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Factors Associated With Failed Induction of Labour: A Retrospective Study

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Abstract

Background

Failed induction of labour (IOL) is a leading cause of emergency caesarean births, putting both the mother and the neonate at risk of preventable adverse outcomes. Although labour induction is increasingly common, local data on its failure rates and associated factors are limited in Pakistan. Therefore, the present study was undertaken to identify the factors associated with failed IOL and to determine its frequency at a tertiary care hospital in Pakistan.

Methods

This retrospective study was conducted at a tertiary care hospital in Pakistan. The medical records of all women who underwent IOL between June 2023 and June 2025 were reviewed, and 245 women who met the inclusion criteria were enrolled through consecutive sampling. Data on maternal, obstetric, and neonatal variables were extracted using a structured proforma. Failed IOL was defined as the failure to achieve active labour (cervical dilatation ⩾5 cm with regular uterine contractions) after completion of the induction regimen. Women with successful and failed induction were compared using the chi-square test, and binary logistic regression was performed to identify independently associated factors, with a sensitivity analysis using Firth's penalized logistic regression. A p-value <0.05 was considered statistically significant.

Results

Of the 245 women, 47 (19.18%) had a failed induction. In univariate analysis, failed induction was significantly associated with maternal age >35 years, nulliparity, pregnancy-induced hypertension, a pre-induction Bishop score ⩽5, premature rupture of membranes, and neonatal birth weight ⩾4000 g (p<0.05). In multivariable analysis, maternal age >35 years (adjusted odds ratio (AOR): 5.59; 95% confidence interval (CI): 2.30-13.56; p<0.001), Bishop score ⩽5 (AOR: 3.11; 95% CI: 1.43-6.73; p=0.004), and neonatal birth weight ⩾4000 g (AOR: 3.26; 95% CI: 1.11-9.55; p=0.031) were independently associated with failed induction. The association with pregnancy-induced hypertension (AOR: 2.81; 95% CI: 1.01-7.84; p=0.048) was borderline and became non-significant in sensitivity analysis (p=0.051).

Conclusions

Approximately one in five women undergoing induction experienced a failed induction. Maternal age >35 years, an unfavourable Bishop score (⩽5), and birth weight ⩾4000 g were independently associated with failed induction, whereas the association with pregnancy-induced hypertension was borderline. Because birth weight is known only after delivery, prospective studies using pre-induction estimated fetal weight are needed to confirm these associations before they are used for risk stratification.

Categories: Obstetrics/Gynecology, Quality Improvement, Epidemiology/Public Health
Keywords: association, bishop score, cesarean section, factors, failed induction, induction of labor, pregnancy

Introduction

Induction of labour (IOL) is defined as the artificial initiation of uterine contractions before spontaneous onset to achieve safe delivery when continuation of pregnancy carries increased maternal or fetal risk [1]. Labour induction is commonly accomplished through pharmacologic agents, including prostaglandin preparations and oxytocin infusion, and through mechanical techniques such as cervical ripening with balloon or Foley catheters and artificial rupture of membranes [2].

IOL is indicated when risks of continuing pregnancy exceed benefits of delivery. Maternal indications include preeclampsia/eclampsia, chronic hypertension, pre-labour rupture of membranes, diabetes mellitus, obstetric cholestasis, and severe maternal disease. Fetal indications include post-term pregnancy (>41

weeks), intrauterine growth restriction with abnormal Doppler, oligohydramnios, chorioamnionitis, and intrauterine fetal demise [3-5].

Worldwide, IOL accounts for >20% of all deliveries, with 29.4% resulting in caesarean section following failed induction [5,6]. The definition of failed IOL varies across guidelines; according to the World Health Organization (WHO), failed IOL refers to the failure to establish active labour, generally defined as cervical dilation of ⩾5 cm accompanied by regular uterine contractions, despite adequate use of induction methods such as oxytocin infusion and/or amniotomy within a specified period [7]. The reported prevalence of failed IOL ranges from 15.5% to 37.7% worldwide (US 19.7%, Germany 37.7%, Nigeria 24.1%) [8-11]. In Pakistan, it ranges from 18.1% to 34% across tertiary centres [12].

Failed IOL is associated with adverse maternal outcomes such as emergency caesarean, postpartum haemorrhage, hysterectomy, wound infection, chorioamnionitis, endometritis, sepsis, uterine hyperstimulation, and rarely uterine rupture, especially with an unfavourable cervix and prior uterine scar. Neonatal complications include fetal distress and hypoxia from hyperstimulation or prolonged labour, low Apgar scores, respiratory distress, hypoglycaemia, and higher neonatal intensive care unit admission, particularly in post-term, growth-restricted, and diabetic pregnancies [5,9,13-15].

Several maternal, obstetric, and induction-related factors are associated with unsuccessful labour induction. Maternal characteristics include advanced age, obesity, and first-time pregnancy, while obstetric factors include gestational age, hypertensive disorders, diabetes in pregnancy, and early rupture of membranes. An unfavourable cervical score before induction is especially important, as cervical readiness determines progression to active labour. Additional associated factors include large fetal weight, a previous complicated obstetric history, and prolonged early labour. Although their individual impact varies between populations, the risk of caesarean rises with longer induction duration and clinician decision-making [8-14,16,17].

Although factors associated with failed IOL have been widely studied worldwide [13,14,16,17], local data from Pakistan identifying the factors independently associated with failed induction remain limited. Consequently, clinicians often rely on risk profiles from other populations when counselling women undergoing induction. This study therefore aimed primarily to identify the maternal, obstetric and neonatal factors associated with failed IOL and, secondarily, to determine its frequency at a tertiary care hospital in Pakistan. The study examines associations and was not designed to develop a predictive tool. Such local evidence may help inform the counselling of women undergoing induction and guide the design of future prospective studies in our population.

Materials And Methods

Study design and study population

This retrospective study was conducted at Ayub Teaching Hospital, a tertiary care hospital in Abbottabad, Pakistan. Medical records of all 245 eligible pregnant women who underwent IOL during the two-year study period, from June 2023 to June 2025, were assessed. Consecutive sampling was employed, and all patients meeting the predefined inclusion and exclusion criteria were included in the study. Medical records were reviewed to identify maternal, obstetric, and clinical factors associated with failed IOL. Ethical approval was obtained from the institutional review board. Patient confidentiality was maintained throughout the study, and all data were anonymized before statistical analysis.

Inclusion and exclusion criteria

Women aged ⩾18 years who underwent IOL at ⩾37 weeks of gestation with singleton, cephalic pregnancies were included. Both primiparous and multiparous women, irrespective of BMI or comorbidities such as diabetes and hypertension, were eligible if relevant clinical and delivery records were available. Women with multiple pregnancies, non-cephalic presentations, spontaneous labour without induction, or caesarean delivery without attempted induction were excluded. Patients with previous caesarean delivery or major uterine surgery without a trial of labour, and those with incomplete medical records, were also excluded.

Primary outcome and secondary outcomes

The primary objective of this study was to identify factors associated with failed IOL among pregnant women undergoing induction at a tertiary care hospital. The secondary objective was to determine the frequency of failed IOL among the study population.

Assessment of study variables

IOL was defined as the artificial initiation of uterine contractions using pharmacological agents and/or mechanical methods before the spontaneous onset of labour to achieve vaginal delivery [1,8]. According to our standard departmental protocol, three methods were used: prostaglandin E2 (PGE2) alone, an intracervical Foley catheter alone, or a combination of both, with durations of 12-18 hours, 10-12 hours, and approximately 22-30 hours, respectively. As per the same protocol, and consistent with WHO recommendations [7], failed induction was defined as failure to achieve active labour (cervical dilatation ⩾5

cm with regular uterine contractions) after completion of the induction regimen, while women who reached active labour were classified as successful inductions, irrespective of the mode of delivery. The Bishop score, calculated from cervical dilatation, effacement, consistency, position, and fetal station, was used to assess cervical favourability before induction [18].

Data collection

Data were collected from hospital medical records using a structured proforma comprising two sections. The first section recorded maternal demographic and obstetric characteristics: maternal age (⩽35 or >35 years), body mass index (BMI; <30 or ⩾30 kg/m^2), gestational age (term or post-term), parity (nulliparous or multiparous), gestational diabetes mellitus (yes/no), pregnancy-induced hypertension (yes/no), and pre-induction Bishop score. The second section recorded induction-related and labour characteristics: premature rupture of membranes (PROM) (yes/no), duration of the latent phase (<18 or ⩾18 hours), and neonatal birth weight (grams), all recorded after delivery. Owing to the retrospective design, diagnoses such as pregnancy-induced hypertension, gestational diabetes mellitus and PROM were recorded as documented in the medical records by the treating clinicians, according to departmental practice.

Data analysis

Data were analyzed using the IBM SPSS Statistics for Windows, Version 25 (Released 2017; IBM Corp., Armonk, New York). There were no missing data for the variables included in the analysis; all 245 women were included in both the univariate and multivariable analyses. Categorical variables were presented as frequencies and percentages, and maternal age as mean ± standard deviation (SD). Comparisons between the successful and failed induction groups were performed using the chi-square test. Variables significant on univariate analysis ($p<0.05$) were entered simultaneously (Enter method) into a binary logistic regression model to identify factors independently associated with failed induction. Multicollinearity was assessed using variance inflation factors, influential observations using Cook's distance, and discrimination using the area under the receiver operating characteristic curve (AUC). Given the limited number of events (47 events, six parameters), a sensitivity analysis was performed using Firth's penalized logistic regression in Python (Python Software Foundation, Beaverton, USA). A p-value of less than 0.05 was considered statistically significant.

Results

Among the 245 women who underwent IOL, 198 (80.82%) had a successful induction, while 47 (19.18%) experienced failed induction. The mean maternal age was 29.76 ± 6.48 years in the study population.

The maternal and obstetric characteristics of the study population are summarized in Table *1*. Statistically significant differences between the successful and failed induction groups were observed in maternal age >35 years, nulliparity, pregnancy-induced hypertension, pre-induction Bishop score ⩽5, premature rupture of membranes (PROM), and neonatal birth weight ⩾4000 g (all $p < 0.05$). Although higher proportions of failed induction were observed among women with BMI ⩾30 kg/m^2, post-term gestation, gestational diabetes mellitus, and prolonged latent phase, these differences were not statistically significant (all $p > 0.05$).

Variable	Category	Total, n (%)	Successful induction n=198 (80.82%)	Failed induction n = 47 (19.18%)	Test Statistic χ^2 value	p-value
Maternal age (years)	>35	37 (15.10)	21 (10.61)	16 (34.04)	16.27	<0.001*
	≤35	208 (84.90)	177 (89.39)	31 (65.96)		
BMI (kg/m²)	≥30	50 (20.41)	37 (18.69)	13 (27.66)	1.88	0.170
	<30	195 (79.59)	161 (81.31)	34 (72.34)		
Gestational age	Post-term	47 (19.18)	36 (18.18)	11 (23.40)	0.67	0.414
	Term	198 (80.82)	162 (81.82)	36 (76.60)		
Parity	Nulliparous	123 (50.20)	91 (45.96)	32 (68.09)	7.44	0.006*
	Multiparous	122 (49.80)	107 (54.04)	15 (31.91)		
Gestational diabetes mellitus	Yes	28 (11.43)	20 (10.10)	8 (17.02)	1.80	0.180
	No	217 (88.57)	178 (89.90)	39 (82.98)		
Pregnancy-induced hypertension	Yes	23 (9.39)	14 (7.07)	9 (19.15)	6.51	0.011*
	No	222 (90.61)	184 (92.93)	38 (80.85)		
Pre-induction Bishop score	≤5	105 (42.86)	76 (38.38)	29 (61.70)	8.43	0.004*
	>5	140 (57.14)	122 (61.62)	18 (38.30)		
Premature rupture of membranes	Yes	32 (13.06)	18 (9.09)	14 (29.79)	14.33	<0.001*
	No	213 (86.94)	180 (90.91)	33 (70.21)		
Prolonged latent phase	Yes	68 (27.76)	52 (26.26)	16 (34.04)	1.15	0.284
	No	177 (72.24)	146 (73.74)	31 (65.96)		
Neonatal birth weight	≥4000 g	20 (8.16)	11 (5.56)	9 (19.15)	9.36	0.002*
	<4000 g	225 (91.84)	187 (94.44)	38 (80.85)		

TABLE 1: Maternal and obstetric characteristics by induction of labour outcome

*p < 0.05 was considered statistically significant. BMI: body mass index.

The results of the binary logistic regression analysis are presented in Table 2. Variables showing statistically significant associations in the univariate analysis were included in the multivariable model. After

adjustment, maternal age >35 years, pre-induction Bishop score ⩽5, birth weight ⩾4000 g, and pregnancy-induced hypertension remained independently associated with failed IOL. In contrast, nulliparity and PROM were not independently associated with the outcome after adjustment.

Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Maternal age >35 years (ref: ≤35 years)	4.35 (2.05–9.25)	<0.001	5.59 (2.30–13.56)	<0.001*
Nulliparity (ref: multiparity)	2.51 (1.28–4.92)	0.007	2.07 (0.97–4.40)	0.059
Pregnancy-induced hypertension (ref: No)	3.11 (1.26–7.71)	0.014	2.81 (1.01–7.84)	0.048*
Bishop score ≤5 (ref: >5)	2.59 (1.34–4.97)	0.004	3.11 (1.43–6.73)	0.004*
Premature rupture of membranes (ref: No)	4.24 (1.92–9.36)	<0.001	2.36 (0.94–5.92)	0.068
Neonatal birth weight ≥4000 g (ref: <4000 g)	4.03 (1.56–10.38)	0.004	3.26 (1.11–9.55)	0.031*

TABLE 2: Regression analysis of factors associated with failed induction of labour

Variables significant (p < 0.05) on univariate analysis were entered into the multivariable model. *p < 0.05 was considered statistically significant in the adjusted model. COR: crude odds ratio; AOR: adjusted odds ratio; CI: confidence interval; ref: reference category.

The model converged without evidence of separation, multicollinearity (all variance inflation factors ⩽1.13) or influential observations (maximum Cook's distance 0.043), and showed acceptable discrimination (AUC 0.77). In sensitivity analysis using Firth's penalized logistic regression, maternal age >35 years (AOR 5.23, 95% CI 2.18-12.52), Bishop score ⩽5 (AOR 2.93, 95% CI 1.37-6.23) and birth weight ⩾4000 g (AOR 3.15, 95% CI 1.09-9.16) remained significantly associated with failed induction, whereas the association with pregnancy-induced hypertension became borderline (AOR 2.75, 95% CI 1.00-7.57; p=0.051).

Discussion

This study found that failed IOL was a frequent problem among women undergoing induction at a tertiary care hospital, occurring in nearly one in five women. In univariate analysis, women with failed IOL were more likely to be older than 35 years and nulliparous and to have pregnancy-induced hypertension, an unfavourable pre-induction Bishop score, PROM, and a neonatal birth weight of ⩾4000 g. After adjustment, maternal age >35 years, an unfavourable Bishop score, and birth weight ⩾4000 g remained independently associated with failed IOL, with advanced maternal age showing the strongest association, whereas the association with pregnancy-induced hypertension was borderline.

In the present study, failed IOL occurred in 19.18% of women, a rate that lies within the range reported internationally (15.50%-37.70%) [8-11] and in tertiary care centres across Pakistan in different regions (18.10%-34%) [12]. This wide variation is likely due to differences in maternal characteristics, indications for induction and cervical ripening methods, and, above all, the lack of a uniform definition of failed induction across guidelines and studies [1,8].

Regarding maternal characteristics, the association between increased maternal age and failed induction is well documented. Lonsako et al. and Batinelli et al. reported markedly higher odds of failure among older women [8,9]. The lower success of induction in older women may be explained by age-related decline in myometrial contractility, reduced uterine responsiveness to oxytocin, and a greater burden of obstetric comorbidities [5]. Pregnancy-induced hypertension was also independently associated with failed IOL, in line with previous studies [2,6]. Women with hypertensive disorders are commonly induced earlier in term and for pressing maternal reasons, often before the cervix is favourable. They are also more likely to require caesarean delivery if maternal or fetal well-being worsens during induction [3,16]. Therefore, this association may partly reflect a lower clinical threshold for expediting delivery rather than an impaired response to induction alone. Moreover, the association was of borderline significance (95% CI: 1.01-7.84) and became non-significant in sensitivity analysis using penalized regression (p=0.051), so it should be interpreted with caution and confirmed in larger studies.

An unfavourable Bishop score (⩽5) was associated with roughly threefold higher odds of failed IOL. This highlights the key role of cervical ripeness in the progress of labour: an unripe, firm and closed cervix responds poorly to uterine contractions, which delays progression to the active phase and raises the chance of caesarean delivery [18]. Our study results are consistent with those of Ejigu and Lambyo and Raghoji et al., all of whom found a low Bishop score to be an important risk factor for failed induction [13,14]. Similarly, neonatal birth weight ⩾4000 g was independently associated with failed IOL in our cohort, consistent with previous studies reporting that higher birth weight increases the likelihood of caesarean delivery following induction. A large fetus may be associated with a high or poorly applied presenting part, which may reduce

pressure on the cervix and impair cervical change during the latent phase. Larger fetuses may also prompt a lower threshold for caesarean delivery when progress is slow [2,13,19]. However, as birth weight was recorded after delivery, this finding cannot be directly applied before induction, and ultrasound-estimated fetal weight, which is less precise, would be required in clinical practice.

After adjustment, nulliparity and PROM lost statistical significance, although both were associated with failed IOL on univariate analysis. This is probably due to their overlap with other associated factors, particularly an unfavourable Bishop score among women with PROM; both have been reported as independent predictors in previous studies [6,9]. Likewise, obesity, gestational diabetes, post-term pregnancy, and a prolonged latent phase were more frequent among women with failed induction, but these differences did not reach statistical significance, whereas earlier studies have shown a similar association of these factors with failed IOL [16,20-22]. These discrepancies may reflect the small number of women in these subgroups. Larger studies using standardized definitions are needed to clarify these associations.

Clinically, these findings suggest that maternal age, cervical status, and fetal size may be considered when counselling women before induction. However, the predictive performance of these factors for individual women was not evaluated, and induction strategies were not compared; therefore, these findings should not yet be used to select women for induction or to choose induction methods. Although induction at or beyond term may improve perinatal outcomes without increasing caesarean delivery rates [4,15], failed IOL may be associated with adverse maternal and neonatal outcomes [16,17]. However, the observational design of this study does not establish causality.

This study's strengths include the consecutive inclusion of all eligible women over two years, multivariable analysis of clinically relevant factors and a sensitivity analysis using penalized regression, although adjustment cannot ensure complete control of confounding. Its limitations include the retrospective, single-centre design and reliance on medical records; diagnoses of key variables were based on clinical documentation rather than standardized criteria applied for the study, which may have introduced misclassification. Owing to the retrospective design, detailed caesarean indications among successfully induced women were not consistently documented, and caesarean decisions in women with hypertensive disorders may have been influenced by maternal or fetal indications. Exclusion of records with incomplete documentation may have introduced selection bias. The relatively small number of events (47) and small subgroups resulted in wide confidence intervals and may have limited the power to detect other associations; although most associations were robust in sensitivity analysis, the association with pregnancy-induced hypertension was borderline and requires confirmation. Birth weight was recorded after delivery and is therefore not available when deciding on induction; ultrasound-estimated fetal weight would be required for pre-induction assessment. In addition, the method of induction was not analyzed as a variable, although success rates may differ between methods. Larger prospective multicentre studies using standardized definitions are needed to confirm these findings and to develop and validate tools for predicting failed IOL.

Conclusions

Failed IOL occurred in nearly one in five women in our population. After adjustment, maternal age >35 years, an unfavourable pre-induction Bishop score (⩽5), and neonatal birth weight ⩾4000 g were independently associated with failed induction, whereas the association with pregnancy-induced hypertension was borderline and not robust in sensitivity analyses. As birth weight is known only after delivery, and no prediction model or comparison of induction strategies was evaluated, these findings should be interpreted as associations rather than tools for selecting induction methods. Large multicentre prospective studies using pre-induction estimated fetal weight and standardized definitions are warranted to validate these observations and to explore strategies that could increase induction success and lower caesarean delivery rates.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. The Institutional Review Board (IRB) of Ayub Teaching Hospital issued approval IRB.ATH.2841/25. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **AI use statement:** The authors used ChatGPT and Claude free version as follows: language polishing, structure or formatting, translation in Introduction and Discussion. The researchers reviewed the AI-assisted content, verified its accuracy, and corrected any inaccuracies. The final manuscript was reviewed and approved by the researchers, who take full responsibility for its accuracy and integrity. The authors confirm that they have reviewed and verified all AI-assisted content and take full responsibility for the work. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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