Cesarean without Attempting Vaginal Birth: A Retrospective Cohort Study

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Abstract

Objective: To determine the contribution that pre-labor cesarean (cesarean performed without attempting vaginal birth) makes to all cesarean births, and to cesarean births within subgroups of the pregnant population. Design: Retrospective cohort study. Setting: 15 hospitals in the Pacific Northwest of the United States. Population: Births at 23+0-42+6 weeks' gestation between January 1, 2017 and March 31, 2018. Methods: Review of clinical data abstracted from medical records. Main Outcome Measures: The contribution of pre-labor cesarean to all cesareans and to primary cesareans. The indications for pre-labor primary cesarean in singleton term cephalic pregnancies. Results: Of 32756 births in the study population, 10290 (31.4%) were cesarean births. Pre-labor cesareans represented: 63.7% of all cesareans; 32.4% of cesareans in nulliparas; 58.7% of cesareans in multiparas with no history of cesarean; and 20.0% of all births. Pre-labor cesareans constituted 68.3% (2418/3542) of cesareans in singleton term cephalic multiparas with one previous cesarean, 89.4% (356/398) of cesareans in multiple pregnancies, and 53.2% (216/406) of cesareans in twin pregnancies where Baby A was cephalic. In singleton term cephalic pregnancies with no previous cesarean 18.3% (674/3682) of cesareans were pre-labor and suspected macrosomia (28.9%) and maternal request (18.1%), jointly accounted for 47.0% of indications for these surgeries. Conclusions: Cesarean without attempting vaginal birth is a major contributor to both primary and repeat cesarean birth rates. Greater tracking of the rate and indications for these cesarean births may be important in the effort to understand and potentially reduce the primary cesarean birth rate.

Tweetable abstract:

Pre-labor cesarean (cesarean without attempting vaginal birth) is a major contributor to primary and repeat cesarean birth rates.

Introduction

In 2012, national guidelines were published in the United States with the goal of reducing the first or "primary" cesarean birth.[1,2] These guidelines considered a broad range of opportunities to reduce cesarean birth but focused predominantly on strategies to reduce the rate of primary cesarean in labor ("intrapartum cesarean"). The contribution of pre-labor cesarean, cesarean without an attempt at labor or vaginal birth, has received much less attention.

Recently Hehir et al.[3] used US vital statistics birth certificate data and the Robson 10-Group Classification System[4] to examine cesarean birth rates in the US between 2005 and 2014. Cesareans identified in the birth certificate as being performed without a trial of labor were assigned as "pre-labor". The study suggested pre-labor cesareans in singleton term cephalic pregnancies with no history of cesarean constituted 27% of

all cesareans in the US. Additionally, studies in Ireland[5]and Australia[6] identified increases in both repeat cesarean *and* pre-labor cesarean in singleton term cephalic nulliparas as contributing to an increase in the total cesarean rate between 2005 and 2014.

The goal of our study was to evaluate the contribution of cesarean performed without attempting vaginal birth to all cesareans, and to cesareans within subgroups of the pregnant population. Additionally, stimulated by the studies by Hehir et al.[3], we wanted to evaluate the rate and indications for cesarean without attempting vaginal birth in singleton term cephalic pregnancies with no history of cesarean.

Methods :

This retrospective cohort study included births of 23^{+0}-42^{+6} weeks' gestation at 15 hospitals (5 Level I, 4 Level II, and 6 Level III/IV) in the Pacific Northwest of the US between January 1, 2017 and March 31, 2018. Intra-partum transfers from other hospitals or planned community-based birth settings were excluded.

The data for the study came from the Foundation for Health Care Quality's Obstetrical Care Outcomes Assessment Program (OB COAP), an ongoing multicenter, clinician-led, perinatal quality collaborative that has been previously described in detail.[7] The program collects data from the medical records of consecutive births> 20 weeks' gestation at hospitals in urban, suburban, and rural settings. Trained abstractors at each site enter the data into a cloud-based database. Subsets of variables are also uploaded electronically from electronic medical records at some sites. Data undergo real-time data quality and validation checks, both at the site and aggregate level. Ad hoc quality checks are also conducted on a routine basis by OB COAP staff. Patients were not involved in the study.

Cesareans performed without attempting vaginal birth in the OB COAP database are defined as cesareans where "surgical delivery has been previously planned (planned primary or repeat cesarean) or if [the] patient presents with an immediate need to deliver surgically (unexpected maternal or fetal compromise upon presentation)". These cesareans were assigned as "pre-labor", although it is likely that some of these women were in labor at the time of initial presentation to hospital.

Characteristics of the study population were explored including demographic, pre-pregnancy, and pregnancy characteristics, and hospital level of neonatal care (I – III/IV). Fisher's exact test was used to test for association between demographic characteristics and whether vaginal birth was attempted.

Births in the study population were then grouped using the Robson 10-Group Classification System,[4] described in detail on the World Health Organization website.[8] The Robson classification categorizes all births in the population into ten mutually exclusive groups based on parity, type of labor (spontaneous or induced), previous cesarean birth, presentation, plurality, and gestational age at birth (term or preterm) (Table 1).

The contribution of each of the Robson classification groups to all births in the study population, the cesarean birth rate in each group, the contribution of cesareans in the group to all births ("absolute contribution"), and the contribution of cesareans in the group to all cesarean births ("relative contribution"), were calculated. In addition, we calculated the percentage of cesareans in each Robson group that were pre-labor cesareans. For multiple pregnancies, cesarean rates were based on the birth of the presenting baby (Baby A). Births that could not be assigned to a Robson group because of missing data were categorized as "non-classifiable". The rate of pre-labor cesarean in the nulliparous term singleton vertex (NTSV) population (Robson groups 1, 2a, and 2b), the standardized metric for cesarean birth in nulliparas in the US, was additionally examined.

The primary cesarean (first cesarean irrespective of parity) rate cannot be calculated directly from the Robson classification because some of the Robson groups (7, 8, 9 and 10) include patients with and without previous cesarean births. As a result, we separately calculated the rate of primary cesarean, the percentage of all births that were pre-labor cesareans, and the percentage of all cesareans that were pre-labor in women with no history of cesarean birth.

Indications for pre-labor cesareans in singleton term cephalic pregnancies with no history of cesarean (Robson groups 2b and 4b) were also examined. The "indication for cesarean" field in the OB COAP database includes

the primary indication for cesarean stated in the surgeon's operative note. If a patient had a cesarean planned but presented in labor with or without ruptured membranes, data abstractors were directed to enter the original indication for the planned cesarean in the "indication for cesarean" field. The "indication for cesarean" field includes 20 specific indications for cesarean birth and the option to choose "Other" if the indication does not fall into one of the specified indications. For cesareans that fall into the "Other" category, the indication is entered into a separate free text field. Indications (including those in the free text field) were assigned by one of the study authors (VS) into groups including maternal medical condition, concern for fetal status, placental or cord complication, fetal abnormality, pre-eclampsia/gestational hypertension, maternal request, suspected macrosomia, suspected cephalopelvic disproportion, complication in previous pregnancy, previous uterine surgery, active genital herpes, other, and not known.

Descriptive statistics were calculated using R version 3.4.2.

Results

During the study period 33262 births took place at 15 participating hospitals. After exclusion of intrapartum transfers to the delivering hospital (n=506), the final study cohort comprised of 32756 births. Demographic, pre-pregnancy, and pregnancy characteristics of the study population are shown in Table 2. Rates of cesarean without attempting vaginal birth increased with increasing maternal age, increasing BMI, and the presence of pre-pregnancy medical issues and pregnancy complications (Table 2). Rates varied with race and ethnicity: Hispanic women had the lowest rate (17.8%) and African American women had the highest rate (23.0%). One in four women (26.4%) with Class II or III obesity ($>$ 35 kg/m^2) had a cesarean with no attempt at vaginal birth. Maternal medical complications such as diabetes and hypertension, and fetal anomalies were also associated with lower rates of attempting vaginal birth. Approximately 1 in 4 multiparous women had a cesarean without attempting vaginal birth compared to approximately 1 in 10 nulliparous women (26.3% vs 10.4%; p$<$0.001).

The total cesarean rate in the study population was 31.4%: 11.4% were cesareans in women attempting vaginal birth and 20.0% were pre-labor cesareans. Sixty-three percent (6551/10290) of *all cesarean births* were performed with no attempt at vaginal birth.Approximately 1/3 of cesareans births in nulliparous women, 58.7% of primary cesareans in multiparous women with no history of cesarean, and 39.3% of all primary cesarean births were performed without attempting vaginal birth (Table 3).

Cesarean birth rates in each of the Robson groups are shown in Table 4. Births were non-classifiable due to missing data in 0.5% of the study population. Robson group 5 (previous cesarean, singleton, cephalic [?]37 weeks) made the single greatest contribution to cesarean birth (38.3%). More than nine out of ten (92.5%) cesarean births in Robson group 5 were performed without attempting vaginal birth. In Robson group 10 (singleton, cephalic, pregnancies [?]36 weeks including previous cesareans) 72.9% of cesareans were performed with no attempt at vaginal birth (Table 4). Of the 406 twin pregnancies (in Robson group 8) where Baby A was in a cephalic presentation, 216 (53.2%) had a cesarean without attempting vaginal birth, as did 2418 (68.3%) of the 3542 women with one previous cesarean in Robson group 5.

Of Robson groups 1-4 (singleton term cephalic pregnancies with no history of cesarean), 18.3% (674/3682) of cesareans were performed without an attempt at vaginal birth (Robson groups 2b and 4b).

The NTSV population (Robson groups 1, 2a, and 2b) constituted 37.2% (12201/32756) of all births and contributed 28.8% (2959/10290) of cesareans in the study population. The cesarean rate was 24.3% (2959/12,201) in the NTSV population: 11.1% (1349) after induction of labor, 9.8% (1194) in spontaneous labor, and 3.4% (416) pre-labor cesarean. Approximately 1 in 7 (416/2959) cesareans in the NTSV population were pre-labor.

Pre-labor cesareans in Robson groups 2b and 4b comprised 6.6% (674/10290) of all cesarean births in our study population.

The "indication for cesarean" field was completed for 99.3% of pre-labor cesareans in singleton term cephalic pregnancies with no history of cesarean (Robson groups 2b and 4b). The most common indications were

suspected macrosomia (28.9%) and maternal request (18.1%) (Table S1). Placental or cord complications, concern for fetal status, and maternal medical complications each represented approximately 10% of the indications for pre-labor cesarean. Pre-eclampsia/gestational hypertension was the indication in 1.2%, and active genital herpes in 3.1%. Thirteen percent (n=34) of pre-labor cesareans in multiparous women were performed due to complications in previous pregnancies (including shoulder dystocia, third- or fourth-degree tear, and traumatic previous birth).

Birth weight was available for 99.5% (194/195) of the cesareans performed without attempting vaginal birth for suspected macrosomia in Robson groups 2b and 4b. In 77.3% of cases the birth weight was <4500g (150/194). Of the 38 women with gestational diabetes in this group, birth weight was <4500g in 84.2% (n=32).

Discussion

Main Findings

Our goal was to evaluate the contribution that cesarean performed without attempting vaginal birth (pre-labor cesarean) makes to all cesarean births, and to cesarean births within subgroups of the pregnant population. In our population, almost two-thirds of *all cesareans*and approximately 1 in 5 of *all births* were performed without attempting vaginal birth. Pre-labor cesareans also constituted 1 in 7 cesareans in the NTSV population, the standard metric for monitoring primary cesarean birth rates in the US. These pre-labor cesareans are invisible when reported within the NTSV cesarean metric.

The Robson classification highlighted patient groups where the contribution of pre-labor was *especially* high, including multiple pregnancies and singleton term cephalic pregnancies with a previous cesarean. This was true even in apparently more favorable clinical situations: only half of twins with twin A in a cephalic presentation, and 1/3 of singleton term cephalic pregnancies with one previous cesarean, attempted vaginal birth.

Cesarean without attempting vaginal birth also constituted 39.3% of all*primary* cesarean births in our study (58.7% of cesareans in multiparous women with no history of cesarean and 32.4% of primary cesareans in nulliparous women), a contribution that has been largely unappreciated.

We were particularly interested in examining the rate and indications for pre-labor cesarean in singleton term cephalic pregnancies with no history of cesarean birth (Robson groups 1-4) compared to recently reported US national data.[3] In our data, pre-labor cesareans constituted 20% of cesarean births in Robson groups 1-4. However, these pre-labor cesareans represented only 6.6% of all cesareans in our study population, much lower than the 27% contribution suggested in the study by Hehir et al.[3] Suspected macrosomia and maternal request were the most common indications for primary pre-labor cesarean birth in singleton term cephalic pregnancies, these indications jointly accounting for almost half of cases. Notably, more than $\frac{3}{4}$ of the pre-labor cesareans performed due to suspected macrosomia were associated with an actual birth weight of <4500g.

Strengths and Limitations

Strengths of our study include large sample size and the depth of chart-abstracted clinical data allowing us to explore indications for pre-labor cesarean as well as the rates within Robson groups. Although our data are derived from a diverse group of hospitals, it is unknown whether our findings are generalizable to other populations in the US.

Data abstracted from medical records resulted in few non-classifiable births (0.5%) in the Robson classification. Additionally, Group 9 was appropriate in size and associated with a high cesarean birth rate, findings highlighted by Robson as indicators of the quality and completeness of cesarean birth datasets.[12] Chart abstracted data also gave us greater insight into why these surgeries were performed.

Interpretation

The rates of pre-labor and laboring cesarean in our data are very similar to those in a 2016 hospital birth population in Sydney, Australia[6]. However, comparable studies on the contribution of primary cesarean without attempting vaginal birth to the total cesarean birth rate in the US are limited and are based on births that pre-date the 2014 ACOG guidance aimed at reducing cesarean birth.[2]

Our observation that*primary* pre-labor cesareans in singleton term cephalic pregnancies, constitute 6.6% of all cesareans births, is similar to the 7.9% rate reported by Zhang et al.[9] using chart abstracted data on births between 2002 and 2008 from the Consortium on Safe Labor cohort. Joesch et al.[10], using administrative (procedural code) data, reported that between 1979 and 2004 the rate of *primary* pre-labor cesarean as a proportion of*all* live births varied between 4.5% and 6.6% which is similar to the 6.7% observed in our study.

Huesch et al.[11], reported variation in pre-labor cesarean rates among hospitals in their study and highlighted the pre-labor cesarean rate as a potentially important metric. However, the heavy reliance on administrative data for quality improvement in maternity care in the US is a barrier to using pre-labor cesarean as a metric. Pre-labor and laboring cesarean are not easily distinguishable in administrative data and rely on the assumption that if there is an ICD procedural code for cesarean in the absence of a code consistent with labor, pre-labor cesarean was the mode of delivery. This involves searching for multiple procedural codes and may be subject to reliability issues.

National birth certificates provide another data source for evaluating cesarean birth in the US. However, the finding by Hehir et al[3] that pre-labor cesareans in Robson groups 2b and 4b (singleton term cephalic pregnancies with no history of cesarean), constitute 27% of all cesarean births when using US Birth Certificate data compared to 6.6% in our data raises the possibility of misclassification in the US national birth certificate data.

On examining indications for cesarean in Robson groups 2b and 4b in our clinical dataset, the rate of pre-labor cesarean without a medical indication in the nulliparous term cephalic singleton population was low 0.6%, suggesting that cesarean for maternal request is uncommon in first time mothers. This is consistent with other authors.[12] The finding that suspected macrosomia was the most common indication for primary cesarean without attempting vaginal birth in singleton term cephalic pregnancies was unexpected and may be an increasingly common indication.[13] A study from France reporting on potentially avoidable planned cesarean births also reported suspected macrosomia to be one of the more common stated indications.[14] ACOG does not consider suspected macrosomia to be an indication for cesarean birth unless the estimated fetal weight is >4500g in a diabetic woman or >5000g in a non-diabetic woman, when "prophylactic cesarean delivery may be considered".[15] It is therefore of concern that we found birth weight was <4500g in more than 3/4 of cesareans performed without attempting vaginal birth for suspected macrosomia in singleton term cephalic nulliparous pregnancies. Our findings are consistent those of Boyle et al.[16] who reported 80.3% of primary cesareans performed for fetal macrosomia were associated with an actual birth weight of <4500g.

The basis for "suspected macrosomia" could not be determined from the OB COAP database but it seems likely that ultrasound-derived estimated fetal weights contributed in many cases. A "large for dates" diagnosis based on ultrasound measurements has been associated with an increased risk for both pre-labor and intrapartum cesarean independent of the actual birth weight of the baby.[17,18]

Conclusion

Our study demonstrates the considerable contribution that cesarean without attempting vaginal birth makes to cesarean birth rates. Evaluating cesarean without attempting vaginal birth using the Robson classification helped identify patient groups where efforts to reduce these cesareans may be most impactful, both within the group itself and for the total cesarean birth rate.

Currently "pre-labor cesarean" is used interchangeably to describe subtly different clinical scenarios and there may be no perfect definition for this group. However, the most useful metric may be one that encompasses both the decision *not* to attempt vaginal birth at the time of admission (irrespective of labor status) and the*indication* for this decision.

Research to understand the factors behind clinician decisions to perform "pre-labor" cesareans and barriers to attempting vaginal birth in cases where there is no absolute contraindication to doing so, may lead to strategies that enable a greater number of women to safely attempt vaginal birth. Analysis of clinical, as opposed to administrative, data is critical to quality improvement efforts in maternity care but is rarely possible in the US due to a lack of clinical data, outside of research studies. These data and analyses are important as we pursue a national strategy to decrease cesarean birth in the US.

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Disclosure of Interests

Vivienne Souter co-owns a patent for an obstetric task trainer (postpartum uterus model) for obstetric simulation training.

Contribution of authorship

VS, EK, KS and BL designed the study and contributed to the writing, analysis and editing of the paper. PG contributed to the analysis, writing and editing. IP performed the data analyses and statistics.

Details of Ethics Approval

The Western IRB, WA, USA determined on August 18, 2015 that OB COAP is not engaged in human subjects research and thus does not require IRB review. WIRB Work Order #18995651

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REFERENCES

1 Spong CY, Berghella V, Wenstrom KD, Mercer BM, Saade GR. Preventing the first cesarean delivery Summary of a Joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, and American College of Obstetricians and Gynecologists Workshop. Obstet Gynecol 2012;120:1181–93.

2 ACOG Safe Prevention of the Primary Cesarean Delivery. Obstetric Care Consensus No. 1. American College of Obstetricians and Gynecologists. Obstet Gynecol 2014;123:693–711.

3 Hehir MP, Ananth CV, Siddiq Z, Flood K, Friedman AM, D'Alton ME. Cesarean delivery in the United States 2005 through 2014: a population-based analysis using the Robson 10-Group Classification System. Am Obstet Gynecol 2018: 105.e11

4 Robson M, Hartigan L, Murphy M. Methods of achieving and maintaining an appropriate caesarean section rate. Best Practice & Research Clinical Obstetrics and Gynaecology 2013;27:297–308.

5 Crosby DA, Murphy MM, Segurado R, Byrne F, Mahony R, Robson M, McAuliffe FM.

Cesarean delivery rates using Robson classification system in Ireland: What can we learn?

Eur J Obstet Gynecol Reprod Biol. 2019 May;236:121-126.

6 Morton R, Burton AE, Kumar P, et al. Cesarean delivery: Trend in indications over three decades within a major city hospital network. Acta Obstet Gynecol Scand. 2020;00:1–8.

7 Kauffman E, Souter VL, Katon JG, Sitcov K. Cervical Dilation on Admission in Term

Spontaneous Labor and Maternal and Newborn Outcomes. Obstet Gynecol 2016; 127: 481-488.

8 Robson Classification: Implementation Manual. Geneva: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.

9 Zhang J, Troendle J, Reddy UM, Laughon SK, Branch DW, Burkman R, et al. Contemporary Cesarean Delivery Practice in the United States. Am J Obstet Gynecol 2010;203:326.e1-326.e10.

10 Joesch JM, Gossman GL, Tanfer K. Primary Cesarean Deliveries Prior to Labor in the United States, 1979–2004 Matern Child Health J 2008 ;12:323–331.

11 Huesch MD, Currid-Halkett E, Doctor JN. Measurement and risk adjustment of prelabor cesarean rates in a large sample of California hospitals. Am J Obstet Gynecol 2014;210:443.

12 Robson M, Murphy M, Byrne F. Quality assurance: The 10-Group Classification System

(Robson classification), induction of labor, and cesarean delivery. International Journal of Gynecology and Obstetrics. 2015;131:S23–S27.

13 Barber EL, Lundsberg L, Belanger K, Pettker CM, Funai EF, Iluzzi JL. Contributing Indications to the Rising Cesarean Delivery Rate Obstet Gynecol . 2011;118: 29–38.

14 Coulm B, Blondel B, Alexander S, Boulvain M, Le Ray, C Potential avoidability of planned cesarean sections in a French national database. Acta Obstetricia et Gynecologica Scandinavica 2014;93:905–912.

15 Fetal macrosomia. Practice Bulletin No. 173. American College of Obstetricians and Gynecologists. Obstet Gynecol 2016;128:e195–209.

16 Boyle, A, Reddy UM, Landy HJ, Huang C, Driggers RW, Laughon SK. Primary Cesarean Delivery in the United States Obstet Gynecol. 2013; 122: 33–40.

17 Little SE, Edlow AG, Thomas AM, Smith NA. Estimated fetal weight by ultrasound: a modifiable risk factor for cesarean delivery? Am J Obstet Gynecol 2012;207:309.e1–6.

18 Scifres CM, Feghali M, Dumont, T, Althouse AD, Speer P, Caritis SN, Catov JM. Large-for-Gestational-Age Ultrasound Diagnosis and Risk for Cesarean Delivery in Women With Gestational Diabetes Mellitus Obstet Gynecol 2015;126:978–86.

Table 1 Summary of Robson 10-group Classification

Robson Group	**Patient population**
1	Nulliparous, singleton, cephalic, [?]37 weeks, spontaneous labor
2a	Nulliparous, singleton, cephalic, [?]37 weeks, induction of labor
2b	Nulliparous singleton, cephalic, [?]37 weeks, pre-labor cesarean
3	Multiparous (excluding previous cesareans), singleton, cephalic, [?]37 weeks, spontaneous labor
4a	Multiparous (excluding previous cesareans), singleton, cephalic, [?]37 weeks, induction of labor
4b	Multiparous singleton, cephalic, [?]37 weeks, pre-labor cesarean
5	Previous cesarean, singleton cephalic [?]37 weeks
6	All nulliparous breeches
7	All multiparous breeches (including previous cesareans)
8	All multiple pregnancies (including previous cesareans)

Robson Group	**Patient population**
9	All singleton abnormal lies (including previous cesareans)
10	All singleton cephalic, [?]36 weeks (including previous cesareans)

Table 2 Characteristics of the study population.

	Pre-Labor Cesarean N = 6551 % (n)	Attempted vaginal birth N = 26204 % (n)	p-value*
Age at admission			<0.001
<20	8.4 (88)	91.6 (960)	
20-34	17.8 (4371)	82.2 (20233)	
35-39	28.3 (1664)	71.7 (4209)	
[?]40	35.0 (425)	65.0 (790)	
Missing or implausible value	0.05 (3)	0.05 (12)	
Race and ethnicity			<0.001
White, non-Hispanic	20.4 (3433)	79.6 (13415)	
African American, non-Hispanic	23.0 (437)	77.0 (1461)	
Hispanic	17.8 (985)	82.2 (4567)	
Asian or Pacific Islander	20.9 (1282)	79.1 (4851)	
American Indian or Alaska Native	18.7 (79)	81.3 (344)	
Other	18.5 (213)	81.5 (940)	
Missing	1.9 (122)	2.4 (626)	
Body mass index (BMI)			
<25 kg/m^2	14.7 (498)	85.3 (2888)	<0.001
25-29 kg/m^2	17.0 (1941)	83.0 (9456)	
30-34 kg/m^2	19.9 (1833)	80.1 (7356)	
>35 kg/m^2	26.4 (2140)	73.6 (5972)	
Missing/improbable value	20.7 (139)	79.3 (532)	
Parity			<0.001
Nulliparous	10.4 (1360)	89.6 (11694)	
Multiparous	26.3 (5191)	73.7 (14510)	
Pre-pregnancy diabetes			<0.001
Yes	39.9 (267)	60.1 (403)	
No	19.6 (6284)	80.4 (25801)	
Pre-pregnancy hypertension			<0.001
Yes	35.6 (385)	64.4 (696)	
No	19.5 (6166)	80.5 (25508)	
Gestational diabetes			<0.001
Yes	25.5 (828)	74.5 (2420)	
No	19.4 (5723)	80.6 (23784)	

Pre-eclampsia / gest hypertension			<0.001
Yes	22.6 (707)	77.4 (2421)	
No	19.7 (5844)	80.3 (23783)	
Fetal anomaly			<0.001
Yes	29.1 (209)	70.9 (509)	
No	19.8 (6342)	80.2 (25695)	
History of stillbirth			<0.001
Yes	32.1 (134)	67.9 (283)	
No	19.8 (6417)	80.2 (25921)	
Level of neonatal care			<0.001
I	17.9 (477)	82.1 (2191)	
II	17.5 (1177)	82.5 (5541)	
III-IV	21.0 (4897)	79.0 (18472)	

* Fisher's exact test.

Table 3 Contribution of pre-labor cesarean to births in women**with no history of cesarean** .

Births in women with no previous cesarean*	Cesarean birth rate % (n)	Percentage of all births that were pre-labor cesareans % (n)	Percentage of all cesareans that were pre-labor % (n)
Multiparous (N=14036)	10.4 (1462)	6.1 (858)	58.7%
Nulliparous (N=13055)	31.7 (4132)	10.3 (1338)	32.4%
Total (N=27091)	20.7 (5594)	8.1 (2196)	39.3%

* The primary cesarean birth rate cannot be derived from the Robson classification and was calculated separately.

Table 4 Robson 10-Group and cesarean without attempting vaginal birth.

Robson Group	**Contribution of group to all births % (n)**	**Cesarean birth rate in group % (n)**	***Absolute group contribution to overall CS rate %**	**+ Relative group contribution to overall CS rate %**	**Cesareans in each group performed without attempting vaginal birth % (n)**
1	21.0 (6868)	17.4 (1194)	3.6	11.6	-
2a	12.0 (3917)	34.4 (1349)	4.1	13.1	-
2b	1.3 (416)	100 (416)	1.3	4.0	100 (416)
3	25.4 (8307)	2.5 (207)	0.6	2.0	-
4a	11.9 (3899)	6.6 (258)	0.9	2.5	-
4b	0.8 (258)	100 (258)	0.8	2.5	100 (258)
5	14.8 (4832)	81.5 (3937)	12.0	38.3	92.5 (3640)
6	2.1 (672)	96.4 (648)	2.0	6.3	90.0 (583)
7	1.9 (616)	95.6 (589)	1.8	5.7	89.3 (526)
8	1.7 (557)	71.5 (398)	1.2	3.9	89.4 (356)

Robson Group	Contribution of group to all births % (n)	Cesarean birth rate in group % (n)	*Absolute group contribution to overall CS rate %	+ Relative group contribution to overall CS rate %	Cesareans in each group performed without attempting vaginal birth % (n)
9	0.4 (145)	92.4 (134)	0.4	1.3	73.1 (98)
10	6.3 (2079)	38.7 (805)	2.5	7.8	72.9 (587)
Not classifiable	0.5 (190)	51.1 (97)	0.3	0.9	89.7 (87)
Total	100 (32756)	31.4 (10290)	31.4	100	63.7 (6551)

*Absolute contribution (%) = n of CS in the group / total N of women delivered in the population x 100

+Relative contribution (%) = n of CS in the group / total N of CS in the population x 100