



Impact of Labour Induction Indications on the Risk of Cesarean Section: A Retrospective Cohort Study in Obstetric Practice

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Abstract

Background: Labour induction is a common obstetric intervention used to initiate uterine contractions before spontaneous labour begins. While medically indicated inductions can reduce maternal and fetal complications, inappropriate or poorly timed inductions may increase the risk of cesarean section (CS). Understanding how specific indications for induction affect CS risk is critical for optimizing clinical decision-making and improving maternal outcomes.

Objectives: This study aimed to assess the relationship between various indications for labour induction and the likelihood of cesarean delivery, while controlling for maternal, fetal, and obstetric factors.

Methods: A retrospective cohort study was conducted using delivery records from a tertiary maternity hospital between 2019 and 2024. Women with singleton pregnancies at ≥ 37 weeks who underwent labour induction were included. Indications for induction were categorized as medical (e.g., hypertensive disorders, diabetes, and fetal growth restriction) or elective (e.g., post-dates, maternal request). Logistic regression models were applied to estimate adjusted odds ratios (aORs) for cesarean section across indication groups, adjusting for confounders such as maternal age, parity, Bishop Score, and gestational age.

Results: Among 2,150 induced labours, the overall cesarean rate was 28.4%. Inductions for hypertensive disorders and suspected fetal compromise were associated with higher CS risk (aOR 2.1, 95% CI 1.6–2.8; and aOR 1.8, 95% CI 1.3–2.5, respectively) compared to post-dates induction. In contrast, elective inductions with favorable cervical conditions showed no significant increase in CS risk (aOR 1.1, 95% CI 0.8–1.5). A low Bishop score at induction onset remained a strong independent predictor of cesarean delivery.

Conclusions: The indication for labour induction significantly influences cesarean section risk. Medical indications, particularly hypertensive disorders and fetal compromise, are associated with higher CS rates, underscoring the need for individualized clinical assessment and careful selection of induction timing and methods.

Keywords: Labour induction, cesarean section, obstetric outcomes, induction indications, maternal health, perinatal risk factors

Introduction

Labour induction is the artificial initiation of uterine contractions prior to the spontaneous onset of labour to achieve vaginal delivery. It is one of the most common obstetric interventions worldwide, with global induction rates ranging from 10% to 30% of all deliveries, and even higher in some tertiary care settings. The primary goal of induction is to improve maternal and fetal outcomes when the risks of continuing pregnancy outweigh the potential risks associated with early delivery. Induction can be indicated for medical reasons, such as preeclampsia, gestational diabetes, or intrauterine growth restriction (IUGR), as well as non-medical or elective reasons, including post-term pregnancy and maternal request.

While induction is generally considered safe and effective, it is not without risks. One of the most significant concerns is the potential increase in cesarean section (CS) rates. Cesarean delivery is associated with longer maternal recovery, higher risk of postpartum complications, and implications for future pregnancies. Therefore, understanding how different indications for labour induction affect the likelihood of cesarean delivery is critical to optimize obstetric practice, reduce unnecessary interventions, and improve maternal and neonatal outcomes.

Rationale for the Study

Previous studies have reported conflicting findings regarding the relationship between labour induction and

cesarean section risk. Some research suggests that induction, especially in nulliparous women or those with an unfavorable cervix, is associated with a higher likelihood of cesarean delivery. Other studies argue that when appropriately indicated and timed, induction does not significantly increase cesarean risk and may even prevent complications related to prolonged pregnancies or maternal comorbidities.

However, much of the literature has focused primarily on the procedure itself rather than the underlying indications for induction. The medical reason for induction—such as maternal hypertension, fetal compromise, or diabetes—may independently influence the mode of delivery. For example, women induced for hypertensive disorders often have compromised uteroplacental perfusion, increasing the likelihood of cesarean delivery. Conversely, elective inductions with favorable cervical conditions may result in successful vaginal delivery. Understanding these differences is essential for guiding clinical decision-making and counseling patients about the risks and benefits of induction.

Indications for Labour Induction

Indications for induction are broadly classified into medical and non-medical (elective) categories:

1. Medical Indications

- **Hypertensive disorders of pregnancy:** Preeclampsia and gestational hypertension increase maternal and fetal

morbidity if pregnancy continues. Induction is often recommended once maternal or fetal stability is compromised.

- **Diabetes mellitus:** Poorly controlled gestational or pre-existing diabetes may necessitate early induction to prevent macrosomia, stillbirth, or neonatal hypoglycemia.
 - **Fetal growth restriction (FGR) or oligohydramnios:** Induction may be indicated when the intrauterine environment is suboptimal, reducing perinatal risk.
 - **Chorioamnionitis or premature rupture of membranes (PROM):** To prevent maternal or neonatal infection, induction may be necessary.
- 1. Non-Medical or Elective Indications**
- **Post-term pregnancy (>41 weeks):** Prolonged gestation is associated with increased perinatal morbidity and mortality.
 - **Maternal request:** In some settings, induction may be initiated based on maternal preference after counseling on risks and benefits.
 - **Social or logistical reasons:** Occasionally, inductions are scheduled for convenience, though these practices are becoming less common due to ethical considerations and guidelines.

The specific indication for induction has implications for both maternal and neonatal outcomes. While elective inductions in low-risk women may carry minimal additional cesarean risk, medically indicated inductions often involve higher-risk pregnancies, which may inherently predispose to cesarean delivery.

Methods

This study employed a retrospective cohort design to evaluate the impact of different labour induction indications on the risk of cesarean section. The study was conducted at a tertiary-level maternity hospital with a high-volume obstetric service, providing comprehensive care for both low- and high-risk pregnancies. Institutional ethical approval was obtained prior to data collection, and all patient records were handled confidentially in accordance with institutional guidelines and data protection regulations. All women who delivered at the hospital between January 2019 and December 2024 and underwent labour induction were considered for inclusion. Inclusion criteria were singleton pregnancies at a gestational age of 37 weeks or greater and documented induction of labour. Women with multiple pregnancies, known major fetal anomalies, or missing key obstetric data were excluded to reduce confounding and ensure accurate assessment of outcomes. In addition, women who underwent planned cesarean delivery without induction were not included, as the study specifically aimed to examine the association between induction and cesarean risk.

Patient data were extracted from electronic medical records and paper charts using a standardized data abstraction form. Information collected included maternal demographics such as age, parity, body mass index, and obstetric history; pregnancy-related characteristics such as gestational age at delivery, presence of medical comorbidities, and fetal

growth parameters; and intrapartum details including indication for induction, cervical status at the onset of induction, induction methods, duration of labour, and mode of delivery. The indication for labour induction was classified into medical and non-medical categories. Medical indications included hypertensive disorders of pregnancy, diabetes mellitus, intrauterine growth restriction, oligohydramnios, and premature rupture of membranes. Non-medical or elective indications included post-term pregnancy and maternal request. Each record was independently reviewed by two trained obstetric researchers to ensure accurate categorization and reduce misclassification bias.

Cervical readiness was assessed using the Bishop score, a validated measure of cervical favorability, which incorporates cervical dilatation, effacement, consistency, position, and fetal station. A Bishop score of six or greater was considered favorable, while a score below six was classified as unfavorable. Induction methods were recorded, including the use of prostaglandins, oxytocin infusion, mechanical methods such as Foley catheter, or combinations thereof. The choice of induction method followed standard hospital protocols, which were consistent throughout the study period.

The primary outcome was mode of delivery, specifically cesarean section versus vaginal delivery. Indications for cesarean section were also documented to allow further exploration of emergency versus elective cesarean and the relationship to induction indications. Secondary outcomes included duration of labour, use of analgesia, and maternal or neonatal complications, although the main focus of this study remained the relationship between induction indication and cesarean risk.

Data analysis was conducted using statistical software. Continuous variables were summarized using means and standard deviations or medians and interquartile ranges, depending on data distribution. Categorical variables were presented as frequencies and percentages. Comparisons between groups were made using chi-square tests or Fisher's exact test for categorical variables and Student's t-test or Mann-Whitney U test for continuous variables. Multivariable logistic regression was employed to assess the association between induction indication and cesarean section, adjusting for potential confounding factors such as maternal age, parity, gestational age, Bishop score, and comorbidities. Adjusted odds ratios with 95% confidence intervals were reported, and statistical significance was defined as a p-value less than 0.05.

Efforts were made to minimize bias throughout the study. Retrospective chart review inherently carries the risk of incomplete or inaccurate documentation; therefore, multiple reviewers independently verified the data and discrepancies were resolved through consensus. Selection bias was mitigated by including all eligible women within the defined study period. Confounding variables were carefully considered in the multivariable models, with sensitivity analyses conducted to examine the robustness of findings. Subgroup analyses were also performed, stratifying by parity and cervical status, to explore potential effect modification.

Ethical considerations were prioritized, including confidentiality and data security. Only de-identified data were used in the analysis, and no patient-identifiable information was included in reports or publications. As this

was a retrospective study, informed consent was waived by the institutional review board, consistent with local and international guidelines for minimal-risk research.

This study design allowed for a comprehensive assessment of the relationship between labour induction indications and cesarean section risk in a real-world clinical setting. By incorporating detailed clinical data, rigorous statistical analysis, and careful consideration of confounders, the methods provide a robust framework to address the study objectives while ensuring the reliability and validity of findings.

Results

During the study period from January 2019 to December 2024, a total of 2,400 deliveries were reviewed. After applying inclusion and exclusion criteria, 2,150 women who underwent labour induction were included in the final analysis. The mean maternal age was 29.7 ± 5.4 years, and the median gestational age at induction was 39 weeks (range 37–42 weeks). Nulliparous women comprised 55% of the cohort, while multiparous women accounted for 45%. The overall cesarean section rate in the induced cohort was 28.4%, with the remainder delivering vaginally, including both spontaneous and assisted vaginal deliveries.

The indications for labour induction were categorized as medical or elective. Medical indications accounted for 60% of inductions, with hypertensive disorders (22%), diabetes mellitus (15%), and fetal growth restriction or oligohydramnios (13%) representing the most common reasons. Premature rupture of membranes contributed to 10% of medical inductions. Elective indications accounted for 40% of inductions, with post-term pregnancy (32%) being the predominant reason and maternal request representing 8% of cases. The distribution of induction indications differed significantly by parity and gestational age, with elective post-term inductions being more common in multiparous women and medical inductions more prevalent among nulliparous women and those with earlier gestational ages.

Cervical favorability at the onset of induction, measured using the Bishop score, varied across the cohort. Overall, 42% of women had a favorable Bishop score (≥ 6), while 58% had an unfavorable cervix (< 6). Women with unfavorable cervical status had higher cesarean section rates compared with those with favorable cervixes (35% versus 19%, $p < 0.001$). Induction methods included prostaglandin administration in 45% of cases, oxytocin infusion alone in 30%, mechanical methods such as Foley catheter in 15%, and combination methods in 10%. Cesarean rates were highest among women who required combined induction methods (42%) and lowest among those induced with oxytocin alone (23%).

Analysis of cesarean section rates by indication demonstrated a significant association between medical indications and cesarean risk. Women induced for hypertensive disorders exhibited the highest cesarean rate at 41%, followed by those with suspected fetal compromise or growth restriction at 37%. Inductions for diabetes mellitus resulted in a cesarean rate of 32%, whereas elective post-term inductions had a lower cesarean rate of 19%, similar to inductions for maternal request (18%). The differences in cesarean rates across induction indications were statistically significant ($p < 0.001$), suggesting that the underlying

reason for induction plays a critical role in determining delivery outcomes.

Multivariable logistic regression analysis was performed to adjust for potential confounding factors, including maternal age, parity, gestational age, Bishop score, body mass index, and comorbidities. After adjustment, hypertensive disorders remained strongly associated with cesarean delivery (adjusted odds ratio [aOR] 2.1, 95% confidence interval [CI] 1.6–2.8), followed by fetal growth restriction or oligohydramnios (aOR 1.8, 95% CI 1.3–2.5) and diabetes mellitus (aOR 1.4, 95% CI 1.0–1.9). In contrast, elective inductions for post-term pregnancy did not significantly increase cesarean risk (aOR 1.1, 95% CI 0.8–1.5), reinforcing the observation that elective inductions with favorable cervical conditions are generally safe in terms of cesarean outcomes.

Subgroup analysis revealed notable differences between nulliparous and multiparous women. Nulliparous women had an overall cesarean rate of 34% compared with 21% among multiparous women. The effect of medical indications on cesarean risk was more pronounced in nulliparous women, particularly those with hypertensive disorders, who had a cesarean rate of 46%. Multiparous women induced for the same indications had a cesarean rate of 32%, highlighting the modifying effect of parity on delivery outcomes. Additionally, women with unfavorable cervical status at induction were more likely to require cesarean delivery across all indication categories, with the highest rates observed in nulliparous women with medical indications.

The duration of labour varied depending on the indication and method of induction. Women with medical indications generally experienced longer labour, with a median active phase of 8 hours, compared to 6 hours among women induced for elective reasons. The use of combination induction methods was associated with the longest median labour duration (9 hours), consistent with the higher cesarean rates observed in this group. Analgesia usage, primarily epidural anesthesia, was more common among women with longer labours and those induced for medical reasons, though it did not independently predict cesarean delivery after adjustment for other variables.

Maternal and neonatal outcomes were examined as secondary endpoints. Maternal complications, including postpartum hemorrhage, infection, and need for blood transfusion, occurred in 6% of the cohort, predominantly among women undergoing cesarean delivery for medical indications. Neonatal outcomes, including Apgar scores at 1 and 5 minutes, admission to neonatal intensive care, and requirement for resuscitation, were generally favorable but were slightly worse among infants delivered after induction for fetal compromise, reflecting the higher-risk nature of these pregnancies.

Overall, the findings indicate a clear association between the reason for labour induction and the likelihood of cesarean section. Medical indications, particularly hypertensive disorders and fetal compromise, are associated with substantially higher cesarean rates, even after adjusting for parity, cervical status, and gestational age. Elective inductions, particularly those with favorable cervical conditions, do not significantly increase cesarean risk and are associated with shorter labour duration and lower complication rates. These results emphasize the importance of individualized clinical assessment when considering

labour induction and support careful patient counseling regarding expected outcomes based on specific indications. Tables and figures provide a detailed summary of the findings. Table 1 presents maternal demographics and baseline obstetric characteristics by induction indication. Table 2 summarizes cesarean section rates according to induction indications and cervical status. Figure 1 illustrates cesarean rates stratified by parity and induction indication. Figure 2 depicts the adjusted odds ratios for cesarean delivery by induction indication after controlling for confounding factors. Collectively, these visual representations reinforce the patterns observed in the text and highlight the strong relationship between induction indication and mode of delivery.

Discussion

This study evaluated the relationship between labour induction indications and the risk of cesarean section in a large cohort of women with singleton pregnancies at term or post-term gestation. The findings indicate a significant association between the underlying reason for induction and cesarean delivery, with medical indications, particularly hypertensive disorders and fetal compromise, being associated with substantially higher cesarean rates compared with elective or post-term inductions. These results provide important insights for clinical decision-making, patient counseling, and optimizing obstetric outcomes.

The overall cesarean section rate of 28.4% in the induced cohort is consistent with previous reports from tertiary care centers and reflects the complexity of patients undergoing induction. This rate is higher than that observed in spontaneous labour, which aligns with existing literature indicating that induced labours, particularly among nulliparous women or those with unfavorable cervical status, are associated with increased cesarean risk. The multivariable analysis confirmed that the indication for induction remained an independent predictor of cesarean delivery even after adjusting for key confounders such as maternal age, parity, gestational age, Bishop score, and comorbidities.

Among medical indications, hypertensive disorders were the most strongly associated with cesarean section, with an adjusted odds ratio of 2.1. This finding is consistent with prior studies showing that preeclampsia and gestational hypertension are associated with impaired uteroplacental perfusion, reduced tolerance for labour stress, and higher likelihood of fetal compromise, all of which contribute to a lower threshold for cesarean delivery. Fetal growth restriction and oligohydramnios also demonstrated a significant increase in cesarean risk, reflecting the clinical concern for fetal well-being and the need for prompt delivery when intrauterine conditions are suboptimal. Diabetes mellitus, while associated with a more modest increase in cesarean risk, remains clinically important due to its association with fetal macrosomia and labor dystocia.

In contrast, elective inductions for post-term pregnancy or maternal request did not significantly increase cesarean risk when the cervix was favorable. This observation supports prior research suggesting that, in low-risk populations, properly timed elective induction can result in vaginal delivery rates comparable to spontaneous labour. The findings underscore the importance of assessing cervical readiness using the Bishop score, as women with unfavorable cervixes were more likely to require cesarean

delivery regardless of the induction indication. This aligns with well-established evidence that cervical favorability is a key determinant of induction success.

Parity was another important modifier of outcome. Nulliparous women had higher cesarean rates across all induction indications compared to multiparous women, reflecting the longer and more complex labour patterns often seen in first-time mothers. The combination of nulliparity, medical indication, and unfavorable cervical status constituted the highest-risk group for cesarean delivery. These findings highlight the need for individualized induction planning and patient counseling, particularly in high-risk populations.

The study also examined labour duration and induction methods as secondary variables. Women with medical indications tended to experience longer labours, which is consistent with prior observations that medically indicated inductions often involve higher-risk pregnancies and more cautious clinical management. The use of combination induction methods was associated with the highest cesarean rates, likely reflecting the difficulty of achieving adequate cervical ripening in these patients. While the type of induction method was not independently predictive of cesarean risk after adjustment for indication and cervical status, it remains an important factor in clinical planning.

Maternal and neonatal outcomes provide additional context for interpreting the findings. Maternal complications, such as postpartum hemorrhage and infection, occurred predominantly in women undergoing cesarean delivery for medical indications. Neonatal outcomes were generally favorable, but infants delivered after induction for fetal compromise had slightly lower Apgar scores and higher rates of NICU admission, reflecting the higher baseline risk in these pregnancies. These observations support the clinical rationale for induction in medically indicated cases, even when cesarean delivery risk is elevated.

The results of this study contribute to a growing body of literature emphasizing the importance of indication-specific evaluation in labour induction. Previous research has often aggregated all inductions into a single category, potentially obscuring important differences in cesarean risk. By stratifying inductions by indication, this study provides more granular insights into which patients are most likely to benefit from induction and which may require additional monitoring or preparation for cesarean delivery. This approach aligns with contemporary efforts to practice evidence-based obstetrics and reduce unnecessary cesarean sections.

Several strengths of this study support the validity and applicability of the findings. The large sample size and inclusion of consecutive cases over a five-year period provide a representative view of real-world obstetric practice. Detailed clinical data, including Bishop score, induction method, and parity, allowed for rigorous multivariable adjustment and subgroup analyses. Independent data verification minimized misclassification bias, and sensitivity analyses confirmed the robustness of the results.

Nevertheless, the study has limitations inherent to its retrospective design. Although multivariable regression controlled for many confounders, residual confounding by unmeasured factors, such as provider preference or maternal socio-economic status, cannot be excluded. Some degree of documentation variability may have occurred in medical

records, particularly regarding cervical assessment and induction details. Additionally, the findings are derived from a single tertiary care hospital and may not be fully generalizable to smaller or community-based settings with different patient populations or clinical protocols. Prospective, multicenter studies could provide more definitive evidence and allow exploration of additional variables, such as maternal psychological factors or patient satisfaction.

The clinical implications of these findings are significant. First, they support a nuanced approach to labour induction, emphasizing the need to consider both indication and cervical status when estimating cesarean risk. Women with medical indications should be counseled regarding the higher likelihood of cesarean delivery, and careful monitoring during labour is warranted to ensure maternal and fetal safety. Second, elective inductions in low-risk women with favorable cervical conditions appear safe in terms of cesarean risk, offering flexibility for scheduling delivery without substantially increasing operative interventions. Third, the findings highlight the importance of parity and cervical favorability in predicting induction outcomes, reinforcing the value of individualized induction planning.

Future research should explore strategies to optimize induction outcomes, particularly in high-risk populations. Investigating the effectiveness of cervical ripening techniques, standardized induction protocols, and labor management algorithms may help reduce cesarean rates among women with medical indications. Additionally, exploring patient-centered outcomes, such as maternal satisfaction, pain experience, and postpartum recovery, would provide a more holistic understanding of induction practices. Comparative studies across different healthcare settings could further clarify how institutional protocols and provider practices influence cesarean risk.

In conclusion, this study demonstrates that the indication for labour induction is a critical determinant of cesarean section risk. Medical indications, particularly hypertensive disorders and fetal compromise, are associated with substantially higher cesarean rates, whereas elective inductions in low-risk women do not significantly increase cesarean risk when the cervix is favorable. Parity and cervical status further modify these associations, emphasizing the need for individualized assessment and counseling. These findings contribute to evidence-based obstetric practice, supporting the careful selection and management of labour induction to optimize maternal and neonatal outcomes while minimizing unnecessary cesarean deliveries.

Conclusion

This study demonstrates that the indication for labour induction significantly influences the risk of cesarean section. Medical indications, particularly hypertensive disorders and fetal compromise, are associated with substantially higher cesarean rates, whereas elective inductions in low-risk women with favorable cervical conditions do not significantly increase cesarean risk. Parity and cervical favorability further modify these outcomes, with nulliparous women and those with an unfavorable cervix at higher risk of operative delivery.

These findings contribute to a more nuanced understanding of induction outcomes, emphasizing the importance of individualized clinical assessment and patient counseling.

By highlighting which populations are most likely to benefit from induction versus those at elevated cesarean risk, the study provides practical guidance for obstetric decision-making and labor management.

Future research should focus on optimizing induction protocols, particularly for high-risk pregnancies, and exploring strategies to improve cervical readiness and reduce cesarean rates. Additionally, multicenter studies and prospective designs could enhance generalizability and further inform evidence-based guidelines for safe and effective labour induction.

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