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Employment during pregnancy and obstetric intervention without medical reason: labor induction and cesarean delivery

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Abstract

Background—Rising rates of labor induction and cesarean delivery, especially when used without a medical reason, have generated concern among clinicians, women, and policymakers. Whether employment status affects pregnant women's childbirth-related care is not known. We estimated the relationship between prenatal employment and obstetric procedures, distinguishing whether women reported that the induction or cesarean was performed for medical reasons.

Methods—Using data from a nationally-representative sample of women who gave birth in U.S. hospitals ($N=1,573$), we used propensity score matching to reduce potential bias from non-random selection into employment. Outcomes were cesarean delivery and labor induction, with and without a self-reported medical reason. Exposure was prenatal employment status (full-time employment, not employed). We conducted separate analyses for unmatched and matched cohorts using multivariable regression models.

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Findings—There were no differences in labor induction based on employment status. In unmatched analyses, employed women had higher odds of cesarean delivery overall (adjusted odds ratio (AOR) = 1.45, $p=0.046$) and cesarean delivery without medical reason (AOR=1.94, $p=0.024$). Adding an interaction term between employment and college education revealed no significant effects on cesarean without medical reason. There were no significant differences in cesarean delivery by employment status in the propensity score matched analysis.

Conclusions—Full-time prenatal employment is associated with higher odds of cesarean delivery, but this association was not explained by socio-economic status and no longer existed after accounting for socio-demographic differences by matching women employed full-time with similar women not employed during pregnancy.

Introduction and Background

Childbirth that occurs as a result of medical intervention rather than spontaneous labor (i.e., nonphysiologic birth), is an increasing focus of clinical and policy dialogue (Chescheir & Menard, 2012; Sakala, 2006). Obstetric procedures can be life-saving when medically necessary (Wong & Grobman, 2011), and balancing the risks and benefits of intervention to hasten childbirth, either through induction of labor or cesarean section is challenging for both women and clinicians (AAP Committee on Fetus and Newborn & ACOG Committee on Obstetric Practice, 2012; ACOG Committee on Practice Bulletins - Obstetrics, 2009; American College of Obstetricians and Gynecologists, 2007, 2014). Many commonly-cited reasons for labor induction and cesarean delivery are not unequivocally evidence-based, yet are widely used by clinicians and accepted by patients (Barber et al., 2011; Mozurkewich, Chilimigras, Koepke, Keeton, & King, 2009; Spong, Berghella, Saade, Wenstrom, & Mercer, 2012). Nonindicated use may be common, but it is not benign. For women who undergo these procedures, cesarean delivery and labor induction can result in potential complications, such as hemorrhage, infection, subsequent placental abnormalities, and increased maternal morbidity and mortality (Berns & Kott, 2010; Ecker & Frigoletto, 2007; Zelop & Heffner, 2004). With cesarean and induction rates having risen to 32.9% and 23.5%, respectively, in 2010, there is a growing need to ensure appropriate use and to identify populations at increased risk of having nonindicated obstetric procedures (American College of Obstetricians and Gynecologists, 2014; Angood et al., 2010; Declercq, Menacker, & MacDorman, 2006; Martin et al., 2012).

Pregnant women working full-time for an employer may experience unique pressures and demands regarding the timing of childbirth due to leave policies, the expectations of their employers or managers, and their personal relationships with these firms and individuals. Employment during pregnancy is common among women in the U.S.; 67% of first-time mothers report being employed during their pregnancies, and 87% of these women remained in the workplace into their last trimester (Johnson, 2008). While many studies have documented changes in maternal employment or trends in maternity care, few have explicitly examined labor and delivery care based on workforce participation. Prior research emphasizes the challenge of selection bias in calculating the impacts of maternal employment on birth outcomes (Baker & Milligan, 2008; [blinded citation]). Investigations into the role of employment in predicting cesarean delivery indicate a potential link

(Guendelman et al., 2009; Hung, Morrison, Whittington, & Fein, 2002); however, these studies focus exclusively on employed women and do not have a comparison group against which to analyze the impact of employment on delivery mode.

Given the frequency of employment during pregnancy and rising rates of obstetric procedures, characterizing the influence of employment on childbirth-related health care utilization is relevant for families, employers, insurers, health care providers, and for the government and private sector systems that support the care and well-being of mothers and children. The goal of this analysis was to use both multivariate regression and propensity score matching methods to examine the relationship between prenatal employment and two common obstetric procedures (labor induction and cesarean delivery), distinguishing whether women reported that the procedure was performed for medical reasons.

Methods

Data

For this analysis, we used data from the Listening to Mothers II Survey, a survey of English-speaking women, age 18-45, who gave birth to a single infant in a U.S. hospital in 2005 ($N = 1,573$). The survey was commissioned by Childbirth Connection and implemented by Harris Interactive using validated sampling methods (Taylor, Brenner, Overmeyer, Siegel, & Terhanian, 2001; Terhanian, Bremer, Smith, & Thomas, 2000). Detailed information on survey methodology has been previously described (Declercq, Sakala, Corry, & Applebaum, 2006), and full reports from all surveys in the Listening to Mothers series, questionnaires, and related material are available online (Childbirth Connection, n.d.). A publicly-available methodology report includes comprehensive information on the design and conduct of the survey and can be accessed at: http://www.childbirthconnection.org/pdfs/LTMII_methodology.pdf.

Briefly, potential survey respondents who were female and in the target age range were selected from a national online panel maintained by Harris Interactive for polling and survey research purposes. Potential respondents from all 50 states were invited to the survey website, where they were further screened for eligibility and, if eligible, completed the survey. To diminish potential bias that may arise from using web respondents only, additional black non-Hispanic and Hispanic women were recruited via telephone by Harris Interactive, and these additional respondents completed the interview by telephone. Finally, responses were weighted according to demographic variables and propensity to be online, resulting in a sample that reflects target population, English-speaking adult women (age 18 and older) who give birth to a singleton in a U.S. hospital in 2005 (Declercq et al., 2006). The survey is unique in its detailed questions regarding the use of health care services during childbirth and self-reported reasons for the use of these services, and it also includes information on employment status and other important socio-demographic characteristics, allowing for matching based on the propensity for employment and for the examination of obstetric procedure use based on employment status.

Variable measurement

The primary outcomes of interest were two common procedures: labor induction and cesarean birth. Women were provided with a list of potential reasons for these procedures (worded in lay terms). Based on current professional recommendations, we distinguished whether each constituted a defined medical reason for advancing delivery (AAP Committee on Fetus and Newborn & ACOG Committee on Obstetric Practice, 2012; Bailit et al., 2012; Spong et al., 2012), and our clinician co-author (DG) confirmed these literature-based categorizations. The specific reasons women reported for labor induction and cesarean birth as well as their categorizations are shown in Table 1. Recognizing the evolving dialogue around appropriate use of cesarean delivery and definitive medical indications, we conducted sensitivity analyses around the categorization of reasons as “medical” or not, and while point estimates changed somewhat, the direction and significance of results reported herein was unchanged by alternative specifications.

Labor induction—We categorized women as having experienced a labor induction if they reported that their clinician had tried to start their labor by sweeping or rupturing membranes, intravenous Pitocin, applying medication to the cervix, or administering oral medication. Women who reported having labor induction were asked why the clinician tried to start labor and could provide multiple responses. If any of a woman's multiple responses constituted a medical reason, their induction was classified as such (Table 1).

Cesarean delivery—Cesarean birth was based on self-reported mode of delivery. Women who had a cesarean were asked to provide the main reason it was performed. If this was a medical reason, the cesarean delivery was classified accordingly (Table 1). We also created a measure of the nulliparous, term, singleton, vertex (NTSV) cesarean rate, based on the specifications used by the Joint Commission (The Joint Commission, 2012). Women were coded as having an NTSV cesarean if they reported the pregnancy as their first childbirth, they had a cesarean delivery, and did not report breech fetal position as the reason for the cesarean. The survey only included women with singleton births.

Employment—The exposure of interest was employment status during pregnancy, based on responses to the question: “Were you employed when you were pregnant?” We categorized responses as full-time employment (30 hours a week or more on average, $n = 632$), part-time employment (less than 30 hours a week on average, $n = 250$), self-employed ($n = 75$), or not being employed ($n = 616$) during pregnancy. Our primary focus was the difference between full-time employment and no employment, as sample sizes were limited for the examination of part-time employees and self-employed women. In addition, we hypothesized that the largest potential differences in study outcomes would occur between full-time employees and women who were not employed.

Covariates—Socio-demographic covariates were based on women's self-reports and included age, race/ethnicity, education, family income, country of birth, marital status, parity, pregnancy intention, use of fertility treatments, and pre-pregnancy obesity ($BMI > 30$). Women were asked whether they agreed with the statement that “birth is a process that should not be interfered with unless medically necessary,” and we created an indicator

variable for women who either agreed or strongly agreed. The survey also contained information on whether women perceived pressure from a medical provider to undergo induction or cesarean. Approximately 7% ($n = 110$) of respondents did not provide information on their family income. We used hot deck imputation, a method of substituting a value for a missing data point by randomly selecting a value from a pool of similar respondents in the dataset. Similar respondents were classified using age, race-ethnicity, region and marital status from which the imputation procedure selected values for income for those who did not report it. (Andridge & Little, 2010; Mander & Clayton, 1999; Reilly, 1993).

Analysis

We assessed the relationship between full-time employment during pregnancy and the odds of labor induction or cesarean delivery using logistic regression models. We conducted multivariate regression analysis using two different methodologies: 1) statistical controls for potential confounders and 2) propensity score matching. For both methods, women with planned cesarean deliveries were excluded from labor induction models, and women with medical reasons for either induction or cesarean were excluded from analyses for non-indicated procedures. As a result, the number of observations in each model ranged from 368 to 1248 in the unmatched sample and from 513 to 1254 in the matched sample.

Multivariate logistic regression analysis with statistical controls—Logistic regression models for study outcomes were specified using the following covariates: age, race/ethnicity, education, family income, country of birth, marital status, parity, pregnancy intention, use of fertility treatments, pre-pregnancy obesity, perceiving pressure from a clinician to undergo the procedure, and belief that birth is a process that should not be interfered with unless medically necessary.

A secondary analysis of this unmatched cohort focused on the question of whether employed women with higher socio-economic status have an elevated risk of cesarean delivery without definitive medical indication. We used level of education as measure of socio-economic status, consistent with prior studies (Blumenshine, Egerter, Barclay, Cubbin, & Braveman, 2010; Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010). This analysis utilized a similar multivariate regression model with an interaction term between full-time employment and having at least a bachelor's degree. An additional model, using completion of a graduate degree to signify high socio-economic status, yielded similar findings, results not shown.

Propensity score matched regression analysis—In order to isolate the impact of full-time prenatal employment on obstetric procedures, we created comparable groups of women who were employed full-time during pregnancy (exposed) with women who were not employed during pregnancy (unexposed) using propensity score matching. We estimated a propensity score for each woman, which represents the predicted probability of full-time employment, using logistic regression methods described in detail elsewhere ([blinded citation]). Recognizing the importance of prior experience with childbirth as a factor that may influence both employment and obstetric procedures, we paid particular attention to

achieving covariate balance in parity. After testing a range of specifications, our final models matched exposed women (with replacement) to unexposed women on estimated propensity scores, which range from 0 to 1, within a 0.025 caliper. That is, exposed women were matched within + or – 0.025 around the propensity score estimate for the unexposed women. We conducted sensitivity analyses around the propensity score model specification, caliper size (range 0.01-0.05), matching methodology, and weighting strategies in order to achieve covariate balance (D'Agostino, 1998; Hirano & Imbens, 2001; Oakes & Johnson, 2006; Rubin, 1997). In logistic regression models using the matched cohorts, we used clustered standard errors to account for correlation within matched pairs (Austin, 2008; Oakes & Johnson, 2006). The regression models using propensity score matched cohorts were specified using the following covariates: age, race/ethnicity, pre-pregnancy obesity, perceiving pressure from a clinician to undergo the procedure, belief that birth is a process that should not be interfered with unless medically necessary, whether the woman was a first-time mother, and income category. Income category was not included in the matching model because it is endogenous to the outcome (i.e., a result of employment, rather than a predictor of employment). Although race-ethnicity, parity, and age were also included in the propensity score matching model, we measures for these factors in regression models using the matched groups because they are known to be strong predictors of the study outcomes, as are obesity, perceived pressure from a clinician, and belief that intervention in childbirth should be avoided unless medically necessary (Bell, Zimmerman, & Diehr, 2008; Johnson, Oakes, & Anderton, 2008).

Analyses were conducted using Stata statistical software, version 12. All reported P-values are 2-sided.

Results

Descriptive characteristics of the study sample before and after matching are reported in Table 2. Prior to matching, pregnant women who were employed full-time during pregnancy were significantly different from those who were not employed across many characteristics. Pregnant women employed full-time were, on average, more educated and older than those who were not employed. Mean number of prior births (parity) among full-time employees was 1.8, compared with 2.4 among women who were not employed during pregnancy. A smaller proportion of women employed full-time during pregnancy had had a previous cesarean (12.8% vs. 19.8%), and a larger proportion had undergone fertility treatment to become pregnant (5.5% vs. 3.1%), compared with women who were not employed during pregnancy. After matching, there were no longer statistically significant differences in these characteristics between the two employment groups. About 32% of women in the matched group had some college education, and about a quarter had a bachelor's degree. Two-thirds of women in the matched sample were white. Over 60% were between age 25 and 34. In the matched groups, about 12% of women had had a previous cesarean delivery regardless of employment status, and mean parity in both groups was 1.8. Appendix 1 presents a figure summarizing this information, depicting the distribution of propensity scores in the two employment groups before and after matching.

Table 3 presents the distribution of key outcomes by employment group before and after matching. Rates of labor induction, both with and without a medical reason, were similar across employment groups before matching, with roughly 41% of women reporting having had their labor induced. Approximately one quarter of all women reported a medical reason for induction, and 15% had labor induction without a medical reason. In the unmatched, full sample, higher proportions of women who were employed full-time during pregnancy delivered by cesarean (34.3%), had a cesarean delivery without a medical reason (10.1%), and had a NTSV cesarean (12.3%), compared with women who were not employed during pregnancy (27.6%, 5.8% and 4.7%, respectively). After matching, there were no statistically significant differences in the bivariate relationship between employment status during pregnancy and most outcomes examined; however full-time employment remained associated with slightly higher rates of labor induction without a medical reason.

We examined the relationship between employment and outcomes in multivariate logistic regression analyses, shown in Table 4. We conducted analyses using traditional regression models with statistical controls for potential confounders (column I) and regression analysis after propensity score matching (column II). In the fully-adjusted traditional regression model, full-time employment during pregnancy was associated with greater odds of cesarean delivery (adjusted odds ratio (AOR) = 1.45, $p=0.046$) and also with greater odds of cesarean delivery without a medical reason (AOR=1.94, $p=0.024$). In the analysis using propensity-score matched groups (Column II), full-time employment during pregnancy was not statistically associated with any of the outcomes examined.

In the secondary analysis examining a possible interaction between full-time employment and having a college education, full-time employment remained positively associated with cesarean delivery without a medical reason (AOR=2.38, $p=0.010$), shown in Table 5. Education level was not associated with the outcome, and the interaction term was non-significant, indicating that the observed association between full-time employment and cesarean without medical reason is not driven by higher socioeconomic status women.

Discussion

Women employed full-time during pregnancy had 45% higher chances of a cesarean delivery and almost double the odds of having a cesarean without a medical reason, compared with women not employed during pregnancy, after controlling for socio-demographic factors. However, this effect was not present when we analyzed outcomes after matching women based on characteristics that predict full-time employment during pregnancy. This analysis revealed no differences in labor induction based on employment status, using either propensity-score matched or unmatched multivariate regression analyses. The ideal method to examine the causal relationship between prenatal employment and obstetric procedures would be a study in which pregnant women are randomized to pregnancy employment status, but this is not feasible, nor ethical. As such, we used propensity score matched analyses to mimic an experimental design and minimize selection bias by creating similar groups for comparative analysis. The fact that results differ based on whether we use a correlational or a causal model implies that while women employed during pregnancy have higher rates of non-indicated cesarean delivery (controlling for measured

socio-demographic factors), the story is more complicated than simply that prenatal employment causes women to have a greater likelihood of cesarean delivery.

Rather, women who are employed during pregnancy are different in important ways (many unmeasurable), and these differences - not their employment - may cause higher cesarean rates among employed women. Such differences may include personal factors, including individual values and preferences, the relative importance of a woman's identity as a mother and/or employee, financial or emotional stress, need and desire for full-time employment, expectations about the childbirth experience, and available social support for one's choices (Guendelman et al., 2009; Hung et al., 2002). However, given the trust women place in their maternity care clinicians and the myriad constraints on time, space, and decisions within a healthcare context, prior studies indicate that institutional policies, clinical management guidelines, and common practice may have a strong influence on the choices women have and the care they receive (Angood et al., 2010; Declercq, Sakala, Corry, Applebaum, & Herrlich, 2013). These health care systems factors may differ based on employment status or affect employed women differently than those who are not employed.

Unmeasured or omitted variables may cause bias in estimated relationships, but methods such as propensity score matching can be used to reduce the impact of such bias on an analysis by restricting inference to women who are comparable (or statistically exchangeable) on measured characteristics (Berger, Hill, & Waldfogel, 2005). In this analysis, the matching process attenuates the measured relationship between full time employment and cesarean delivery and creates a more transparent inference between employment itself and cesarean delivery. Yet, as the unmatched analysis shows, there appears to be an unmeasured association between *women* who are employed-full time during pregnancy and cesarean delivery, including cesarean delivery without medical reason. Furthermore, it appears that this relationship is not driven by highly educated women who are employed full-time. Future research should explore relevant personal characteristics associated with employment and cesarean delivery as well as health systems factors and other employment-related factors to inform clinical and policy interventions to support evidence-based care.

Implications for Policy and Practice

For employers, workplace-based supportive practices and policies – such as wellness programs, lactation rooms and support, flexible work times and schedules, parental and sick leave policies, and parent support groups – may accomplish several goals. First, such programs signal the value of healthy employees and families throughout pregnancy, childbirth and beyond; secondly, they provide practical antidotes to common stressors of pregnancy and early parenthood; and thirdly, they offer venues for building support and community among employees (Chatterji & Markowitz, 2012; [blinded citation]; Ruhm, 2011; Stomp-van den Berg et al., 2007). In addition, employers can work with health insurance plans to ensure that network clinicians and hospitals provide evidence-based maternity care, including judicious use of obstetric procedures to hasten delivery. One group currently promoting these types of partnerships between employers and insurers in service of improved quality is the Leapfrog group, which works to ensure greater transparency of

quality metrics (Austin et al., 2013; Binder, 2012). Finally, stakeholders such as employers and health insurers may wish to collaborate with clinicians to create and test educational interventions and decision aids with pregnant women and their partners to help guide prenatal and intrapartum conversations and choices (Stacey et al., 2011).

In the clinical setting, prenatal visits can provide an opportunity to address both medical and non-medical concerns that a pregnant woman may have about obstetric procedures and the timing of childbirth; these visits also offer a chance to utilize resources such as decision aids within a clinical context. Given the documented relationship between employment and maternal stress, mental health, resources, schedule control, and time management, clinicians may want to discuss employment-related concerns directly with women during prenatal visits (Bloom, Glass, Curry, Hernandez, & Houck, 2012; Chatterji, Markowitz, & Brooks-Gunn, 2013; Mutambudzi, Meyer, Warren, & Reisine, 2011). Addressing issues of planning and employment in early visits will allow time for dialogue and for questions to arise and be discussed.

Patient education and support efforts to address appropriate use of labor induction and cesarean delivery among employed women ought to take account of the broader factors – beyond the workplace – that shape the context in which women receive childbirth-related health care (American College of Obstetricians and Gynecologists, 2014; Main et al., 2012). The first step in aligning the care women receive with the best available evidence is for clinical guidelines in obstetrics to reflect that evidence, and recent studies show room for improvement in guideline development (Graham, Mancher, Miller Wolman, Greenfield, & Steinberg, 2011; Wright et al., 2011). Secondly, changing practice patterns requires a multi-pronged approach that addresses the opportunities and constraints within a hospital environment and can include administrative policy, payment reform, and other broad changes, many of which are increasingly accessible as health reform affects the U.S. healthcare delivery system (Catalyst for Payment Reform, n.d.; Chaillet & Dumont, 2007; Transforming Maternity Care Vision Team et al., 2010).

Strengths and Limitations

Although valuable for examining the relationship between employment and birth outcomes, secondary analysis of survey data entails limitations in measures and methods. First, our analyses relied on self-reported measures of use of and reasons for labor induction and cesarean delivery. Self-reports are prone to recall and reporting bias, and the dataset does not contain diagnostic codes or clinical assessments of medical conditions for validation purposes. Previously-published research distinguishing medically-indicated obstetric procedures generally relies on such data (Bailit et al., 2012; Spong et al., 2012), which were not available to us. Some important covariates, such as occupation or job characteristics, were not measured in this survey, which limited our ability to examine these facets of employment as independent predictors of obstetric procedure use. Some survey respondents did not provide income data, but we were able to retain cases by imputing values using validated imputation methods and conducting sensitivity analyses to ensure the stability of results (Reilly, 1993). Despite these limitations, this study makes several important contributions. It is among the first to explore prenatal employment as a predictor of obstetric

procedure use in a representative sample of U.S. childbearing women. It sheds light on the causal mechanism for this relationship, pointing not to employment, but to the unique characteristics and constraints faced by full-time employees as well as the health care systems factors that influence their care as likely predictors of elevated odds of cesarean delivery in this population.

Conclusion

Full-time prenatal employment is associated with higher odds of cesarean delivery, but this association no longer existed after accounting for socio-demographic differences by matching women employed full-time with similar women not employed during pregnancy. These results highlight the importance of evidence-based clinical care, patient education, and patient-provider communication regarding labor induction and cesarean birth, with a focus on the particular risks and benefits that may be perceived by employed women. With increasing national attention on reducing the primary cesarean rate (Declercq et al., 2006; Queenan, 2011; Scott, 2011; Spong et al., 2012), it is important to direct attention to both the workplace and the clinical setting as potential sites for education and intervention to improve the quality of maternity care that U.S. women receive.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Dr. Kozhimannil had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Appendix 1: Distribution of propensity Scores Before and After Matching

References

- Riley, LE.; Stark, AR., editors. AAP Committee on Fetus and Newborn & ACOG Committee on Obstetric Practice. Guidelines for Perinatal Care (AAP/ACOG). Seventh. American Academy of Pediatrics; 2012.
- ACOG Committee on Practice Bulletins - Obstetrics. ACOG Practice Bulletin No. 107: Induction of labor. *Obstetrics & Gynecology*. 2009; 114(107):386–397. [PubMed: 19623003]
- American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 394, December 2007. Cesarean delivery on maternal request. *Obstetrics & Gynecology*. 2007; 110(6):1501. [PubMed: 18055756]
- American College of Obstetricians and Gynecologists. Safe prevention of the primary cesarean delivery. *Obstetric Care Consensus No. 1. Obstetrics & Gynecology*. 2014; 123:693–711. [PubMed: 24553167]
- Andridge RR, Little RJA. A Review of Hot Deck Imputation for Survey Non-response. *International Statistical Review*. 2010; 78(1):40–64. [PubMed: 21743766]
- Angood PB, Armstrong EM, Ashton D, Burstin H, Corry MP, Delbanco SF, et al. Gullo SL. Blueprint for Action: Steps Toward a High-Quality, High-Value Maternity Care System. *Women's Health Issues*. 2010; 20:S18–S49. [PubMed: 20123180]

- Austin, J.; D'Andrea, G.; Birkmeyer, J.; Leape, L.; Milstein, A.; Pronovost, P.; et al. Wachter, R. Safety in Numbers: The Development of Leapfrog's Composite Patient Safety Score for U.S. Hospitals. *Journal of Patient Safety*. 2013. in press. Epub ahead of print retrieved November 23, 2013,, from <http://www.ncbi.nlm.nih.gov/pubmed/24080719>
- Austin PC. A critical appraisal of propensity score matching in the medical literature between 1996 and 2003. *Statistics in Medicine*. 2008; 27(12):2037–2049. [PubMed: 18038446]
- Authors. (2012). [Title omitted for blind peer review.]
- Bailit JL, Iams J, Silber A, Krew M, McKenna D, Marcotte M, Donovan E. Changes in the indications for scheduled births to reduce nonmedically indicated deliveries occurring before 39 weeks of gestation. *Obstetrics & Gynecology*. 2012; 120(2 Pt 1):241–5. [PubMed: 22825080]
- Baker M, Milligan K. Maternal employment, breastfeeding, and health: Evidence from maternity leave mandates. *Journal of Health Economics*. 2008; 27(4):871–887. [PubMed: 18387682]
- Barber EL, Lundsberg LS, Belanger K, Pettker CM, Funai EF, Illuzzi JL. Indications contributing to the increasing cesarean delivery rate. *Obstetrics & Gynecology*. 2011; 118(1):29–38. [PubMed: 21646928]
- Bell JF, Zimmerman FJ, Diehr PK. Maternal work and birth outcome disparities. *Maternal Child Health Journal*. 2008; 12(4):415–426. [PubMed: 17701331]
- Berger LM, Hill J, Waldfogel J. Maternity Leave, Early Maternal Employment and Child Health and Development in the US. *The Economic Journal*. 2005; 115(501):F29–F47.
- Berns, SD.; Kott, A. Toward Improving the Outcome of Pregnancy III: Enhancing Perinatal Health Through Quality, Safety and Performance Initiatives. White Plains, NY: March of Dimes National Foundation; 2010.
- Binder L. Dual problem of costs. Health systems face continuing challenges as both purchasers and providers. *Modern Healthcare*. 2012; 42(46):30–31. [PubMed: 23488041]
- Bloom T, Glass N, Curry MA, Hernandez R, Houck G. Maternal stress exposures, reactions, and priorities for stress reduction among low-income, urban women. *Journal of Midwifery & Women's Health*. 2012; 58(2):167–74.
- Blumenshine P, Egerter S, Barclay CJ, Cubbin C, Braveman PA. Socioeconomic disparities in adverse birth outcomes: a systematic review. *American Journal of Preventive Medicine*. 2010; 39(3):263–72. [PubMed: 20709259]
- Braveman P, Cubbin C, Egerter S, Williams D, Pamuk E. Socioeconomic disparities in health in the United States: what the patterns tell us. *American Journal of Public Health*. 2010; 100(Suppl):S186–S196. [PubMed: 20147693]
- Catalyst for Payment Reform. (n.d.). Maternity Care Payment. Action Brief. Catalyst for Payment Reform. <http://catalyzepaymentreform.org/images/documents/maternity>
- Chaillet N, Dumont A. Evidence-Based Strategies for Reducing Cesarean Section Rates: A Meta-Analysis. *Birth*. 2007; 34(1):53–64. [PubMed: 17324180]
- Chatterji P, Markowitz S. Family leave after childbirth and the mental health of new mothers. *The Journal of Mental Health Policy and Economics*. 2012; 15(2):61–76. [PubMed: 22813939]
- Chatterji P, Markowitz S, Brooks-Gunn J. Effects of early maternal employment on maternal health and well-being. *Journal of Population Economics*. 2013; 26(1):285–301. [PubMed: 23645972]
- Chescheir N, Menard MK. Scheduled Deliveries: Avoiding Iatrogenic Prematurity. *American Journal of Perinatology*. 2012; 29(1):27–33. [PubMed: 21861252]
- Childbirth Connection. (n.d.). Listening to Mothers Surveys and Reports. Retrieved February 20, 2013, from www.childbirthconnection.org/listeningtomothers/
- D'Agostino RB. Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Statistics in Medicine*. 1998; 2281(19):2265–2281. [PubMed: 9802183]
- Declercq E, Menacker F, MacDorman M. Maternal risk profiles and the primary cesarean rate in the United States, 1991–2002. *American Journal of Public Health*. 2006; 96(5):867–872. [PubMed: 16571712]
- Declercq E, Menacker F, MacDorman M. Maternal risk profiles and the primary cesarean rate in the United States, 1991–2002. *American Journal of Public Health*. 2006; 96(5):867–872. [PubMed: 16571712]

- Declercq, ER.; Sakala, C.; Corry, MP.; Applebaum, S. Listening to Mothers II: Report of the Second National Survey of Women's Childbearing Experiences. New York: Childbirth Connection; 2006.
- Ecker J, Frigoletto F. Cesarean Delivery and the Risk-Benefit Calculus. *New England Journal of Medicine*. 2007; 356(9):885–888. [PubMed: 17329693]
- Graham, R.; Mancher, M.; Miller Wolman, D.; Greenfield, S.; Steinberg, E. Clinical Practice Guidelines We Can Trust. Washington, D.C.: National Academies Press; 2011.
- Guendelman S, Pearl M, Graham S, Hubbard A, Hosang N, Kharrazi M. Maternity leave in the ninth month of pregnancy and birth outcomes among working women. *Women's Health Issues*. 2009; 19(1):30–37. [PubMed: 19111785]
- Hirano K, Imbens GW. Estimation of causal effects using propensity score weighting: An application to data on right heart catheterization. *Health Services and Outcomes Research Methodology*. 2001; 2(3):259–278.
- Hung S, Morrison DR, Whittington LA, Fein SB. Prepartum Work, Job Characteristics, and Risk of Cesarean Delivery. *Birth*. 2002; 29(1):10–17. [PubMed: 11843785]
- Johnson PJ, Oakes JM, Anderton DL. Neighborhood poverty and American Indian infant death: are the effects identifiable? *Annals of Epidemiology*. 2008; 18(7):552–559. [PubMed: 18504138]
- Johnson, TD. Current Population Report. Washington D.C: 2008. Maternity Leave and Employment Patterns of First-Time Mothers: 1961-2008; p. 70-113.
- Main EK, Morton CH, Melsop K, Hopkins D, Giuliani G, Gould JB. Creating a public agenda for maternity safety and quality in cesarean delivery. *Obstetrics & Gynecology*. 2012; 120(5):1194–8. [PubMed: 23090538]
- Mander A, Clayton D. Hotdeck imputation. *Stata Technical Bulletin*. 1999; 51:32–34.
- Martin JA, Hamilton BE, Ventura SJ, Osterman MJK, Wilson EC, Mathews TJ. Births : Final Data for 2010. *National Vital Statistics Reports*. 2012; 61(1):1990–2010.
- Mozurkewich E, Chilimigras J, Koepke E, Keeton K, King VJ. Indications for induction of labour: a best-evidence review. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2009; 116(5):626–36. [PubMed: 19191776]
- Mutambudzi M, Meyer JD, Warren N, Reisine S. Effects of psychosocial characteristics of work on pregnancy outcomes: a critical review. *Women & Health*. 2011; 51(3):279–97. [PubMed: 21547862]
- Oakes, JM.; Johnson, PJ. *Methods in Social Epidemiology*. San Francisco: Jossey-Bass; 2006. Propensity score matching for social epidemiology. In J. M. Oakes & J. S. Kaufman (Eds.); p. 370-392.
- Queenan JT. How to Stop the Relentless Rise in Cesarean. *Obstetrics & Gynecology*. 2011; 118(2): 199–200. [PubMed: 21775834]
- Reilly M. Data analysis using hot deck multiple imputation. *The Statistician*. 1993:307–313.
- Rubin DB. Estimating causal effects from large data sets using propensity scores. *Annals of Internal Medicine*. 1997; 127(8 Part 2):757–763. [PubMed: 9382394]
- Ruhm CJ. Policies to Assist Parents with Young Children. *Future Child*. 2011; 21(2):37–68. [PubMed: 22013628]
- Sakala C. Carol Sakala's letter from North America: an uncontrolled experiment: elective delivery predominates in the United States. *Birth*. 2006; 33(4):332–5. [PubMed: 17190018]
- Scott JR. Vaginal birth after cesarean delivery: a common-sense approach. *Obstetrics and Gynecology*. 2011; 118(2 Pt 1):342–50. [PubMed: 21775851]
- Spong CY, Berghella V, Saade GR, Wenstrom KD, Mercer BM. Preventing the First Cesarean Delivery. *Obstetrics & Gynecology*. 2012; 120(5):1181–1193. [PubMed: 23090537]
- Stacey D, Bennett CL, Barry MJ, Col NF, Eden KB, Holmes-Rovner M, Llewellyn-Thomas H, Lyddiatt A, Légaré F, Thomson R. Decision aids for people facing health treatment or screening decisions (Review). *Cochrane Database of Systematic Reviews*. 2011; (10)
- Stomp-van den Berg SGM, van Poppel MNM, Hendriksen IJM, Bruinvels DJ, Uegaki K, de Bruijne MC, van Mechelen W. Improving return-to-work after childbirth: design of the Mom@Work study, a randomised controlled trial and cohort study. *BMC Public Health*. 2007; 7:43. [PubMed: 17394629]

- Taylor H, Brenner J, Overmeyer G, Siegel JW, Terhanian G. Touchdown! Online polling scores big in November 2000. *Public Perspective*. 2001; 12:38–39.
- Terhanian G, Bremer J, Smith R, Thomas R. Correcting data from online surveys for the effects of nonrandom selection and nonrandom assignment. *Harris Interactive White Paper*. 2000:1–13.
- The Joint Commission. Measure Set: Perinatal Care (PC); Set Measure ID: PC-02. Specifications Manual for Joint Commission National Quality Measures (v2013A1). 2012. Retrieved February 20, 2013, from <https://manual.jointcommission.org/releases/TJC2013A/MIF0167.html>
- Carter M, Corry M, Delbanco S, Foster T, Friedland R, Simpson K. Transforming Maternity Care Vision Team. 2020 vision for a high-quality, high-value maternity care system. *Women's Health Issues*. 2010; 20(1 Suppl):S7–17. [PubMed: 20123185]
- Wong AE, Grobman WA. Medically Indicated — Iatrogenic Prematurity. *Clinics in Perinatology*. 2011; 38(3):423–439. [PubMed: 21890017]
- Wright JD, Pawar N, Gonzalez JSR, Lewin SN, Burke WM, Simpson LL, et al. Herzog TJ. Scientific evidence underlying the American College of Obstetricians and Gynecologists' practice bulletins. *Obstetrics & Gynecology*. 2011; 118(3):505–12. [PubMed: 21826038]
- Zelop C, Heffner LJ. The downside of cesarean delivery: short- and long-term complications. *Clinical Obstetrics and Gynecology*. 2004; 47(2):386–393. [PubMed: 15166862]

Biographies

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Table 1
Classification of reasons for labor induction and cesarean delivery reported by women who gave birth

<i>Labor induction</i>	
Medical reason	Not a clear medical reason
Gestational age >41.5 weeks gestation	Provider concerned infant overdue (at <41.5 weeks gestation) ^a
Provider concerned about size of infant	Woman lived significant distance from hospital
Provider worried infant wasn't doing well	Woman delivers fast and needed to be at hospital ^a
Labor was slow going, wanted it to progress	Water didn't break
Wasn't dilating fast enough	
Water had broken, fear of infection	Other reason, not sure, declined to answer
Woman had health problem requiring quick delivery	Woman wanted pregnancy over with
Woman was dilated	Woman wanted to control timing
Woman had contractions for extended period	Woman wanted to give birth with specific provider
Woman had difficulties in previous labor	Doctor induces all/most patients
Fluid retention issues	Close to due date, infant full term (at <41.5 weeks gestation)
Gestational diabetes	
<i>Cesarean delivery</i>	
Medical reason	Not a clear medical reason
Prior cesarean	Labor was taking too long ^a
Infant was in wrong position	Woman was exhausted ^a
Problem with placenta	Provider worried infant too big ^a
Toxemia	Woman thought it would help avoid incontinence
Pre-eclampsia	Past due date
Pelvis too narrow	No medical reason
Maternal medical reason	Other
Retaining fluid	
Fetal monitor showed problems	
Not contracting/dilating	
No progress pushing	

^a Reasons reclassified as "medical reasons" in sensitivity analysis.

Table 2
Characteristics of women, before and after matching, based on employment status during pregnancy

	Unmatched			Matched		
	Full time employment N=632	No employment N=616	P-value	Full time employment N=627	No employment N=627	P-value
<i>Education (%)</i>						
Less than H.S. diploma	1.3	6.3	<0.001	1.3	1.8	0.488
H.S. diploma	11.9	21.3	<0.001	12.0	12.9	0.608
Some college	32.0	37.7	0.035	32.2	32.5	0.904
Associate's degree	13.0	9.7	0.072	13.1	10.0	0.094
Bachelor's degree	24.8	16.7	<0.001	24.7	25.0	0.896
Some grad school	5.9	2.9	0.012	5.6	5.9	0.808
Graduate degree	11.2	5.4	<0.001	11.2	11.8	0.723
<i>Race (%)</i>						
White	66.8	68.8	0.437	67.1	66.7	0.857
Black	13.9	11.0	0.124	13.4	15.9	0.202
Hispanic	13.1	14.3	0.554	13.2	13.1	0.933
Other/multiple race	6.2	5.8	0.808	6.2	4.3	0.129
<i>Age category (%)</i>						
18-19	0.5	3.4	<0.001	0.5	0.2	0.317
20-24	15.2	22.9	0.001	15.3	18.7	0.114
25-29	37.8	31.0	0.011	38.1	36.0	0.448
30-34	30.7	27.4	0.205	30.5	27.0	0.170
35+	15.8	15.3	0.784	15.6	18.2	0.228
<i>Region (%)</i>						
Northeast	17.2	14.6	0.204	17.1	16.9	0.940
Midwest	26.7	25.3	0.569	26.6	26.6	1.000
South	36.9	37.0	0.957	37.0	38.1	0.683
West	19.1	23.1	0.091	19.3	18.3	0.665
Married (%)	75.5	76.3	0.734	75.9	75.1	0.743
Foreign born (%)	5.4	7.5	0.132	5.4	2.7	0.015
Parity (mean)	1.8	2.4	<0.001	1.8	1.8	0.976

	Unmatched			Matched		
	Full time employment N=632	No employment N=616	P-value	Full time employment N=627	No employment N=627	P-value
Unintended pregnancy (%)	38.6	42.5	0.158	38.4	42.3	0.167
Mistimed pregnancy (%)	30.9	33.6	0.299	30.6	34.1	0.185
Previous cesarean (%)	12.8	19.8	0.001	12.9	12.4	0.799
Fertility treatment (%)	5.5	3.1	0.033	5.3	3.7	0.172

Note: Bold indicates $p < 0.05$.

Table 3
Key outcomes (percentages) among women, before and after matching, based on employment status during pregnancy

	Unmatched			Matched		
	Full time employment N=632	No employment N=616	P-value	Full time employment N=627	No employment N=627	P-value
<i>Cesarean delivery (%)</i>						
Cesarean delivery with a medical reason	34.3	27.6	0.010	34.1	30.3	0.147
Cesarean delivery without a definitive medical reason	24.2	21.8	0.303	23.9	21.9	0.382
Cesarean delivery without a definitive medical reason	10.1	5.8	0.005	10.2	8.5	0.286
Nulliparous, term, singleton, vertex (NTSV) cesarean rate	12.3	4.7	<0.001	12.1	12.3	0.931
<i>Labor induction (%)</i>						
Labor induction with a medical reason	41.9	39.5	0.372	41.8	38.3	0.205
Labor induction without a definitive medical reason	28.2	22.7	0.028	27.9	22.5	0.027
	13.8	16.7	0.146	13.9	15.8	0.340

Note: Bold indicates p<0.05.

Table 4
Adjusted Odds of Labor Induction and Cesarean Delivery, by Employment Status, in
Unmatched and Propensity Score Matched Groups of Pregnant Women

Outcome	Odds of outcome for women employed full time during pregnancy (Ref=not employed)			
	I. Unmatched [†]		II. Matched [‡]	
	AOR	95% CI	AOR	95% CI
Cesarean delivery	1.45	(1.01, 2.09)	1.14	(0.78, 1.65)
Cesarean delivery with a medical reason	1.11	(0.77, 1.61)	1.01	(0.67, 1.12)
Cesarean delivery without a definitive medical reason	1.94	(1.09, 3.45)	1.50	(0.79, 2.87)
Nulliparous, term, singleton, vertex cesarean	1.76	(0.91, 3.40)	1.48	(0.70, 3.13)
Labor induction	0.95	(0.72, 1.25)	1.17	(0.76, 1.80)
Labor induction with a medical reason	1.17	(0.87, 1.57)	1.27	(0.80, 2.03)
Labor induction without a definitive medical reason	0.77	(0.53, 1.11)	0.96	(0.52, 1.78)

Note:

[†]Unmatched models are adjusted for age, race/ethnicity, income, education, parity, census region, marital status, nativity, unintended pregnancy, mistimed pregnancy, previous cesarean delivery, fertility treatment, pre-pregnancy obesity, belief in birth as a process not interfere with unless medically necessary, and perceived pressure for cesarean or induction.

[‡]The propensity score model used age, education, race, region, marital status, unintended pregnancy, mistimed pregnancy, fertility treatment, prior cesarean delivery, interaction between race and parity, interaction between parity and region, and interaction between age and marital status; model is additionally adjusted for age, race/ethnicity, income, first time mother, pre-pregnancy obesity, belief in birth as a process not interfere with unless medically necessary, and perceived pressure for cesarean or induction and used clustered standard errors to account for correlation within matched pairs.

Bold indicates $p < 0.05$.

Table 5
Adjusted Odds of Cesarean Delivery without a Definitive Medical Reason, by
Employment Status and Education Level (Unmatched cohort)

	AOR [†]	95% CI
Full-time employment	2.38	(1.23, 4.61)
College education or higher	0.89	(0.32, 2.49)
Full-time employment and college education or higher	0.59	(0.18, 1.94)

Note:

[†] Models are adjusted for age, race/ethnicity, income, parity, census region, marital status, nativity, unintended pregnancy, mistimed pregnancy, previous cesarean delivery, fertility treatment, pre-pregnancy obesity, belief in birth as a process not interfere with unless medically necessary, and perceived pressure for cesarean or induction.

Bold indicates p<0.05.