

Comparison of Maternal and Neonatal Outcomes Following Induction of Labour at 39 Weeks versus 40 Weeks in Low-risk Pregnancies: A Retrospective Cohort Study

TARU GUPTA¹, SAUMYA RAJPUT², NUPUR GUPTA³, JYOTI BAGLA⁴

ABSTRACT

Introduction: Optimum timing of delivery is crucial for a healthy pregnancy outcome. The decision to terminate low-risk full-term pregnancies, i.e., between 39 weeks 0 days and 40 weeks 6 days, has remained controversial. The risk-to-benefit ratio must be weighed in relation to the induction of labour and the prolongation of pregnancy.

Aim: To compare foeto-maternal outcomes after elective induction of labour in low-risk antenatal women at 39 and 40 weeks of gestation.

Materials and Methods: The present study was a retrospective cohort study conducted in the Department of Obstetrics and Gynaecology, ESIC PGIMS Basaidarapur, New Delhi, India, from December 2020 to April 2022. Eighty low-risk pregnant women carrying a live singleton foetus in cephalic presentation, who had undergone elective induction of labour, were selected and assigned into two categories: Group A: Elective induction at 39 completed weeks (N=40), Group B: Elective induction at 40 completed weeks (N=40). Labour induction was performed according to standard institutional protocol. The primary outcome studied was the caesarean section rates. Data were analysed using Statistical Package for Social Sciences (SPSS) v25.0. Quantitative variables were summarised as mean±Standard Deviation (SD) or median {Interquartile Range (IQR)} and compared using the independent t-test. Categorical variables were expressed as numbers (%) and compared using the Chi-square or Fisher's exact test.

Results: Sociodemographic data were comparable between the two groups, with the mean age of participants being 25.7±3.48 years in the 39-week group and 25.9±3.48 years in

the 40-week group. The distribution of women according to parity was comparable between the two groups. Nulliparous women comprised 24 (60%) in the 39-week cohort and 30 (75%) in the 40-week cohort, while multiparous women comprised 16 (40%) and 10 (25%) of the 39 and 40-week cohorts, respectively (p=0.152). The rate of caesarean delivery was significantly increased in women undergoing elective induction of labour at 40 weeks versus 39 weeks, at 22 (55%) vs. 11 (27.5%), respectively (p=0.013). Instrumental delivery occurred in 3 (7.5%) women induced at 39 weeks but in none induced at 40 weeks. There was a non-significant increase in postpartum haemorrhage occurred after eIOL at 40 weeks: 1 (2.5%) in the 39 weeks group versus 6 (15%) in the 40 weeks group (p=0.108). No significant between-group differences were observed in adverse neonatal outcomes. APGAR score at 1 and 5 minutes were comparable, with 3 (7.5%) and 4 (10%) babies having APGAR <7 at 1 minute in the 39 and 40-week groups, respectively, while APGAR <7 at 5 minutes was seen in 1 (2.5%) and 3 (7.5%) babies, respectively. The mean duration of NICU stay was 2.25±1.2 days for neonates born at 39 weeks and 3.0±1.5 days for neonates born at 40 weeks.

Conclusion: Elective induction of labour at 39 weeks is associated with a reduced incidence of caesarean section compared to induction at 40 weeks of gestation. There is no increased incidence of adverse neonatal outcomes after induction at 39 weeks. This suggests that clinical practice can be modified to incorporate elective induction at 39 completed weeks in the absence of high-risk foeto-maternal factors, instead of waiting until 40 weeks, to reduce maternal morbidity associated with caesarean section.

Keywords: Elective induction of labour, Foeto-maternal outcomes, Full term

INTRODUCTION

The gestational age at delivery is a crucial factor in ensuring healthy maternal and neonatal outcomes. Preterm births prelude to neonatal complications owing to prematurity [1], while late-term and postterm period are linked with greater risks for the mother, foetus, and the newborn [2]. American College of Obstetricians and Gynecologists (ACOG) recommends avoiding termination of pregnancy before 39 (0/7) weeks of gestation [3]. The dilemma of managing uncomplicated full-term pregnancies, i.e., from 39 0/7 to 40 6/7 weeks, remains unsettled.

Various observational and randomised studies have explored pregnancy outcomes after elective induction at 39 weeks or expectant management, but the results have been conflicting. Burn S et al., [4] conducted an extensive retrospective cohort study in the U.S., using data from the National Center for Health

Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) Vital Statistics (2015-2017), to assess the effects of elective induction at 39 weeks versus expectant management through 42 weeks in low-risk pregnancies. They found that elective induction at 39 weeks significantly reduced the need for caesarean section and lowered the risk of neonatal morbidity.

Souter V et al., [5] (2019) conducted a retrospective cohort study in the Northwest U.S. (2012-2017), including 4,002 women electively induced at ≥39 weeks and 51,692 managed expectantly. Among low-risk singleton pregnancies, elective induction at 39 weeks reduced caesarean delivery rates in nulliparous women (14.7% vs 23.2%) and lowered the incidence of pregnancy-induced hypertension in both nulliparous and multiparous women.

Miller NR et al., [6] (2015) conducted a randomised controlled trial at a military tertiary care centre involving women who were categorised

into elective induction at 39 weeks or expectant management up to 42 weeks. The primary outcome, i.e., caesarean section rate, showed no significant difference between the two groups.

Osmundson S et al., [7,8] (2011, 2010) performed two separate retrospective cohort studies evaluating outcomes between elective induction of labour at 39 weeks versus expectant management in nulliparous women. One study included women with Bishop score ≥ 5 , while the other included women with a Bishop score < 5 . In both studies, there were no significant differences in caesarean section among induced women versus those managed expectantly. Limited data exists in this regard in the Indian context [9,10].

With rising awareness and increasing participation of women in decision-making regarding the timing and mode of delivery, it is pertinent that they be given informed choices supported by evidence-based medicine. The decision for termination of high-risk pregnancies, depending on the type of co-morbidity, is well defined in various standard guidelines. However, clear evidence-based guidelines regarding the ideal gestational age for delivery in low-risk pregnancies are lacking.

Hence, the present study was carried out to compare foeto-maternal outcomes after elective induction at 39 versus 40 weeks of gestation in an Indian setting.

MATERIALS AND METHODS

The present study was a retrospective cohort study conducted in the Department of Obstetrics and Gynaecology at ESIC PGIMS, Basaidarapur, New Delhi, from December 2020 to April 2022. The study was approved by the Institutional Ethics Committee (IEC No. ESIPGIMSRIEC/202000022).

Inclusion criteria: Singleton pregnancy with cephalic presentation, a live foetus, low-risk women aged ≥ 21 years, and a confirmed first-trimester Ultrasound Sonography (USG).

Exclusion criteria: Women with hypertension, diabetes, liver or cardiac disorders, Intrauterine Growth Restriction (IUGR) or Foetal Growth Restriction (FGR), intrauterine foetal demise, congenital anomalies in the foetus, premature rupture of membranes, multifoetal pregnancy, hypersensitivity to prostaglandins, previous caesarean section or uterine scar, oligohydramnios, or maternal age below 21 years or above 35 years were excluded. Additionally, women with contraindications to vaginal delivery, including cephalo-pelvic disproportion, placenta previa, or malpresentations, were also excluded.

Sample size calculation: In the study of Grobman WA et al., [11], the caesarean section rate after elective induction at 39 weeks was 18.6%. Assuming a 30% difference in caesarean rate between induction at 39 and 40 weeks, with 80% power and 5% significance level, the minimum required sample size was 40 participants in each study group. Thus, the total sample size was 80.

Based on the gestational age at elective induction, participants were categorised into two groups:

- Group A (n=40): Elective induction at 39 completed weeks of gestation
- Group B (n=40): Elective induction at 40 completed weeks of gestation

All women underwent general and obstetric examinations, including assessment of the Bishop score prior to induction. The induction of labour was carried out using intracervical dinoprostone gel (0.5 mg) administered at 6-hour intervals, up to a maximum of three doses. This was followed by amniotomy with or without oxytocin augmentation, depending on cervical status and uterine contractions, alongside continuous foetal heart rate monitoring.

Labour was allowed to progress spontaneously, with expected vaginal delivery as the goal. Caesarean section was performed in cases of non-reassuring foetal heart rate patterns, failed induction, or other obstetric indications.

Maternal and neonatal outcomes, including caesarean section rates, Postpartum Haemorrhage (PPH), APGAR scores at 1 and 5 minutes, birth weight, need for NICU admission, and neonatal respiratory support requirements, were recorded.

STATISTICAL ANALYSIS

Data analysis was performed using the SPSS version 25.0 (IBM, Chicago, USA). Chi-square or Fisher's exact test was used for categorical variables, and the Independent t-test was used for continuous variables, as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic variables were comparable between the groups [Table/Fig-1]. The mean Body Mass Index (BMI) was similar between the two groups, with no significant difference. The majority of women fall under the normal BMI category [Table/Fig-2]. All participants had Bishop's score ≤ 5 on admission.

Age (years)	39 weeks (n=40)	40 weeks (n=40)	Total	p-value
21-25	23 (57.50%)	17 (42.50%)	40 (50%)	0.277*
26-30	13 (32.50%)	20 (50%)	33 (41.25%)	
31-35	4 (10%)	3 (7.50%)	7 (8.75%)	
Mean \pm SD	25.7 \pm 3.48	25.9 \pm 3.48	25.8 \pm 3.46	0.798†
Median (25 th -75 th percentile)	25 (23-28.25)	27 (23-28)	25.5 (23-28)	
Parity				
Nulliparous	24 (60%)	30 (75%)	54 (67.5%)	0.152‡
Multiparous	16 (40%)	10 (25%)	26 (32.5%)	

[Table/Fig-1]: Demographic details of study subjects.
Fisher's exact test, Independent t test; Chi-square test

BMI category (kg/m ²)	39 weeks group (n=40)	40 weeks group (n=40)	Total (n=80)
<18.5 (underweight)	1 (2.5%)	2 (5%)	3 (3.75%)
18.5-24.9 (normal)	26 (65%)	28 (70%)	54 (67.5%)
25-29.9 (overweight)	9 (22.5%)	7 (17.5%)	16 (20%)
≥ 30 (obese)	4 (10%)	3 (7.5%)	7 (8.75%)
Mean \pm SD	24.2 \pm 3.7	23.8 \pm 3.4	
p-value	0.542 (Not significant)		

[Table/Fig-2]: BMI Distribution.
Chi square test

Cesarean delivery occurred with a significantly greater frequency in women induced at 40 weeks compared to those induced at 39 weeks (55% vs 27.5% respectively, p-value 0.013) [Table/Fig-3]. Foetal distress was the most common indication for caesarean section overall, accounting for 22% of the total cases [Table/Fig-4].

Mode of delivery	39 weeks (n=40)	40 weeks (n=40)	Total	p-value
Caesarean delivery	11 (27.50%)	22 (55%)	33 (41.25%)	0.013‡
Normal vaginal delivery	26 (65%)	18 (45%)	44 (55%)	
Instrumental delivery	3 (7.50%)	0 (0%)	3 (3.75%)	
Total	40 (100%)	40 (100%)	80 (100%)	

[Table/Fig-3]: Mode of delivery.
Fisher's exact test

PPH occurred more frequently in the 40 weeks group (6 in 40 weeks, vs 1 in 39 weeks group). However, this difference was not statistically significant ($p=0.108$). Atonic PPH was the most common cause. One patient suffered traumatic PPH in the 40 weeks group, who underwent caesarean delivery in view of failed instrumental delivery. No cases of traumatic PPH were observed in the 39 weeks group. Duration from induction to delivery was comparable between both the groups, with the mean (± 1 SD) of 15.53 \pm 7 hours at 39 weeks and 15.86 \pm 5.38 hours

Indication of caesarean delivery	39 weeks (n=11)	40 weeks (n=22)	Total	p-value
Deep transverse arrest	0 (0%)	1 (4.55%)	1 (3.03%)	0.912 [†]
Failed induction	0 (0%)	1 (4.55%)	1 (3.03%)	
Failed instrumental delivery	0 (0%)	1 (4.55%)	1 (3.03%)	
Foetal distress	7 (63.64%)	15 (68.18%)	22 (66.67%)	
MSL with poor bishop score	3 (27.27%)	3 (13.64%)	6 (18.18%)	
NPOL	1 (9.09%)	1 (4.55%)	2 (6.06%)	
Total	11 (100%)	22 (100%)	33 (100%)	

[Table/Fig-4]: Indications for caesarean delivery.

Meconium stained liquor; Non progression of labour; [†]Fisher's exact test

at 40 weeks ($p=0.815$). The mean neonatal birth weight was similar in both groups (3 ± 0.37 kg at 39 weeks vs 2.94 ± 0.47 kg at 40 weeks, $p=0.574$). No cases of low birth weight or macrosomia were observed.

There was no difference in the incidence of meconium-stained liquor between the two groups, with three cases in each group affected by meconium-stained liquor ($p=0.912$). APGAR (Appearance (skin color), Pulse (heart rate), Grimace (reflex irritability), Activity (muscle tone), and Respiration) score was found to be similar between the two groups. APGAR <7 at 1 minute was found in 3 (7.5%) neonates at 39 weeks and 4 (10%) neonates at 40 weeks ($p=1$). APGAR <7 at 5 minutes was found in 1 (2.5%) neonate at 39 weeks and 3 (7.5%) neonates at 40 weeks ($p=0.615$). There were no significant differences between groups regarding NICU admission requirements {4 (10%) at 39 weeks vs 5 (12.5%) at 40 weeks, $p=1$ }.

Transient tachypnoea of the newborn was the most common indication for Neonatal Intensive Care Unit (NICU) admission, observed in 3 neonates (7.5%) at 39 weeks and 2 neonates (5%) at 40 weeks. Meconium Aspiration Syndrome (MAS) was reported in 1 case (2.5%) at 39 weeks and 2 cases (5%) at 40 weeks. Early-Onset Neonatal Sepsis (EONS) was observed only in the 40-week group, affecting 1 neonate (2.5%).

Among the neonates admitted to the NICU, some required respiratory support. The oxygen hood was the most common mode of supplemental oxygen, needed in 1 neonate (2.5%) at 39 weeks and 2 neonates (5%) at 40 weeks. Continuous Positive Airway Pressure (CPAP) was required equally in both groups, with 1 neonate in each group (2.5% per group). Mechanical ventilation was required in only 1 neonate (2.5%) in the 40-week group [Table/Fig-5]. The mean

Variables	39 weeks (n=40)	40 weeks (n=40)
Indications for NICU Admission		
Transient tachypnoea of newborn	3 (7.5%)	2 (5%)
Meconium aspiration syndrome	1 (2.5%)	2 (5%)
Early onset neonatal sepsis	0 (0%)	1 (2.5%)
Total NICU admissions	4 (10%)	5 (12.5%)
Mode of respiratory support		
Oxygen hood	1 (2.5%)	2 (5%)
CPAP	1 (2.5%)	1 (2.5%)
Mechanical ventilation	0 (0%)	1 (2.5%)
Total requiring respiratory support	2 (5%)	4 (10%)

[Table/Fig-5]: Indicators for NICU admission and type of respiratory support required.

Study	Parity of participants	Type of Study	Year	n		39 weeks (%)	40 weeks/EM group (%)	p-value
				eIOL	EM			
Present study	Nulliparous+Multiparous	Retrospective cohort	2021	40	40	27.5%	55%	0.013
Sinkey RG et al., [17]	Multiparous	Retrospective cohort	2019	453	2174	5.1%	6.6%	aOR (95% CI)=0.60 (0.37-0.97)
ARRIVE Trial [11]	Nulliparous	RCT	2018	3062	3044	18.6%	22.2%	<0.001
Sinkey RG et al., [18]	Nulliparous	Monte Carlo micro- simulation model	2018	-	-	13.9%	35.9%	<0.01
Walker KF et al., [13]	Nulliparous >35 years	RCT	2016	304	314	32%	33%	0.92

[Table/Fig-6]: Comparison of Caesarean Section frequency among various studies [11,13,17,18].

duration of NICU stay was 2.25 ± 1.2 days at 39 weeks and 3.0 ± 1.5 days at 40 weeks, showing no significant difference ($p=0.529$).

DISCUSSION

It is crucial to decide the optimum gestational age for delivery for all pregnant women to benefit both mother and child. In the present study, the primary outcome, i.e., the frequency of caesarean delivery, was significantly higher with induction at 40 weeks compared to induction at 39 weeks (55% vs. 27.5%, respectively, $p=0.013$). This is consistent with the ARRIVE (A Randomized Trial of Induction Versus Expectant Management) trial [11] (2018), in which caesarean rates were significantly lower in nulliparous women electively induced at 39 weeks compared to women undergoing Expectant Management (EM) (18.6% vs. 22.2%, respectively, $p<0.001$).

A retrospective cohort study by He H et al., [12] compared pregnancy outcomes between women induced at 40 vs 41 weeks of gestation. This study found a significantly greater incidence of caesarean section among women induced at 41 weeks (33.7%) with respect to those induced at 40 weeks (25.1%, $p=0.021$). There were no differences in the neonatal outcomes between the two groups. The findings of present study contradict those of Walker KF et al., [13]; however, their study included only women >35 years of age, whereas the present study included women aged 21 to 35 years. In the present study, the most frequent cause of caesarean section was foetal distress. With advancing gestational age, liquor tends to reduce resulting in oligohydramnios [14,15]. This can contribute toward foetal distress with labour induction, necessitating caesarean section. This might explaining the higher caesarean rates with induction at 40 weeks.

There was an increased need for instrumental delivery with induction at 39 weeks, similar to studies by Souter V et al., [5] and Walker KF et al., [13]. Walker KF et al., [13] (2016) assessed maternal and neonatal outcomes in women >35 years of age, who underwent induction of labour between 39 weeks 0 days to 39 weeks 6 days, and in women who underwent expectant management. Assisted vaginal delivery was performed in 115 (38%) women in the induction group and 104 (33%) women in the expectant management group, although the difference was not statistically significant ($p=0.08$).

In the multicenter study by Souter V et al., [5] (2019), operative vaginal birth was more prevalent in nulliparous women undergoing elective induction of labour at 39 weeks compared with those who underwent expectant management (18.5% vs. 10.8%; adjusted odds ratio, 1.8; 95% confidence interval, 1.28-2.54).

Induction at 39 weeks led to a normal progression of labour, with complications arising at later stages when instrumental delivery was feasible. In contrast, with induction at 40 weeks, complications developed in early stages of labour when instrumental delivery was not possible. This could explain the greater need for instrumental delivery at 39 weeks.

PPH occurred more frequently in the eIOL at 40 weeks arm compared to 39 weeks group (15% vs. 2.5%, $p=0.108$). The ARRIVE trial [11] and the meta-analysis by Sotiriadis A et al., [16] similarly reported no significant difference in the incidence of PPH between the induced and expectantly managed groups.

The present study did not show any significant difference in neonatal outcomes between the two groups. [Table/Fig-7] compared the present study with previous studies with respect to NICU admission requirement in both the study groups [5,11,17].

Study	39 weeks (%)	40 weeks/EM group (%)	p-value
Present study	10	12.5	1
Sinkey RG et al., [17]	6	3	aOR (95% CI)=1.57 (0.96-2.58)
Grobman WA et al., [11]	11.7	13	0.12
Souter V et al., [5]	1.8	5.6	0.046*

[Table/Fig-7]: Comparison of Neonates requiring NICU Admission among various studies [5,11,17].

One of the strengths of the study is its inclusion of both nulliparous and multiparous women, which may lead to a more generalised application of the study's results rather than restricted to a particular parity. The period of gestation was verified by including women who claimed to be sure of the date of their last missed period and also had a first-trimester ultrasound.

The primary objective of pregnancy and delivery is to ensure optimum maternal and neonatal outcomes. Therefore, the timing of delivery is critically important to appropriately balance the potential risks and benefits associated with prolonging pregnancy till term or terminating at 39 weeks. Although the traditional approach has been to wait until the estimated due date for spontaneous labour, recent evidence indicates that elective induction at 39 weeks may be more beneficial for maternal and neonatal outcomes compared to induction at 40 weeks. This approach may contribute to a reduction in caesarean section rates, thereby positively impacting future obstetric outcomes and maternal reproductive health.

Limitation(s)

One of the limitations is the need to adhere to a specific induction protocol. Hence, we do not know whether following different induction regimes would result in similar findings. Furthermore, the study included women aged 21 to 35 years; therefore, authors do not know whether these findings would replicate in women older than 35 years or younger than 21 years. Another limitation is the small sample size included in the study. The smaller sample size in the present study might be responsible for the relatively greater frequency of caesarean sections observed in our study compared to previous studies a factor which can be overcome by including a larger sample size. Larger studies are needed to validate these findings.

CONCLUSION(S)

Elective induction of labour at 39 weeks results in a lower frequency of caesarean section compared to induction at 40 weeks. Other maternal and foetal outcomes were similar irrespective of the gestational age at induction. Further research is warranted to

guide clinical practice. However, with the current evidence, low-risk pregnant women can safely be offered elective induction of labour at 39 weeks of gestation, without any untoward complications.

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PARTICULARS OF CONTRIBUTORS:

- Professor, Department of Obstetrics and Gynaecology, ESIC PGIMS, Basaidarapur, New Delhi, India.
- Senior Resident, Department of Obstetrics and Gynaecology, ESIC PGIMS, Hyderabad, Telangana, India.
- Professor, Department of Obstetrics and Gynaecology, ESI Hospital Okhla, New Delhi, India.
- Professor, Department of Paediatrics, ESI Medical College, Alwar, Rajasthan, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Saumya Rajput,
Flat 101, 275 A/B, Lotus Residency, MLA Colony Road No. 12, Banjara Hills,
Hyderabad, Telangana, India.
E-mail: saum95@gmail.com

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Apr 19, 2025
- Manual Googling: Sep 23, 2025
- iThenticate Software: Sep 25, 2025 (7%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

Date of Submission: Apr 04, 2025

Date of Peer Review: Jun 24, 2025

Date of Acceptance: Sep 27, 2025

Date of Publishing: Apr 01, 2026