KKU RESEARCH JOURNAL (GRADUATE STUDIES)
Vol. 18 NO. 4: October-December 2018

Mode of delivery and pregnancy outcomes in preterm birth

วิธีการคลอดและผลลัพธ์การตั้งครรภ์ในทารกคลอดก่อนกำหนด

Bao Yen Luong Thanh*,** Dr. Porjai Pattanittum (ดร.พอใจ พัทธนิตย์ธรรม)[1],***
Dr. Malinee Laopaiboon (ดร.มาลินี เหล่าไพบูลย์)*** Pisake Lumbiganon (ภิเศก ลุมพิกานนท์)****

ABSTRACT

To assess the association of mode of delivery and pregnancy outcomes in preterm birth. This is a secondary analysis of Thai database of the World Health Organization Multi-country Survey. We included 880 women with singleton neonates who delivered between 22 and <37 weeks of gestation from 12 hospitals in Thailand. We used multilevel logistic regression to assess the association between mode of delivery and pregnancy outcomes in singleton preterm births, including maternal intensive care unit (MICU) admission, maternal near miss, maternal death; Apgar score <7 at 5 minutes, neonatal intensive care unit (NICU) admission, fresh stillbirth, early neonatal, and perinatal death. All analysis were performed by R program. The prevalence of women delivered by Caesarean Section (CS) was 34.7%. There was only one maternal death and this case was observed in vaginal birth group; only two women delivered by CS were admitted to MICU. CS was associated with significantly increased odds of maternal near miss (adjusted odds ratio (aOR): 12.0; 95% confidence interval (CI): 1.6-87.4), NICU admission (aOR: 1.8; 95%CI: 1.2-2.9). The odds of Apgar score <7 at 5 minutes (aOR: 1.9; 95%CI: 0.8-4.3), fresh stillbirth (aOR: 0.8; 95%CI: 0.2-2.8), early neonatal death (aOR: 0.6; 95%CI: 0.1-6.3), and perinatal death (aOR: 0.7; 95%CI: 0.1-3.2) were not significantly different between CS and vaginal birth. In preterm birth, CS was associated with increased the odds of maternal near miss, and NICU admissions but not significant different for the odds of Apgar score <7, fresh stillbirth, early neonatal death, and perinatal death.

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่างวิธีการคลอดและผลลัพธ์การตั้งครรภ์ในทารกคลอดก่อนกำหนด โดยวิเคราะห์ข้อมูลทุติยภูมิของโครงการ the World Health Organization Multi-country Survey เฉพาะประเทศไทย ตัวอย่างในการศึกษา คือ หญิงตั้งครรภ์และทารกครรภ์เดี่ยวที่คลอดระหว่างอายุครรภ์ 22 – 36 สัปดาห์ 880 คน จากโรงพยาบาล 12 แห่ง วิเคราะห์ความสัมพันธ์ระหว่างวิธีการคลอดและผลลัพธ์การตั้งครรภ์ในทารก

[1]*Correspondent author: pporja@kku.ac.th*

* *Student, Master of Public Health in Biostatistics, Department of Epidemiology and Biostatistics, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand*

** *Department of Biostatistics, Demography and Reproductive Health, Faculty of Public Health, Hue University of Medicine and Pharmacy, Hue University, Hue, Vietnam*

*** *Department of Epidemiology and Biostatistics, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand*

*****Department of Obstetrics and Gynaecology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*

ที่คลอดก่อนกำหนด ได้แก่ การเข้ารับการรักษาของหญิงตั้งครรภ์ในหอผู้ป่วยหนัก การเกือบเสียชีวิตของมารดา การเสียชีวิตของมารดา Apgar score ของทารกหลังคลอดที่ 5 นาที น้อยกว่า 7 คะแนน การเข้ารับการรักษาของทารกในหอผู้ป่วยหนัก การตายคลอดของทารก การเสียชีวิตของทารกในระยะต้น และการตายปริกำเนิดของทารก โดยใช้ multilevel logistic regression ด้วยโปรแกรม R พบว่า ความชุกของการผ่าตัดคลอดทางหน้าท้องเท่ากับร้อยละ 34.7 มีหญิงตั้งครรภ์ซึ่งคลอดผ่านช่องคลอดเสียชีวิต 1 คน หญิงตั้งครรภ์ซึ่งคลอดด้วยวิธีการผ่าตัดทางหน้าท้อง 2 คน เข้ารับการรักษาในหอผู้ป่วยหนัก การผ่าตัดคลอดทางหน้าท้องมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับการเกือบเสียชีวิตของมารดา (adjusted odds ratio (aOR): 12.0; 95% confidence interval (CI): 1.6-87.4) การเข้ารับการรักษาของทารกในหอผู้ป่วยหนัก (aOR: 1.8; 95%CI: 1.2-2.9) และมีโอกาสเสี่ยงต่อ APGAR score ของทารกหลังคลอดที่ 5 นาที น้อยกว่า 7 คะแนน (aOR: 1.9; 95%CI: 0.8-4.3) การตายคลอดของทารก (aOR: 0.8; 95%CI: 0.2-2.8) การเสียชีวิตของทารกในระยะต้น (aOR: 0.6; 95%CI: 0.1-6.3) และการตายปริกำเนิด (aOR: 0.7; 95%CI: 0.1-3.2) ในทารกคลอดก่อนกำหนดการผ่าตัดคลอดทางหน้าท้องมีความสัมพันธ์ต่อการเกือบเสียชีวิตของมารดา การเข้ารับการรักษาของทารกในหอผู้ป่วยหนัก แต่ไม่มีความสัมพันธ์ต่อ Apgar score การตายคลอดของทารก การเสียชีวิตของทารกในระยะต้น และการตายปริกำเนิด

Keywords: Mode of delivery, Preterm birth, Pregnancy outcomes
คำสำคัญ: วิธีการคลอด ทารกคลอดก่อนกำหนด ผลลัพธ์การตั้งครรภ์

Introduction

Caesarean section (CS), also known as C-section or Caesarean delivery, is defined as the birth of a fetus through incisions in the abdominal wall and the uterine wall. Since it was introduced to the obstetrics practice, its rates have been increasing worldwide, from 6.7% in 1990 to 19.1% in 2014 [1]. Similar trend was observed in Thailand, where CS rates increased from 15.2% in 1990 [2] to 34.1% in 2008 [3]. Several factors, such as the advantage in health care technologies, the maternal request, and the willingness of practioners to perform CS might be the reasons for this increase [4-5]. These CS rates have been exceeding 15%, which is recommended by the World Health Organization (WHO) [6].

Many researches have been conducted to assess whether CS or vaginal birth (VB) improves the outcomes of mothers and their neonates but findings remain controversial, especially for preterm births. Some observational studies have shown that neonates delivered by CS were associated with decereased risk of perinatal outcomes compared to those delivered by VB [7-9]. Some studies presented that neonates delivered by CS was associated with an increase risk of neonatal mortality than those delivered by VB [10]. Others suggested that there was no statistically difference in the risk of neonatal mortality between both groups [11-16]. Women delivered by CS were found to be associated with more severe adverse outcomes than VB group [11, 17]. Randomized controlled trials had also been conducted to examine this question, but failed to meet the planned sample sizes due to difficulties in recruiting pregnant women [18-22].

Moreover, most of these studies were carried out in high income countries but limited in low and middle income countries, and also in Thailand. Therefore, this secondary analysis was conducted in order to assess the relationship between mode of delivery and pregnancy outcomes in preterm births.

Research methodology and instruments

This is a secondary analysis of facility-based, cross-sectional survey of the World Health Organization Multi-country Survey on Maternal and Newborn Health (2010 – 2011) in Thailand. Details of this survey has been described elsewhere [23]. Briefly, part of this survey was conducted in Thailand from 2010 to 2011. Data was collected within two or three months depending on the institutional number of annual births. Information of all women and their neonates were collected from medical records and could not be linked to participants. The survey in Thailand was approved by the local Ethical Review Committee of each participated hospital.

We included 880 women with singleton neonates who delivered between 22 and <37 weeks of gestation from 12 selected hospitals in Thailand and their newborns. Women with ectopic pregnancies or abortion, pregnancies with congenital malformation, neonates with birth weight was missing or less than 500g, and those with macerated stillbirth were exluded from the analysis (Figure 1).

Our dependent variables were adverse maternal and perinatal outcomes. For maternal outcomes, we assessed admission to maternal intensive care unit (MICU), maternal near miss, and maternal mortality up to hospital discharge. Maternal near miss was defined as a woman who presented with any life-threatening condition and survived; a complication during pregnancy, childbirth or within 7 days of termination of pregnancy. For perinatal outcomes, we evaluated APGAR score <7 at 5 minutes after birth, admission to neonatal intensive care unit (NICU), early neonatal death (death of a live born neonate at discharge or within 7 days after birth), fresh stillbirth (fetal death, with no signs of maceration), and perinatal death (fresh stillbirth or early neonatal death). Our main independent variable was mode of delivery, which was classified as VB or CS. We also consider other potential confounding variables, such as maternal sociodemographic and obstetric characteristics (i.e marital status, maternal age, maternal education, parity); maternal underlying disease (HIV/ chronic hypertension/ malaria/ dengue fever/ heart/ lung/ renal disease/ anaemia); obstetric complications (i.e preeclampsia, eclampsia); and fetal and neonatal characteristics (i.e fetal presentation, severity of preterm birth, birth weight, and sex). The facility complexity index (FCI) was used to determine the level of services available in each participated facilities and to evaluate its capacity to provide obstetric care [24]. Sampled facilities scored from 44 to 57 points.

We used frequency and percentage to present the characteristics of the study participants, which were categorical data. Multilevel logistic regression was performed to obtain odds ratio (OR) and 95% confidence intervals (95%CI) for assessing the association between mode of delivery and adverse pregnancy outcomes. These models were adjusted for potential confounding factors and facility was also adjusted as a random effect. VB was treated as a reference group. We used the Akaike's information criterion (AIC) [25] to assess the goodness of fit of the model at

$p<0.05$. All analyses were performed using R program [26], and the *lme4* package [27] was used for generalized linear mixed model.

Research results

From 8,973 pregnant women available from the dataset of Thailand, 880 women with a singleton delivery from 22 to <37 weeks of gestation were included in the analysis (Figure 1). Of these preterm births, the prevalences of CS and VB were 34.7% and 65.3%, respectively.

Table 1 presented the maternal, fetal and neonatal characteristics of the VB and CS groups. We found that maternal age, maternal education attainment, parity, underlying disease, preeclampsia, fetal presentation, corticosteroids administration, were statistically different between CS and VB; but marital status, eclampsia, gestational age, newborn's sex, and birth weight were not significantly different between both groupss. In women delivered by CS, the proportion of women with advanced maternal age (23.0% vs. 13.4%), underlying diseases (7.5% vs. 2.8%), preeclampsia (13.8% vs. 2.3%), non-vertex fetal presentation (18.7% vs. 3.0%), using antenatal corticosteroids therapy (19.7% vs. 13.2%) were higher than those delivered vaginally (Table 1).

One maternal death was reported in those delivered vaginally and two cases were admitted to MICU in CS group. Women delivered by CS was significantly associated with increased odds of maternal near miss (aOR: 12.0; 95%CI: 1.6-87.4). For perinatal outcomes, neonates that were delivered by CS was associated with significantly increased odds of NICU admission (aOR: 1.8; 95%CI: 1.2-2.9), but the odds of Apgar score <7 at 5 minutes (aOR: 1.9; 95%CI: 0.8-4.3), fresh stillbirth (aOR: 0.8; 95%CI: 0.2-2.8), early neonatal death (aOR: 0.6; 95%CI: 0.1-6.3), and perinatal death (aOR: 0.7; 95%CI: 0.1-3.2) were not statistically different between neonates delivered by CS and by VB (Table 2).

Discussion

Our findings showed that CS was associated with significantly increased odds of maternal near miss and NICU admission. The odds of Apgar score <7 at 5 minutes, fresh stillbirth, early neonatal death, and perinatal death were not significantly different between CS and VB. There was only one maternal death among women delivered vaginally and only two women delivered by CS were admitted to MICU.

Our study found that CS was associated with increased odds of maternal near miss. Previous reports were in accordance with our study [11, 28]. There was one maternal death reported in VB group and no cases were seen in CS group. However, autopsy was not performed so that we could not confirm whether the cause of death was directly related to mode of delivery or maternal underlying disease. Furthermore, there was no maternal deaths in the CS group. Similarly, two MICU admission cases were reported in CS group but no cases were observed in VB group. Therefore, we could not perform the analysis to assess the association between CS and VB in term of maternal death and MICU admission. Durnwald et al. via a prospective four year observational study, with a bigger sample size of

3,119 women with singleton preterm pregnacy of 24 to 36 weeks of gestation at 19 academic medical centers in United States found that there was no significant for the risk of maternal death [29].

Our finding was consistent with previous report that preterm neonates delivered by CS was associated with a significantly increased odds of NICU admission compared to those delivered by VB. That is the retrospective cohort study of Phaloprakarn et al., which involved 455 singleton late preterm neonates in Vajira hospital in Thailand [30]. The study of Sangkomkamhang et al. also showed a significantly shorter length of hospital stay in neonates delivered vaginally than those delivered by CS [11]. One explanation might be that neonates delivered by CS might be because of their fetal distress or other fetal conditions and therefore, they were more likely to be admitted to NICU for further advanced care.

Our findings also illustrated that neonates delivered by CS was not significantly associated with the odds of Apgar score <7 at 5 minutes, fresh stillbirth, early neonatal death, and perinatal death. These findings were consistent with previous studies [11, 13, 31-34]. However, it was contradicted with the work of Werner et al., which invoved 20,231 neonates borned from 24 to 34 weeks of gestation [35]. Werner et al. found that CS was associated with increased odds of Apgar score < 7 at 5 minutes and neonatal death. A study of Malloy et al. conducted in the United States also found that CS was associated with an increased odds of early neonatal death [10]. This might be due to differences in the study population. Malloy et al. included a much more restricted group of preterm fetuses with birthweight ranges that varies for specific gestational ages and Werner et al. studied on neonates with appropriate birthweight for gestational age.

A randomized controlled trial might be a better study design to assess the association between mode of delivery and pregnancy outcomes in preterm birth. However, most randomized control trials conducted had to stop early due to difficulty in recruiting enough planned sample size of pregnant women [18-22]. Therefore, this observational designs would be a more practical approach to assess these associations. Our study also had some potential limitations. First, our data on mortality and morbidities was only up to hospital discharge or up to seven days after delivery; and no data on long-term pregnancy outcomes. Hence, we could not evaluate the overall risks and benefits of mode of delivery. Second, data obtaining from the patients' records lead to missing information on some variables. Third, despite adjusting for potential confounding factors in the models, there might be some other factors that we could not account for, such as the willingness of the obstetricians to perform CS or maternal request to received CS.

Conclusions

Our findings showed that preterm births with CS were associated with an increased odds of maternal near miss and NICU admission. There were no significant difference for the odds of Apgar score less than 7 at 5 minutes, fresh stillbirth, early neonatal death and perinatal death. Further well-designed prospective observational studies are needed to assess the effect of mode of delivery on pregnancy outcomes in preterm births. While waiting for future

studies, we suggest that potential benefits and harms of the CS or VB should be discussed with mother and their relatives before choosing which mode of delivery would be performed.

Acknowledgements

We thank all members of the WHO Multi-Country Survey on Maternal and Newborn Health Research Network, including regional and country coordinators, data collection coordinators, facility coordinators, data collectors, all staff of the participating facilities who made the surveys possible; and Prof. Surasak Taneepanichskul, Thai country coordinator, for allowing us to use Thai database for our analysis. We would like to thank Dr. Cameron Hurst for his helpful suggestions in data analysis and Mr. Siwanon Rattanakanokchai for translating abstract into Thai language. We would also like to thank the Thailand Research Fund (Distinguished Professor Award) for supporting this secondary analysis.

Disclosure of Interests

We declare that we have no competing interests.

Contribution to Authorship

BYLT, PP, PL, ML conceptualized the research question and participated in the analysis plan. BYLT performed the data analysis and drafted the manuscript. All authors read and approved the final draft of the manuscript.

Funding

The WHO Multi-Country Survey on Maternal and Newborn Health was financially supported by the UNDP/ UNFPA/ UNICEF/ WHO/ World Bank Special Programme of Research, Development and Research Training in Human Reproduction; WHO; USAID; the Ministry of Health, Labour and Welfare of Japan; and Gynuity Health Projects.

References

1. Betran AP, Ye J, Moller AB, Zhang J, Gulmezoglu AM, Torloni MR. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. PloS One. 2016 Feb;11(2):e0148343.
2. Tangcharoensathien V. Pattern of hospital delivery in Thailand 1990-1996. 1998.
3. Lumbiganon P, Laopaiboon M, Gülmezoglu AM, Souza JP, Taneepanichskul S, Ruyan P, et al. Method of delivery and pregnancy outcomes in Asia: the WHO global survey on maternal and perinatal health 2007–08. The Lancet. 2010;375(9713):490-499.
4. Kovavisarach E, Ruttanapan K. Self-Preferred Route of Delivery of Thai Obstetricians and Gynecologists. J Med Assoc Thai. 2016;99 Suppl 2:S84-90.

5. Kovavisarach E, Sukontaman W. Preferred Route of Delivery of Thai Pregnant Women. J Med Assoc Thai. 2017;100(2):131.
6. Appropriate technology for birth. Lancet. 1985 Aug; 2(8452): 436-437.
7. Demol S, Bashiri A Fau - Furman B, Furman B Fau - Maymon E, Maymon E Fau - Shoham-Vardi I, Shoham-Vardi I Fau - Mazor M, Mazor M. Breech presentation is a risk factor for intrapartum and neonatal death in preterm delivery. Eur J Obstet Gynecol Reprod Biol. 2000 Nov; 93(1): 47-51.
8. Hogberg U, Hakansson S, Serenius F, Holmgren PA. Extremely preterm cesarean delivery: a clinical study. Acta Obstet Gynecol Scand. 2006; 85(12): 1442-1447.
9. Hogberg U, Holmgren PA. Infant mortality of very preterm infants by mode of delivery, institutional policies and maternal diagnosis. Acta Obstet Gynecol Scand. 2007; 86(6): 693-700.
10. Malloy MH. Impact of cesarean section on intermediate and late preterm births: United States, 2000-2003. Birth. 2009 Mar; 36(1): 26-33.
11. Sangkomkamhang U, Pattanittum P, Laopaiboon M, Lumbiganon P. Mode of delivery and outcomes in preterm births. J Med Assoc Thai. 2011 Apr; 94(4): 415-420.
12. Haque KN, Hayes AM, Ahmed Z, Wilde R, Fong CY. Caesarean or vaginal delivery for preterm very-low-birth weight (< or =1,250 g) infant: experience from a district general hospital in UK. Arch Gynecol Obstet. 2008 Mar; 277(3): 207-212.
13. Alfirevic Z, Milan SJ, Livio S. Caesarean section versus vaginal delivery for preterm birth in singletons. Cochrane Database Syst Rev. 2013 Sep 12(9): CD000078.
14. Ghi T, Maroni E, Arcangeli T, Alessandroni R, Stella M, Youssef A, et al. Mode of delivery in the preterm gestation and maternal and neonatal outcome. J Matern Fetal Neonatal Med. 2010 Dec; 23(12): 1424-1428.
15. Malloy MH, Onstad L, Wright E. The effect of cesarean delivery on birth outcome in very low birth weight infants. National Institute of Child Health and Human Development Neonatal Research Network. Obstet Gynecol. 1991 Apr; 77(4): 498-503.
16. Sonkusare S, Rai L, Naik P. Preterm birth: mode of delivery and neonatal outcome. Med J Malaysia. 2009 Dec; 64(4):303-306.
17. Souza JP, Gulmezoglu A, Lumbiganon P, Laopaiboon M, Carroli G, Fawole B, et al. Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health. BMC Med. 2010 Nov 10; 8: 71.
18. Lumley J, Lester A, Renou P, Wood C. A failed RCT to determine the best method of delivery for very low birth weight infants. Control Clin Trials. 1985 Jun; 6(2): 120-127.
19. Penn ZJ, Steer PJ, Grant A. A multicentre randomised controlled trial comparing elective and selective caesarean section for the delivery of the preterm breech infant. Br J Obstet Gynaecol. 1996 Jul; 103(7): 684-689.
20. Viegas OA, Ingemarsson I, Sim LP, Singh K, Cheng M, Ratnam SS, et al. Collaborative study on preterm breeches: vaginal delivery versus caesarean section. Asia Oceania J Obstet Gynaecol. 1985 Sep;11(3): 349-355.

21. Wallace Rl, Schifrin BS, Paul RH. The delivery route for very-low-birth-weight infants. A preliminary report of a randomized, prospective study. J Reprod Med. 1984 Oct; 29(10): 736-740.
22. Zlatnik FJ. The Iowa premature breech trial. Am J Perinatol. 1993 Jan; 10(1): 60-63.
23. Souza JP, Gulmezoglu AM, Carroli G, Lumbiganon P, Qureshi Z, WHOMCS Research Group. The world health organization multicountry survey on maternal and newborn health: study protocol. BMC Health Serv Res. 2011 Oct 26; 11: 286.
24. Vogel JP, Souza JP, Mori R, Morisaki N, Lumbiganon P, Laopaiboon M, et al. Maternal complications and perinatal mortality: findings of the World Health Organization Multicountry Survey on Maternal and Newborn Health. BJOG. 2014 Mar; 121: 76-88.
25. Akaike H. A new look at the statistical model identification. IEEE Transactions on Automatic Control. 1974 Dec; 19(6):716-723.
26. R Development Core Team. R: A language and enviroment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2014.
27. Bates D, Maechler M, Bolker B, Walker S. Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software. 2015; 67(1): 1-48.
28. Villar J, Carroli G, Zavaleta N, Donner A, Wojdyla D, Faundes A, et al. Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. BMJ. 2007 Nov; 335(7628): 1025.
29. Durnwald CP, Rouse DJ, Leveno KJ, Spong CY, MacPherson C, Varner MW, et al. The Maternal-Fetal Medicine Units Cesarean Registry: safety and efficacy of a trial of labor in preterm pregnancy after a prior cesarean delivery. Am J Obstet Gynecol. 2006 Oct; 195(4): 1119-1126.
30. Phaloprakarn C, Manusirivithaya S, Boonyarittipong P. Risk score comprising maternal and obstetric factors to identify late preterm infants at risk for neonatal intensive care unit admission. J Obstet Gynaecol Res. 2015 May; 41(5): 680-688.
31. Wylie BJ, Davidson LL, Batra M, Reed SD. Method of delivery and neonatal outcome in very low-birthweight vertex-presenting fetuses. Am J Obstet Gynecol. 2008 Jun; 198(6): e1-7; discussion e1-4.
32. Durie DE, Sciscione AC, Hoffman MK, Mackley AB, Paul DA. Mode of delivery and outcomes in very low-birth-weight infants in the vertex presentation. Am J Perinatol. 2011 Mar; 28(3): 195-200.
33. Werner EF, Savitz DA, Janevic TM, Ehsanipoor RM, Thung SF, Funai EF, et al. Mode of delivery and neonatal outcomes in preterm, small-for-gestational-age newborns. Obstet Gynecol. 2012 Sep; 120(3): 560-564.
34. Riskin A, Riskin-Mashiah S, Lusky A, Reichman B, Israel Neonatal Network. The relationship between delivery mode and mortality in very low birthweight singleton vertex-presenting infants. BJOG. 2004 Dec; 111(12): 1365-1371.
35. Werner EF, Han CS, Savitz DA, Goldshore M, Lipkind HS. Health outcomes for vaginal compared with cesarean delivery of appropriately grown preterm neonates. Obstet Gynecol. 2013 Jun; 121(6): 1195-1200.

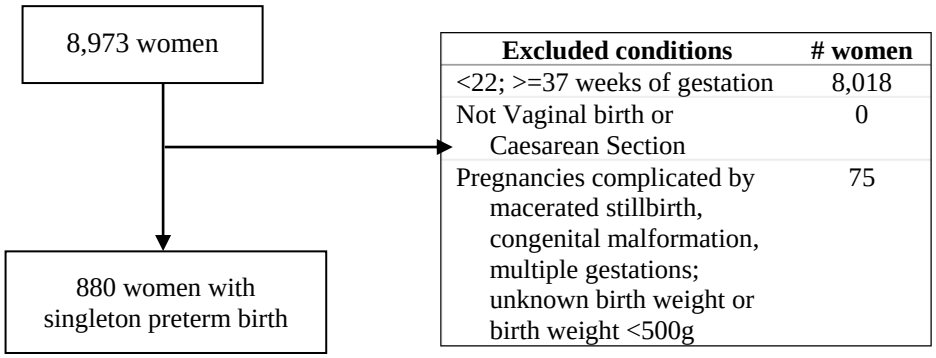

Figure 1 Study population

Table 1 Characteristics of mothers, fetuses and neonates by mode of delivery

	VB (N=575) n/ N (%)	CS (N=305) n/ N (%)	p- value
Maternal characteristics			
Marital status			
Single	31/ 575 (5.4)	15/ 305 (4.9)	0.76
Married/ cohabiting	544/ 575 (94.6)	290/ 305 (95.1)	
Maternal age (years)			
<20	106/ 575 (18.4)	19/ 305 (6.2)	<0.001
20–34	392/ 575 (68.2)	216/ 305 (70.8)	
≥35	77/ 575 (13.4)	70/ 305 (23.0)	
Education attainment (years)*			
≤5	68/544 (12.5)	17/ 280 (6.1)	<0.001
6-9	274/ 544 (50.4)	103/ 280 (36.8)	
10-12	114/ 544 (20.9)	62/ 280 (22.1)	
>12	88/ 544 (16.2)	98/ 280 (25.0)	
Parity			
Nulliparous	312/ 575 (54.3)	134/ 305 (43.9)	0.004
Multiparous	263/ 575 (65.3)	171/ 305 (56.1)	
Underlying disease			
Yes	16/ 575 (2.8)	23/ 305 (7.5)	0.002
No	559/ 575 (97.2)	282/ 305 (92.5)	
Preeclampsia			
Yes	13/ 575 (2.3)	42/ 305 (13.8)	<0.001
No	562/ 575 (97.7)	263/305 (86.2)	
Eclampsia			

Table 1 Characteristics of mothers, fetuses and neonates by mode of delivery (Cont.)

	VB (N=575)	**CS (N=305)**	**p- value**
	n/ N (%)	**n/ N (%)**	
Yes	2/ 575 (0.3)	4/ 305 (1.3)	0.1
No	573/ 575 (99.7)	301/ 305 (98.7)	
Perinatal characteristics			
Gestational age			
Extremely preterm	23/ 575 (4.0)	8/ 305 (2.6)	0.41
Very preterm	43/ 575 (7.5)	28/ 305 (9.2)	
Moderate preterm	509/ 575 (88.5)	269/ 305 (88.2)	
Fetal presentation			
Vertex	558/ 575 (97.0)	248/ 305 (81.3)	<0.001
Non-vertex	17/ 575 (3.0)	57/ 305 (18.7)	
Corticosteroids			
No	499/ 575 (86.8)	245/ 305 (80.3)	0.015
Yes	76/ 575 (13.2)	60/ 305 (19.7)	
Sex			
Female	281/ 575 (48.9)	147/ 305 (48.2)	0.91
Male	294/ 575 (51.1)	158/ 305 (51.8)	
Birth weight			
≤1,000g	22/ 575 (3.8)	15/ 305 (4.9)	0.78
>1,000-1,500g	31/ 575 (5.4)	18/ 305 (5.9)	
>1,500-2,500g	245/ 575 (42.6)	134/ 305 (43.9)	
>2500g	277/ 575 (48.2)	138/ 305 (45.3)	

* Number of mothers for this characteristic were not the same due to missing data.

Table 2 Association between mode of delivery and pregnancy outcomes in preterm births

Pregnancy outcomes	n/ N (%)			Crude OR (95%CI)		aOR (95%CI)	
Maternal outcomes							
MICU admission	2/	880	(0.2)				
VB	0/	575	(0.0)	-		-	
CS	2/	305	(0.7)	-		-	
Maternal near miss	12/	880	(1.4)				
VB	2/	575	(0.3)	1		1	*
CS	10/	305	(3.3)	9.4	(2.0-45.5)	12.0	(1.6-87.4)
Maternal death	1/	880	(0.1)				
VB	1/	575	(0.2)	-		-	
CS	0/	305	(0.0)	-		-	
Perinatal outcomes							
APGAR score <7 at 5 minutes	33/	851	(3.9)				
VB	17/	556	(3.1)	1		1	†
CS	16/	295	(5.4)	1.9	(0.9-3.8)	1.9	(0.8-4.3)
NICU admission	237/	851	(27.8)				
VB	131/	556	(23.6)	1		1	‡
CS	106/	295	(35.9)	1.9	(1.4-2.6)	1.8	(1.2-2.9)
Fresh stillbirth	29/	880	(3.3)				
VB	19/	575	(3.3)	1		1	§
CS	10/	305	(3.3)	0.9	(0.4-1.9)	0.8	(0.2-2.8)
Early neonatal death	4/	851	(0.5)				
VB	3/	556	(0.5)	1		1	‖
CS	1/	295	(0.3)	0.6	(0.1-6.1)	0.6	(0.1-6.3)
Perinatal death	33/	880	(3.6)				
VB	22/	575	(3.8)	1		1	**
CS	11/	305	(3.6)	0.8	(0.4-1.8)	0.7	(0.1-3.2)

*adjusted for underlying disease, eclampsia, and mode of delivery; facility was adjusted as a random effect; †adjusted for maternal education, mode of delivery, fetal presentation, and FCI; facility was adjusted as a random effect; ‡adjusted for maternal age, maternal education, underlying disease, mode of delivery, gestational age, birth weight, corticosteroids, and FCI; facility was adjusted as a random effect; §adjusted for maternal education, mode of delivery, gestational age, fetal presentation, birth weight, corticosteroids, and FCI; facility was adjusted as a random effect; ‖adjusted for mode of delivery, and gestational age; facility was adjusted as a random effect; **adjusted for maternal education, mode of delivery, gestational age, fetal presentation, birth weight, corticosteroids; facility was adjusted as a random effect.