

ANALYSIS OF INDUCTION OF LABOUR AND FETOMATERNAL OUTCOMES AMONG WOMEN IN ROBSON TEN-GROUP CLASSIFICATION SYSTEM GROUPS 1, 2A AND 2B

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ABSTRACT

Background: The rising rate of cesarean section (CS) is a global concern, particularly among nulliparous women. The Robson Ten Group Classification System provides a standardized approach to evaluate CS rates. Induction of labour (IOL), especially in Robson Group 2, plays a significant role in influencing delivery outcomes and fetomaternal health.

Methods: This retrospective observational study was conducted among 323 nulliparous women with singleton cephalic pregnancies at ≥ 37 weeks. Participants were categorized into Group 1 (36.5%), Group 2a (44.0%), and Group 2b (19.5%). Data on demographic characteristics, indications for induction, mode of delivery, maternal complications, and neonatal outcomes were collected and analyzed using appropriate statistical methods.

Results: Post-dated pregnancy (36.6%) was the most common indication for induction. Vaginal delivery was highest in Group 1 (78.0%) compared to Group 2a (54.9%), while cesarean section rates were significantly higher in Group 2a (32.4%) and Group 2b (100%). The failed induction rate in Group 2a was 32.4%. Maternal complications such as postpartum hemorrhage were higher in Group 2b (23.8%) compared to Group 2a (12.7%) and Group 1 (6.8%). NICU admissions were also highest in Group 2b (30.2%), followed by Group 2a (18.3%) and Group 1 (10.2%). Most neonates (88.2%) had Apgar scores ≥ 7 . Induction was associated with prolonged labour, with 25.3% exceeding 15 hours.

Conclusion: Induction of labour is associated with higher cesarean rates, prolonged labour, and increased maternal and neonatal complications compared to spontaneous labour. Pre-labour cesarean section carries the highest risk. Optimizing induction protocols and careful patient selection are essential to improve fetomaternal outcomes and reduce unnecessary cesarean deliveries.

Keywords: Cesarean section, Fetomaternal outcomes, Induction of labour, Nulliparous women, Robson classification

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INTRODUCTION:

The rising trend of cesarean section (CS) rates across the globe has become a major concern in modern obstetric practice due to its significant implications on maternal morbidity, neonatal outcomes, healthcare costs, and future reproductive health. The highlights that despite the life-saving potential of cesarean delivery, its overuse—especially in the absence of clear medical indications—has been associated with increased risks such as infection, hemorrhage, longer hospital stay, and adverse neonatal

consequences. Global data suggest substantial variability and inequity in CS rates across regions, reflecting differences in healthcare systems, clinical practices, and socioeconomic factors [1]. To address this variability and enable standardized assessment, the Robson Ten Group

Classification System (TGCS), endorsed by the World Health Organization, has emerged as a reliable and universally accepted tool for auditing and comparing cesarean rates across institutions and populations [2].

The Robson classification categorizes all pregnant women into ten mutually exclusive groups based on key obstetric

parameters such as parity, gestational age, fetal presentation, onset of labour, and previous cesarean history. Among these, Groups 1 and 2, which include nulliparous women with singleton, cephalic pregnancies at term, contribute significantly to the overall CS burden due to their large proportion in obstetric populations (4,10). Group 2 is further subdivided into Group 2a (induced labour) and Group 2b (pre-labour cesarean section), allowing a more detailed evaluation of clinical decision-making and intervention patterns. Studies have shown that these groups collectively account for nearly 40–50% of cesarean deliveries, making them critical targets for intervention to reduce unnecessary CS rates [3].

Induction of labour (IOL) is one of the most commonly performed obstetric interventions worldwide, with rates ranging from 10% to over 30% depending on clinical settings and population characteristics [4]. It is indicated in several maternal and fetal conditions such as post-term pregnancy, hypertensive disorders, gestational diabetes, and intrauterine growth restriction. When appropriately indicated and carefully managed, induction has been shown to reduce perinatal mortality without significantly increasing adverse neonatal outcomes [5]. However, induction is not without risks; it is associated with complications such as failed induction, prolonged labour, increased requirement for oxytocin augmentation, and higher likelihood of operative vaginal delivery or cesarean section, particularly when performed in women with an unfavourable cervix. The relationship between induction of labour and cesarean section remains complex and somewhat controversial. While earlier observational studies suggested that induction increases the risk of cesarean delivery, more recent evidence indicates that, under standardized protocols, induction in low-risk nulliparous women may not increase—and may even reduce—the rate of cesarean sections compared to expectant management [6]. Nevertheless, in many clinical settings, especially where protocols are inconsistent, women undergoing induction (Group 2a) continue to demonstrate higher cesarean rates compared to those in spontaneous labour (Group 1), emphasizing the importance of patient selection and labour management practices [7].

Neonatal outcomes associated with induction of labour are generally comparable to those of spontaneous labour when induction is appropriately timed and conducted. Studies have reported no significant increase in adverse neonatal outcomes such as low Apgar scores, NICU admissions, or early neonatal morbidity [8]. However, failed induction leading to cesarean delivery may increase the risk of neonatal respiratory complications, underscoring the need for proper clinical judgment and preparedness [9].

Furthermore, comparison between Group 2a (induced labour) and Group 2b (pre-labour cesarean section) reveals important differences in maternal and neonatal outcomes. Pre-labour cesarean section is associated with higher maternal morbidity, including surgical complications and longer recovery periods, without providing significant

neonatal benefit in the absence of specific indications [10]. In contrast, successful induction leading to vaginal delivery is associated with better maternal recovery and favourable neonatal adaptation. Given these considerations, analyzing induction practices and fetomaternal outcomes within Robson Groups 1, 2a, and 2b is essential for identifying determinants of cesarean delivery, optimizing labour management strategies, and improving overall obstetric care. Such evaluation can guide evidence-based interventions aimed at reducing unnecessary cesarean sections while ensuring maternal and neonatal safety.

METHODOLOGY

The present study was conducted as a **hospital-based observational cross-sectional study** aimed at evaluating the induction of labour and associated fetomaternal outcomes among women classified under selected groups of the Robson Ten Group Classification System. The cross-sectional design enabled simultaneous assessment of obstetric characteristics and outcomes within the defined study population without any intervention.

The study was carried out in the **Department of Obstetrics and Gynaecology at Sree Balaji Medical College and Hospital, Chennai**, a tertiary care teaching institution catering to a large and diverse patient population, thereby ensuring adequate representation of obstetric cases. The study was conducted over a **period of one year**, during which all eligible participants were included.

The study population consisted of women meeting the predefined **inclusion criteria**, which included **singleton pregnancy, cephalic presentation, nulliparous status, gestational age of 37 weeks or more, and women classified under Robson Groups 1, 2a, and 2b**. The **exclusion criteria** were carefully defined to avoid confounding factors and included **multiple gestations, malpresentations, preterm pregnancies (<37 weeks), women with significant maternal medical disorders, and those with a history of previous cesarean section**. These criteria ensured homogeneity of the study population and improved the validity of comparisons across groups.

A **non-probability consecutive sampling technique** was adopted for the study. All eligible cases presenting during the study period and fulfilling the inclusion criteria were included sequentially until the required sample size was achieved. This method minimized selection bias and ensured that the study population reflected routine clinical practice.

The **sample size** was calculated using the standard formula for prevalence studies:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

where n denotes the required sample size, Z represents the standard normal deviate at 95% confidence interval (1.96), p is the estimated prevalence obtained from previous studies, q is calculated as $(1 - p)$, and d is the allowable error fixed at 5%. Based on this calculation, the final sample size was determined to be **323 participants**, which was considered adequate for statistical analysis.

Participants were categorized according to the **Robson Ten Group Classification System** into three groups for analysis: **Group 1**, comprising nulliparous women with singleton cephalic pregnancies at term in spontaneous labour; **Group 2a**, comprising nulliparous women with singleton cephalic pregnancies at term who underwent induction of labour; and **Group 2b**, comprising nulliparous women with singleton cephalic pregnancies at term who underwent pre-labour cesarean section. This classification allowed standardized comparison of labour characteristics and outcomes.

The study included comprehensive **maternal and neonatal parameters**. Maternal variables assessed included **age, gestational age, indication for induction, Bishop score, mode of delivery, duration of labour, need for augmentation, and complications such as postpartum hemorrhage and infection**. Neonatal parameters included **birth weight, Apgar scores at 1 and 5 minutes, requirement for NICU admission, and early neonatal complications**. In addition, the **rate of failed induction and its contribution to cesarean delivery** were specifically evaluated.

The **study procedure** involved obtaining institutional approval prior to initiation. Data were collected by reviewing hospital records of eligible patients. Participants were categorized into appropriate Robson groups based on obstetric characteristics. For women who underwent induction of labour, detailed information regarding the **method of induction, progression of labour, and outcomes** was recorded. In cases of cesarean section, the **indications and intraoperative findings** were documented. Standard hospital protocols for labour management and neonatal care were followed throughout the study period.

Data collection was performed using a **structured and predesigned case record form**, ensuring uniformity and completeness. Information was retrieved from multiple hospital sources, including **admission registers, labour room records, case sheets, and discharge summaries**. The collected data were systematically compiled and entered into a master chart for analysis, ensuring accuracy and consistency.

The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. **Descriptive statistics**, including mean, standard deviation, frequencies, and percentages, were used to summarize the data. **Comparative analysis** between study groups was carried out using suitable statistical tests such as the **Chi-square test for categorical variables and t-test or ANOVA for continuous variables**. A **p-value of less than 0.05** was considered statistically significant.

The study was conducted after obtaining approval from the **Institutional Ethics Committee**. As the study was observational and cross-sectional in nature, no intervention was performed on participants. **Patient confidentiality was strictly maintained**, and all data were anonymized prior to analysis. No personal identifiers were disclosed at any stage. Since the study involved analysis of existing clinical data, there was **no risk to participants**, and informed consent

procedures were followed as per institutional guidelines wherever applicable.

Results

Table 1: Distribution of Study Participants According to Robson Groups

Robson Group	Number (n)	Percentage (%)
Group 1	118	36.5
Group 2a	142	44.0
Group 2b	63	19.5
Total	323	100

The majority of participants belonged to **Group 2a (44.0%)**, indicating a high rate of induction of labour among nulliparous women. Group 1 constituted 36.5%, while Group 2b accounted for 19.5%, reflecting a moderate proportion of pre-labour cesarean sections.

Table 2: Age Distribution of Participants

Age Group (years)	Number (n)	Percentage (%)
18–22	96	29.7
23–27	148	45.8
28–32	58	18.0
>32	21	6.5

Most participants (45.8%) were in the **23–27 years age group**, indicating that the majority of nulliparous women presenting for delivery were in the optimal reproductive age group.

Table 3: Indications for Induction of Labour (Group 2a, n=142)

Indication	Number (n)	Percentage (%)
Post-dated pregnancy	52	36.6
PIH	34	23.9
Oligohydramnios	21	14.8
GDM	18	12.7
Others	17	12.0

The most common indication for induction was **post-dated pregnancy (36.6%)**, followed by pregnancy-induced hypertension (23.9%), highlighting standard obstetric indications.

Figure 1: Indications for Induction of Labour

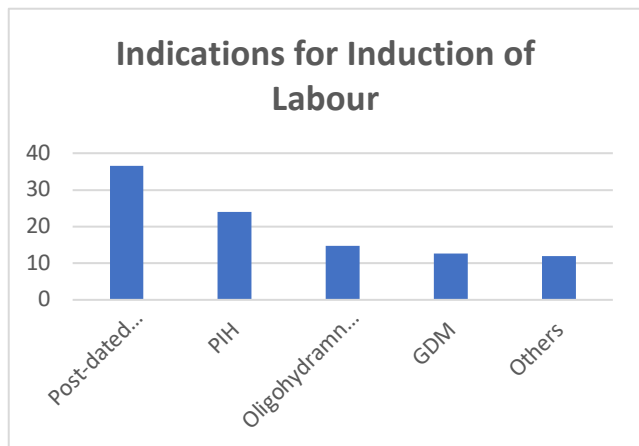


Figure 3: Rate of Failed Induction (Group 2a)

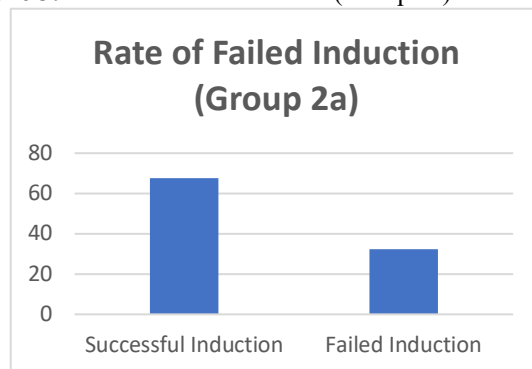


Table 4: Mode of Delivery Across Groups

Mode of Delivery	Group 1 (n=118)	Group 2a (n=142)	Group 2b (n=63)
Vaginal Delivery	92 (78.0%)	78 (54.9%)	0
Instrumental Delivery	10 (8.5%)	18 (12.7%)	0
Cesarean Section	16 (13.5%)	46 (32.4%)	63 (100%)

Cesarean rates were highest in Group 2b (100%), while Group 2a showed higher cesarean rates (32.4%) compared to Group 1 (13.5%), indicating increased operative intervention with induction.

Figure 2: Mode of Delivery Across Groups

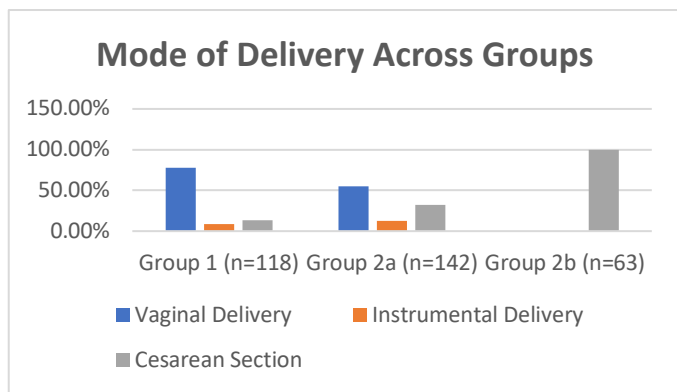


Table 5: Rate of Failed Induction (Group 2a)

Outcome	Number (n)	Percentage (%)
Successful Induction	96	67.6
Failed Induction	46	32.4

The failed induction rate was 32.4%, contributing significantly to cesarean sections in Group 2a.

Table 6: Maternal Complications

Complication	Group 1	Group 2a	Group 2b
Postpartum Hemorrhage	8 (6.8%)	18 (12.7%)	15 (23.8%)
Infection	5 (4.2%)	14 (9.9%)	13 (20.6%)
ICU Admission	2 (1.7%)	6 (4.2%)	8 (12.7%)

Maternal complications were highest in Group 2b, followed by Group 2a, indicating increased morbidity associated with cesarean delivery.

Figure 4: Maternal Complications

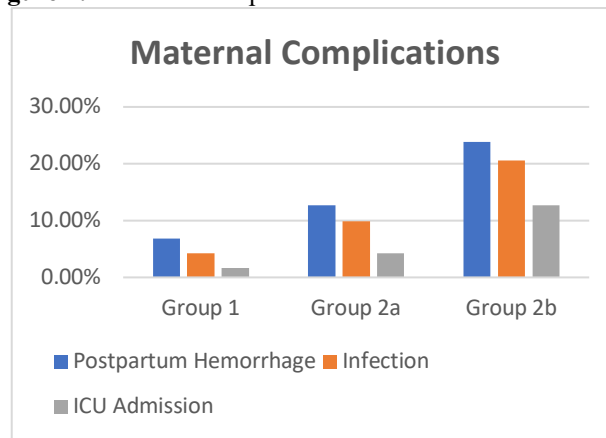


Table 7: Neonatal Birth Weight Distribution

Birth Weight (kg)	Number (n)	Percentage (%)
<2.5	62	19.2
2.5–3.5	211	65.3
>3.5	50	15.5

Most neonates (65.3%) had normal birth weight (2.5–3.5 kg), indicating a predominantly healthy neonatal population.

Figure 5: Neonatal Birth Weight Distribution

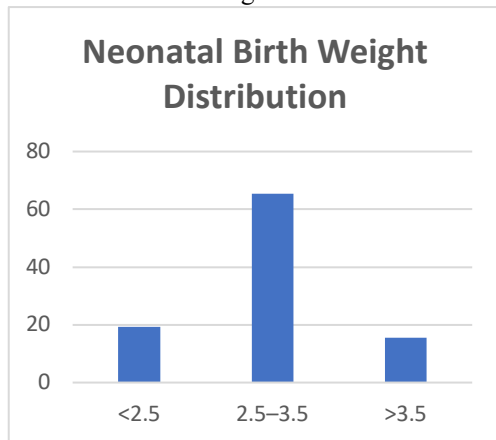


Table 8: Apgar Score at 5 Minutes

Apgar Score	Number (n)	Percentage (%)
<7	38	11.8
≥7	285	88.2

A large majority (88.2%) of neonates had **Apgar ≥7**, suggesting good neonatal outcomes overall.

Figure 6: Apgar Score at 5 Minutes

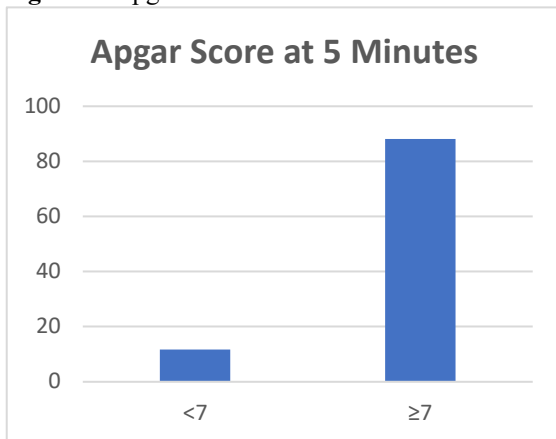


Table 9: NICU Admission Rate

Group	NICU Admission (n)	Percentage (%)
Group 1	12	10.2
Group 2a	26	18.3
Group 2b	19	30.2

NICU admissions were highest in **Group 2b (30.2%)**, followed by Group 2a, indicating relatively poorer neonatal outcomes with cesarean delivery.

Figure 7: NICU Admission Rate

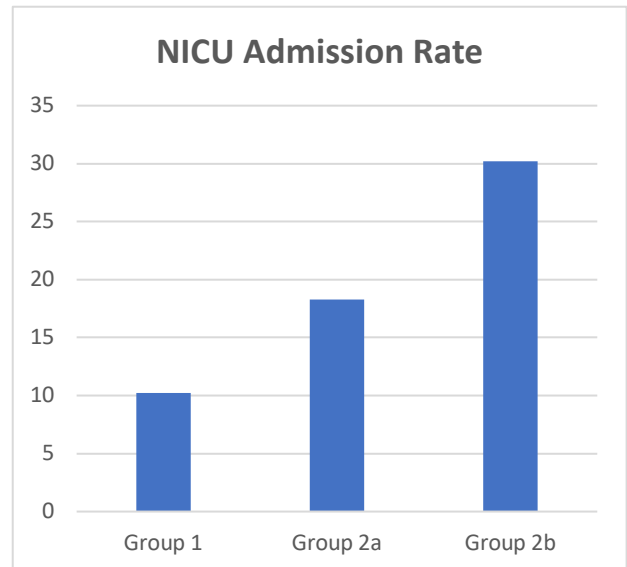
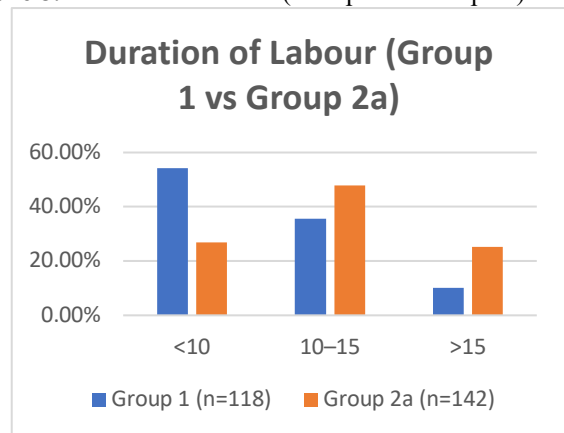


Table 10: Duration of Labour (Group 1 vs Group 2a)

Duration (hours)	Group 1 (n=118)	Group 2a (n=142)
<10	64 (54.2%)	38 (26.8%)
10-15	42 (35.6%)	68 (47.9%)
>15	12 (10.2%)	36 (25.3%)

Labour duration was longer in **Group 2a**, with 25.3% exceeding 15 hours, reflecting prolonged labour associated with induction.

Figure 8: Duration of Labour (Group 1 vs Group 2a)



1. Discussion

The present study evaluated induction of labour and fetomaternal outcomes among women in Robson Groups 1, 2a, and 2b, with a total sample size of 323 participants, and the findings provide important insights into the impact of labour induction and cesarean section practices in nulliparous term pregnancies. In this study, Group 2a constituted the largest proportion (44.0%), followed by Group 1 (36.5%) and Group 2b (19.5%), indicating a high prevalence of induction of labour. This finding aligns with

Amyx et al., 2024, [11] global trends reported in European data, where induction rates in groups 2a and 4a have shown a rising trend and contributed significantly to overall cesarean section rates. The increasing proportion of induced labours in the present study highlights the growing reliance on induction as an obstetric intervention and its potential role in influencing delivery outcomes.

The age distribution in the present study showed that the majority of participants (45.8%) were between 23–27 years, representing the optimal reproductive age group. This demographic similarity reduces confounding due to age-related risks and is comparable to other institutional studies where the majority of deliveries occur in younger reproductive age groups. The homogeneity in age distribution supports that the observed differences in outcomes are more likely attributable to labour characteristics rather than maternal age. The indications for induction in Group 2a were predominantly post-dated pregnancy (36.6%), followed by pregnancy-induced hypertension (23.9%), oligohydramnios (14.8%), and gestational diabetes mellitus (12.7%). These findings reflect standard obstetric indications and are consistent with clinical practice. However, the high proportion of induction cases emphasizes the need to evaluate its outcomes critically. In the study by Paz et al. (2022) [12] induction in Group 2a was associated with relatively lower cesarean rates of 18.4%, indicating effective induction protocols. In contrast, the present study observed a higher cesarean rate of 32.4% in Group 2a, suggesting possible variations in induction practices, cervical favorability, or institutional protocols.

The mode of delivery analysis in the present study demonstrated that vaginal delivery was highest in Group 1 (78.0%), compared to 54.9% in Group 2a, while cesarean section rates were 13.5% in Group 1 and significantly higher at 32.4% in Group 2a. Group 2b, by definition, had a 100% cesarean rate. These findings clearly indicate that induction of labour is associated with increased cesarean section rates compared to spontaneous labour. Similar observations were reported by Jogia et al. (2019) [13] where Group 2 contributed 21% to the overall cesarean rate and was identified as a major contributor after Group 5. Likewise, Saharan et al. (2021) [14] reported that Group 2 contributed 27.14% to total cesarean sections, reinforcing the role of induced labour in increasing surgical deliveries. These comparisons validate the present study findings and emphasize the importance of careful selection and monitoring during induction.

The failed induction rate in the present study was 32.4%, which significantly contributed to cesarean deliveries. This relatively high failure rate highlights the challenges associated with induction, particularly in nulliparous women. Jogia et al. (2019) [13] emphasized that failed induction is a major contributor to primary cesarean section and recommended strict implementation of induction protocols to reduce such outcomes. The discrepancy between the present study and the lower cesarean rates

observed in the Paz et al. (2022) [12] study suggests that improved induction protocols and patient selection could potentially reduce failure rates and improve outcomes.

Maternal complications in the present study were observed to increase progressively from Group 1 to Group 2b. Postpartum hemorrhage was reported in 6.8% of Group 1, 12.7% of Group 2a, and 23.8% of Group 2b. Similarly, infection rates were 4.2%, 9.9%, and 20.6% across Groups 1, 2a, and 2b respectively, while ICU admissions were highest in Group 2b (12.7%). These findings clearly demonstrate that cesarean section, particularly pre-labour cesarean, is associated with higher maternal morbidity. These results are consistent with global evidence suggesting increased maternal risks associated with cesarean delivery compared to vaginal birth. The findings further support the need to avoid unnecessary cesarean sections and promote safe vaginal deliveries wherever possible.

Neonatal outcomes in the present study were generally favorable, with 65.3% of neonates having a birth weight between 2.5–3.5 kg and 88.2% achieving an Apgar score ≥ 7 at 5 minutes. However, 11.8% of neonates had Apgar scores < 7 , indicating some degree of neonatal compromise. The study by Makinde et al. (2023) [15] demonstrated that certain Robson groups are associated with higher odds of low Apgar scores, reinforcing the importance of Robson classification in identifying high-risk groups. Although the present study focused on Groups 1 and 2, the relatively lower proportion of low Apgar scores suggests acceptable neonatal outcomes in these groups when managed appropriately.

The NICU admission rates in the present study showed a clear increasing trend from Group 1 (10.2%) to Group 2a (18.3%) and Group 2b (30.2%). This indicates that both induction and cesarean delivery are associated with increased neonatal morbidity, with the highest risk seen in pre-labour cesarean sections. These findings are in line with the observations of Syed et al. (2023), [16] reported that multiple Robson groups, including Group 2, contribute significantly to cesarean rates and associated neonatal outcomes. The higher NICU admissions in Group 2b further question the benefit of elective cesarean section in the absence of clear medical indications. The duration of labour was also significantly prolonged in induced cases. In the present study, only 26.8% of women in Group 2a delivered within 10 hours compared to 54.2% in Group 1, while prolonged labour (> 15 hours) was observed in 25.3% of induced cases compared to 10.2% in spontaneous labour. This clearly indicates that induction is associated with longer labour duration, which may contribute to maternal exhaustion, increased intervention rates, and higher cesarean section rates. These findings reinforce the need for careful monitoring and timely decision-making during induction.

Overall, the findings of the present study are consistent with existing literature and highlight that while induction of labour is a valuable obstetric intervention, it is associated with increased cesarean rates, prolonged labour, and higher

maternal and neonatal complications compared to spontaneous labour. Group 2 remains a major contributor to cesarean section rates, as demonstrated in multiple studies including Saharan et al. (2021) [14], Jogia et al. (2019) [13], and Syed et al. (2023) [16]. The results also emphasize that pre-labour cesarean section (Group 2b) carries the highest risk of adverse outcomes and should be reserved for clear medical indications. The study underscores the importance of optimizing induction protocols, ensuring appropriate patient selection, and implementing regular audits using the Robson classification system. Such measures can help reduce unnecessary cesarean sections, improve fetomaternal outcomes, and enhance the quality of obstetric care.

Conclusion

The present study concludes that induction of labour in nulliparous term women, particularly in Robson Group 2a, is associated with higher rates of cesarean section, prolonged labour, and increased maternal and neonatal complications when compared to spontaneous labour in Group 1. The findings also highlight that pre-labour cesarean section (Group 2b) carries the greatest risk of adverse maternal outcomes, including postpartum hemorrhage, infection, and higher NICU admissions, without significant additional neonatal benefit. The substantial contribution of Group 2 to overall cesarean rates underscores the need for careful selection of candidates for induction, proper assessment of cervical readiness, and strict adherence to standardized induction protocols. Promoting evidence-based labour management, reducing failed inductions, and avoiding unnecessary pre-labour cesarean sections can significantly improve fetomaternal outcomes. Thus, regular auditing using the Robson classification system is essential to optimize clinical practices and ensure safer obstetric care.

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