

Induction of labor in breech presentations - a retrospective cohort study

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Abstract

Introduction: There is limited evidence on the safety and outcome of induction of breech labor. In this study, we aimed to compare the outcomes of spontaneous and induced breech deliveries and to describe variations in induction rates.

Material and methods: This was a retrospective cohort study comprising 1054 singleton live fetuses in breech presentation at Trondheim University Hospital from 2012 to 2019. The main outcome was intrapartum cesarean section, and secondary outcomes were postpartum hemorrhage, anal sphincter ruptures, Apgar scores, pH in the umbilical artery, and metabolic acidosis. All data were obtained from the hospital birth journal.

Results: Induction of labor was performed in 127/606 (21.0%) women with planned vaginal birth. The frequency of intrapartum cesarean section was 48.0% for induced labor vs 45.7% for spontaneous labor ($P = .64$). We found no differences in the frequency of postpartum hemorrhage or anal sphincter ruptures between induced and spontaneous births. The median pH in the umbilical artery was significantly lower in neonates with induced labor compared with neonates with spontaneous labor (7.22 vs 7.25; $P = .02$). The frequency of pH <7.05 was 7.0% for induced labor vs 2.9% ($P = .05$) for spontaneous labor, but the frequency of pH <7.0 was not significantly different: 2.6% vs 0.8% ($P = .14$), respectively. Three neonates with planned vaginal birth had metabolic acidosis: two with spontaneous labors and one with induced labor. Three fetuses with planned vaginal birth died during labor: two with spontaneous onset of labor and one with induced labor. All three were extremely preterm: two were delivered in week 23 and one in week 25. We did not observe any significant trend in induction rates in either parous or nulliparous women.

Conclusions: The induction rates were stable during the study period. We did not observe any significant difference in intrapartum cesarean section rates, in the frequency of pH <7.0 in the umbilical artery, or in the frequency of metabolic acidosis when comparing induced and spontaneous breech deliveries.

Abbreviations: ICS, intrapartum cesarean section; IOL, induction of labor; TBT, Term Breech Trial.

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KEYWORDS

cesarean delivery, high-risk pregnancy, induction of labor, pregnancy, preterm birth, stillbirth

1 | INTRODUCTION

About 3%-4% of fetuses have breech presentation at term.¹ In 2000, the Term Breech Trial (TBT) was published in *The Lancet*.² This study included 121 centers in 26 countries, and showed that planned cesarean sections were associated with less neonatal mortality and morbidity than planned vaginal births for breech-presenting fetuses at term. The maternal outcome was equal for the two delivery methods. This study resulted in a huge decrease in breech deliveries worldwide.³ Six years later, a prospective observational study comparing planned vaginal and cesarean breech deliveries in France and Belgium found a low rate of neonatal mortality and morbidity in both groups. This study concluded that it was safe to deliver selected breech-presenting fetuses vaginally, in modern, well-equipped obstetrical units at term.⁴ After the TBT was published, there were discussions in Norway about whether the study could be applied to Norwegian obstetrical practice. An expert group from the Norwegian Centre of Medical Method Evaluation reviewed the literature on delivery methods for breech-presenting fetuses. The expert group concluded that both the selection process for breech deliveries and the experience of obstetricians in Scandinavia differed from those described in the TBT. The expert group concluded that vaginal delivery of breech-presenting fetuses could be advised for Norwegian women, provided that there was a rigorous selection process, careful birth monitoring and the presence of qualified clinicians.⁵ Authors of a Registry-based Cohort Study in Norway came to the same conclusion.⁶ The frequency of vaginal breech deliveries in Norway decreased after the TBT, but has stabilized between 30% and 34% after 2010.⁷

Induction of labor (IOL) in vertex position increased from 20% to 24% in Norway during our study period.⁷ Induction is associated with increased rates of cesarean section in international retrospective register studies, but not in randomized controlled trials.^{8,9} It is unclear whether the high cesarean rates are due to induction itself or to confounding by indication.¹⁰ IOL has become an accepted procedure in breech presentations in Norway. There is limited evidence, solely from case series, on the safety of breech induction.^{11,12} This paper seeks to add to that body of evidence. We aimed to compare the outcomes of spontaneous and induced breech deliveries and to describe variations in induction rates over time.

2 | MATERIAL AND METHODS

This was a retrospective cohort study, evaluating the management of labor and birth outcomes in breech presentations at Trondheim University Hospital (St. Olavs Hospital), Norway, from 1 January 2012 to 31 December 2019. The obstetric ward had responsibility for patients in the Central Norway Regional Health Authority,

Key message

Intrapartum cesarean section rates were similar in induced and spontaneous breech deliveries. There was no significant difference in metabolic acidosis nor in pH <7.0 in the umbilical artery when comparing the two groups.

with approximately 3700 births each year. Standardized, quality-controlled procedures were used to collect and record information relating to births and deliveries in an electronic birth journal.

Women with a single fetus in breech presentation were first recommended an external cephalic version, and if external cephalic version failed, a vaginal birth was recommended for women with uncomplicated pregnancies. The selection criteria for vaginal breech deliveries at the hospital all through the study period included gestational age of more than 34 weeks, estimated birthweight between 2000 and 4500 g, and complete or frank breech presentation. Fetal growth restriction was not a criterion for exclusion. Cesarean section was not recommended at the hospital before pregnancy week 25. Between pregnancy weeks 25 and 34 a vaginal birth was allowed in women with their cervix fully dilated and the presenting part of the fetus at a low station at admission.

Pelvimetry was performed using computer tomography in women who had not given birth vaginally previously and with a planned vaginal breech delivery after 37 weeks of gestation. The local guidelines for pelvimetry criteria follow the Norwegian guidelines for breech deliveries. The following measurements are suggested when pelvimetry is used to determine if vaginal breech delivery is an option (pelvimetry is not mandatory): the pelvic inlet sagittal diameter should be larger than 11 cm and the pelvic outlet, measured as the sum of the interspinous distance, the intertuberous diameter, and the sagittal pelvic outlet diameter, should be larger than 31.5 cm.

The planned delivery route was thoroughly discussed with the woman at the outpatient clinic during the third trimester. In the case of an unknown breech presentation at admittance, the mode of delivery was determined by the doctor on call after discussion with the woman, following the same criteria. Pelvimetry was not performed in women arriving late in labor.

Induction of labor was an approved option in the hospital guidelines, and the indications for induction were similar for cephalic and breech presentations. The induction procedure started with a balloon catheter, misoprostol or dinoprostone administered vaginally in women with an unripe cervix. In women with a ripe cervix the recommendation for cephalic induction was amniotomy, followed by oxytocin infusion. However, amniotomy was usually avoided as a start procedure in breech inductions because of the risk of umbilical cord prolapse.

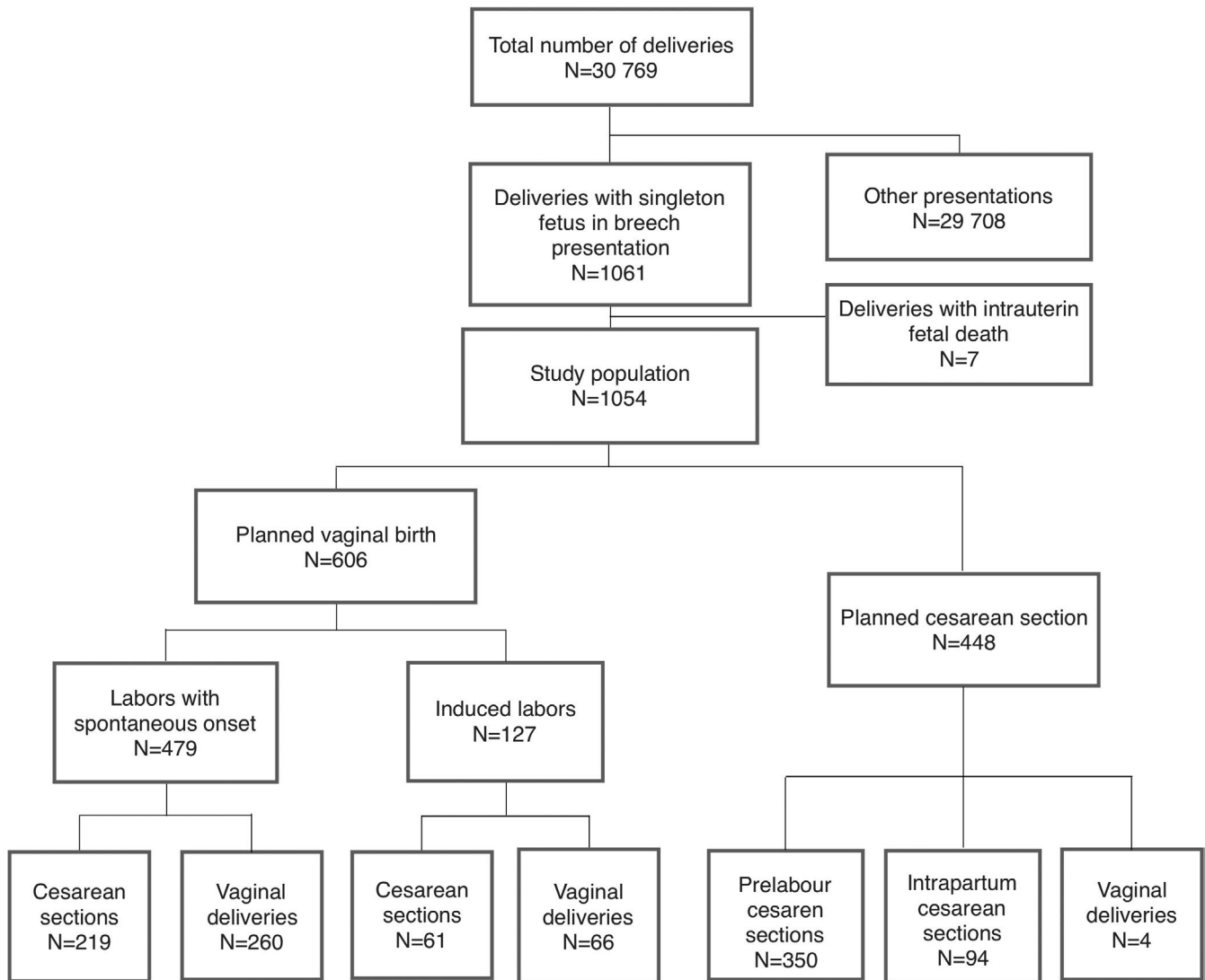


FIGURE 1 Flow chart of the study population

The main outcome was intrapartum cesarean section (ICS), and secondary outcomes were postpartum hemorrhage, sphincter ruptures, Apgar scores, pH in the umbilical artery, and metabolic acidosis. Metabolic acidosis was defined as pH <7.0 combined with a base excess lower than -12. All data were obtained from the hospital birth journal, Natus (CSAM).

2.1 | Statistical analyses

We performed an a priori power analysis based on an estimate of 30% ICS in spontaneous breech deliveries and 45% ICS in induced breech deliveries and an induction rate of 20% in planned vaginal births. Using a chi-squared test, $\alpha = 0.05$ and power = 0.80, 515 women were needed in the study (412 spontaneous labors and 103 induced labors).

Categorical variables were compared using a chi-squared test or Fisher's exact test and continuous variables were compared with a Mann-Whitney *U* test. Variations over time were analyzed with

linear-by-linear association. The association between ICS and IOL was analyzed using logistic regression and adjusted for potential confounders such as parity, maternal age, body mass index, gestational age, and ethnicity. Duration of labor in spontaneous and induced labors was analyzed with survival methods and compared with a log-rank test. Cesarean sections and labors with duration >15 hours were censored.

Data were analyzed with the statistical software package SPSS statistics version 26.0. (IBM SPSS) and *P* values <.05 were considered statistically significant.

2.2 | Ethical approval

The study was approved by the Regional Committees for Medical and Health Research Ethics on 12 September 2019 (2019/7190) and approved by the health authority at St. Olavs Hospital on 12 December 2019.

3 | RESULTS

In all, 30 769 women delivered at Trondheim University Hospital during the study period. The number of annual deliveries varied from 3556 to 4021. The frequency of preterm deliveries (before pregnancy week 37) was 4.7% in women with a single fetus in cephalic presentation. The mean birthweight was 3535 g and 1.6% of neonates had an Apgar score of <7 at 5 minutes, 3.2% had pH <7.10, 1.3% had pH <7.05, and 0.5% had pH <7.0 in the umbilical artery.

Of the women, 1061 had a singleton fetus in breech presentation (3.5% of the total births). We excluded seven women with intrauterine fetal death before the start of the labor, leaving 1054 women in the study population. In all, 210/1054 (20%) women delivered before 37 weeks of gestation. Figure 1 presents a flow chart of the study population. A vaginal birth was planned in 606 (57.5%) women and cesarean section was planned in 448 (42.5%) women; a further 350 of the 448 neonates were delivered by prelabor cesarean section. Four women with a planned cesarean section delivered vaginally. Because the labor started before the scheduled date, 94 neonates were delivered with ICS. In all, 22 women delivered vaginally before pregnancy week 34, of whom 14 were in week 23 or 24. Characteristics of the study population are presented in Table 1. Variations in the frequency of overall cesarean sections, planned vaginal births, successful vaginal births, and frequency of induced labors are shown in Figure 2 for nulliparous women and in Figure 3 for parous women.

We did not observe any significant change in induction rates during the study period ($P = .10$ and $P = .55$) in nulliparous women and parous women, respectively. Table 2 compares the outcome of planned cesarean section and planned vaginal delivery.

Induction of labor was performed in 127/606 (21.0%) women with planned vaginal birth. The indications for induction were prolonged prelabor rupture of membranes (21/127), postterm pregnancies (17), oligohydramnios (13), hypertensive disorders (11), diabetes (4), growth restriction (6), large fetuses (4), maternal request (3), or a combination of indications (48). The induction started with the use of a balloon catheter in 70 cases, vaginal misoprostol in 46 cases, dinoprostone in seven cases, oxytocin in three cases, and amniotomy in one case.

We found no significant difference in the frequency of ICS when comparing induced and spontaneous deliveries: 48.0% vs 45.7%, respectively ($P = .64$). Table 3 compares the outcomes of labor and neonates in spontaneous and induced labors. Logistic regression analyses are presented in Table 4. Unadjusted and adjusted odd ratios for an ICS in women with induced labors were 1.08 (95% CI 0.73-1.60) and 1.65 (95% CI 0.92-2.94), respectively. The median birthweight was significantly higher in induced labors than in labors with spontaneous onset, 3452 g vs 3120 g, respectively ($P < .01$). The median length of the pregnancy was significantly longer in induced labors than in labors with spontaneous onset with gestational age of 283 days vs 274 days, respectively ($P < .01$).

Three fetuses with planned vaginal birth died during labor, two after spontaneous onset of labor and one after induced labor. All

TABLE 1 Background and labor characteristics of the study population (n = 1054) at Trondheim University Hospital, Norway from 1 January 2012 to 31 December 2019

	n or median	% or range
Maternal characteristics		
Nulliparous	653	62.0
Maternal age (years)	31	18-46
Prepregnant body mass index	25	16-53
Labor characteristics		
Induction of labor	129	12.2
Epidural analgesia	274	26.0
Oxytocin augmentation	288	27.3
Forceps	77	7.3
Characteristics of the newborn		
Gestational age at delivery (days)	273	161-296
Birthweight (g)	3260	330-5195
Head circumference (cm)	35	20-49
Apgar score 1 minute	9	0-10
Apgar score 5 minutes	10	0-10
Apgar score <7 after 5 minutes	83	7.9
pH in umbilical artery (n = 866)	7.28	6.78-7.51
pH <7.10	50	5.8
pH <7.05	20	2.3
pH <7.00	6	0.7
Metabolic acidosis	3	0.3
Birth characteristics		
Postpartum hemorrhage (mL)	400	100-5000
Third- and fourth-degree anal sphincter tears	13	1.2

three were extremely preterm, two in pregnancy week 23 and one in week 25. The fetus in pregnancy week 25 had spontaneous onset of labor and was delivered by emergency ICS. Birthweight was 575 g, but the baby was stillborn.

Arterial pH was measured in 489/606 (81%) of the planned vaginal deliveries. The median pH in the umbilical artery was significantly lower in neonates with induced labors compared with neonates with spontaneous labors (7.22 vs 7.25; $P = .02$), the frequency of pH <7.05 was 7.0% vs 2.9% ($P = .05$) in the two groups. The frequency of pH <7.0 was not significantly different between neonates with induced and spontaneous labors; 2.6% vs 0.8% ($P = .14$), respectively. Three neonates with planned vaginal birth had metabolic acidosis. In the first case, labor started spontaneously in pregnancy week 41 and the woman delivered vaginally. This child was treated with hypothermia, had normal magnetic resonance imaging of the brain after 5 days and was without any sequelae at the age of 3 years. The second neonate was delivered in week 32, after spontaneous onset of labor, followed by ICS because of preterm labor and bleeding. In the third case, labor was induced in pregnancy week 38. The neonate was delivered with ICS because of fetal distress. We have not received

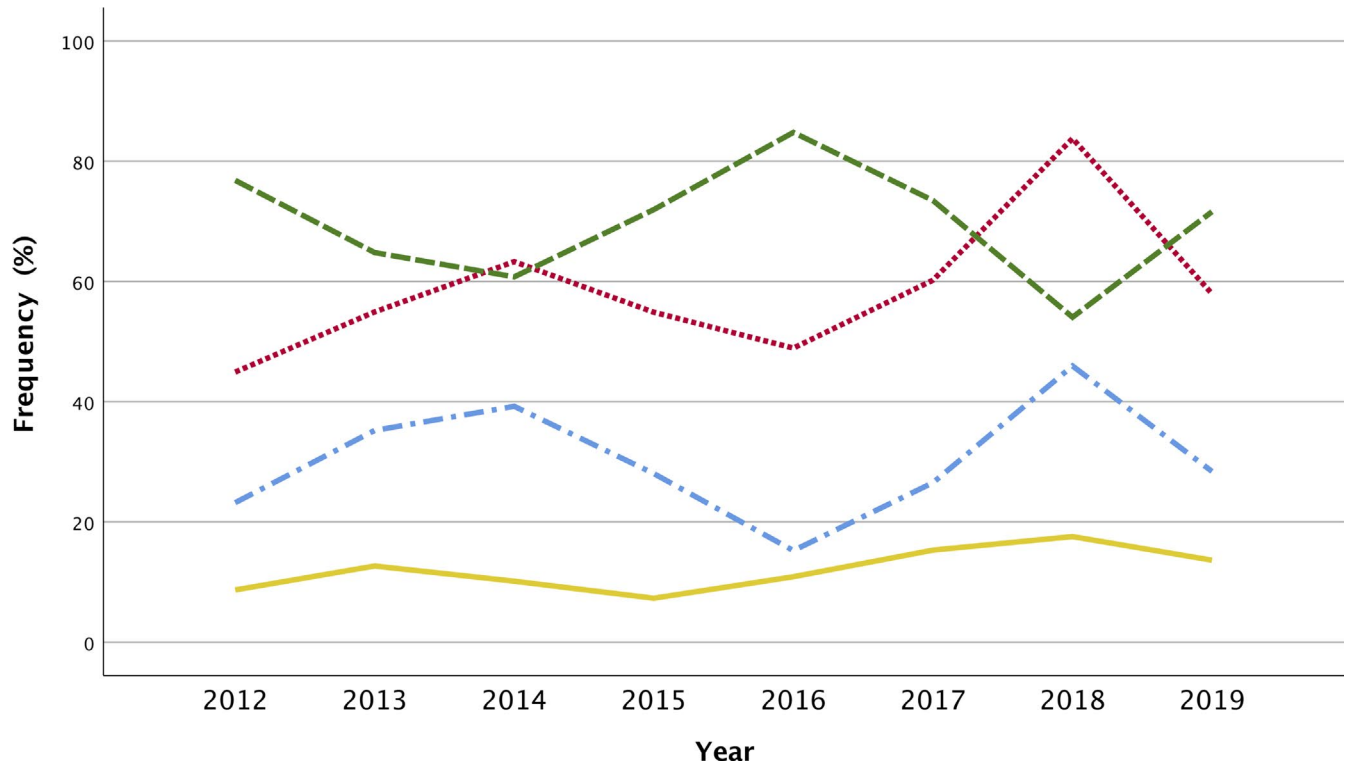


FIGURE 2 Variations in breech deliveries at Trondheim University Hospital (St. Olavs Hospital), Norway, from January 1st 2012 to December 31st 2019 in nulliparous women. Induced labors (yellow line _____), vaginal births (blue line · · · · ·), planned vaginal births (red line ·····) and cesarean section (green line - - - - -) [Colour figure can be viewed at wileyonlinelibrary.com]

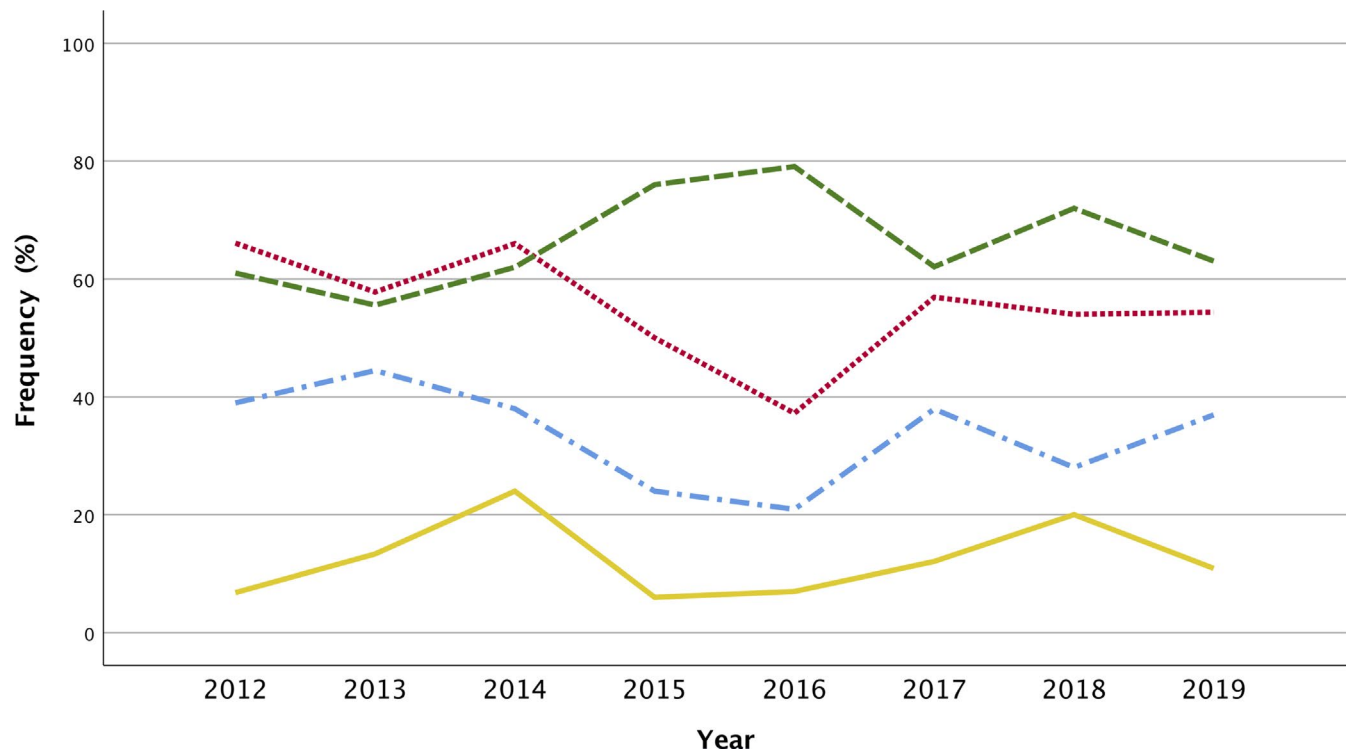


FIGURE 3 Variations in breech deliveries at Trondheim University Hospital (St. Olavs Hospital), Norway, from January 1st 2012 to December 31st 2019 in parous women. Induced labors (yellow line _____), vaginal births (blue line · · · · ·), planned vaginal births (red line ·····) and cesarean section (green line - - - - -) [Colour figure can be viewed at wileyonlinelibrary.com]

	Planned vaginal birth		Planned cesarean section		P value
	n = 606		n = 448		
	n or median	% or range	n or median	% or range	
Labor characteristics					
Cesarean section	280	46.2	444	99.1	<.01
Postpartum hemorrhage (mL)	350	100-3000	420	100-5000	<.01
Third- and fourth-degree tears	12	2.0	1	0.2	.01
Forceps	75	12.4	2	0.4	<.01
Newborn characteristics					
Gestational age (days)	275	161-296	272	167-295	<.01
Birthweight (g)	3220	330-5195	3320	445-4990	<.01
Head circumference (cm)	35	20-49	36	22-40	<.01
Apgar score 1 min	8.5	0-10	9	1-10	<.01
Apgar score 5 min	9	0-10	10	0-10	<.01
Apgar score 5 min <7	68	11.4	15	3.3	<.01
pH in umbilical artery (n = 866)	7.24	6.78-7.51	7.30	7.04-7.43	<.01
pH <7.10	47	9.6	3	0.8	<.01
pH <7.05	19	3.9	1	0.3	<.01
pH <7.00	6	1.2	0	0	.04 ^a
Metabolic acidosis	3	0.6	0	0	.26 ^a

^aData were compared with Mann-Whitney *U* test, chi-squared test, or Fisher's exact test.

informed consent from the parents to publish follow-up results from the latter two cases with metabolic acidosis at birth.

In nulliparous women with planned vaginal birth, the estimated median duration of the active phase of labor was 547 minutes (95% CI 466-628 minutes) in induced labors vs 478 minutes (95% CI 434-522 minutes) in spontaneous labors (log-rank test; $P = .44$). In parous women with planned vaginal birth, the estimated median duration was 214 minutes (95% CI 49-379 minutes) in induced labors and 264 minutes (95% CI 205-323 minutes) in spontaneous labors (log-rank test; $P = .89$).

4 | DISCUSSION

When comparing induced and spontaneous breech deliveries, we found no difference in the frequency of ICS. There was no significant difference in the frequency of pH <7.0 and the frequency of metabolic acidosis was <1% in both groups. Intrapartum deaths occurred only in extremely preterm cases.

The TBT led to a change in the practice of delivering term breech fetuses towards more planned cesarean sections in many countries.³ A study from Ireland found a significant increase in planned cesarean section in nulliparous and parous women when comparing the time periods before and after the TBT.¹³ In Norway, 57% of breech-presenting fetuses were delivered by cesarean section from 1991 to 2000. The cesarean section rate increased to 67.6% during 2001-2010 and was stable at 67.8% during 2011-2018.⁷

TABLE 2 Comparison of planned vaginal birth and planned cesarean section for breech-presenting fetuses at Trondheim University Hospital, Norway, from 1 January 2012 to 31 December 2019

A few publications have studied the safety of induction of breech deliveries. A study from France and Belgium compared induction of breech labor with planned cesarean section. They found no significant differences in maternal or fetal outcome, and supported IOL as an alternative for breech-presenting fetuses.¹²

We found no difference in the ICS rate when comparing spontaneous and induced labors. This is different from what was found in a systematic review and meta-analysis of seven studies from 2018,¹¹ which found that the cesarean section rate increased when labor was induced. The neonatal outcomes were similar in both groups.

We observed a significantly higher median birthweight in induced labors than in spontaneous labors, probably because of higher gestational age. The Apgar score was significantly higher in neonates with planned cesarean section compared with neonates with planned vaginal birth. This is in accordance with international studies as well as other Norwegian studies.¹⁴⁻¹⁷ The median pH in the umbilical artery was significantly lower in induced labors compared with labors with spontaneous onset. The meta-analysis from 2018 did not find any statistically significant differences in pH in the umbilical artery when comparing induced and spontaneous labors.¹¹ A Dutch population-based study found increased perinatal death when comparing induced breech deliveries with spontaneous breech deliveries.¹⁷ We observed three stillbirths in the group with planned vaginal birth. Two of these births were spontaneous, one was induced. All three fetuses were extremely premature. We believe that neither the selection of a planned vaginal birth nor the choice of induction had any consequence for their outcome.

TABLE 3 Comparison between spontaneous and induced labors in women with planned vaginal delivery at Trondheim University Hospital (St. Olavs Hospital), Norway, from 1 January 2012 to 31 December 2019

	Labors with spontaneous onset		Induced labors		P-value
	n = 479		n = 127		
	n or median	% or range	n or median	% or range	
Labor characteristics					
Cesarean section	219	45.7	61	48.0	.64
Postpartum hemorrhage (mL)	350	100-3000	350	100-1200	.77
Third- and fourth-degree tears	8	1.7	4	3.1	.29
Forceps	60	12.5	15	11.8	.83
Newborn characteristics					
Gestational age (days)	274	161-293	283	162-296	<.01
Birthweight (g)	3120	330-5195	3452	455-4685	<.01
Head circumference (cm)	35	20-49	36	20-39	<.01
Apgar score 1 min	8	0-10	9	0-10	.14
Apgar score 5 min	9	0-10	10	0-10	.11
Apgar score 5 <7	59	12.5	9	7.1	.09
pH in umbilical artery (n = 489)	7.25	6.78-7.51	7.22	6.92-7.47	.02
pH <7.10	31	8.3	16	14	.07
pH <7.05	11	2.9	8	7.0	.05
pH <7.0	3	0.8	3	2.6	.14 ^a
Metabolic acidosis	2	0.5	1	0.9	.55 ^a

^aData were compared with Mann-Whitney U test, chi-squared test, or Fisher's exact test.

TABLE 4 Logistic regression analyses of variables associated with cesarean section

	Unadjusted odds ratio	95% CI	Adjusted odds ratio	95% CI
Induced labors	1.08	0.73-1.60	1.65	0.92-2.94
Parity (nulliparous vs parous)	0.82	0.67-1.00	0.64	0.45-0.92
Maternal age	1.03	1.00-1.07	1.05	0.99-1.10
Body mass index	1.06	1.01-1.11	1.06	1.005-1.112
Caucasian (yes/no)	1.19	0.70-2.03	1.12	0.46-2.70
Gestational age	0.985	0.98-0.99	0.99	0.98-1.00

National guidelines have different recommendations for IOL in breech deliveries. The Royal College of Obstetricians and Gynaecologists guidelines state that women should be informed that IOL is normally not recommended.¹⁸ The Canadian guidelines of 2009 did not recommend IOL because of a paucity of evidence. The 2019 Canadian guidelines list the limited evidence and recommend IOL as an acceptable option.¹⁹ In France, breech presentation at term is not a contraindication to IOL.²⁰

In view of the worldwide increase in cesarean section rates for breech deliveries, it is important to consider the possible consequences that the first cesarean section may have for subsequent labors. According to a meta-analysis from 2018, subsequent labors following a cesarean section will show an increased risk of

hysterectomy, abnormal placentation, uterine rupture, stillbirth, and premature birth.²¹

Another result of the increasing trend towards planned cesarean sections in breech deliveries is the potential lack of training in vaginal delivery for obstetrical staff. Around 20% of breech presentations were undiagnosed at admission,²² some leading to difficult abdominal deliveries.²³ The American College of Obstetricians and Gynecologists notes the decreasing number of practitioners with the skills and experience to perform vaginal breech delivery.²⁴ Obstetrical skills to manage vaginal breech delivery should be as widespread as breech presentation.²⁵ Suboptimal antenatal care and/or management of in-hospital deliveries is more common in deliveries with intrapartum or neonatal death than in deliveries where the offspring survives.²⁶

Multiple methods have been tried in the search for improved birth outcomes for breech-presenting fetuses. A retrospective cohort study published in 2017 compared vaginal delivery in the dorsal position with vaginal delivery in an upright position. The paper concluded that upright vaginal breech delivery was associated with reductions in maternal and neonatal injuries, the cesarean rate, duration of the second stage of labor, and the number of maneuvers required.²⁷ This method seems promising, and has the potential to rekindle vaginal breech deliveries. Especially in low-resource countries, it is important to avoid unnecessary operative interventions.

The main strength of our study is a large study population in a hospital where all clinicians on call have maintained skills in vaginal breech deliveries. To the best of our knowledge, this is also the first Norwegian study to focus on induction of breech presentations.

The most important limitation is that we do not have long-term follow-up results for the cohort. Other limitations are a retrospective design and missing umbilical cord samplings in around 20% of the fetuses studied. Pelvimetry was routinely performed after pregnancy week 37 in nulliparous women with a planned vaginal birth, but unfortunately we lack information about the frequency of pelvimetry in women with unknown breech presentation at admission. Another limitation is that data on transfer of neonates to the neonatal intensive care unit are lacking.

5 | CONCLUSION

When comparing the outcome of spontaneous and induced breech deliveries, we found no significant difference in the frequency of ICS. Further, we did not find any significant differences in pH <7.0 or in metabolic acidosis between the two groups. Lastly, we did not observe any significant change in induction rates over time in either nulliparous or parous women.

ACKNOWLEDGMENTS

We would like to thank Gabrielle K. Welle-Strand and Daphne Tagg for proofreading the manuscript.

CONFLICT OF INTEREST

None.

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How to cite this article: Welle-Strand JAH, Tappert C, Eggebø TM. Induction of labor in breech presentations - a retrospective cohort study. *Acta Obstet Gynecol Scand.* 2021;00:1-9. <https://doi.org/10.1111/aogs.14083>