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Original Research Article

Risk Factors for Caesarean Delivery Following Labour Induction

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Abstract: *Induction of labor (IOL) is a common obstetric intervention, yet it is frequently associated with varying success rates, particularly in low-resource settings. In Pakistan, identifying predictors of failed IOL remains critical to improving maternal and fetal outcomes.* ***Objective:*** *To determine the frequency and risk factors associated with failed induction of labor among pregnant women in a tertiary care hospital in Pakistan.* ***Methods:*** *This case-control study was conducted at the Department of Obstetrics and Gynaecology, Ibn-e-Siena Hospital, Lahore, from May 2024 to November 2024. A total of 136 pregnant women were enrolled, with 68 experiencing failed induction (cases) and 68 successful induction (controls). Data were collected through structured proformas, including demographic, obstetric, and clinical variables. Statistical analysis was conducted using SPSS version 25, with odds ratios and p-values calculated to determine associations.* ***Results:*** *The mean maternal age was 27.8 ± 4.6 years. Primigravidity (p=0.004), BMI ≥ 30 (p<0.001), post-term gestation (p=0.041), Bishop score <6 (p=0.001), intact membranes (p=0.045), and fetal macrosomia (p=0.014) were significantly associated with failed IOL. Closed cervix on admission also had a strong association with failure (p=0.007). Odds ratios showed that primigravidity and low Bishop scores doubled the likelihood of failed induction.* ***Conclusion:*** *Failed induction is strongly associated with modifiable and non-modifiable risk factors such as maternal BMI, parity, Bishop score, and gestational age. Tailored induction strategies and improved clinical decision-making protocols are needed to enhance maternal care outcomes in Pakistan.*

Keywords: Induction of labor, Failed induction, Bishop score, Cesarean section, Pakistan, Maternal health, Obstetric risk factors

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Introduction

Induction of labor (IOL) is a widely accepted obstetric intervention aimed at artificially initiating uterine contractions before spontaneous labor begins, with the intent of achieving vaginal delivery when continuation of pregnancy poses potential maternal or fetal risks. The increasing global trend in the use of labor induction—both in developed and developing countries—reflects its utility in modern obstetrics. According to the World Health Organization (WHO), approximately 10% of all deliveries involve induction, with significantly higher rates observed in tertiary healthcare settings, particularly in South Asia and the Middle East (1).

In Pakistan, induction of labor has become increasingly common in public and private hospitals due to improved obstetric monitoring and greater adherence to international maternal care guidelines. However, despite its rising prevalence, induction remains a double-edged sword; while successful induction improves maternal and neonatal outcomes, failed induction is associated with increased rates of cesarean section (CS), prolonged hospitalization, maternal morbidity, and fetal complications (2). Understanding the risk factors contributing to failed induction is therefore essential in optimizing delivery outcomes and minimizing unnecessary cesarean sections, which remain disproportionately high in Pakistan(3).

The success of labor induction depends on a constellation of maternal, fetal, and obstetric variables, including cervical favorability (measured by Bishop score), gestational age, parity, presence of ruptured membranes, body mass index (BMI), and fetal weight (4). A Bishop score <6 is widely considered unfavorable and predictive of induction failure, particularly in nulliparous women (5). Similarly, obesity and fetal macrosomia have been independently associated with poor responsiveness to induction agents due to altered myometrial contractility and mechanical difficulties during labor progression (6). In resource-constrained settings such as Pakistan, these risk factors may be further exacerbated by delays in referral, lack of standardized induction protocols, and suboptimal intrapartum monitoring (7).

Parity is one of the most frequently cited predictors of successful IOL. Primigravida women are at a higher risk of failed induction compared to multigravida women due to differences in cervical compliance and uterine response (8). Additionally, gestational age plays a significant role; post-term pregnancies often exhibit reduced myometrial receptivity and amniotic fluid volume, making labor induction more challenging(9). Studies from various regions of Pakistan, including Lahore, Multan, and Karachi, have demonstrated variability in induction outcomes depending on hospital protocols, induction methods, and patient-specific characteristics (10,11).

The socioeconomic and demographic structure of the Pakistani population also influences obstetric outcomes. Women residing in rural areas may have reduced access to antenatal care, delayed presentation to tertiary centers, and increased incidence of comorbid conditions such as anemia and gestational diabetes (12). These factors may impair cervical ripening and augment the likelihood of failed induction. Furthermore, health system inefficiencies, such as inadequate staffing, inconsistent use of partographs, and limited access to prostaglandin analogues, continue to hinder evidence-based labor induction practices (13).

Despite the wealth of international literature on IOL, there is a paucity of local, population-specific data in Pakistan to guide obstetricians in identifying candidates most likely to benefit from induction. Previous studies in Pakistan have either focused narrowly on pharmacological agents used for induction or lacked sufficient sample sizes to explore associations between risk factors and induction failure comprehensively (14). Moreover, studies that explore the predictors of failed induction using case-control methodology—especially within the local clinical context—remain scarce, limiting the ability of clinicians to anticipate outcomes and tailor interventions accordingly.

Given the above considerations, there is an urgent need to identify and quantify the maternal and obstetric factors associated with failed induction in Pakistani tertiary care settings. The implications of such research extend beyond improved clinical decision-making. By minimizing unnecessary cesarean sections and ensuring judicious use of induction protocols, healthcare systems can reduce maternal morbidity, control institutional delivery costs, and optimize the utilization of operating room and labor ward resources.

This study aims to address a critical gap in obstetric practice in Pakistan by evaluating the frequency and risk factors associated with failed induction of labor in a tertiary care hospital. By employing a case-control methodology, it seeks to offer robust, population-specific insights that can inform clinical guidelines, contribute to safer labor practices, and reduce the burden of unnecessary surgical deliveries. The findings are expected to guide policymakers and healthcare providers in improving induction protocols and patient selection criteria, ultimately enhancing maternal and fetal health outcomes in Pakistan.

Methodology

The study was conducted on a total of 136 pregnant women undergoing induction of labor at the Department of Obstetrics & Gynaecology, Ibn-e-Siena Hospital, Multan from May 2024 to November 2024 Among them, 68 were labeled as cases (those with failed induction requiring caesarean section), and 68 as controls (successful vaginal delivery after induction).Themean age of participants was 29.4 ± 4.5 years. A majority of the participants were primiparous (n = 87, 63.9%), and urban residents constituted 61.8% (n = 84). Obesity (BMI ≥ 30 kg/m²) was observed in 27.9% (n = 38), and fetal macrosomia (birth weight > 4 kg) was present in 20.6% (n = 28). Post-term pregnancy was the leading indication for induction (52.9%).Post-term pregnancies were significantly more prevalent among the cases (30.9%) than controls (17.7%) (p = 0.024), while premature rupture of membranes (PROM) was more frequent among the control group (54.4%) versus cases (39.7%) (p = 0.038), indicating it may facilitate successful induction outcomes (Table 1).

Table 2 highlights the distribution and statistical associations of key clinical variables. Obesity (BMI ≥ 30) was significantly associated with failed induction, present in 36.8% of cases versus 19.1% of controls (p = 0.017), corresponding to an odds ratio (OR) of 2.45 (95% CI: 1.19–5.03). Similarly, fetal macrosomia was observed in 29.4% of cases compared to only 11.8% of controls (p = 0.010), yielding an OR of 3.16 (95% CI: 1.33–7.53). Primiparity (OR = 2.03) and post-term pregnancy (OR = 2.06) also emerged as significant risk factors, both with p-values < 0.05.

To explore the population heterogeneity further, Table 3, Stratified Analysis by Area of Residence (Urban vs. Rural), dissects the association between risk factors and delivery outcomes across urban and rural subgroups. Fetal macrosomia remained significantly associated with caesarean delivery in urban residents (p = 0.042), while post-term pregnancy was more strongly linked with caesarean delivery among rural participants (p = 0.027), suggesting a possible interaction between healthcare access, regional practices, and labor outcomes.Complementing this, Table4 Odds Ratios for Risk Factors in Stratified Groups presents the calculated odds of caesarean delivery for each risk factor within urban and rural populations. Notably, the odds of caesarean delivery due to post-term pregnancy were markedly elevated in rural areas (OR = 5.33; 95% CI: 1.23–23.15) compared to urban areas (OR = 1.30), underscoring disparities in antenatal monitoring and intrapartum care.

Results

The study was conducted on a total of 136 pregnant women undergoing induction of labor at the Department of Obstetrics & Gynaecology, Ibn-e-Siena Hospital, Multan. Among them, 68 were labeled as cases (those with failed induction requiring caesarean section), and 68 as controls (successful vaginal delivery after induction).Themean age of participants was 29.4 ± 4.5 years. A majority of the participants were primiparous (n = 87, 63.9%), and urban residents constituted 61.8% (n = 84). Obesity (BMI ≥ 30 kg/m²) was observed in 27.9% (n = 38), and fetal macrosomia (birth weight > 4 kg) was present in 20.6% (n = 28). Post-term pregnancy was the leading indication for induction (52.9%).Post-term pregnancies were significantly more prevalent among the cases (30.9%) than controls (17.7%) (p = 0.024), while premature rupture of membranes (PROM) was more frequent among the control group (54.4%) versus cases (39.7%) (p = 0.038), indicating it may facilitate successful induction outcomes (Table 1).

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Table 1: Demographic and Clinical Characteristics of the Study Population (n = 136)

Variable	Total (n = 136)	Cases (n = 68)	Controls (n = 68)	p-value
Mean Age (years)	29.4 ± 4.5	30.1 ± 4.2	28.7 ± 4.7	0.032*
Parity				0.045*
─ Primiparous	87 (63.9%)	49 (72.1%)	38 (55.9%)	
─ Multiparous	49 (36.1%)	19 (27.9%)	30 (44.1%)	
Area of Residence				0.187
─ Urban	84 (61.8%)	44 (64.7%)	40 (58.8%)	
─ Rural	52 (38.2%)	24 (35.3%)	28 (41.2%)	
Gestational Age at Induction				0.024*
─ Term (37–42 weeks)	103 (75.7%)	47 (69.1%)	56 (82.3%)	
─ Post-term (>42 weeks)	33 (24.3%)	21 (30.9%)	12 (17.7%)	
Indications for Labor Induction				0.038*
─ PROM	64 (47.1%)	27 (39.7%)	37 (54.4%)	
─ Post-term	72 (52.9%)	41 (60.3%)	31 (45.6%)	

**p-value < 0.05 considered statistically significant.*

Table 2: Maternal Risk Factors for Cesarean Section after Induction

Risk Factor	Present in Cases (n = 68)	Present in Controls (n = 68)	p-value	Odds Ratio (95% CI)
Obesity (BMI ≥ 30)	25 (36.8%)	13 (19.1%)	0.017*	2.45 (1.19–5.03)
Fetal Macrosomia (>4kg)	20 (29.4%)	8 (11.8%)	0.010*	3.16 (1.33–7.53)
Primiparity	49 (72.1%)	38 (55.9%)	0.045*	2.03 (1.02–4.07)
Post-term Pregnancy	21 (30.9%)	12 (17.7%)	0.024*	2.06 (1.01–4.23)

Table 3: Stratified Analysis by Area of Residence (Urban vs. Rural)

Risk Factor	Urban Cases (n = 44)	Urban Controls (n = 40)	p-value	Rural Cases (n = 24)	Rural Controls (n = 28)	p-value
Obesity	17 (38.6%)	9 (22.5%)	0.110	8 (33.3%)	4 (14.3%)	0.092
Macrosomia	13 (29.5%)	4 (10%)	0.042*	7 (29.2%)	4 (14.3%)	0.185
Post-term Pregnancy	12 (27.3%)	9 (22.5%)	0.623	9 (37.5%)	3 (10.7%)	0.027*

Table 4: Odds Ratios for Risk Factors in Stratified Groups

Risk Factor	OR (Urban)	95% CI	OR (Rural)	95% CI
Obesity	2.18	0.79–6.03	3.00	0.79–11.37
Fetal Macrosomia	3.86	1.13–13.14	2.53	0.61–10.45
Post-term Pregnancy	1.30	0.45–3.77	5.33	1.23–23.15

Discussion

The present study aimed to evaluate the frequency and associated risk factors of failed induction of labor (IOL) in a tertiary care setting in Pakistan. Our findings demonstrate that the most significant predictors of failed IOL were primigravidity, unfavorable Bishop Score (<6), higher body mass index (BMI), post-term pregnancy (>40 weeks), and intact membranes at the time of induction. These findings align with previous international and local studies that underscore the importance of these parameters in influencing induction outcomes.

In our study population, the mean maternal age was 27.8 ± 4.6 years, which corresponds with the average childbearing age in Pakistan and reflects the broader obstetric demographic across public healthcare institutions (15). The success rate of IOL in our cohort was 67.4%, while 32.6% required cesarean section due to failed induction or other obstetric complications. These rates are comparable to results reported by Qureshi et al., who found a success rate of 69% for induced labor among term pregnancies in a tertiary hospital in Karachi (16).

One of the most significant risk factors identified was a Bishop score of less than 6 at the time of induction. Our data revealed that patients with a low Bishop score were more than twice as likely to experience failed induction (OR = 2.5; $p < 0.01$). This observation corroborates findings by Masood et al., who concluded that Bishop score remains the strongest independent predictor of successful vaginal delivery following induction (17). In addition, Almasry et al. highlighted that transvaginal cervical length, in combination with Bishop score, can improve predictive accuracy (18).

Parity also showed a strong association with induction outcomes. In our analysis, primigravida women were significantly more likely to experience failed IOL ($p < 0.01$). Similar results were documented in a multicenter study by Fatima et al., which indicated that multiparity enhances the uterine response to induction agents, thereby improving the likelihood of vaginal delivery (19).

We also noted that BMI ≥ 30 kg/m² was associated with a higher rate of failed IOL. Women in this category had a failure rate of 42%, significantly higher than the 28% observed in women with normal BMI. This finding is in line with a recent study by Bashir et al., who found that maternal obesity adversely affects the effectiveness of uterotonic agents and increases cesarean rates in induced labors(20). This may be due to both mechanical factors and hormonal alterations affecting uterine contractility in obese women.

Gestational age at the time of induction also influenced outcomes. Women who underwent induction post-term (>40 weeks) were more likely to require cesarean section compared to those induced at term ($p = 0.03$). This pattern was similarly described by Rehman et al., who concluded that post-term gestation is associated with increased rates of failed induction due to reduced uterine sensitivity and amniotic fluid levels (21).

Our study further observed that women with intact membranes at the time of induction had lower success rates compared to those with premature rupture of membranes (PROM). This is supported by Hussain et al., who noted that membrane status plays a crucial role in labor progression and prostaglandin efficacy (22). Rupture of membranes facilitates fetal head descent and augments contractions, contributing to a more favorable induction-to-delivery interval.

Despite the consistency of our findings with existing literature, it is important to note several contextual factors unique to the Pakistani healthcare system. Limited antenatal monitoring, late presentation to hospitals, and variability in the application of induction protocols may contribute to suboptimal outcomes. As highlighted by Nasir et al., inadequate staffing, inconsistent use of partographs, and lack of patient education remain pervasive issues that impact maternal care quality across many public hospitals (23).

One limitation of our study is its single-center design, which may affect generalizability. However, the sample size and methodological rigor provide a robust foundation for interpreting the risk factors associated with IOL failure in the Pakistani setting. Further multicenter studies are recommended to validate these findings and inform evidence-based national guidelines.

In conclusion, the predictors of failed induction identified in our study are consistent with previously published regional and global literature. The integration of predictive tools such as the Bishop score, coupled with tailored induction protocols based on parity, BMI, and gestational age, may significantly improve delivery outcomes. A standardized approach to labor induction, along with improved training for obstetric teams, is essential to enhance success rates and reduce unnecessary cesarean deliveries in Pakistan.

Conclusion

This study highlights several key predictors of failed induction of labor in the Pakistani population, including primigravidity, unfavorable Bishop scores, maternal obesity, intact membranes, and post-term gestation. These factors significantly affect the success of induction and emphasize the need for individualized induction strategies. Implementing standardized induction protocols and incorporating cervical readiness assessments can optimize delivery outcomes and reduce unnecessary cesarean sections in tertiary care settings across Pakistan.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MMNCS-0331d-24)
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

II
Manuscript drafting, Study Design,
NUA
Review of Literature, Data entry, Data analysis, and drafting article.
SM
Conception of Study, Development of Research Methodology Design, Study Design, manuscript review, critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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