Trends in Low-Calorie Sweetener Consumption Among Pregnant Women in the United States

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ABSTRACT

Background: Minimizing consumption of added sugars is recommended to prevent excessive weight gain among pregnant women. A common approach to lowering sugar intake is the use of low-calorie sweeteners (LCSs), yet little is known about LCS use during pregnancy or its effects on infant weight and health.

Objective: The aim of the study was to investigate temporal trends in LCS consumption by source (foods, beverages, or packets) among pregnant women in the United States from 1999 to 2014 and to compare recent LCS consumption patterns across sociodemographic subgroups and product categories.

Methods: Data were collected from pregnant women aged 20–39 y (n = 1,265) who participated in the NHANES from 1999–2000 through 2013–2014. Prevalence of LCS consumption was assessed using two 24-h dietary recalls. Analytical procedures for complex survey design were used, and sampling weights were applied to estimate national prevalence of LCS use. Rao–Scott modified chi-square tests were used to compare consumption prevalence across sociodemographic subgroups, and logistic regression was used to examine trends in LCS use over time.

Results: The prevalence of LCS consumption among pregnant women increased by approximately 50% rising from 16.2% in 1999–2004 to 24.0% in 2007–2014, $P = 0.04$, with the highest prevalence observed in 2005–2006 (38.4%). This trend was driven predominantly by increases in LCS beverage use (9.9% in 1999–2004 compared with 18.3% in 2007–2014, $P = 0.02$). Prevalence of LCS consumption was highest among non-Hispanic white women and increased with education and income. No differences were observed based on prepregnancy weight status or trimester of pregnancy.

Conclusions: Approximately one-quarter of pregnant women in the United States reported consumption of LCS during at least 1 of 2 dietary recalls. Given the widespread LCS consumption during pregnancy, research to elucidate potential effects of early life LCS exposure on taste preferences, weight trajectory, and risk of later metabolic disease is needed. *Curr Dev Nutr* 2019;3:nzz004.

Keywords: diet soda, artificial sweeteners, gestational weight gain, soft drinks, children

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Supplemental Tables 1–3 are available from the "Supplementary data" link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/cdn/.

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Introduction

Low-calorie sweeteners (LCSs) provide sweetness without calories and are commonly used as replacements for added sugars by food manufacturers and consumers. Consumption of LCSs is widespread in US children (25%) and nonpregnant adults (41%) and has increased over the past decade (1, 2). In nonpregnant adults, LCS use is associated with obesity, diabetes, and other unfavorable health consequences in epidemiologic studies (3, 4), yet randomized controlled trials demonstrate beneficial (5) or neutral (3) effects on body weight. LCS use below the acceptable daily intake level established by the US FDA is considered safe during pregnancy (6); meanwhile, recommendations for child LCS consumption are inconsistent (7).

It was recently reported that maternal LCS use during pregnancy is associated with higher infant body weight at 1 year of age (8). A similar study demonstrated that maternal LCS consumption predicted higher birth weight and increased risk of childhood obesity at 7 y of age (9). However, in other studies, no associations were observed between maternal LCS consumption and birthweight (10) or weight gain during childhood (11). Although a causal relation between in utero LCS exposure and future weight and health has not been established, maternal behaviors during pregnancy are known to influence offspring weight and health (12). In addition, it is well established that the development of taste and flavor preferences begins prenatally (13, 14). Particular concern has been raised with respect to excessive sweetness exposure during critical developmental periods (15), because this may predispose children to overconsume sweetened foods and beverages, which often contain excess sugar and calories. Given the ubiquity of LCSs in the food and beverage supply (16, 17), assessing LCS consumption patterns and determining whether LCS exposure in utero may impact fetal and infant weight trajectory and future metabolic health (18, 19) are of paramount importance. However, to our knowledge, the prevalence of LCS consumption among pregnant women in the United States has not been previously investigated. The purpose of this study was to describe temporal trends in the prevalence of LCS consumption in a nationally representative sample of pregnant women in the United States and to compare estimates by LCS source (foods, beverages, packets) and across sociodemographic subgroups. Importantly, the present study was not designed to evaluate effects of LCSs on fetal or infant health.

Subjects and Methods

The national health and nutrition examination survey (NHANES) is a cross-sectional survey of the United States population, which is conducted in 2-y cycles. Details of the NHANES methods and sampling methodology are described elsewhere (20). The current analysis included data collected during 8 NHANES survey cycles: 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010, 2011–2012, and 2013–2014. All NHANES survey procedures were reviewed and approved by the National Center for Health Statistics (NCHS).

The present analysis included women 20–39 y of age ($n = 1265$) determined to be pregnant by pregnancy status at exam (positive laboratory pregnancy test) or self-reported pregnant status at the mobile examination center. Females 19 y of age and younger were excluded because in survey cycles following 2007, the NCHS only released pregnancy data for females aged 20–44 y. Owing to the small number of pregnant women 40 y of age or older ($n = 21$), the age range for our sample was capped at 39 y old (21). Only those with complete data for at least 1 dietary recall (reliable and met minimum criteria) were included in the analysis. Pregnant women with missing data for any sociodemographic characteristic were excluded only from the specific subgroup comparison for which the data were missing, but were included in all other analyses. This resulted in a final analytic sample of 1265 pregnant women (Table 1).

TABLE 1 Sample characteristics of US pregnant women ages 20–39 y in NHANES 1999–2014[1]

	N	Percentage (95% CI)
Age at screening, y		
20–24	410	29.6 (25.9, 33.3)
25–29	415	31.6 (28.0, 35.1)
30–34	310	24.9 (20.9, 29.0)
35–39	130	13.9 (10.7, 17.1)
Race/ethnicity		
Non-Hispanic white	565	54.1 (48.8, 59.5)
Mexican American	336	14.3 (11.5, 17.0)
Non-Hispanic black	195	15.9 (12.6, 19.2)
Other	169	15.7 (11.5, 19.9)
Poverty level		
Missing	87	7.4 (4.9, 9.8)
PIR <130%	391	24.3 (20.8, 27.7)
PIR 130 to <350%	418	32.9 (28.7, 37.2)
PIR ≥350%	369	35.4 (30.2, 40.7)
Education level		
Missing	1	<1 (0, 0.9)[2]
Less than high school	325	18.5 (15.3, 21.6)
HS diploma or GED	268	18.8 (15.3, 22.2)
Some college	359	31.8 (27.8, 35.9)
College degree	312	30.9 (26.7, 35.1)
Marital status		
Missing	40	3.7 (1.9, 5.5)
Married	811	63.6 (59.2, 68.1)
Not married	414	32.6 (28.4, 36.9)
Trimester		
Missing	177	20.6 (16.5, 24.7)
1st (1–3 mo)	257	24.1 (20.7, 27.5)
2nd (4–6 mo)	426	28.0 (24.3, 31.6)
3rd (7–10 mo)	405	27.3 (23.6, 31.0)
Prepregnancy BMI[2]		
Missing	25	2.1 (0.7, 3.6)[2]
Underweight	68	5.9 (3.8, 8.0)
Normal weight	658	50.3 (45.9, 54.7)
Overweight	287	23.4 (19.9, 26.9)
Obese	227	18.3 (15.1, 21.5)
Physician-diagnosed diabetes	15	1.3 (0.2, 2.4)[2]

[1] $n = 1265$. HS, high school; PIR, poverty to income ratio.
[2] Relative SE >30%. Column percentages are survey-weighted.

Prevalence of LCS consumption was assessed using data collected during 1 ($n = 604$) or 2 ($n = 661$) 24-h dietary recalls (depending on the survey cycle), the first of which was conducted in person, whereas the second was conducted by telephone. When available, data from both dietary recalls were used, although participants with only 1 reliable recall were also included in the analysis ($n = 604$). Frequency of LCS consumption (times per day) was assessed using the 1 in-person dietary recall only. Consistent with our prior studies (1, 2, 21), LCS-containing foods and beverages were identified using food descriptions provided in the Food and Nutrient Database for Dietary Studies (FNDDS). The FNDDS version used corresponded to each of the respective 2-y cycles in our analysis (1999–2000 through 2013–2014). The FNDDS includes all foods and beverages consumed by NHANES participants and is based on detailed food-composition data from the USDA National Nutrient Database for Standard Reference (22). Food codes were evaluated for terms including "diet," "dietetic," "low-calorie," "no sugar added," "light," "sugar-free," "sugar substitute,"

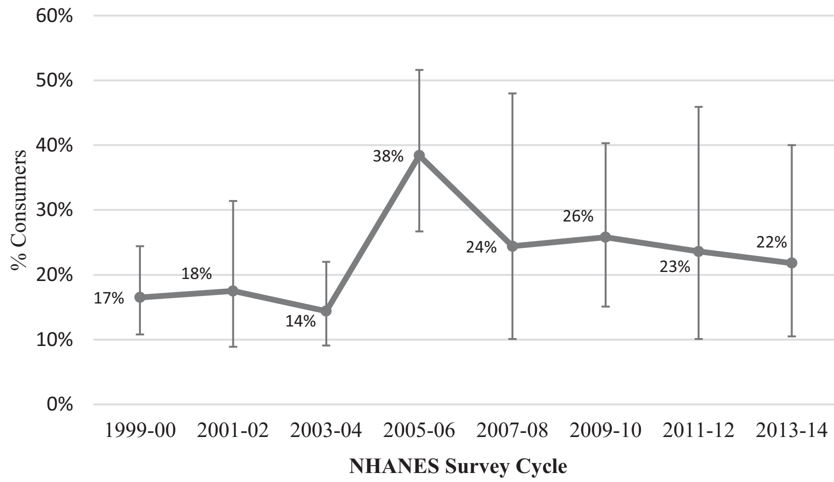

FIGURE 1 Prevalence of low-calorie sweetener consumption among US pregnant women by NHANES Survey Cycle, NHANES 1999–2014. The percentage of US pregnant women consuming low-calorie sweeteners (from any source) increased by approximately 50%, rising from 16.2% in 1999–2004 to 24.0% in 2007–2014, with a marked peak in consumption prevalence observed (38.4%) in 2005–2006 (*P* trend = 0.04).

"low-calorie sweetener," or "no-calorie sweetener." Each code was then categorized as an LCS beverage, LCS food, or LCS packet. A total of 2874 unique food and beverage items were reported in either of 2 recalls by our sample of 1265 pregnant women in NHANES 1999–2014. Of these unique items, 79 contained LCSs. The 79 LCS-containing foods and beverages were grouped into 3 mutually exclusive categories: beverages (44 types), foods including condiments (31 types), and packets (4 types).

Subgroup analyses were conducted to assess differences in the prevalence of LCS consumption during pregnancy based on sociodemographic characteristics, prepregnancy weight status, and trimester of gestation. Age was categorized as 20–24, 25–29, 30–34, or 35–39 y. Race/ethnicity was categorized as non-Hispanic white, non-Hispanic black, Mexican American, or other. Income was categorized using the poverty to income ratio (PIR) (low PIR <100% to 185%, middle 130% to 350%, or high >350%) and education level as less than high school, high school diploma, or GED, some college, or college degree and above. Marital status was assessed dichotomously as married or nonmarried, and prepregnancy BMI was categorized using standard BMI cutoffs for underweight, normal weight, overweight, and obese (23).

Statistical analysis

All analyses were performed using SAS 9.4, using complex survey procedures to account for the NHANES survey design and were weighted to generate nationally representative estimates (20). Prevalence estimates were determined using frequency procedures and expressed as percentage of consumers (95% CI). Rao–Scott modified chi-square tests were used to compare prevalence of LCS consumption across sociodemographic, weight status, and pregnancy trimester subgroups and across product categories. Trends in prevalence of consumption over time were assessed using chi-square tests for trend and *F* tests. Logistic regression models were used to test for trends in prevalence across survey cycles. Tukey-adjusted pairwise differences were also conducted to compare prevalence over time. Relative SEs were checked and reported if >30%. *P* values of <0.05 were considered statistically significant.

Results

Characteristics of the sample of US pregnant women participating in NHANES 1999–2014 are summarized in Table 1. Pregnant women were oversampled in the 4 earliest cycles, and thus sample sizes are

TABLE 2 Prevalence (percentage of consumers) of LCS consumption among US pregnant women NHANES 1999–2004, 2005–2006, and 2007–2014

	1999–2004 *N* = 726 Percentage (95% CI)	2005–2006 *N* = 313 Percentage (95% CI)	2007–2014 *N* = 226 Percentage (95% CI)	*P* trend[1]
Any LCSs	16.2 (11.9, 21.6)[a]	38.4 (26.7, 51.6)[b]	24.0 (17.1, 32.7)	0.0419*
LCS beverages	9.9 (6.6, 14.6)[a]	29.3 (20.1, 40.7)[b]	18.3 (12.0, 26.9)	0.0181*
LCS foods	5.6 (3.1, 10.1)[2]	11.6 (5.6, 22.5)[2]	4.3 (2.0, 8.9)[2]	0.282
LCS packets	2.9 (1.3, 6.0)[2]	8.0 (3.0, 19.5)[2]	5.7 (2.5, 12.4)[2]	0.113

[1] *P* trend: 1-sided *P* value for a linear trend across survey cycles using survey-weighted logistic regression. Significant Tukey-adjusted pairwise differences ($P < 0.05$) between cycles are indicated by different superscript letters. *Statistically significant, $P < 0.05$. LCS, low-calorie sweetener.
[2] Relative SE >30%.

larger for 1999–2000, 2001–2002, 2003–2004, and 2005–2006 than for the later survey cycles (**Supplemental Table 1**). No differences in sociodemographic, pregnancy, or health characteristics were observed across the 8 survey cycles (Supplemental Table 1).

As shown in **Figure 1** and **Supplemental Table 2**, prevalence estimates for LCS consumption in 1999–2000, 2001–2002, and 2003–2004 were similar, as were estimates in the 2007–2008, 2009–2010, 2011–2012, and 2013–2014 survey cycles. We therefore combined the cycles as follows: 1999–2004 and 2007–2014 survey years because of the small sample of pregnant women in the later cycles and high (>30%) relative SEs (**Table 2**). The percentage of US pregnant women consuming LCSs (from any source) increased by approximately 50%, rising from 16.2% in 1999–2004 to 24.0% in 2007–2014, with a marked peak in consumption prevalence observed (38.4%) in 2005–2006 (*P* trend = 0.04). A parallel increase in the percentage of US pregnant women reporting LCS beverage use was observed, rising from 9.9% in 1999–2004 to 18.3% in 2007–2014 (*P* trend = 0.02), with peak prevalence in 2005–2006 (29.3%). A trend toward increasing LCS packet use was also observed (*P* trend = 0.11), increasing from 2.9% in 1999–2004 to 5.7% in 2007–2014, with no differences in the prevalence of LCS-containing food consumption. Across LCS product categories, the highest prevalence of consumption was consistently observed in the 2005–2006 survey cycle (38.4%, 29.3%, 11.6%, and 8.0% for any LCS, LCS beverages, LCS foods, and LCS packets, respectively), consistent with reports among nonpregnant individuals (2). As shown in **Table 3**, increases in the prevalence of LCS consumption among pregnant women were of a considerably smaller magnitude (16.5% in 1999–2000 to 21.8% in 2013–2014) than the increases observed among nonpregnant women 20–39 y of age (24.4% in 1999–2000 to 31.0% in 2013–2014) and in the general US population (24.7% in 1999–2000 to 38.5% in 2013–2014).

Among pregnant women reporting LCS consumption, the majority reported LCS consumption once per day (69.0%). Twenty-two (22.4%) percent indicated consumption of a LCS-containing food or beverage twice, and 8.6% reported LCS consumption 3 or more times, respectively, during their in-person 24-h dietary recall (**Supplemental Table 3**).

Analyses of data from the most recent decade (2005–2014) indicated significant variability in LCS consumption across sociodemographic characteristics (**Table 4**). Although comparisons for LCS foods and LCS packets were limited because of the small sample size and large relative SEs, prevalence of any LCSs and LCS beverage consumption were highest among non-Hispanic white women ($P < 0.0001$), whereas LCS beverage consumption increased with higher education ($P = 0.003$) and income ($P = 0.01$) and was higher among married than among not-married women ($P = 0.02$). Prevalence of LCS consumption also increased with maternal age ($P = 0.02$). No differences were observed across prepregnancy weight status or pregnancy trimester (Table 4).

Discussion

Our findings demonstrate that the prevalence of LCS consumption has increased among US pregnant women over the past 2 decades, which is consistent with reports in nonpregnant women of similar age and in the general US population (1, 2, 17, 24), albeit of a smaller magnitude.

TABLE 3 LCS consumption among pregnant women, similar-age nonpregnant women, and US general population

	Overall	1999–2000	2001–2002	2003–2004	2005–2006	2007–2008	2009–2010	2011–2012	2013–2014	*P* trend[1]
Pregnant women 20–39 y										
N	1265	241	279	206	313	55	65	47	59	–
Percentage of LCS consumers (95% CI)	19.5 (15.0, 24.0)	16.5 (10.8, 24.4)	17.5 (8.9, 31.4)	14.4 (9.1, 22.0)	38.4 (26.7, 51.6)	24.4 (10.1, 48.0)	25.8 (15.1, 40.3)	23.6 (10.1, 45.9)	21.8 (10.5, 40.0)	0.1249
Non-pregnant women 20–39 y										
N	6031	607	716	621	674	836	958	785	834	–
Percentage of LCS consumers (95% CI)	34.7 (32.7, 36.7)	24.4 (19.6, 30.0)	24.6 (20.1, 29.7)	35.0 (29.2, 41.4)	41.6 (36.3, 47.1)	39.3 (35.0, 43.8)	38.7 (34.4, 43.3)	41.3 (36.3, 46.5)	31.0 (24.9, 37.9)	0.0001
US general population 2+ y										
N	67,502	8074	9033	8273	8579	8529	9042	7935	8067	–
Percentage of LCS consumers (95% CI)	36.1 (35.2, 37.1)	24.7 (23.2, 26.4)	25.2 (22.3, 28.3)	33.7 (31.1, 36.5)	39.8 (37.4, 42.2)	40.2 (38.4, 42.0)	42.9 (40.5, 45.2)	40.1 (37.3, 42.9)	38.5 (35.4, 41.7)	<0.0001

[1] *P* trend: 1-sided *P* value for a linear trend across survey cycles using survey-weighted logistic regression. LCS, low-calorie sweetener.

TABLE 4 Prevalence (%) of LCS consumption among US pregnant women, NHANES 2005–2014[1]

		Percentage of consumers (95% CI)			
	N	Any LCSs	LCS beverages	LCS foods	LCS packets
All women	539	29.4 (23.6, 35.2)	21.6 (16.5, 26.6)	7.7 (4.2, 11.2)	6.5 (3.0, 10.0)
Age at screening, y					
20–24	182	25.5 (15.7, 35.2)	17.5 (9.8, 25.1)	3.3 (0.6, 5.9)[2]	5.4 (0.5, 10.2)[2]
25–29	184	23.0 (12.9, 33.0)	17.7 (8.1, 27.4)	6.9 (1.9, 12.0)[2]	5.3 (0.0, 11.6)[2]
30–34	119	30.1 (18.8, 41.4)	18.6 (8.1, 29.1)	9.6 (2.2, 17.0)[2]	6.9 (0.0, 14.8)[2]
35–39	54	48.7 (32.8, 64.6)	41.1 (25.4, 56.7)	14.6 (0.0, 29.3)[2]	10.4 (0.8, 20.1)[2]
P value		0.0264*	0.0221*	0.28	0.79
Race/ethnicity					
NH white	210	39.3 (31.2, 47.5)	31.7 (24.1, 39.2)	9.4 (3.3, 15.5)[2]	9.5 (3.2, 15.8)[2]
Mexican American	145	18.5 (10.5, 26.6)	11.4 (3.9, 18.9)[2]	5.1 (2.3, 7.8)	3.4 (0.0, 6.9)[2]
NH black	102	15.5 (8.0, 23.0)	12.1 (6.4, 17.8)	4.5 (0.0, 8.9)[2]	0
Other	82	20.4 (10.2, 30.7)	6.8 (2.4, 11.1)[2]	7.6, (0.28, 15.0)[2]	6.0 (0.0, 12.3)[2]
P value		<0.0001*	<0.0001*	0.47	–
Family income[3]					
PIR <130%	181	18.9 (11.5, 26.3)	11.8 (5.9, 17.8)	5.3 (1.4, 9.3)[2]	2.8 (0.0, 6.2)[2]
PIR 130–350%	178	34.7 (24.2, 45.3)	21.9 (13.0, 30.9)	8.8 (2.8, 14.7)[2]	11.0 (2.6, 19.5)[2]
PIR >350%	143	35.0 (24.5, 45.4)	30.5 (20.9, 40.1)	8.6 (1.9, 15.3)[2]	6.2 (0.1, 12.4)[2]
P value		0.0427*	0.0097*	0.66	0.26
Education					
Less than high school	142	23.6 (13.4, 33.8)	18.1 (8.4, 27.7)	1.7 (0.0, 3.5)[2]	4.2 (0.0, 9.0)[2]
HS diploma or GED	116	14.1 (6.1, 22.1)	11.6 (3.9, 19.2)[2]	3.6, (1.1, 6.0)[2]	0.4 (0.0, 1.2)[2]
Some college	167	31.4 (19.6, 43.2)	16.3 (8.3, 24.2)	8.7, (3.3, 14.1)[2]	7.6 (0.0, 15.4)[2]
College degree or above	114	40.0 (28.4, 51.6)	35.1 (23.3, 46.9)	12.6 (3.3, 21.8)[2]	10.3 (1.7, 18.9)[2]
P value		0.0113*	0.0030*	0.0484*	0.24
Marital status[4]					
Married	330	33.6 (26.2, 41.0)	24.6 (17.4, 31.8)	10.2 (4.9, 15.5)	6.8 (2.2, 11.4)[2]
Not married	208	21.7 (14.0, 29.3)	15.9 (9.2, 22.6)	3.0 (0.6, 5.4)[2]	5.9 (0.1, 11.8)[2]
P value		0.0236*	0.10	0.0214*	0.82
Trimester[5]					
1st (1–3 mo)	120	40.0 (25.1, 54.9)	30.3 (19.3, 41.3)	8.1 (0.0, 16.4)[2]	13.8 (1.7, 25.8)[2]
2nd (4–6 mo)	157	31.0 (20.2, 41.8)	19.0 (8.2, 29.8)	8.2 (2.3, 14.0)[2]	5.8 (2.4, 9.1)[2]
3rd (7–10 mo)	165	29.3 (17.9, 40.7)	23.3 (12.1, 34.6)	11.3 (3.5, 19.1)[2]	3.5 (0.0, 7.5)[2]
P value		0.47	0.38	0.36	0.17
Prepregnancy BMI[6]					
Underweight	23	12.1 (0.0, 28.5)[2]	12.1 (0.0, 28.5)[2]	0	0
Normal weight	271	26.7 (18.4, 35.0)	18.8 (11.9, 25.7)	8.8 (3.4, 14.2)	5.0 (1.6, 8.3)[2]
Overweight	137	37.2 (25.7, 48.6)	31 (19.5, 42.7)	6.4 (0.6, 12.3)[2]	8.6 (0.3, 16.9)[2]
Obese	96	30.0 (17.6, 42.4)	18.3 (6.8, 29.9)[2]	8.7 (1.8, 15.6)[2]	8.7 (0.0, 19.1)[2]
P value		0.21	0.14	–	–

[1] *Statistically significant, $P < 0.05$. HS, high school; LCS, low-calorie sweetener; NH, non-Hispanic; PIR, poverty to income ratio.
[2] Relative SE >30%.
[3] 37 participants missing data for family income.
[4] 1 participant missing marital status.
[5] 97 participants missing data on pregnancy trimester.
[6] 12 participants missing data on prepregnancy BMI, underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), obese (≥30 kg/m^2). Survey-weighted percentages; Rao–Scott modified chi-square tests within LCS product types (omnibus *P* values shown).

In NHANES 2007–2014, approximately 24% of US pregnant women reported LCS use during at least 1 of their 2 dietary recalls, similar to recent estimates reported among pregnant women in the Canadian Healthy Infant Longitudinal Development birth cohort (8). As has been demonstrated in nonpregnant individuals, an increase in LCS beverage consumption, rather than LCS-containing foods or packets, appears to be driving this trend (2, 25) with particularly marked increases observed in 2005–2006. Although the reason for this disproportionate increase in LCS consumption in 2005–2006 is not clear, considerable public health emphasis was placed on reducing consumption of added sugar during this time frame. For example, in 2005, the Center for Science in the Public Interest published its report on "Liquid Candy" (26). Furthermore, several LCS-containing food codes were reported in 2005–2006 that were not present in earlier cycles, although the appearance of these food codes does not fully explain the increases observed.

Despite rising LCS consumption during pregnancy, it is currently unclear whether LCS exposure in utero impacts fetal or infant weight and health (27). Although potential effects of prenatal LCS exposure have not been well studied in humans (19), 2 recent observational analyses have reported associations between maternal LCS consumption and child weight gain (8, 9), although a third analysis reported null findings (11). Epidemiologic associations between maternal LCS intake and preterm delivery have also been reported (28, 29), yet possible biological mechanisms explaining the observational link between LCSs and premature birth have not been elucidated.

In contrast with the observational literature, randomized controlled trials in nonpregnant individuals demonstrate neutral (3) or beneficial (5, 30) effects of LCS use on weight management. It is therefore possible that LCSs may serve as a useful tool for preventing excessive gestational weight gain and related pregnancy complications in pregnant women, if used carefully for the purpose of weight loss (31) and in parallel with more comprehensive lifestyle changes (32). As with in the general population, however, it is not clear whether LCSs are used in this manner among the majority of pregnant women, especially as many individuals consume LCSs inadvertently (33, 34), as opposed to intentionally for the purpose of restricting energy intake. It is also possible that in utero LCS exposure may predispose the fetus to metabolic complications, independently of weight (35) or postnatal diet (36). Experimental human data linking in utero LCS exposure with offspring weight and health are lacking to date (37), and more research is required to fully understand the implications, if any, of LCS use during pregnancy and to develop evidence-based guidelines for or against their use among expectant mothers (27).

Strengths of our study include evaluation of a large sample of pregnant women using nationally representative data collected in NHANES, enabling comparison across sociodemographic characteristics, prepregnancy weight status, and pregnancy trimester, and between product categories. As prevalence of LCS consumption during pregnancy has not, to our knowledge, been previously documented in the United States, our results complement prior studies reporting consumption estimates in the general, nonpregnant US population (1, 24, 38).

In addition to previously described limitations of assessing LCS consumption using NHANES (1, 2), including inability to assess specific types of LCSs, which have different properties and may exert different physiological effects, or to calculate absolute quantities of LCS consumed, our analysis was further limited by the small sample size, resulting in large relative SEs for sociodemographic comparisons for LCS foods and LCS packets. The relatively small number of pregnant women surveyed, particularly in the most recent 4 cycles of NHANES (2007–2014), also restricted our ability to assess temporal trends in overall LCS consumption within population subgroups. Despite these limitations, however, our estimates provide confirmation that recently documented increases in LCS use in the United States (1, 2) also apply to expectant mothers, with similar sociodemographic correlates as reported in nonpregnant adults. Our findings underscore the need for careful investigation as to whether use of LCSs by pregnant women reduces excessive gestational weight gain and if in utero LCS exposure influences infant and child taste preferences, weight trajectory, and long-term metabolic health.

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The authors' responsibilities were as follows—ACS, MIG, KIR, and JAW: designed the study; JF: performed the statistical analyses; ACS: wrote the first draft of the manuscript; and all authors: read and approved the final manuscript.

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