Risk-Adjusted Cesarean Section Rates for California Hospitals 1995 to 1997

Technical Report

Prepared by:

Beate Danielsen, PhD, Director, Health Information Solutions
Anne G. Castles, MA, MPH, Pacific Business Group on Health

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The Pacific Business Group on Health
The California Perinatal Quality of Care Collaborative

Sponsors

The Pacific Business Group on Health (PBGH)
PBGH is a business coalition of large California employers. PBGH's 32 large private and public sector purchasers represent approximately 2.5 million employees, dependents and retirees and $3 billion in annual health care expenditures. As of July 1999, PBGH also began to administer Pacific Health Advantage, a small employer purchasing pool representing 150,000 employees and dependents. PBGH's mission is to improve the quality of health care in California while moderating health care costs. PBGH's quality initiatives are designed to: 1) measure the quality of health care services provided by health plans, hospitals and physician groups and 2) institute marketplace incentives that motivate improvements in service delivery among those organizations. Examples of PBGH involvement in quality projects include the medical group-level Physician Value Check Survey to assess patient satisfaction, the health plan-level HEDIS measurement project, the hospital-level California CABG Mortality Reporting Program, and the Quality-Based Provider Payment Initiative designed to financially reward provider organizations that demonstrate superior performance.

The California Perinatal Quality of Care Collaborative (CPQCC)
CPQCC is a statewide partnership aimed at improving quality of care and outcomes for infants and mothers. CPQCC is committed to procuring timely and high-quality data on maternal and child health indicators, and using these data for determining benchmarks and promoting best practices and performance improvement in perinatal care and outcomes statewide. Members of the Collaborative include organizations such as the California Association of Neonatologists, the California Department of Health Services, the American College of Obstetrician Gynecologists, the Regional Perinatal Programs of California, and the Office of Statewide Health Planning and Development (OSHPD).

History of the Report
PBGH has monitored c-section rates in California since 1991. Previous PBGH c-section studies have focused on variation in practices among privately-insured patients by examining the ratios of observed to expected c-section rates. In 1999, CPQCC partnered with PBGH to build a more comprehensive analytic framework for scientifically evaluating cesarean section practices in California. PBGH and CPQCC would like to extend special thanks to the following CPQCC members for their extensive assistance in shaping and reviewing the analysis presented in this report:

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Executive Summary

The appropriate use of the cesarean section procedure has become a compelling quality of care issue. Sparking the debate was the observation that national c-section rates quadrupled between 1970 and 1987, from 6% to 24%. Subsequent research indicating significant variation in risk-adjusted cesarean section rates across hospitals—without apparent differences in outcome—suggested that the cesarean section procedure was being over-utilized. Moreover, studies showing variation in risk-adjusted c-section rates across geography, payer source and provider type created concerns that the decision to perform a c-section was not always based on clinical factors alone.

These findings highlighted potential quality of care issues and led the U.S. Public Health Service to set a target c-section rate of 15% for the year 2000. As the national c-section rate has gradually begun to drop, it has now been suggested that further reductions in the c-section rate could adversely impact maternal and infant outcomes. Unfortunately, efforts to study the association between perinatal health outcomes and delivery mode at the hospital level have been stymied by a lack of high-quality diagnostic data and challenges in developing measures of infant health that accurately reflect the quality of obstetric care.

Regardless of the current lack of consensus on the "right" c-section rate, some California hospitals continue to perform substantially more c-sections than would be expected, even after controlling for case mix. For example, in the period between 1995 and 1997, over one-third of California hospitals had risk-adjusted c-section rates of 25% or higher among their nulliparous patients. Moreover, substantial variation continues to be seen among California hospitals after controlling for case mix. In 1997, risk-adjusted c-section rates for nulliparous women ranged from 11% to 44% across California hospitals. The above findings have motivated efforts to continue analysis and reporting of delivery practices at individual hospitals.

This ***Technical Report*** describes in detail the methods used to develop risk-adjusted c-section rates for California hospitals. The companion ***Hospital Report*** presents the risk-adjusted c-section rates for all California hospitals with at least 10 deliveries in 1995, 1996 and 1997. These reports focus on nulliparous women, the group most logically targeted for reducing c-section rates over the long term. Promoting vaginal delivery among this group of women not only reduces the likelihood of a c-section for the primary delivery, but also for any future deliveries the woman may have. The reports are intended to stimulate discussion of best practices in delivery management among California hospitals, with a view to encouraging hospitals to review and adapt their own practices as necessary.

<u>Data</u>

The analysis was based on a linked database made up of data sets publicly available from the California Department of Health Services and the California Office of Statewide Health Planning and Development. The data sets linked included: the infant vital statistics birth record, the infant hospital discharge record, the maternal hospital discharge record, and any infant or maternal hospital discharge records reflecting re-hospitalizations or transfers. The linked database allowed evaluation of a rich set of clinical and demographic risk factors represented in the various individual data sets.

Study Population

The study population consisted of all deliveries of single live births in California civilian hospitals in 1995, 1996, and 1997 for whom the vital statistics birth record and the infant and maternal hospital discharge records could be linked. The total study population for the three-year period consisted of 1,521,226 deliveries at over 300 hospitals. The analysis of the nulliparous population serves as an example when describing the methodologies used in this report . The analyses for multiparous women, both with and without previous c-sections, are presented in the Appendix to this report.

Methods

Risk-adjustment models were developed for three strata of women: nulliparous, multiparous with no previous c-section, and multiparous with a previous c-section. Data elements were initially chosen for evaluation in the models based on the recommendations of an expert panel and a review of the relevant literature. Stepwise logistic regression was used to determine the subset of clinical and demographic variables to be included in each risk-adjustment model. The final logistic regression model was fit using the Probit link function. The final model was designed to include variables reflecting patient clinical and behavioral characteristics that predict the risk of a cesarean section, and exclude those variables reflecting provider practice decisions.

Results

In each of the three study years, average c-section rates were approximately 22% among nulliparous women. Between 1995 and 1997, one-third of California hospitals had c-section rates higher than 25% for nulliparous patients *after* adjusting for breech presentation, genital herpes, placental conditions, hypertension/eclampsia, birth weight, maternal age, post-term pregnancy, diabetes, oligohydramnios, premature rupture of membranes, anemia, prenatal care, race and education. 16.5% of hospitals had risk-adjusted c-section rates greater than 30%.

In 1997, among hospitals with at least 100 deliveries, the observed c-section rate for nulliparous women ranged from 9.5% to 39%. The risk-adjusted c-section rate for nulliparous women ranged from 11% to 44.1%. Variation in the c-section rate also differed among regions. Among nulliparous women between 1995 and 1997, only 0.6% of Bay Area hospitals had a risk-adjusted c-section rate greater than 30%. In contrast, 22% of Los Angeles Area hospitals and 21% of Central California hospitals had risk-adjusted c-section rates greater than 30%.

Hospital-Specific Results

The companion *Hospital Report* presents risk-adjusted c-section rates for California hospitals that performed at least 10 deliveries and three cesarean sections in the nulliparous population. Data for multiparous women, with and without previous c-sections, can be found on a companion website *(www.cpqcc.org/csection)*.

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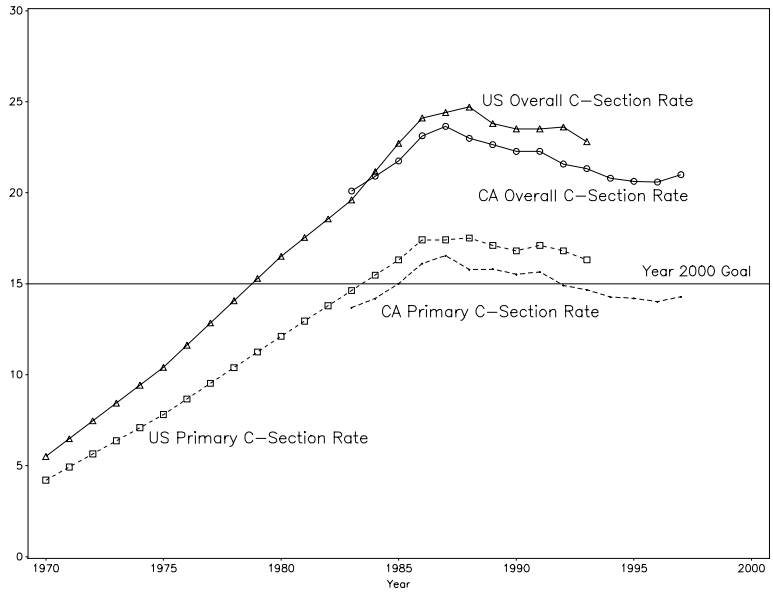
1 Introduction

The appropriate use of the cesarean section procedure has become a compelling quality of care issue over the last decade. Sparking the debate was the observation that national c-section rates had quadrupled between 1970 and 1987, from 5.5% to 24.4% (Figure 1) [1]. Subsequent research indicating significant variation in risk-adjusted cesarean section rates across hospitals—without apparent differences in outcome—suggested that the cesarean section procedure was being over-utilized [1] [2]. Moreover, studies showing variation in risk-adjusted c-section rates across geography, payer source and provider type created concerns that the decision to perform a c-section was not based on clinical factors alone [3] [4] [5] [6]. These findings highlighted potential quality of care issues and led the U.S. Public Health Service to set a target c-section rate of 15% for the year 2000 [1].

Figure 1: Overall and Primary Cesarean Section Rate, United States and California, 1970 to 1997



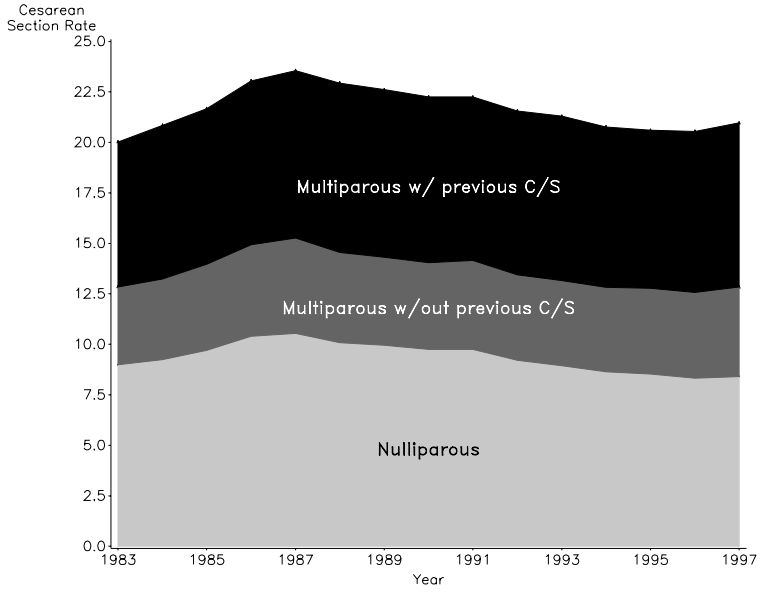
Notes:
The overall cesarean section rate was calculated as the ratio of all cesarean sections and to live births. The primary c-section rate was calculated as the ratio of cesarean sections to all live births among women with no previous cesarean section (i.e., nulliparous women were included).
Source: US rates: [1]; California rates: Vital Statistics Birth Files, 1983 to 1997, California Department of Health Services

Since 1987, the national c-section rate has slowly edged down to approximately 23% (1993). It has been suggested that after risk-adjusting for the changing composition of the California childbearing population, the reductions in the cesarean section rates in California were primarily due to an increase in the number of vaginal birth after c-section (VBAC).[7] A recent opinion article in the New England Journal of Medicine stated that further reductions in the c-section rate could adversely impact maternal and infant outcomes [8].

Complicating the debate over the appropriate use of c-sections is the lack of solid data about the infant health outcomes associated with the two modes of delivery. The sponsors of this report believe that it is important to report measures of infant health outcome in conjunction with risk-adjusted cesarean rates in order to more comphrehensively evaluate hospital performance. Several such measures were formulated as aprt of this work, but more research is needed to

develop measures that are methodologically-sound and that accurately reflect the quality of obstetric care.

Figure 2: Cesarean Section Rates, Overall and by Parity and Previous Cesarean Section, California, 1983 to 1997



Source: California Vital Statistics Birth Files, 1983 to 1997.

Regardless of the current lack of consensus on the "right" c-section rate, significant variations in the use of c-sections continue to be seen among California hospitals, even after controlling for clinical case mix. In 1997, risk-adjusted nulliparous c-section rates ranged from 11% to 44% across California hospitals. Between 1995 and 1997, over one quarter of California hospitals continued to perform c-sections on 25% or more of their nulliparous patients. One-third of California hospitals had *risk-adjusted* c-section rates higher than 25% for nulliparous patients. The above findings have motivated continued efforts to report on c-section practices at individual hospitals.

This report describes in detail the methods used to develop risk-adjusted c-section rates for all hospitals in California for the study years 1995, 1996 and 1997. Analyses of the nulliparous population serve as examples when describing the methodologies used in this report . The analyses for multiparous women, both with and without previous c-sections, are presented in the Appendix to this report. Hospital-level results can be found in the Hospital Report or on the companion website (www.cpqcc.org/csection).

2 Study Design

2.1 Data

This study was based on a linked database available upon request from the Office of Statewide Health Planning and Development (OSHPD), Health Information Policy Division. The study database was the result of a three-way match:

Infant Vital Statistics Birth Record (Birth Certificate) published by the California Department of Health Services (DHS)
↓
Newborn Discharge Record published by OSHPD
↓
Maternal Discharge Record published by OSHPD

For each vital statistics birth record, it was attempted to link:[1]

a) The infant hospital discharge record referring to the hospitalization at time of birth.

b) The maternal hospital discharge record referring to the hospitalization at time of delivery.

c) Infant hospital discharge records referring to any re-hospitalizations or transfers.

d) Maternal hospital discharge records referring to any prenatal or postnatal hospitalizations of the mother.

With this linked database, we were able to simultaneously evaluate risk factors and outcomes gathered by multiple data sources. For instance, the vital statistics data were used for obtaining socio-demographic and pregnancy-related data, although outcomes information available from these data was limited to birth weight and infant death. The maternal discharge record provided additional risk factors coded in the maternal hospital discharge record. The infant discharge record provided additional infant outcomes, e.g., length of stay, total charges, up to 25 diagnoses and up to 21 procedures, in addition to birth weight and infant death. Including infant re-hospitalization and transfer records enabled us to track an infant beyond the initial hospital stay. Because records for infants transferred immediately after birth are often incomplete, linking to the record that documents the infant stay at the second hospital allowed us to obtain a more complete picture of an infant's health.

2.2 Study Population

The study population consisted of all deliveries of single live births in California civilian hospitals reporting to the Office of Statewide Health Planning and Development in 1995, 1996, and 1997 for whom the vital statistics birth record, the infant hospital discharge record, and the maternal hospital discharge record could be linked. Note that we did not include multiple gestation deliveries since at this time the linkage for these cases has not yet been validated.[2] The study population for the three-year period consisted of 1,521,226 deliveries.

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[1] Deterministic methodologies were used to obtain the first two linkages. The linkage of the re-hospitalizations, transfers, maternal prenatal, and maternal postnatal hospitalizations was established using probabilistic linkage techniques. The discussion of the linkage techniques is beyond the scope of this report. Relevant documents can be obtained from published literature or OSHPD.[9, 10]

All linkages performed very well. In excess of 97% of neonatal records and in excess of 98% of maternal records referring to births in California civilian hospitals reporting to OSHPD were linked. The probabilistic linkages all had linkage percentages exceeding 95%.

[2] We excluded 20,225 multiple gestation deliveries in California civil hospitals from the study. The cesarean section rate for these deliveries was 60.84%. The unadjusted odds ratio for a cesarean section outcome for multiple compared to single births was 6.09 (lower 95% confidence limit: 5.92; upper 95% confidence limit: 6.27).

As all three databases included variables indicating delivery mode (vaginal vs. c-section), we calculated kappa values to evaluate the extent of agreement for this variable across databases.[3] Agreement was excellent with kappa values of 0.973 and 0.947 respectively when comparing 1) the vital statistics birth and maternal discharge data and 2) the vital statistics birth and infant discharge data. In order to ensure that women were conservatively designated as having had a c-section when there was disagreement among the three data sources, we compared the maternal mean length of stay for routine discharges for women in each of the following four groups:

Data Source for Cesarean Section Event	Number of C-Section Events	Mean Length of Stay
1. Infant vital statistics birth record only	2,038	1.7 days
2. Infant discharge record only	4,042	1.7 days
3. Both infant vital statistics and infant discharge record	1,971	3.2 days
4. Maternal discharge record only	1,346	2.8 days

Maternal mean length of stay was significantly higher for all four groups compared to the mean length of stay for women who had *vaginal delivery* reported in all three data sources (1.5 days). However, only groups 3 and 4 had a mean length of stay corresponding to an actual occurrence of a cesarean event. In order to minimize the possibility of attributing too many cesarean sections to a hospital, the following conservative decision rule was applied when the data sources disagreed on the c-section variable: if the maternal discharge record indicated a cesarean section or if the vital statistics birth and infant discharge record both indicated a cesarean section, we assigned the delivery mode as a 'cesarean section;' otherwise, we assigned the delivery mode as a 'vaginal delivery.'

The vital statistics birth record and maternal discharge record both indicated whether or not a multiparous woman had a previous cesarean section. The kappa value for agreement of this variable across the two databases was 0.788 indicating substantial agreement. We designated a woman as having had a previous cesarean section if either of the databases indicated so. Using this criterion, we determined that 2,807 (0.18%) deliveries to nulliparous women were also reported as having had a previous cesarean section. These records were excluded from the study.

Table 1 displays the at risk population, number of cesarean sections, and cesarean section rates by parity and previous delivery mode. Note that the overall statewide cesarean section rate was 20.3%, 20.8%, and 20.4% for 1995, 1996, and 1997 respectively.

Table 1: At Risk Population, Cesarean Sections, and Cesarean Section Rates by Study Strata

	Nulliparous			**Multiparous without previous cesarean section**			**Multiparous with previous cesarean section**		
	N	**Cesarean Deliveries**	**Cesarean Section Rate**	**N**	**Cesarean Deliveries**	**Cesarean Section Rate**	**N**	**Cesarean Deliveries**	**Cesarean Section Rate**
1995	205,287	45,081	21.96%	245,502	16,961	6.91%	69,124	43,578	63.04%
1996	196,792	42,814	21.76%	242,759	16,745	6.90%	68,597	43,142	62.89%
1997	190,356	41,514	21.81%	233,850	16,096	6.88%	66,137	42,628	64.45%
All years	592,435	129,409	21.84%	722,111	49,802	6.90%	203,858	129,348	63.45%

[3] For a discussion of kappa, see [11].

Table 2 displays the unadjusted odds ratios (OR) corresponding to the above data. For example, the *All Years* unadjusted odds ratio of 3.773 presented in the first column (Group 1 vs. Group 2) can be interpreted as follows: the likelihood of a nulliparous women undergoing a c-section was almost four times as high as that for a woman who had a previous vaginal delivery.

Table 2: Unadjusted Odds Ratios Reflecting Association of Parity and Delivery Mode of any Previous Births and Delivery Mode of Most Recent Delivery

	Group 1 vs. Group 2	Group 1 vs. Group 3	Group 2 vs. Group 1	Group 2 vs. Group 3	Group 3 vs. Group 1	Group 3 vs. Group 2
1995	3.792	0.165	0.264	0.044	6.062	22.986
1996	4.096	0.179	0.244	0.044	5.585	22.876
1997	3.773	0.154	0.265	0.041	6.501	24.531
All Years	3.773	0.161	0.265	0.043	6.211	23.435

Note: Group 1 refers to nulliparous women; Group 2 refers to multiparous women without a previous cesarean section; Group 3 refers to multiparous women with a previous cesarean section.

Previous studies have suggested fitting unique models based on maternal parity and prior mode of delivery.[12] In view of the findings presented in Table 1 and Table 2, we also decided to stratify the study population by parity and prior mode of delivery. Specifically, models were fit for: 1) nulliparous women; 2) multiparous women without a previous cesarean section; and 3) multiparous women with a previous cesarean section.

Note that the focus of this document is the group of nulliparous women. Analyses for the other two study groups are included in the Appendix. C-section rates for nulliparous women were highlighted for a number of reasons. First, significant hospital to hospital variation continues to exist for this group . Presentation of comparative c-section data for nulliparous women may therefore help hospitals gauge new opportunities to safely reduce their own cesarean section rates. Second, because nulliparous women are not at risk for rupturing a previous cesarean incision, in contrast to the group of multiparous women with a previous cesarean section, clinical indicators alone should predict the decision to perform a cesarean section. In other words, neither provider nor patient concerns about uterine rupture will play a role in determining the mode of delivery. Third, this is the group most logically targeted for quality improvement purposes in terms of reducing c-section rates over the long term. Promoting vaginal delivery among this group of women not only reduces the likelihood of a cesarean section in the first delivery, but also for any future deliveries the woman may undergo.

2.3 Methods

Cesarean Section Risk Adjustment Model.

In attempting to distinguish among health care organizations on the quality of care they deliver, it is important to develop risk-adjustment models that control for variables reflecting patient physiological, clinical or behavioral characteristics that predict the risk of an event—independent of care decisions made by the provider. Simultaneously, it is important to exclude from the model those variables that do reflect provider practice decisions.

The variables that were evaluated for inclusion in the risk adjustment model were the result of recommendations by a CPQCC expert panel and a review of the relevant literature.[12-19] A detailed list of variables and the form in which they were entered as well as all interaction terms tested are given in Table 11, Appendix Section 5.1. We used simple descriptive statistics and unadjusted odds ratios to evaluate the association between potential risk-adjustment variables and cesarean section risk in each of the three study groups and each of the three study years.

For each year and each of the three strata of women (nulliparous, multiparous with no previous cesarean section, multiparous with previous cesarean section), we evenly divided the population into an estimation and validation set. We then used stepwise logistic regression based on the estimation set to determine the subset of variables that should be included in a risk-adjustment model for the cesarean section outcome. The logistic regression model was fit using the Probit link function. We decided upon the final model by retaining all variables that had consistently entered the stepwise regression models with a statistically significant reduction of the log likelihood function (significance level = 0.05).

We obtained parameter estimates for all effects included in the models. Using the validation sample, we then verified whether parameter estimates fell within 90% confidence boundaries of those obtained using the estimation sample. All risk-adjustment models were further validated using R^2s and the area under the ROC curve (c-statistic). The Hosmer-Lemeshow test was used to assess the calibration properties of the models.

We refit the final models using all observations. The results were used to obtain the predicted probability of a cesarean section for each individual observation.[4]

Hospital-Specific Cesarean Section Rate Calculations

For each California hospital with at least 10 deliveries and 3 cesarean sections, we tabulated the *observed* and *risk-adjusted* cesarean section rates for the years 1995 through 1997. Risk-adjusted c-section rates were obtained by multiplying the *observed* hospital-level c-section rates by a casemix index. The casemix index was calculated as the ratio of the *observed statewide* c-section rate and the hospital-level *expected* c-section rate. The casemix index is larger than one if a hospital's casemix resulted in an *expected* c-section rate lower than the *observed statewide* c-section rate. In other words, if a hospital's casemix suggests that fewer c-sections are needed when compared to the statewide c-section rate, the casemix index will be greater than one, and will therefore scale up the *observed* hospital-level c-section rate to result in a higher *adjusted* c-section rate.

The estimation process is explained by three examples in Table 3. Columns (1) and (2) display the hospital-level and statewide *observed* c-section rates. Column (3) displays the *expected* c-section rate that was obtained for each hospital based on the logistic regression model for the hospital's casemix. The casemix index was obtained by dividing column (2) by column (3). The *risk-adjusted* c-section rate (column (6)) was obtained by multiplying column (1) by the casemix index in column (4).

Hospital A had an *expected* cesarean section rate of 28.9%, higher than the statewide cesarean section rate of 21.9%. Compared to the overall state population , this hospital's casemix might have included a larger percentage of breech babies or older mothers. That is, its casemix suggested that the hospital was likely to perform a greater number of cesarean sections. This is reflected by a casemix index of less than 1. The *observed* c-section rate was thus adjusted downward to result in a lower *risk-adjusted* cesarean section rate . In contrast, Hospital B had an *expected* c-section rate of 14.4%, suggesting a casemix that would result in fewer cesarean sections than if the statewide casemix prevailed at Hospital B. The casemix index was therefore larger than 1, and the *observed* c-section rate was scaled up to result in a higher *adjusted* rate.

The observed to expected ratio (O/E ratio) in the last column was obtained by dividing the observed number of c-sections by the expected number of c-sections which is equivalent to

[4] Note that the we obtained a final set of 9 models: three groups of women × three years of data.

dividing column 1 by column 3. An O/E ratio of less than 1 indicates that the hospital performed fewer cesarean sections than what would have been expected based on the statewide average; an O/E ratio of more than 1 indicates that the hospital performed more c-sections than what would have been expected based on the statewide average.

Table 3: Hypothetical Example of the Calculation for Hospital Risk-Adjusted Cesarean Section Rate

	Hospital Level Observed C-Section Rate (1)	California Observed C-Section Rate (2)	Hospital Level Expected C-Section Rate Derived from Logistic Regression (3)	Casemix Index (4) = (2)/(3)	Risk Adjusted C-Section Rate (5) = (1)*(4)	Observed to Expected (O/E) Ratio (6) = (1)/(3)
Provider A	25.5 %	21.9 %	28.9 %	0.76	19.4 %	0.88
Provider B	17.4 %	21.9 %	14.4 %	1.52	26.5 %	1.21
Provider C	22.1 %	21.9 %	21.9 %	1.00	22.1 %	1.01

The mathematical formulation of the calculation of risk-adjusted cesarean section rates and observed to expected ratios is outlined in Section 5.2.

3 Results

3.1 Descriptive Statistics for Covariates

Figure 3 and Figure 4 show the cesarean section rates by birth weight for all births and for the three strata respectively. In Figure 3, a u-shaped relationship between birth weight and the cesarean section rate is apparent, with an initial peak in the cesarean section rate for infants with birth weight between 750 and 1,000 grams, a trough at about 3,000 grams, and a second peak at the highest birth weights. Note that Figure 4 suggests that the u-shaped relationship varies among the three subgroups of women (nulliparous, multiparous without previous cesarean section, and multiparous with previous cesarean section).

Fitting a cubic term in birth weight to account for the initial upswing (under 500 to 750 gram category) was evaluated and subsequently rejected. Because only 6,407 (0.42%) infants over the three years fell into this category and the cubic term did not result in consistent results for the fitted model from year to year, it was decided not to include a cubic term for birth weight in the final model.

Figure 3: Cesarean Section Rates by Birth Weight, California, 1995-1997

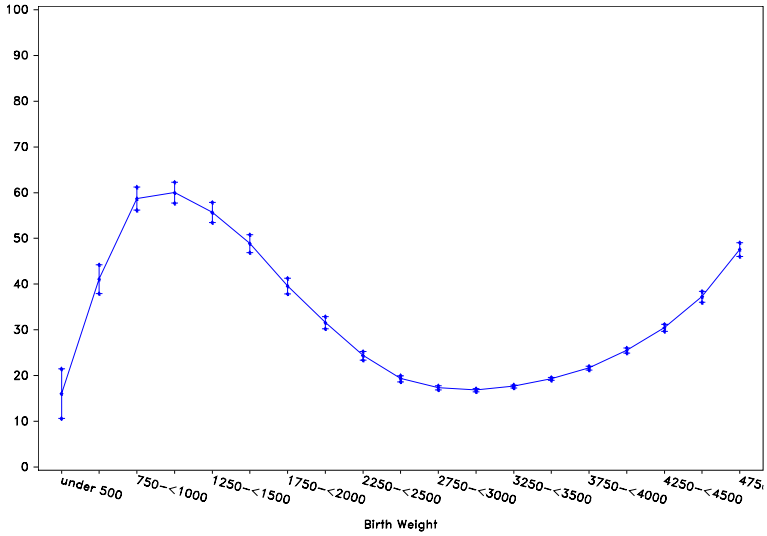
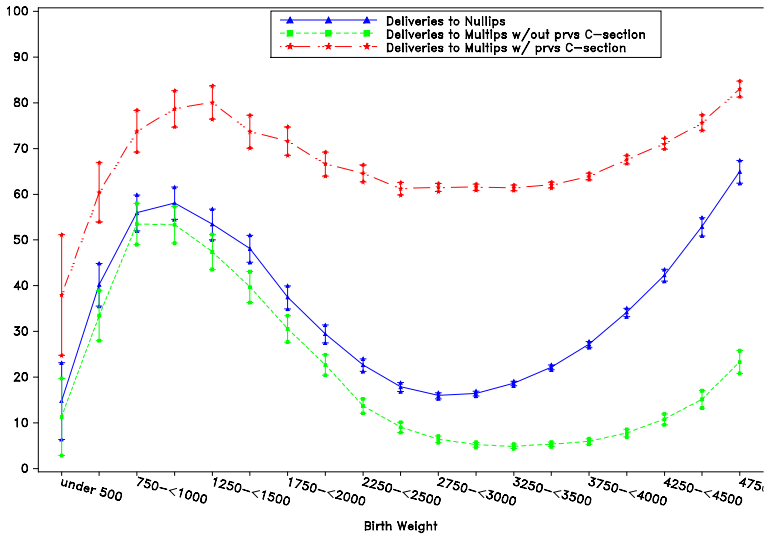


Figure 4: Cesarean Section Rates by Birth Weight, Parity, and Delivery Mode of Any Previous Delivery, California 1995-1997



Next, we evaluated the frequency, percent, and unadjusted odds ratio for cesarean sections by clinical and demographic characteristics. The variables evaluated were those that previous studies have associated with an increased risk of cesarean section and that were considered important by an expert panel. Table 4 displays the results for nulliparous women for all three study years combined. For the purpose of this summary, the aggregation over three years was considered appropriate since we found that the effect of each of the variables was similar from year to year. Table 12 and Table 13 in Section 5.3 show the equivalent tables for multiparous women with and without a previous cesarean section.

The unadjusted odds ratios for all clinical variables were statistically significant. The largest effect was observed among infants presenting as breech, a condition which resulted in a cesarean section in almost 100% of cases. A prolapsed cord led to the second largest effect. The next largest effects were observed for cases with active genital herpes and serious placental conditions.

Except for the variables *African American* and *Other Race*, the unadjusted odds ratios for the demographic variables were also statistically significant. Among all the demographic variables, maternal age had the largest impact on the likelihood of a cesarean section.

Also note that Table 3, Table 12, and Table 13 present the unadjusted odds ratio for a number of variables that--for reasons noted below--were ultimately not included in the final regression model. These variables include payer source, prolapsed cord and polyhydramnios.

The effect of each variable on the likelihood of a cesarean section met our expectations with one exception. We had anticipated that inadequate prenatal care would lead to an increase in the likelihood of a cesarean section. We found however that the opposite was true; inadequate prenatal care decreased the likelihood of a c-section—independent of the form in which the prenatal care variable was operationalized.

Interpreting Table 4: Using Anemia as an Example

Column 1 denotes the variable as defined in Section 5.1.

Column 2 presents the number of nulliparous women reported as anemic (50,027).

Column 3 presents the number of cesarean sections among nulliparous women reported as anemic (14,696).

Column 4 presents the cesarean section rate for nulliparous women reported as anemic (29.38%).

Column 5 presents the unadjusted odds ratio comparing the risk of a cesarean section in nulliparous women who were anemic to those who were not. If the odds ratio exceeds 1, the risk of a cesarean section is higher; if the odds is less than 1, the risk of a cesarean section is lower. A value of 1.55 in this table denotes that anemic nulliparous women are 55% more likely to have a c-section than nulliparous women who are not anemic.

Columns 6 and 7 show the lower and upper 95% confidence limits for the unadjusted odds ratio. If the lower 95% confidence limit exceeds 1, the listed covariate increases the risk of a cesarean section statistically significantly; if the upper 95% confidence limit is less than 1, the listed variable statistically significantly decreases the risk of a cesarean section.

Table 4: Frequency of Characteristics Among Nulliparous Women, Cesarean Section Rate, and Unadjusted Odds Ratio, California, 1995-1997 (N=592,435)

Covariate	Events	Number of Cesarean Sections	Cesarean Section Rate	Unadjusted Odds Ratio (OR)	Lower 95% CL for OR	Upper 95% CL for OR
Clinical Factors						
Anemia	50,027	14,696	29.38	1.55	1.52	1.58
Breech Presentation	23,050	22,195	96.29	111.9	104.48	119.85
Genital Herpes	2,749	1,799	65.44	6.86	6.34	7.42
Gestational Diabetes	14,523	5,343	36.79	2.13	2.06	2.2
Hypertension/Eclampsia/Pre-Eclampsia	43,053	17,106	39.73	2.57	2.51	2.62
Incompetent Cervix	1,349	415	30.76	1.59	1.42	1.79
Insulin-dependent Diabetes	2,715	1,424	52.45	3.98	3.69	4.29
Intrauterine Growth Retardation	8,856	3,408	38.48	2.27	2.18	2.37
Large for gestational age	29,016	12,262	42.26	2.79	2.72	2.86
Oligohydramnios	17,177	7,006	40.79	2.55	2.47	2.63
Placenta Abruptio/Previa	6,844	4,213	61.56	5.89	5.61	6.18
Polyhydramnios	1,498	870	58.08	4.98	4.5	5.52
Postterm	35,995	12,395	34.44	1.97	1.93	2.02

Prolapsed Cord	221	166	75.11	10.81	7.97	14.67
Premature Rupture of Membranes	14,188	4,542	32.01	1.71	1.65	1.77
Small for Gestational Age	10,185	3,114	30.57	1.59	1.52	1.66
Demographic Factors						
Maternal Age < 20	145,535	20,709	14.23	0.71	0.7	0.73
Maternal Age 20-<25	166,847	31,512	18.89	Reference Group		
Maternal Age 25-<30	138,896	32,764	23.59	1.33	1.3	1.35
Maternal Age 30-<35	95,396	27,268	28.58	1.72	1.69	1.75
Maternal Age 35-<40	37,973	13,710	36.1	2.43	2.37	2.49
Maternal Age >=40	7,788	3,446	44.25	3.41	3.25	3.57
No High School Degree (Mother)	173,067	31,990	18.48	0.75	0.74	0.76
No High School Degree (Father)	138,469	27,135	19.6	0.84	0.83	0.85
Inadequate PNC initialization (Kotelchuck)	18,861	3,232	17.14	0.73	0.71	0.76
Onset of PNC after first trimester	108,237	19,805	18.3	0.77	0.75	0.78
Inadequate frequency of PNC visits (Kotelchuck)	17,505	3,122	17.83	0.77	0.74	0.8
Inadequate PNC (Kotelchuck)	66,463	11,897	17.9	0.76	0.74	0.77
No prenatal care	3,552	544	15.32	0.65	0.59	0.71
MediCal	265,816	54,267	20.42	0.76	0.74	0.77
Private Insurance	114,075	28,774	25.22	Reference Group		
Managed Care Plan	197,582	43,463	22.00	0.83	0.82	0.85
Uninsured/Self Pay	14,362	2,806	19.54	0.72	0.69	0.75
Other Source	600	99	16.5	0.58	0.47	0.72
Non-Hispanic White	222,729	51,114	22.95	Reference Group		
Hispanic	258,490	53,387	20.65	0.87	0.86	0.89
African American	39,562	9,242	23.36	1.02	1	1.05
South East Asian	13,139	2,457	18.7	0.77	0.74	0.81
Other Asian	37,399	8,294	22.18	0.96	0.93	0.98
Other Race	21,116	4,915	23.28	1.02	0.99	1.05

Note: CL: Confidence Limit; PNC: Prenatal Care

3.2 Stepwise Logistic Procedures

Table 5 shows results for the stepwise logistic regression based on the 1997 estimation set for nulliparous women. For the stepwise procedures we forced birth weight (two terms), a quadratic term in birth weight, and maternal age (five terms) into all models. For this reason, the first position at which any of the subsequent variables could enter into the model was 8.

The Probit function was used to fit the logistic regression models. While using a Logit link led to similar validation results, the calibration was worse compared to models using the Probit function. For all stepwise selections, breech presentation was always the first variable added. It also accounted for the largest increase in the coefficient of determination (R^2). For instance, in Table 4, breech presentation accounts for 77% of the final R^2 achieved.

As noted above, the risk-adjustment model was designed to control for those variables reflecting underlying patient clinical characteristics that increase the risk of a cesarean section, and exclude those variables that reflect provider practice decisions. As such, a number of variables were excluded from evaluation in the stepwise logistic regression, in spite of an unadjusted odds ratios suggesting a significant association with the risk of a cesarean event. The variable for payer source is one example. Although the unadjusted odds ratio for the payer source variable is

significant, a patient's insurance coverage should not be related to the mode of delivery, and it was therefore excluded.

Due to a small number of cases and definitional difficulties, the additional following variables were not evaluated in the stepwise procedures: incompetent cervix, prolapsed cord, and polyhydramnios. Prolapsed cord was further excluded because it may indicate a provider practice decision (rupture of the membranes when the head is too high) rather than an underlying patient characteristic.

As suggested in the previous section, the clinical variables were of far greater importance than the demographic variables. For instance, in Table 5, the first 12 variables that were entered into the model were all clinical variables leading to an generalized R^2 of 0.2871. Adding the remaining 13 variables into the model, 7 of which were demographic variables, improved the generalized R^2 by only 0.0073. Results for the other years and other groups are shown in the Appendix (Section 5.4).

Table 5: Results of Stepwise Logistic Regression, Estimation Set, Nulliparous Women, 1997

Variable	Position Entered	χ^2-Score	p-value	R^2	Generalized R^2
Breech Presentation	8	8039.20	0.0001	0.1467	0.2254
Hypertension/Eclampsia/Pre-Eclampsia	9	1384.90	0.0001	0.1590	0.2444
Placenta Abruptio, Placenta Previa	10	821.20	0.0001	0.1665	0.2560
Postterm Pregnancy	11	531.70	0.0001	0.1712	0.2631
Breech and Birth Weight < 1,500 grams	12	453.10	0.0001	0.1747	0.2685
Oligohydramnios	13	331.10	0.0001	0.1775	0.2729
Genital Herpes	14	325.70	0.0001	0.1805	0.2774
Premature Rupture of Membranes	15	214.90	0.0001	0.1823	0.2802
Anemia	16	155.90	0.0001	0.1837	0.2823
Large for Gestational Age	17	140.40	0.0001	0.1849	0.2842
Insulin-dependent Diabetes	18	111.70	0.0001	0.1859	0.2857
Intrauterine Growth Retardation	19	105.50	0.0001	0.1868	0.2871
Hispanic	20	106.90	0.0001	0.1877	0.2886
African American	21	127.80	0.0001	0.1889	0.2903
Hypertension and Birth Weight < 1,500 grams	22	87.50	0.0001	0.1897	0.2916
Hypertension and Birth Weight 1,500-<2,500 grams	23	63.81	0.0001	0.1903	0.2924
Gestational Diabetes	24	61.46	0.0001	0.1908	0.2933
Other Race	25	27.82	0.0001	0.1910	0.2936
Hypertension and Oligohydramnios	26	16.63	0.0001	0.1912	0.2938
No High School Degree (Mother)	27	12.84	0.0003	0.1913	0.2940
Native American	28	7.66	0.0057	0.1914	0.2941
Breech and Birth Weight 1,500-<2,500 grams	29	5.72	0.0168	0.1914	0.2942
Hypertension and Black	30	5.59	0.018	0.1914	0.2943
Hispanic and Maternal Age < 20	31	5.16	0.0231	0.1915	0.2943
Other Asian	32	4.30	0.0381	0.1915	0.2944

1. Variables are shown in the order in which they were entered into the model.
2. The χ^2-score shows the value of the χ^2-statistic used to test the hypothesis that the coefficient associated with the variable is zero.
3. For the generalized coefficient of determination, generalized R^2, the simple R^2 is scaled such that it can achieve the value 1. For a more detailed description of the generalized coefficient of determination, see [20], [21].

3.3 Final Regression Models

3.3.1 Model Validation

Based on the stepwise logistic regression results, we formulated the final model. In the next step, we evaluated the predictive validity of the model: that is, how well does the model predict the outcome of interest. We estimated the coefficients for each covariate in the final model using the estimation set. In order to validate these estimates, we verified whether coefficients estimated based on the validation set were within 90% confidence limits of those parameter estimates obtained from the estimation set. The results of this step are shown in Table 6. For easier reading, we have bolded those parameter coefficients that could not be validated. For all three years for which regressions were validated, only 12 coefficients could not be validated, two of which pertained to non-significant effects. We checked the affected coefficients for the validation sample and found that 1) they all were also considered significant and 2) they indicated an effect in the same direction. Note that the results shown are based on the Probit link. We also attempted to fit models using the Logit link, however, while model validation was similar, model calibration was considerably better using the Probit link function.

Table 6: Validation of Final Logistic Regression Model, Nulliparous Women, California, 1995-1997

		1995			1996			1997		
Characteristic		**Odds Ratio**	**Significance**	**Validation**	**Odds Ratio**	**Significance**	**Validation**	**Odds Ratio**	**Significance**	**Validation**
	Birth Weight	0.71	***	Y	0.74	***	Y	0.7	***	Y
	Birth Weight*Birth Weight	1.02	***	Y	1.02	***	Y	1.02	***	Y
Maternal Age	Under 20	0.76	***	Y	0.73	***	Y	0.69	***	**N**
	20 to under 25	Reference Group								
	25 to under 30	1.34	***	Y	1.27	***	Y	1.32	***	Y
	30 to under 35	1.73	***	Y	1.69	***	Y	1.7	***	Y
	35 to under 40	2.39	***	Y	2.27	***	Y	2.43	***	Y
	40 or older	3.31	***	Y	3.21	***	Y	3.42	***	Y
High School	Completed	Reference Group								
	Not Completed	1.06	***	**N**	1.08	***	Y	1.08	***	Y
Prenatal Care	Some	Reference Group								
	None	0.66	***	Y	0.69	**	Y	0.85		**N**
Race/Ethnicity	Non-Hispanic White	Reference Group								
	Hispanic	1.32	***	Y	1.33	***	Y	1.29	***	Y
	African American	1.71	***	Y	1.61	***	Y	1.52	***	**N**
	Native American	1.58	***	**N**	1.25		Y	1.42	***	Y
	South East Asian	1.05		**N**	1.05		Y	1.06		Y
	Other Asian	1.06		Y	1.1	***	Y	1.07	*	**N**
	Other Race	1.32	***	Y	1.35	***	Y	1.28	***	Y
Clinical Factors	Breech Presentation	1132.67	***	Y	1344.14	***	Y	1334.82	***	Y
	Anemia	1.36	***	Y	1.4	***	Y	1.36	***	Y
	Large for Gestational Age	1.42	***	**N**	1.39	***	Y	1.42	***	Y
	Insulin-dependent Diabetes	2.26	***	Y	2.37	***	Y	3.12	***	Y
	Gestational Diabetes	1.54	***	Y	1.57	***	Y	1.43	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension	2.62	***	Y	2.46	***	Y	2.5	***	Y
	Genital Herpes	12.46	***	**N**	9.15	***	Y	7.15	***	Y
	Intrauterine Growth Retardation	1.66	***	Y	1.66	***	Y	1.63	***	Y

	Oligohydramnios	2.36	***	Y	2.23	***	Y	2.17	***	Y
	Premature Rupture of Membranes	1.86	***	Y	1.98	***	Y	1.83	***	Y
	Placenta Abruptio/Previa	7.02	***	Y	6.48	***	Y	7.86	***	Y
	Postterm Baby	2.04	***	**N**	1.91	***	Y	1.99	***	Y
Interaction Terms	Hypertension and Oligohydramnios	0.42	***	**N**	0.55	***	Y	0.56	***	Y
	Breech Presentation and Birth Weight 1,500-<2,500 grams	0.48	***	Y	0.45	***	Y	0.61	*	Y
	Breech Presentation and Birth Weight <1,500 grams	0.03	***	Y	0.02	***	Y	0.02	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension and Birth weight 1,500-	1.87	***	Y	1.8	***	Y	1.95	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension and Birth weight <1,500	6.04	***	Y	8.65	***	**N**	8.17	***	Y

Note: Since we have fitted logistic models using the Probit link function, the odds ratio shown in the table was not estimated directly by the model. Instead it is based on the estimated probabilities obtained from the Probit model.

The next step in the validation process was the calculation of the c-statistics, or equivalently the area under the receiver-operator curve (ROC) and the calculation of the generalized coefficient of determination of the final model.[21] [22] [20]

We calculated the c-statistic for the following situations:

a) the observed values from the estimation set and the predicted values that were derived from a model that was based on the estimation set;

b) the observed values from the validation set and the predicted values that were derived from a model that was based on the estimation set;

c) the observed values from the validation set and the predicted values that were derived from a model that was based on the validation set;

d) the total population.

The results for all calculations for the group of nulliparous women are shown in Table 7. (See Table 18 and Table 20 for results for the groups of multiparous women with and without a previous cesarean section respectively, Section 5.5.)

Table 7: Generalized R2 and C-Statistic for Final Logistic Regression Model, Nulliparous Women, California, 1995-1997

Statistic	Evaluation Group	1995	1996	1997
Generalized R^2	for estimation set	0.326	0.331	0.338
	for validation set	0.320	0.338	0.335
	for total population	0.323	0.334	0.336
c-Statistic	based on estimation sample predictions for estimation set	0.768	0.767	0.770
	based on estimation sample predictions for validation set	0.767	0.771	0.770
	based on validation sample predictions for validation set	0.767	0.767	0.769
	based on total population predictions for total population	0.767	0.768	0.770

The generalized R^2 was similar for all three years and all three evaluation sets (0.33). These results were very good when compared to values found in other health services research risk

adjustment analyses.[23] [24] [20] The c-statistics were also similar in all three evaluation sets (0.76) indicating good model validation.

3.3.2 Model Calibration

If the average of the predicted values approaches the average of the observed outcomes well, a model is considered well calibrated. The Hosmer-Lemeshow test statistic is commonly used to assess these properties.[20, 21] In order to calculate this test statistic the data set is sorted in ascending order by the predicted probability of a cesarean section. The data set is then split into ten subsets by grouping the first 1/10 of observations into the first set, and so forth. For each subset, the difference between the observed and predicted number of c-sections is determined on which the Hosmer-Lemeshow test statistic is based.

Similar to the calculation for the c-statistic in the previous section, we calculated the Hosmer-Lemeshow statistic for several evaluation groups. The results for the group of nulliparous women are shown in Table 8. (Table 21 and

Table 23 display results for the groups of multiparous women without and with a previous cesarean section respectively, Section 5.6).

Table 8: Hosmer-Lemeshow Test Statistic for Final Regression Model, Nulliparous Women, California, 1995-1997

Evaluation Group	1995	1996	1997
Based on estimation sample predictions for estimation sample	36.287	64.820	45.440
Based on estimation sample predictions for validation sample	48.686	45.672	58.482
Based on validation sample predictions for validation sample	31.752	62.923	54.768
Based on total population predictions for total population	79.718	90.937	101.419

All Hosmer-Lemeshow test statistics led to a rejection of the null hypothesis of no difference between observed and predicted values. As this result was not desirable we studied the differences in observed and expected cesarean sections within each subgroup induced by the Hosmer-Lemeshow grouping as explained further above. The results are shown in Table 9. Note that due to the way in which the subsets were constructed the cesarean section rates implied by the observed or predicted number of c-sections increases as we move from group1 to group 10.

Table 9: Observed and Expected Cesarean Sections for Hosmer-Lemeshow Test Induced Subgroups, Nulliparous Women, 1995-1997

	1995				1996				1997			
Group	N	Obs. C/S	Pred. C/S	Difference	N	Obs. C/S	Pred. C/S	Difference	N	Obs. C/S	Pred. C/S	Difference
1	19,847	1,203	1,237	34	18,909	1,163	1,161	2	18,292	1,165	1,101	64
2	19,849	1,610	1,689	79	18,923	1,474	1,595	121	18,296	1,376	1,521	145
3	19,847	1,845	2,045	200	18,943	1,774	1,926	152	18,292	1,693	1,846	153
4	19,842	2,271	2,402	131	18,923	2,069	2,258	189	18,322	2,022	2,181	159
5	19,847	2,741	2,815	74	18,923	2,580	2,636	56	18,265	2,497	2,551	54
6	19,848	3,451	3,313	138	18,923	3,154	3,099	55	18,291	2,989	3,011	22
7	19,847	4,075	3,980	95	18,923	3,856	3,729	127	18,295	3,706	3,631	75
8	19,845	5,186	4,983	203	18,923	4,955	4,677	278	18,293	4,839	4,546	293
9	19,851	7,150	6,860	290	18,923	6,686	6,420	266	18,292	6,571	6,264	307
10	19,838	14,167	14,274	107	18,911	13,518	13,628	110	18,275	13,111	13,226	115

When we evaluated the implied observed and expected c-section rates in each group, we found that for the second, third, and fourth group, the implied c-section rates differed statistically significantly at the 95% level. In other words, model calibration was good for the remaining seven groups-- among them the groups with the highest cesarean section. We also found that the implied observed cesarean section rates were significantly different for all between-group comparisons, e.g., the implied observed cesarean section rate for group 1 was statistically significantly lower than the implied observed cesarean section rate for group 2, etc.

Therefore, even though the Hosmer-Lemeshow test statistic lent little support for a well-calibrated model (a frequent occurrence), inspecting the detail of the Hosmer-Lemeshow procedure-induced subgroups indicated that the model was satisfactorily calibrated.

3.3.3 Summary of Final Model

In attempting to identify hospital with a very high c-section rate, the final model was designed to control for variables reflecting patient physiological, clinical or behavioral characteristics that

predict the risk of an event—independent of care decisions made by the provider. Simultaneously, we excluded from the model those variables that reflect provider practice decisions.

Given the above, a number of variables were excluded from the final model, including payer source and prolapsed cord. While payer source is significantly associated with the risk of a c-section, a patient's insurance coverage is not a clinical indicator for a cesarean and was therefore excluded. Prolapsed cord was excluded because it may indicate a provider practice decision (rupture of the membranes when the head is too high) rather than an underlying patient characteristic. A variable for dystocia was never considered at all, due to the poor definition of the term as well as the concern that dystocia is a function of the obstetric care delivered. Other variables, including polyhydramnios and incompetent cervix, were excluded due to the small incidence of the conditions.

It was ultimately decided however, to include the race/ethnicity variable in the models. Race/ethnicity was found to be an independent and statistically significant predictor of the c-section event in nulliparous women in this risk-adjusted analysis. When controlling for all other variables, nulliparous African-American and Hispanic women were significantly more likely to undergo a c-section. To the sponsors, it is unclear whether this effect is physiological, or one reflective of care decisions made by the provider. In the absence of data that refutes a physiological mechanism, it was decided to include race/ethnicity as a risk-adjustment variable in the model presented in this report. Comparisons of this model to one that did not adjust for race/ethnicity showed only minor differences in the risk-adjusted c-section rates at the hospital level. Regardless, future research will be required to explore this association at more length. In particular, it will be important to ensure that inclusion of race/ethnicity does not hide potential differences in quality of care being delivered to minority populations.

The estimated odds ratio and significance level for all covariates in the final model are displayed in Table 10. The results in this table were based on the total population of nulliparous women for each year. More detailed results for these models are displayed in Section 5.7. Note that we did not include any interaction terms that were not significant for all three years for which we had data. We also included a linear and quadratic term in birth weight into the final models.

Table 10: Odds Ratio and Significance Level for Covariates in Final Model Based on the Total Population of Nulliparous Women, 1995-1997

Characteristic		1995		1996		1997	
		Odds Ratio	Significance	Odds Ratio	Significance	Odds Ratio	Significance
	Birth Weight	0.7	***	0.74	***	0.71	***
	Birth Weight*Birth Weight	1.02	***	1.02	***	1.02	***
Maternal Age	under 20	0.75	***	0.72	***	0.72	***
	20 to under 25	Reference Group					
	25 to under 30	1.35	***	1.28	***	1.33	***
	30 to under 35	1.72	***	1.67	***	1.73	***
	35 to under 40	2.39	***	2.29	***	2.44	***
	40 or older	3.27	***	3.16	***	3.53	***
High School	Completed	Reference Group					
	Not Completed	1.03	*	1.06	***	1.07	***
Prenatal Care	Some	Reference Group					
	None	0.65	***	0.73	***	0.73	***
Race/ Ethnicity	Non-Hispanic White	Reference Group					

	Hispanic	1.33	***	1.32	***	1.31	***
	African American	1.65	***	1.58	***	1.6	***
	Native American	1.31	***	1.33	***	1.24	*
	South East Asian	1.16	***	1.02		1.08	
	Other Asian	1.03		1.1	***	1.03	
	Other Race	1.25	***	1.28	***	1.27	***
Clinical Factors	Breech Presentation	1027.05	***	1418.66	***	1269.51	***
	Anemia	1.37	***	1.41	***	1.33	***
	Large for Gestational Age	1.34	***	1.4	***	1.37	***
	Insulin-dependent Diabetes	2.19	***	2.35	***	3.19	***
	Gestational Diabetes	1.5	***	1.54	***	1.43	***
	Eclampsia/Pre-Eclampsia/Hypertension	2.54	***	2.49	***	2.51	***
	Genital Herpes	9.89	***	8.64	***	6.93	***
	Intrauterine Growth Retardation	1.68	***	1.62	***	1.62	***
	Oligohydramnios	2.36	***	2.32	***	2.26	***
	Premature Rupture of Membranes	1.85	***	1.94	***	1.85	***
	Placenta Abruptio/Previa	6.91	***	6.77	***	7.62	***
	Postterm Baby	1.96	***	1.96	***	1.92	***
Interaction Terms	Hypertension and Oligohydramnios	0.51	***	0.54	***	0.63	***
	Breech Presentation and Birth Weight 1,500-<2,500 grams	0.49	***	0.49	***	0.55	***
	Breech Presentation and Birth Weight <1,500 grams	0.03	***	0.03	***	0.02	***
	Eclampsia/Pre-Eclampsia/Hypertension and Birth weight 1,500-	1.94	***	1.91	***	1.89	***
	Eclampsia/Pre-Eclampsia/Hypertension and Birth weight <1,500	6.94	***	11.56	***	9.16	***

4 Summary

We have provided a detailed description of the analytic methods for obtaining risk-adjusted c-section rates for California hospitals. The hospital level risk-adjusted rates are presented in the companion ***Hospital Report*** for each hospital with at least 10 deliveries and 3 c-sections for each of the three subgroups of women, nulliparous, multiparous without previous cesarean section, and multiparous with previous cesarean section.

The following set of figures serves to further put the hospital-level cesarean section rates into perspective. Figure 5 displays hospital-level observed and adjusted cesarean section rates for nulliparous women. Variability of c-section rates from hospital to hospital was high. Between 1995 and 1997, only 69 hospitals had an observed c-section rate of 15% or lower. 152 hospitals had a risk-adjusted c-section rate of more than 30. The largest number of hospitals had a c-section rate between 20 to 25%.

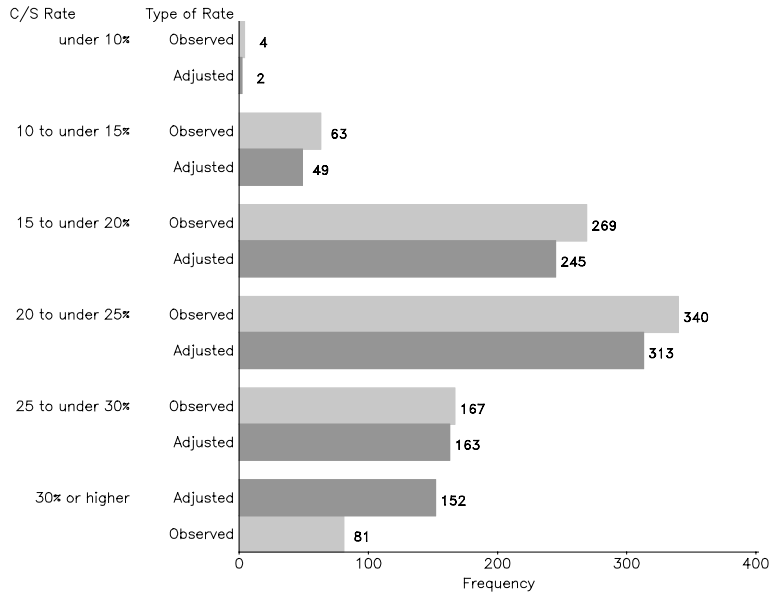
Figure 6 displays risk-adjusted c-section rates by type of hospital control.[5] For government-controlled hospitals, the peak in c-section rates was between 15 and 20%. For investor owned institutions, there were almost equal numbers of providers observed with c-section rates from 20 to 25%, 25 to 30%, or higher than 30%.

Figure 7 displays risk-adjusted cesarean section rates for nulliparous women by California region. The figure highlights stark regional differences in c-section rates. For the Bay Area, the largest number of hospitals had a risk-adjusted c-section rate between 15 and 20% while for all other regions the risk-adjusted c-section rate peaked between 20 and 25%. Only one Bay Area hospital in one of the three years, 1995 to 1997, had a c-section rate exceeding 30%.

Finally, Figure 8 displays risk-adjusted cesarean section rates for nulliparous women by size of hospital and teaching status.[5] For small or rural hospitals, c-sections exceeding 30% were most common. In contrast, most teaching hospitals had risk-adjusted c-section rates between 15 and 20%.

The materials presented in this report are intended to stimulate discussion of best practices in delivery management among California hospitals, with a view to encouraging hospitals to review and adapt their own practices as necessary. The sponsors recognize the importance of balancing the c-section process measure presented here with a measure of infant health outcome that reflects the quality of obstetric care. Several such measures were formulated, but more research is needed to develop methodologically-sound measures of health outcomes to be reported in tandem with c-section rates in the future. The sponsors are committed to such continuing research.

Figure 5: Hospital-Level Observed and Risk-Adjusted Cesarean Section Rates for Nulliparous Women, 1995-1997



[5] The classification adopted here was obtained from OSHPD, http://www.oshpd.cahwnet.gov.

Figure 6: Risk-Adjusted Cesarean Section Rates for Nulliparous Women, by Type of Control, 1995-1997

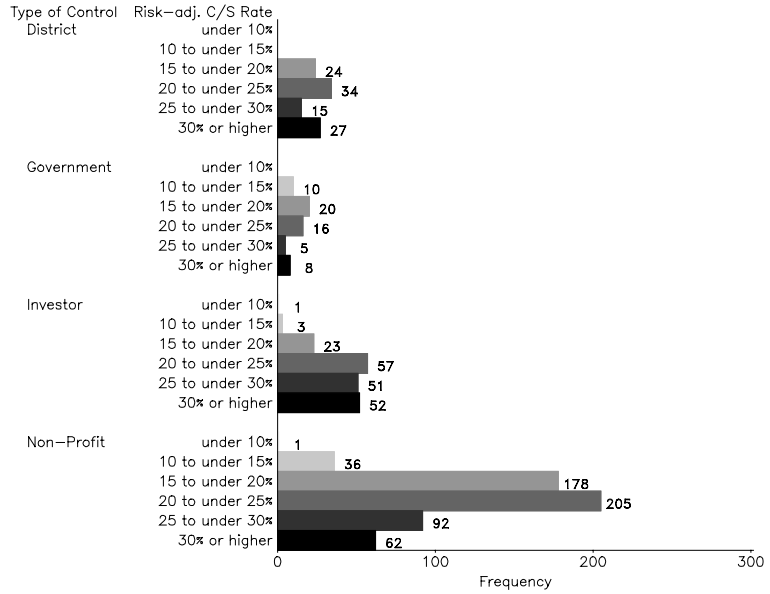


Figure 7: Risk-Adjusted Cesarean Section Rates for Nulliparous Women, by California Region, 1995-1997

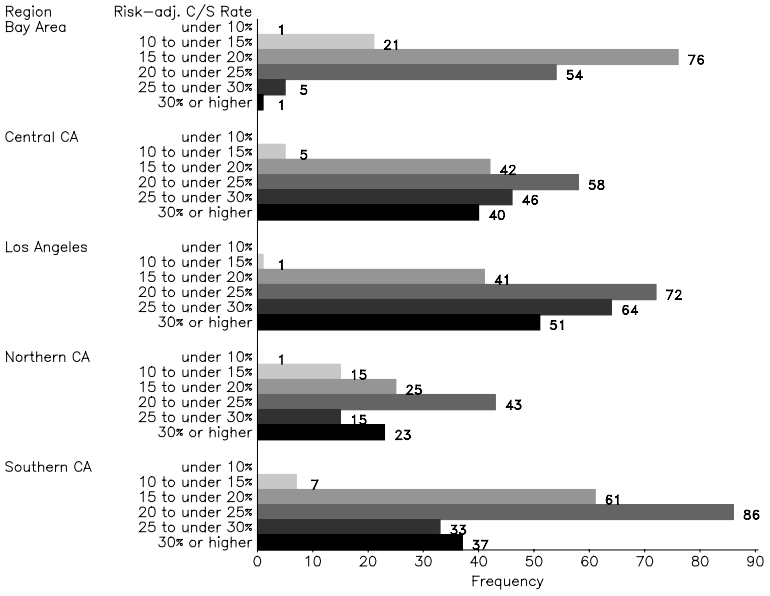
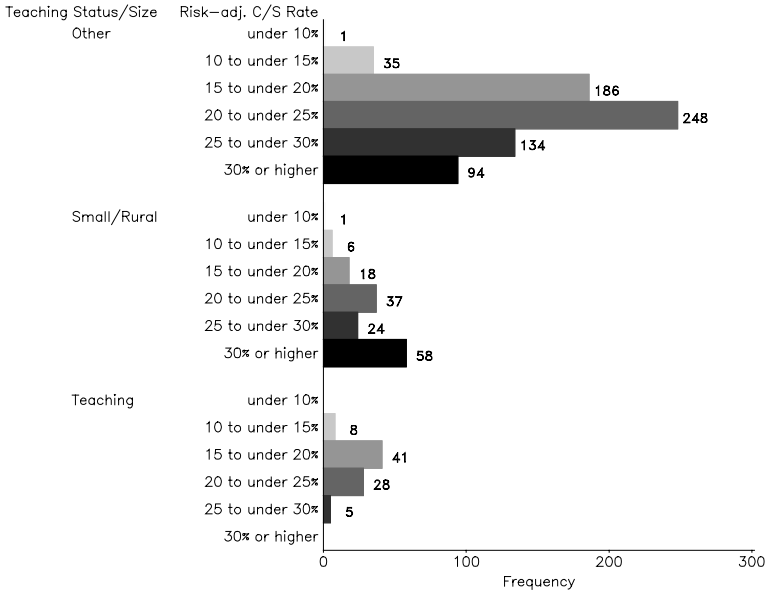


Figure 8: Risk-Adjusted Cesarean Section Rates for Nulliparous Women, by Size/Teaching Status, 1995-1997



5 Appendix

5.1 Description of Variables Used in the Study

The following abbreviations are used in the description of study variables:

VSB: Vital Statistics Birth File (published by Department of Health Services).

MPDD: Maternal Patient Discharge Record (published by the Office of Statewide Planning and Development).

IPDD: Infant Patient Discharge Record, includes all records that pertain to an infant prior to the first discharge home (published by the Office of Statewide Planning and Development).

Table 11: Description of Study Variables

Variable	Source file and comments
Parity	VSB: Distinguish primiparous (parity 1 after birth) and multiparous (parity 2 or higher after birth)
Birth Weight	VSB: Continuous variable; quadratic term.
Maternal Age	VSB: Categorized as less than 20, 20 to under 25, 25 to under 30, 30 to under 35, 35 to under 40, 40 or older.
Mother no high school degree	VSB: It is assumed that a person who spends less than 12 years on education does not have a high school degree.
Father no high school degree	VSB: It is assumed that a person who spends less than 12 years on education does not have a high school degree.
Race/Ethnicity	VSB: Race/Ethnicity categorized as Non-Hispanic White, Hispanic, African American, Native American (American Indian, Eskimo, Aleut), South East Asian (Vietnamese, Cambodian, or Laotian), Other Asian (Chinese, Japanese, Korean, Thai, Other Asian), and Other Race (Indian, Filipino, Hawaiian, Guamanian, Samoan, Other Pacific Islander, Other specified race).
Insurance Status	VSB: Insurance type for labor and delivery categorized as MediCal, Private Insurance, HMO/PPO, Self Pay, or other payer source.
Prenatal Care	VSB: This variable was modeled in two forms: Categorized according to the Kotelchuck Index; or No prenatal care.
Previous C-Section	VSB: Delivery mode indicates either a VBAC or a cesarean after a previous cesarean MPDD: 654.2 Previous cesarean delivery, Uterine scar from previous cesarean delivery
Multiple Birth	IPDD: V31, V32, V33, V34, V35, V36, V37 MPDD: 651: Multiple gestation; 652.6: Multiple gestation with malpresentation of fetus or more; 761.5 Multiple pregnancy 660.5 Locked twins

Breech	MPDD: 652.2 Breech presentation without mention of version, Breech delivery (assisted) (spontaneous) NOS. 669.6 Breech extraction, w/out mention of indication (excludes breech delivery: 652.2) 72.5 (procedure code) Breech extraction
Abruptio Placenta/Placenta Previa/3rd Trimester Bleeding	MPDD: 641: Antepartum hemorrhage, abruptio placenta, and placenta previa 641.0 Placenta previa without hemorrhage, Low implantation of placenta without hemorrhage, Placenta previa noted: during pregnancy without hemorrhage before labor (and delivered by cesarean delivery) without hemorrhage; 641.1 Hemorrhage from placenta previa, Low-lying placenta NOS or with hemorrhage (intrapartum), Placenta previa: incomplete NOS or with hemorrhage (intrapartum), marginal NOS or with hemorrhage (intrapartum), partial NOS or with hemorrhage (intrapartum), total NOS or with hemorrhage (intrapartum), Excludes: hemorrhage from vasa previa (663.5); 641.2 Premature separation of placenta, Ablatio placentae, Abruptio placentae, Accidental antepartum hemorrhage, Couvelaire uterus, Detachment of placenta (premature), Premature separation of normally implanted placenta; 641.3 Antepartum hemorrhage associated with coagulation defects, Antepartum or intrapartum hemorrhage associated with: afibrinogenemia, hyperfibrinolysis, hypofibrinogenemia
Oligohydramnios	MPDD: 658.0 Oligohydramnios, Oligohydramnios without mention of rupture of membranes
Polyhydramnios	MPDD: 657 Polyhydramnios
IUGR	MPDD: 656.5 Poor Fetal Growth IPDD: 764 Slow Fetal Growth and Fetal Malnutrition
Insulin-dependent diabetes	MPDD: 250 Diabetes mellitus; Excludes: gestational diabetes (648.8), hyperglycemia NOS (790.6), neonatal diabetes mellitus (775.1), non-clinical diabetes (790.2) 648.0 Diabetes mellitus; Conditions classifiable to 250, Excludes: gestational diabetes (648.8)
Gestational diabetes	MPDD: 648.8 Abnormal glucose tolerance; Conditions classifiable to 790.2, Gestational diabetes
Active Herpes	MPDD: 054.10 Genital herpes, unspecified; Herpes progenitalis 054.11 Herpetic vulvovaginitis 054.12 Herpetic ulceration of vulva 054.19 Other
Anemia	MPDD: 280 Iron deficiency anemias 281 Other deficiency anemias 282 Hereditary hemolytic anemias 283 Acquired hemolytic anemias 284 Aplastic anemias 285 Other and unspecified anemias 648.2 Anemia, Conditions classifiable to 280-285
Postterm	MPDD: 645 Prolonged pregnancy, Post term pregnancy, Pregnancy which has advanced beyond 42 weeks of gestation
Large Baby	IPDD: 766.0 Exceptionally large baby 766.1 Other “heavy for dates” infant 775.0 Syndrome of “infant of a diabetic mother”
Hypertension/Eclampsia/Pre-Eclampsia	MPDD: 642 Hypertension complicating pregnancy, childbirth, and the puerperium

Prolapsed Cord	IPDD: 762.4 Prolapsed cord; Cord presentation
PROM	MPDD: 658.2 PROM with delayed delivery
Incompetent Cervix	MPDD: 654.5 Cervical incompetence. Presence of Shirodkar suture with or without mention of cervical incompetence
Interaction Term 1	No prenatal care and no high school degree (mother)
Interaction Term 2	No prenatal care and no high school degree for either mother or father
Interaction Term 3	No high school degree for either mother or father
Interaction Term 4	African American and Maternal Age under 20
Interaction Term 5	Hispanic and Maternal Age under 20
Interaction Term 6	African American and MediCal insured
Interaction Term 7	Hispanic and MediCal insured
Interaction Term 8	Maternal age under 20 and MediCal insured
Interaction Term 9	Maternal age under 20, MediCal insured, and African American
Interaction Term 10	Maternal age under 20, MediCal insured, and Hispanic
Interaction Term 11	Diabetes and large for gestational age
Interaction Term 12	Gestational diabetes and large for gestational age
Interaction Term 13	Hypertension and Oligohydramnios
Interaction Term 14	Hypertension and African American
Interaction Term 15	Hypertension and Hispanic
Interaction Term 16	Maternal age under 20 and no prenatal care
Interaction Term 17	Breech presentation and birth weight under 1,500 grams
Interaction Term 18	Breech presentation and birth weight between 1,500 and 2,500 grams
Interaction Term 19	Hypertension and birth weight under 1,500 grams
Interaction Term 20	Hypertension and birth weight between 1,500 and 2,500 grams

5.2 Hospital Level Risk-Adjusted Outcome Rates

We undertook the following steps to obtain hospital level risk-adjusted cesarean section rats. Note that the index *i* refers to the hospitals in the study, $i=1,...,I$; the index *j* refers to an individual observation within a hospital *i*, $j=1,...,J_i$.

1. For each hospital, we determined the at-risk population. The at-risk population was the number of single live births to nulliparous women in each hospital (P_i). The total at risk-population for California was designated by *P*.
2. For each hospital, we determined the observed number of cesarean sections, (O_i). The total number of cesarean sections for California was designated by *O*.
3. For each hospital, we obtained the observed cesarean section rate as the ratio of observed events and at risk population:

$$o_i = \frac{O_i}{P_i} \times 100 .$$

4. We determined the California wide cesarean section rate as the ratio of observed number of cesarean sections and the at-risk population:

$$o_{CA} = \frac{O}{P} \times 100 \ .$$

5. We obtained the product of the statewide cesarean section rate and the at risk population in each hospital:

$$UE_i = \frac{o_{CA} \times P_i}{100} .$$

   This quantity can be interpreted as the expected number of cesarean sections in hospital *i* under the assumption that the same cesarean section rate as in California operated in hospital *i*. The problem with this expected number of cesarean sections is that it is not adjusted for the particular case mix of patients that hospital *i* treats.

6. Based on the risk-adjustment model, we calculated the expected risk of a cesarean section for each delivery in hospital *j*, e_{ij}. For each hospital, we obtained the expected number of cesarean sections by summing up the expected risks for each of the hospital's patients:

$$E_i = \sum_{j}^{J_i} e_{ij} \ .$$

7. For each hospital, we obtained a case mix severity index as the ratio of the expected number of cesarean sections had the California wide cesarean section rate applied in hospital *i* and the expected number of cesarean sections based on the risk adjustment model:

$$s_i = \frac{UE_i}{E_i} = \frac{o_{CA} \times P_i}{100 \times E_i} .$$

   Note that the case mix severity index is less than 1 if the case mix for hospital *i* is at a higher risk of cesarean sections than the case mix for California as a whole; the case mix severity index is greater than 1 if the case mix for hospital *i* is at a lower risk of cesarean sections than the case mix for California as a whole.

8. Using the case mix severity index, the observed cesarean section rate for hospital *i* was scaled up if the case mix of hospital *i* was at lower risk of cesarean section compared to California, and it was scaled down if the delivery case mix of hospital *i* was at a higher risk of cesarean section compared to California.

$$r_i = o_i \times s_i .$$

The quantity r_I was referred to as the risk-adjusted cesarean section rate.

9. Based on the observed number of events, confidence limits for the risk-adjusted cesarean section rate were obtained. If the observed number of events was 15 or less, we determined exact 95% confidence limits.[25] If the observed number exceeded 15, we determined 95% confidence limits based on the normal assumption:

$$r_{i,\mathrm{LOW}} = \mathrm{Max}\left[0, r_i - 1.96 \times 100 \times \frac{s_i}{P_i} \times \sqrt{\sum_j^{J_i} e_{ij} \times (1 - e_{ij})}\right]$$

$$r_{i,\mathrm{HIGH}} = \mathrm{Min}\left[1, r_i + 1.96 \times 100 \times \frac{s_i}{P_i} \times \sqrt{\sum_j^{J_i} e_{ij} \times (1 - e_{ij})}\right]$$

10. Note that the risk adjusted cesarean section rate is equivalent to the observed to expected ratio:

$$r_i = o_i \times s_i = \frac{O_i}{P_i} \times \frac{o_{CA} \times P_i}{E_i} \times 100 = \frac{O_i}{E_i} \times o_{CA} \times 100 .$$

5.3 Frequency of Covariates, Cesarean Section Rates and Unadjusted Odds Ratios for Multiparous Women with and without a Previous Cesarean Section

Table 12: Frequency of Characteristics Among Multiparous Women without a Previous Cesarean Section and Unadjusted Odds Ratio, California, 1995-1997 (N=722,111)

Covariate	Events	Number of Cesarean Sections	Cesarean Section Rate	Unadjusted Odds Ratio (OR)	Lower 95% CL for OR	Upper 95% CL for OR
Clinical Factors						
Anemia	46,734	7,455	15.95	2.84	2.76	2.91
Breech Presentation	16,064	14,344	89.29	157.72	149.86	165.99
Genital Herpes	1,935	942	48.68	13.03	11.92	14.26
Gestational Diabetes	22,250	3,163	14.22	2.32	2.23	2.41
Hypertension/Eclampsia/Pre-Eclampsia	22,016	4,118	18.7	3.3	3.18	3.41
Incompetent Cervix	1,566	291	18.58	3.09	2.72	3.51
Insulin-dependent Diabetes	3,762	773	20.55	3.53	3.26	3.82
Intrauterine Growth Retardation	6,112	1,415	23.15	4.16	3.91	4.41
Large for gestational age	49,126	6,162	12.54	2.07	2.01	2.13
Oligohydramnios	11,622	2,245	19.32	3.34	3.18	3.5
Placenta Abruptio/Previa/3rd Trimester Bleeding	9,944	5,354	53.84	17.52	16.83	18.25
Polyhydramnios	2,463	776	31.51	6.29	5.78	6.85
Postterm	29,946	2,709	9.05	1.36	1.31	1.42
Prolapsed Cord	368	296	80.43	55.82	43.14	72.23
PROM	6,623	1,174	17.73	2.95	2.77	3.15
Small for Gestational Age	7,364	1,411	19.16	3.26	3.08	3.46
Demographic Factors						
Maternal Age < 20	33,812	1,400	4.14	0.85	0.8	0.9
Maternal Age 20-<25	159,828	7,733	4.84	Reference Group		
Maternal Age 25-<30	214,673	13,100	6.1	1.28	1.24	1.32
Maternal Age 30-<35	194,004	14,609	7.53	1.6	1.56	1.65
Maternal Age 35-<40	97,800	9,755	9.97	2.18	2.11	2.25
Maternal Age >=40	21,994	3,205	14.57	3.35	3.21	3.51
No High School Degree (Mother)	267,487	18,854	7.05	1.04	1.02	1.06
No High School Degree (Father)	224,136	15,940	7.11	1.05	1.03	1.07
Inadequate PNC initialization (Kotelchuck)	32,109	2,081	6.48	0.93	0.89	0.98
Onset of PNC after first trimester	161,651	10,630	6.58	0.94	0.92	0.96
Inadequate frequency of PNC visits (Kotelchuck)	34,877	2,230	6.39	0.92	0.88	0.96
Inadequate PNC (Kotelchuck)	107,031	6,807	6.36	0.9	0.88	0.93
No prenatal care	8,361	575	6.88	1	0.92	1.09
MediCal	361,380	26,511	7.34	1.07	1.04	1.1
Private Insurance	124,164	8,558	6.89	Reference Group		
Managed Care Plan	215,978	13,406	6.21	0.89	0.87	0.92
Uninsured/Self Pay	19,871	1,301	6.55	0.95	0.89	1

Other Source	718	26	3.62	0.51	0.34	0.75
Non-Hispanic White	235,050	15,585	6.63	Reference Group		
Hispanic	364,697	25,464	6.98	1.06	1.04	1.08
African American	49,644	4,301	8.66	1.34	1.29	1.39
South East Asian	15,090	916	6.07	0.91	0.85	0.98
Other Asian	35,774	1,855	5.19	0.77	0.74	0.81
Other Race	21,856	1,681	7.69	1.18	1.12	1.24

Note: CL: Confidence Limit

Table 13: Frequency of Characteristic Among Multiparous Women with at least one Previous Cesarean Section, Cesarean Section Rate, and Unadjusted Odds Ratio, California, 1995-1997 (N=203,858)

Covariate	Events	Number of Cesarean Sections	Cesarean Section Rate	Unadjusted Odds Ratio (OR)	Lower 95% CL for OR	Upper 95% CL for OR
Clinical Factors						
Anemia	20,133	13,796	68.52	1.28	1.24	1.33
Breech Presentation	9,482	9,260	97.66	25.8	22.58	29.49
Genital Herpes	1,046	833	79.64	2.26	1.94	2.63
Gestational Diabetes	10,260	7,543	73.52	1.64	1.56	1.71
Hypertension/Eclampsia/Pre-Eclampsia	9,687	7,216	74.49	1.72	1.64	1.8
Incompetent Cervix	730	498	68.22	1.24	1.06	1.45
Insulin-dependent Diabetes	2,449	1,958	79.95	2.32	2.1	2.56
Intrauterine Growth Retardation	1,928	1,397	72.46	1.52	1.38	1.68
Large for gestational age	17,934	13,055	72.79	1.6	1.55	1.66
Oligohydramnios	4,070	2,674	65.7	1.11	1.04	1.18
Placenta Abruptio/Previa/3rd Trimester Bleeding	4,597	3,885	84.51	3.21	2.96	3.48
Polyhydramnios	1,144	945	82.6	2.75	2.36	3.2
Postterm	6,043	3,081	50.98	0.59	0.56	0.62
Prolapsed Cord	95	87	91.58	6.27	3.04	12.93
PROM	2,330	1,293	55.49	0.72	0.66	0.78
Small for Gestational Age	2,421	1,627	67.2	1.18	1.09	1.29
Demographic Factors						
Maternal Age < 20	5,188	2,966	57.17	0.9	0.85	0.96
Maternal Age 20-<25	32,978	19,691	59.71	Reference Group		
Maternal Age 25-<30	57,483	35,492	61.74	1.09	1.06	1.12
Maternal Age 30-<35	63,242	40,510	64.06	1.2	1.17	1.24
Maternal Age 35-<40	36,736	24,806	67.53	1.4	1.36	1.45
Maternal Age >=40	8,231	5,883	71.47	1.69	1.6	1.78
No High School Degree (Mother)	65,907	41,283	62.64	0.95	0.93	0.97
No High School Degree (Father)	57,151	36,035	63.05	0.98	0.96	1
Inadequate PNC initialization (Kotelchuck)	7,596	4,316	56.82	0.75	0.72	0.79
Onset of PNC after first trimester	39,930	24,158	60.5	0.86	0.84	0.87
Inadequate frequency of PNC visits (Kotelchuck)	7,799	4,312	55.29	0.7	0.67	0.74
Inadequate PNC (Kotelchuck)	25,579	15,073	58.93	0.8	0.78	0.83
No prenatal care	1,845	892	48.35	0.54	0.49	0.59

MediCal	94,731	61,841	65.28	0.94	0.92	0.96
Private Insurance	40,629	27,041	66.56		Reference Group	
Managed Care Plan	64,049	37,925	59.21	0.72	0.71	0.74
Uninsured/Self Pay	4,273	2,456	57.48	0.67	0.63	0.72
Other Source	176	85	48.3	0.47	0.35	0.63
Non-Hispanic White	70,873	45,044	63.56		Reference Group	
Hispanic	98,876	62,883	63.6	1	0.98	1.02
African American	16,391	10,790	65.83	1.11	1.07	1.15
South East Asian	2,657	1,393	52.43	0.63	0.59	0.68
Other Asian	8,688	5,220	60.08	0.86	0.83	0.9
Other Race	6,373	4,018	63.05	0.98	0.93	1.03

Note: CL: Confidence Limit

5.4 Selected Results of Stepwise Procedure

Table 14: Results of Stepwise Logistic Regression, Nulliparous Women

Variable	Position Entered in Model	χ^2-Score	p-value	R^2	Generalized R^2
1995					
Breech Presentation	8	8658.20	0.0001	0.1428	0.2190
Hypertension/Eclampsia/Pre-Eclampsia	9	1563.40	0.0001	0.1557	0.2388
Placenta Abruptio, Placenta Previa	10	796.40	0.0001	0.1624	0.2491
Postterm Pregnancy	11	607.40	0.0001	0.1674	0.2568
Genital Herpes	12	458.50	0.0001	0.1714	0.2629
Oligohydramnios	13	387.90	0.0001	0.1745	0.2677
Breech and Birth Weight < 1,500 grams	14	340.90	0.0001	0.1769	0.2713
Premature Rupture of Membranes	15	246.80	0.0001	0.1788	0.2743
Anemia	16	164.30	0.0001	0.1802	0.2764
Large for Gestational Age	17	154.50	0.0001	0.1814	0.2783
African American	18	147.10	0.0001	0.1826	0.2801
Hispanic	19	220.50	0.0001	0.1844	0.2829
Intrauterine Growth Retardation	20	117.30	0.0001	0.1854	0.2843
Gestational Diabetes	21	91.53	0.0001	0.1861	0.2855
Insulin-dependent Diabetes	22	68.96	0.0001	0.1867	0.2863
Hypertension and Birth Weight < 1,500 grams	23	64.88	0.0001	0.1872	0.2872
Hypertension and Birth Weight 1,500-<2,500 grams	24	59.58	0.0001	0.1877	0.2880
Hypertension and Oligohydramnios	25	42.20	0.0001	0.1881	0.2885
Other Race	26	35.53	0.0001	0.1884	0.2889
Native American	27	17.01	0.0001	0.1885	0.2891
Breech and Birth Weight 1,500-<2,500 grams	28	15.18	0.0001	0.1886	0.2893
No Prenatal Care	29	14.12	0.0002	0.1887	0.2895
Hispanic and Maternal Age < 20	30	10.17	0.0014	0.1888	0.2896
Hypertension and Hispanic	31	8.53	0.0035	0.1889	0.2897
No High School Degree (Mother)	32	7.43	0.0064	0.1889	0.2898
1996					
Breech Presentation	8	8331.20	0.0001	0.1419	0.2185
Hypertension/Eclampsia/Pre-Eclampsia	9	1413.70	0.0001	0.1541	0.2373
Placenta Abruptio, Placenta Previa	10	716.60	0.0001	0.1605	0.2471
Postterm Pregnancy	11	442.80	0.0001	0.1642	0.2529
Genital Herpes	12	429.50	0.0001	0.1681	0.2588
Breech and Birth Weight < 1,500 grams	13	405.00	0.0001	0.1711	0.2635
Oligohydramnios	14	366.40	0.0001	0.1742	0.2682
Premature Rupture of Membranes	15	292.80	0.0001	0.1766	0.2720
Anemia	16	179.20	0.0001	0.1782	0.2743
Hispanic	17	144.30	0.0001	0.1794	0.2763
African American	18	185.40	0.0001	0.1810	0.2787
Gestational Diabetes	19	128.40	0.0001	0.1821	0.2803
Intrauterine Growth Retardation	20	122.80	0.0001	0.1831	0.2819
Hypertension and Birth Weight < 1,500 grams	21	97.07	0.0001	0.1840	0.2833

Large for Gestational Age	22	103.90	0.0001	0.1849	0.2847
Insulin-dependent Diabetes	23	64.78	0.0001	0.1854	0.2855
Hypertension and Birth Weight 1,500-<2,500 grams	24	53.23	0.0001	0.1859	0.2862
Other Race	25	40.92	0.0001	0.1862	0.2868
Hypertension and Oligohydramnios	26	20.58	0.0001	0.1864	0.2870
Breech and Birth Weight 1,500-<2,500 grams	27	17.68	0.0001	0.1865	0.2872
No High School Degree (Mother)	28	12.52	0.0004	0.1867	0.2874
Hypertension and Hispanic	29	10.87	0.001	0.1867	0.2876
No Prenatal Care	30	8.72	0.0032	0.1868	0.2877
Hispanic and Maternal Age < 20	31	8.73	0.0031	0.1869	0.2878
Other Asian	32	7.13	0.0076	0.1870	0.2879
1997					
Breech Presentation	8	8039.20	0.0001	0.1467	0.2254
Hypertension/Eclampsia/Pre-Eclampsia	9	1384.90	0.0001	0.1590	0.2444
Placenta Abruptio, Placenta Previa	10	821.20	0.0001	0.1665	0.2560
Postterm Pregnancy	11	531.70	0.0001	0.1712	0.2631
Breech and Birth Weight < 1,500 grams	12	453.10	0.0001	0.1747	0.2685
Oligohydramnios	13	331.10	0.0001	0.1775	0.2729
Genital Herpes	14	325.70	0.0001	0.1805	0.2774
Premature Rupture of Membranes	15	214.90	0.0001	0.1823	0.2802
Anemia	16	155.90	0.0001	0.1837	0.2823
Large for Gestational Age	17	140.40	0.0001	0.1849	0.2842
Insulin-dependent Diabetes	18	111.70	0.0001	0.1859	0.2857
Intrauterine Growth Retardation	19	105.50	0.0001	0.1868	0.2871
Hispanic	20	106.90	0.0001	0.1877	0.2886
African American	21	127.80	0.0001	0.1889	0.2903
Hypertension and Birth Weight < 1,500 grams	22	87.50	0.0001	0.1897	0.2916
Hypertension and Birth Weight 1,500-<2,500 grams	23	63.81	0.0001	0.1903	0.2924
Gestational Diabetes	24	61.46	0.0001	0.1908	0.2933
Other Race	25	27.82	0.0001	0.1910	0.2936
Hypertension and Oligohydramnios	26	16.63	0.0001	0.1912	0.2938
No High School Degree (Mother)	27	12.84	0.0003	0.1913	0.2940
Native American	28	7.66	0.0057	0.1914	0.2941
Breech and Birth Weight 1,500-<2,500 grams	29	5.72	0.0168	0.1914	0.2942
Hypertension and Black	30	5.59	0.018	0.1914	0.2943
Hispanic and Maternal Age < 20	31	5.16	0.0231	0.1915	0.2943
Other Asian	32	4.30	0.0381	0.1915	0.2944

Notes:

1. Variables are shown in the order in which they were entered into the model.
2. The χ^2-score shows the value of the χ^2-statistic that is used to test the hypothesis that the coefficient for the variable to the left is zero.
3. The p-value is the probability that under the null hypothesis the χ^2-score is observed (see previous note).
4. For the generalized coefficient of determination, generalized R^2, the simple R^2 is scaled such that it can achieve the value 1.[6]

[6] For a more detailed description of the generalized coefficient of determination, see [20], [21].

Table 15: Results of Stepwise Logistic Regression, Multiparous Women Without Previous Cesarean Section

Variable	Position Entered in Model	χ^2-Score	p-value	R^2	Generalized R^2
1995					
Breech Presentation	8	9576.90	0.0001	0.1059	0.2688
Placenta Abruptio, Placenta Previa	9	2364.40	0.0001	0.1226	0.3111
Hypertension/Eclampsia/Pre-Eclampsia	10	560.60	0.0001	0.1263	0.3205
Genital Herpes	11	441.70	0.0001	0.1293	0.3280
Breech and Birth Weight < 1,500 grams	12	439.70	0.0001	0.1320	0.3351
Anemia	13	355.90	0.0001	0.1344	0.3411
Oligohydramnios	14	221.50	0.0001	0.1359	0.3448
Large for Gestational Age	15	133.90	0.0001	0.1368	0.3472
Postterm Pregnancy	16	92.85	0.0001	0.1375	0.3488
Premature Rupture of Membranes	17	77.88	0.0001	0.1380	0.3502
Gestational Diabetes	18	67.87	0.0001	0.1385	0.3514
Intrauterine Growth Retardation	19	66.72	0.0001	0.1389	0.3525
Other Asian	20	45.46	0.0001	0.1393	0.3534
Hypertension and Birth Weight 1,500-<2,500 grams	21	46.10	0.0001	0.1396	0.3542
Breech and Birth Weight 1,500-<2,500 grams	22	36.88	0.0001	0.1399	0.3549
Hypertension and Birth Weight < 1,500 grams	23	32.42	0.0001	0.1401	0.3555
African American	24	31.00	0.0001	0.1403	0.3560
Hispanic	25	41.47	0.0001	0.1406	0.3568
Insulin-dependent Diabetes	26	26.19	0.0001	0.1408	0.3573
No Prenatal Care	27	18.08	0.0001	0.1409	0.3576
No High School Degree (Mother)	28	13.38	0.0003	0.1410	0.3579
Gestational diabetes and Large for Gestational Age	29	9.23	0.0024	0.1411	0.3580
Other Race	30	8.08	0.0045	0.1412	0.3582
Hypertension and Oligohydramnios	31	4.34	0.0373	0.1412	0.3582
Hypertension and Hispanic	32	4.17	0.0412	0.1412	0.3583
1996					
Breech Presentation	8	9063.00	0.0001	0.1028	0.2618
Placenta Abruptio, Placenta Previa	9	2632.90	0.0001	0.1220	0.3106
Genital Herpes	10	615.60	0.0001	0.1263	0.3215
Anemia	11	582.50	0.0001	0.1302	0.3316
Hypertension/Eclampsia/Pre-Eclampsia	12	415.40	0.0001	0.1330	0.3386
Breech and Birth Weight < 1,500 grams	13	381.50	0.0001	0.1355	0.3449
Oligohydramnios	14	257.10	0.0001	0.1372	0.3492
Large for Gestational Age	15	171.30	0.0001	0.1384	0.3523
Postterm Pregnancy	16	98.58	0.0001	0.1391	0.3540
Gestational Diabetes	17	94.03	0.0001	0.1397	0.3557
Premature Rupture of Membranes	18	64.77	0.0001	0.1402	0.3568
Hypertension and Birth Weight < 1,500 grams	19	60.27	0.0001	0.1406	0.3580
Insulin-dependent Diabetes	20	58.33	0.0001	0.1410	0.3590
Intrauterine Growth Retardation	21	51.87	0.0001	0.1414	0.3600
African American	22	48.65	0.0001	0.1417	0.3608

Hispanic	23	77.86	0.0001	0.1423	0.3623
Breech and Birth Weight 1,500-<2,500 grams	24	39.72	0.0001	0.1426	0.3630
No Prenatal Care	25	22.84	0.0001	0.1427	0.3634
Hypertension and Birth Weight 1,500-<2,500 grams	26	18.12	0.0001	0.1429	0.3638
Other Asian	27	10.17	0.0014	0.1430	0.3640
Gestational diabetes and Large for Gestational Age	28	9.84	0.0017	0.1430	0.3642
Hypertension and Oligohydramnios	29	9.04	0.0026	0.1431	0.3643
Native American	30	7.17	0.0074	0.1431	0.3645
Hispanic and Maternal Age < 20	31	5.10	0.024	0.1432	0.3645
1997					
Breech Presentation	8	9536.80	0.0001	0.1111	0.2826
Placenta Abruptio, Placenta Previa	9	2071.70	0.0001	0.1263	0.3213
Genital Herpes	10	504.90	0.0001	0.1299	0.3304
Anemia	11	482.90	0.0001	0.1333	0.3390
Hypertension/Eclampsia/Pre-Eclampsia	12	333.20	0.0001	0.1356	0.3449
Breech and Birth Weight < 1,500 grams	13	280.20	0.0001	0.1374	0.3493
Oligohydramnios	14	180.80	0.0001	0.1386	0.3525
Large for Gestational Age	15	128.70	0.0001	0.1396	0.3549
Intrauterine Growth Retardation	16	116.60	0.0001	0.1404	0.3571
Gestational Diabetes	17	102.30	0.0001	0.1411	0.3589
Premature Rupture of Membranes	18	88.37	0.0001	0.1418	0.3605
Postterm Pregnancy	19	86.68	0.0001	0.1424	0.3621
Other Asian	20	37.02	0.0001	0.1427	0.3628
Hypertension and Birth Weight < 1,500 grams	21	33.56	0.0001	0.1429	0.3635
African American	22	32.56	0.0001	0.1432	0.3641
Hispanic	23	46.39	0.0001	0.1435	0.3650
Hypertension and Birth Weight 1,500-<2,500 grams	24	29.36	0.0001	0.1438	0.3656
Insulin-dependent Diabetes	25	28.90	0.0001	0.1440	0.3661
Breech and Birth Weight 1,500-<2,500 grams	26	17.46	0.0001	0.1441	0.3664
No High School Degree (Mother)	27	13.86	0.0002	0.1442	0.3667
Other Race	28	11.24	0.0008	0.1443	0.3669
Hypertension and Oligohydramnios	29	6.73	0.0095	0.1443	0.3670
Hypertension and Hispanic	30	6.90	0.0086	0.1444	0.3672
No Prenatal Care	31	6.34	0.0118	0.1444	0.3673

Notes:

1. Variables are shown in the order in which they were entered into the model.
2. The χ^2-score shows the value of the χ^2-statistic that is used to test the hypothesis that the coefficient for the variable to the left is zero.
3. The p-value is the probability that under the null hypothesis the χ^2-score is observed (see previous note).
4. For the generalized coefficient of determination, generalized R^2, the simple R^2 is scaled such that it can achieve the value 1.[7]

[7] For a more detailed description of the generalized coefficient of determination, see [20], [21].

Table 16: Results of Stepwise Logistic Regressions, Multiparous Women with a Previous Cesarean Section

Variable	Position Entered in Model	χ^2-Score	p-value	R^2	Generalized R^2
1995					
Breech Presentation	8	844.90	0.0001	0.0408	0.0558
Placenta Abruptio, Placenta Previa	9	125.80	0.0001	0.0447	0.0610
Hypertension/Eclampsia/Pre-Eclampsia	10	114.30	0.0001	0.0480	0.0656
Gestational Diabetes	11	42.69	0.0001	0.0493	0.0673
Breech and Birth Weight < 1,500 grams	12	35.16	0.0001	0.0501	0.0685
No Prenatal Care	13	29.16	0.0001	0.0509	0.0696
Premature Rupture of Membranes	14	28.40	0.0001	0.0517	0.0707
African American	15	23.12	0.0001	0.0524	0.0716
Genital Herpes	16	22.72	0.0001	0.0530	0.0725
Hypertension and Birth Weight 1,500-<2,500 grams	17	22.08	0.0001	0.0537	0.0734
Insulin-dependent Diabetes	18	21.47	0.0001	0.0543	0.0743
Hypertension and Birth Weight < 1,500 grams	19	20.31	0.0001	0.0550	0.0752
Postterm Pregnancy	20	20.08	0.0001	0.0556	0.0760
Large for Gestational Age	21	16.25	0.0001	0.0560	0.0766
South East Asian	22	13.96	0.0002	0.0564	0.0772
Other Asian	23	12.45	0.0004	0.0568	0.0776
Anemia	24	10.53	0.0012	0.0571	0.0780
Hispanic	25	4.14	0.0418	0.0572	0.0782
Hypertension and Oligohydramnios	26	3.98	0.0459	0.0573	0.0784
1996					
Breech Presentation	8	883.90	0.0001	0.0435	0.0593
Placenta Abruptio, Placenta Previa	9	150.60	0.0001	0.0481	0.0657
Hypertension/Eclampsia/Pre-Eclampsia	10	82.10	0.0001	0.0506	0.0690
Postterm Pregnancy	11	74.57	0.0001	0.0527	0.0719
Breech and Birth Weight < 1,500 grams	12	64.33	0.0001	0.0543	0.0740
Gestational Diabetes	13	45.45	0.0001	0.0556	0.0758
South East Asian	14	40.44	0.0001	0.0568	0.0774
Anemia	15	29.95	0.0001	0.0576	0.0786
Genital Herpes	16	28.27	0.0001	0.0585	0.0798
Hypertension and Birth Weight < 1,500 grams	17	26.90	0.0001	0.0594	0.0810
No Prenatal Care	18	26.75	0.0001	0.0601	0.0820
Large for Gestational Age	19	26.90	0.0001	0.0609	0.0831
Hypertension and Birth Weight 1,500-<2,500 grams	20	25.51	0.0001	0.0617	0.0841
Insulin-dependent Diabetes	21	19.10	0.0001	0.0622	0.0849
Intrauterine Growth Retardation	22	17.19	0.0001	0.0627	0.0856
Premature Rupture of Membranes	23	14.75	0.0001	0.0631	0.0861
Other Asian	24	10.97	0.0009	0.0635	0.0866
Native American	25	9.21	0.0024	0.0637	0.0869
Hispanic	26	7.66	0.0056	0.0639	0.0872
African American	27	5.78	0.0162	0.0641	0.0874
Gestational diabetes and Large for Gestational	28	4.67	0.0306	0.0642	0.0876

Age					
1997					
Breech Presentation	8	792.90	0.0001	0.0413	0.0567
Placenta Abruptio, Placenta Previa	9	124.10	0.0001	0.0453	0.0623
Postterm Pregnancy	10	105.30	0.0001	0.0484	0.0666
Hypertension/Eclampsia/Pre-Eclampsia	11	76.41	0.0001	0.0507	0.0698
Gestational Diabetes	12	43.98	0.0001	0.0521	0.0716
Breech and Birth Weight < 1,500 grams	13	34.60	0.0001	0.0529	0.0728
Insulin-dependent Diabetes	14	33.36	0.0001	0.0540	0.0742
Anemia	15	31.88	0.0001	0.0549	0.0755
No Prenatal Care	16	22.58	0.0001	0.0556	0.0765
Hypertension and Birth Weight < 1,500 grams	17	22.50	0.0001	0.0564	0.0776
South East Asian	18	18.59	0.0001	0.0569	0.0783
African American	19	17.05	0.0001	0.0574	0.0790
Genital Herpes	20	16.31	0.0001	0.0579	0.0797
Hypertension and Birth Weight 1,500-<2,500 grams	21	14.93	0.0001	0.0584	0.0803
Gestational diabetes and Large for Gestational Age	22	14.60	0.0001	0.0588	0.0809
Premature Rupture of Membranes	23	14.07	0.0002	0.0592	0.0815
Intrauterine Growth Retardation	24	10.54	0.0012	0.0596	0.0819
Other Asian	25	9.36	0.0022	0.0598	0.0823
Oligohydramnios	26	6.57	0.0104	0.0600	0.0826
Diabetes and Large for Gestational Age	27	3.87	0.0493	0.0601	0.0827

Notes:

1. Variables are shown in the order in which they were entered into the model.
2. The χ^2-score shows the value of the χ^2-statistic that is used to test the hypothesis that the coefficient for the variable to the left is zero.
3. The p-value is the probability that under the null hypothesis the χ^2-score is observed (see previous note).
4. For the generalized coefficient of determination, generalized R^2, the simple R^2 is scaled such that it can achieve the value 1.[8]

[8] For a more detailed description of the generalized coefficient of determination, see [20], [21].

5.5 Validation of Logistic Regression Models for Multiparous Women with and without a Previous Cesarean Section

Table 17: Validation of Final Logistic Regression Model, Multiparous Women without Previous Cesarean Section, 1995-1997

Characteristic		1995			1996			1997		
		Odds Ratio	Significance	Validation	Odds Ratio	Significance	Validation	Odds Ratio	Significance	Validation
	Birth Weight	0.63	***	Y	0.67	***	Y	0.64	***	Y
	Birth Weight*Birth Weight	1.02	***	Y	1.02	***	Y	1.02	***	Y
Maternal Age	under 20	0.85	**	Y	0.81	**	Y	0.95		Y
	20 to under 25	Reference Group								
	25 to under 30	1.18	***	Y	1.24	***	Y	1.28	***	Y
	30 to under 35	1.38	***	Y	1.46	***	Y	1.51	***	Y
	35 to under 40	1.8	***	Y	1.81	***	Y	1.85	***	Y
	40 or older	2.57	***	Y	2.41	***	Y	2.49	***	Y
High School	Completed	Reference Group								
	Not Completed	1.1	***	Y	1.04		Y	1.11	***	Y
Prenatal Care	Some	Reference Group								
	None	0.65	***	Y	0.55	***	Y	0.74	*	N
Race/Ethnicity	Non-Hispanic White	Reference Group								
	Hispanic	1.12	***	Y	1.19	***	Y	1.13	***	Y
	African American	1.36	***	Y	1.46	***	Y	1.41	***	Y
	Native American	1.01		Y	1.44	***	Y	1.12		Y
	South East Asian	0.94		Y	0.88		Y	0.86		Y
	Other Asian	0.75	***	Y	0.84	**	Y	0.79	***	Y
	Other Race	1.19	***	Y	1.11		Y	1.22	***	N
Clinical Factors	Breech Presentation	934.28	***	Y	1531.38	***	Y	1488.69	***	Y
	Anemia	1.88	***	Y	2.18	***	Y	2.03	***	Y
	Large for Gestational Age	1.44	***	Y	1.52	***	Y	1.42	***	Y
	Insulin-dependent Diabetes	1.69	***	N	2.23	***	Y	1.77	***	Y
	Gestational Diabetes	1.49	***	Y	1.58	***	Y	1.61	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension	2.08	***	Y	1.94	***	Y	1.81	***	Y
	Genital Herpes	17.85	***	N	26.18	***	Y	19.67	***	Y
	Intrauterine Growth Retardation	1.64	***	Y	1.59	***	Y	2.15	***	Y
	Oligohydramnios	2.29	***	Y	2.46	***	Y	2.12	***	Y
	Premature Rupture of Membranes	1.87	***	Y	1.79	***	Y	2.03	***	N
	Placenta Abruptio/Previa	16.05	***	Y	21.64	***	N	15.87	***	N

	Postterm Baby	1.57	***	Y	1.58	***	Y	1.54	***	Y
Interaction Terms	Hypertension and Oligohydramnios	0.64	*	Y	0.51	**	Y	0.54	**	Y
	Breech Presentation and Birth Weight 1,500-<2,500 grams	0.38	***	Y	0.35	***	Y	0.44	***	Y
	Breech Presentation and Birth Weight <1,500 grams	0.02	***	Y	0.01	***	Y	0.03	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension and Birth weight 1,500-	2.49	***	Y	1.75	***	N	2	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension and Birth weight <1,500	3.86	***	Y	6.41	***	Y	5.15	***	Y

Table 18: Generalized R2 and C-Statistic for Final Logistic Regression Model, Multiparous Women without Previous Cesarean Section, California, 1995-1997

Statistic	Evaluation Group	1995	1996	1997
Generalized R^2	for estimation sample	0.388	0.395	0.404
	for validation sample	0.395	0.399	0.401
	for total population	0.391	0.397	0.402
c-Statistic	based on estimation sample predictions for estimation sample	0.822	0.827	0.827
	based on estimation sample predictions for validation sample	0.828	0.828	0.827
	based on validation sample predictions for validation sample	0.821	0.828	0.825
	based on total population predictions for total population	0.824	0.828	0.827

Table 19: Validation of Final Logistic Regression Model, Multiparous Women with Previous Cesarean Section, California, 1995-1997

Characteristic		1995			1996			1997		
		Odds Ratio	Significance	Validation	Odds Ratio	Significance	Validation	Odds Ratio	Significance	Validation
	Birth Weight	0.95		Y	0.99		N	0.97		Y
	Birth Weight*Birth Weight	1	***	Y	1	*	N	1	***	Y
Maternal Age	under 20	0.9		Y	1.02		Y	0.76	***	Y
	20 to under 25	Reference Group								
	25 to under 30	1.09	*	Y	1.04		Y	1.04		Y
	30 to under 35	1.23	***	Y	1.17	***	Y	1.1	*	Y
	35 to under 40	1.38	***	Y	1.38	***	Y	1.27	***	Y
	40 or older	1.68	***	Y	1.5	***	Y	1.58	***	Y
High School	Completed	Reference Group								
	Not Completed	0.98		Y	0.96		Y	0.95		Y
Prenatal Care	Some	Reference Group								
	None	0.55	***	Y	0.52	***	Y	0.55	***	Y
Race/Ethnicity	Non-Hispanic White	Reference Group								
	Hispanic	1.06	*	Y	1.11	***	Y	1.03		Y
	African American	1.24	***	Y	1.12	*	N	1.19	***	Y
	Native American	0.99		Y	1.77	***	Y	0.88		Y
	South East Asian	0.69	***	Y	0.55	***	Y	0.65	***	Y
	Other Asian	0.83	**	Y	0.87	*	Y	0.84	**	Y
	Other Race	0.94		Y	1		Y	0.92		Y
Clinical Factors	Breech Presentation	29.26	***	Y	37.34	***	Y	34.91	***	Y
	Anemia	1.14	***	Y	1.25	***	Y	1.25	***	Y
	Large for Gestational Age	1.21	***	Y	1.24	***	Y	1.15	***	Y
	Insulin-dependent Diabetes	1.62	***	Y	1.69	***	Y	1.99	***	Y
	Gestational Diabetes	1.41	***	Y	1.41	***	Y	1.43	***	Y
	Eclampsia/Pre-Eclampsia/Hypertension	1.47	***	Y	1.32	***	Y	1.33	***	Y
	Genital Herpes	2.43	***	Y	2.45	***	Y	2.1	***	Y
	Intrauterine Growth Retardation	1.04		Y	1.48	***	N	1.33	***	Y
	Oligohydramnios	1.05		Y	1.1		Y	1.24	*	Y
	Premature Rupture of Membranes	0.62	***	Y	0.71	***	Y	0.71	***	Y
	Placenta Abruptio/Previa	2.83	***	Y	3.12	***	Y	2.92	***	Y
	Postterm Baby	0.75	***	N	0.57	***	Y	0.49	***	Y
Interaction Terms	Hypertension and Oligohydramnios	0.56	*	Y	0.54	*	Y	0.95		Y
	Breech Presentation and Birth Weight 1,500-<2,500 grams	1.1		Y	1.07		N	0.6		Y
	Breech Presentation and Birth Weight <1,500	0.19	***	Y	0.12	***	Y	0.19	***	Y

grams									
Eclampsia/Pre-Eclampsia/Hypertension and Birth weight 1,500-	2.74	***	N	2.3	***	Y	1.82	***	Y
Eclampsia/Pre-Eclampsia/Hypertension and Birth weight <1,500	7.47	***	Y	11.07	***	Y	7.87	***	Y

Table 20: Generalized R^2 and C-Statistic for Final Logistic Regression Model, Multiparous Women with Previous Cesarean Section, California, 1995-1997

Statistic	Evaluation Group	1995	1996	1997
Generalized R^2	for estimation sample	0.131	0.151	0.148
	for validation sample	0.141	0.149	0.141
	for total population	0.135	0.149	0.144
c-Statistic	based on estimation sample predictions for estimation sample	0.611	0.621	0.617
	based on estimation sample predictions for validation sample	0.620	0.615	0.610
	based on validation sample predictions for validation sample	0.608	0.617	0.616
	based on total population predictions for total population	0.615	0.617	0.613

5.6 Model Calibration for Final Regression Models for Multiparous Women with or without a Previous Cesarean Section

Table 21: Hosmer-Lemeshow Statistic for Final Logistic Regression Models, Multiparous Women Without Previous Cesarean Section, 1995-1997

Evaluation Group	1995	1996	1997
based on estimation sample predictions for estimation sample	16.342	21.849	20.982
based on estimation sample predictions for validation sample	46.922	25.807	33.841
based on validation sample predictions for validation sample	11.377	22.814	12.496
based on total population predictions for total population	36.403	45.216	36.062

Table 22: Observed and Expected Cesarean Sections for Hosmer-Lemeshow Test Induced Subgroups, Multiparous Women Without Previous Cesarean Section, 1995-1997

	1995				1996				1997			
Group	N	Obs. C/S	Pred. C/S	Difference	N	Obs. C/S	Pred. C/S	Difference	N	Obs. C/S	Pred. C/S	Difference
1	23,722	363	352	11	23,323	329	328	1	22,456	309	317	8
2	23,725	419	456	37	23,319	375	431	56	22,459	378	409	31
3	23,698	462	528	66	23,366	450	512	62	22,486	465	486	21
4	23,619	523	586	63	23,319	510	579	69	22,460	491	554	63
5	23,724	627	661	34	23,316	633	661	28	22,545	579	640	61
6	23,743	758	768	10	23,320	769	762	7	22,452	714	740	26
7	23,718	922	928	6	23,329	882	919	37	22,458	848	893	45
8	23,723	1,194	1,206	12	23,319	1,212	1,197	15	22,457	1,187	1,150	37
9	23,723	1,867	1,742	125	23,319	1,795	1,761	34	22,460	1,737	1,664	73
10	23,824	9,169	8,988	181	23,249	9,079	8,768	311	22,348	8,636	8,393	243

Table 23: Hosmer-Lemeshow Statistic for Final Logistic Regression Models, Multiparous Women With Previous Cesarean Section, 1995-1997

Evaluation Group	1995	1996	1997
based on estimation sample predictions for estimation sample	6.677	8.615	8.804
based on estimation sample predictions for validation sample	17.613	29.036	21.573
based on validation sample predictions for validation sample	31.491	12.935	17.397
based on total population predictions for total population	11.893	11.703	10.196

Table 24: Observed and Expected Cesarean Sections for Hosmer-Lemeshow Test Induced Subgroups, Multiparous Women With Previous Cesarean Section, 1995-1997

	1995				1996				1997			
Group	N	Obs. C/S	Pred. C/S	Difference	N	Obs. C/S	Pred. C/S	Difference	N	Obs. C/S	Pred. C/S	Difference
1	6,690	3,336	3,324	12	6,595	3,205	3,233	28	6,357	3,192	3,215	23
2	6,689	3,747	3,673	74	6,579	3,678	3,593	85	6,369	3,680	3,627	53
3	6,688	3,822	3,799	23	6,595	3,723	3,725	2	6,360	3,787	3,742	45
4	6,689	3,830	3,901	71	6,594	3,835	3,827	8	6,360	3,841	3,834	7
5	6,689	3,952	3,999	47	6,587	3,936	3,922	14	6,361	3,873	3,924	51
6	6,689	4,097	4,105	8	6,600	4,030	4,040	10	6,363	3,974	4,019	45
7	6,692	4,211	4,236	25	6,587	4,112	4,165	53	6,356	4,163	4,126	37
8	6,689	4,440	4,418	22	6,594	4,333	4,350	17	6,362	4,243	4,289	46
9	6,690	4,730	4,752	22	6,594	4,654	4,697	43	6,360	4,569	4,573	4
10	6,671	5,975	5,934	41	6,606	5,946	5,902	44	6,342	5,702	5,676	26

5.7 Detailed Results of Final Regression Models

Table 25: Detailed Results for Final Regression Models

Nulliparous	Parameter Estimate	Standard Error	Wald χ^2	Prob>χ^2	Standardized Estimate	Odds Ratio
1995						
Intercept	-0.634	0.066	92.3	0.0001	.	
Uncorrected Birth Weight (grams)	-0.001	0.000	498.3	0.0001	-0.486	0.7
Quadratic Term in Birth Weight	0.000	0.000	1056.0	0.0001	0.692	1.02
Maternal Age < 20	-0.176	0.011	276.5	0.0001	-0.076	0.75
Maternal Age 25-<30	0.190	0.010	374.2	0.0001	0.080	1.35
Maternal Age 30-<35	0.338	0.011	945.7	0.0001	0.124	1.72
Maternal Age 35-<40	0.538	0.015	1339.5	0.0001	0.129	2.39
Maternal Age >=40	0.725	0.029	642.6	0.0001	0.080	3.27
No High School Degree (Mother)	0.020	0.009	4.8	0.0287	0.009	1.03
No Prenatal Care	-0.268	0.048	30.9	0.0001	-0.022	0.65
Hispanic	0.180	0.009	418.8	0.0001	0.089	1.33
African American	0.312	0.014	468.7	0.0001	0.078	1.65
Native American	0.170	0.051	11.0	0.0009	0.011	1.31
South East Asian	0.092	0.026	12.9	0.0003	0.013	1.16
Other Asian	0.019	0.015	1.6	0.2067	0.005	1.03
Other Race	0.139	0.019	51.2	0.0001	0.025	1.25
Breech Presentation	3.098	0.036	7408.6	0.0001	0.597	1027.05
Anemia	0.198	0.012	283.8	0.0001	0.055	1.37
Large for Gestational Age	0.184	0.016	133.7	0.0001	0.040	1.34
Insulin-dependent Diabetes	0.487	0.044	120.9	0.0001	0.034	2.19
Gestational Diabetes	0.254	0.021	144.0	0.0001	0.038	1.5
Hypertension/Eclampsia/Pre-Eclampsia	0.575	0.013	1925.2	0.0001	0.149	2.54
Genital Herpes	1.330	0.046	837.5	0.0001	0.087	9.89
Intrauterine Growth Retardation	0.323	0.022	211.5	0.0001	0.051	1.68
Oligohydramnios	0.532	0.020	701.2	0.0001	0.088	2.36
Premature Rupture of Membranes	0.384	0.017	487.2	0.0001	0.069	1.85
Placenta Abruptio/Previa	1.143	0.028	1658.8	0.0001	0.124	6.91
Postterm Pregnancy	0.418	0.013	1069.7	0.0001	0.101	1.96
Hypertension and Oligohydramnios	-0.419	0.060	49.3	0.0001	-0.023	0.51
Breech and Birth Weight 1,500-<2,500 grams	-0.442	0.083	28.8	0.0001	-0.028	0.49
Breech and Birth Weight < 1,500 grams	-1.952	0.087	509.3	0.0001	-0.089	0.03
Hypertension and Birth Weight 1,500-<2,500 grams	0.411	0.034	145.4	0.0001	0.041	1.94
Hypertension and Birth Weight < 1,500 grams	1.146	0.082	197.7	0.0001	0.054	6.94
1996						
Intercept	-0.853	0.068	157.2	0.0001	.	
Uncorrected Birth Weight (grams)	-0.001	0.000	336.7	0.0001	-0.407	0.74
Quadratic term in birth weight	0.000	0.000	807.4	0.0001	0.612	1.02

Maternal Age < 20	-0.201	0.011	334.4	0.0001	-0.086	0.72
Maternal Age 25-<30	0.153	0.010	227.6	0.0001	0.065	1.28
Maternal Age 30-<35	0.321	0.011	810.8	0.0001	0.118	1.67
Maternal Age 35-<40	0.512	0.015	1174.7	0.0001	0.125	2.29
Maternal Age >=40	0.706	0.029	609.0	0.0001	0.080	3.16
No High School Degree (Mother)	0.038	0.010	15.0	0.0001	0.017	1.06
No Prenatal Care	-0.200	0.055	13.3	0.0003	-0.015	0.73
Hispanic	0.176	0.009	372.7	0.0001	0.087	1.32
African American	0.284	0.015	360.1	0.0001	0.071	1.58
Native American	0.178	0.054	11.1	0.0009	0.012	1.33
South East Asian	0.012	0.026	0.2	0.6623	0.002	1.02
Other Asian	0.057	0.015	13.9	0.0002	0.014	1.1
Other Race	0.153	0.019	62.5	0.0001	0.029	1.28
Breech Presentation	3.193	0.039	6629.7	0.0001	0.621	1418.66
Anemia	0.214	0.012	314.7	0.0001	0.059	1.41
Large for Gestational Age	0.210	0.016	169.7	0.0001	0.046	1.4
Insulin-dependent Diabetes	0.528	0.047	124.2	0.0001	0.035	2.35
Gestational Diabetes	0.270	0.021	170.1	0.0001	0.042	1.54
Hypertension/Eclampsia/Pre-Eclampsia	0.565	0.014	1747.2	0.0001	0.147	2.49
Genital Herpes	1.260	0.044	834.8	0.0001	0.088	8.64
Intrauterine Growth Retardation	0.301	0.023	170.8	0.0001	0.048	1.62
Oligohydramnios	0.520	0.020	661.3	0.0001	0.089	2.32
Premature Rupture of Membranes	0.411	0.018	544.2	0.0001	0.075	1.94
Placenta Abruptio/Previa	1.132	0.030	1438.2	0.0001	0.119	6.77
Postterm Pregnancy	0.419	0.013	976.3	0.0001	0.099	1.96
Hypertension and Oligohydramnios	-0.387	0.059	43.2	0.0001	-0.023	0.54
Breech and Birth Weight 1,500-<2,500 grams	-0.439	0.087	25.5	0.0001	-0.029	0.49
Breech and Birth Weight < 1,500 grams	-1.896	0.090	443.5	0.0001	-0.089	0.03
Hypertension and Birth Weight 1,500-<2,500 grams	0.403	0.035	134.8	0.0001	0.041	1.91
Hypertension and Birth Weight < 1,500 grams	1.408	0.083	289.3	0.0001	0.072	11.56
1997						
Intercept	-0.705	0.070	100.3	0.0001	.	
Uncorrected Birth Weight (grams)	-0.001	0.000	405.7	0.0001	-0.466	0.71
Quadratic term in birth weight	0.000	0.000	888.1	0.0001	0.674	1.02
Maternal Age < 20	-0.204	0.011	320.3	0.0001	-0.087	0.72
Maternal Age 25-<30	0.177	0.010	294.4	0.0001	0.075	1.33
Maternal Age 30-<35	0.341	0.011	888.6	0.0001	0.127	1.73
Maternal Age 35-<40	0.551	0.015	1387.5	0.0001	0.140	2.44
Maternal Age >=40	0.769	0.028	752.1	0.0001	0.091	3.53
No High School Degree (Mother)	0.044	0.010	19.5	0.0001	0.020	1.07
No Prenatal Care	-0.199	0.053	13.9	0.0002	-0.015	0.73
Hispanic	0.168	0.009	327.5	0.0001	0.083	1.31
African American	0.295	0.015	373.0	0.0001	0.073	1.6
Native American	0.137	0.054	6.4	0.0114	0.009	1.24
South East Asian	0.048	0.025	3.5	0.0610	0.007	1.08
Other Asian	0.017	0.015	1.2	0.2639	0.004	1.03

Other Race	0.150	0.020	59.4	0.0001	0.028	1.27
Breech Presentation	3.161	0.039	6540.5	0.0001	0.611	1269.51
Anemia	0.177	0.012	210.1	0.0001	0.050	1.33
Large for Gestational Age	0.198	0.017	139.0	0.0001	0.042	1.37
Insulin-dependent Diabetes	0.710	0.048	215.1	0.0001	0.047	3.19
Gestational Diabetes	0.223	0.021	115.5	0.0001	0.036	1.43
Hypertension/Eclampsia/Pre-Eclampsia	0.568	0.014	1723.0	0.0001	0.148	2.51
Genital Herpes	1.145	0.045	640.8	0.0001	0.078	6.93
Intrauterine Growth Retardation	0.299	0.023	170.3	0.0001	0.049	1.62
Oligohydramnios	0.505	0.020	612.9	0.0001	0.086	2.26
Premature Rupture of Membranes	0.384	0.018	436.7	0.0001	0.068	1.85
Placenta Abruptio/Previa	1.195	0.030	1610.6	0.0001	0.128	7.62
Postterm Pregnancy	0.404	0.013	919.4	0.0001	0.098	1.92
Hypertension and Oligohydramnios	-0.290	0.062	22.0	0.0001	-0.016	0.63
Breech and Birth Weight 1,500-<2,500 grams	-0.367	0.091	16.4	0.0001	-0.024	0.55
Breech and Birth Weight < 1,500 grams	-1.991	0.091	482.8	0.0001	-0.091	0.02
Hypertension and Birth Weight 1,500-<2,500 grams	0.395	0.035	125.4	0.0001	0.040	1.89
Hypertension and Birth Weight < 1,500 grams	1.290	0.083	241.5	0.0001	0.065	9.16

Multiparous without Previous Cesarean Section	**Parameter Estimate**	**Standard Error**	**Wald χ^2**	**Prob>χ^2**	**Standardized Estimate**	**Odds Ratio**
1995						
Intercept	-0.496	0.071	49.4	0.0001	.	
Uncorrected Birth Weight (grams)	-0.001	0.000	718.8	0.0001	-0.603	0.64
Quadratic term in birth weight	0.000	0.000	809.8	0.0001	0.650	1.02
Maternal Age < 20	-0.089	0.028	10.3	0.0013	-0.019	0.87
Maternal Age 25-<30	0.106	0.014	55.8	0.0001	0.048	1.18
Maternal Age 30-<35	0.196	0.014	187.8	0.0001	0.087	1.37
Maternal Age 35-<40	0.358	0.016	493.4	0.0001	0.121	1.78
Maternal Age >=40	0.566	0.024	547.7	0.0001	0.095	2.5
No High School Degree (Mother)	0.045	0.011	16.0	0.0001	0.022	1.07
No Prenatal Care	-0.284	0.044	41.2	0.0001	-0.033	0.63
Hispanic	0.080	0.012	43.4	0.0001	0.040	1.14
African American	0.219	0.018	141.9	0.0001	0.056	1.42
Native American	0.079	0.066	1.4	0.2294	0.006	1.13
South East Asian	-0.013	0.035	0.1	0.7071	-0.002	0.98
Other Asian	-0.183	0.026	49.9	0.0001	-0.040	0.75
Other Race	0.096	0.027	12.5	0.0004	0.016	1.17
Breech Presentation	3.108	0.027	13256.8	0.0001	0.463	1061.38
Anemia	0.408	0.015	698.4	0.0001	0.099	1.93
Large for Gestational Age	0.240	0.018	186.7	0.0001	0.060	1.47
Insulin-dependent Diabetes	0.423	0.045	89.6	0.0001	0.031	1.98
Gestational Diabetes	0.271	0.023	144.4	0.0001	0.045	1.54
Hypertension/Eclampsia/Pre-Eclampsia	0.452	0.023	377.7	0.0001	0.076	2.07
Genital Herpes	1.733	0.052	1109.8	0.0001	0.088	23.07

Intrauterine Growth Retardation	0.328	0.030	118.3	0.0001	0.041	1.69
Oligohydramnios	0.544	0.029	347.6	0.0001	0.067	2.41
Premature Rupture of Membranes	0.383	0.030	164.7	0.0001	0.046	1.85
Placenta Abruptio/Previa	1.599	0.024	4445.4	0.0001	0.188	17.19
Postterm Pregnancy	0.295	0.020	225.7	0.0001	0.059	1.6
Hypertension and Oligohydramnios	-0.286	0.096	8.9	0.0029	-0.010	0.63
Breech and Birth Weight 1,500-<2,500 grams	-0.690	0.070	97.3	0.0001	-0.035	0.32
Breech and Birth Weight < 1,500 grams	-2.002	0.082	590.5	0.0001	-0.081	0.02
Hypertension and Birth Weight 1,500-<2,500 grams	0.570	0.052	119.5	0.0001	0.036	2.51
Hypertension and Birth Weight < 1,500 grams	0.949	0.102	87.4	0.0001	0.030	4.83
1996						
Intercept	-0.655	0.069	90.5	0.0001	.	
Uncorrected Birth Weight (grams)	-0.001	0.000	715.4	0.0001	-0.569	0.66
Quadratic term in birth weight	0.000	0.000	864.5	0.0001	0.628	1.02
Maternal Age < 20	-0.126	0.030	18.1	0.0001	-0.026	0.82
Maternal Age 25-<30	0.135	0.015	86.7	0.0001	0.062	1.24
Maternal Age 30-<35	0.239	0.015	266.4	0.0001	0.106	1.47
Maternal Age 35-<40	0.370	0.016	511.9	0.0001	0.127	1.81
Maternal Age >=40	0.547	0.024	510.9	0.0001	0.095	2.42
No High School Degree (Mother)	0.036	0.011	10.0	0.0016	0.017	1.06
No Prenatal Care	-0.340	0.053	41.0	0.0001	-0.035	0.58
Hispanic	0.096	0.012	60.6	0.0001	0.048	1.17
African American	0.209	0.019	121.0	0.0001	0.052	1.4
Native American	0.177	0.062	8.1	0.0044	0.013	1.33
South East Asian	-0.036	0.037	0.9	0.3307	-0.005	0.94
Other Asian	-0.105	0.025	17.7	0.0001	-0.023	0.85
Other Race	0.046	0.028	2.6	0.1060	0.008	1.08
Breech Presentation	3.216	0.030	11798.6	0.0001	0.467	1539.04
Anemia	0.461	0.015	899.2	0.0001	0.112	2.1
Large for Gestational Age	0.244	0.017	199.3	0.0001	0.062	1.48
Insulin-dependent Diabetes	0.477	0.047	103.7	0.0001	0.033	2.16
Gestational Diabetes	0.302	0.021	198.7	0.0001	0.052	1.62
Hypertension/Eclampsia/Pre-Eclampsia	0.408	0.024	302.4	0.0001	0.071	1.93
Genital Herpes	1.755	0.050	1225.7	0.0001	0.092	24.25
Intrauterine Growth Retardation	0.310	0.031	100.3	0.0001	0.039	1.64
Oligohydramnios	0.570	0.028	418.7	0.0001	0.074	2.52
Premature Rupture of Membranes	0.381	0.030	159.4	0.0001	0.046	1.84
Placenta Abruptio/Previa	1.653	0.025	4492.6	0.0001	0.191	19.34
Postterm Pregnancy	0.298	0.020	221.0	0.0001	0.059	1.61
Hypertension and Oligohydramnios	-0.352	0.097	13.2	0.0003	-0.012	0.57
Breech and Birth Weight 1,500-<2,500 grams	-0.675	0.076	79.2	0.0001	-0.033	0.33
Breech and Birth Weight < 1,500 grams	-2.053	0.085	584.6	0.0001	-0.082	0.02
Hypertension and Birth Weight 1,500-<2,500 grams	0.484	0.052	87.5	0.0001	0.032	2.18
Hypertension and Birth Weight < 1,500 grams	1.054	0.100	110.8	0.0001	0.034	5.85
1997						

Intercept	-0.553	0.074	56.2	0.0001	.	
Uncorrected Birth Weight (grams)	-0.001	0.000	693.4	0.0001	-0.601	0.64
Quadratic term in birth weight	0.000	0.000	823.8	0.0001	0.661	1.02
Maternal Age < 20	-0.081	0.030	7.4	0.0066	-0.017	0.88
Maternal Age 25-<30	0.133	0.015	79.9	0.0001	0.061	1.24
Maternal Age 30-<35	0.245	0.015	267.7	0.0001	0.109	1.48
Maternal Age 35-<40	0.382	0.017	527.2	0.0001	0.132	1.85
Maternal Age >=40	0.556	0.025	510.0	0.0001	0.097	2.46
No High School Degree (Mother)	0.055	0.012	22.6	0.0001	0.026	1.09
No Prenatal Care	-0.075	0.048	2.5	0.1168	-0.008	0.89
Hispanic	0.096	0.013	58.5	0.0001	0.048	1.17
African American	0.216	0.019	124.0	0.0001	0.054	1.41
Native American	0.077	0.067	1.3	0.2510	0.006	1.13
South East Asian	-0.078	0.039	4.0	0.0459	-0.011	0.88
Other Asian	-0.185	0.027	48.1	0.0001	-0.040	0.74
Other Race	0.069	0.028	6.4	0.0117	0.012	1.12
Breech Presentation	3.240	0.030	11761.2	0.0001	0.476	1672.11
Anemia	0.436	0.015	796.9	0.0001	0.109	2.02
Large for Gestational Age	0.215	0.018	142.0	0.0001	0.054	1.41
Insulin-dependent Diabetes	0.405	0.048	70.9	0.0001	0.029	1.92
Gestational Diabetes	0.295	0.022	189.1	0.0001	0.053	1.6
Hypertension/Eclampsia/Pre-Eclampsia	0.364	0.024	226.9	0.0001	0.063	1.79
Genital Herpes	1.653	0.053	962.1	0.0001	0.084	19.36
Intrauterine Growth Retardation	0.445	0.031	209.3	0.0001	0.055	2.05
Oligohydramnios	0.472	0.029	263.2	0.0001	0.061	2.14
Premature Rupture of Membranes	0.379	0.033	132.2	0.0001	0.043	1.84
Placenta Abruptio/Previa	1.619	0.025	4090.0	0.0001	0.185	17.98
Postterm Pregnancy	0.287	0.020	197.5	0.0001	0.057	1.58
Hypertension and Oligohydramnios	-0.223	0.103	4.7	0.0310	-0.007	0.7
Breech and Birth Weight 1,500-<2,500 grams	-0.646	0.080	64.7	0.0001	-0.031	0.35
Breech and Birth Weight < 1,500 grams	-2.047	0.091	510.1	0.0001	-0.079	0.02
Hypertension and Birth Weight 1,500-<2,500 grams	0.440	0.054	67.0	0.0001	0.028	2.03
Hypertension and Birth Weight < 1,500 grams	1.134	0.109	107.9	0.0001	0.035	6.78

Multiparous with Previous Cesarean Section	**Parameter Estimate**	**Standard Error**	**Wald χ^2**	**Prob>χ^2**	**Standardized Estimate**	**Odds Ratio**
1995						
Intercept	0.120	0.101	1.4	0.2357	.	
Uncorrected Birth Weight (grams)	0.000	0.000	6.5	0.0109	-0.089	0.94
Quadratic term in birth weight	0.000	0.000	25.0	0.0001	0.172	1
Maternal Age < 20	-0.019	0.034	0.3	0.5741	-0.003	0.97
Maternal Age 25-<30	0.037	0.016	5.6	0.0178	0.017	1.06
Maternal Age 30-<35	0.110	0.016	48.5	0.0001	0.051	1.19
Maternal Age 35-<40	0.185	0.018	105.8	0.0001	0.070	1.34
Maternal Age >=40	0.295	0.030	95.4	0.0001	0.056	1.6

No High School Degree (Mother)	-0.036	0.013	8.1	0.0043	-0.017	0.94
No Prenatal Care	-0.382	0.048	62.2	0.0001	-0.040	0.54
Hispanic	0.046	0.013	12.8	0.0003	0.023	1.08
African American	0.155	0.020	59.2	0.0001	0.042	1.28
Native American	0.045	0.070	0.4	0.5201	0.003	1.07
South East Asian	-0.277	0.045	37.6	0.0001	-0.031	0.64
Other Asian	-0.095	0.026	13.5	0.0002	-0.019	0.86
Other Race	-0.039	0.030	1.6	0.2014	-0.007	0.94
Breech Presentation	1.876	0.062	912.3	0.0001	0.394	32
Anemia	0.099	0.018	32.2	0.0001	0.029	1.17
Large for Gestational Age	0.130	0.021	36.9	0.0001	0.037	1.23
Insulin-dependent Diabetes	0.299	0.053	32.3	0.0001	0.032	1.62
Gestational Diabetes	0.200	0.026	60.6	0.0001	0.042	1.38
Hypertension/Eclampsia/Pre-Eclampsia	0.243	0.028	74.6	0.0001	0.052	1.48
Genital Herpes	0.557	0.080	48.4	0.0001	0.039	2.46
Intrauterine Growth Retardation	0.026	0.042	0.4	0.5462	0.003	1.04
Oligohydramnios	0.064	0.039	2.7	0.0977	0.009	1.11
Premature Rupture of Membranes	-0.255	0.040	40.8	0.0001	-0.033	0.66
Placenta Abruptio/Previa	0.656	0.041	255.8	0.0001	0.097	2.91
Postterm Pregnancy	-0.255	0.028	82.7	0.0001	-0.045	0.66
Hypertension and Oligohydramnios	-0.421	0.121	12.1	0.0005	-0.020	0.51
Breech and Birth Weight 1,500-<2,500 grams	0.077	0.194	0.2	0.6906	0.005	1.13
Breech and Birth Weight < 1,500 grams	-0.975	0.147	44.2	0.0001	-0.054	0.2
Hypertension and Birth Weight 1,500-<2,500 grams	0.459	0.079	33.4	0.0001	0.038	2.09
Hypertension and Birth Weight < 1,500 grams	1.078	0.171	39.8	0.0001	0.055	6.12
1996						
Intercept	0.118	0.106	1.2	0.2665	.	
Uncorrected Birth Weight (grams)	0.000	0.000	9.1	0.0026	-0.110	0.93
Quadratic term in birth weight	0.000	0.000	32.3	0.0001	0.205	1.01
Maternal Age < 20	-0.007	0.034	0.0	0.8446	-0.001	0.99
Maternal Age 25-<30	0.042	0.016	7.0	0.0081	0.019	1.07
Maternal Age 30-<35	0.099	0.016	38.2	0.0001	0.046	1.17
Maternal Age 35-<40	0.194	0.018	113.6	0.0001	0.074	1.36
Maternal Age >=40	0.257	0.030	74.6	0.0001	0.050	1.51
No High School Degree (Mother)	-0.008	0.013	0.4	0.5049	-0.004	0.99
No Prenatal Care	-0.451	0.057	61.6	0.0001	-0.040	0.48
Hispanic	0.056	0.013	18.7	0.0001	0.028	1.09
African American	0.126	0.021	37.6	0.0001	0.034	1.22
Native American	0.266	0.071	14.2	0.0002	0.020	1.53
South East Asian	-0.308	0.046	45.1	0.0001	-0.034	0.61
Other Asian	-0.080	0.026	9.4	0.0022	-0.016	0.88
Other Race	-0.032	0.030	1.1	0.2880	-0.006	0.95
Breech Presentation	2.019	0.071	814.4	0.0001	0.422	44.97
Anemia	0.147	0.018	67.9	0.0001	0.043	1.26
Large for Gestational Age	0.121	0.022	30.8	0.0001	0.034	1.21
Insulin-dependent Diabetes	0.361	0.055	43.3	0.0001	0.038	1.78

Gestational Diabetes	0.212	0.025	72.6	0.0001	0.047	1.4
Hypertension/Eclampsia/Pre-Eclampsia	0.179	0.028	40.4	0.0001	0.038	1.33
Genital Herpes	0.553	0.076	53.2	0.0001	0.041	2.45
Intrauterine Growth Retardation	0.162	0.043	14.4	0.0001	0.021	1.29
Oligohydramnios	0.054	0.039	2.0	0.1582	0.008	1.09
Premature Rupture of Membranes	-0.190	0.039	23.7	0.0001	-0.025	0.74
Placenta Abruptio/Previa	0.716	0.041	298.4	0.0001	0.107	3.22
Postterm Pregnancy	-0.348	0.030	137.7	0.0001	-0.058	0.57
Hypertension and Oligohydramnios	-0.171	0.134	1.6	0.2034	-0.008	0.76
Breech and Birth Weight 1,500-<2,500 grams	-0.315	0.166	3.6	0.0579	-0.021	0.6
Breech and Birth Weight < 1,500 grams	-1.450	0.146	98.8	0.0001	-0.075	0.08
Hypertension and Birth Weight 1,500-<2,500 grams	0.399	0.077	27.1	0.0001	0.033	1.9
Hypertension and Birth Weight < 1,500 grams	1.197	0.171	48.8	0.0001	0.062	7.64
1997						
Intercept	-0.016	0.107	0.0	0.8799	.	
Uncorrected Birth Weight (grams)	0.000	0.000	0.3	0.5730	-0.020	0.99
Quadratic term in birth weight	0.000	0.000	9.2	0.0024	0.109	1
Maternal Age < 20	-0.121	0.035	11.8	0.0006	-0.019	0.82
Maternal Age 25-<30	0.032	0.016	3.9	0.0493	0.014	1.05
Maternal Age 30-<35	0.079	0.016	23.2	0.0001	0.036	1.13
Maternal Age 35-<40	0.157	0.018	73.3	0.0001	0.061	1.29
Maternal Age >=40	0.256	0.030	74.2	0.0001	0.052	1.51
No High School Degree (Mother)	-0.019	0.013	2.2	0.1383	-0.009	0.97
No Prenatal Care	-0.421	0.058	52.9	0.0001	-0.038	0.51
Hispanic	0.026	0.013	3.9	0.0481	0.013	1.04
African American	0.114	0.021	28.5	0.0001	0.030	1.2
Native American	-0.018	0.074	0.1	0.8089	-0.001	0.97
South East Asian	-0.282	0.046	38.0	0.0001	-0.032	0.64
Other Asian	-0.097	0.026	13.8	0.0002	-0.020	0.86
Other Race	-0.056	0.031	3.3	0.0675	-0.010	0.91
Breech Presentation	1.951	0.071	765.7	0.0001	0.413	38.16
Anemia	0.132	0.018	55.0	0.0001	0.040	1.24
Large for Gestational Age	0.102	0.023	20.4	0.0001	0.028	1.18
Insulin-dependent Diabetes	0.382	0.055	48.9	0.0001	0.042	1.85
Gestational Diabetes	0.191	0.025	59.5	0.0001	0.043	1.36
Hypertension/Eclampsia/Pre-Eclampsia	0.190	0.029	43.0	0.0001	0.040	1.35
Genital Herpes	0.434	0.081	28.9	0.0001	0.030	2.01
Intrauterine Growth Retardation	0.173	0.043	16.3	0.0001	0.023	1.32
Oligohydramnios	0.092	0.039	5.5	0.0192	0.013	1.16
Premature Rupture of Membranes	-0.236	0.041	32.5	0.0001	-0.030	0.69
Placenta Abruptio/Previa	0.692	0.043	254.6	0.0001	0.101	3.09
Postterm Pregnancy	-0.405	0.031	175.3	0.0001	-0.067	0.52
Hypertension and Oligohydramnios	-0.091	0.149	0.4	0.5424	-0.004	0.87
Breech and Birth Weight 1,500-<2,500 grams	-0.408	0.164	6.2	0.0127	-0.026	0.52
Breech and Birth Weight < 1,500 grams	-1.122	0.151	55.0	0.0001	-0.060	0.15
Hypertension and Birth Weight 1,500-<2,500	0.343	0.076	20.4	0.0001	0.030	1.73

grams						
Hypertension and Birth Weight < 1,500 grams	1.123	0.183	37.5	0.0001	0.054	6.65

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