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Short title: Outcomes of preterm breeches by planned delivery route

Abstract

Objective: To assess whether planned route of delivery is associated with perinatal and 2-year outcomes for preterm breech singletons.

Design: Prospective nationwide population-based EPIPAGE-2 cohort study.

Setting: France, 2011.

Sample: 390 women with breech singletons born at 26-34 weeks of gestation after preterm labor or preterm prelabor rupture of membranes.

Methods: Propensity-score analysis.

Main Outcome Measures: Survival at discharge, survival at discharge without severe morbidity, and survival at two years of corrected age without neurosensory impairment.

Results: Vaginal and cesarean delivery were planned in 143 and 247 women, respectively. Neonates with planned vaginal delivery and planned cesarean delivery did not differ in survival (93.0% vs 95.7%, p=.14), survival at discharge without severe morbidity (90.4% vs 89.9%, p=.85) or survival at two years without neurosensory impairment (86.6% vs 91.6%, p=.11). After applying propensity scores and assigning inverse probability of treatment weighting, as compared with planned vaginal delivery, planned cesarean delivery was not associated with improved survival (odds ratio [OR] 1.31 [95% confidence interval [95% CI] 0.67-2.59]), survival without severe morbidity (0.75 [0.45-1.27]) or survival at two years without neurosensory impairment (1.04 [0.60-1.80]). Results were similar after matching on the propensity score.

Conclusion: No association between planned cesarean delivery and improved outcomes for preterm breech singletons born at 26 to 34 weeks after preterm labor or preterm prelabor rupture of membranes was found. The route of delivery should be discussed with women, balancing neonatal outcomes with the higher risks of maternal morbidity associated with cesarean section performed at low gestational age.

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Key words: EPIPAGE-2, prematurity, breech, cesarean, vaginal delivery, neonatal outcomes, mode of delivery, delivery route, neurosensory impairment, cerebral palsy

Tweetable abstract:

Planned cesarean delivery is not associated with improved outcomes for breech singletons born at 26-34 weeks.

Introduction

Preterm birth is associated with a high frequency of breech presentation, which increases with decreasing gestational age.[1] The mode of delivery of these fragile fetuses remains controversial. Vaginal delivery and its potential complications, such as head entrapment, might imply higher risks of perinatal mortality, birth trauma or neurologic morbidity, whereas cesarean section, with potential technical difficulties when performed at low gestational age, could lead to short- and long-term maternal morbidity.[2–4]

Choosing the optimal mode of delivery for both infant and mother according to the evidence-based literature is a challenge for clinicians because of three major pitfalls. First, there are no contributive randomized controlled trials (RCT) comparing vaginal and cesarean deliveries in preterm pregnancies: all were interrupted early because of recruitment difficulties.[5,6] A review of four trials involving 116 women concluded a lack of reliable evidence for the benefit of one route after stratification on fetal presentation.[3] Second, most studies consider the actual delivery route, which is subject to major indication bias, instead of the planned delivery route. Thus, one can partly explain the benefits of cesarean section on neonatal outcomes, reported by most retrospective studies,[7–11] because infants are more likely to be delivered vaginally in cases of concerns about chances of survival (e.g., with extremely low gestational age). Studies with a more robust design (i.e., based on the center policy) showed no impact of planned cesarean delivery on outcomes for preterm breech infants.[12–14] Third, very few studies address mid- and long-term outcomes, which yet are relevant when assessing perinatal practices within a high-risk population such as preterm infants.

In the absence of RCT, observational studies with prospective data collection and appropriate statistical methods are the best compromise between quality and feasibility to assess the impact of planned delivery route on neonatal outcome with preterm breech birth. EPIPAGE-2 is a nationwide population-based prospective cohort of preterm infants recruited in France in 2011.[15] We aimed to examine breech deliveries to determine whether planned delivery route was associated with perinatal and 2-year outcomes, after propensity-score analysis to ensure comparability of the study groups and to minimize indication bias. We hypothesized that planning a cesarean section would be associated with improved perinatal and 2-year outcomes.

Materials and Methods

Setting and data collection

EPIPAGE-2 was implemented to describe short- and long-term outcomes of preterm infants and to assess the impact of medical practices and organization of care on child health and development. Briefly, eligible participants in the overall cohort included all infants liveborn or stillborn and all terminations of pregnancy from $22^{0/7}$ to $34^{6/7}$ weeks' gestation from March to December 2011 in 25 French regions, involving 546 maternity units. Recruitment took place at birth, and children were included in the cohort and data collected only after families had received information and agreed to participate. Infants were included at three different periods by gestational age at birth: 8-month recruitment for births at 22 to 26 completed weeks, 6-month recruitment for 27 to 31 weeks, and 5-week recruitment for 32 to 34 weeks. Extremely preterm births (22-26 weeks) were recruited during a longer period because of their very low incidence and only a sample of moderate preterm births (32-34 weeks) was recruited. Maternal, obstetric, and neonatal data were collected prospectively from the obstetric and neonatal records following a standardized protocol. Maternity and neonatal

units were asked to complete a general questionnaire about their annual activity and the policies implemented. At two years of corrected age, for children included in the follow-up with parental consent, a detailed neurological and sensory examination was performed by the referring physician. Full details of the cohort recruitment, follow-up and data collection were previously reported.[15,16]

Patient involvement

Patients were not involved in designing the EPIPAGE-2 cohort study, or in making decisions about research questions and outcome measures. However, parents of preterm infants provided massive support to the study through high participation and follow-up rates. National parents' associations assisted with the dissemination of the results.

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Participants

This study was a planned analysis from the EPIPAGE-2 cohort. The study population included all singleton breech fetuses delivered in the hospital from $26^{0/7}$ to $34^{6/7}$ weeks after preterm labor (PTL) or preterm prelabor rupture of membranes (PPROM) who were alive at the beginning of labor or at the decision of performing a cesarean section before labor. We excluded births before 26 weeks because active antenatal care, including the willingness to perform a cesarean section, can differ among maternity wards and can depend on the practitioner's judgment of prognosis.[17,18] Pregnancies with hypertensive disorders, fetal growth restriction or isolated placental abruption were excluded because cesarean section is almost systematically performed and neonatal prognosis is largely related to the underlying pathology. Other exclusion criteria were termination of pregnancy, fetal death before maternal admission at the hospital or before labor, multifetal pregnancies and homebirths. We also excluded infants with prenatal discussion of care limitation, i.e. who were not expected to survive or whose parents desired to withhold resuscitation. In these cases, vaginal delivery is preferred and may be associated with death during labor or just after birth, thereby leading to a major classification bias.

French guidelines

Guidelines from the National College of French Gynecologists and Obstetricians state no specific restrictions on the weight or term of birth that can justify the systematic practice of cesarean delivery in case of breech presentation, whatever its type (frank or complete).[19,20]

Main outcome and exposition measures

Exposure was the planned route of delivery. Planned vaginal delivery (PVD) was defined as vaginal delivery or cesarean section performed during labor for abnormal fetal heart rate or failure to progress. Planned cesarean delivery (PCD) was considered if performed during labor for the indication 'systematically due to gestational age and/or fetal position' or before labor whatever the indication. Women with two or more cesarean sections for previous pregnancies were allocated to PCD whatever the actual route of delivery because French guidelines recommend performing a cesarean section for women with more than one previous cesarean delivery.

The primary outcome was survival, defined as the number of children discharged alive from the hospital relative to the number of fetuses alive at the beginning of labor. The secondary outcome was survival to discharge without severe neonatal morbidity.[21] Severe neonatal morbidity was defined as any of the following: grade 3 or 4 intraventricular hemorrhage, cystic periventricular leukomalacia, stage II or III necrotizing enterocolitis, stage 3 or greater retinopathy of prematurity and/or laser treatment and severe bronchopulmonary dysplasia defined as requiring oxygen for at least 28 days in addition to the requirement of 30% or more oxygen and/or mechanical ventilator support or continuous positive airway pressure at 36 weeks' postmenstrual age. The third outcome was survival without neurosensory impairment at 2 years of corrected age, defined as survival without cerebral palsy, blindness or deafness.[16] Cerebral palsy was diagnosed if the child had permanent disorders of movement and/or posture and disorders of motor function due to a non-progressive lesion located in the developing brain.[22] Although the core outcome set for preterm birth was not

established yet when the study was designed, all the components of the neonatal set of outcomes were collected and used to define the outcomes of the present analysis.[23]

Other studied factors

The following variables were included in the analysis: maternal characteristics (age, married or living with a partner, nationality, employment), obstetric characteristics (parity, previous caesarean section, spontaneous labor diagnosed at admission, suspicion of chorioamnionitis, cause of preterm birth), obstetric management (antenatal steroids, tocolysis), neonatal characteristics (gestational age, sex, birth weight < 10^{th} percentile of the normalized z-score) and maternity characteristics (type of unit, annual number of births before 34 weeks).

Gestational age was determined as the best obstetrical estimate combining last menstrual period and ultrasonography assessment. Causes of preterm delivery were PPROM (rupture of membranes more than 24 hr before birth) or spontaneous PTL (defined as contractions associated with cervical dilation and rupture of membranes less than 24 hr before birth). Spontaneous labor at admission was defined as direct admission to the delivery room with cervix dilation > 2 cm and/or an interval of less than 10 hr from admission to birth. We did not report the use of magnesium sulphate for neuroprotection which was only recommended after our study period in women with spontaneous preterm labor.

Statistical analysis

Demographic and clinical characteristics and outcomes of infants were first described as frequencies and percentages. Percentages were weighted according to the duration of the recruitment periods by gestational age: weights were 1.0 (35/35) for births at 24 to 26 weeks,

1.34 (35/26) at 27 to 31 weeks and 7.0 (35/5) at 32 to 34 weeks. Weighting allowed us to account for the sampling scheme of the cohort and to ensure representativeness. We then compared characteristics between PVD and PCD groups by chi-square test or Fisher's exact test as appropriate for categorical variables, based on the weighted percentages.

We used a propensity-score analysis to minimize indication bias in planned delivery route. The propensity score reflects the likelihood of planning a PCD rather than PVD depending on the woman baseline characteristics. This analysis followed a three-step process: first, multiple logistic regression was used with the main exposure (i.e., planned route of delivery) regressed by the baseline characteristics selected a priori according to clinical considerations. Then inverse probability of treatment weighting based on estimated propensity scores was used to obtain a synthetic population in which planned delivery route was independent of measured baseline covariates, as confirmed by balance diagnostics. Finally, the association of planned delivery route and the three outcomes was quantified by odds ratios (ORs) and 95% confidence intervals (95% CIs) estimated from a logistic regression model, without further adjustment.

A propensity-score matching analysis was performed to ascertain the validity of the results. Two comparable groups were created by matching individuals (1:1 matching without replacement by using the nearest Mahalanobis distance within a caliper of +/- .20 standard deviation of the logit of the propensity score). If more than one woman in the PVD group could be matched, the algorithm considered in priority the closest gestational age. Unmatched individuals were deleted from the analysis. Finally, the association of planned delivery route and outcomes was quantified by ORs and 95% CIs estimated with a generalized estimating

equation to account for paired data, with logit-binomial distribution[24], and without further adjustment.

We also performed different sensitivity analyses of births at $26^{0/7}$ to $31^{6/7}$ weeks' gestation and women who were not in labor at admission.

The proportion of missing data ranged from 0% to 19.5% for each covariate. Multiple imputation by Monte Carlo Markov chains involved use of all baseline variables and outcomes of the propensity-score model, with a logistic regression imputation model for binary variables and a multinomial imputation model for categorical variables. Propensity scores were estimated for each of the 25 independent imputed datasets generated, and results were pooled in a single estimate according to Rubin's rules.[25] SAS v9.3 was used for data analysis. Statistical significance was set at two-tailed $p < .05$.

Results

The overall population consisted of 390 women with singleton pregnancies and breech-presenting neonates born at 26 to 34 weeks after PTL or PPROM; 143 were allocated to PVD and 247 to PCD (Figure 1).

Maternal, obstetric, neonatal and center characteristics by planned delivery route are in Table 1. PCD was more frequent for women with a previous cesarean section and married or living with a partner. Homemakers and women admitted to hospital after the onset of labor more

frequently had a PVD. In the PVD group, 30 infants (18.4%) were delivered by cesarean section because of abnormal fetal heart rate or abnormal progression of labor. In the PCD group, only one infant (0.2%) was delivered vaginally because labor progressed too rapidly to perform a cesarean section. Neonatal characteristics, as well as gestational age and type III maternity units, were not associated with the planned delivery route.

One fetus from the PVD group died during delivery because of cord prolapse and head entrapment (Table 2). However, neonates with PVD compared to PCD did not differ in survival at discharge (93.0% vs 95.7%, p=.14), survival at discharge without severe morbidity (90.4% vs 89.9%, p=.85) or survival at two years without neurosensory impairment (86.6% vs 91.6%, p=.11) (Tables 2 and S1). After applying propensity scores and assigning inverse probability of treatment weighting, as compared with PVD, PCD was not associated with improved survival at discharge (OR 1.31 [95%CI 0.67-2.59]), survival at discharge without severe morbidity (OR 0.75 [0.45-1.27]) or survival at two years without neurosensory impairment (OR 1.04 [0.60-1.80]) (Table 3). Analysis of the matched dataset revealed no association between PCD and survival at discharge (OR 1.17 [0.47-2.94]), survival at discharge without severe morbidity (OR 0.69 [0.34-1.39]) or survival at two years without neurosensory impairment (OR 1.23 [0.62-2.44]) as compared with PVD (Table 3). Sensitivity analyses of women who were not in labor at admission and women who delivered at 26 to 31 weeks' gestation gave consistent results (Table S2).

Discussion

Main findings

In cases of preterm breech delivery at 26 to 34 weeks after PTL or PPROM, as compared with PVD, PCD was not associated with improved survival, survival at discharge without severe morbidity, or survival at two years of corrected age without neurosensory impairment.

Strengths and Limitations

The main strength of this study is its design based on both planned delivery route and propensity-score analysis. Indeed, taking into account the actual route of delivery is not realistic from an "intent-to-treat" perspective and can lead to classification bias.[14,26,27] For instance, if a cesarean is performed during labor because of a labor-related complication, cesarean delivery is more likely to be found associated with poor neonatal outcomes. Hence, allocating these cases to the cesarean delivery group may introduce bias by worsening the neonatal prognosis. Our definition would then be more likely to burden the PVD group, and can hardly be an explanation for not having showed a protective effect of planned cesarean section in preterm breech deliveries. Second, propensity-score analysis allowed us to balance observed baseline covariates across the two groups and therefore minimize indication bias. Because RCTs on this topic likely will never be completed,[6] analyzing data from a prospective nationwide population-based cohort, with good representativeness of population and practices, as well as appropriate statistical methods provides robust and relevant alternative insights for daily obstetric management. Moreover, the EPIPAGE-2 questionnaires were especially designed to address this crucial issue. Another strength is in considering adverse outcomes related to labor, including stillbirth. Finally, follow-up of the

children at 2 years of corrected age is rarely reported in previous studies and allows for robust evaluation of potential neurological complications related to delivery route.

Our results must be interpreted in light of certain limitations. We cannot exclude that a sub-group of vaginal deliveries should have been classified as PCD, for example, if labor progressed too quickly to perform a cesarean section and resulted in vaginal delivery. This classical misclassification can result in bias in either direction.[11,28] The exclusion of women admitted after the beginning of active labor did not modify our findings, so if any bias existed, it would be weak. Second, although the number of preterm breech deliveries was substantial, the EPIPAGE-2 cohort sample size was not calculated to compare outcomes of preterm breech births by mode of delivery. Overall, it should be noted that the magnitude of the between-group difference was quite small and with quite limited clinical impact. However, we cannot completely rule out that the limited number of adverse outcomes in our sample might not have been sufficient to reveal a statistically significant effect of the mode of delivery. The power of this study was greater than 85% to detect a three-fold reduction in mortality with PCD versus PVD but only 20% to show a mortality rate reduced by 40%. Unfortunately, we lacked data to adequately estimate maternal adverse consequences in our sample. Finally, we had no information on the type of breech presentation (frank or complete), but we have no reason to think that this could bias our findings.[13]

Interpretation

One of the greatest risks associated with PVD is head entrapment. In this study, only one infant from the PVD group died because of head entrapment as compared with none in the PCD group. Thus, head entrapment is a rare complication and can also occur with planned cesarean section.[14] In terms of perinatal mortality and severe morbidity, our results agree with

studies addressing the impact of planned route of delivery and neonatal outcome in preterm breeches.[11,13,14,29] A retrospective cohort study involving data from the population-based Netherlands Perinatal Registry from 2000 to 2011, with 8356 singleton breech deliveries at 26 to 36 weeks,[11] found that overall, perinatal mortality and composite mortality and severe morbidity did not differ between intended cesarean delivery and intended vaginal delivery. The authors found some significant differences on subgroup analyses, potentially related to limited restrictive criteria to attempt vaginal delivery (77% of women were allocated to PVD) or to composite morbidity scores that emphasized some benign pathologies (e.g., fracture of the clavicle), which are more likely to occur with PVD.[30] The quality of routinely collected data is questionable, as is the lack of information about long-term prognosis, because the database provides outcomes only until 28 days after birth. The retrospective study by Reddy et al. including 768 pregnancies with breech presentation at 24 to 31 weeks found attempted vaginal delivery associated with higher risk of death than with PCD.[28] Notably, indicated preterm births, mainly related to pre-eclampsia, were not excluded whereas few vaginal deliveries are usually attempted in these situations. The low rate (17-28%) of successful vaginal delivery might reflect inappropriate criteria to attempt vaginal deliveries, although the authors did not provide information about these criteria. Moreover, poor outcomes might not necessarily be related to the route of delivery but may be associated with obstetric or fetal context, especially when physicians prefer to attempt vaginal delivery for fetuses with perceived worse outcomes. Some other studies appeared biased because they did not account for gestational age at birth, the major determinant of neonatal outcome,[26,31,32] or antenatal steroids,[11,28] that are known to be associated with improved prognosis.

Although a key point in counseling parents, long-term outcomes have been addressed in very few studies.[12,33] Only one study investigated the association of a policy of cesarean section for early preterm breech delivery and found no improvement in survival without disability or handicap documented at two years of corrected age.[12] Finally, when discussing with parents to choose the route of delivery, the high risks of maternal morbidity associated with cesarean section performed at low gestational age should be taken into consideration. Reddy et al. reported high incidences of serious short-term maternal complications after early preterm delivery, up to 14.4% with cesarean delivery versus 3.5% with vaginal delivery, without considering long-term adverse consequences.[2]

Conclusion

Our study indicates that planned cesarean delivery is not associated with improved neonatal outcomes for preterm breech singletons born at 26 to 34 weeks after PTL or PPROM, even though it might lack power to show a difference for rare events. The route of delivery should be discussed with women, balancing neonatal outcomes with the higher risks of maternal morbidity associated with cesarean section performed at low gestational age.

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Contribution to authorship:

Study concept and design of the EPIPAGE 2 study: FG

Study concept and design of the present study: EL, LS, GK

Acquisition, analysis and interpretation of data: EL, LS, MQ, CL, NW, HT, FG, PD, GK

Statistical analysis: EL, MQ, HT

Drafting of the manuscript: EL, LS, MQ, GK

Critical revision of the manuscript for important intellectual content: EL, LS, MQ, CL, NW, HT, FG, PD, GK

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Ethics approval

As required by French law and regulations, EPIPAGE 2 was approved by the national data protection authority (Comission Nationale de l'Informatique et des Libertés, CNIL n°911009), the appropriate ethics committees (CCTIRS: Comité Consultatif sur le Traitement de l'Information en matière de Recherche, approval granted November 18, 2010) and the committee for the protection of people participating in biomedical research (CPP: Comité de Protection des Personnes, approval granted March 18, 2011).

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Figure 1: Flow diagram

Description of figure 1:

The flow chart summarizes how the sample size of the analysis was reached.

Legends of figure 1:

PTL: preterm labor, PPROM: preterm prelabor rupture of membranes, w: weeks' gestation

Table 1: Unit, maternal, obstetric and neonatal characteristics by planned delivery route.

Characteristics	**Planned delivery route**		
	PVD (n=143) N (%)*	PCD (n=247) N (%)*	p-value
Unit characteristics			
Annual number of births before 34 weeks (n=390)			
0-50	33 (32.9)	70 (44.9)	.23
51-100	43 (29.8)	69 (21.8)	
101-150	30 (16.1)	52 (17.8)	
>150	37 (21.2)	56 (15.5)	
Type III maternity unit (n=390)	115 (70.7)	201 (65.6)	.49
Maternal characteristics			
Mother age (years) (n=390)			
≤ 20	10 (3.6)	8 (1.8)	.25
21-34	109 (78.9)	178 (73.5)	
≥ 35	24 (17.5)	61 (24.7)	
French nationality (n=379)	121 (84.2)	201 (84.7)	.92
Married or living with a partner (n=384)	120 (86.8)	220 (95.2)	.004
Employment (n=370)			
Employed	82 (61.1)	159 (70.9)	.02
Unemployed	25 (11.2)	42 (16.2)	
Homemaker	29 (27.7)	33 (12.9)	
Obstetric characteristics			
Nulliparity (n=390)	76 (48.9)	107 (49.2)	.97
Previous cesarean section (n=371)	10 (5.8)	42 (14.3)	.04
Spontaneous labor at admission (n=388)	58 (38.7)	39 (17.0)	<.001
Antenatal steroids (n=384)	105 (69.3)	200 (73.4)	.56
Tocolysis (n=387)	84 (54.2)	170 (61.2)	.34
Suspicion of chorioamnionitis (n=363)	23 (10.6)	67 (18.0)	.08
Cause of preterm birth (n=390)			

Preterm labor	92 (61.7)	123 (55.2)	.37
Preterm premature rupture of membranes	51 (38.3)	124 (44.8)	
Cesarean delivery (n=390)	30 (18.4)	246 (99.8)	<.001
Gestational age (weeks) (n=390)			
26-27	54 (18.0)	72 (14.4)	.50
28-29	29 (11.7)	56 (13.3)	
30-31	33 (13.4)	75 (17.8)	
32-34	27 (56.9)	44 (54.5)	
Neonatal characteristics			
Male sex (n=390)	83 (54.7)	139 (56.72)	.78
Birth weight <10th percentile of the normalized z-score (n=390)	16 (16.5)	28 (13.3)	.57

PVD: planned vaginal delivery, PCD: planned cesarean delivery

* Percentages are weighted by gestational age.

Table 2: Outcomes by planned route of delivery.

Outcomes	**Planned delivery route**		
	PVD	PCD	
	N (%)*	N (%)*	p-value
Vital status			
Stillbirth during labor	1/143 (0.3)	0/247 (0)	.14
Death in delivery room	5/143 (1.6)	2/247 (0.4)	
Death in NICU	14/143 (5.1)	19/247 (3.9)	
Survival at discharge	123/143 (93.0)	226/247 (95.7)	
Severe morbidity among survivors at discharge			
IVH and/or cPVL	2/116 (0.8)	10/216 (2.6)	.09
BPD	4/121 (1.3)	11/221 (2.4)	.29
NEC	3/123 (1.2)	6/226 (1.4)	.80
ROP	0/121	0/221	-
Survival at discharge without severe morbidity†	113/141 (90.4)	196/244 (89.9)	.85
Neurosensory impairment among survivors at 2 years corrected age with follow-up			
Cerebral palsy	6/93 (3.3)	8/178 (2.6)	.69
Blindness	0/91 (0)	0/169 (0)	-
Deafness	0/91 (0)	1/175 (0.3)	.46
Survival at 2 years of corrected age without neurosensory impairment‡	87/116 (86.6)	168/198 (91.6)	.11

PVD: planned vaginal delivery, PCD: planned cesarean delivery, NICU: neonatal intensive care unit, IVH: intraventricular hemorrhage, cPVL: cystic periventricular leukomalacia, BPD: bronchopulmonary dysplasia, NEC: necrotizing enterocolitis, ROP: retinopathy of prematurity

* Percentages are weighted by gestational age.

† Survival at discharge without severe IVH, cPVL, NEC or ROP, 5/390 missing data

‡ Neurosensory impairment: cerebral palsy (any stage), blindness or deafness, 19/390 missing data and 57/390 children lost to follow-up

Table 3: Association between planned route of delivery and outcomes (propensity-score analysis*).

Outcome	IPTW	Matching
Planned delivery route	OR (95% CI)	OR (95% CI)
Survival at discharge	(n=390)	
Planned vaginal delivery	Ref	Ref
Planned cesarean delivery	1.31 (0.67-2.59)	1.17 (0.47-2.94)
Survival at discharge without severe morbidity	(n=390)	
Planned vaginal delivery	Ref	Ref
Planned cesarean delivery	0.75 (0.45-1.27)	0.69 (0.34-1.39)
Survival at 2 years of corrected age without neurosensory impairment	(n=390)	
Planned vaginal delivery	Ref	Ref
Planned cesarean delivery	1.04 (0.60-1.80)	1.23 (0.62-2.44)

IPTW=inverse probability of treatment weighting

Data are imputed.

*Propensity score: probability of a planned cesarean delivery conditional on the following characteristics: unit characteristics (type of maternity unit, annual number of births before 34 weeks), maternal characteristics (age, nationality, employment, marital status), obstetrics characteristics (parity, previous cesarean section, cause of preterm birth, spontaneous labor at admission, antenatal steroids, tocolysis, suspicion of chorioamnionitis, gestational age) and birth weight z-score as a proxy for fetal growth restriction.