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Alcohol Consumption by Women Before and During Pregnancy

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Abstract

Objectives—To determine the prevalence, patterns, and predictors of alcohol consumption prior to and during various intervals of pregnancy in the U.S.

Methods—Alcohol-related, pregnancy-related, and demographic data were derived from computer-assisted telephone interviews with 4,088 randomly selected control mothers from the National Birth Defects Prevention Study who delivered live born infants without birth defects during 1997–2002. Alcohol consumption rates and crude and adjusted odds ratios (OR) were calculated.

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Findings were presented as posters at the following meetings (i) The 2nd International Conference on Fetal Alcohol Spectrum Disorder, March 7–10, 2007, Victoria, British Columbia, Canada; (ii) The Texas Birth Defects Research Symposium, April 19, 2006, Austin, Texas; (iii) The 9th Annual Meeting of the National Birth Defects Prevention Network, January 30–Feb 1, 2006, Arlington, Virginia; (iv) The Centers for Birth Defects Research and Prevention Partners Meeting, November 16, 2005, Washington, DC

Results—30.3% of all women reported drinking alcohol at some time during pregnancy, of which 8.3% reported binge drinking (4+ drinks on one occasion). Drinking rates declined considerably after the first month of pregnancy, during which 22.5% of women reported drinking, although 2.7% of women reported drinking during all trimesters of pregnancy and 7.9% reported drinking during the 3rd trimester. Pre-pregnancy binge drinking was a strong predictor of both drinking during pregnancy (adjusted OR = 8.52, 95% CI = 6.67–10.88) and binge drinking during pregnancy (adjusted OR = 36.02, 95% CI = 24.63–52.69). Other characteristics associated with both any drinking and binge drinking during pregnancy were non-Hispanic white race/ethnicity, cigarette smoking during pregnancy, and having an unintended pregnancy.

Conclusions—Our study revealed that drinking during pregnancy is fairly common, three times the levels reported in surveys that ask only about drinking during the month before the survey. Women who binge drink before pregnancy are at particular risk for drinking after becoming pregnant. Sexually active women of childbearing ages who drink alcohol should be advised to use reliable methods to prevent pregnancy, plan their pregnancies, and stop drinking before becoming pregnant.

Keywords

Alcohol drinking; Pregnant women; Women; Prevalence

Introduction

Maternal alcohol consumption during pregnancy has been associated with a range of adverse outcomes for the developing fetus, including spontaneous abortion, structural malformations, pre- and post-natal growth retardation, central nervous system damage, and neurodevelopmental abnormalities [1, 2]. The adverse outcomes associated with prenatal alcohol exposure are collectively known as fetal alcohol spectrum disorders (FASD) [3], of which fetal alcohol syndrome (FAS) is perhaps the most well-known, first described in France in 1968 [4] and in the United States in 1973 [5, 6]. FAS is characterized by a specific pattern of abnormal facial features, growth retardation, and central nervous system abnormalities which frequently result in behavioral and/or cognitive disabilities [7]. FAS is estimated to affect 0.5–3 children per 1,000 live births in the United States [7]. Three times as many children are estimated to have neurodevelopmental disabilities from prenatal alcohol without the characteristic physical features of FAS [8]. FASD are thought to be the most common preventable cause of mental retardation.

Since 1981, the Surgeon General of the United States has advised that pregnant women and women who are considering pregnancy should not drink alcohol [8]. Still, a number of state and national surveys have shown that women in the U.S. consume alcohol during pregnancy [9]. The most commonly reported data come from the Behavioral Risk Factor Surveillance System (BRFSS), a state-based telephone survey conducted annually since 1984 and currently in all states, the District of Columbia, Puerto Rico, the Virgin Islands and Guam (www.cdc.gov/brfss/). BRFSS data indicate that 11.4% of women ages 18–44 who recognized they were pregnant reported that they consumed alcohol during the 30 days prior to being interviewed in 1997, 12.8% in 1999, and 10.1% in 2002 [10, 11]. BRFSS data have also shown that non-Hispanic white women, women with a college education, women with

higher household incomes, and women who smoked cigarettes were more likely to drink alcohol during pregnancy [12, 13].

The National Survey on Drug Use and Health (NSDUH), an annual survey conducted in respondents' homes, found in 2002–2003 that 9.8% of pregnant women ages 15–44 drank alcohol during the month before being interviewed [14].

The Pregnancy Risk Assessment Monitoring System (PRAMS), an on-going mail survey of U.S. women who recently had a live birth, asks about alcohol use during the 3 months before conception and during the last 3 months of pregnancy [15]. Data from 27 states that participated in PRAMS in 2002 indicated that 47.5% of women drank alcohol during the 3 months before pregnancy and 5.6% of women drank during the last 3 months of pregnancy [15]. Women who drank five or more alcohol drinks on one occasion during the 3 months before conception were more likely to drink during the last 3 months of pregnancy, according to PRAMS data from 1996 to 1999 [16].

The National Maternal and Infant Health Survey (NMIHS) was conducted by mail, telephone, or in-person with a nationally representative sample of women who had a live birth, fetal death, or infant death during 1988 [17]. Women were asked about alcohol use during the 3 months before they recognized they were pregnant and from the time they recognized they were pregnant until delivery. Among NMIHS participants who had a live birth, 20.7% reported they used alcohol after they learned they were pregnant [18].

The National Survey of Family Growth (NSFG), which has been conducted periodically since 1973 in respondents' homes, asked women how often they usually drank alcoholic beverages during their last pregnancy [19]. In the 1988 NSFG, 33.5% of women ages 15–44 who had been pregnant and whose pregnancy resulted in a live birth or a spontaneous fetal death reported they drank alcohol during the pregnancy [19]. Drinking during pregnancy was more common among non-Hispanic white women, women with more education, and women with higher incomes.

Each of these surveys has limitations. BRFSS and NSDUH only ask about alcohol consumption during the month prior to the interview, and neither collects information on the length of gestation at the time of interview for women who recognize they are pregnant. PRAMS does not ask about alcohol use during the first 6 months of pregnancy. NMIHS asks about alcohol use during 2 time spans: the 3 months before pregnancy recognition, thus combining pre-pregnancy and early pregnancy into one time frame, and from pregnancy recognition to delivery. NSFG asks about alcohol use during the entire pregnancy.

For the current study we analyzed data from the National Birth Defects Prevention Study (NBDPS) [20]. NBDPS is a large, on-going, multi-state, CDC-sponsored case-control study of risk factors for over 30 major types of birth defects in the United States. In contrast to the data sources described above, NBDPS collects information on alcohol use during eight contiguous time spans (six individual months and two trimesters) from 3 months before conception through delivery. The NBDPS therefore provides a unique opportunity to describe patterns of alcohol use in the months immediately prior to conception and during several intervals covering the entire pregnancy using a large U.S. population.

The objectives of this study were to describe reported alcohol consumption during pregnancy and the 3 months before pregnancy, and to identify maternal characteristics associated with alcohol consumption during pregnancy. Our assumption was that alcohol use decreases after women recognize they are pregnant, but women who abstain from alcohol in early pregnancy might not continue to abstain throughout the remainder of the pregnancy. We expected alcohol use during pregnancy to be higher among non-Hispanic white women, women with higher incomes and women with higher levels of education.

Methods

The NBDPS study protocol, procedures, and interview questions were approved by the Institutional Review Boards of all participating study centers and the Centers for Disease Control and Prevention. Detailed methods and features of the NBDPS have been described elsewhere [20]. Briefly, the NBDPS includes an extensive computer-assisted telephone interview, approximately 1 h long, conducted in English or Spanish with women who had a pregnancy with a birth defect (case women) and women who delivered live born infants without malformations (control women). The NBDPS telephone interview with case and control women includes questions about demographic characteristics and selected exposures, including nutritional and behavioral factors.

For this study we analyzed responses to alcohol consumption questions from control women only with expected delivery dates during October 1997 through December 2002. During this time frame, eight states participated in the NBDPS: Arkansas, California, Georgia, Iowa, Massachusetts, New Jersey, New York and Texas. Approximately 150 controls per year per study site were randomly selected from live birth certificates (Iowa, Massachusetts, New Jersey) or birth hospitals (California, New York, Texas). Arkansas and Georgia randomly selected controls from birth hospitals at the start of the study and switched to selection from birth certificates in 2000. Regardless of which method was used, each birth had the same probability of being selected from within each geographic area (representing 35,000–75,000 births yearly). A randomly selected control was ineligible for inclusion in the study if the child had a major birth defect, the mother was not a resident of the geographic area covered by the participating study center's population-based birth defects registry at the time of delivery, the child was adopted or in foster care, the child was stillborn, or the mother was deceased.

Interviews were completed within 24 months of the woman's expected delivery date. Women were asked about their use of alcohol during each of eight time periods: the 3rd, 2nd, and 1st month before conception; the 1st, 2nd, and 3rd month of pregnancy; and the 2nd and 3rd trimesters of pregnancy. Time spans before and during pregnancy were derived from the woman's estimated date of conception, which was calculated as her expected delivery date (obtained from the subject at the beginning of the interview) minus 280 days, plus 14 days. For each woman, the computer-assisted telephone interview application created a pregnancy calendar indicating gestational periods in normal calendar time, then inserted the appropriate dates into interview questions about the timing of events before and during pregnancy.

First, women were asked if they drank any alcoholic beverages from 3 months before pregnancy until the date of their infant's birth. If they responded yes, they were asked, "During which months did you drink any alcoholic beverages?" For each month or trimester during which they drank, women were asked the following three questions: On average, how many days did you drink alcoholic beverages? On those days that you drank alcoholic beverages, on average, how many drinks did you have per day? What was the greatest number of drinks you had on one occasion?

The percent of control women who reported they drank any alcohol and the percent who binge drank (four or more drinks on at least one occasion) were calculated for each month from 3 months before pregnancy through the 3rd month after conception, and for the 2nd and 3rd trimesters of pregnancy. The percent of women who drank any alcohol during pregnancy and the percent who binge drank during pregnancy were also calculated by the following maternal characteristics: age (<20, 20–24, 25–29, 30–34, 35+ years), race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, other), education (0–11, 12, 13–15, 16+ years), household income (<10,000; 10–19,999; 20–29,999; 30–39,999; 40–49,999; 50,000+ US \$), birthplace (United States, Mexico, other), NBDPS site from which the woman was recruited (Arkansas, California, Georgia, Iowa, Massachusetts, New Jersey, New York, Texas), smoking before and during pregnancy (no, yes), drinking before pregnancy (did not drink, drank but never binged, binged), and pregnancy intention (not intended, intended). For this study, binge drinking was defined as taking four or more drinks on at least one occasion; however, we also calculated the percent of women who reported drinking five or more drinks on at least one occasion to compare with available literature. Women who stopped using contraception to get pregnant and women who wanted to be pregnant at the time they became pregnant were considered to have intended to become pregnant.

To identify factors associated with reported alcohol use during pregnancy, we fitted logistic regression models to calculate crude and adjusted odds ratios (OR) and 95% confidence intervals. We first compared maternal socio-demographic characteristics including age, race/ethnicity, education, household income, birthplace and study site (independent variables) of women who reported they drank alcohol during pregnancy (dependent variable) to non-drinkers; for these models we excluded women with missing values in any of the variables in the model. Second, we compared the same maternal socio-demographic characteristics of women who reported binge drinking during pregnancy (dependent variable) to non-drinkers; in these analyses we further excluded women with missing or incomplete data on alcohol consumption that prevented us from establishing whether or not they binge drank. Third, using the same logistic regression procedure we compared maternal smoking during pregnancy, pre-pregnancy drinking and pregnancy intention (independent variables) of women who drank or binge drank during pregnancy to non-drinkers. SAS version 9.1.3 was used for all analyses (SAS Institute Inc., Cary, North Carolina, 2002–2003).

Results

The interview participation rate was 67.9%. This study included telephone interviews with 4,088 control women who delivered live born infants without birth defects during 1997–

2002. Maternal age, infant birth weight, gestational age and plurality from hospital medical records and birth certificates were available for interviewed and non-interviewed controls during 1997–2003 for the eight states included in this study, plus one year of data from Utah and North Carolina (two states that joined the NBDPS in 2003). Chi-square tests showed that compared with non-interviewed controls, interviewed controls did not differ in the percent of infants born with low birth weight, pre-term, and/or with multiple births ($P > 0.5$). Although the maternal age distribution differed between interviewed and non-interviewed controls (Chi-square test, $P < 0.0001$), the actual differences were small (11% vs. 12% for age <20 years, and 41% vs. 38% for age 30+ for interviewed and non-interviewed mothers, respectively).

We found that 30.3% of women reported they drank alcohol at any time during pregnancy. Of those, 8.3% binge drank during pregnancy (four or more drinks on at least one occasion) and 5.7% consumed five or more drinks on at least one occasion during pregnancy. There was no statistical difference between women interviewed 6 or fewer months after their expected delivery date (EDD), 7–12 months after EDD, and 13–24 months after EDD in the percent who reported any alcohol use during pregnancy (Chi-square test, $P > 0.3$) or in the percent who reported binge drinking during pregnancy ($P > 0.5$).

Wine was the most commonly reported alcoholic beverage consumed, with 26.0% of women reporting they drank wine during the period from 3 months before pregnancy through delivery, followed by beer (21.9%), mixed drinks (15.7%), and shots of liquor (4.2%).

During the 3 months before pregnancy combined, 39.7% of women reported they drank any alcohol and 13.7% binge drank. During each of the individual 3 months before pregnancy, 32.3–33.1% of women reported drinking any alcohol and 10.6–10.8% reported binge drinking (Fig. 1). The fact that the percent of women who drank alcohol during the 3 months before pregnancy combined is higher than for each of the months separately indicates that some women drank during one or two of the months but not all three.

During the first 3 months of pregnancy combined (the first trimester), 25.2% of women reported drinking any alcohol and 8.1% reported binge drinking. The proportion of women who used any alcohol in the 1st month of pregnancy was 22.5% and this decreased to 8.5 and 5.5% in the 2nd and 3rd months of pregnancy, respectively (Fig. 1). Alcohol consumption increased to 7.4% in the 2nd trimester and 7.9% in the 3rd trimester. The prevalence of binge drinking decreased steadily across pregnancy, from 7.4% in the 1st month to 0.5% in the 3rd trimester. Among the women who reported they drank, both the quantity and frequency of alcohol use also declined over the course of the pregnancy (Figs. 2 and 3). As pregnancy progressed, the women who drank alcohol consumed fewer drinks per day and drank on fewer days per month or trimester.

The most common pattern of alcohol use reported was to drink during the 1st month, and then abstain during the rest of pregnancy (13.9%) (Table 1); however, the second most common pattern was to drink during all the trimesters of pregnancy (2.7%). The third most common pattern was to abstain until the 3rd trimester, and then consume alcohol (2.5%).

Reported alcohol use during pregnancy varied by maternal demographic and behavioral characteristics. The percent of women who reported they drank any alcohol during pregnancy increased with increasing age, from 19.0% among women less than 20 years of age to 37.2% among women 35 years and older (Table 2). For binge drinking during pregnancy, the pattern was reversed, with the highest level of binge drinking reported among women aged 20–24 (10.3%) and the lowest level among women 35 and older (6.6%).

Use of any alcohol during pregnancy also increased with increasing education, from 20.1% among women with less than 12 years of education to 37.1% among women with 16 or more years, and with increasing income, from 21.1% among women with annual household incomes of less than \$10,000 to 39.8% among women with incomes of \$50,000 or more. Binge drinking during pregnancy, on the other hand, was highest among women with 13–15 years of education (10.3%) and women with household incomes of \$30,000–\$39,000 per year (9.7%).

Focusing on the women who reported they did not drink during the 3 months before pregnancy, we found that 14.8% of these women reported they drank alcohol during their pregnancy, and 2.5% binge drank (Table 2). This could indicate a sporadic or episodic pattern of drinking.

Several demographic and behavioral factors were significantly ($P < 0.05$) associated with alcohol use and/or binge drinking during pregnancy (Tables 3 and 4). Non-Hispanic black women were 48% less likely to drink any alcohol during pregnancy (adjusted OR = 0.52, 95% CI = 0.39–0.68) and 62% less likely to binge drink (adjusted OR = 0.38, 95% CI = 0.23–0.61) than non-Hispanic white women (Table 3). Hispanic women and women of other race/ethnic groups were also significantly less likely to drink any alcohol and to binge drink during pregnancy, compared to non-Hispanic white women.

Women with annual household incomes of \$50,000 or more were approximately 1.5 times as likely to drink any alcohol during pregnancy as those with incomes less than \$10,000 (adjusted OR = 1.46, 95% CI = 1.08–1.97) (Table 3). For binge drinking during pregnancy, we did not find an association with household income, after adjusting for other socio-demographic factors.

Women who were born in Mexico were less likely than U.S.-born women to binge drink during pregnancy (adjusted OR = 0.42, 95% CI = 0.19–0.89), although use of any alcohol during pregnancy was not associated with birthplace, after adjustment. We also found significant differences among the eight study locations for both any alcohol use and binge drinking during pregnancy (Table 3).

Women who intended to become pregnant were significantly less likely to drink any alcohol (adjusted OR = 0.74, 95% CI = 0.61–0.89) or to binge drink (adjusted OR = 0.48, 95% CI = 0.34–0.69) than women whose pregnancies were not intended (Table 4). Women who smoked during pregnancy were twice as likely to drink alcohol (adjusted OR = 2.31, 95% CI = 1.84–2.89) and were 3 times as likely to binge drink (adjusted OR = 3.21, 95% CI = 2.20–4.69) as non-smokers.

Drinking during the 3 months before pregnancy was a strong indicator of alcohol use during pregnancy. Women who drank alcohol but never binged during the 3 months before pregnancy were 4 times as likely to drink any alcohol during pregnancy (adjusted OR = 4.47, 95% CI = 3.70–5.42) and almost twice as likely to binge drink during pregnancy (adjusted OR = 1.84, 95% CI = 1.12–3.03) as women who did not drink before pregnancy. Women who binge drank during the 3 months before pregnancy were 8 times as likely to drink any alcohol during pregnancy (adjusted OR = 8.52, 95% CI = 6.67–10.88) and 36 times as likely to binge drink during pregnancy (adjusted OR = 36.02, 95% CI = 24.63–52.69) as women who did not drink before pregnancy.

Discussion

In summary, the results of this study show that (a) alcohol use declines once women recognize they are pregnant; (b) women with unintended pregnancies, women who smoke cigarettes, non-Hispanic white women, and women with higher incomes are more likely to drink alcohol during pregnancy; (c) women who drink before becoming pregnant are at increased risk of continued alcohol use during pregnancy; and (d) the risk of alcohol exposure during pregnancy is particularly elevated among women who binge drink before becoming pregnant. Based on these findings, women's health care providers should discuss alcohol use with all women of childbearing ages regardless of their socioeconomic status, encourage sexually active women who drink alcohol to use reliable methods of contraception, and encourage all women to plan their pregnancies, get preconception health care, and stop drinking before becoming pregnant. Novel interventions may be necessary to reach women without a regular source of health care.

Using 1997–2002 data from control women in the NBDPS, this study found that 30.3% of women drank alcohol at any time during pregnancy and 5.7% consumed five or more drinks on at least one occasion during pregnancy. These percentages are 3 times the rates reported in the 2002 BRFSS, which found only 10.1% of currently pregnant women used alcohol and 1.9% consumed five or more drinks on one occasion [11]. Our findings are also higher than those of the 2003 NSDUH, which found that 9.8% of pregnant women used alcohol and 4.1% reported five or more drinks on one occasion [14]. The differences can be attributed to differences in methodology. Both the BRFSS and the NSDUH ask only about alcohol use in the month before being interviewed and therefore those surveys yield conservative estimates of drinking during pregnancy, which usually spans 9 months, and neither of those surveys is able to ascertain women who are pregnant but have not yet recognized it. Although our finding that 30.3% of women used alcohol during pregnancy in 1997–2002 is similar to the 33.5% reported in the 1988 NSFG [19], it is discouraging that alcohol use during pregnancy has not substantially declined in the decade between the two studies.

Our study is the first to report on alcohol use during eight contiguous time frames from 3 months before pregnancy through delivery. We found that the most common pattern of use during pregnancy was to drink alcohol during the first month (presumably before pregnancy recognition) and then abstain for the remainder of the pregnancy, although 3% of women drank during all trimesters of pregnancy, and another 3% drank only during the 3rd trimester. Edwards and Werler found that time to recognize pregnancy ranged from 7 to 227

days, with a median of 31 days, and the median did not vary between women who drank and women who did not drink alcohol [22]. Some of the patterns of use reported in our study may represent delayed recognition of the pregnancy; other patterns may correspond to special occasions at which a pregnant woman consumed alcohol. Because alcohol use varies from month to month, asking currently pregnant women only about their past month drinking markedly underestimates alcohol exposure during pregnancy.

This study also found that 8.3% of women binge drank (defined as four or more alcoholic drinks on at least one occasion) at some time during pregnancy, and 7.4% binge drank during the first month of pregnancy, a critical period of embryonic development. No level of alcohol consumption during pregnancy has been shown to be safe, and binge drinking is particularly dangerous because it exposes the fetus to a high blood alcohol concentration, which can damage the developing fetal brain and lead to severe cognitive and behavioral problems [23]. Further, the more alcohol a woman consumes in one sitting, the longer it takes her liver to metabolize the alcohol ingested, so binge drinking exposes the fetus to high levels of alcohol for prolonged periods of time. A limitation of this study is that the interview did not ask the number of episodes of binge drinking per drinking month or trimester during pregnancy.

This study found that 39.7% of women reported drinking alcohol during the 3 months before conception combined. This is slightly lower than the 2002 PRAMS, which found that 47.5% of women used alcohol during the 3 months before pregnancy [15]. We also found that 7.9% of women reported they consumed alcohol during the 3rd trimester of pregnancy, slightly higher than the 2002 PRAMS which reported that 5.6% of women drank during the 3rd trimester. These differences may be attributable to regional differences in alcohol use. The 2002 PRAMS data came from 27 U.S. states, which varied widely in the prevalence of pre-pregnancy drinking (range for the 27 PRAMS states: 21.4–65.2%) and 3rd trimester alcohol use (range: 2.0–11.6%). Our study used data collected in eight U.S. states, of which only three states participated in the 2002 PRAMS.

Strengths of this study are that the NBDPS is population-based, has a large sample size from multiple states, and collects information about alcohol use during all trimesters of pregnancy and during the 3 months before conception. It provides a more comprehensive and accurate assessment of alcohol exposure before and during pregnancy than other large, population-based surveys, such as the BRFSS, NSDUH, and PRAMS. The age distribution of our study participants was similar to the distribution for all U.S. women who delivered live born infants during 2002 (33% vs. 36% for age 24 or less, and 41% vs. 37% for age 30+ for our participants and all U.S. live births during 2002, respectively), as was the race/ethnic distribution (60% vs. 57% for non-Hispanic white race/ethnicity, and 12% vs. 14% for non-Hispanic black), but our participants were more likely to have greater than 12 years of education (58% vs. 47%) [24].

A limitation of this study is that it describes alcohol use only among women whose pregnancies resulted in live born infants without birth defects. Alcohol use increases risks of spontaneous abortion, fetal death, and birth defects, but women with these pregnancy outcomes were not included. Women with serious alcohol use problems may have been less

likely to participate in the NBDPS, and recollection errors or under-reporting of alcohol use may have occurred. For all of these reasons, the prevalence of alcohol use during pregnancy ascertained in this study may underestimate the true prevalence.

Three out of 10 women reported they drank alcohol at some time during pregnancy, and 1 in 12 pregnant women reported binge drinking. These data indicate a continued need for prevention efforts to identify and reduce alcohol exposure during pregnancy. Health care professionals can play an essential role by incorporating validated alcohol screening questions into routine care [25–27]. Among pregnant women who screen positive for alcohol use, discussing the importance of quitting alcohol may be sufficient for those who are not alcohol dependent and who are motivated to change their behavior. Brief interventions have been effective in helping pregnant women reduce or eliminate their use of alcohol [27] and have been successfully provided by non-medical professionals, such as nutritionists [28]. In some cases, referral to a substance abuse treatment program may be appropriate.

Among women who are not pregnant, screening provides an opportunity for health care providers to discuss the importance of giving up alcohol before becoming pregnant. Since pre-pregnancy drinking is a strong predictor of alcohol use during pregnancy, sexually active women of childbearing ages who drink alcohol should be advised to use reliable methods to prevent pregnancy, plan their pregnancies, and stop drinking before they become pregnant.

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Fig. 1. Alcohol consumption before and during pregnancy, NBDPS, 1997–2002. This line graph shows the percent of women who consumed any alcohol (line with diamond markers) and the percent who binge drank (4+ drinks on at least one occasion; line with square markers) during eight intervals before and during pregnancy

Fig. 2.

Number of drinking days per month or trimester, among women who drank during that month or trimester, NBDPS, 1997–2002. This grouped bar chart shows how frequently women reported they drank alcohol during each of eight intervals before and during pregnancy. Percentages are calculated among the women who reported they drank, hence the sample size varies for each interval and is noted on the x-axis label

Fig. 3. Number of drinks per drinking day, among women who drank during that month or trimester, NBDPS, 1997–2002. This grouped bar chart shows the quantity of alcohol women reported they consumed during each of eight intervals before and during pregnancy. Percentages are calculated among the women who reported they drank, hence the sample size varies for each interval and is noted on the x-axis label

Table 1

Common patterns of alcohol consumption during pregnancy, in descending order by frequency, NBDPS, 1997–2002

Pregnancy interval during which alcohol was consumed (✓ = drank alcohol)					Number of control women	Percent of control women	Percent among control women who drank
1st month	2nd month	3rd month	2nd trimester	3rd trimester			
✓					2842	69.6	N/A
✓	✓	✓	✓	✓	568	13.9	45.8
					111	2.7	9.0
✓	✓				103	2.5	8.3
					96	2.4	7.7
			✓		80	2.0	6.5
	✓				50	1.2	4.0
✓	✓	✓			30	0.7	2.4
✓				✓	28	0.7	2.3
		✓			23	0.6	1.9
			✓	✓	23	0.6	1.9
✓	✓	✓	✓		20	0.5	1.6
Other patterns of use					107	2.6	8.6
Total ^a					4081	100.0	100.0

^aExcludes women who answered "don't know," for all months and trimesters of pregnancy

Number and percent of women who drank any alcohol and who binge^a drank during pregnancy, by maternal characteristics, NBDPS, 1997–2002

Table 2

Characteristic	Total women	Women who drank any alcohol during pregnancy		Women who binge ^a drank during pregnancy	
		Number	Percent	Number	Percent
Overall	4088	1239	30.3	338	8.3
Age (years)					
< 20	459	87	19.0	35	7.7
20–24	880	240	27.3	89	10.3
25–29	1063	298	28.0	83	7.9
30–34	1102	397	36.0	93	8.5
35+	584	217	37.2	38	6.6
Race/ethnicity					
White non-Hispanic	2452	896	36.5	254	10.5
Black non-Hispanic	490	96	19.6	26	5.3
Hispanic	931	202	21.7	50	5.4
Other ^b	204	42	20.6	8	3.9
Missing	11	3	27.3	0	0.0
Education (years)					
0–11	676	136	20.1	41	6.1
12	1028	252	24.5	91	8.9
13–15	1103	377	34.2	112	10.3
16+	1273	472	37.1	94	7.4
Missing	8	2	25.0	0	0.0
Household income (US \$)					
<10,000	645	136	21.1	50	7.9
10–19,999	469	109	23.4	35	7.5
20–29,999	494	132	26.7	38	7.8
30–39,999	370	102	27.6	36	9.7
40–49,999	300	99	33.0	26	8.8
50,000+	1282	510	39.8	115	9.1
Missing	528	151	28.6	38	7.2

Characteristic	Total women	Women who drank any alcohol during pregnancy		Women who binge ^a drank during pregnancy	
		Number	Percent	Number	Percent
Birthplace					
United States	3329	1083	32.5	312	9.5
Mexico	367	63	17.2	10	2.7
Other ^c	387	92	23.8	16	4.2
Missing	5	1	20.0	0	0.0
Research site					
Arkansas	499	116	23.3	35	7.1
California	597	140	23.5	33	5.6
Georgia	457	139	30.4	40	8.9
Iowa	478	142	29.7	60	12.7
Massachusetts	535	200	37.4	48	9.0
New Jersey	572	200	35.0	35	6.2
New York	447	168	37.6	46	10.4
Texas	503	134	26.6	41	8.3
Smoking during the 3 months before pregnancy					
No	3279	872	26.6	176	5.4
Yes	808	367	45.4	162	20.5
Missing	1	0	0.0	0	0.0
Smoking during pregnancy					
No	3254	859	26.4	169	5.2
Yes	715	349	48.8	156	22.3
Missing	119	31	26.1	13	11.2
Drinking during the 3 months before pregnancy					
Did not drink	2450	363	14.8	61	2.5
Drank ^d , but never binged	1051	513	48.8	34	3.3
Binged ^a	558	347	62.2	243	43.7
Missing	29	16	55.2	0	0.0
Pregnancy intention					
Not intended	1645	519	31.6	178	11.0

Characteristic	Total women	Women who drank any alcohol during pregnancy		Women who binge ^a drank during pregnancy	
		Number	Percent	Number	Percent
Intended	2435	718	29.5	159	6.6
Missing	8	2	25.0	1	12.5

^aFour or more drinks on at least one occasion. Excludes 38 women with missing or incomplete data for alcohol consumption

^bAsian, Pacific Islander, Native American or Alaskan Native, others

^cEuropean, Asian, African and other American countries

^dOne to three drinks per occasion

Table 3

Association of maternal socio-demographic characteristics with alcohol use and binge^a drinking during pregnancy, NBDPS, 1997–2002

Characteristic	Women who drank any alcohol during pregnancy compared to non-drinkers			Women who binge ^a drank during pregnancy compared to non-drinkers		
	Drinkers/ Non-drinkers	Crude OR ^b (95% CI) ^c	Adjusted OR ^d (95% CI)	Binge ^a drinkers/ Non-drinkers	Crude OR (95% CI)	Adjusted OR ^d (95% CI)
Age (years)						
< 20	64/281	1.00	1.00	28/281	1.00	1.00
20–24	211/554	1.67 (1.22–2.29)	1.46 (1.05–2.04)	80/554	1.45 (0.92–2.28)	1.26 (0.78–2.03)
25–29	255/659	1.70 (1.25–2.31)	1.22 (0.87–1.71)	75/659	1.14 (0.72–1.80)	0.86 (0.52–1.43)
30–34	355/621	2.51 (1.86–3.39)	1.50 (1.06–2.12)	83/621	1.34 (0.85–2.11)	0.90 (0.53–1.53)
35+	179/333	2.36 (1.70–3.27)	1.29 (0.89–1.88)	33/333	1.00 (0.59–1.69)	0.61 (0.33–1.13)
Race/ethnicity						
White non-Hispanic	772/1362	1.00	1.00	225/1362	1.00	1.00
Black non-Hispanic	92/340	0.48 (0.37–0.61)	0.52 (0.39–0.68)	24/340	0.43 (0.28–0.66)	0.38 (0.23–0.61)
Hispanic	164/602	0.48 (0.40–0.58)	0.67 (0.51–0.88)	44/602	0.44 (0.32–0.62)	0.62 (0.39–0.97)
Other ^e	36/144	0.44 (0.30–0.64)	0.49 (0.32–0.74)	6/144	0.25 (0.11–0.58)	0.34 (0.14–0.83)
Education (years)						
0–11	109/409	1.00	1.00	32/409	1.00	1.00
12	216/675	1.20 (0.93–1.56)	0.91 (0.68–1.21)	81/675	1.53 (1.00–2.35)	1.14 (0.72–1.80)
13–15	328/633	1.94 (1.51–2.50)	1.27 (0.95–1.71)	101/633	2.04 (1.35–3.09)	1.41 (0.87–2.29)
16+	411/731	2.11 (1.65–2.69)	1.00 (0.72–1.38)	85/731	1.49 (0.97–2.27)	0.84 (0.49–1.45)
Household income (US \$)						
< 10,000	133/501	1.00	1.00	50/501	1.00	1.00
10–19,999	106/360	1.11 (0.83–1.48)	0.99 (0.74–1.33)	35/360	0.97 (0.62–1.53)	0.83 (0.52–1.33)
20–29,999	130/355	1.38 (1.05–1.82)	1.05 (0.78–1.42)	38/355	1.07 (0.69–1.67)	0.77 (0.48–1.23)
30–39,999	102/268	1.43 (1.07–1.93)	1.01 (0.73–1.40)	36/268	1.35 (0.86–2.12)	0.93 (0.56–1.53)
40–49,999	98/197	1.87 (1.38–2.55)	1.24 (0.87–1.75)	26/197	1.32 (0.80–2.18)	0.91 (0.52–1.60)
50,000+	495/767	2.43 (1.95–3.04)	1.46 (1.08–1.97)	114/767	1.49 (1.05–2.12)	1.24 (0.76–2.01)
Birthplace						
United States	938/1967	1.00	1.00	275/1967	1.00	1.00
Mexico	49/234	0.44 (0.32–0.60)	0.70 (0.47–1.02)	9/234	0.28 (0.14–0.54)	0.42 (0.19–0.89)

Characteristic	Women who drank any alcohol during pregnancy compared to non-drinkers			Women who binge ^d drank during pregnancy compared to non-drinkers		
	Drinkers/ Non-drinkers	Crude OR ^b (95% CI) ^c	Adjusted OR ^d (95% CI)	Binge ^d drinkers/ Non-drinkers	Crude OR (95% CI)	Adjusted OR ^d (95% CI)
Other ^f	77/247	0.65 (0.50–0.85)	0.75 (0.55–1.02)	15/247	0.43 (0.25–0.74)	0.62 (0.34–1.11)
Research site						
Arkansas ^g	109/348	1.00	1.00	33/348	1.00	1.00
California	120/385	1.00 (0.74–1.34)	1.28 (0.93–1.77)	28/385	0.77 (0.45–1.30)	1.06 (0.61–1.86)
Georgia	118/261	1.44 (1.06–1.96)	1.61 (1.16–2.23)	37/261	1.50 (0.91–2.46)	2.24 (1.32–3.78)
Iowa	113/285	1.27 (0.93–1.72)	1.02 (0.74–1.39)	53/285	1.96 (1.24–3.11)	1.68 (1.05–2.70)
Massachusetts	181/282	2.05 (1.54–2.72)	1.66 (1.23–2.25)	43/282	1.61 (1.00–2.60)	1.69 (1.02–2.80)
New Jersey	180/324	1.77 (1.34–2.35)	1.72 (1.27–2.33)	34/324	1.11 (0.67–1.83)	1.39 (0.82–2.36)
New York	131/237	1.77 (1.30–2.39)	1.67 (1.22–2.29)	35/237	1.56 (0.94–2.58)	1.79 (1.07–3.00)
Texas	112/326	1.10 (0.81–1.49)	1.38 (0.98–1.93)	36/326	1.17 (0.71–1.91)	1.49 (0.86–2.56)
Total sample size	3512 ^h			2747 ^h		

^aFour or more drinks on at least one occasion. Excludes women with missing or incomplete data for alcohol consumption

^bOdds ratio

^cConfidence Interval

^dAdjusted for age, race/ethnicity, education, household income, birthplace, and research site

^eAsian, Pacific Islander, Native American or Alaskan Native, others

^fEuropean, Asian, African and other American countries

^gReferent because it has the lowest per capita alcohol consumption compared to the other sites [21]

^hExcludes missing

Table 4Association of smoking, pre-pregnancy drinking, and pregnancy intention with alcohol use and binge^a drinking during pregnancy, NBDPS, 1997–2002

Characteristic	Women who drank any alcohol during pregnancy compared to non-drinkers			Women who binge ^d drank during pregnancy compared to non-drinkers		
	Drinkers/ Non-drinkers	Crude OR ^b (95% CI) ^c	Adjusted OR ^d (95% CI)	Binge ^d drinkers/ Non-drinkers	Crude OR (95% CI)	Adjusted OR ^d (95% CI)
Smoking during pregnancy						
No	743/2058	1.00	1.00	151/2058	1.00	1.00
Yes	300/322	2.58 (2.16–3.08)	2.31 (1.84–2.89)	137/322	5.80 (4.74–7.52)	3.21 (2.20–4.69)
Drinking during the 3 months before pregnancy						
Did not drink	316/1762	1.00	1.00	52/1762	1.00	1.00
Drank ^e , but never binged	431/460	5.22 (4.37–6.24)	4.47 (3.70–5.42)	27/460	1.99 (1.24–3.20)	1.84 (1.12–3.03)
Binged ^a	296/158	10.44 (8.32–13.11)	8.52 (6.67–10.88)	209/158	44.82 (31.76–63.26)	36.02 (24.63–52.69)
Pregnancy intention						
Not intended	439/930	1.00	1.00	162/930	1.00	1.00
Intended	604/1450	0.88 (0.76–1.02)	0.74 (0.61–0.89)	126/1450	0.50 (0.39–0.64)	0.48 (0.34–0.69)
Total sample size	3423 ^f			2668 ^f		

^aFour or more drinks on at least one occasion. Excludes women with missing or incomplete data for alcohol consumption^bOdds ratio^cConfidence Interval^dAdjusted for age, race/ethnicity, education, household income, birthplace, research site, smoking during pregnancy, pre-pregnancy drinking, and pregnancy intention^eOne to three drinks per occasion^fExcludes missing