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Original Research Article

Predictors of Failed Labour Induction in Low-Risk Term Pregnancies: A Prospective Observational Study at a Tertiary Care Centre

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Abstract

Background: Labour induction accounts for approximately 25% of term deliveries worldwide, yet failed induction occurs in 20–25% of cases, contributing to unplanned cesarean deliveries and increased maternal morbidity. Identification of predictive factors for induction failure remains crucial for optimizing patient selection and counselling in resource-limited settings.

Objectives: To determine the incidence of failed labour induction in low-risk term pregnancies and to identify independent clinical and demographic predictors of induction failure.

Materials and Methods: A prospective observational cohort study was conducted at a tertiary care centre from January 2024 to June 2024 involving 142 women with singleton, low-risk term pregnancies (≥37 weeks). Data regarding demographics, Bishop score, induction protocols, and maternal-neonatal outcomes were collected using a structured proforma. Chi-square tests and multivariate logistic regression analysis were performed, with statistical significance set at $p<0.05$.

Results: Failed induction occurred in 35 of 142 women (24.6%). In multivariate analysis, Bishop score <4 emerged as the strongest independent predictor of failed induction (adjusted OR 4.12, 95% CI 1.82–9.33, p=0.001), followed by nulliparity (adjusted OR 3.48, 95% CI 1.41–8.59, p=0.007), BMI ≥30 kg/m² (adjusted OR 2.96, 95% CI 1.28–6.85, p=0.011), and maternal age >30 years (adjusted OR 2.54, 95% CI 1.12–5.76, p=0.026). The combined risk model achieved 78% predictive accuracy.

Conclusion: Unfavourable Bishop score, nulliparity, obesity, and advancing maternal age are significant independent predictors of failed labour induction. A composite risk assessment using these factors can aid clinical decision-making and resource allocation.

Keywords: Labour induction; failed induction; Bishop score; nulliparity; obesity; predictors; term pregnancy; cesarean section.

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Introduction

Induction of labour (IOL) is defined as the artificial stimulation of uterine contractions prior to the spontaneous onset of labour, with the aim of achieving vaginal delivery when the continuation of pregnancy poses greater risks to the mother or the fetus than delivery itself [1]. According to the World Health Organization (WHO), up to 25% of all deliveries at term in developed countries now involve induction of labour, with rising trends observed over recent decades [1]. In developing countries, while the rates are generally lower, certain institutional settings report induction rates comparable to those observed in the developed world [2]. In India, IOL rates have shown considerable variation across institutional settings, with some tertiary care centres reporting induction rates between 12% and 30% [3]. The decision to induce labour is predicated on the principle that the expected benefits of expeditious delivery outweigh the potential risks of continuing the pregnancy [1]. Common medical indications for IOL include post-term pregnancy, premature rupture of membranes (PROM), oligohydramnios, hypertensive disorders of pregnancy, gestational diabetes, and intrauterine growth restriction [4]. Despite its widespread use, IOL is not devoid of risks. It is associated with longer labour duration, increased use of analgesia, higher rates of instrumental and operative deliveries, and extended hospital stays [5]. The most clinically significant complication of IOL is

failed induction, which is broadly defined as the inability to achieve the active phase of labour despite adequate induction protocols, frequently necessitating emergency cesarean delivery [6].

Failed induction of labour represents a substantial clinical challenge, occurring in approximately 20–25% of all induced labours [7]. The consequences of failed induction extend beyond the immediate operative delivery and include increased maternal morbidity from emergency cesarean sections, longer hospitalization, greater healthcare costs, higher risk of surgical site infections, and significant psychological distress for the patient [5,8]. Furthermore, a primary cesarean delivery has long-term implications for future pregnancies, including the risk of placenta accreta spectrum disorders, uterine rupture in subsequent trial of labour, and repeat cesarean sections [9].

The Bishop scoring system, introduced by Edward Bishop in 1964, remains the most widely utilized clinical tool for assessing cervical readiness prior to induction [10]. The score evaluates five cervical parameters — dilation, effacement, consistency, position, and station of the presenting part — with higher scores indicating a more favourable cervix and a greater likelihood of successful vaginal delivery. A meta-analysis by Teixeira et al. (2012), encompassing 59 studies, demonstrated that women with higher Bishop scores were significantly more likely to achieve vaginal delivery, with summary odds ratios ranging from 1.98 to 5.48 depending on the cut-off used [11]. However, while the Bishop score is a useful clinical indicator, its predictive capacity as a standalone tool has been debated, and several studies have advocated for the incorporation of additional clinical parameters to enhance prognostic accuracy [12].

Multiple maternal and obstetric factors have been identified as predictors of failed induction. Nulliparity is consistently recognized as a significant risk factor, as primigravid women typically have a less favourable cervix and less compliant myometrium compared to multiparous women [6,7]. Maternal obesity has emerged as another important predictor, with a systematic review by Ellis et al. (2019) demonstrating that women with obesity require longer inductions, higher doses of cervical ripening agents, and are more likely to end labour induction with cesarean delivery compared to women of normal weight [13]. Advanced maternal age, generally defined as age ≥35 years at delivery, has also been associated with age-related cervical resistance, myometrial dysfunction, and increased cesarean delivery rates following induction [14]. A large Nordic register-based study by Bergholt et al. (2020), encompassing over 3.3 million deliveries, demonstrated that the rate of cesarean section following induction increased progressively with advancing maternal age, from 14.0% in women under 20 years to 39.9% in women aged 40 years and older among nulliparous women [15].

Despite the considerable body of evidence from Western and high-income settings, data on predictive factors for failed induction in the Indian context remains relatively limited. Indian tertiary care centres manage a diverse obstetric population with unique demographic characteristics, different BMI distributions, and varying cervical ripening practices. Furthermore, the definition of failed induction and the thresholds for proceeding to cesarean delivery may differ across institutions, contributing to heterogeneity in reported failure rates [3]. Therefore, there is a compelling need for institution-specific data that can inform local clinical protocols, optimize patient selection for IOL, and improve pre-induction counselling in the Indian setting.

The present study was undertaken to address this knowledge gap by evaluating the incidence and predictors of failed labour induction in low-risk term pregnancies at a tertiary care centre. By focusing on a low-risk obstetric population, this study aimed to identify baseline predictive factors unconfounded by high-risk medical conditions, thereby providing a clearer understanding of the demographic and clinical variables that influence induction outcomes.

Aims and Objectives

1. To determine the incidence of failed labour induction in low-risk term pregnancies at a tertiary care centre.
2. To identify independent clinical and demographic predictors of induction failure using univariate and multivariate analysis.

Materials and Methods

Study Design and Setting: This was a prospective observational cohort study conducted at the Department of Obstetrics and Gynaecology of a tertiary care teaching hospital over a six-month period from January 2024 to June 2024.

Study Population: The study population comprised pregnant women admitted for induction of labour who met the predefined eligibility criteria. A total of 142 women were enrolled during the study period.

Inclusion Criteria: The following inclusion criteria were applied: (a) singleton pregnancy; (b) term gestation (≥37 completed weeks of gestation); (c) cephalic presentation confirmed by clinical examination and/or ultrasound; (d) low-risk pregnancy as defined by the absence of significant medical or obstetric comorbidities; and (e) intact or ruptured membranes at the time of admission.

Exclusion Criteria: Women were excluded from the study if they had: (a) previous cesarean section or any uterine scar; (b) multiple gestation; (c) malpresentation (breech, transverse lie, or oblique lie); (d) high-risk conditions including pre-eclampsia, eclampsia, placenta praevia, placental abruption, or known fetal anomalies; (e) contraindications to vaginal delivery; or (f) refusal to provide informed consent.

Sample Size Calculation: The sample size was calculated based on a reported incidence of failed induction of approximately 25% in low-risk term pregnancies [7], with a 95% confidence level, 7% absolute precision, and an anticipated 10% non-response rate, yielding a minimum required sample of 140 participants. A total of 142 women were enrolled consecutively during the study period.

Data Collection: Data were collected using a structured proforma that included the following variables: maternal age, parity, body mass index (BMI, calculated from pre-induction weight and height), gestational age at induction (confirmed by first trimester ultrasonography), indication for induction, pre-induction Bishop score (assessed by the attending obstetrician), method of induction employed, and the induction-to-delivery interval.

Outcome variables included mode of delivery (vaginal delivery, instrumental delivery, or cesarean section) and the primary outcome of interest — failed induction.

Definition of Failed Induction: Failed induction was defined as the inability to achieve the active phase of labour (defined as cervical dilation ≥4 cm with regular uterine contractions) despite adequate cervical ripening and oxytocin augmentation over a period of at least 24 hours, or the need for emergency cesarean section during the induction process for indications of failed induction, including failure to progress.

Induction Protocol: The induction protocol followed the institutional guidelines. Women with an unfavourable cervix (Bishop score <6) received cervical ripening with intravaginal dinoprostone (PGE2) gel or tablet, administered at standard doses. Oxytocin augmentation was initiated if spontaneous labour did not commence following cervical ripening. Women with a favourable cervix underwent amniotomy followed by oxytocin infusion where indicated. Continuous electronic fetal monitoring was performed during the active phase of labour.

Statistical Analysis: Data were entered and analysed using SPSS version 25.0 (IBM Corporation, Armonk, NY). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as frequencies and percentages. The chi-square test was used for comparing categorical variables between the successful and failed induction groups. Variables found to be significant on univariate analysis ($p<0.05$) were entered into a multivariate logistic regression model to identify independent predictors of failed induction. Results were expressed as adjusted odds ratios (aOR) with 95% confidence intervals (CI). A p-value <0.05 was considered statistically significant. The discriminative ability of the combined prediction model was assessed using the area under the receiver operating characteristic (AUROC) curve.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrolment. Confidentiality of patient data was maintained throughout the study.

Results

A total of 142 women with singleton, low-risk term pregnancies undergoing labour induction were enrolled during the study period. Among these, 107 women (75.4%) achieved successful vaginal delivery following induction, while 35 women (24.6%) had failed induction requiring cesarean delivery.

Table 1: Induction Outcomes (n=142)

Outcome	n	Percentage (%)
Successful induction (vaginal delivery)	107	75.4
Failed induction (cesarean delivery)	35	24.6
Total	142	100.0

The overall incidence of failed labour induction in low-risk term pregnancies was 24.6%.

Table 2: Baseline Characteristics by Induction Outcome

Variable	Successful Induction (n=107)	Failed Induction (n=35)	p-value
Parity			
Nulliparous	52 (48.6%)	28 (80.0%)	0.001
Multiparous	55 (51.4%)	7 (20.0%)	
Maternal Age			
≤30 years	79 (73.8%)	17 (48.6%)	0.005
>30 years	28 (26.2%)	18 (51.4%)	
Body Mass Index			
BMI <30 kg/m²	83 (77.6%)	19 (54.3%)	0.008
BMI ≥30 kg/m²	24 (22.4%)	16 (45.7%)	
Bishop Score			
Bishop score ≥4	76 (71.0%)	11 (31.4%)	<0.001
Bishop score <4	31 (29.0%)	24 (68.6%)	

The analysis of baseline characteristics revealed significant differences between the two groups. Nulliparous women constituted 80.0% of the failed induction group compared to 48.6% of the successful induction group (p=0.001). Women aged >30 years comprised 51.4% of the failed induction group versus 26.2% in the successful group (p=0.005). Obesity (BMI ≥30 kg/m²) was observed in 45.7% of women with failed induction compared to 22.4% of those with successful induction (p=0.008). An unfavourable Bishop score (<4) was present in 68.6% of the failed induction group compared to 29.0% of the successful group (p<0.001).

Table 3: Indications for Labour Induction and Failed Induction Rates

Indication	Total (n)	Successful (n)	Failed (n)	Failure Rate (%)
Post-dates	66	52	14	21.2
PROM	32	24	8	25.0
Oligohydramnios	25	19	6	24.0
Maternal request	8	6	2	25.0
Gestational hypertension	6	4	2	33.3
Others	5	2	3	60.0
Total	142	107	35	24.6

Post-dates pregnancy was the most common indication for induction (46.5%), followed by PROM (22.5%) and oligohydramnios (17.6%). The highest failure rate was observed in the "others" category (60.0%), followed by gestational hypertension (33.3%), PROM and maternal request (25.0% each), oligohydramnios (24.0%), and post-dates (21.2%).

Table 4: Univariate Analysis — Predictors of Failed Induction

Variable	Odds Ratio (OR)	95% CI	p-value
Nulliparity	4.23	1.73–10.32	0.001
Age >30 years	2.99	1.37–6.52	0.005
BMI ≥30 kg/m²	2.91	1.31–6.47	0.008
Bishop score <4	5.35	2.32–12.33	<0.001

On univariate analysis, all four clinical variables — nulliparity, maternal age >30 years, BMI ≥30 kg/m², and Bishop score <4 — were significantly associated with failed induction. The Bishop score <4 demonstrated the highest crude odds ratio (OR 5.35, 95% CI 2.32–12.33, p<0.001), followed by nulliparity (OR 4.23, 95% CI 1.73–10.32, p=0.001), maternal age >30 years (OR 2.99, 95% CI 1.37–6.52, p=0.005), and BMI ≥30 kg/m² (OR 2.91, 95% CI 1.31–6.47, p=0.008).

Table 5: Multivariate Logistic Regression — Independent Predictors of Failed Induction

Variable	Adjusted OR	95% CI	p-value
Bishop score <4	4.12	1.82–9.33	0.001
Nulliparity	3.48	1.41–8.59	0.007
BMI ≥30 kg/m²	2.96	1.28–6.85	0.011
Maternal age >30 years	2.54	1.12–5.76	0.026

In the multivariate logistic regression model, all four variables retained statistical significance as independent predictors of failed induction after adjusting for confounders. Bishop score <4 emerged as the strongest independent predictor with a four-fold increased risk of failed induction (aOR 4.12, 95% CI 1.82–9.33, p=0.001). Nulliparity was associated with a three-and-a-half-fold increased risk (aOR 3.48, 95% CI 1.41–8.59, p=0.007). Obesity carried approximately three-fold higher odds of failure (aOR 2.96, 95% CI 1.28–6.85, p=0.011), and maternal age >30 years was associated with a two-and-a-half-fold increased risk (aOR 2.54, 95% CI 1.12–5.76, p=0.026). The combined risk prediction model incorporating all four variables achieved an area under the receiver operating characteristic curve (AUROC) of 0.78, indicating acceptable discriminative ability for clinical decision-making.

Discussion

The present study evaluated the incidence and predictors of failed labour induction in a cohort of 142 low-risk women with term singleton pregnancies at a tertiary care centre. Our findings demonstrate that failed induction occurred in approximately one-quarter (24.6%) of the study population, consistent with the globally reported failure rates of 20–25% in comparable obstetric populations [1,7].

The 24.6% failure rate observed in our study aligns closely with several published studies from diverse geographical settings. Rayamajhi et al. (2009), in a prospective study conducted at a Nepalese tertiary hospital involving 156 induced women, reported a combined failure rate of 34.6%, with higher rates observed in nulliparous women (41.2%) compared to multiparous women (23.7%) [3]. The higher overall rate in their study may be attributable to the inclusion of women across a broader gestational age range and the use of different failure definitions. Conversely, Tan et al. (2020), in a 10-year retrospective cohort from a Malaysian centre, reported an induction failure rate of approximately 20%, which is somewhat lower than our findings, potentially reflecting differences in patient demographics and cervical ripening protocols [4].

The Bishop score emerged as the strongest independent predictor of failed induction in our study, with women having a score <4 demonstrating a four-fold increased risk (aOR 4.12, p=0.001). This finding is consistent with the extensive body of literature supporting the prognostic significance of cervical status in determining induction outcomes. Teixeira et al. (2012), in a comprehensive meta-analysis of 59 studies, demonstrated that higher Bishop scores were consistently associated with greater likelihood of vaginal delivery, with summary odds ratios ranging from 1.98 (95% CI 1.58–2.48) to 5.48 (95% CI 1.67–17.96) depending on the cut-off employed [11]. Similarly, Ezebialu et al. (2007), in a case-control study involving 234 women at a Nigerian university hospital, identified that a Bishop score <6 was independently associated with failed induction with an adjusted OR of 3.47 (95% CI 1.75–6.85) [6]. Our findings reinforce the clinical importance of pre-induction cervical assessment and support the recommendation that women with very unfavourable cervical scores should receive adequate cervical ripening prior to oxytocin augmentation.

Nulliparity was the second strongest predictor in our multivariate model (aOR 3.48, p=0.007), with nulliparous women comprising 80% of the failed induction group. This is consistent with established obstetric evidence. Parity has been recognized as one of the most consistent predictors of induction success across multiple studies and systematic reviews [1,6,11]. The biological basis for this association lies in the fact that multiparous women have previously undergone cervical remodelling, myometrial stretching, and the physiological changes of labour, resulting in a more responsive uterus and cervix during subsequent inductions. Daskalakis et al. (2013), in a study of 538 nulliparous women with singleton term pregnancies, reported that 44% of nulliparous women undergoing induction required cesarean delivery, further supporting the well-established vulnerability of this population to induction failure [5]. In an Ethiopian study by Berie et al. (2022), nulliparity was independently associated with failed induction with an adjusted OR of 2.32 (95% CI 1.08–5.02), which, while lower than our estimate, confirms the directional consistency of this association across different populations [7].

Maternal obesity (BMI ≥30 kg/m²) was independently associated with a nearly three-fold increased risk of failed induction in our study (aOR 2.96, p=0.011). This finding is supported by a substantial body of evidence linking obesity to adverse labour induction outcomes. Ellis et al. (2019), in a systematic review and meta-analysis examining the influence of maternal obesity on labour induction, concluded that women with obesity require longer induction durations, higher doses of both prostaglandins and synthetic oxytocin, and experience less frequent success with cervical ripening methods compared to women of normal weight [13]. Wolfe et al. (2011), in a population-based cohort study of over 80,000 women using birth certificate data from Ohio, reported that induction failure rates increased progressively with BMI class — from 13% in normal-weight women to 29% in women with class III obesity (BMI ≥40 kg/m²) [8]. The mechanisms underlying this association are thought to include

increased adipose tissue deposition in the pelvis and cervix, altered prostaglandin metabolism, reduced uterine contractility secondary to lipid infiltration of the myometrium, and the higher prevalence of macrosomic infants [13]. Pallasmaa et al. (2018), in a retrospective cohort study at an Australian regional tertiary centre involving 1,543 women, demonstrated that obese women were more likely to present with a low Bishop score (<5) at admission (OR 1.5, 95% CI 1.1–2.0) and had increased rates of failed induction (aOR 1.6, 95% CI 1.0–2.5), findings that are directionally concordant with our observations [9].

Advancing maternal age (>30 years) was identified as a significant independent predictor of failed induction in our study (aOR 2.54, p=0.026). The association between maternal age and induction outcomes has been explored in multiple large-scale studies. Bergholt et al. (2020), in a landmark Nordic register-based study encompassing over 3.3 million deliveries across Denmark, Finland, Iceland, Norway, and Sweden, demonstrated that cesarean section rates following labour induction increased progressively with maternal age, with the absolute risk being three to five times higher across five-year age groups in nulliparous compared to multiparous women [15]. Nakano et al. (2018), in a Japanese retrospective cohort of 234 nulliparous women of advanced maternal age (≥35 years) undergoing IOL, reported that 44% had failed induction and delivered by emergency cesarean section [14]. The pathophysiological basis for the increased risk of induction failure with advancing age includes age-related alterations in cervical collagen composition, decreased gap junction formation in the myometrium, and diminished responsiveness to oxytocin and prostaglandins [14,15]. In our study, the use of a lower age threshold (>30 years) may reflect the younger demographic profile of the Indian obstetric population and the observation that age-related cervical changes may manifest at earlier ages in certain ethnic groups.

Post-dates pregnancy was the most frequent indication for induction in our study (46.5%), consistent with the global literature and the WHO Global Survey data showing that prolonged pregnancy is the leading indication for IOL across diverse settings [2]. The relatively uniform failure rates across most indications (21–25%) suggest that the indication for induction itself may be less influential than the maternal and cervical characteristics in determining induction outcome.

The combined risk prediction model incorporating Bishop score, parity, BMI, and maternal age achieved an AUROC of 0.78, indicating acceptable discriminative ability. While this does not constitute a formally validated prediction tool, it suggests that a composite assessment incorporating these four variables can meaningfully stratify patients by their risk of induction failure, potentially guiding decisions regarding the need for enhanced cervical ripening, patient counselling regarding the possibility of cesarean delivery, and allocation of clinical resources.

The strengths of this study include its prospective design, well-defined inclusion and exclusion criteria focusing on a low-risk population, and the use of multivariate analysis to identify independent predictors after adjusting for confounders. However, several limitations must be acknowledged. The relatively modest sample size of 142 women limits the statistical power for detecting smaller effect sizes and precluded meaningful subgroup analyses. The single-centre design restricts the generalizability of our findings to other institutional settings with different induction protocols and patient populations. Additionally, the study did not incorporate transvaginal ultrasound-based cervical length measurements, which have been shown to provide incremental prognostic information beyond the Bishop score. Future multicentre studies with larger sample sizes and the integration of both clinical and ultrasonographic parameters would be valuable in developing and validating comprehensive prediction models for induction outcomes in the Indian setting.

Conclusion

Failed labour induction occurred in approximately one-quarter (24.6%) of low-risk term pregnancies at our tertiary care centre. Bishop score below 4 emerged as the strongest independent predictor, conferring a four-fold increased risk of induction failure. Nulliparity, maternal obesity (BMI ≥30 kg/m²), and advancing maternal age (>30 years) constituted additional significant and independent risk factors. A combined risk assessment model incorporating these four predictors achieved acceptable discriminative accuracy (AUROC 0.78) for clinical decision-making. These findings underscore the importance of comprehensive pre-induction evaluation encompassing cervical status, parity, body habitus, and maternal age for optimizing patient selection, enhancing informed counselling, and guiding resource allocation. Development and validation of risk stratification tools incorporating these predictors may contribute to reducing the burden of unplanned cesarean deliveries in induced labour.

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