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Original Research Article

## Failed induction of labor and associated factors among women undergoing induction of labor

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### ABSTRACT

**Background:** Induction of labor (IOL) is increasingly employed in modern obstetric care, yet carries a significant risk of failure, contributing to higher caesarean rates and associated maternal-neonatal morbidity. Identifying factors that influence IOL success is essential for individualized labor management.

**Methods:** This prospective observational study was conducted over one year at a tertiary care center in Karnataka, India. A total of 504 women undergoing IOL at  $\geq 37$  weeks gestation were enrolled. The induction protocol included mifepristone followed by misoprostol and oxytocin augmentation. Primary outcome was failed induction, defined as failure to enter active labor or caesarean delivery for failed progress. Associations between maternal and obstetric variables and IOL failure were analyzed using chi-square tests.

**Results:** Out of 504 women, 181 (35.9%) experienced failed induction. PROM was the strongest predictor of failure (81.9%), followed by unfavorable Bishop score  $< 5$  (70.8%), maternal age  $< 20$  years (76.3%) or  $> 35$  years (67.5%), BMI  $> 25$  (58.3%), and post-term pregnancy (71.42%). Primigravidity and birth weight  $> 4$  kg were also significant contributors. Most caesareans due to failed induction resulted in favorable neonatal outcomes, though a small proportion required NICU admission.

**Conclusions:** Failed induction is prevalent in women with PROM, low Bishop scores, maternal age extremes, high BMI, and suspected macrosomia. Pre-induction risk stratification and cervical ripening optimization can enhance IOL success and reduce cesarean burden.

**Keywords:** Bishop score, Caesarean section, Failed induction, Induction of labor, Maternal outcome, Neonatal outcome PROM, Risk factors

### INTRODUCTION

Labor is a complex physiological process involving a cascade of hormonal, mechanical, and inflammatory changes that culminate in regular uterine contractions, progressive cervical dilation, and eventual expulsion of the fetus, placenta, and membranes. While the majority of pregnancies reach spontaneous onset of labor, there are clinical scenarios where prolongation of gestation increases the risk of adverse outcomes. In such situations,

induction of labor (IOL) becomes necessary to achieve timely and safe vaginal delivery.

IOL is defined as the artificial initiation of uterine contractions before the spontaneous onset of labor.<sup>1</sup> The global rise in the rate of IOL has been attributed to better antenatal surveillance, increasing maternal age, and a higher prevalence of comorbidities such as hypertensive disorders, gestational diabetes mellitus, and other medical complications. Common indications for IOL include post-

term pregnancy, preeclampsia, PROM (premature rupture of membranes), intrauterine growth restriction (IUGR), oligohydramnios, Rh isoimmunization, and multiple gestations.

Various methods are employed to induce labor, including pharmacological agents like prostaglandins (misoprostol and dinoprostone), mechanical methods such as Foley catheter or membrane sweeping, and less commonly, hormonal or alternative agents.<sup>2</sup> The selection of an appropriate method depends on gestational age, parity, Bishop score, and maternal-fetal condition.

Despite its clinical utility, IOL is associated with a considerable failure rate, especially in the presence of an unfavorable cervix. Failed induction of labor is generally defined as the failure to establish adequate uterine contractions and cervical changes following standard induction protocols, or the need for caesarean section due to lack of labor progress or fetal distress.<sup>3</sup> The incidence of failed induction varies between 10% and 30%, depending on the population and criteria used.

Numerous maternal and obstetric factors have been implicated in failed IOL. These include an unfavorable cervical score (Bishop score <5), maternal age extremes (<20 years or >35 years), obesity (BMI >25), PROM with poor cervical status, primigravidity, suspected macrosomia, and post-term pregnancy.<sup>4</sup> PROM, although a common indication for IOL, has been linked to higher failure rates when cervical ripening is inadequate.

Obesity has been associated with altered myometrial response and hormonal resistance, further complicating induction. The Bishop score remains the most widely accepted tool to predict the success of induction and guide pre-induction counseling.

Understanding these risk factors is crucial, particularly in the context of rising cesarean delivery rates and the associated maternal and neonatal morbidity. Accurate identification of women at higher risk of failed IOL enables personalized care, informed counseling, and early planning of alternative delivery strategies.<sup>5</sup>

This study was undertaken to determine the prevalence of failed induction of labor, identify the maternal and obstetric risk factors contributing to induction failure, and assess associated maternal and neonatal outcomes. The findings aim to enhance evidence-based labor management and improve perinatal outcomes in women undergoing IOL in a tertiary care setting.

## **METHODS**

### ***Study design and setting***

This prospective observational study was conducted in the labor ward of S. S. Institute of Medical Sciences and Research Centre (SSIMS & RC), Davanagere Karnataka,

India, over a one-year period from January to December 2024. Ethical clearance was obtained from the Institutional Ethics Committee, and informed written consent was obtained from all participants prior to enrolment.

### ***Study population***

All pregnant women admitted for induction of labor during the study period were screened. Eligible participants included women with singleton pregnancies, cephalic presentation, gestational age  $\geq 37$  weeks, and reactive non-stress tests (NST) at admission. Women with controlled mild preeclampsia or gestational diabetes mellitus were included, provided there were no contraindications to vaginal delivery or induction of labor. Exclusion criteria were prior uterine surgery (e.g., caesarean section or myomectomy), malpresentation, cephalopelvic disproportion, multiple gestation, uterine anomalies, placental complications such as previa or abruption, severe preeclampsia, uncontrolled diabetes, or a non-reactive NST.

### ***Sample size***

A total of 504 women who met the eligibility criteria and underwent induction of labor were included in the final analysis.

### ***Induction protocol***

Upon admission, baseline maternal vitals were recorded and fetal well-being was assessed via NST. Cervical favorability was evaluated using the Bishop score. Induction was carried out according to institutional protocol. Each participant received 200 mg of mifepristone orally on admission. After 24 hours, 20 mcg of misoprostol dissolved in 20 mL of water was administered every two hours, up to a maximum of five doses, depending on cervical response and fetal condition. Bishop scoring was repeated every 4 hours. Once active labor was established, labor was augmented with oxytocin infusion as per protocol.

### ***Monitoring***

Fetal heart rate was monitored hourly during the latent phase and every 30 minutes during active labor, either via CTG or intermittent auscultation. Cervical assessment and labor progression were documented at regular intervals. In cases of abnormal fetal heart rate, initial resuscitative measures such as left lateral positioning and intravenous fluids were administered. If the fetal status did not improve, artificial rupture of membranes (ARM) or emergency caesarean section was performed, based on the individual patient clinical scenario.

### ***Outcome measures***

The primary outcome was the prevalence of failed induction, defined as the failure to enter active labor

despite completion of the induction protocol, or caesarean delivery for failed progress. Secondary outcomes included maternal and obstetric risk factors (e.g., age, BMI, hypertensive disorders, PROM), as well as neonatal outcomes (e.g., NICU admission, Apgar score).

**Statistical analysis**

Data were recorded in Microsoft Excel and analyzed using SPSS software version 26. Descriptive statistics were used to summarize categorical variables. Associations between risk factors and failed induction were assessed using chi-

square tests. A p-value of <0.05 was considered statistically significant.

**RESULTS**

A total of 504 women underwent induction of labor during the study period. Of these, 181 women (35.9%) experienced failed induction and required caesarean delivery. The remaining 323 women had successful inductions, resulting in either vaginal or caesarean delivery for other indications.

**Table 1: Risk factors and their association with failed induction.**

Risk factor	Total (N)	Failed induction (N)	Failed induction (%)
PIH (pregnancy-induced HTN)	298	163	54.7
Age > 35 years	151	102	67.5
Age < 20 years	198	151	76.3
PROM (premature rupture of membranes)	160	131	81.9
Bishop score <5	250	177	70.8
Birth weight >4 kg	36	23	63.88
BMI >25	302	176	58.3
Post-term pregnancy	42	30	71.42
Primigravida	176	99	56.3

Table 1 summarizes the maternal and obstetric factors associated with failed induction. PROM was the most strongly associated risk factor, with a failure rate of 81.9%. Other significant associations included a Bishop score <5 (70.8%), maternal age <20 years (76.3%) and >35 years (67.5%), post-term pregnancy (73.0%), and high BMI (>25) with a failure rate of 58.3%. Nulliparity was also a notable factor, with a 56.3% failure rate.

Of the 504 women, 204 (40.5%) delivered vaginally, while 300 (59.5%) underwent caesarean section. Among caesarean deliveries, 181 cases (60.3%) were due to failed induction. Other indications for caesarean delivery included fetal distress, meconium-stained amniotic fluid, non-progression of labor, and refusal of further induction doses.

**Table 2: Mode of delivery.**

Vaginal delivery	Caesarean section
204	300

**Table 3: Indications for caesarean section.**

Indication	Number of cases
Failed induction	181
Other causes*	119

\*Other causes include: fetal distress, meconium-stained amniotic fluid, non-progression of labor, and refusal of misoprostol

Among neonates delivered by cesarean section due to failed induction, 14 required NICU observation and 3 were admitted for intensive care. Most neonates had satisfactory immediate outcomes.

Overall, the most significant predictors of failed induction included PROM, an unfavorable Bishop score, teenage or advanced maternal age, hypertensive disorders of pregnancy, higher fetal birth weight, and elevated maternal BMI. Cervical dilation was found to be the most critical component of the Bishop score in determining the likelihood of successful induction.

**Table 4: Neonatal outcomes following caesarean for failed induction.**

Outcome	Number of neonates
Observation in NICU	14
NICU admission	3
Motherside	164

**DISCUSSION**

**Principal findings**

This study aimed to determine the prevalence and associated risk factors for failed induction of labor (IOL) among 504 women. The overall failure rate was 35.9%, which is in agreement with previously reported global rates ranging from 10% to 30% depending on patient

characteristics and clinical protocols. Among the variables analyzed, an unfavorable Bishop score (<5), PROM, maternal age extremes, obesity, post-term pregnancy, and macrosomia were significantly associated with failed induction.

### ***Role of cervical status and PROM***

A low Bishop score was the strongest predictor of failed IOL in this cohort, with a failure rate of 70.8%. This supports extensive prior evidence that cervical status is a key determinant of induction outcomes. Studies by Vrouenraets et al and Laughon et al have shown a consistent association between low Bishop scores and increased likelihood of caesarean delivery following failed induction.<sup>6,7</sup>

PROM was associated with the highest rate of failure (81.9%). Although PROM is a common indication for IOL, its success heavily depends on cervical status. The high failure rate observed in this group may be due to underlying subclinical infections, inadequate cervical ripening, or unfavorable fetal positions. Similar findings were reported by Tan et al, who emphasized the need for effective cervical priming strategies in PROM cases to improve success rates.<sup>8,9</sup>

### ***Impact of maternal age***

Extremes of maternal age were significantly associated with failed IOL. Women aged <20 years had a failure rate of 76.3%, while those aged >35 years experienced a 67.5% failure rate. This may reflect differing pathophysiological mechanisms: adolescent mothers often have underdeveloped pelvic structures and less favourable cervical compliance, whereas advanced maternal age is linked with comorbidities and reduced uterine contractility. Treacy et al and Cnattingius et al have similarly reported increased risks of labor dystocia and caesarean delivery in these populations.<sup>10,11</sup>

### ***Obesity and fetal size***

Elevated maternal BMI (>25) was significantly associated with IOL failure (58.3%). Obesity is thought to impair myometrial contractility and may alter the pharmacodynamics of labor-inducing agents. Vahratian et al. observed that obese parturients had slower labor progression and increased caesarean rates.<sup>12</sup>

Fetal macrosomia, defined in this study as birth weight >4 kg, was also linked to a higher failure rate (64.2%). Larger fetuses are more likely to encounter cephalopelvic disproportion, leading to labor arrest or non-reassuring fetal heart tracings. These observations are consistent with those by Weissmann-Brenner et al, who reported a strong association between macrosomia and both failed IOL and caesarean delivery.<sup>13</sup>

### ***Parity and post-term pregnancy***

Primigravida women experienced a 56.3% failure rate, highlighting the challenges of labor induction in nulliparous patients. Crane et al documented similar findings in nulliparous women, especially when cervical status was unfavorable at the start of induction.<sup>14</sup>

Post-term pregnancy was associated with a failure rate of 73.0%, likely due to reduced placental function, oligohydramnios, and impaired fetal well-being during labor. These findings underscore the importance of earlier intervention or more aggressive cervical ripening strategies in post-term cases, as supported by Divon et al.<sup>15</sup>

### ***Clinical implications***

The high failure rate in this study underscores the importance of thorough pre-induction assessment and individualized induction strategies. Factors such as cervical score, parity, maternal age, BMI, fetal weight, and gestational age should be considered when counseling patients and planning labor induction. PROM cases, in particular, warrant careful evaluation, and alternative or adjunctive cervical ripening methods (e.g., Foley catheter, combination therapy) should be considered in unfavorable scenarios.

Furthermore, the association between failed induction and subsequent caesarean delivery is of clinical concern, especially given the rising caesarean rates worldwide and their implications for maternal morbidity in current and future pregnancies. Proactive identification of high-risk cases, coupled with appropriate clinical decision-making, could potentially reduce unnecessary surgical interventions and improve outcomes.

### ***Strengths and limitations***

This study benefits from a prospective design and adequate sample size, which strengthens the validity of the findings. Uniform institutional protocols were followed, ensuring consistency in induction and monitoring practices. However, limitations include the single-center setting, which may affect the generalizability of results. Additionally, factors such as the time from induction to delivery, the role of adjunctive mechanical methods, or maternal satisfaction were not assessed. Neonatal outcomes were only evaluated in the immediate postpartum period, and long-term consequences were beyond the scope of this study.

## **CONCLUSION**

Failed induction of labor remains a common obstetric challenge, particularly in women with low Bishop scores, PROM, maternal age extremes, high BMI, and suspected macrosomia. These findings reinforce the need for individualized induction planning, risk stratification, and shared decision-making with patients. Optimizing cervical

ripening methods and identifying at-risk populations can help improve the likelihood of successful vaginal delivery and reduce the burden of caesarean section.

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