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Determinants of Cesarean Delivery in the U.S.: A Lifecourse Approach

Whitney P. Witt, PhD, MPH[a], **Lauren E. Wisk, PhD**[b], **Erika R. Cheng, PhD, MPA**[b], **Kara Mandell, MA**[b], **Debanjana Chatterjee, MA**[b], **Fathima Wakeel, MPH, PhD**[b], **Amy L. Godecker, PhD, MS**[b,c], and **Dakota Zarak**[b]

[a]Behavioral Health and Quality Research, Truven Health Analytics, Bethesda, MD

[b]Department of Population Health Sciences, University of Wisconsin School of Medicine and Public Health, Madison, WI

[c]The University of Wisconsin Carbone Cancer Center

Abstract

Objectives—This study takes a lifecourse approach to understanding the factors contributing to delivery methods in the United States by identifying preconception and pregnancy-related determinants of medically indicated and non-medically indicated Cesarean section (C-section).

Methods—Data are from the *Early Childhood Longitudinal Study-Birth Cohort*, a nationally representative, population-based survey of women delivering a live baby in 2001 (n=9,350).

Three delivery methods were examined: (1) vaginal delivery (reference); (2) medically indicated C-section; and (3) non-medically indicated C-section. Using multinomial logistic regression, we examined the role of sociodemographics, health, healthcare, stressful life events, pregnancy complications, and history of C-section on the odds of medically indicated and non-medically indicated C-section, compared to vaginal delivery.

Results—74.2% of women had a vaginal delivery, 11.6% had a non-medically indicated C-section, and 14.2% had a medically indicated C-section. Multivariable analyses revealed that prior C-section was the strongest predictor of both medically indicated and non-medically indicated C-sections. However, we find salient differences between the risk factors for indicated and non-indicated C-sections.

Conclusions—Surgical deliveries continue to occur at a high rate in the United States despite evidence that they increase the risk for morbidity and mortality among women and their children. Reducing the number of non-medically indicated C-sections is warranted to lower the short and long-term risks for deleterious health outcomes for women and their babies across the lifecourse. Healthcare providers should address the risk factors for medically indicated C-sections to optimize low-risk delivery methods and improve the survival, health, and well-being of children and their mothers.

Corresponding Author Whitney P. Witt, PhD, MPH, Department of Population Health Sciences, School of Medicine and Public Health, University of Wisconsin, Madison WI, 610 North Walnut Street, WARF Office 503, Madison, WI 53726, wwitt@wisc.edu.

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Keywords

Lifecourse; Cesarean section; Vaginal delivery; Stressful Life Events

INTRODUCTION

The prevalence of Cesarean section (C-section) among women in the United States (U.S.) has dramatically risen from 21% in 1997 to an unprecedented level of 33% in 2011 (1, 2); however, such surgery is often not medically necessary and poses serious short- and long-term health risks to the mother and baby (3-5). Furthermore, in the U.S., C-sections cost considerably more than vaginal deliveries (i.e., $12,739 versus $9,048, respectively, in 2010) (6) and are associated with elevated rates of postpartum medical care utilization and re-hospitalizations (7, 8). In addition to the significant health risks and costs associated with C-sections, the factors leading to C-sections versus vaginal delivery, particularly medically indicated C-sections compared to non-medically indicated C-sections (1), are not well understood.

This study takes a lifecourse approach to understanding the factors contributing to vaginal and medically indicated and non-medically indicated C-section deliveries in the U.S. As the lifecourse model posits that perinatal health is influenced by cumulative effects of events across the lifespan as well as intergenerational effects (9), preconception health has become an increasingly important concern for researchers and practitioners alike. Hence, our study evaluates both preconception and pregnancy-related determinants of delivery methods using data from the *Early Childhood Longitudinal Study-Birth Cohort* (ECLS-B), a nationally representative, population-based cohort of women and their babies. This research has important implications for clinical interventions and public health policies to prevent unnecessary C-sections and improve subsequent maternal and child health outcomes.

METHODS

Data are from the first wave of the *Early Childhood Longitudinal Study, Birth Cohort* (ECLS-B), a nationally representative cohort of children born in 2001 and their parents. The ECLS-B used a clustered, list frame design to select a nationally representative probability sample of the approximately four million children born in 2001, with oversampling of children from racial and ethnic minority groups, twins, and children born at very low and low birthweights, based on registered births from the National Center for Health Statistics vital statistics system (10). Children born to mothers under 15 years of age, those who were adopted after the birth certificate was issued, and those who did not survive until nine months of age were not included in the sampling frame. Over 14,000 births were sampled and contacted; from these sampled births, the final study cohort (consisting of completed nine month interviews) of 10,700 was formed when the children were approximately nine months old.

Restricted data for this study were obtained by permission and approval from the Institute for Education Sciences (IES) Data Security Office of the U.S. Department of Education, National Center for Education Statistics (NCES). In accordance with NCES guidelines, all reported unweighted sample sizes are rounded to the nearest 50. The University of Wisconsin-Madison Health Sciences Institutional Review Board considered this study exempt from review.

Participants were eligible for the present study if the main survey respondent was the biological mother of the infant (n=10,550); 450 additional records with missing birth certificate data were subsequently excluded. The ECLS-B included individual records for each child within twin pairs identified through oversampling; for this analysis, we randomly selected one twin from each pair to retain in the sample. For other multiples in the sample (i.e., not explicitly recruited as part of the oversampling), only one infant from in the household was surveyed. Our final sample included 9,350 mother-child dyads.

Measures

Delivery Method—Data from the birth certificate were used to determine if the method of delivery involved a C-section or a vaginal birth; women who delivered via C-section were further classified into two mutually exclusive groups: medically indicated C-section and non-medically indicated C-section (hereafter referred to as indicated and non-indicated C-section, respectively). Women who delivered via C-section and also had any labor complication or delivered a preterm (<37 weeks) baby were classified as having an indicated C-section. Labor complications were listed on the birth certificate and included: use of vacuum or forceps during delivery; fetal distress; dysfunctional labor; prolonged labor (>20 hours); precipitate labor (<3 hours); breech/malpresentation; cephalopelvic disproportion; cord prolapsed, febrile (>100° F); excessive bleeding; seizures during labor; anesthetic complications; and other labor complications. Women who delivered a term (≥37 weeks) baby via C-section without any labor complications were classified as having a non-indicated C-section.

Stress and Obstetric Factors—The date of conception was derived using information from the birth certificate on the length of gestation and date of birth of the index child. Women were coded as having experienced a stressful life event *prior* to conception (PSLE) if they indicated that one or more of the following events occurred *prior* to conception: (1) death of the respondent's mother; (2) death of the respondent's father; (3) death of a previous live born child; (4) divorce; (5) separation from partner; (6) death of a spouse; or (7) fertility problems. Women were coded as having experienced a SLE *in pregnancy* if they indicated that one or more of the following events occurred *during* their pregnancy: (1) death of the respondent's mother; (2) death of the respondent's father; (3) divorce; (4) separation from partner; or (5) death of a spouse.

Data from the birth certificate were used to determine if women had experienced any of the following pregnancy complications: anemia; diabetes; (oligo) hydramnios; hypertension during pregnancy; eclampsia; incompetent cervix; Rh sensitization; uterine bleeding; premature rupture of membranes; placental abruption; or placenta previa. Prepregnancy body mass index (BMI) was calculated from the respondent's measured height and self-report of weight prior to pregnancy (<18.5 [underweight]; between 18.5 and 24.9 [normal]; between 25 and 29.9 [overweight]; 30 or above [obese]; and unknown). In addition, we

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evaluated timing of initiation of prenatal care (in the first trimester; in the second or third trimester; or did not receive prenatal care), whether the index child was a singleton or multiple birth, number of prior live births (none; one; two or more), and if the current delivery was induced or stimulated. Data from the birth certificate also identified women who had chronic conditions (including: cardiac disease; lung disease; genital herpes; hemoglobinopathy; chronic hypertension; renal disease; or other medical risk factors), and women who had a prior live birth that was delivered via C-section.

Maternal Sociodemographic Factors—Maternal sociodemographic factors included: age (15-19; 20-24; 25-29; 30-34; or 35 years of age or older); race/ethnicity (white [non-Hispanic]; Black [non-Hispanic]; Asian/Pacific Islander [non-Hispanic]; other race [non-Hispanic]; or Hispanic); marital status at the infant's birth (married or living with partner; separated, divorced or widowed; or never married); health insurance coverage during pregnancy (no health insurance; any publicly funded insurance; or private health insurance coverage only); U.S. region of residence (Northeast; Midwest; South; or West); urbanicity (urban; suburban; or rural by Metropolitan Statistical Area [MSA] status); and socioeconomic status (SES). SES was defined using a five-category composite index (quintiles) generated by the NCES that incorporated the following household-level socioeconomic factors: (1) father/male guardian's education; (2) mother/female guardian's education; (3) father/male guardian's occupation; (4) mother/female guardian's occupation; and (5) household income.

Statistical Analyses

Analyses were conducted using survey procedures from SAS version 9.2 (Cary, NC). The standard errors were corrected due to clustering within strata and the primary sampling unit, and applied survey weights were used to produce estimates that accounted for the complex survey design, unequal probabilities of selection, and survey non-response. Summary statistics were generated to describe the sample characteristics; chisquare tests were used to determine significant differences in stress, obstetric, and maternal sociodemographic characteristics by delivery method. Multivariable multinomial logistic regression models were used to examine the impact of exposure to stress, obstetric, and maternal sociodemographic factors on delivery method, adjusting for all factors simultaneously.

We also performed a series of sensitivity analyses to investigate: (1) the count of PSLEs as a predictor of delivery method; and (2) the impact of exposure to stress, obstetric, and sociodemographic factors on delivery method for women delivering their first child. For these analyses, women were identified as first-time mothers if the birth certificate indicated no live-births prior to the current pregnancy (N=3,700). Multinomial logistic regression was used for both sensitivity analyses.

RESULTS

74.2% of women had a vaginal birth, 11.6% had a non-indicated C-section, and 14.2% had an indicated C-Section (Table 1; Figure 1). Women who delivered via indicated or non-indicated C-section were more likely to have experienced any PSLE than women who delivered vaginally (25.0%, 26.1% and 17.7%, respectively; overall p-value <.0001);

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however, there were no differences in stressful life events *during* pregnancy by delivery method. Compared with women delivering vaginally, women who had a non-indicated C-section were more likely to have had a prior C-section, one or more prior live births, be obese before pregnancy, or aged 35 or older. Women whose C-sections were indicated were more likely to have any pregnancy complication, any chronic condition, given birth to multiples, no prior live births, and were the least likely to live in the West compared to their counterparts who delivered vaginally.

In adjusted analyses (Table 2), women had significantly higher odds of delivering via non-indicated C-section if they had a prior C-section (Adjusted Odds Ratio [AOR]: 105.77, 95% Confidence Interval [CI]: 75.15-148.86), were obese prior to pregnancy, delivered multiples, or were age 20 or older. Women had significantly higher odds of delivering via indicated C-section than delivering vaginally if they experienced any PSLE (AOR: 1.38, 95% CI: 1.11-1.71), experienced any pregnancy complication, had a chronic condition, had a prior C-section, were obese prior to pregnancy, delivered multiples, were age 25 or older, or living in the South. The adjusted odds of delivering via non-indicated and indicated C-section were significantly lower when labor was induced or stimulated and for women with one or more prior live births. Stressful life events during pregnancy, timing of initiation of prenatal care, health insurance during pregnancy, maternal race/ethnicity, marital status, socioeconomic status, and urbanicity were not associated with delivery method, adjusting for other factors.

Sensitivity Analyses

Each additional PSLE was associated with a 23% increase in the odds of delivering via non-indicated C-section compared to delivering vaginally (AOR: 1.23, 95% CI: 1.04-1.47, data not shown). When the analyses were restricted to women delivering their first child, prepregnancy obesity, delivering multiples, and older age remained significant predictors of both indicated and non-indicated C-sections. Among first-time mothers, experiencing any pregnancy complication, having a chronic condition, or living in the South were associated with significantly higher odds of delivering via indicated C-section; having labor induced or stimulated or living in the Northeast was associated with significantly lower odds of delivering via non-indicated C-section. Notably, the effect of PSLEs on indicated C-section was modified by maternal age such that women aged 20-34 were more vulnerable to the effect of PSLEs, while younger (aged 15-19) and older (aged 35+) women experienced buffering against the effect (data not shown).

DISCUSSION

In the U.S., there has been a steep increase in C-section deliveries over the last decade (1, 2). However, little is known about the preconception and pregnancy-related determinants of medically versus non-medically indicated C-section deliveries. Using a nationally-representative sample of infants born in 2001, our study is the first, to our knowledge, to take a lifecourse perspective to understanding risk factors of C-section deliveries.

We estimate that 25.8% of U.S. mothers delivered via C-section in 2001, 45.0% of which were considered non-indicated by our criteria. Although some studies have found geographic (1), physician and clinic characteristics (11) and incentives (12) to be more

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predictive of delivery method than maternal characteristics, we identified several important maternal predictors of C-section, including prior C-section, obesity, delivery of multiples, labor induction/stimulation, increasing age, and parity. Previous research using U.S. birth certificate data from 1996-2006 found that C-section rates were highest for women who had a previous C-section and were 35 years and older. Higher parity (1), prepregnancy obesity (13), and antepartum depression (14) have also been associated with an increased risk for C-section, though these studies have not differentiated between indicated and non-indicated C-sections. The results of our study suggest that such a distinction between indicated and non-indicated C-section is particularly important for understanding the psychosocial determinants of C-sections.

In addition to sociodemographic predictors of C-sections, we identified PSLEs as a salient risk factor for indicated C-sections, despite the null association between PSLEs and non-indicated C-sections. In line with other studies that highlight the importance of preconception stress on adverse obstetric outcomes (15-19), it is possible that the experience of major life stressors prior to pregnancy may increase a woman's biological vulnerability to negative obstetric outcomes, which in turn may contribute to indications for medically necessary C-sections. Moreover, prior research suggests that stress impacts obstetric outcomes when environmental stimuli (e.g., PSLEs) overwhelm an individual's coping resources (20) and leads to subsequent physiological and behavioral responses (21-23), such as neuroendocrine and immune/inflammatory processes that are associated with pregnancy complications, (24) labor complications (25), and poor birth outcomes (21, 23, 26). As stressful life events *during* pregnancy were not related to delivery method, preventing adverse indications of C-sections may require the adoption of a lifecourse perspective (9) that emphasizes the relevance of the preconception period for influencing long-term health and obstetric outcomes.

Importantly, the financial costs of C-sections are not trivial, with such deliveries costing nearly $4,000 more than vaginal deliveries (6) and contributing to significant adverse health outcomes for mothers and their children. Therefore, reducing the annual rate of C-section delivery by ameliorating the effects of upstream predictors (such as PSLEs) is important from a financial standpoint, as well as a public health perspective. Assuming that a causal relationship exists and that our point estimates are accurate, we estimate that mitigating the effect of PSLEs on C-sections would have reduced the total number of C-sections among women who experienced any PSLE by 27,240 in 2001, saving approximately $101 million in C-section-related expenditures.[1] Reducing C-section rates also stands to lower future healthcare costs associated with additional adverse outcomes related to C-sections. Such potential future risks may include a longer maternal hospital stay, increased risks of respiratory problems for the infant, and complications in successive pregnancies (e.g., uterine rupture, placental implantation problems, and the need for hysterectomy) (27, 28).

[1]We estimated the total number of C-sections attributable to PSLEs by differencing the average marginal effect of PSLEs on C-sections under the assumption that all women with any PSLE became unexposed (note that this estimate amounts to 11% of all C-sections among women exposed to any PSLEs, or 2.8% of all C-sections). We then multiplied this number by the difference in allowed paid amount between vaginal and C-section delivery cited by Truven (6) ($3,691 per delivery) to obtain the total C-section-related expenditures associated with these deliveries.

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Such cost savings could be used to provide needed mental health services to help women cope with the immediate and long-term effects of PSLEs across the lifecourse.

Our study shows that the strongest predictor of any C-section was a prior C-section, suggesting that many women are at an increased risk for such negative outcomes due to avoidable repeat C-sections (28, 29). Particularly given the dramatic effect of having a prior C-section on non-indicated C-sections, women, providers, and health systems have a clear opportunity to lower the risk of non-optimal deliveries by adhering to ACOG recommendations (30). In fact, ACOG recently stated that: "Cesarean delivery on maternal request particularly is not recommended for women desiring several children, given that the risks of placenta previa, placenta accreta, and gravid hysterectomy increase with each cesarean delivery" (2013, p.1) (27). As such, providers should initiate discussions with women about their reproductive plans (e.g., desiring several children) and about the risks associated with repeat C-sections. Further, providers should continue this discussion with pregnant women even after they have a C-section, as Vaginal Birth after Cesarean (VBAC) is a viable option for many women. However, since 1996, the number of VBACs has declined substantially (31) and may even be unavailable in some clinical settings despite compelling evidence that a trial of labor after C-section is safe and successful for a majority of women, and recommended by professional guidelines (32, 33). Clearly, the empirical evidence and guidelines call for multilevel changes, including shared decision-making, a reexamination of provider incentives, and changes to hospital policy in order to promote the use of VBAC when appropriate.

Several potential limitations should be considered when interpreting our results. First, children who died before nine months of age were not included in the sampling frame of the ECLS-B. Second, data from the first wave of the ECLS-B (collected approximately nine-months postpartum) may be subject to recall bias. Third, data collected from the birth certificate may under or incorrectly report some information (e.g., labor complications), leading to misclassification (34). We also could not examine indications for C-section deliveries other than those indicated on the birth certificate. Further inquiry into factors leading to non-indicated C-section deliveries, including those associated with maternal request, hospital policy or pelvic preservation, is needed to further understand the degree to which C-sections are preventable. Finally, although consistent with a lifecourse perspective, the null relationship for C-section and stressful life events *during* pregnancy may have been due to the limited number of events that were evaluated and their low incidence given the relatively short time frame of pregnancy.

However, this study also has important strengths. To our knowledge, our study provides the most comprehensive evaluation of multiple maternal predictors of delivery method, separating indicated and non-indicated C-section, while utilizing a large, nationally representative, population-based cohort of newborns in the U.S. in 2001. The robust set of maternal predictors and population-based sample supports several important clinical and public health implications. First, our findings suggest that screening women for PSLEs and offering targeted interventions, including interventions that provide women with resources (e.g., mental healthcare) to cope with PSLEs (35), may be instrumental for lowering the risk of having an indicated C-section. Second, as our study provides further evidence that a prior

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C-section is the strongest predictor of a non-indicated C-section, greater awareness is needed among women and their healthcare providers about the deleterious risks associated with repeat C-sections in order to promote discussion and use of alternative options (e.g., VBAC) when safe and available. Finally, despite the short- and long-term risk and financial costs associated with C-sections, rates in the U.S. remain high; reducing the number of C-sections, both indicated and non-indicated, will likely require a coordinated effort to inform patients and providers about the upstream stress and obstetric factors that contribute to the odds of such surgery.

Conclusions

Surgical deliveries continue to occur at a high rate in the United States despite evidence that they increase medical spending, morbidity, and mortality among women and their children. Our population-based study adopted a lifecourse approach to provide a comprehensive assessment of multiple psychosocial and demographic determinants of medically indicated and non-medically indicated C-sections among U.S. women. We found salient differences between the risk factors for indicated and non-indicated C-sections. Our findings suggest that in order to improve the short- and long-term health of women and children and decrease unnecessary medical spending, multilevel and multifaceted changes may be needed to address the risk factors for both indicated and non-indicated C-sections. To reduce non-medically indicated C-section, it may be necessary to promote shared decision-making, educate patients and providers about best practice guidelines, and reexamine provider incentives and hospital policy. To reduce medically indicated C-section, clinical, programmatic, and policy interventions may need to address determinants of health prior to conception, including addressing the negative health consequences of stressful life events. Such multilevel, multifaceted interventions may improve delivery outcomes for, and the health trajectories of, women and their children.

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References

1. MacDorman MF, Menacker F, Declercq E. Cesarean birth in the United States: epidemiology, trends, and outcomes. Clin Perinatol. 2008; 35(2):293–307. [PubMed: 18456070]
2. Hamilton, B.; Martin, J.; Ventura, S. Natl Vital Stat Rep. Vol. 60. Hyattsville, MD: National Center for Health Statistics; 2011. Births: preliminary data for 2010; p. 2
3. Boutsikou T, Malamitsi-Puchner A. Caesarean section: impact on mother and child. Acta Paediatrica. 2011; 100(12):1518–1522. [PubMed: 21950660]
4. Pai M. Unnecessary medical interventions: Caesarean sections as a case study. Economic and Political Weekly. 2000; 35(31):2755–2761.
5. Soet, JE.; Brack, GA.; DiIorio, C. Birth. Vol. 30. Berkeley, Calif: 2003. Prevalence and predictors of women’s experience of psychological trauma during childbirth; p. 36-46.

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6. The cost of having a baby in the United States. Ann Arbor, MI: Truven Health Analytics; 2013. Available from: http://transform.childbirthconnection.org/wp-content/uploads/2013/01/Cost-of-Having-a-Baby1.pdf

7. Declercq E, Barger M, Cabral HJ, et al. Maternal outcomes associated with planned primary cesarean births compared with planned vaginal births. Obstet Gynecol. 2007; 109(3):669–677. [PubMed: 17329519]

8. Liu TC, Chen CS, Lin HC. Does elective caesarean section increase utilization of postpartum maternal medical care? Medical Care. 2008; 46(4):440–443. [PubMed: 18362825]

9. Halfon N, Hochstein M. Life course health development: an integrated framework for developing health, policy, and research. Milbank Quarterly. 2002; 80(3):433–479. [PubMed: 12233246]

10. Early Childhood Longitudinal Study, Birth Cohort, Nine-Month Data Collection. U S Department of Education, National Center For Education Statistics. Washington, D.C.: U.S. Department of Education, National Center For Education Statistics; 2001.

11. Kalish RB, McCullough L, Gupta M, et al. Intrapartum elective cesarean delivery: a previously unrecognized clinical entity. Obstet Gynecol. 2004; 103(6):1137–1141. [PubMed: 15172844]

12. Johnson, EM.; Rehavi, MM. Physicians treating physicians: Information and incentives in childbirth. Cambridge, MA: National Bureau of Economic Research; 2013. Available from: http://www.nber.org/papers/w19242

13. Chu S, Kim S, Schmid C, et al. Maternal obesity and risk of cesarean delivery: a meta - analysis. Obesity Reviews. 2007; 8(5):385–394. [PubMed: 17716296]

14. Bansil P, Kuklina EV, Meikle SF, et al. Maternal and fetal outcomes among women with depression. Journal of Women's Health. 2010; 19(2):329–334.

15. Khashan A, McNamee R, Abel K, et al. Rates of preterm birth following antenatal maternal exposure to severe life events: a population-based cohort study. Human Reproduction. 2009; 24(2):429–437. [PubMed: 19054778]

16. Khashan AS, McNamee R, Abel KM, et al. Reduced infant birthweight consequent upon maternal exposure to severe life events. Psychosom Med. 2008; 70(6):688–694. [PubMed: 18606728]

17. Class QA, Khashan AS, Lichtenstein P, et al. Maternal Stress and Infant Mortality: The Importance of the Preconception Period. Psych Science. 2013; 24(7):1309–1316.

18. Witt WP, Cheng ER, Wisk LE, et al. Maternal Stressful Life Events Prior to Conception and the Impact on Infant Birth Weight in the United States. AJPH. 2014; 104(S1):S81–S89.

19. Witt WP, Cheng ER, Wisk LE, et al. Preterm Birth in the United States: The Impact of Stressful Life Events Prior to Conception and Maternal Age. AJPH. 2014; 104(S1):S73–S80.

20. Cohen, S.; Williamson, GM. Perceived stress in a probability sample of the United States. In: Spacapan, S.; Oskamp, S., editors. The social psychology of health: Claremont Symposium on applied social psychology. Newbury Park, CA: Sage Publications; 1987. p. 31-49.

21. Dunkel-Schetter C. Psychological science on pregnancy: Stress processes, biopsychosocial models, and emerging research issues. Annu Rev Psychol. 2011; 62:531–558. [PubMed: 21126184]

22. McEwen BS. Stress, adaptation, and disease: Allostasis and allostatic load. Ann NY Acad Sci. 2006; 840(1):33–44. [PubMed: 9629234]

23. Wadhwa PD, Culhane JF, Rauh V, et al. Stress, infection and preterm birth: a biobehavioural perspective. Paediatr Perinat Epidemiol. 2001; 15(S2):17–29. [PubMed: 11520397]

24. Seng JS, Oakley DJ, Sampselle CM, et al. Posttraumatic stress disorder and pregnancy complications. Obstet Gynecol. 2001; 97(1):17–22. [PubMed: 11152900]

25. Da Costa D, Larouche J, Dritsa M, et al. Psychosocial correlates of prepartum and postpartum depressed mood. Journal of Affective Disorders. 2000; 59(1):31–40. [PubMed: 10814768]

26. Kramer MR, Hogue CJ, Dunlop AL, et al. Preconceptional stress and racial disparities in preterm birth: an overview. Acta Obstet Gynecol Scand. 2011; 90(12):1307–1316. [PubMed: 21446927]

27. The American Congress of Obstetricians and Gynecologists (ACOG) committee opinion no. 559. Cesarean delivery on maternal request. Obstetrics and gynecology. 2013; 121(4):904–907. [PubMed: 23635708]

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28. Grobman WA, Gersnoviez R, Landon MB, et al. Pregnancy outcomes for women with placenta previa in relation to the number of prior cesarean deliveries. Obstet Gynecol. 2007; 110(6):1249–1255. [PubMed: 18055717]
29. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. Obstet Gynecol. 2006; 107(6):1226–1232. [PubMed: 16738145]
30. Safe prevention of the primary cesarean delivery. Obstetric Care Consensus No. 1. American College of Obstetricians and Gynecologists. Obstet Gynecol. 2014; 210(3):179–193.
31. Cunningham, FG.; Bangdiwala, S.; Brown, S., et al. Vaginal birth after cesarean: New insights. National Institutes of Health Consensus Development Conference; 2010. p. 1279-1295.
32. Leeman LM, Beagle M, Espey E, et al. Diminishing Availability of Trial of Labor After Cesarean Delivery in New Mexico Hospitals. Obstet Gynecol. 2013; 122(2, Part 1):242–247. [PubMed: 23969790]
33. Roberts, RG.; Deutchman, M.; King, VJ., et al. Birth. Vol. 34. Berkeley, Calif: 2007. Changing policies on vaginal birth after cesarean: impact on access; p. 316-322.
34. Martin, J.; Hamilton, B.; Ventura, S., et al. Natl Vital Stat Rep. Vol. 61. Hyattsville, MD: National Center for Health Statistics; 2012. Births: Final data for 2010; p. 1
35. Wakeel F, Wisk L, Gee R, et al. The balance between stress and personal capital during pregnancy and the relationship with adverse obstetric outcomes: findings from the 2007 Los Angeles Mommy and Baby (LAMB) study. Arch Womens Ment Health. 2013; 16(6):435–451. [PubMed: 23812738]

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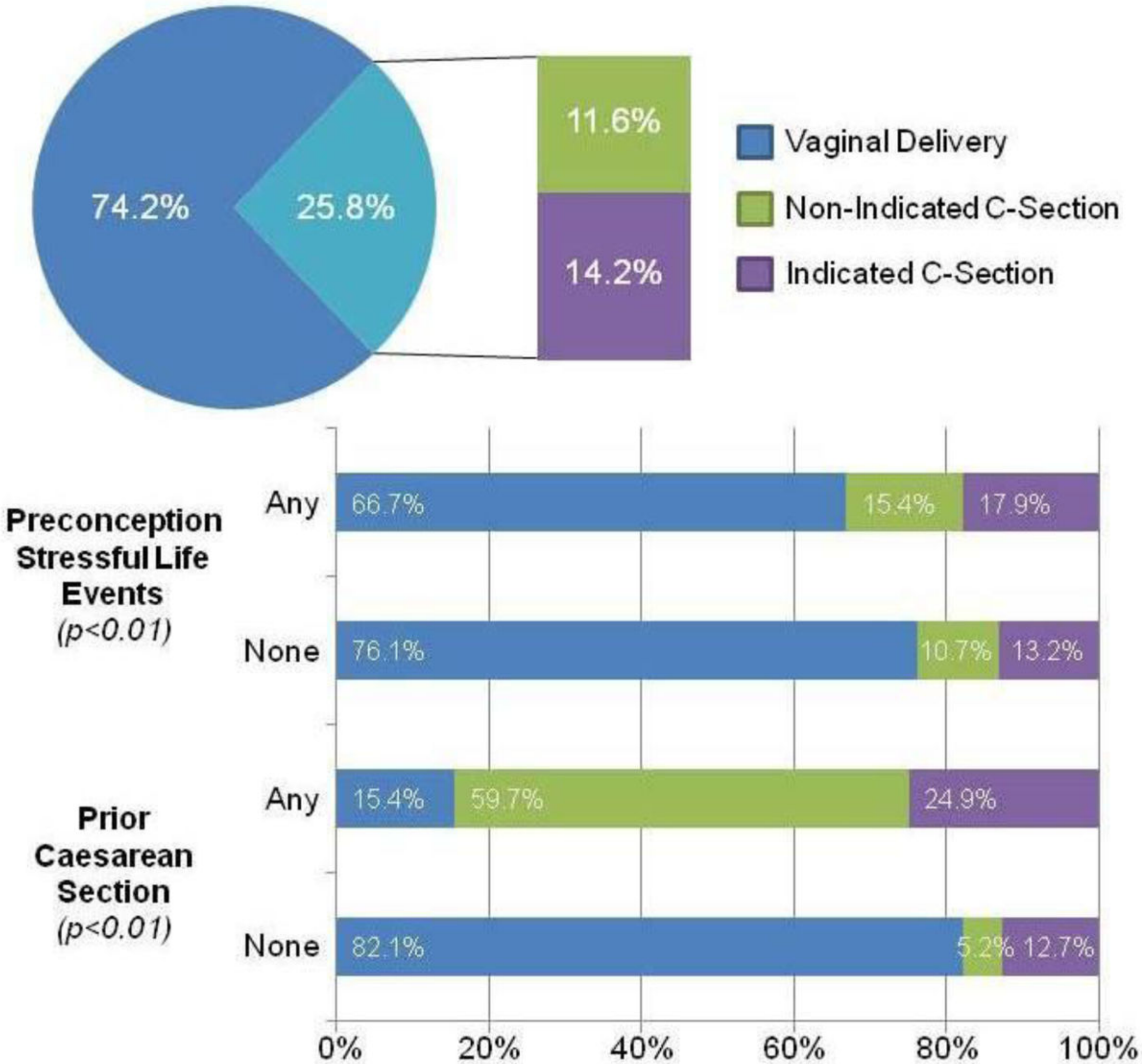

Figure 1. Distribution of Delivery Methods in the United States, 2001 Early Childhood Longitudinal Study-Birth Cohort (ECLS-B)

Weighted frequency distributions were used to examine the distribution of delivery methods for the full sample (pie chart) and by preconception stressful life events and prior Caesarean section (C-section) delivery (stacked bar chart). Sections shaded with dark blue represent the distribution of vaginal deliveries (74.2% overall), while green and purple represent the distribution of non-indicated and indicated C-sections, respectively. Survey weights were used to produce estimates that accounted for the complex survey design, unequal probabilities of selection, and survey non-response.

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Table 1

Descriptive Statistics by Delivery Method, Early Childhood Longitudinal Study-Birth Cohort (ECLS-B)-2001

		Delivery Method				
	Total	**Vaginal Delivery**	**Non-Indicated C-Section**	**Indicated C-Section**	**Overall p-value**	**Sub-group p-value**
TOTAL (weighted)	3,774,441	2,801,901	437,858	534,682		
%		74.2%	11.6%	14.2%		
TOTAL (unweighted)	9,350	6,400	900	2,000		
Stress and Obstetric Factors						
Preconception Stressful Life Events					<.01	
None	80.3%	82.3%	73.9%	75.0%		
Any	19.7%	17.7%	26.1%	25.0%		
Count (Mean)	0.22	0.20	0.31	0.28		
Stressful Life Events in Pregnancy					0.62	
None	94.2%	94.4%	93.5%	94.0%		
Any	5.8%	5.6%	6.5%	6.0%		
Pregnancy Complications					<.01	
None	86.4%	87.8%	87.5%	78.0%		
Any	13.6%	12.2%	12.5%	22.0%		
Chronic Conditions					<.01	
None	79.4%	80.4%	82.5%	72.0%		
Any	20.6%	19.6%	17.5%	28.0%		
Prior Caesarean Section					<.01	
None	88.2%	97.5%	39.2%	79.3%		
Any	11.8%	2.5%	60.8%	20.7%		
Prepregnancy Body Mass Index					<.01	
Underweight	3.3%	3.6%	1.9%	3.2%		0.10
Normal	49.5%	52.2%	41.7%	41.8%		<.01
Overweight	26.8%	26.9%	26.0%	27.0%		0.90
Obese	17.9%	15.1%	27.5%	24.4%		<.01
Unknown	2.5%	2.2%	2.9%	3.6%		0.07
Initiation of Prenatal Care					0.56	

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		Delivery Method				
	Total	Vaginal Delivery	Non-Indicated C-Section	Indicated C-Section	Overall p-value	Sub-group p-value
In the first trimester	95.5%	95.6%	95.9%	94.8%		0.53
In the second or third trimester	4.2%	4.1%	3.8%	4.6%		0.75
Did not receive prenatal care	0.3%	0.3%	0.3%	0.6%		0.30
Labor Induction/Stimulation					<.01	
Labor not induced or stimulated	64.2%	59.7%	87.3%	68.5%		
Labor induced or stimulated	35.8%	40.3%	12.7%	31.5%		
Number of Children Born					<.01	
Singleton	98.3%	99.2%	98.3%	93.4%		
Multiple	1.7%	0.8%	1.7%	6.6%		
Number of Prior Live Births					<.01	
None	40.7%	40.4%	26.5%	53.8%		<.01
One	32.8%	32.7%	43.2%	24.9%		<.01
Two or more	26.5%	26.9%	30.3%	21.3%		<.01
Sociodemographic Factors						
Age					<.01	
15-19 years	7.5%	8.3%	3.3%	6.4%		<.01
20-24 years	24.2%	25.6%	19.0%	21.3%		<.01
25-29 years	26.2%	26.4%	26.1%	25.6%		0.91
30-34 years	25.0%	24.8%	25.4%	25.5%		0.86
35+ years	17.1%	14.9%	26.2%	21.1%		<.01
Race/Ethnicity					0.67	
White, N-H	57.4%	57.7%	55.0%	57.3%		0.36
Black, N-H	14.1%	13.7%	15.8%	14.5%		0.24
Asian/Pacific Islander, N-H	3.5%	3.6%	2.9%	3.4%		0.18
Other, N-H	2.5%	2.5%	2.3%	2.4%		0.89
Hispanic	22.6%	22.4%	24.0%	22.4%		0.72
Marital Status (at birth)					0.14	
Married or living with partner	83.4%	83.1%	85.3%	83.6%		0.38
Separated/Divorced/Widowed	3.1%	2.9%	3.9%	3.3%		0.37
Never married	13.5%	14.1%	10.8%	13.1%		0.06

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		Delivery Method				
	Total	Vaginal Delivery	Non-Indicated C-Section	Indicated C-Section	Overall p-value	Sub-group p-value
Health Insurance Status					0.77	
Private Only	59.1%	59.0%	60.4%	58.6%		0.82
Any Public	37.4%	37.4%	36.1%	38.7%		0.69
None	3.4%	3.5%	3.5%	2.7%		0.53
Socioeconomic Status					0.06	
First quintile (lowest)	19.7%	20.3%	17.6%	18.4%		0.19
Second quintile	20.0%	20.4%	17.0%	20.2%		0.14
Third quintile	20.1%	19.4%	23.7%	20.5%		0.04
Fourth quintile	20.2%	19.6%	23.1%	20.7%		0.12
Fifth quintile (highest)	20.1%	20.3%	18.5%	20.2%		0.60
Region					0.03	
Northeast	17.1%	16.5%	16.3%	20.6%		0.07
Midwest	22.3%	22.7%	20.9%	21.2%		0.53
South	36.9%	36.0%	39.9%	39.1%		0.23
West	23.8%	24.8%	22.9%	19.1%		0.02
MSA Status					0.45	
Urban	73.8%	73.7%	73.0%	74.9%		0.73
Suburban	11.9%	12.1%	13.2%	10.0%		0.19
Rural	14.3%	14.2%	13.8%	15.0%		0.79

Data are from the 2001 Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) and are weighted to reflect the complex sampling design of the ECLS-B (unless otherwise noted). National Center for Education Statistics (NCES) rounding rules applied to unweighted Ns; unweighted subgroup Ns may not add to the total due to rounding. MSA = Metropolitan Statistical Area; N-H = Non-Hispanic.

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Table 2

Multinomial Logistic Regression Modeling Delivery Method Predicted by Stress, Obstetric and Sociodemographic Factors, Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), 2001

	Non-Indicated C-Section[a]			Indicated C-Section[a]		
	AOR	95% CI		AOR	95% CI	
<u>**Stress and Obstetric Factors**</u>						
Preconception Stressful Life Events						
None	1.00	Reference		1.00	Reference	
Any	1.19	0.85	1.67	1.38	1.11	1.71
Stressful Life Events in Pregnancy						
None	1.00	Reference		1.00	Reference	
Any	1.16	0.74	1.83	1.05	0.71	1.56
Pregnancy Complications						
None	1.00	Reference		1.00	Reference	
Any	0.98	0.71	1.36	1.64	1.35	2.00
Chronic Conditions						
None	1.00	Reference		1.00	Reference	
Any	0.81	0.60	1.09	1.35	1.11	1.65
Prior Caesarean Section						
None	1.00	Reference		1.00	Reference	
Any	105.77	75.15	148.86	19.50	14.58	26.06
Prepregnancy Body Mass Index						
Underweight	0.60	0.31	1.17	1.05	0.67	1.65
Normal	1.00	Reference		1.00	Reference	
Overweight	0.90	0.69	1.17	1.15	0.93	1.42
Obese	2.00	1.54	2.59	1.95	1.55	2.44
Unknown	1.36	0.65	2.84	1.92	1.22	3.04
Initiation of Prenatal Care						
In the first trimester	1.00	Reference		1.00	Reference	
In the second or third trimester	0.97	0.53	1.78	1.15	0.73	1.80
Did not receive prenatal care	0.70	0.10	5.12	1.29	0.22	7.67

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	Non-Indicated C-Section[a]			Indicated C-Section[a]		
	AOR	95% CI		AOR	95% CI	
Labor Induction/Stimulation						
Labor not induced or stimulated	1.00	Reference		1.00	Reference	
Labor induced or stimulated	0.33	0.24	0.46	0.68	0.57	0.82
Number of Children Born						
Singleton	1.00	Reference		1.00	Reference	
Multiple	4.35	2.94	6.43	13.83	11.51	16.60
Number of Prior Live Births						
None	1.00	Reference		1.00	Reference	
One	0.30	0.22	0.41	0.25	0.20	0.32
Two or more	0.16	0.11	0.22	0.17	0.13	0.23
Sociodemographic Factors						
Age						
15-19 years	1.00	Reference		1.00	Reference	
20-24 years	1.63	1.01	2.64	1.27	0.87	1.87
25-29 years	1.98	1.25	3.13	1.86	1.23	2.80
30-34 years	2.33	1.35	4.00	2.13	1.37	3.29
35+ years	3.99	2.39	6.65	3.13	1.96	4.97
Race/Ethnicity						
White, N-H	1.00	Reference		1.00	Reference	
Black, N-H	1.16	0.88	1.52	1.03	0.81	1.31
Asian/Pacific Islander, N-H	0.95	0.68	1.33	1.06	0.81	1.39
Other, N-H	0.73	0.42	1.29	0.82	0.49	1.37
Hispanic	1.12	0.83	1.49	1.07	0.83	1.38
Marital Status (at birth)						
Married or living with partner	1.00	Reference		1.00	Reference	
Se pa rated/Divorced/Widowed	1.01	0.48	2.09	1.05	0.56	1.95
Never married	0.80	0.56	1.14	0.80	0.60	1.05
Health Insurance Status						
Private Only	1.00	Reference		1.00	Reference	
Any Public	1.10	0.82	1.49	1.25	0.97	1.61

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	Non-Indicated C-Section[a]			Indicated C-Section[a]		
	AOR	95% CI		AOR	95% CI	
None	0.94	0.50	1.79	0.77	0.43	1.37
Socioeconomic Status						
First quintile (lowest)	1.13	0.66	1.93	1.19	0.83	1.70
Second quintile	1.17	0.80	1.71	1.34	0.97	1.85
Third quintile	1.34	0.94	1.93	1.25	0.96	1.62
Fourth quintile	1.26	0.89	1.77	1.11	0.84	1.48
Fifth quintile (highest)	1.00	Reference		1.00	Reference	
Region						
Northeast	0.81	0.51	1.27	1.25	0.92	1.69
Midwest	1.01	0.68	1.50	1.19	0.95	1.48
South	1.19	0.80	1.76	1.48	1.18	1.85
West	1.00	Reference		1.00	Reference	
MSA Status						
Urban	1.00	Reference		1.00	Reference	
Suburban	1.02	0.77	1.37	0.84	0.62	1.15
Rural	1.03	0.75	1.43	0.98	0.76	1.26

Data are from the 2001 Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) and are weighted to reflect the complex sampling design of the ECLS-B. AOR = Adjusted Odds Ratio; CI = Confidence Interval; MSA = Metropolitan Statistical Area; N-H = Non-Hispanic.

[a] Versus vaginal delivery