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Factors Associated With Employment Status Before and During Pregnancy: Implications for Studies of Pregnancy Outcomes

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Abstract

Background—Potential confounding or effect modification by employment status is frequently overlooked in pregnancy outcome studies.

Methods—To characterize how employed and non-employed women differ, we compared demographics, behaviors, and reproductive histories by maternal employment status for 8,343 mothers of control (non-malformed) infants in the National Birth Defects Prevention Study (1997–2007) and developed a multivariable model for employment status anytime during pregnancy and the 3 months before conception.

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AUTHORS' CONTRIBUTIONS
CMR conceived of the work; all authors participated in the design of the work; CMR and SJB analyzed data; all authors interpreted data for the work; CMR drafted the work; CCL, PAR, TAD, AJA, EB, and SMG provided critical revisions; all authors have approved the submitted version and agree to be accountable for the work.

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Results—Sixteen factors were independently associated with employment before or during pregnancy, including: maternal age, pre-pregnancy body mass index, pregnancy intention, periconceptional/first trimester smoking and alcohol consumption, and household income.

Conclusions—Employment status was significantly associated with many common risk factors for adverse pregnancy outcomes. Pregnancy outcome studies should consider adjustment or stratification by employment status. In studies of occupational exposures, these differences may cause uncontrollable confounding if non-employed women are treated as unexposed instead of excluded from analysis.

Keywords

employment; pregnancy; confounding factors (epidemiology); healthy worker effect

INTRODUCTION

Parental employment status (whether a person is employed or not) and occupation (the type of work performed during employment) are often omitted or overlooked as critical variables of interest in studies of pregnancy outcomes in the United States. Many surveillance systems and national surveys (e.g., the Pregnancy Risk Assessment Monitoring System) traditionally have not collected this information. In a 2009 survey, only 16 states voluntarily collected information on parental occupation on birth certificates and 24 collected information on parental occupation on fetal death certificates [Fitzgerald et al., 2009]. Even when occupational information is collected, it is often incomplete or of poor quality [Shaw et al., 1990; Brender et al., 2008]—though the quality of information can be greatly improved when staff are trained on the importance of occupational data [Armenti et al., 2010]. The lack of information on parental employment status or occupation has limited research on employment and pregnancy outcomes.

Employment status might be an important confounder or effect modifier to consider in studies of pregnancy outcomes associated with non-occupational risk factors, because self-selection to employment is likely driven by many factors including reproductive history (e.g., the number and ages of children at home), family structure, attitudes towards employment and motherhood, and access to affordable childcare [Budig, 2003; Crohn et al., 2014]. Employment, in turn, affects important factors such as access to health insurance, income, and paid leave for pre- and post-natal care. Type of occupation is also an important component of socioeconomic status, capturing social prestige in a way that income and education alone do not [Liberatos et al., 1988; Fujishiro et al., 2010]. Even when this information is available, most pregnancy outcome studies rarely consider that employment might confound or modify the effects of other, non-occupational risk factors.

Among the subset of studies examining occupational exposures and pregnancy outcomes, another issue arises when considering how to treat non-employed women in analyses. These women are at times excluded from analysis (which is equivalent to stratifying by employment status, since no exposure occurs among non-employed women so no effect estimates can be estimated), used as the unexposed reference group, or else included in the reference group along with unexposed employed women. We have encountered disagreements regarding use of unemployed women as a reference group [Rocheleau et al., 2012] and anecdotal suggestions to retain non-employed women in analyses of occupational exposures. Those in favor of retaining non-employed women often cite previously published criticisms of an exposure potential restriction rule [Poole, 1986, 1987], while those in favor of excluding non-employed women often consider restriction necessary to control confounding by characteristics related to employment, for example the "healthy worker effect." Countering this, however, are assertions that the healthy worker effect is not relevant to pregnancy outcome studies because all included women were healthy enough to become pregnant. There are few data available with which to contribute empirically to this methodological discussion.

To address these issues, we used recent data from a population-based study to i) identify how employment before and during pregnancy is associated with demographics, health history, and health behaviors that are frequently cited as risk factors for adverse pregnancy outcomes; ii) assess whether differences between employed and non-employed women could be adequately adjusted for in multivariable models using other proxy variables; and iii) discuss the relevance of these findings to future pregnancy outcome studies.

MATERIALS AND METHODS

Study Design

We analyzed data from mothers of live-born infants without birth defects born on or after October 1, 1997, with an estimated due date on or before December 31, 2007, from the National Birth Defects Prevention Study (NBDPS). The NBDPS is a population-based case-control study of birth defects conducted by population-based surveillance systems in 10 states (Arkansas, California, Georgia, Iowa, Massachusetts, New Jersey, New York, North Carolina, Texas, and Utah). The NBDPS control population has been shown to be representative of the US population of child-bearing women on several demographic characteristics [Cogswell et al., 2009]. Control infants were identified from hospital delivery logs or birth certificate files. Details of the study design have been described elsewhere [Yoon et al., 2001; Reefhuis et al., 2015]. A computer-assisted telephone interview (CATI) was administered in English or Spanish no sooner than 6 weeks and no later than 24 months after the infant's due date. Data collection included: demographics, pregnancy characteristics, family history, medical and prenatal care, diet, lifestyle, and occupational history.

Study Variables

We analyzed a range of demographic, behavioral, and health history variables available in the NBDPS that are commonly associated with adverse pregnancy outcomes (miscarriage, stillbirth, birth defects, preterm birth, and low birth-weight/small-for-gestational-age) in the literature [Wilcox, 2010; Buck Louis and Platt, 2011]. Demographic variables included the mother's self-reported age at the time of delivery; maternal and paternal race, nativity, and education; annual household income (categorized); number of people in the household; and NBDPS site (resident state at delivery). Reproductive history variables included maternal parity, prior miscarriages, pregnancy intention, and use of fertility drugs or procedures to become pregnant. Maternal health variables included height and pre-pregnancy weight (used to calculate body mass index (BMI)), and diabetes or hypertension diagnosed before or during the pregnancy. Health behaviors included maternal smoking and alcohol consumption in the month prior to conception and/or within the first trimester of pregnancy, maternal and paternal illicit drug use during the 3 months prior to conception or during the pregnancy, and maternal use of a folic acid supplement during the 1 month prior to conception through 1 month after conception. Finally, pregnancy outcomes assessed included plurality of the pregnancy, gestational age, and birthweight.

Mothers were asked to describe all jobs they held for at least 1 month during the 3 months prior to pregnancy through the end of the pregnancy (B3-P_{end}); this included full- or part-time jobs and jobs worked at home, on a farm, or outside the home. For each job, a mother reported her employer's name, what the employer produced or the service it provided, her job title, her typical job duties, any chemicals/substances or equipment she handled, her typical number of days per week and hours per day worked, the month and year she started working the job, and (if applicable) the month and year she stopped working the job.

Exclusions

There were 8,450 NBDPS control mothers eligible for our analysis. We excluded mothers who did not provide any information on their employment status B3-P_{end} (n = 98), reported working during this time period but did not provide any job description (n = 7), or reported working 0 days per week and/or 0 hr per day (n = 2) from analysis. This left 8,343 (98.7%) mothers in the analysis.

Statistical Analysis

Characteristics of women who were employed at all during B3-P_{end} and those who were not employed were first compared using a chi-square test. For characteristics missing more than 100 responses, a missing category was created; this allowed us to also examine associations between missing data and other characteristics. Next, we used stepwise forward selection to develop an unconditional multivariable logistic regression model of employment during B3-P_{end}. Infant birth weight, plurality, and gestational age at birth were not considered for inclusion in this model of employment during pregnancy and the preconceptional period. For all other variables, cutoff values for entering and exiting the multivariable models were $P <$ 0.10 and $P < 0.05$, respectively. A subanalysis based on complete data (observations with missing values were excluded) was conducted to assess the sensitivity of the results to modeling missing values. All analyses were conducted with SAS 9.3 software (SAS Institute, Inc; Cary, NC).

RESULTS

Among the 8,343 mothers in this study, 2,365 (28.3%) were not employed at all during B3-P_{end}. Most non-employed mothers reported being homemakers/parents (80.4%) or students (14.1%); a small proportion reported being disabled (1.2%), between jobs (3.5%), or another reason/did not specify (0.8%) (Table I).

The proportion of mothers employed during B3-P_{end} differed across NBDPS sites, ranging from 84.1% in Iowa to 58.0% in Texas. Compared to employed mothers, non-employed mothers were significantly more likely to be: <20 years old, Hispanic, born outside the United States, have more people living in the household, have a household income <10,000/year, and have not completed high school (Table II). Their babies' fathers were also more likely to be Hispanic, born outside the United States, and have not completed high school.

Non-employed mothers were also significantly more likely to be parous, report that their pregnancy was unintended, not smoke cigarettes or drink alcohol in the month before conception and the first trimester of pregnancy, use a multivitamin or take a folic acid supplement in the month before and after conception, report gestational diabetes in a prior (but not current) pregnancy, to not report high blood pressure during the pregnancy (either pre-existing hypertension that continued during pregnancy or pre-eclampsia), and to have not used fertility drugs or treatments to conceive the index pregnancy compared to employed mothers (Table III). While there was no difference in infant's gestational age at delivery by maternal employment status, employed mothers were more likely to have infants with either a low birth weight (<2,500 g) or high birth weight (>4,000 g) (Table IV). For all variables examined, the proportion of missing responses varied by employment status, with non-employed mothers twice as likely as employed mothers to be missing data on household income and paternal education and four times more likely to be missing data on maternal pre-pregnancy BMI (Tables II and III).

Sixteen variables were significantly ($P < 0.05$) associated with employment during B3-P_{end} in a multivariable model: maternal age, birth outside the United States, pre-pregnancy BMI, hypertension, prior parity, prior history of miscarriage, pregnancy intention, smoking in the month prior to conception or the first trimester, and alcohol consumption during the month prior to conception or the first trimester; paternal race/ethnicity; maternal and paternal education, household income, family size, study site, and use of fertility medications or procedures to become pregnant (Table V). The final multivariable model described only a small proportion of the variability in the distribution of employment during B3-P_{end} in the data set, as measured by the likelihood-based pseudo R^2 measure ($R^2 = 0.1803$). A subanalysis restricting to complete data, rather than using a missing indicator, produced similar results (Supplemental Table SI).

DISCUSSION

Differences Between Employed and Non-Employed Mothers

Employed and non-employed women and their families differed across a wide variety of characteristics that are generally recognized risk factors for adverse pregnancy outcomes. To the extent that the results from this analysis of NBDPS data could be considered representative of other study populations, our observations should serve as a reminder that employment status is closely related to many aspects of a woman's life. It is, therefore, important to consider employment status as a possible confounder or effect modifier in pregnancy outcome studies, even when the main exposure of interest is not occupational.

Our crude results are consistent with previous studies showing that women who were employed during pregnancy were more likely to have higher income and/or education, be non-Hispanic white, be in low-risk reproductive age categories, be nulliparous, and report that the pregnancy was planned [Savitz et al., 1990; Moss and Carver, 1993; Henriksen et al., 1994]. The National Natality Study also found that employed women were less likely to abstain completely from alcohol [Savitz et al., 1990], consistent with our observations.

The unique contribution of this work is the development of a multivariable model of employment status before and during pregnancy. In our adjusted analysis, some odds ratios changed dramatically or even reversed the direction of association; these included paternal race/ethnicity, paternal education, and pregnancy intention. This underscores the importance of understanding the complex relationships between maternal health, family demographics, reproductive history, and employment. Studies of pregnancy outcomes that ignore employment status may be missing an important component by overlooking the role of employment as a confounder or effect modifier in research studies, and a barrier or facilitator in interventional studies.

Maternal employment status was not only associated with maternal characteristics, but with paternal demographic and behavioral characteristics as well. In studies of paternal exposures and pregnancy outcomes, stratifying by maternal employment status might be appropriate given these findings.

The Healthy—or Unhealthy—Worker Effect

Occupational exposure studies often discuss the "healthy worker effect," a specific form of bias in occupational studies in which underlying health conditions might increase risks of adverse health outcomes, while also reducing the likelihood of an individual being able to work [Choi, 1992; Baillargeon, 2001]. Most studies of the healthy worker effect were conducted among men, however, and this issue has not been well-evaluated in women. A higher proportion of women versus men are outside the labor force (i.e., neither employed nor seeking employment). As of 2011, 15.7% of civilian, non-institutionalized men aged 25–54 in the United States were outside the labor force, compared to 28.9% of women [Bureau of Labor Statistics, 2012]. The difference likely lies in caregiving and maternity leave, creating a far more complex scenario of potential confounding and selection bias in studying occupation and pregnancy outcomes. A recent study in Japan, for example, found little evidence of a healthy worker effect even among highly educated women, which the authors hypothesized might be due to strong social norms towards traditional caregiving/homemaking roles for women [Nishikitani et al., 2012].

Because maternity leave policies and caregiving norms vary widely, results may not be comparable between countries, cultures, and time periods. The literature comparing employed and non-employed women during pregnancy, however, is sparse and generally limited to crude analysis [Savitz et al., 1990; Moss and Carver, 1993; Henriksen et al., 1994; Baillargeon et al., 1998]. Our observations can add to this literature: non-employed mothers were not significantly more likely to be overweight or obese compared to employed mothers, though they were more likely to be underweight. High blood pressure during the index pregnancy was more common among working mothers versus nonworking mothers;

non-employed mothers were more likely to report a history of pre-eclampsia in a past but not the current pregnancy. Alcohol use and smoking were more common among working mothers than non-working mothers, however. These observations paint a more complicated picture of the healthy worker effect among women before and during pregnancy.

In reproductive epidemiology, an alternate “unhealthy worker effect” has been proposed: women who are healthier are more likely to be fertile and capable of carrying a pregnancy to term, therefore more likely to be removed from the workplace due to maternity leave or being caregivers to their children [Wilcox, 2010, p 159]. This hypothesis is supported by previous studies that found a history of miscarriage was more common among employed women than unemployed [Savitz et al., 1990; Henriksen et al., 1994]. In contrast, we found that employed women were less likely to report a prior miscarriage. Consistent with previous studies, we found that employed women were more likely to report using fertility treatments or medications to conceive versus non-employed women—the strength of the association was substantially attenuated, however, after adjusting for other characteristics. It is also unclear whether this finding reflects underlying differences in fertility between employed and non-employed women, or simply is due to differences in health insurance access. Discordant results across studies might be due to adjusting for different sets of variables, changing trends in women being employed outside the home, or geographic variations in the prevalence of women employed outside the home. Recent surveys in the United States show that women tend to maintain employment throughout pregnancy. Among first births in which mothers worked before or at conception, 82% worked until at least 1 month before delivery [Laughlin, 2011]. Among all mothers, pregnancy overall did not affect the hazards of leaving the workforce, though having an infant did [Budig, 2003]. In settings where this is not the case, the predictors of working before pregnancy might be different from predictors of working after pregnancy identification.

The literature on employment and pregnancy outcomes is inconsistent; previous studies have shown better outcomes for mothers who were employed during pregnancy [Murphy et al., 1984; Meyer et al., 2010], worse outcomes [Lemasters and Pinney, 1989], and generally no difference [Moss and Carver, 1993, Henriksen et al., 1994]. Our findings were mixed as well; we observed no differences in gestational age at birth for the children of women who were employed versus non-employed, but employed women were slightly more likely to have babies with very low or high birthweight.

Implications for Studies of Occupational Exposures and Pregnancy Outcomes

For pregnancy outcome studies that examine occupational exposures, the observed differences between employed and non-employed mothers clarify whether including non-employed women in the unexposed reference group is likely to cause bias. Anecdotally, some epidemiologists have argued that excluding non-employed women is necessary to prevent confounding, while others cite criticisms of an exposure opportunity restriction rule as justification to include non-employed women. It is important to note, however, those criticisms asserted that exposure opportunity alone is not a sufficient cause for restriction, not that it is inappropriate to restrict to control confounding (where confounding could not be easily controlled otherwise) by variables related to exposure potential [Poole, 1986, 1987]. Including non-employed women in the reference group—that is, women with no potential for exposure to the occupational exposure of interest—when examining an occupational exposure is therefore only appropriate if one of the following conditions is true: i) there is no potential for confounding based on employment status or related variables; or ii) confounding by employment status or related variables can be controlled analytically. Otherwise, confounding is possible by factors that are causally related to both employment (and therefore occupational exposure) and the outcome (Fig. 1); this confounding pathway can be blocked by conditioning on employment.

In an occupational exposure study, characteristics that are causally related to both a given pregnancy outcome and employment status can become confounders when a causal pathway is completed between employment status and occupational exposure by including non-employed women (who are by definition unexposed) in the analysis. Because we observed that many common risk factors for adverse pregnancy outcomes were associated with employment status, and cannot rule out that those relationships with employment status are causal, we cannot meet the first condition.

The second condition—that all confounders can be controlled analytically—cannot be met if we do not know all the confounders, cannot measure all the confounders, or must adjust for so many confounders that our statistical power is greatly reduced. Our attempt to build a multivariable model for employment status gives us insight into how difficult controlling for confounding mediated by employment status might be. First, we see that differences between employed and non-employed mothers cannot be reduced to a small set of adjustment variables, because 16 demographic, maternal health, and behavioral factors were significant in our multivariable model. Second, despite the inclusion of so many variables, our model only explained approximately 18% of the variability in employment status. This suggests that other factors that we did not measure might be important predictors of a mother's employment status before and during pregnancy (e.g., religiosity, relationship status, or social support); yet these factors are difficult to measure and not typically available in epidemiological studies. These two insights suggest that confounding would be challenging to control analytically due to a large number of potential confounders and potentially unknown or unmeasured con-founders; therefore the second condition for including non-employed women in the reference group is unlikely to be met.

Prior studies have also attempted to address confounding by employment status and related variables by simply treating employment status as a confounder and adjusting statistically for it in studies of occupational exposure and pregnancy outcome that included non-employed women in the reference group [Burdorf et al., 2011]. While it might sound like a simple solution, this causes a deterministic violation of positivity and can result in biased effect estimates. A deterministic violation of positivity occurs when one or more levels of the confounder contains participants who cannot possibly receive at least one level of the exposure [Westreich and Cole, 2010]. The confounder in this case is employment status, and one level of that confounder (non-employed) cannot possibly receive at least one level of the exposure (exposed). The simplest- and, for a deterministic violation, safest-solution for positivity violations is restriction [Westreich and Cole, 2010; Petersen et al., 2012].

Additionally, we observed substantial differences in the prevalence of missing data by employment status for several variables. We presented data using a missing indicator to examine whether the proportion of missing data was associated with employment status—and by extension, with exposure when non-employed mothers are included in the study population. Differential rates of missing data by exposure status could introduce additional bias, although in our model restricting to complete data produced little change in the adjusted odds ratios (Supplemental Table SI).

Limitations

An important limitation of our results is that we cannot fully predict the impact of survey non-participation on these results. While control mother participants (64.9% of eligible) were comparable to their source population across many demographic variables [Cogswell et al., 2009], we lack population-level data on employment during/before pregnancy so cannot evaluate whether participation in NBDPS was related to employment status. Predictors of employment are likely to vary geographically and over time. For example, among women in the U.S. with their first birth, only 44.4% reported working during pregnancy in the US in 1961–1965, but by 2006–2008 that had increased to 65.6% [Laughlin, 2011]. Also, we do not know the temporality or directionality of relationships between many variables that were associated with employment status.

Conclusions and Recommendations

Our results show that the relationships between employment status and demographic characteristics, maternal health and behaviors, and maternal reproductive history are extensive and complex. Some of these relationships (maternal age, household income, education, pregnancy intendedness, and pre-pregnancy BMI) suggest that women who are employed before and during pregnancy should have better birth outcomes; others (consuming alcohol and smoking, lack of a folic acid supplement before or during the first month of pregnancy) are associated with poorer birth outcomes. While further work should investigate these differences, particularly between groups of employed mothers (e.g., using SOC 2010 high-level aggregation categories) [Bureau of Labor Statistics, 2010], these data show that differences between employed and non-employed mothers will likely cause uncontrollable confounding in the NBDPS and other studies examining occupational exposure and reproductive outcomes if analyzes are not restricted to employed mothers. This study also high-lights the importance of assessing maternal employment status in epidemiologic studies of pregnancy outcomes, including studies of paternal occupational exposures and birth outcomes.

Based on our findings, we recommend that future studies of pregnancy outcomes:

1. Collect information about employment during the peri-pregnancy period.
2. Evaluate whether maternal employment status is a confounder or effect modifier.
3. When examining occupational exposures, restrict analyzes to employed women to control likely confounding by variables related to employment status.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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DISCLAIMER

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

ETHICS APPROVAL AND INFORMED CONSENT

The study materials and protocols were approved by the Institutional Review Boards of each NBDPS site and the Human Studies Review Board of the CDC, and informed consent was provided by all participants.

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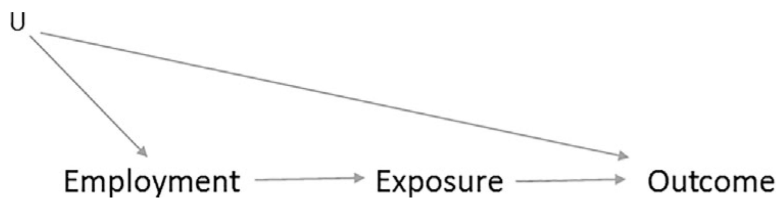

FIGURE 1.
Directed acyclic graph illustrating confounding by U when employment status is in the causalpathway for the exposure of interest. Conditioning on employment status (i.e., restricting to employed workers in a study of occupational exposure) would block confounding by U. U could include a number of sociodemographic, health-related, and pregnancy-history related variables (for example, parity).

TABLE I.

Self-Reported Employment Status During Pregnancy and the 3 Months Before Conception, Control Mothers, National Birth Defects Prevention Study, 1997–2007

Employment status during pregnancy and/or 3 months prior to conception	N women	% of study	% of non-workers
Employed ≥1month	5978	71.7	NA
Non-employed	2365	28.3	100
Homemaker/parent	1902	22.8	80.4
Student	333	4.0	14.1
Disabled	29	0.3	1.2
Unemployed/in between jobs	82	1.0	3.5
Missing /other, did not work	19	0.2	0.8

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TABLE II.

Demographic Characteristics of Control Mothers Who Were Employed for1Month or More During Pregnancy and the 3 Months before Conception VersusThose Who Were Not Employed DuringThisTime Period, National Birth Defects Prevention Study, 1997–2007

	Employed (N = 5978)	Not employed (N = 2365)	
Maternal characteristics	**N[a] (%)**	**N[a] (%)**	***P*-value**
Age (years)			<0.0001
<20	448 (7.5)	409 (17.3)	
20–24	1394 (23.3)	522 (22.1)	
25–29	1654 (27.7)	639 (27.0)	
30–34	1602 (26.8)	504 (21.3)	
35+	880 (14.7)	291 (12.3)	
Race /ethnicity			<0.0001
Non-hispanic white	3828 (64.0)	1115 (47.1)	
Non-hispanic black	722 (12.1)	209 (8.8)	
Hispanic	1061 (17.7)	865 (36.6)	
Other	366 (6.1)	175 (7.4)	
Nativity			<0.0001
US-born	5043 (84.4)	1620 (68.5)	
Born outside the USA	929 (15.5)	740 (31.3)	
Education			<0.0001
Less than high school diploma	617 (10.3)	812 (34.3)	
Completed high school	3223 (53.9)	1045 (44.2)	
Bachelor's degree or higher	2129 (35.6)	503 (21.3)	
NBDPS site			<0.0001
Arkansas	779 (13.0)	276 (11.7)	
California	615 (10.3)	402 (17.0)	
Iowa	780 (13.0)	147 (6.2)	
Massachusetts	802 (13.4)	222 (9.4)	
New Jersey	416 (7.0)	157 (6.6)	
New York	555 (9.3)	169 (7.1)	
Texas	562 (9.4)	407 (17.2)	

	Employed (N = 5978)	Not employed (N = 2365)	
Maternal characteristics	N[a] (%)	N[a] (%)	*P*-value
CDC /Atlanta	653 (10.9)	224 (9.5)	
North Carolina	420 (7.0)	148 (6.3)	
Utah	396 (6.6)	213 (9.0)	
Annual household income			<0.0001
Less than 10 thousand dollars	850 (14.2)	622 (26.3)	
10 to 30 thousand dollars	1468 (24.6)	598 (25.3)	
30 to 50 thousand dollars	1050 (17.6)	315 (13.3)	
More than 50 thousand dollars	2167 (36.2)	506 (21.4)	
Missing	443 (7.4)	324 (13.7)	
Number of people in household			<0.0001
2 or fewer	2351 (39.3)	391 (16.5)	
3–4	2606 (43.6)	1261 (53.3)	
5–6	442 (7.4)	396 (16.7)	
7 or more	89 (1.5)	101 (4.3)	
Missing	490 (8.2)	216 (9.1)	
Partner characteristics (Baby's father)			
Race /ethnicity			<0.0001
Non-hispanic white	3688 (61.7)	1069 (45.2)	
Non-hispanic black	804 (13.4)	235 (9.9)	
Hispanic	1053 (17.6)	871 (36.8)	
Other	362 (6.1)	144 (6.1)	
Missing	71 (1.2)	46 (1.9)	
Nativity			<0.0001
US-born	4902 (82.0)	1554 (65.7)	
Born outside the USA	1030 (17.2)	772 (32.6)	
Education			<0.0001
Less than high school diploma	707 (11.8)	637 (26.9)	
Completed high school	3186 (53.3)	1016 (43.0)	
Bachelor's degree or higher	1945 (32.5)	603 (25.5)	

	Employed (N = 5978)	Not employed (N = 2365)	
Maternal characteristics	**N[a] (%)**	**N[a] (%)**	***P*-value**
Missing	140 (2.3)	109 (4.6)	

B3-P_{end}: 3 months prior to conception through the end of pregnancy.

[a]Data not shown if <100 missing, for: maternal race /ethnicity (n =2 missing), maternal nativity (n =11), maternal education (n =15), paternal nativity (n =85).

TABLE III.

Reproductive History, Health Characteristics, and Behaviors of Control Mothers Who Were Employed for1Month or More at AnyTime During Pregnancy and the 3 Months Before Conception VersusThose Who Were Not Employed DuringThisTime Period, National Birth Defects Prevention Study, 1997–2007

	Employed (N = 5978)	Not employed (N = 2365)	
	N[a] (%)	N[a] %	*P*-value
Pre-pregnancy parity			<0.0001
Parous	3255 (54.4)	1745 (73.8)	
Nulliparous	2722 (45.5)	620 (26.2)	
Prior miscarriage			0.0667
History of miscarriage	1297 (21.7)	557 (23.6)	
No known prior miscarriage	4680 (78.3)	1808 (76.4)	
Pregnancy intention			0.0007
Pregnancy was intended	3685 (61.6)	1359 (57.5)	
Pregnancy was unintended	1828 (30.6)	823 (34.8)	
Pregnancy was neither planned nor unplanned	450 (7.5)	175 (7.4)	
Pre-pregnancy body mass index (BMI)			<0.0001
Underweight (BMI <18.5)	278 (4.7)	156 (6.6)	
Normal weight (18.5 < = BMI < 25)	3240 (54.2)	1160 (49.0)	
Overweight (25 < = BMI < 30)	1355 (22.7)	473 (20.0)	
Obese (> =30)	971 (16.2)	368 (15.6)	
Missing /out of range	134 (2.2)	208 (8.8)	
Diabetes			0.0044
No diabetes of any form	5585 (93.4)	2190 (92.6)	
Type I or II diabetes diagnosed prior to pregnancy	33 (0.6)	14 (0.6)	
Gestational diabetes in previous pregnancy only	105 (1.8)	59 (2.5)	
Any diabetes diagnosed during the index pregnancy	247 (4.1)	93 (3.9)	
Hypertension			0.0004
No history of high blood pressure ever	5151 (86.2)	2061 (87.1)	
History of high blood pressure, but not in index pregnancy	229 (3.8)	120 (5.1)	
High blood pressure during pregnancy	591 (9.9)	181 (7.7)	

	Employed (N = 5978)	Not employed (N = 2365)	
	N[a] (%)	N[a] %	*P*-value
Smoking, B1-P3			<0.0001
Yes	1183 (19.8)	359 (15.2)	
No	4793 (80.2)	2005 (84.8)	
Alcohol consumption, B1-P3			<0.0001
	2517 (42.1)	555 (23.5)	
No	3437 (57.5)	1798 (76.0)	
Use of illicit drugs, B3-P_{end}			0.2883
Yes	325 (5.4)	115 (4.9)	
No	5645 (94.4)	2248 (95.1)	
Partner (baby's father) used illicit drugs, B3-P_{end}			0.0154
Yes	644 (10.8)	230 (9.7)	
No	5244 (87.7)	2080 (87.9)	
Missing/unknown/refused	90 (1.5)	55 (2.3)	
Use of a multivitamin or folic acid supplement, B1-P1			<0.0001
Yes	2746 (45.9)	1331 (56.3)	
No	3232 (54.1)	1034 (43.7)	
Fertility drugs or procedures used by either parent to conceive index pregnancy			<0.0001
Yes	323 (5.4)	56 (2.4)	
No	5439 (91.0)	2246 (95.0)	
Missing	216 (3.6)	63 (2.7)	

B1-P1:onemonthprior toconceptionthroughthefirstmonthofpregnancy;B1-P3:onemonth prior to conceptionthroughthefirst3monthsofpregnancy;B3-Pend:threemonths prior to conception through the end of pregnancy.

[a]Data not shown if <100 missing, for: pre-pregnancy parity (n =1missing), prior miscarriage (n =1), pregnancy intention (n =23), diabetes (n =17), hypertension (n =10), smoking (n =3), alcohol consumption (n =36), and maternal illicit drug use (n =10).

TABLE IV.

Pregnancy Outcomes of Control Mothers Who Were Employed for1Month or More at AnyTime During Pregnancy and the 3 Months Before Conception VersusThose Who Were Not Employed DuringThisTime Period, National Birth Defects Prevention Study, 1997–2007

	Employed (N = 5978)	**Not employed (N = 2365)**	
	N[a] %	**N[a] %**	***P*-value**
Plurality of pregnancy			0.0665
Singleton gestation	5777 (96.6)	2304 (97.4)	
Multiple gestation	192 (3.2)	58 (2.5)	
Gestational age of infant at birth			0.6309
Very preterm (<32 weeks)	88 (1.5)	29 (1.2)	
Preterm (32–36 weeks)	475 (7.9)	195 (8.2)	
Term (37–45 weeks)	5415 (90.6)	2140 (90.5)	
Birthweight of infant			<0.0001
Very low birthweight (<1500 g)	58 (1.0)	10 (0.4)	
Low birthweight (1500–2499 g)	296 (5.0)	101 (4.3)	
Normal birthweight (2500–3999 g)	4965 (83.1)	2056 (86.9)	
Macrosomic (> =4000 g)	631 (10.6)	191 (8.1)	

B3-Pend: three months prior to conception through the end of pregnancy.

[a]Data not shown if <100 missing, for: plurality (n =12 missing), gestational age at birth (n =1), infant birthweight (n =45).

TABLE V.

Crude and Adjusted Models of Control Mother Employment for1Month or More During Pregnancy and the 3 Months before Conception, National Birth Defects Prevention Study, 1997–2007

	Crude	Adjusted[a]	
Characteristic	**OR (95% CI)**	**OR (95% CI)**	**β(SE)**
Maternal			
Age (years)			
<20	0.42 (0.36, 0.50)	0.41 (0.33, 0.52)	−0.8244 (0.0867)
20–24	1.03 (0.90, 1.18)	0.98 (0.83, 1.15)	0.0348 (0.0584)
25–29	1.00 (reference)	1.00 (reference)	
30–34	1.23 (1.07, 1.41)	1.33 (1.14, 1.56)	0.3457 (0.0596)
35+	1.17 (1.00, 1.37)	1.39 (1.14, 1.68)	0.3850 (0.0764)
Nativity			
US-born	1.00 (reference)	1.00 (reference)	
Born outside the USA	0.40 (0.36, 0.45)	0.67 (0.57, 0.79)	−0.4050 (0.0829)
Education			
Less than high school diploma	0.18 (0.16, 0.21)	0.40 (0.32, 0.50)	−0.5697 (0.0617)
Completed high school	0.73 (0.65, 0.82)	0.87 (0.74, 1.04)	0.2176 (0.0411)
Bachelor’s degree or higher	1.00 (reference)	1.00 (reference)	
Annual household income			
Less than 10 thousand dollars	0.32 (0.28, 0.37)	0.48 (0.39, 0.60)	−0.3131 (0.0622)
10 to 30 thousand dollars	0.57 (0.50, 0.66)	0.77 (0.64, 0.93)	0.1538 (0.0550)
30 to 50 thousand dollars	0.78 (0.66, 0.91)	0.87 (0.73, 1.05)	0.2785 (0.0661)
More than 50 thousand dollars	1.00 (reference)	1.00 (reference)	
Missing	0.32 (0.27, 0.38)	0.39 (0.30, 0.51)	−0.5325 (0.0928)
Number of people in household			
2 or fewer	1.00 (reference)	1.00 (reference)	
3–4	0.34 (0.30, 0.39)	0.43 (0.37, 0.49)	−0.2624 (0.0557)
5–6	0.19 (0.16, 0.22)	0.38 (0.30, 0.48)	−0.3797 (0.0780)
7 or more	0.15 (0.11, 0.20)	0.50 (0.34, 0.72)	−0.1055 (0.1384)
Missing	0.38 (0.31, 0.46)	0.65 (0.50, 0.84)	0.1548 (0.1032)

Characteristic	Crude	Adjusted[a]	
	OR (95% CI)	OR (95% CI)	β(SE)
NBDPS site			
Arkansas	0.97 (0.79, 1.19)	0.99 (0.78, 1.25)	0.0398 (0.0778)
California	0.53 (0.43, 0.64)	0.87 (0.69, 1.10)	−0.0905 (0.0770)
Iowa	1.82 (1.44, 2.30)	1.67 (1.29, 2.18)	0.5677 (0.0928)
Massachusetts	1.24 (1.00, 1.53)	0.88 (0.69, 1.12)	−0.0728 (0.0816)
New Jersey	0.91 (0.72, 1.15)	0.79 (0.61, 1.03)	−0.1814 (0.0993)
New York	1.13 (0.90, 1.42)	0.98 (0.76, 1.26)	0.0275 (0.0911)
Texas	0.47 (0.39, 0.58)	0.73 (0.57, 0.93)	−0.2661 (0.0813)
CDC/Atlanta	1.00 (reference)	1.00 (reference)	
North Carolina	0.97 (0.77, 1.24)	1.08 (0.82, 1.41)	0.1252 (0.1017)
Utah	0.64 (0.51, 0.80)	0.78 (0.60, 1.01)	−0.2019 (0.0925)
Prior parity (continuous, per each additional birth)	0.69 (0.66, 0.71)	0.73 (0.68, 0.78)	−0.3184 (0.0326)
Prior miscarriage			
Yes	0.90 (0.80, 1.01)	0.83 (0.73, 0.95)	−0.1824 (0.0665)
No	1.00 (reference)	1.00 (reference)	
Pregnancy intention			
Pregnancy was intended	1.00 (reference)	1.00 (reference)	
Pregnancy was unintended	0.82 (0.74, 0.91)	1.22 (1.07, 1.38)	0.0983 (0.0699)
Pregnancy was neither planned nor unplanned	0.95 (0.79, 1.14)	1.10 (0.89, 1.36)	−0.0012 (0.0699)
Pre-pregnancy body mass index (BMI)			
Underweight (BMI <18.5)	0.64 (0.52, 0.79)	0.73 (0.58, 0.92)	−0.2064 (0.0969)
Normal weight (18.5 < = BMI < 25)	1.00 (reference)	1.00 (reference)	
Overweight (25 < = BMI < 30)	1.03 (0.91, 1.16)	1.10 (0.95, 1.26)	0.2031 (0.0616)
Obese (> =30)	0.95 (0.82, 1.08)	0.96 (0.82, 1.13)	0.0734 (0.0687)
Missing/out of range	0.23 (0.18, 0.29)	0.75 (0.56, 0.99)	−0.1797 (0.1145)
Hypertension			
No history of high blood pressure ever	1.00 (reference)	1.00 (reference)	
History of high blood pressure, but not in this pregnancy	0.76 (0.61, 0.96)	0.72 (0.56, 0.93)	−0.2846 (0.0902)
High blood pressure during pregnancy (with or without prior history)	1.31 (1.10, 1.56)	1.22 (1.00, 1.49)	0.2410 (0.0769)
Smoking, B1-P3			

Characteristic	Crude	Adjusted[a]	
	OR (95% CI)	OR (95% CI)	β(SE)
Yes	1.38 (1.21, 1.57)	1.18 (1.00, 1.38)	0.0818 (0.0406)
No	1.00 (reference)	1.00 (reference)	
Alcohol consumption, B1-P3			
Yes	2.37 (2.13, 2.64)	1.57 (1.39, 1.78)	0.2260 (0.0322)
No	1.00 (reference)	1.00 (reference)	
Paternal			
Paternal race/ethnicity			
Non-Hispanic white	1.00 (reference)	1.00 (reference)	
Non-Hispanic black	0.99 (0.85, 1.16)	1.71 (1.40, 2.09)	0.4228 (0.0913)
Hispanic	0.35 (0.31, 0.39)	1.12 (0.93, 1.35)	−0.0014 (0.0824)
Other	0.73 (0.59, 0.89)	1.14 (0.90, 1.45)	0.0208 (0.1044)
Missing	0.45 (0.31, 0.65)	0.81 (0.49, 1.33)	−0.3288 (0.2008)
Paternal education			
Less than high school diploma	0.34 (0.30, 0.40)	1.67 (1.33, 2.09)	0.1076 (0.0710)
Completed high school	0.97 (0.87, 1.09)	1.80 (1.52, 2.12)	0.1815 (0.0582)
Bachelor's degree or higher	1.00 (reference)	1.00 (reference)	
Missing	0.40 (0.31, 0.52)	1.68 (1.16, 2.44)	0.1147 (0.1292)
Pregnancy characteristics			
Fertility drugs or treatments used to conceive			
Yes	2.38 (1.89, 3.18)	1.42 (1.03, 1.95)	0.0367 (0.1280)
No	1.00 (reference)	1.00 (reference)	
Missing	1.42 (1.07, 1.88)	1.80 (1.19, 2.72)	0.2758 (0.1489)

B1-P1: 1month prior to conception through the first month of pregnancy; B1-P3: one month prior to conception through the first 3 months of pregnancy; B3-Pend: 3 months prior to conception through the end of pregnancy; CI: Confidence interval; OR: Odds ratio; SE: standard error.

[a]Each variable is adjusted for all other variables in the table.