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Exploring Maternal Patterns of Dietary Caffeine Consumption Before Conception and During Pregnancy

Lei Chen,
Global Patient Safety-Pharmacoepidemiology, Eli Lilly and Company, LCC DP 2638, Indianapolis, IN 46285, USA

Erin M. Bell,
University at Albany School of Public Health, One University Place, Rensselaer, NY 12144, USA

Marilyn L. Browne,
University at Albany School of Public Health, One University Place, Rensselaer, NY 12144, USA

Bureau of Environmental and Occupational Epidemiology, New York State Department of Health, Empire State Plaza-Corning Tower, Room 1619, Albany, NY 12237, USA

Charlotte M. Druschel,
University at Albany School of Public Health, One University Place, Rensselaer, NY 12144, USA

Bureau of Environmental and Occupational Epidemiology, New York State Department of Health, Empire State Plaza-Corning Tower, Room 1619, Albany, NY 12237, USA

Paul A. Romitti, and
The University of Iowa College of Public Health, 105 River Street, Iowa City, IA 52242, USA

National Birth Defects Prevention Study
National Center on Birth Defects and Developmental, Disabilities, Centers for Disease Control and Prevention, 1600, Clifton Road, Atlanta, GA 30333, USA

Abstract

We describe patterns of dietary caffeine consumption before and after pregnancy recognition in a cohort of women who recently gave birth. This study included 8,347 mothers of non-malformed liveborn control infants who participated in the National Birth Defects Prevention Study during 1997–2007. Maternal self-reported consumption of beverages (caffeinated coffee, tea, and soda) and chocolate the year before pregnancy was used to estimate caffeine intake. The proportions of prepregnancy caffeine consumption stratified by maternal characteristics are reported. In addition, patterns of reported change in consumption before and after pregnancy were examined by maternal and pregnancy characteristics. Adjusted prevalence ratios were estimated to assess factors most associated with change in consumption. About 97 % of mothers reported any caffeine consumption (average intake of 129.9 mg/day the year before pregnancy) and soda was the primary source of caffeine. The proportion of mothers reporting dietary caffeine intake of more

L. Chen, chen_lei@lilly.com.

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than 300 mg/day was significantly increased among those who smoked cigarettes or drank alcohol. Most mothers stopped or decreased their caffeinated beverage consumption during pregnancy. Young maternal age and unintended pregnancy were associated with increases in consumption during pregnancy. Dietary caffeine consumption during pregnancy is still common in the US. A high level of caffeine intake was associated with known risk factors for adverse reproductive outcomes. Future studies may improve the maternal caffeine exposure assessment by acquiring additional information regarding the timing and amount of change in caffeine consumption after pregnancy recognition.

Keywords

Caffeine; Coffee; Tea; Soda; Pregnancy

Introduction

Coffee, tea, soda, and chocolate are the main sources of caffeine consumption among pregnant women and the US population [1, 2]. In the late 1970s, about 74 % of US pregnant women consumed caffeine with mean intake of 193 milligrams (mg)/day [1]. Since 1980, concern that caffeine might increase adverse birth outcomes led the US Food and Drug Administration to caution pregnant women to limit their caffeine consumption [3]. In the mid- to late 1990s, caffeine consumption declined to 68 % among pregnant women with mean intake of 125 mg/day [1]. During that same time period, consumption of coffee, soda, and tea accounted for 47.6, 26.2, and 22.9 %, respectively, of a pregnant woman's average daily caffeine intake. Caffeine contained in food products varies from 6 mg/ounce (oz) of chocolate [4] to 320 mg/16 oz of store-brewed coffee [5].

Although epidemiologic studies have not implicated caffeine consumption as a risk factor for adverse pregnancy outcomes, concerns persist due to caffeine-induced congenital malformations observed in rodents [6–9] and the high prevalence of caffeine consumption in the general population [1, 2]. Previous studies observed that pregnant women with high caffeine consumption were older in age, less educated, and more likely to smoke and drink alcohol [10]. Statistics currently available for caffeine consumption during pregnancy [1, 2] are based on surveys of the US population and do not address preconception or pregnancy consumption. A previous analysis using National Birth Defects Prevention Study (NBDPS) data [11], observed that pregnancy intention might influence caffeine consumption, but associations with other maternal characteristics were not assessed.

Considering the prevalent caffeine consumption by pregnant women, a slight elevation in risk could produce a significant impact at the population level. Given the lack of studies on caffeine consumption among pregnant women in the past decade and limitations in previous studies, we described patterns of caffeine consumption among pregnant women using self-reports collected by the NBDPS for births from 1997 through 2007, controlling for several maternal and pregnancy characteristics.

Materials and Methods

Study Population

The NBDPS is an ongoing, multi-site, population-based case–control study of 37 major structural defects, excluding cases attributed to known chromosomal or single-gene abnormalities [12]. This analysis included mothers of non-malformed control infants delivered from October 1, 1997 through December 31, 2007 sampled from each NBDPS site (Arkansas, California, Georgia/CDC, Iowa, Massachusetts, New Jersey, New York, North Carolina, Texas, and Utah). Control infants are liveborn without birth defects randomly selected from either birth certificates or hospital birth records [13]. Each site obtained institutional review board approval for the NBDPS; informed consent was provided by all participants.

Exposure Assignment

Trained interviewers administered computer-assisted telephone interviews to mothers of the control infants. Interviews were conducted between 6 weeks and 24 months after the estimated date of delivery (EDD) [13]. The NBDPS uses a shortened version of the Willett food frequency questionnaire (FFQ) [14] to estimate dietary intake the year before pregnancy. Specific questions were asked about consumption of coffee, tea, soda (caffeinated and caffeine-free) and chocolate (see Table 1): henceforth, references to coffee, tea, and soda are limited to caffeinated subtypes. Diet and non-diet sodas were not examined separately.

Total maternal dietary caffeine intake was calculated as the sum of estimated average daily intake (mg/day) of caffeine from beverages and chocolate reported in the interview. The assigned caffeine content for each beverage or food was based on previously published methods [15–19]. Specifically, each cup of coffee was assigned 100 mg of caffeine, and each cup of tea as containing 37 mg of caffeine [15]. The caffeine content of specific brands of soda were based on the caffeine content per 12 oz serving obtained from the soda manufacturers, when available [17]; an average value of 37 mg of caffeine was assigned to sodas for which the caffeine content could not be determined [17]. A weighted average of 10 mg caffeine/oz was used for chocolate similar to previous NBDPS analyses [16, 17]. Total caffeine intake from all beverages and chocolate combined was assigned to five categories (<10, 10 to <100, 100 to <200, 200 to <300, and 300+ mg/day).

For mothers of infants delivered from 1997 through 2005, the NBDPS interview asked if mothers increased, maintained, decreased, or stopped consumption of each beverage during the index pregnancy compared to the year before pregnancy. The interview did not measure change in consumption amount, frequency or date consumption changed. Among the 8,488 mothers, 141 with “don’t know” or missing responses to the change in caffeine consumption question were excluded from the analysis of this question.

Maternal and Pregnancy Characteristics

Associations with self-reported, selected maternal characteristics were examined. These included: age at conception (<20, 20–34, ≥35); race/ethnicity (non-Hispanic White, non-

Hispanic Black, Hispanic, other); education (≤12, >12 years); body mass index (BMI, <18.5, 18.5 to <25, ≥25); pre-gestational type I or type II diabetes (yes, no); parity (0, ≥1); study site; season of conception (December–February, March–May, June–August, September–November); contraception use (never used or stopped using contraception to get pregnant, got pregnant during an interruption in using contraception, got pregnant while consistently using contraception); intent (wanted to be pregnant, wanted to wait until later, did not want to be pregnant at all or did not care); recognition (1st trimester, 2nd or 3rd trimester); initiation of prenatal care (1st trimester, 2nd or 3rd trimester, no care); nausea or vomiting during pregnancy (yes, no); and exposures during 1 month before pregnancy through the first trimester to active and environmental tobacco smoking (ETS) (none, ETS only, active smoking with/without ETS), active smoking frequency (none, <1 pack/day, ≥1 pack/day), alcohol drinking (yes, no), alcohol drinking frequency (none, <1 drink/day, ≥1 drink/day), and binge drinking (none, <4 drinks/occasion, ≥4 drinks/occasion).

Data Analysis

Pattern of Dietary Caffeine Consumption During the Year Before Pregnancy— We described distributions of average estimated dietary caffeine consumption in mg/day for the year before pregnancy, separately, for each beverage type and total consumption by the characteristics listed above.

Change in Beverage Consumption During Pregnancy—Change in beverage consumption during pregnancy was analyzed among mothers who reported consumption the year before pregnancy. Frequencies and percentages of mothers who reported “more”, “the same”, “less”, or “no consumption” of coffee, tea, and soda during pregnancy were calculated. Given that certain maternal characteristics are associated with patterns of consumption before pregnancy, we also calculated prevalence ratios (PR)s and 95 % confidence intervals (CI)s to compare the proportions of mothers who reported increasing, decreasing (or stopping) caffeine consumption to those with no consumption change during pregnancy by beverage type for each covariable listed above, in order to assess if any of the maternal characteristics were strongly related to change in consumption of caffeinated beverages during pregnancy.

Comparison of Consumption Patterns Before Pregnancy to Those During Pregnancy—Percentages of change in consumption for each beverage type during pregnancy were stratified by total caffeine consumption and by beverage type for the year before pregnancy. The PRs were estimated to assess the association between caffeine consumption patterns before pregnancy and change in consumption. The adjusted prevalence ratios (aPRs) were calculated for categories of “increase” and “decrease or stop” compared to the referent category “no change”, by log-binomial regression. Since only one previous study has examined risk factors related to caffeine consumption before and changes during pregnancy [11], and there are no established covariables of these associations, the study made no a priori assumptions about which covariables should remain in the multivariable models. For change in consumption of each beverage, separate models were estimated for “increased” compared to “no change” and for “decreased or stop” compared to “no change”. Covariables with the Wald test p values less than 0.2 in both models were retained in the

final model. Separate models were estimated for each beverage type. The log binomial models were further stratified by characteristics including nausea or vomiting during pregnancy, pregnancy intention, maternal age, smoking, and alcohol drinking to assess if associations were different by these strata. Sensitivity analysis was conducted among mothers who were interviewed within 6 months after the EDD and those who were interviewed after 6 months.

All analyses were conducted with SAS software, version 9.1 (SAS Institute, Inc., Cary, North Carolina).

Results

Pattern of Dietary Caffeine Consumption during the Year before Pregnancy

Overall, 8,488 (64.9 %) control mothers participated in the NBDPS. Of these, 8,347 reportedly consumed caffeine, and 8,071 reported consumption the year before pregnancy, with a mean intake of 129.9 mg/day. Of the 8,347 mothers, 3,786 (45.4 %), 3,845 (46.1 %), and 5,486 (65.7 %) reported consumption of coffee, tea and soda, respectively, the year before pregnancy; mean daily intake of caffeine for each beverage type was 139.2, 34.1, and 64.9 mg, respectively. Distributions of consumption categories for total caffeine intake and for each beverage type are shown in Table 2.

Of the total caffeine consumed by mothers the year before pregnancy, 31, 15, and 36 % was from coffee, tea, and soda; respectively. Table 3 shows dietary caffeine consumption the year before pregnancy by maternal and pregnancy characteristics. An unproportionally high percentage of non-Hispanic white mothers, those who conceived while consistently using contraception, and those who had an unplanned pregnancy (“did not want to become pregnant at all or did not care”) reported caffeine consumption in the highest intake category (300+ mg/day) compared to the other caffeine intake categories. High caffeine intake was also associated with smoking and alcohol drinking during pregnancy. No other maternal characteristics were associated with caffeine intake (see Supplemental Table 1).

Most of the above patterns remained when stratifying by beverage type (data not shown). However, coffee consumption was related with maternal age older than 35 years. Additional characteristics related to frequent consumption of tea and soda (3+ cups/day) included maternal age younger than 20 years, underweight or overweight before pregnancy, and recognition of pregnancy after the first trimester.

Change in Beverage Consumption During Pregnancy

Among mothers reporting any consumption of coffee, tea, or soda the year before pregnancy, most decreased or stopped consumption during pregnancy (Table 4). A total of 223 (3.8 %) mothers reported increased consumption of any caffeinated beverage without decreasing or stopping other types of beverages; 209 (3.6 %) mothers increased consumption of one or two types of beverages and decreased or stopped consumption of other types; 796 (13.7 %) mothers did not change caffeinated beverage consumption; 4,583 (78.9 %) mothers decreased or stopped consumption of one to three beverage types, without switching to other types (data not shown).

Compared to non-smokers, active smokers were less likely to stop the consumption of all three caffeinated beverage types, and more likely to increase tea consumption. Furthermore, among smoking mothers who increased tea consumption during pregnancy and consumed coffee the year before pregnancy (n = 47), 76.6 % decreased or stopped coffee consumption during pregnancy, 12.8 % kept the same consumption level, and 10.6 % increased consumption (see Supplemental Tables 2–4).

Compared to non-drinkers, those who reported drinking alcohol were less likely to increase coffee consumption during pregnancy. Alcohol drinking was not related to change in consumption during pregnancy for either tea or soda (see Supplemental Tables 2–4).

Mothers who recognized their pregnancy after the first trimester, as well as those who had an unplanned pregnancy, continued to use contraception during pregnancy, or started prenatal care after the first trimester were more likely to increase coffee or tea consumption, and were slightly less likely to stop soda consumption compared to those with early recognition of their pregnancy, with a planned pregnancy, who stopped contraception to get pregnant, or who began prenatal care in the first trimester (see Supplemental Tables 2–4).

Comparison of Consumption Patterns Before Pregnancy to Those During Pregnancy

A larger proportion of mothers maintained tea and soda consumption levels than coffee levels, independent of level of preconception caffeine consumption (Tables 4, 5). The percentage of mothers who stopped consuming coffee consistently decreased as prepregnancy total caffeine intake increased; and the decrease, in general, was shown for tea or soda, although not consistently across categories (Table 5).

Caffeine consumption levels before pregnancy were not associated with decreased caffeine consumption after pregnancy recognition; however, mothers who consumed three or more cups of tea before pregnancy were slightly less likely to decrease or stop tea consumption during pregnancy (see Table 6). Compared to mothers who “maintained” consumption, those who increased consumption varied by prepregnancy coffee and soda consumption. Mothers who consumed 1 or 2 cups of coffee per day the year before pregnancy were significantly less likely to increase coffee consumption during pregnancy (aPR 0.2, 95 % CI 0.1–0.4 for 1 cup/day; aPR 0.3, 95 % CI 0.1–0.7 for 2 cups/day) compared to those in the lowest prepregnancy coffee consumption category (1/month–6/week), and those who consumed 3 or more cups of coffee per day the year before pregnancy did not change their pattern of consumption during pregnancy, compared to mothers with none-to-lowest caffeine intake. Those who consumed more than 1 serving/day of soda the year before pregnancy were less likely to increase their consumption during pregnancy (aPR 0.7, 95 % CI 0.6–0.9 for 1–2 servings/day; aPR 0.7, 95 % CI 0.5–1.0 for 3+ servings/day). Further, stratified analysis demonstrated that the crude and adjusted PRs did not differ by maternal nausea or vomiting during pregnancy, pregnancy intention, age, smoking, and alcohol drinking. Sensitivity analysis showed that the results were similar between mothers who were interviewed within 6 months after the EDD and those who were interviewed after 6 months.

Discussion

We described caffeine consumption among pregnant women in the US from 1997 through 2007. Compared to the 1990s, our data showed lower caffeine intake levels among women of childbearing age, although the percentage of women consuming caffeine did not change. In our study population, older mothers consumed more coffee and younger mothers more soda. Further, the current study observed that soda contributed to 36 % of caffeine intake, which surpassed coffee and tea in caffeine contribution. Although coffee is still the major source of caffeine for coffee consumers, more mothers reportedly consumed soda (66 %) than coffee (45 %) in the NBDPS. Daily dietary caffeine intake of 300+ mg from coffee and all dietary sources combined was more common among mothers who smoked, drank alcohol, were non-Hispanic white, or had unplanned pregnancies.

Changes in consumption of coffee, tea, and soda during pregnancy were relatively crude measurements. Our interview only asked if the mother consumed more, the same, less, or none of each caffeinated beverage type during pregnancy than she reportedly consumed the year before pregnancy; therefore, we did not measure the amount of change, or when the change in consumption began. The revised NBDPS interview asks questions about consumption of caffeinated coffee, tea, and soda during the first trimester, as well as usual portion size for coffee. It will be possible to describe both proportion of mothers reporting change and the amount of change as reported in the revised interview when such data are available.

Previous studies suggested that nausea and vomiting were related to decreased caffeine consumption [20, 21]. However, we observed that mothers who reported nausea or vomiting during early pregnancy did not change their consumption during pregnancy compared to those who did not report nausea or vomiting. Young maternal age was consistently associated with increased consumption of coffee, tea, and soda during pregnancy, which might partly explain the association between increased consumption and being non-Hispanic Black or Hispanic, and having less than or equal to a high school education, both of which were closely related to young maternal age. Unplanned or undesired pregnancies were associated with more than twice the prevalence of increased coffee consumption, and 1.5 times the prevalence of increased tea consumption compared to mothers with planned pregnancies. Unplanned pregnancies were more common among mothers of younger age, which was consistent with the findings of a previous NBDPS study [11]. Additionally, we observed that pregnancy intention was not only associated with maternal prepregnancy caffeine consumption and increased consumption during pregnancy, but also with maternal behaviors, such as smoking, alcohol drinking, and continued use of contraception in pregnancy, as observed previously [11].

Our results showed that young mothers with unplanned pregnancies may have more exposures and behaviors that are related to adverse birth outcomes. For example, alcohol drinking and smoking are independently associated with adverse birth outcomes and they are also associated with poor dietary intake. Smoking is associated with reduced total food consumption due to appetite suppression. Alcohol, sodas and chocolate [22], replace potentially nutrient-rich foods with “empty calories” [23]. Diet or non-diet sodas were not

analyzed separately in this study. Future studies of associations between caffeine consumption and adverse birth outcomes should consider the interplay of other dietary factors and maternal behaviors related to caffeine consumption. An understanding of these relationships may be useful in guiding health practice and health education.

Although over 80 % of mothers consumed coffee, tea, or soda the year before pregnancy, most decreased or stopped consumption after pregnancy recognition. When mothers increased consumption of a specific beverage type, they tended to decrease or stop the consumption of the other types. We observed that among those who increased tea consumption, mothers with unplanned pregnancies were more likely to decrease coffee consumption after pregnancy compared to mothers with planned pregnancies. For mothers who were concerned about caffeine intake, tea might have been viewed as a healthier alternative.

Our caffeine intake assessment may suffer from mis-classification through four sources. First, the standardized caffeine contents were assigned to each unit size of coffee, tea, soda, and chocolate; however, caffeine content differs widely by brand and type of coffee bean or tea, brewing time and method, serving size, seasonal variation of consumption or patterns of consumption (all at one time or in small amounts throughout the day). Second, in the NBDPS FFQ, energy drinks were reported in response to the question about soda and soft drinks. Therefore, if a mother did not think an energy drink should be included, she might not have reported her energy drink consumption, perhaps producing an underestimate of her total caffeine intake. Third, our interview asked mothers for their caffeine consumption the year before pregnancy, in order to reflect the consumption during early pregnancy when organogenesis begins but before the pregnancy-related aversion or nausea starts [16]. However, it is possible that some mothers changed their consumption the year before pregnancy and the start of pregnancy because of pregnancy planning or other reasons [16]. In addition, the qualitative assessment of consumption change limited our ability to assess dose and timing of change. Finally, given that caffeine intake was self-reported, recall bias is possible; however, sensitivity analysis showed that the results did not differ by time until interview.

Since study participants were recruited after delivery, non-participation could be related to adverse birth outcomes or pregnancy conditions. Fetal deaths and infants with birth defects, which affect 0.61 % [24] and 3 % [25] of all deliveries in the US, were not included in the analysis. If these adverse outcomes are associated with a high level of maternal caffeine consumption, the observed consumption level might be artificially lowered. Although control participants in the NBDPS generally represented the base population, slightly higher proportions of the control mothers were non-Hispanic white (62.2 vs. 56.4 %) or had post-secondary education (52.5 vs. 47.5 %) compared with the base population [13].

In conclusion, this population-based study explored prepregnancy dietary caffeine consumption and change in consumption during pregnancy. In our study population, soda has surpassed coffee as the most commonly consumed caffeinated beverage, which, while it generally has a lower caffeine content, also has sugar and other components that may be related to risk factors for adverse birth outcomes such as type II diabetes, poor nutrition and

obesity [22]. In addition, consumption of high total caffeine was associated with known risk factors such as smoking and alcohol drinking, regardless of source. It is common that women decrease or stop consumption of coffee, tea, and soda after pregnancy recognition. However, changing consumption of caffeinated beverages was not associated with prepregnancy consumption levels, nor nausea or vomiting in pregnancy, but rather with pregnancy intention and young maternal age.

Although the NBDPS has completed several analyses of caffeine consumption and selected defects [16–19], the observed associations between consumption and known risk factors, suggest that it is worthwhile to continue to assess the reproductive effects of total caffeine consumption given the high prevalence of consumption among pregnant women. Such studies should take the confounding effect of other dietary factors and maternal behaviors into account. In addition, since changing caffeine consumption during pregnancy is common, exposure assessment should be designed to include prepregnancy consumption in conjunction with changes in consumption after pregnancy recognition. Further, given the observed associations between caffeine consumption patterns and known risk factors for birth defects, these additional studies may provide valuable insights for identifying susceptible populations for educational interventions and increased observation during prenatal care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Questions about maternal consumption of chocolate, coffee, tea and soda in the NBDPS CATI

D18. How often, on average, did you use the food items, including chocolate, during the year before you became pregnant with (NOIB)?		
Never or < once per month	Once a week	Once a day
Once a month	2 Times per week	2 Times per day
2 Times per month	3 Times per week	3 Times per day
3 Times per month	4 Times per week	4 Times per day
	5 Times per week	5 Times per day
	6 Times per week	6 Times per day
The next questions are about caffeine. We will be asking you about your average use of coffee, tea and soda during the year before you became pregnant with (NOIB)		
D19. How many cups of caffeinated or regular coffee did you usually drink?		
D20. How many cups of caffeinated or regular tea did you usually drink?		
D21. Did you drink sodas or soft drinks?		
D22. What brand(s) or types did you usually drink?/Anything else?		
D23. Is (brand) diet?		
D24. Is (brand) caffeine free?		
D25. How many cans/glasses/bottles of (brand) did you usually drink?		
D26. When you were pregnant with (NOIB) did you drink more, the same, less, or no caffeinated coffee?		
D27. When you were pregnant with (NOIB) did you drink more, the same, less, or no caffeinated tea?		
D28. When you were pregnant with (NOIB) did you drink more, the same, less, or no caffeinated sodas?		

Table 2

Dietary caffeine intake the year prior to pregnancy among control mothers, the National Birth Defect Prevention Study, 1997–2007 (Total N = 8347)

	Estimated total caffeine intake[a]		Coffee[b]		Tea[b,c]		Soda[b]	
	N	%	N	%	N	%	N	%
Estimated caffeine intake (mg/day)								
0 to <10	1478	(17.7)	4,931	(59. 1)	5,707	(68. 4)	3,816	(45.7)
10 to <100	2,978	(35.7)	856	(10.3)	2,273	(27.2)	3,303	(39.6)
100–200	1,923	(23.0)	1,236	(14.8)	313	(3.7)	888	(10.6)
200 to <300	1,054	(12.6)	746	(8.9)	54	(0.6)	248	(3.0)
300+	914	(11.0)	578	(6.9)	–	–	92	(1.1)
Self-reported coffee consumption (cups)								
0 to <1/month	–	–	4,561	(54.6)	–	–	–	–
1/month–6/week	–	–	1,226	(14.7)	–	–	–	–
1/day	–	–	1,236	(14.8)	–	–	–	–
2/day	–	–	746	(8.9)	–	–	–	–
3+/day	–	–	578	(6.9)	–	–	–	–
Self-reported tea consumption (cups)								
0 to <1/month	–	–	–	–	4,502	(53.9)	–	–
1/month–6/week	–	–	–	–	2,306	(27.6)	–	–
1–2/day	–	–	–	–	1,172	(14.0)	–	–
3+/day	–	–	–	–	367	(4.4)	–	–
Self-reported Soda Consumption (12 oz. serving)								
0 Serving/day	–	–	–	–	–	–	2,861	(34.3)
1/month to <1/day	–	–	–	–	–	–	2,150	(25.8)
1–2/day	–	–	–	–	–	–	2,116	(25.4)
3+/day	–	–	–	–	–	–	1,220	(14.6)

[a] Estimated total caffeine intake from self-reported consumption of coffee, tea, soda, and chocolate

[b] Not mutually exclusive

[c] According to the caffeine content estimating algorithm, no mothers were estimated to have more than 300+ mg/day of caffeine intake from the reported tea consumptions

Table 3

Demographic and pregnancy characteristics of control mothers by categories of caffeine intake the year prior to pregnancy, the National Birth Defects Prevention Study, 1997–2007

	0 to <10 (mg/day)		10 to <100 (mg/day)		100 to <200 (mg/day)		200 to <300 (mg/day)		300+ (mg/day)	
	N	%[a]	N	%[a]	N	%[a]	N	%[a]	N	%[a]
Total	1,478		2,978		1,923		1,054		914	
Maternal age at conception										
≤19	177	(12.0)	476	(16.0)	226	(11.8)	124	(11.8)	107	(11.7)
20–34	1,116	(75.5)	2,269	(76.2)	1,464	(76.1)	757	(71.8)	689	(75.4)
35+	185	(12.5)	233	(7.8)	233	(12.1)	173	(16.4)	118	(12.9)
Maternal race/ethnicity										
Non-Hispanic White	784	(53.0)	1,599	(53.7)	1,119	(58.2)	727	(69.0)	708	(77.5)
Non-Hispanic Black	265	(17.9)	395	(13.3)	157	(8.2)	70	(6.6)	46	(5.0)
Hispanic	327	(22.1)	781	(26.2)	503	(26.2)	198	(18.8)	122	(13.3)
Other	102	(6.9)	201	(6.7)	144	(7.5)	58	(5.5)	38	(4.2)
Maternal education										
0–12 years	512	(34.6)	1,288	(43.3)	814	(42.3)	420	(39.8)	398	(43.5)
>12 years	957	(64.7)	1,679	(56.4)	1,101	(57.3)	632	(60.0)	513	(56.1)
Body mass index										
Underweight (BMI < 18.5)	69	(4.7)	154	(5.2)	98	(5.1)	57	(5.4)	56	(6.1)
Normal weight (18.5 ≤ BMI < 25)	828	(56.0)	1,539	(51.7)	996	(51.8)	553	(52.5)	486	(53.2)
Overweight or obese (BMI > 25)	510	(34.5)	1,149	(38.6)	731	(38.0)	421	(39.9)	358	(39.2)
Contraception use										
Stopped using contraception to get pregnant	1,279	(86.5)	2,488	(83.5)	1,599	(83.2)	886	(84.1)	753	(82.4)
Got pregnant during an interruption in using contraception	113	(7.6)	298	(10.0)	177	(9.2)	90	(8.5)	81	(8.9)
Got pregnant while consistently using contraception	81	(5.5)	182	(6.1)	136	(7.1)	70	(6.6)	76	(8.3)
Pregnancy intention										
Wanted to be pregnant then	966	(65.4)	1,779	(59.7)	1,156	(60.1)	633	(60.1)	508	(55.6)
Wanted to wait till later	209	(14.1)	526	(17.7)	281	(14.6)	147	(13.9)	143	(15.6)
Didn’t want to become pregnant at all or didn’t care	296	(20.0)	668	(22.4)	481	(25.0)	270	(25.6)	261	(28.6)
Pregnancy recognition										

	0 to <10 (mg/day)		10 to <100 (mg/day)		100 to <200 (mg/day)		200 to <300 (mg/day)		300+ (mg/day)	
	N	%[a]	N	%[a]	N	%[a]	N	%[a]	N	%[a]
1st Trimester	1,425	(96.4)	2,865	(96.2)	1,855	(96.5)	1,015	(96.3)	872	(95.4)
2nd or 3rd trimester	46	(3.1)	107	(3.6)	67	(3.5)	36	(3.4)	41	(4.5)
Active and environmental tobacco smoking[b]										
Neither active smoking nor ETS	1,239	(83.8)	2,140	(71.9)	1,286	(66.9)	637	(60.4)	363	(39.7)
ETS only	159	(10.8)	443	(14.9)	272	(14.1)	124	(11.8)	129	(14.1)
Active smoking w/o ETS	77	(5.2)	390	(13.1)	358	(18.6)	292	(27.7)	419	(45.8)
Active smoking frequency[b]										
None	1,401	(94.8)	2,587	(86.9)	1,563	(81.3)	762	(72.3)	493	(53.9)
<1 pack/day	59	(4.0)	304	(10.2)	271	(14.1)	203	(19.3)	233	(25.5)
≥1 pack/day	18	(1.2)	81	(2.7)	83	(4.3)	85	(8.1)	184	(20.1)
Alcohol drinking[b]										
No	1,153	(78.0)	1,991	(66.9)	1,149	(59.8)	516	(49.0)	425	(46.5)
Yes	322	(21.8)	976	(32.8)	760	(39.5)	532	(50.5)	485	(53.1)
Chronic drinking[c]										
No drinking	1,153	(78.0)	1,991	(66.9)	1,149	(59.8)	516	(49.0)	425	(46.5)
<1 Drink/day	299	(20.2)	888	(29.8)	679	(35.3)	461	(43.7)	386	(42.2)
≥1 Drink/day	22	(1.5)	79	(2.7)	75	(3.9)	67	(6.4)	91	(10.0)
Binge drinking[c]										
No drinking	1,153	(78.0)	1,991	(66.9)	1,149	(59.8)	516	(49.0)	425	(46.5)
Drinking but not binge drinking	247	(16.7)	641	(21.5)	507	(26.4)	354	(33.6)	273	(29.9)
Binge drinking (≥4 drinks/occasion)	72	(4.9)	325	(10.9)	246	(12.8)	174	(16.5)	202	(22.1)

[a]The percentages may not add up to 100 % by column for each variable due to the missing values

[b]During one month prior to pregnancy through the first trimester

[c]≥1 Drink/day: mother reported more or equal to 1 drink per day in any month during 1 month prior to pregnancy through the first trimester; <1 drink/day: mothers reported less than 1 drink per day in any month during 1 month prior to pregnancy through the first trimester

Table 4

Change in consumption of caffeinated beverage type during pregnancy compared to consumption the year prior to pregnancy among control mothers reporting any consumption of the same beverage the year prior to pregnancy, the National Birth Defects Prevention Study, 1997–2005

	Coffee		Tea		Soda	
	N	%	N	%	N	%
Increased	60	(1.6)	183	(4.8)	243	(4.4)
No Change	450	(11.9)	760	(19.8)	840	(15.3)
Decreased	1,154	(30.5)	980	(25.5)	2,074	(37.8)
Stopped	1,331	(35.2)	1,172	(30.5)	1,336	(24.4)

Table 5

Percentage of change in consumption of caffeinated beverage type during pregnancy compared to consumption the year prior to pregnancy by estimated total dietary caffeine intake among the control mothers reporting any consumption of the same beverage the year prior to pregnancy, the National Birth Defects Prevention Study, 1997–2005

	0 to <10 (mg/day)	10 to <100 (mg/day)	100 to <200 (mg/day)	200 to <300 (mg/day)	300+ (mg/day)
Coffee					
Increased	4.4	1.9	1.3	1.4	1.6
No change	13.0	9.9	15.5	11.3	8.8
Decreased	11.6	27.3	26.9	32.3	39.2
Stopped	37.7	40.0	34.9	34.8	30.7
Tea					
Increased	3.9	5.2	3.3	5.0	6.3
No change	16.1	19.9	20.8	20.7	18.1
Decreased	15.7	26.2	27.4	23.5	25.9
Stopped	47.0	30.6	28.0	29.9	28.5
Soda					
Increased	6.4	4.8	2.9	4.7	5.5
No change	13.1	15.2	16.0	15.7	14.6
Decreased	25.8	39.7	37.9	37.5	36.7
Stopped	38.6	23.5	25.0	22.2	22.9

[a]No change in consumption of the beverage compared to the year prior to pregnancy

Table 6

Adjusted prevalence ratios for change in consumption by reported beverage consumption the year prior to pregnancy among control mothers reporting any prepregnancy consumption of the same beverage, the National Birth Defects Prevention Study, 1997–2005

Consumption the year prior to pregnancy	No Change in pregnancy N	Increased in pregnancy			Decreased or Stopped in pregnancy		
		N	aPR	95 % CI	N	aPR	95 % CI
Coffee[a] (cups)							
1/month–6/week	127	34	1.0		783	1.0	
1/day	200	10	0.2	(0.1, 0.4)	757	0.9	(0.9, 1.0)
2/day	74	5	0.3	(0.1, 0.7)	528	1.0	(1.0, 1.1)
3 +/day	49	11	0.9	(0.5, 1.6)	417	1.0	(1.0, 1.1)
Tea[b] (cups)							
1/month–6/week	402	107	1.0		1,347	1.0	
1–2/day	260	52	0.8	(0.6, 1.1)	641	0.9	(0.9, 1.0)
3 +/day	96	23	0.9	(0.6, 1.3)	159	0.8	(0.7, 0.9)
Soda[c] (12 oz. Serving)							
1/month to <1/day	300	105	1.0		1,338	1.0	
1–2/day	310	75	0.7	(0.6, 0.9)	1,374	1.0	(1.0, 1.0)
3+/day	225	61	0.7	(0.5, 1.0)	681	1.0	(0.9, 1.0)

[a] No variable was adjusted. Crude prevalence ratios are presented

[b] Adjusted for race/ethnicity, and maternal exposure to active/environmental smoking (none, environmental smoking only, and active smoking with/without environmental smoking) 1 month prior to pregnancy through the first trimester

[c] Adjusted for parity, maternal education, and maternal exposure to active/environmental smoking (none, environmental smoking only, and active smoking with/without environmental smoking) 1 month prior to pregnancy through the first trimester

aPR adjusted prevalence ratio; *CI* confidence intervals