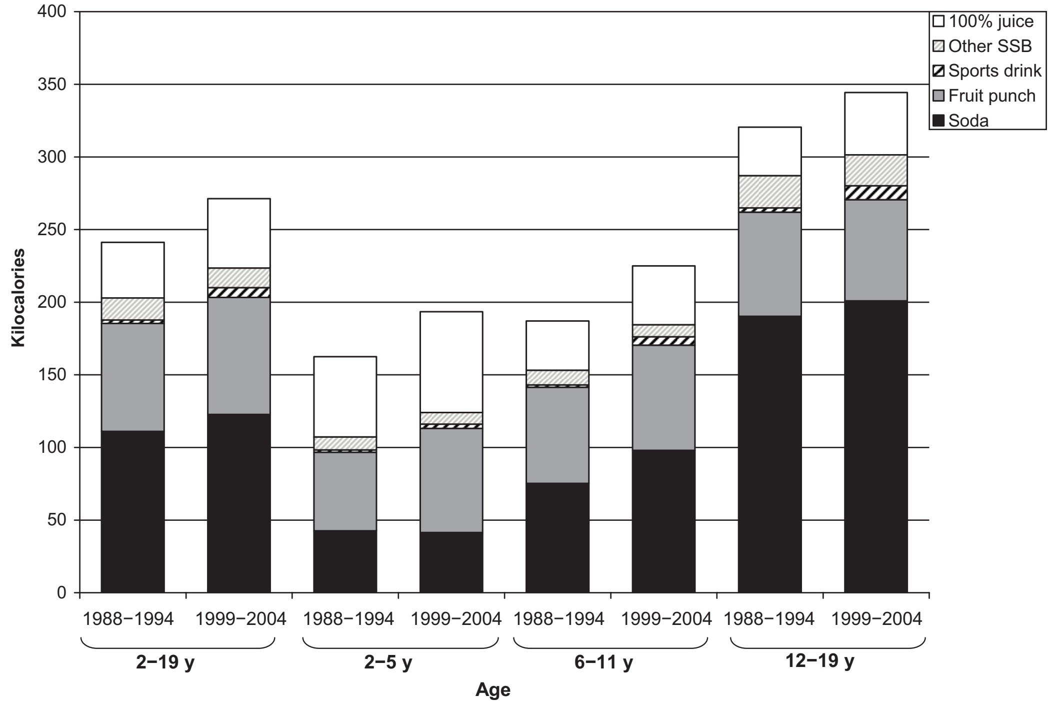

FIGURE 2
Per-capita caloric contributions from SSBs, according to type, and FJs: 1988–1994 Versus 1999–2004. SSBs include soda, fruit punch, sports drinks, and other SSBs (eg, coffee/tea, low-caloric drinks).

attributable to sports drinks increased threefold among adolescents (1%–3% of all total SSB calories).

DISCUSSION

In 1999–2004, US youth consumed an average of 224 kcal per capita per day from SSBs (~11% of their daily energy intake). On any given day, 84% of the adolescents drank SSBs, and these youth consumed an average of 30 oz throughout the day, equivalent to 356 kcal or 16% of their total energy intake. To burn off ~360 extra kcal, an average 15-year-old boy who weighs 50 kg (110 lb) would need to replace sitting by 3.25 hours of walking or 1 hour of jogging. The youngest SSB drinkers (aged 2–5 years) consumed an average of 15.5 oz or 176 kcal from SSB on a typical day (1 regular 12-oz soda contains 140 kcal), ~10% of their total energy intake in 1999–2004. This is more than twice the dietary guideline, which suggests no more than 4 to 6 oz/day for those in this age group. Over the study period, we observed an overall increase in per-capita SSB and FJ consumption (Table 2). This increase parallels secular trends in total energy intake and prevalence of obesity during this decade. Given that the percentage in SSB drinkers changed little over this period, we believe that population-wide increases in SSB consumption are likely driven by increases in daily consumption level.

Our results indicate that carbonated sodas represented less than half of all SSBs consumed by the children aged 2 to 11. In contrast, carbonated sodas comprised approximately two thirds of the SSBs consumed by adolescents. These results suggest the importance of focusing on other SSBs in addition to soda, such as fruit drinks, fruit punch, and sports drinks. Our analysis also points to the rising importance of FJ in children's diet guidelines. Preschool-aged children who drink 100% juice consumed, on average, 10 oz daily, almost twice the APA–recommended amount of 4 to 6 oz/day. This finding echoes previous reports that documented that children aged 1 to 5 years who were enrolled in the Supplemental Nutrition Program for Women, Infants, and Children program received twice the recommended amount of fruit juice (~9.5 fl oz/day).[19,20] Average consumption of 100% juice among teens also exceeded the recommended 8 to 12 oz/day for this age group.

Our results also indicate large increases in SSB consumption among black and Mexican American youths, 2 market segments that have been strategically targeted by advertising efforts and product development in recent years.[6]

Consistent with previous research,[12] we found that most SSB consumption among US children and adolescents occurred at home, and relatively low levels were purchased or consumed in school settings.[26] On a typical weekday, the home environment was the location for 55% to 70% of all SSB calories, depending on age, whereas ~7% to 15% (Fig 1) occurred in school settings. Vending machines and school cafeterias were the source for 1% to 5% (Table 7). This may suggest that initiatives designed to restrict the sale of SSBs in schools may only have a small impact on overall SSB consumption. On the other hand, such initiatives could signal changing norms related to the widespread marketing of these "empty calories" to children.[27] It is possible that such movement will provide incentive for beverage manufacturers to provide smaller serving sizes in all settings or to explore the value in promoting healthier beverages for children and adolescents. Innovative strategies targeted at communities as well as legislative regulations on marking practices and food labeling could potentially have a broad impact on consumer preferences and purchasing behavior. These study results may be useful in providing quantitative benchmarks for the evaluation of such initiatives.

Recently published reviews have linked intake of SSBs to excess weight gain,[5,28] although another review suggested inconclusive evidence.[29] Generally speaking, in contrast to randomized, controlled trials and longitudinal studies that linked change in SSB consumption to change in BMI or obesity incidence, cross-sectional studies that have examined relations between SSB intake and weight status yielded less clear-cut conclusions. Some studies found positive associations between SSB consumption and weight gain,[30–35] and other studies found insignificant[36–40] or weak[41] associations. One study found both positive and negative associations for different subgroups.[42] An important limitation of such cross-sectional designs is the likelihood of reverse causality. For example, we found that overweight children consumed a similar amount of SSBs but significantly more diet beverages per capita than nonoverweight children (1.54 vs 0.76 oz/day in 1999–2004, data not shown), which indicate that overweight children may preferentially consume diet beverages to lose weight or omit SSB consumption. The weaker research design may also lack control for confounding and measurement error. As a result, because our analysis only used cross-sectional surveys of different children during 2 time periods, we are constrained from making any causal inferences about the contribution of SSBs to excess weight gain and obesity.

There are other important limitations associated with using single 24-hour dietary recalls to infer population dietary patterns: (1) The recall method is subject to inaccuracy and bias in reporting all food ingested and quantifying portion size; a systematic underreporting of up to 25% has been documented in adults.[43,44] The validity of reporting beverages is similarly constrained, although some evidence has suggested better accuracy with packaged beverage items such as most SSBs.[45] The extent of underreporting intake in children and the effect of proxy reporting are less studied and would require additional research. (2) An individual's diet may vary greatly from 1 day to the next; therefore, 1 single 24-hour dietary recall does not reliably represent the long-term dietary intake pattern of a respondent. Although this unreliability may reduce the precision of the estimates, it should not have biased our regression estimates of total energy intake.[46] (3) When food servings are converted to energy intake, additional errors are introduced because of assumptions about serving size and food composition defined by the food and nutrient database. Aside from coding error, the use of food-composition data for calculating nutrient intakes assumes that the nutrient values for a given food are representative of the available food consumed by the study subjects. This is particularly relevant for the estimation of total energy intake and possibly less important for quantifying serving size and nutrient content for packaged beverages. (4) Although we used multivariate regression models to adjust for changes in demographic variables and weekday versus weekend recall, our inferences on secular trends and beverage-consumption patterns across the 2 surveys may remain constrained by changes in other compositional variables.

CONCLUSIONS

The consumption of SSBs and FJs continues to rise among children and adolescents. Mounting epidemiologic and experimental evidence suggests that reducing intake of empty calories by limiting SSB consumption may be a key strategy for promoting healthy eating and preventing excess weight gain in youth. Awareness of these trends among pediatricians will be critical in assisting children and parents to identify concrete targets of suboptimal dietary patterns that may contribute to excess caloric intake and obesity. The various types of SSBs are an attractive focus for environmental, policy, and behavioral interventions aimed at curbing the energy imbalance in children and youth.

APPENDIX: CODING DEFINITION FOR NONALCOHOLIC BEVERAGE CATEGORIES: NHANES III AND NHANES 1999–2004

1. Sugar-sweetened beverage (SSB): includes all sodas, fruit drinks, sport drinks, low-calorie drinks, and other beverages (sweetened tea, rice drinks, bean beverages, sugar-cane beverages, horchata, and nonalcoholic wines/malt beverages).
   a. Sport drink: includes all drinks labeled Gatorade or thirst quencher (3 items in NHANES III, 7 items in NHANES 1999–2004).
   b. Fruit drink: includes all fruit drinks, fruit juices, and fruit nectars with added sugar (166 items in NHANES III, 137 items in NHANES 1999–2004).
   c. Soda: includes all carbonated beverages with added sugar (25 items in NHANES III, 21 items in NHANES 1999–2004).
   d. Low-calorie SSB: includes all beverages described as being low-calorie, including fruit juices, teas, and fruit drinks (26 items in NHANES III, 26 items in NHANES 1999–2004).
   e. Other SSB: includes sweetened tea, rice drinks, bean beverages, sugar cane beverages, horchata, nonalcoholic wines/malt beverages, etc (40 items in NHANES III, 37 items in NHANES 1999–2004).
2. Diet beverages: includes all diet sodas and sugar-free carbonated soda water (17 items in NHANES III, 17 items in NHANES 1999–2004).
3. Milk: includes all whole, low-fat, skim, and flavored milk (62 items in NHANES III, 55 items in NHANES 1999–2004). Flavored milk includes fruit-flavored

milk and chocolate milk (60 items in NHANES III, 69 items in NHANES 1999–2004).

4. 100% fruit juice (FJ): includes all 100% juices (eg, apple and orange) and all unsweetened juices (27 items in NHANES III, 17 items in NHANES 1999–2004).

5. Coffee/tea: includes all coffee drinks and unsweetened teas (59 items in NHANES III, 67 items in NHANES 1999–2004).

ACKNOWLEDGMENTS

This work was supported in part by Robert Wood Johnson Foundation grant 260639 and Centers for Disease Control and Prevention grant U48/DP00064-00S1.

REFERENCES

1. Centers for Disease Control and Prevention. Prevalence of overweight among children and adolescents: United States, 1999–2002. Available at: www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm. Accessed September 18, 2007
2. Welsh JA, Cogswell ME, Rogers S, Rockett H, Mei Z, Grummer-Strawn LM. Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999–2002. *Pediatrics.* 2005;115(2). Available at: www.pediatrics.org/cgi/content/full/115/2/e223
3. James J, Thomas P, Cavan D, Kerr D. Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomised controlled trial [published correction appears in *BMJ*. 2004;328(7450):1236]. *BMJ.* 2004;328(7450):1237
4. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet.* 2001;357(9255):505–508
5. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr.* 2006;84(2):274–288
6. Institute of Medicine, Committee on Food Marketing and the Diets of Children and Youth. *Food Marketing to Children and Youth: Threat or Opportunity?* Washington, DC: National Academies Press; 2006
7. Dennison BA, Rockwell HL, Baker SL. Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity [published correction appears in *Pediatrics*. 1997;100(4):733]. *Pediatrics.* 1997;99(1):15–22
8. Faith MS, Dennison BA, Edmunds LS, Stratton HH. Fruit juice intake predicts increased adiposity gain in children from low-income families: weight status-by-environment interaction. *Pediatrics.* 2006;118(5):2066–2075
9. Mattes RD. Dietary compensation by humans for supplemental energy provided as ethanol or carbohydrate in fluids. *Physiol Behav.* 1996;59(1):179–187
10. Bellisle F, Rolland-Cachera MF. How sugar-containing drinks might increase adiposity in children. *Lancet.* 2001;357(9255):490–491
11. DiMeglio DP, Mattes RD. Liquid versus solid carbohydrate: effects on food intake and body weight. *Int J Obes Relat Metab Disord.* 2000;24(6):794–800
12. Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. *Am J Prev Med.* 2004;27(3):205–210
13. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obes Res.* 2002;10(5):370–378
14. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. *Am J Clin Nutr.* 2000;72(5 suppl):1343S–1353S
15. Hamasha AA, Warren JJ, Levy SM, Broffitt B, Kanellis MJ. Oral health behaviors of children in low and high socioeconomic status families. *Pediatr Dent.* 2006;28(4):310–315
16. Ballew C, White LL, Strauss KF, Benson LJ, Mendlein JM, Mokdad AH. Intake of nutrients and food sources of nutrients among the Navajo: findings from the Navajo Health and Nutrition Survey. *J Nutr.* 1997;127(10 suppl):2085S–2093S
17. Stroehla BC, Malcoe LH, Velie EM. Dietary sources of nutrients among rural Native American and white children. *J Am Diet Assoc.* 2005;105(12):1908–1916
18. Giammattei J, Blix G, Marshak HH, Wollitzer AO, Pettitt DJ. Television watching and soft drink consumption: associations with obesity in 11- to 13-year-old schoolchildren. *Arch Pediatr Adolesc Med.* 2003;157(9):882–886
19. Gidding SS, Dennison BA, Birch LL, et al. Dietary recommendations for children and adolescents: a guide for practitioners—consensus statement from the American Heart Association. *Circulation.* 2005;112(13):2061–2075
20. US Department of Health and Human Services, US Department of Agriculture. *Dietary Guidelines for Americans*. 6th ed. Washington, DC: US Government Printing Office; 2005
21. American Academy of Pediatrics, Committee on Nutrition. The use and misuse of fruit juice in pediatrics. *Pediatrics.* 2001;107(5):1210–1213
22. Mello MM, Pomeranz J, Moran P. The interplay of public health law and industry self-regulation: the case of sugar-sweetened beverage sales in schools. *Am J Public Health.* 2008;98(4):595–604
23. Wang YC, Gortmaker SL, Sobol AM, Kuntz KM. Estimating the energy gap among US children: a counterfactual approach. *Pediatrics.* 2006;118(6). Available at: www.pediatrics.org/cgi/content/full/118/6/e1721
24. Popkin BM, Armstrong LE, Bray GM, Caballero B, Frei B, Willett WC. A new proposed guidance system for beverage consumption in the United States. *Am J Clin Nutr.* 2006;83(3):529–542
25. Lohr SL. *Sampling: Design and Analysis*. Pacific Grove, CA: Duxbury Press; 1999
26. Forshee RA, Storey ML, Ginevan ME. A risk analysis model of the relationship between beverage consumption from school vending machines and risk of adolescent overweight. *Risk Anal.* 2005;25(5):1121–1135
27. Utter J, Neumark-Sztainer D, Jeffery R, Story M. Couch potatoes or French fries: are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? *J Am Diet Assoc.* 2003;103(10):1298–1305
28. Pereira MA. The possible role of sugar-sweetened beverages in obesity etiology: a review of the evidence. *Int J Obes (Lond).* 2006;30:S28–S36
29. Bachman CM, Baranowski T, Nicklas TA. Is there an association between sweetened beverages and adiposity? *Nutr Rev.* 2006;64:153–174
30. Ariza AJ, Chen EH, Binns HJ, Christoffel KK. Risk factors for overweight in five- to six-year-old Hispanic-American children: a pilot study. *J Urban Health.* 2004;81(1):150–161
31. Boumtje PI, Huang CL, Lee JY, Lin BH. Dietary habits, demographics, and the development of overweight and obesity among children in the United States. *Food Policy.* 2005;30(2):115–128
32. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. *Am J Clin Nutr.* 2000;72(5 suppl):1343S–1353S
33. Striegel-Moore RH, Thompson D, Affenito SG, et al. Correlates of beverage intake in adolescent girls: the National Heart,

Lung, and Blood Institute Growth and Health Study. *J Pediatr.* 2006;148(2):183–187
34. Phillips S, Bandini L, Naumova E, et al. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. *Obes Res.* 2004;12(3):461–472
35. Cullen KW, Baranowski T, Klesges LM, et al. Anthropometric, parental, and psychosocial correlates of dietary intake of African-American girls. *Obes Res.* 2004;12(suppl):20S–31S
36. Forshee RA, Anderson PA, Storey ML. The role of beverage consumption, physical activity, sedentary behavior, and demographics on body mass index of adolescents. *Int J Food Sci Nutr.* 2004;55(6):463–478
37. Forshee RA, Storey ML. Total beverage consumption and beverage choices among children and adolescents. *Int J Food Sci Nut.* 2003;54(4):297–307
38. Newby PK, Peterson KE, Berkey CS, Leppert J, Willett WC, Colditz GA. Beverage consumption is not associated with changes in weight and body mass index among low-income preschool children in North Dakota. *J Am Diet Assoc.* 2004;104(7):1086–1094
39. Kvaavik E, Andersen LF, Klepp KI. The stability of soft drinks intake from adolescence to adult age and the association between long-term consumption of soft drinks and lifestyle factors and body weight. *Public Health Nutr.* 2005;8(2):149–157
40. Nicklas TA, Yang SJ, Baranowski T, Zakeri I, Berenson G. Eating patterns and obesity in children: the Bogalusa Heart Study. *Am J Prev Med.* 2003;25(1):9–16
41. Øverby NC, Lillegaard IT, Johansson L, Andersen LF. High intake of added sugar among Norwegian children and adolescents. *Public Health Nutr.* 2004;7(2):285–293
42. Bingham SA, Gill C, Welch A, et al. Comparison of dietary assessment methods in nutritional epidemiology: weighed records v. 24 h recalls, food-frequency questionnaires and estimated-diet records. *Br J Nutr.* 1994;72(4):619–643
43. Briefel RR, Sempos CT, McDowell MA, Chien S, Alaimo K. Dietary methods research in the third National Health and Nutrition Examination Survey: underreporting of energy intake. *Am J Clin Nutr.* 1997;65(4 suppl):1203S–1209S
44. Guthrie HA. Selection and quantification of typical food portions by young adults. *J Am Diet Assoc.* 1984;84(12):1440–1444
45. Fox J. *Applied Regression Analysis, Linear Models and Related Methods*. Thousand Oaks, CA: Sage; 1997

Increasing Caloric Contribution From Sugar-Sweetened Beverages and 100% Fruit Juices Among US Children and Adolescents, 1988–2004

Y. Claire Wang, Sara N. Bleich and Steven L. Gortmaker

Pediatrics 2008;121;e1604
DOI: 10.1542/peds.2007-2834

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Increasing Caloric Contribution From Sugar-Sweetened Beverages and 100% Fruit Juices Among US Children and Adolescents, 1988–2004

Y. Claire Wang, Sara N. Bleich and Steven L. Gortmaker

Pediatrics 2008;121;e1604
DOI: 10.1542/peds.2007-2834