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INDICATIONS AND RATE OF CAESAREAN SECTION IN WOMEN WITH INDUCTION OF LABOUR: A CROSS-SECTIONAL STUDY

Original Research

Sundas Nasrullah[1]*, Zartaj Hayat[2], Sehr Nasrullah[3], Huma Mushtaq[4]

[1]MBBS, Postgraduate Trainee, Department of Obstetrics and Gynaecology, Foundation University Islamabad, Pakistan.

[2]FCPS, MRCOG, Professor, Department of Obstetrics and Gynaecology, Foundation University Islamabad, Pakistan.

[3]Consultant Gynecologist, DHQ Hospital, Kotli, Azad Kashmir, Pakistan.

[4]FCPS, Islamabad Medical Complex, Nescom Hospital, Islamabad, Pakistan.

Corresponding Author: Sundas Nasrullah, Postgraduate Trainee, Department of Obstetrics and Gynaecology, Foundation University Islamabad, Pakistan, khansundas509@gmail.com

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ABSTRACT

Background: The increasing use of labour induction in obstetrics has contributed to a global rise in cesarean section (CS) rates. Although induction is a valuable intervention when prolonged pregnancy endangers maternal or fetal health, it has been associated with a higher likelihood of operative delivery. Understanding the relationship between induction and CS is vital to ensure safe obstetric practices and optimal perinatal outcomes.

Objective: To determine the indications and rate of cesarean section among women undergoing induction of labour.

Methods: This cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Unit II, Fauji Foundation Hospital, Foundation University Islamabad, over six months (September 2, 2023–February 28, 2024). A total of 138 women aged 20–35 years with singleton live pregnancies between 37 and 42 weeks and cephalic presentation were enrolled. Women with prior cesarean sections, malpresentations, uterine anomalies, or multiple pregnancies were excluded. Induction was initiated with prostaglandin E2 (dinoprostone) gel or tablet, and oxytocin infusion was used for augmentation when necessary. Maternal and neonatal outcomes were recorded, including cardiotocography (CTG) findings, Apgar scores, and neonatal intensive care unit (NICU) admissions. Data were analyzed using SPSS version 26, with a p-value <0.05 considered statistically significant.

Results: Of the 138 women, 87 (63.0%) were primigravida, and 51 (37.0%) were multigravida. Fetal growth restriction (36.0%) and oligohydramnios (25.9%) were the most frequent indications for induction. Vaginal delivery occurred in 120 women (87.0%), while 18 (13.0%) required cesarean section. Non-reactive CTG was significantly associated with cesarean delivery ($p = 0.019$). Neonates delivered via CS had higher NICU admissions (27%) compared to vaginal deliveries (20%) ($p = 0.002$), and a higher proportion had Apgar scores <7 ($p = 0.008$).

Conclusion: Labour induction at term, when performed in well-selected patients under strict monitoring, was associated with a low rate of cesarean sections. Fetal growth restriction and oligohydramnios remained the most common indications for induction, emphasizing the importance of individualized assessment and vigilant intrapartum care to improve maternal and neonatal outcomes.

Keywords: Apgar score, Cardiotocography, Cesarean section, Fetal growth restriction, Induction of labour, Oligohydramnios, Pregnancy outcome.

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INTRODUCTION

Cesarean section (CS) has become an increasingly common mode of delivery worldwide, largely influenced by the rising frequency of obstetric interventions such as induction of labour. Induction of labour is a routinely performed obstetric procedure indicated when prolonging pregnancy poses potential risks to maternal or fetal health. Despite the associated maternal and neonatal risks of cesarean delivery, its global incidence continues to rise, prompting concern among healthcare professionals and policymakers (1,2). Evidence suggests that women who undergo induction of labour have nearly twice the likelihood of requiring a cesarean section compared to those who experience spontaneous onset of labour (3). The concept of labour induction dates back to Hippocrates, who documented techniques such as mechanical cervical dilation and mammary stimulation to initiate uterine contractions (4). Modern obstetrics considers induction when the anticipated benefits for the mother or fetus outweigh those of continuing pregnancy. Common indications include pregnancy-induced hypertension (PIH), premature rupture of membranes (PROM), fetal growth restriction (FGR), post-term gestation, diabetes, chronic hypertension, and certain fetal concerns. However, the decision to induce labour must be carefully balanced against the potential complications, including prolonged labour, increased cesarean delivery rates, and higher neonatal intensive care admissions before 41 weeks of gestation (5,6).

Contemporary evidence-based guidelines have expanded indications for induction in conditions such as placental abruption, placenta previa, abnormal fetal lie, and umbilical cord prolapse. Furthermore, global demographic and clinical shifts—including advanced maternal age, uterine scarring from previous surgeries, and an overall rise in medical interventions—have contributed to the increased reliance on cesarean sections (7,8). Over the past three decades, the worldwide rate of cesarean delivery has escalated steadily, now reaching approximately 18% (9). This trend underscores a significant transformation in obstetric practice, where safety concerns and evolving clinical thresholds for intervention have reshaped labour management strategies. Despite institutional protocols designed to regulate induction practices, substantial variation persists across hospitals and regions. For instance, Nicholson reported that 9.9% of births following labour induction resulted in cesarean delivery, reflecting differences in practice patterns and patient populations (10,11). These findings highlight a critical need for ongoing evaluation of induction protocols to ensure that clinical decisions align with evidence-based standards and minimize unnecessary surgical interventions. The present study seeks to determine the indications and rate of cesarean section among women undergoing induction of labour. By analyzing the association between induction practices and surgical delivery outcomes, this research aims to identify key contributors to the rising cesarean rate and promote safer, guideline-driven obstetric care. The findings will enhance understanding of how induction influences delivery outcomes, ultimately guiding improved patient selection and optimizing perinatal health in term pregnancies. The objective of this study is to determine the indications and rate of cesarean section in women with induction of labour.

METHODS

This cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Unit II, Foundation University Islamabad—Fauji Foundation Hospital, Rawalpindi, over a six-month period from September 2, 2023, to February 28, 2024, following approval from the Institutional Ethical Review Committee. The study aimed to determine the indications and rate of cesarean section among women undergoing induction of labour. The sample size was calculated using the World Health Organization (WHO) sample size calculator, based on an anticipated cesarean section frequency of 9.9% in women with induced labour (8), a 5% margin of error, and a 95% confidence level. The estimated sample size was 138 participants. Women aged 20–35 years with singleton live pregnancies between 37 and 42 weeks of gestation and cephalic presentation were included. Exclusion criteria encompassed women with uterine anomalies, multiple gestations, previous cesarean deliveries, or fetal malpresentations. Eligible participants were recruited from the emergency department, labour room, and outpatient department after obtaining written informed consent. Each participant underwent a thorough obstetric and medical evaluation to validate the indication for induction. Comprehensive baseline investigations were performed for every patient, including blood grouping and cross-matching, complete blood count, blood glucose levels, urine detailed report, and serological screening for hepatitis B and C. Obstetric ultrasonography was conducted to confirm gestational age and assess fetal well-being. The Bishop score was recorded to evaluate cervical readiness for induction. Fetal monitoring was performed using

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cardiotocography (CTG) to assess fetal heart rate patterns, while Apgar scores and neonatal intensive care unit (NICU) admissions were documented post-delivery.

Induction of labour was initiated using prostaglandin E2 (dinoprostone) vaginal gel (0.5 mg), inserted into the posterior vaginal fornix every six hours, with a maximum of two doses within 24 hours. In patients presenting with premature rupture of membranes (PROM), prostaglandin E2 vaginal tablets were administered. Participants were kept in a reclined position for 30 minutes following insertion to facilitate absorption. When effective uterine contractions failed to establish despite adequate cervical dilatation and fetal head application, artificial rupture of membranes (ARM) was performed under aseptic precautions using Kocher artery forceps. ARM served to augment contractions and enhance labour progression, with continuous maternal and fetal surveillance maintained throughout the procedure. If contractions remained insufficient after cervical ripening and amniotomy, further augmentation was achieved using intravenous oxytocin (Syntocinon). An infusion containing 10 IU of oxytocin in 1000 ml of Ringer's lactate or normal saline was administered via an infusion pump, starting at 2 mU/min and increased by 2 mU/min every 30 minutes. The target uterine activity was 3–4 contractions per 10 minutes, each lasting 40–60 seconds, while carefully avoiding uterine hyperstimulation. Fetal cardiac activity was continuously monitored during oxytocin administration. All patients were managed according to the World Health Organization (WHO) Labour Care Guide, which provided a standardized framework for evidence-based intrapartum management. This guide facilitated the identification of deviations from normal labour progression, enabling timely interventions and clinical decision-making. Data on mode of delivery, CTG abnormalities, Apgar scores at 1 and 5 minutes, and NICU admissions were systematically recorded. All data were entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Categorical variables such as parity, indication for induction, mode of delivery, CTG findings, Apgar score categories, and NICU admissions were summarized as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test, and a p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 138 women were included in the study. The majority of participants were aged between 26–30 years (33.9%) and 31–35 years (33.6%), followed by 32.5% in the 20–25 years age group. Most of the women (63.0%) were primigravida, while 37.0% were multigravida. In terms of gestational age, 66.4% were between 39 weeks and 40 weeks + 6 days, 28.3% between 41–42 weeks, and 5.3% between 37–38 weeks + 6 days. Regarding body mass index (BMI), 43.7% of the participants were in the overweight category (25–29), 30.4% were obese (>30), and 25.9% had a normal BMI (18–24). The most frequent indication for induction of labour was fetal growth restriction (36.0%), followed by oligohydramnios (25.9%), gestational diabetes mellitus (12.2%), premature rupture of membranes (8.6%), pregnancy-induced hypertension (6.5%), post-dated pregnancy (5.8%), and preeclampsia (4.3%). These findings indicate that the majority of inductions were medically indicated rather than elective. Regarding the mode of delivery, 120 women (87.0%) achieved vaginal delivery, while 18 (13.0%) required cesarean section. A statistically significant association was observed between the method of induction and the method of delivery ($p = 0.006$). Among women induced with prostaglandin E2, 110 delivered vaginally and 18 underwent cesarean section, whereas those induced with Syntocinon had exclusively vaginal deliveries. Fetal heart rate patterns assessed by cardiotocography (CTG) showed that 100 women (75.2%) had reactive tracings and most delivered vaginally. Non-reactive CTG patterns were observed in 38 women (24.8%), among whom 6 required cesarean section. The relationship between CTG findings and mode of delivery was statistically significant ($p = 0.019$), indicating that abnormal CTG patterns were associated with higher cesarean section rates.

Apgar score assessment revealed that a good Apgar score (≥7) was recorded in 98 neonates delivered vaginally and 13 delivered via cesarean section, whereas a poor Apgar score (<7) was noted in 22 vaginal deliveries and 5 cesarean deliveries. Although cesarean sections constituted a smaller proportion of total births, the relative frequency of poor Apgar scores was higher in this group. The association between mode of delivery and Apgar score was statistically significant ($p = 0.008$). Neonatal outcomes further indicated that 25 (20%) neonates delivered vaginally and 5 (27%) born via cesarean section required NICU admission. The difference between groups was statistically significant ($p = 0.002$), demonstrating that cesarean deliveries were associated with relatively poorer neonatal outcomes compared to vaginal deliveries. A subgroup analysis was performed to examine the relationship between specific indications for induction of labour and the mode of delivery. Among all indications, fetal growth restriction (FGR) and oligohydramnios were the most frequent contributors to cesarean delivery. Out of 50 women induced for FGR, 10 (20%) required cesarean section, while 40 (80%) delivered vaginally. Similarly, among 36 women with oligohydramnios, 5 (13.9%) underwent cesarean section. Cesarean rates were comparatively lower among those induced for gestational diabetes mellitus (11.8%), premature rupture of membranes (8.3%), and

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INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

pregnancy-induced hypertension (11.1%). No cesarean sections were observed among patients with post-dated pregnancies or preeclampsia, reflecting favorable vaginal outcomes in these subgroups. Statistical evaluation revealed that the association between the indication for induction and the mode of delivery was not statistically significant ($p = 0.071$), indicating that while certain conditions such as FGR and oligohydramnios were more commonly associated with cesarean delivery, they did not independently predict surgical delivery within this sample size. This analysis underscores that although pathological fetal or maternal conditions like FGR and oligohydramnios increase the likelihood of cesarean delivery, other labor and fetal monitoring variables—such as CTG patterns and cervical favorability—may play a stronger predictive role. Future regression modeling with a larger sample size would better delineate independent risk factors for cesarean birth among induced labours.

Table 1: Baseline Demographic properties of the subjects.

Baseline properties	**Number**	**Percentage**
Age		
20-25	45	32.5%
26-30	47	33.9%
31-35	46	33.6%
Parity		
Primigravida	87	63.0%
Multigravida	51	37.0%
BMI		
18-24	36	25.9%
25-29	60	43.7%
>30	42	30.4%
Gestational age		
37 - 38 weeks 6 days	7	5.3%
39 - 40 weeks 6 days	92	66.4%
41 - 42 weeks	39	28.3%
Indication for induction of labour		
PDP	8	5.8
GDM	17	12.2
PE	6	4.3
PROM	12	8.6
OLIGO	36	25.9
PIH	9	6.5
FGR	50	36.0

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Table 2: Association Between Method of Induction and Method of Delivery

Method of delivery	Prostaglandin E2	Syntocinon	Total
Vaginal delivery	110	10	120 (87%)
Cesarean	18	0	18(13%)
			P value 0.006

Table 3: Association Between Mode of Delivery and CTG report

CTG report	Vaginal delivery	Cesarean	Total
Reactive	88	12	100(75.2%)
Non-reactive	32	6	38(24.8%)
			P value 0.019

Table 4: Association Between Method of Delivery and Apgar score with Neonatal condition

Method of delivery	Good score ≥ 7	Bad score < 7	Total
Vaginal delivery	98	22	120
Cesarean	13	5	18
	80.4%	19.6%	P value 0.008
Neonatal condition	Vaginal delivery		Cesarean
NICU admission	25(20%)		5(27%)
			P value 0.002

Table 5: Association Between Indication for Induction and Mode of Delivery

Indication for Induction	Total (n)	Vaginal Delivery n (%)	Cesarean Section n (%)
Fetal Growth Restriction (FGR)	50	40 (80.0%)	10 (20.0%)
Oligohydramnios	36	31 (86.1%)	5 (13.9%)
Gestational Diabetes Mellitus (GDM)	17	15 (88.2%)	2 (11.8%)
Premature Rupture of Membranes (PROM)	12	11 (91.7%)	1 (8.3%)
Pregnancy Induced Hypertension (PIH)	9	8 (88.9%)	1 (11.1%)
Post-dated Pregnancy (PDP)	8	8 (100%)	0 (0%)
Preeclampsia (PE)	6	6 (100%)	0 (0%)
Total	138	119 (86.2%)	19 (13.8%)
p-value			0.071 (NS)

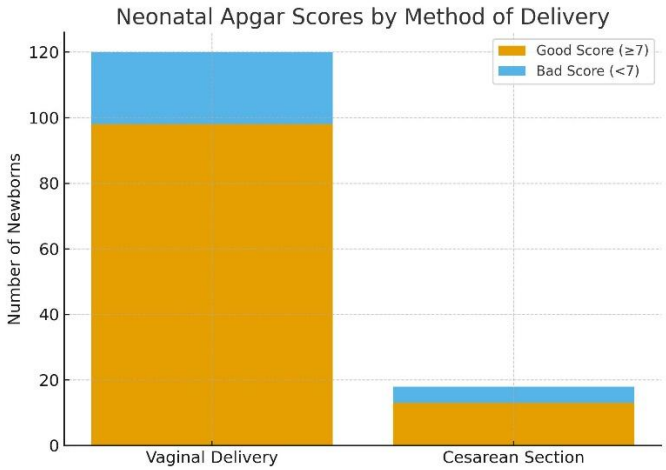

Figure 2 Neonatal Apgar Scores by Method of Delivery

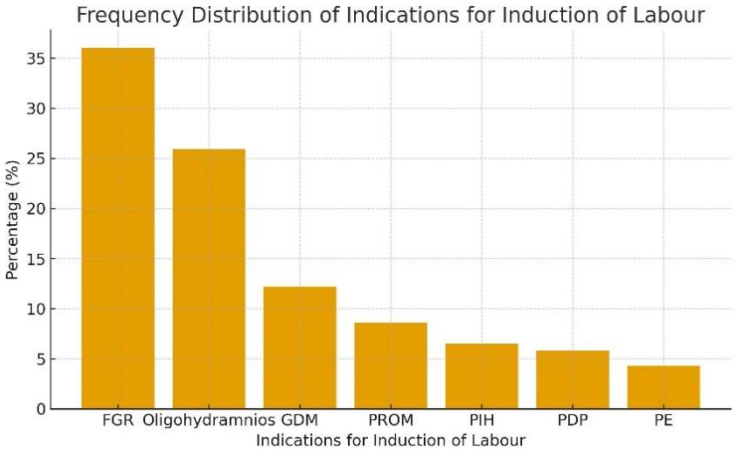

Figure 2 Frequency Distribution of Inductions for Induction od Labour

DISCUSSION

The present study provided important insights into the indications and rate of cesarean section among women who underwent induction of labour in a tertiary care setting. Conducted at Fauji Foundation Hospital, Rawalpindi, under the Department of Obstetrics and Gynecology, Unit II, Foundation University Islamabad, this research contributes valuable local evidence regarding maternal and fetal outcomes following induction. The findings emphasize the importance of appropriate case selection, adherence to evidence-based guidelines, and vigilant intrapartum monitoring in optimizing delivery outcomes and minimizing unnecessary surgical interventions. In the current study, the majority of participants were between 26 and 30 years of age, with 63.0% being primigravida. This demographic trend suggests that first-time mothers are more frequently subjected to labour induction, likely due to closer antenatal surveillance and a lower threshold for intervention in response to suspected fetal compromise. Similar patterns have been documented in previous research, which demonstrated higher induction and cesarean section rates among primigravida women (12-14). The increased susceptibility to cesarean delivery in this group can be attributed to factors such as an unfavourable cervix, prolonged latent phase, and less efficient uterine contractility. These findings highlight the need for improved cervical assessment and individualized induction planning, especially in first pregnancies. Gestational age significantly influenced the outcomes of induction. Most inductions were carried out between 39 and 40 weeks and 6 days, which aligns with international evidence suggesting optimal induction outcomes in this gestational window. Studies conducted elsewhere have shown that induction beyond 41 weeks may increase the risk of cesarean delivery and neonatal morbidity. Although cervical favourability (Bishop score) is a key determinant of induction success, this parameter was not evaluated in the present study, representing a methodological limitation (15-17). Future studies should incorporate cervical assessment tools to enhance predictability of induction outcomes.

The predominant indications for induction in this cohort were fetal growth restriction (36%) and oligohydramnios (25.9%), reflecting a proactive clinical approach toward early identification and management of potential fetal compromise. This trend indicates improved utilization of third-trimester ultrasonography and Doppler studies for surveillance, enabling timely interventions before progression to post-term gestation or severe hypertensive complications. Other studies have reported differing trends, with post-dated pregnancy and preeclampsia being more frequent reasons for induction (18). Such variation likely reflects institutional policies, population risk profiles, and accessibility to prenatal diagnostics. Interestingly, no statistically significant correlation was observed between hypertensive disorders and cesarean delivery in this study, contrary to previous research which associated conditions like preeclampsia and eclampsia with higher cesarean rates (19). This discrepancy may be explained by effective antenatal management and timely induction practices that prevented disease progression in the studied population. Likewise, induction in cases of premature rupture of membranes did not increase cesarean risk, supporting existing evidence that timely induction in PROM cases reduces infectious complications without adversely affecting delivery outcomes (20,21). The cesarean section rate following induction in this study was 13.0%, closely resembling reported rates in other populations (8–10%). The low rate can be attributed to strict adherence to clinical guidelines such as the WHO

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INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Labour Care Guide and NICE recommendations, which emphasize continuous fetal monitoring and evidence-based decision-making. The statistically significant association between non-reactive cardiotocography ($p = 0.019$) and cesarean section underscores fetal distress as a key determinant of surgical intervention. Despite the predominance of vaginal births, cesarean deliveries were associated with poorer neonatal outcomes, including lower Apgar scores and increased NICU admissions ($p = 0.008$ and $p = 0.002$, respectively). These findings are consistent with prior literature describing higher neonatal respiratory morbidity among infants delivered by cesarean section, primarily due to reduced thoracic compression during birth and delayed surfactant production.

The results reinforce the importance of cautious decision-making in managing inductions under suboptimal fetal conditions such as FGR or oligohydramnios. Continuous intrapartum surveillance and preparedness for neonatal resuscitation are vital in such cases to mitigate adverse outcomes. Other studies have suggested that in the presence of multiple maternal or fetal risk factors, elective cesarean delivery may be a safer alternative (22,23). However, well-timed and properly monitored inductions, particularly after 41 weeks, have been shown to reduce cesarean rates and improve perinatal outcomes. The strengths of this study include its standardized protocol for induction, use of validated tools for fetal monitoring, and adherence to WHO-based labour management guidelines. These factors contribute to the internal validity of findings and underscore the role of structured obstetric care in reducing unnecessary cesarean deliveries. Nonetheless, certain limitations must be acknowledged. The study was conducted at a single tertiary care centre, which may limit generalizability to other settings. The sample size, although adequate for frequency estimation, was not powered to evaluate independent predictors of cesarean section through multivariate analysis. Furthermore, the exclusion of parameters such as Bishop score and maternal comorbidities from statistical modeling restricts the depth of causal interpretation. In summary, the study demonstrates that with appropriate patient selection, timely intervention, and adherence to standardized labour management protocols, the rate of cesarean delivery following induction of labour can be kept within acceptable limits. Future multicentric studies incorporating larger cohorts and regression analyses are warranted to identify independent predictors of cesarean delivery and refine induction protocols for improved maternal and neonatal outcomes in resource-limited settings.

CONCLUSION

This study concluded that labour induction, when performed at term in carefully selected women, is a safe and effective procedure that can minimize the likelihood of cesarean delivery, particularly in conditions such as oligohydramnios and fetal growth restriction. Fetal distress, indicated by non-reactive cardiotocography, emerged as the main factor necessitating cesarean intervention, while poorer neonatal outcomes in operative births underscored the importance of vigilant intrapartum monitoring. The findings emphasize that individualized patient assessment, attention to fetal well-being, and cervical readiness are essential before initiating induction. Adherence to standardized management tools, such as the World Health Organization's Labour Care Guide, plays a vital role in ensuring favourable maternal and neonatal outcomes. Further large-scale research is warranted to strengthen evidence-based practices and refine induction protocols that promote safer deliveries and reduce unnecessary surgical interventions (17).

AUTHOR CONTRIBUTION

Author	Contribution
Sundas Nasrullah*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Zartaj Hayat	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sehr Nasrullah	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

Author	Contribution
Huma Mushtaq	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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