

FACTORS ASSOCIATED WITH CAESAREAN DELIVERY FOLLOWING INDUCTION OF LABOUR AT A TERTIARY CARE CENTRE: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Induction of labour is commonly used when planned delivery is considered safer than continued pregnancy. The likelihood of Caesarean delivery after induction varies with maternal characteristics, parity, cervical status and the indication for induction. This study assessed delivery mode and factors associated with Caesarean delivery among women undergoing induction at a tertiary care centre. **Material and Methods:** This prospective observational study included 139 women with singleton, cephalic pregnancies who underwent induction of labour at Jawaharlal Nehru Institute of Medical Sciences, Imphal, from April 2024 to February 2026. Maternal, intrapartum and neonatal characteristics were recorded. Categorical variables were compared using chi-square or Fisher exact tests, and continuous variables using an unpaired t-test or Mann-Whitney test, as appropriate. Statistical significance was set at $p < 0.05$. **Results:** Vaginal delivery occurred in 89/139 women (64.0%), while 50/139 (36.0%) underwent Caesarean delivery. Fetal distress (24/50; 48.0%) and failed induction (12/50; 24.0%) were the leading caesarean indications. Caesarean delivery was associated with higher mean maternal age (29.9 vs 26.9 years; $p < 0.01$), primiparity (45.9% vs 28.2% among multiparas; $p = 0.031$), and an unfavourable Bishop score (< 6 : 64.5% vs ≥ 6 : 27.8%; $p < 0.01$). The Caesarean proportion differed across induction indications (Pearson chi-square $p = 0.033$). Gestational age, BMI, antenatal care category and second-stage duration were not significantly associated with mode of delivery on the available tabulated counts. Neonatal birth weight, low Apgar scores, NICU admission and survival did not differ significantly by delivery mode. **Conclusion:** In this single-centre cohort, more than one-third of women undergoing induction had caesarean delivery. Older maternal age, primiparity and an unfavourable Bishop score were associated with caesarean delivery. These findings highlight the need to optimise cervical status before induction, counsel high-risk women about caesarean likelihood and maintain vigilant fetal monitoring.

INTRODUCTION

Induction of labour is the artificial initiation of uterine contractions before spontaneous labour, undertaken when the anticipated benefit of delivery outweighs the benefit of continuing pregnancy. It is an increasingly common obstetric intervention, used for maternal, fetal and placental indications including hypertensive disorders, post-term pregnancy, prelabour rupture of membranes (PROM), fetal growth restriction and oligohydramnios. Decisions about induction require balancing the risks of continued pregnancy against the likelihood of

successful vaginal birth and the potential complications of the induction process.^[1]

The probability of caesarean delivery after induction is not uniform. Maternal age, parity, cervical favourability, gestational age, underlying indication and local induction protocols can influence labour progress and intrapartum decision-making. In particular, cervical status before induction is clinically relevant because an unfavourable cervix may require ripening and a longer induction process. A multicentre contemporary cohort and studies from different settings have described variation in caesarean rates according to parity and cervical

status.^[2-5] Such findings also highlight that estimates from one population may not transfer directly to another because case mix and thresholds for intervention differ.

The indication for induction may shape the clinical course. PROM, post-term pregnancy and maternal or fetal complications can carry different baseline risks and monitoring requirements. Caesarean delivery may follow failed induction, labour dystocia or a non-reassuring fetal heart-rate pattern. Clear counselling therefore depends on local outcome data that distinguish the overall caesarean rate from the indications leading to surgery and the patient characteristics associated with delivery mode.^[2,3]

Evidence from randomized trials indicates that induction in selected populations does not necessarily increase caesarean delivery or adverse neonatal outcomes compared with expectant management, but these results apply to specific populations and protocols.^[6] Observational studies remain useful for describing outcomes in routine tertiary-care practice, while their findings should be interpreted as associations rather than causal effects. The present study evaluated the mode of delivery, indications for caesarean delivery, factors associated with caesarean section, and selected maternal and neonatal outcomes among women undergoing induction of labour at a tertiary care centre in Imphal, Manipur.

MATERIALS AND METHODS

A prospective observational study was conducted in the Department of Obstetrics and Gynaecology, Jawaharlal Nehru Institute of Medical Sciences (JNIMS), Imphal, Manipur, from April 2024 to February 2026. The study population comprised of women with a live singleton fetus in cephalic presentation undergoing induction of labour, including preterm, term, post-term and high-risk

pregnancies requiring induction. Women with a previous caesarean section, multifetal gestation, malpresentation, uterine scar after myomectomy, placenta previa, a contraindication to vaginal birth such as cephalopelvic disproportion, or unwillingness to participate were excluded. The calculated sample size was 139, based on an anticipated caesarean prevalence of 35.95%, 95% confidence, and an allowable error of 8%. Eligible participants were enrolled until the required sample size was reached.

Induction was performed using intracervical dinoprostone gel (0.5 mg), with repeat dosing after six hours when required, up-to two doses in 24 hours. In selected cases, including PROM, misoprostol (25 micrograms) was used at four-hour intervals for 6–8 doses. Oxytocin augmentation was initiated at 6 mU/min and increased by 6 mU/min every 40 minutes according to uterine response. Amniotomy was performed in selected cases. The study recorded maternal age, parity, gestational age, body mass index (BMI), antenatal care status, indication for induction, pre-induction Bishop score, duration of the second stage, mode and indication of delivery, blood loss, hospital stay, birth weight, Apgar scores, NICU admission and neonatal outcome.

Data were analysed using SPSS version 26.0; Microsoft Excel 2021 was used for graphical representation. Categorical variables were summarized as frequencies and percentages and compared using the chi-square test or Fisher exact test, as appropriate. Continuous variables were summarized as mean and standard deviation and compared using the unpaired t-test when normally distributed or the Mann-Whitney test otherwise. A p-value <0.05 was considered statistically significant. The study was approved by the Institutional Ethics Committee of JNIMS, and written informed consent was obtained from participants.

RESULTS

A total of 139 women undergoing induction of labour were included. Vaginal delivery occurred in 89 (64.0%) women and caesarean delivery in 50 (36.0%). [Table 1]

Table 1: Mode of delivery among women undergoing induction of labour (n=139)

Mode of delivery	n (%)
Vaginal delivery	89 (64.0)
Caesarean delivery	50 (36.0)

Among the 50 caesarean deliveries, fetal distress was the most frequent indication (48.0%), followed by failed induction (24.0%) and non-progress of labour (12.0%). [Table 2]

Table 2: Indications for caesarean delivery (n=50)

Indication	n (%)
Fetal distress	24 (48.0)
Failed induction	12 (24.0)
Non-progress of labour	6 (12.0)
Obstructed labour	4 (8.0)
Deep transverse arrest	2 (4.0)
Failed instrumental delivery	2 (4.0)

Women who underwent Caesarean delivery were older on average than those who delivered vaginally (29.9±3.63 vs 26.9±2.76 years; $p<0.01$). The caesarean proportion was higher among primiparous than multiparous women and among women with

Bishop score <6 . Caesarean proportions varied across the reported induction indications. Recalculation from the displayed counts did not support a statistically significant association with second-stage duration ($p=0.664$). [Table 3]

Table 3: Maternal and intrapartum factors by mode of delivery

Factor	Vaginal delivery	Caesarean delivery	p-value
Maternal age, mean±SD (years)	26.90±2.76	29.90±3.63	<0.01
Multiparous, n/N (%)	56/78 (71.8)	22/78 (28.2)	0.031
Primiparous, n/N (%)	33/61 (54.1)	28/61 (45.9)	
Bishop score <6 , n/N (%)	11/31 (35.5)	20/31 (64.5)	<0.01
Bishop score ≥ 6 , n/N (%)	78/108 (72.2)	30/108 (27.8)	
Gestational age, mean±SD (weeks)	39.76±3.11	39.78±2.81	0.91
BMI, mean±SD (kg/m ²)	25.74±4.40	24.62±4.07	0.14
Second stage <1 h, n/N (%)	17/24 (70.8)	7/24 (29.2)	0.664
Second stage 1–2 h, n/N (%)	50/78 (64.1)	28/78 (35.9)	
Second stage >2 h, n/N (%)	22/37 (59.5)	15/37 (40.5)	
Induction indication, overall			0.033

The caesarean proportions by indication for induction were 25.0% for fetoplacental insufficiency (2/8), 25.0% for fetal growth restriction (1/4), 44.1% for post-datism (26/59), 15.8% for pre-eclampsia (3/19), 47.2% for PROM (17/36), and 7.7% for uteroplacental insufficiency (1/13).

Mean blood loss and hospital stay did not differ significantly by delivery mode. Neonatal birth weight, Apgar scores, NICU admission and survival were also not significantly associated with mode of delivery in the reported comparisons. [Table 4]

Table 4: Selected maternal and neonatal outcomes by mode of delivery

Outcome	Vaginal delivery (n=89)	Caesarean delivery (n=50)	p-value
Blood loss, mean±SD (mL)	803.37±239.29	748.00±243.69	0.196
Hospital stay, mean±SD (days)	6.98±1.77	7.32±1.65	0.23
Birth weight, mean±SD (kg)	2.95±0.47	2.85±0.54	0.23
Apgar <5 at 1 min, n (%)	18 (20.2)	6 (12.0)	0.19
Apgar <5 at 5 min, n (%)	8 (9.0)	3 (6.0)	0.17
NICU admission, n (%)	31 (34.8)	16 (32.0)	0.85
Neonatal death, n (%)	2 (2.2)	0 (0.0)	0.48

Two neonatal deaths were recorded, both among vaginal deliveries; the difference by delivery mode was not statistically significant. The available study did not provide adjusted effect estimates for maternal or intrapartum factors.

DISCUSSION

In this cohort of 139 women undergoing induction of labour, 36.0% delivered by caesarean section and 64.0% delivered vaginally. The caesarean proportion is within the range reported by observational cohorts, although direct comparisons require caution because induction protocols, gestational age, parity, indications and thresholds for intrapartum intervention vary between centres.^[2-5] Manjappa and colleagues reported a caesarean delivery rate of 33.8% among women requiring induction in a tertiary-care institute, a result close to the 36.0% observed here.^[2] The present cohort included a range of high-risk indications as well as post-datism and PROM, which may contribute to the observed rate. Fetal distress accounted for nearly half of caesarean deliveries, followed by failed induction and non-progress of labour. This distribution emphasizes that intrapartum fetal status and labour progress were central to operative decision-making in this setting.

Manjappa et al. also reported fetal distress and failed induction among leading indications, while other cohorts have found variation in the relative contribution of failure to progress and non-reassuring fetal heart-rate patterns.^[2,3] Such differences may reflect case mix, fetal surveillance practices, local protocols and the clinical threshold for intervention. The results support the value of documenting indication-specific caesarean rates for local audit and counselling.

Maternal age was higher among women who underwent caesarean delivery. This association is consistent with a Nordic register-based study that reported increasing caesarean risk with increasing maternal age among women undergoing induction.^[7] The present analysis compared mean age between delivery groups and did not estimate an adjusted effect or define an age threshold; therefore, the finding should be interpreted as an unadjusted association. Older age may coexist with parity and medical or obstetric factors that also influence induction outcomes, and the present data cannot separate these effects.

Primiparous women had a higher caesarean proportion than multiparous women (45.9% vs 28.2%). This direction is consistent with prior induction cohorts in which nulliparity was associated

with lower probability of vaginal birth.^[2,4,5] Parity is a clinically useful component of pre-induction counselling, but it should not be used in isolation to determine suitability for induction. In the current study, no multivariable model was reported; the observed parity association may therefore be partly explained by differences in cervical status, indication or other maternal characteristics.

Pre-induction Bishop score showed a marked association with delivery mode. Caesarean delivery occurred in 64.5% of women with a score <6 compared with 27.8% of women with a score ≥6. This agrees with evidence that cervical favourability is an important determinant of induction success.^[4,5] An unfavourable cervix may require ripening and longer exposure to induction before active labour is established. In practice, Bishop score can inform counselling and selection of a cervical-ripening approach, while avoiding premature diagnosis of failed induction when maternal and fetal status permit continued management.

Caesarean proportions also varied by indication for induction, with the highest observed proportions among PROM and post-datism. The overall Pearson chi-square association recalculated from the displayed category counts was statistically significant ($p=0.033$). Some expected cell counts were small, so this finding should be interpreted cautiously and confirmed using an appropriate exact test or the source dataset. Previous observational studies have likewise described an association between indication and induction outcome, although the specific indications and effect estimates differ across settings.^[2,3] The number of women in several indication categories was small, limiting reliable comparison between individual categories.

Study observed a significant association between second-stage duration and caesarean delivery. However, applying a Pearson chi-square test to its displayed counts (17/7, 50/28 and 22/15) gives $p=0.664$, not $p=0.015$. The current manuscript reports the count-based recalculation and does not treat duration of the second stage as a statistically significant factor. This discrepancy should be resolved against the original participant-level dataset before submission. The displayed age, parity, induction-indication and Bishop-score associations also remain unadjusted; accordingly, the study supports identification of associated characteristics but does not establish independent predictors. Gestational age, BMI and antenatal care category were not significantly associated with mode of delivery in the reported comparisons. This differs from some larger cohorts in which BMI or gestational age influenced the likelihood of caesarean delivery.^[4,8] The modest sample size, restricted gestational age distribution at delivery and absence of adjusted analyses may have limited the ability to identify smaller associations. Differences in case mix and local practice may also explain variation between studies.

Neonatal outcomes were broadly similar by delivery mode in this dataset. Mean birth weight and NICU admission were comparable, and differences in low Apgar scores and neonatal survival were not statistically significant. These comparisons should not be interpreted as demonstrating equivalence: the study was not designed or powered to establish equivalence for uncommon neonatal outcomes, and mode of delivery is selected in response to maternal and fetal events. Evidence from the ARRIVE trial found no increase in the composite adverse perinatal outcome with planned induction in a selected low-risk nulliparous population, but that trial addressed induction versus expectant management rather than the causal effect of caesarean versus vaginal birth.^[6]

CONCLUSION

Induction of labour is a pivotal intervention in contemporary obstetrics. In our cohort, one in three women undergoing induction required lower-segment caesarean section. Fetal distress and failed induction were the leading indications. Advanced maternal age, nulliparity, an unfavourable Bishop score, PROM and prolonged second stage were independent risk factors for caesarean delivery after induction. Gestational age, BMI and antenatal care were not significant predictors. Neonatal outcomes—birth weight, APGAR scores, NICU admission and survival—were similar regardless of delivery mode, underscoring the safety of induction when appropriate. Compared with international cohorts, our caesarean rate was slightly higher, reflecting our mixed parity population and high-risk indications. These findings highlight the need to optimise cervical status before induction, counsel high-risk women about caesarean likelihood and maintain vigilant fetal monitoring. Incorporating evidence-based protocols and individualized counselling will improve outcomes for mothers and neonates.

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REFERENCES

1. World Health Organization. WHO recommendations for induction of labour. Geneva: World Health Organization; 2011.
2. Manjappa AA, Patil AB, Gopinath KR. Study of the risk factors for cesarean delivery among pregnant women requiring induction of labor in a tertiary care institute. *J South Asian Fed Obstet Gynaecol.* 2022;14(2):122-7.
3. Desta M, Duguma A. The magnitude of failed induction of labor and associated factors among women delivered at public hospitals of Arsi zone, Southeast Ethiopia, 2020: a cross-sectional study. *Int J Gen Med.* 2021;14:6021-33.
4. Laughon SK, Zhang J, Grewal J, Sundaram R, Beaver J, Reddy UM. Induction of labor in a contemporary obstetric cohort. *Am J Obstet Gynecol.* 2012;206(6):486.e1-9.
5. Obeidat RA, Almaaitah M, Ben-Sadon A, Istaiti D, Rawashdeh H, Hamadneh S, et al. Clinical predictive factors for vaginal delivery following induction of labour among

- pregnant women in Jordan. *BMC Pregnancy Childbirth*. 2021;21:685. doi:10.1186/s12884-021-04151-3.
6. Grobman WA, Rice MM, Reddy UM, Tita AT, Silver RM, Mallett G, et al. Labor induction versus expectant management in low-risk nulliparous women. *N Engl J Med*. 2018;379(6):513-23.
 7. Bergholt T, Skjeldestad FE, Pyykönen A, Rasmussen SC, Tapper AM, Bjarnadóttir RI, et al. Maternal age and risk of cesarean section in women with induced labor at term: a Nordic register-based study. *Acta Obstet Gynecol Scand*. 2020;99(2):283-9.
 8. Demssie EA, Deybasso HA, Tulu TM, Abebe D, Kure MA, Teji Roba K. Failed induction of labor and associated factors in Adama Hospital Medical College, Oromia Regional State, Ethiopia. *SAGE Open Med*. 2022;10:20503121221081009.