OCCURRENCE OF MECONIUM STAINED LIQUOR AND FETOMATERNAL OUTCOME IN VAGINAL MISOPROSTOL INDUCED PREGNANT WOMEN IN LABOUR

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ABSTRACT

Background: Induction of labour (IOL) is most common intervention in obstetrics, especially in Indian tertiary care settings, often involving the use of vaginal misoprostol due to its cost-effectiveness and efficacy. However, concerns exist regarding its association with meconium stained liquoor (MSL), a potential indicator of foetal compromise.

Objective: To determine the incidence of meconium-stained amniotic fluid (liquor) in women who are induced with vaginal misoprostol, and assess its impact on caesarean section rates, neonatal outcomes such as NICU admission, and other foetomaternal complications.

Methods: A prospective hospital-based study was conducted from February 2024 to June 2025, enrolling 61 women undergoing labour induction with vaginal misoprostol at RL Jalappa Hospital. Patients were monitored for cervical ripening, labor progression, fetal status, and delivery outcomes. Data on the APGAR scores, NICU admissions, and maternal complications were colected. Statistic analysis was then conducted using SPSS v26.0, with $p<0.05$ considered significant.

Results: MSL was observed in 19.7% of cases. Vaginal delivery occurred in 80.3% of women, with 19.7% requiring emergency LSCS—mostly due to fetal distress. NICU admission was needed in 32.7% of neonates, with RDS and birth asphyxia being the most common complications. Despite MSL presence, the association with adverse neonatal outcomes was not

statistically significant. Maternal complications included PPH (19.7%), cervical and perineal tears.

Conclusion: Vaginal Miisoprostol is proven effective for labour induction even in women those with unfavourable cervices. Although meconium-stained liquor was relatively common, it did not significantly impact neonatal outcomes when managed appropriately. Close intrapartum monitoring is crucial to optimize maternal and foetal safety.

Keywords: Misoprostol, Labor induction, Meconium-stained liquor, Fetal distress, Vaginal delivery, Neonatal outcomes, Cesarean section, Postpartum hemorrhage

INTRODUCTION

Induction of Labour (IOL) is a widely performed Procedure in obstetrics in India, which is defined as the initiation of uterine contractions artificially before their onset spontaneously, with the goal to achieve vaginal delivery. As per the WHO(World Health Organization), the average Global rate of IOL is approximately 10%, although in countries like India, rates can vary significantly depending on institutional protocols, healthcare access, and urban–rural disparities[12]. In tertiary care centers across India, IOL is a common intervention, particularly in government and teaching hospitals where high-risk pregnancies and referrals are frequent.

IOL is generally recommended when the risks of continuing the pregnancy outweigh those with intervention, with common indications for

induction including **post-term pregnancy**, **Gestational Hypertension**, **Oligo-hydramnios**, **Intrauterine Growth Restriction (IUGR)Premature Rupture Of Membranes (PROM)**[1,3]. Given the diversity of clinical conditions across Indian obstetric populations, the decision to induce labour must be made through a shared decision-making process that considers the clinical scenario, patient preference, and institutional resources[4,5].

The pharmacological agent **misoprostol**, a E_1 type of Prostaglandin analogue, is widely used for ripening of cervix and induction of labour due to its low cost, thermostability, and multiple routes of administration—particularly the **vaginal route**, which is favoured for its prolonged uterotonic action and efficacy in low-resource environments[6–8] . However, despite its effectiveness, concerns have been raised regarding its association with **Meconium-Stained Liquor (MSL)**, a potential marker of Foetal distress, particularly in primigravida and women with Unfavourable cervices.

Several Indian studies have reported increased incidence of MSL following vaginal misoprostol induction, especially in term pregnancies with oligohydramnios or poor Bishop scores. Despite the elevated occurrence of MSL, some researchers argue that with appropriate fetal monitoring and timely intervention, maternal and neonatal outcomes remain favourable.

Given the high volume of labor inductions across Indian healthcare institutions and the frequent use of vaginal misoprostol, further study is

essential to clarify the relationship between misoprostol, MSL, and feto-maternal outcomes. This study aims in investigation of the **occurrence of Meconium stained liquor and its impact over neonatal and maternal outcomes** in pregnant women induced with vaginal misoprostol in labour, with the goal of contributing to evidence-based practices that enhance maternal and perinatal care in the Indian context.

OBJECTIVES OF STUDY

1. T0 study the Incidence of meconium-stained liquor In misoprostol induced labour
2. To study the intervention rate Of Caesarean section in patients wiith Meconium-stained liquor in vaginal misoprostol induced patients
3. To study the incidence of foetal distress, non stress test variations, foetal outcomes such as Neonatal Intensive Care Unit admission rates

REVIEW OF LITERATURE

INDUCTION OF LABOUR

Induction Of Labour (IOL) is a commonly practiced intervention in obstetrics globally[9] . It's often indicated when continuing the pregnancy presents a higher risk for mother, foetus or for both[10]. In such cases, delivery is planned in a woman-centered approach with proper counseling and involvement of the mother in the decision-making process[11,12]. The decision to induce labour should ideally be made by the most experienced obstetrician available, after discussion with the care team. Importantly, once IOL is initiated, the pregnancy is considered high-risk and requires close monitoring throughout labour and delivery[10].

Epidemiology

The global rate of IOL varies significantly across regions and is on the rise. The IOL rate has increased from 29.4% in 2016–2017 to 31.6% in 2017–2018[13]. This rise is largely attributed to advancements in maternal-

fetal medicine, increasing maternal age, and socioeconomic influences[14–16]. A WHO global survey also highlighted unmet needs for IOL, especially in resource-limited settings, where average rates hover around 4.4%[17].

Definitions

- **Induction of Labour (IOL)**: Artificial Initiation of contractions of uterus at or after foetal viability, performed when benefits of delivery outweigh risks of pregnancy continuation[18].
- **Successful IOL**: It is defined as achieving vaginal delivery with in 24–48 hours[19].
- **Failed IOL**: According to NICE guidelines, failure occurs when a full cycle of IOL does not initiate contractions[20]. Some define it as failure to develop adequate contractions after 6–8 hours of maximum oxytocin administration[21].
- **Cervical Ripening**: Biochemical and structural changes in the cervix, leading to softening, effacement, and dilation, increasing the chances of vaginal delivery. This may occur naturally or be induced pharmacologically or mechanically[22,23].
- **Tachysystole**: More than five contractions occurring in 10 minutes over a 30-minute window period, with or without foetal heart rate changes[24,25].
- **Hypertonus**: It is defined as the uterine contractions lasting longer than two minutes without any fetal heart changes, indicating increased intrauterine pressure[24].

- **Hyperstimulation**: Hypertonicity or Tachysystole accompanied by abnormal foetal heart rate patterns. This word hasbeen replaced with more precise terminology[25].

Understanding the Onset of Labour

Labour onset remains a complex physiological event not yet fully understood. Despite advances in research, the mechanism behind spontaneous labour and the variability in timing across individuals remains unclear, complicating the planning and execution of IOL[24]. Labour typically begins with a cascade of biochemical signals that promote cervical ripening, membrane rupture and increased Uterine contractility, leading to fetal expulsion[26].

Spontaneous labour is influenced by signals originating from the fetus, placenta, membranes, and maternal system, acting through paracrine and autocrine hormones. Progesterone withdrawal mediated by an altered balance of progesterone receptor isoforms (increased PR-A relative to PR-B), promotes transcription of the named contractile proteins like connexin-43 (CX43), enhancing myometrial gap junction formation[26–28]. Oxytocin receptor expression increases with gestation, promoting uterine contractions through intracellular calcium release[29]. Prostaglandins particularly PGE2 and PGF2α, play critical roles by activating Calcium channels and initiating myometrial contractility. Inflammatory responses, including infiltration by leukocytes and cytokine release (notably IL-1β), further facilitate labour initiation by promoting uterine contractility and cervical changes[26,27,29].

Indications and Contraindications for IOL

The decision of labour induction must be based on clinical judgment, weighing the risks and benefits. A shared decision making approach involving the woman and her care team is essential. Proper counseling about the indications, risks, methods, and expectations is necessary before obtaining informed consent[30].

Common Indications for IOL [20,29]

- Post-term pregnancy (>42 weeks)
- Late term (41–42 weeks)
- Eclampsia or Pre-eclampsia (>37 weeks)
- Gestational or Chronic hypertension
- Diabetes (pre-existing or gestational)
- IntraUterine Growth Restriction (IUGR)
- Intrauterine Fetal demise (IUFD)
- Oligohydramnios or chorioamnionitis
- Premature rupture of membranes (PROM)
- Obstetric cholestasis
- Multiple pregnancies (at defined gestational limits)

Absolute Contraindications[20,31].

- Patient refusal
- Classical caesarean scar or prior full-thickness uterine surgery
- Multiple previous caesarean sections
- Malpresentations of the foetus(e.g., breech presentation, transverse lie)
- Placenta previa or vasa previa
- Genital herpes infection
- Invasive malignancy of cervix

Relative Contraindications:

- Previous stillbirth
- Suspected macrosomia
- Maternal or caregiver request
- One prior lower segment caesarean section (LSCS)

Preinduction Cervical Assessment

The Bishop score is a key clinical tool used to evaluate cervical readiness prior to the initiation of labour induction (IOL). This scoring system helps predict the likelihood of successful IOL by assessing cervical characteristics such as dilation, consistency, effacement, position, and foetal station[31–37]. Attempting IOL without proper Bishop score assessment may lead to failed induction, as the cervix typically remains firm and non-compliant throughout pregnancy until it begins to ripen in preparation for labour. Cervical ripening is a physiologic Process involving effacement and dilation of the cervix. It precedes both spontaneous and medically induced labour and results from complex biochemical re-modelling. The cervix consists of connective tissue types including collagen fibre types I, III, and IV, Elastin fibre, vasculature, fibroblasts, and smooth muscle[31,32].

Biochemistry of Cervical Ripening

Cervical re-modelling is marked by enhanced vascularization, hypertrophy of stromal and glandular tissues, and an inflammatory response characterized by cytokine activity and increased metalloproteinase (MMP-2 and MMP-9) production. These enzymes degrade cervical Collagen, while a shift in extracellular matrix composition—specifically, a decrease in proteoglycans and increase in glycosaminoglycans—reduces tissue rigidity and enhances cervical compliance[32]. Cyclooxygenase-2 (COX-2) expression increases locally,

elevating prostaglandin levels (PGE2 and PGF2α), which stimulate collagen breakdown, increase hyaluronic acid, promote leukocyte infiltration, and enhance local interleukin-8 levels. Nitric oxide synthase (iNOS) produce nitric-oxide(NO) also contribute in ripening through its role in activating MMPs[32–35].

Bishop Score

Initially proposed by Dr.Edward Bishop in 1964, the Bishop score has evolved through several modifications. The modification by Calder replaced effacement of the cervix with length of cervix and evaluates cervical dilation, length, station, consistency, and position with a maximum score of 12. A score ≥6 is considered favourable for induction[32,36,37] . Recent studies suggest that a higher Bishop score (8–10) is associated with significantly higher success rates for IOL than scores between 6 and 7[38]. Additionally, transvaginal ultrasound for cervical length assessment may offer better predictive value than the Bishop score, though it is not routinely used in practice[39].

Table 1. Calder modification of Bishop Score [36,37]

Cervical Feature	**0**	**1**	**2**	**3**
Dilation of cervix (cm)	0	1–2	3–4	>4
Length of cervix(cm)	>4	3–4	1–2	<1
Station of Presenting Part	-3	-2	-1/0	+1/+2

Consistency of cervix	hard	Average	Smooth	—
Cervical position	Posterior	Mid/Anterior	—	—

Induction of Labour Checklist

A standardized checklist for IOL enhances patient safety, ensures preparedness, and helps prevent complications. This should include:

- Patient identification and bio data
- Consent after clear explanation
- Gestation age confirmation
- IOL indiication
- Results from routiine investigations
- Coexisting medical conditions
- Bishop score
- Latest ultrasound (including fetal weight and placental location)
- Admission cardiotocography (CTG)
- Selected method for IOL
- Responsible clinician's documentation[40]

Agents for ripening of cervix and induction

Agents for ripening of cervix are broadly categorized into:

- **Pharmacological**
- **Mechanical**

- **Combination approaches**

Prostaglandins

Prostaglandins are among the most accepted and widely used agents for both cervical ripening and labour induction. However, there is a small risk for incidence of Tachysystole and foetal heart rate abnormalities[13]. In 2017, FIGO released updated misoprostol dosing guidelines across various obstetric and gynaecological applications, endorsed by the Safe Motherhood and New born Health Committee[41].

Table 2. Cervical ripening and induction agents

Pharmacological	**Mechanical**	**Combination**
Prostaglandins (PGE2 - Dinoprostone)	Transcervical catheters (Foley, Cook)	Transcervical catheter + Prostaglandins
Prostaglandin E1 (Misoprostol)	Extra-amniotic saline infusion	Transcervical catheter + Oxytocin
Oxytocin	Stripping of membranes	
	Laminaria or Hygroscopic Dilators	

Misoprostol (Prostaglandin E1)

Background and Clinical Use

Misoprostol, a synthetic analogue of prostaglandin E1, was initially developed to treat and prevent gastric ulcer. In the mid-1980s and early 1990s, it was observed that misoprostol induces contractions of uterus when administered orally in early pregnancy[42–45]. Later studies confirmed its efficacy for inducing abortions in the first and second trimesters via intra vaginal administration[44,45]. In 1987, Mariani Neto et al[46]. used oral misoprostol for induction of labour in women with intrauterine foetal demise and un-ripe cervices, reporting a successful termination in all cases with minimal side effects. This set the foundation for broader clinical use in labour induction.

FIGURE 1. CHEMICAL STRUCTURE OF MISOPROSTOL

Subsequent studies, including one by Margulies, validated its effectiveness intra-vaginally for labour induction in the third trimester[47]. Sanchez-Ramos conducted a U.S.-based randomized trial comparing intra-vaginal misoprostol (50μg) with intravenous oxytocin, demonstrating a significant short induction-to-delivery interval in those induced with misoprostol group[48]. A meta-analysis of eight trials further showed reduced caesarean rates and increased delivery within 24 hours using vaginal misoprostol[48], findings reinforced by several later controlled trials and meta-analyses[49–52].

Mechanism of Action

Chemically, Misoprostol is a methyl ester derivative of PGE1, which converts into its active form, misoprostol acid, after enzymatic

cleavage[53,54]. It interacts with EP receptors (EP_1-EP4) of the G protein–coupled receptor family, modulating uterine contractility. EP_2 and EP4 promote smooth muscle relaxation, while EP_1 and EP3 contribute to muscle contraction through intracellular calcium mobilization or cAMP inhibition[55].

Pharmacokinetics

Misoprostol can be administered via Various routes: Oral, Vaginal, Rectal, or Sublingual. Pharmacokinetics vary with administration. Oral use peaks rapidly between 12–60 minutes, with plasma levels declining by 120 minutes. Vaginal application peaks between 60–120 minutes and maintains levels longer. Sublingual administration achieves the highest plasma concentration but lacks a fully standardized dosage or safety protocol[56] .

Figure 2. Effect of prostaglandins on the Myometrium

Dosage and Administration

Misoprostol is available in 100 and 200μg tablets. Despite being "off-label" for obstetric use, it is routinely administered by splitting tablets into 25–50 μg doses. Vaginal administration of 25μg every 3–6 hours is recommended by ACOG[57] and WHO[58] . Oral regimens suggest 25–50μg every 2–4 hours[59]. Although higher doses have been used, they are associated with increased uterine tachysystole and are generally discouraged[60]. Misoprostol is also available in various forms, including oral titrated solutions[61], buccal, sublingual, rectal suppositories, and slow-release vaginal inserts[62].

Figure 3. Slow-release misoprostol insert to time for vaginal delivery

Effectiveness

Strong evidence, including two network meta-analyses[63], supports misoprostol's efficacy for cervical ripening and induction of labour. Low-dose vaginal misoprostol (25–50 μg) shows the highest likelihood of achieving vaginal delivery within 24 hours. Comparative data on different dosing protocols and routes indicate minimal differences in caesarean rates but suggest a shorter delivery interval with vaginal misoprostol[64].

Complications and Safety

High dosage of Misoprostol may cause Uterine tachy-systole and increased meconium-stained amniotic fluid[65]. Uterine rupture, has also been reported particularly in those women with prior caesarean deliveries, prompting ACOG to advise against its third-trimester use in these patients[66]. Common side effects such as fever and diarrhoea, are rare at the doses used for induction.

Table 3. Cervical Ripening Method: Misoprostol (PGE1 Analogue)

Route(s)	**Dose Options**
Vaginal, Buccal, Oral	25–50 mcg every 4–6 hours

- Associated with short labour durations and no increase in hyperstimulation of uterus or amniotic fluid staining with meconium in **nullipara** patients compared to **dinoprostone**[67].
- A regimen with single dose before initiating oxytocin is acceptable only for patients with a Bishop score more than 4 after first dose, or in multipara individuals[68].

- In **nullipara** individuals, **vaginal dose** may require repitation **up to 7 doses** until the Bishop score reaches at least 8[68].
- When available, oral solution (25 mcg every 2 hours) is better when compared to dinoprostone or oxytocin in reducing caesarean birth rates without increasing uterine hyperstimulation[59] .
- **Buccal administration** is inferior to **vaginal dosing** in terms of labour duration, caesarean rate, and foetal outcomes when membranes are intact[69].
- **Contraindication is** in individuals with **prior surgery of uterus** due to increased risk of rupture of uterus.

MECONIUM STAINED LIQUOUR

The term **"meconium"** originates from the Greek word mekoni, meaning "poppy juice" or "opium-like," reflecting an ancient belief—attributed to Aristotle—that exposure of foetus to meconium caused sedation or depression of the neonate[70]. Meconium is the **first intestinal discharge of the fetus or newborn**, composed primarily of **water (70–80%)**, **exfoliated epithelium and squamous cells**, **vernix caseosa**, **lanugo hair**, **amniotic fluid**, **pigments of bile(like bilirubin)**, **acids of bile**, **pancreatic enzymes**, and **free fatty acids**[71]. Its greenish-yellow colour is due to bile pigments, notably bilirubin, which appears in the foetal liver and gallbladder from **week 14 of gestation**[72] . While adult contents

of the intestine is microbiota-rich, **meconium is sterile during foetal life**, as confirmed by meta-genomic and animal studies[73].

Obstetrical Relevance of Meconium

Meconium-stained amniotic fluid (MSAF) is a significant obstetric concern. First reported in 1687 by Völtern as being associated with foetal death[74], MSAF has since been linked to:

- **Neonatal hypoxic-ischemic encephalopathy**
- **Neonatal sepsis and seizures**
- **Meconium aspiration syndrome (MAS)**
- **Cerebral palsy**

Risk Factors for MSAF[74]:

- Post-teerm pregnancy
- Prolong Labour
- Preeclampsia
- Oligohydramnios
- Chorioamnionitis
- Foetal growth restriction
- Breech delivery
- Maternal drug/herbal use (e.g., cocaine, castor oil)
- Intrahepatic cholestasis of pregnancy

Gestational Age and Meconium Passage

The incidence of MSAF **increases with gestational age**, reaching up to **27% at 42 weeks**[75]. The phenomenon is partially attributed to **maturation**

of foetal gastrointestinal motility, supported by motility studies in humans and animal models[76].

Hormonal Influences on Meconium Passage:

1. **Motilin** – Promotes peristalsis; found in higher concentrations in term neonates[77].
2. **Cortisol** – Rises during parturition; promotes gut motility and meconium passage in animal models[78].
3. **Corticotropin-releasing factor (CRF)** – Increases with increase in gestation and stimulates gut motility[79].

Foetal Hypoxia and Meconium Passage

Foetal **acidaemia and hypoxia** are strongly linked to MSAF. In a study of 42,709 term pregnanciies, MSAF was associated with increased rates of:

- Low **Apgar scores**
- **Umbilical artery pH ≤7.00**
- **NICU admission**
- **Respiratory distress**
- **Caesarean delivery** (due to foetal distress or dystocia)[80]

However, not all studies show consistent associations, possibly due to differences in foetal monitoring techniques[81]. Interestingly, some **experimental animal studies** challenge the assumption that hypoxia alone causes meconium passage. It may instead involve **autonomic regulation**, particularly sympathetic blockade[82].

Intraamniotic Infection/Inflammation and Meconium

MSAF is frequently observed alongside **intraamniotic infection or inflammation**, both in preterm and term pregnancies[83,84]. Studies show:

- Higher rates of **positive amniotic cultures** in green-stained fluid vs. clear
- Elevated **IL-6** and **endotoxin concentrations** in MSAF[84]
- Meconium may act as a **growth medium for bacteria**, promoting infection and reducing the antimicrobial properties of amniotic fluid[85]

Oxidative stress and inflammatory signaling can also contribute to the discoloration and content of meconium-stained fluid.

Assessment of Meconium-Stained Amniotic Fluid (MSAF)

Diagnosis of MSAF typically occurs:

- **After membrane rupture**, when green-tinged fluid is visually observed.
- **Via amniocentesis**, especially if performed in the third trimester or for genetic indications.

In some cases, **ultrasound may suggest MSAF**, particularly when particulate matter is visualized. Proposed **ultrasound signs** include:

1. Diffuse echogenicity through out the amniotic fluid.
2. Clear visual contrast between umbilical vessels and amniotic fluid.
3. Gravity-dependent layering of particulate matter[86].

However, these ultrasound patterns are **non-specific** and can also result from vernix or blood. In one study, echogenic fluid had a **sensitivity of only 14%** and a **positive predictive value of 44%** for MSAF, making ultrasound a **limited diagnostic tool**[87].

Grading and Clinical Relevance

MSAF is **classified by consistency**:

- **Grade1**: Yellow/Green stained
- **Grade2**: Yellow/Green with visible particles.
- **Grade3**: "pea-soup" consistency[88] .

In practice, it is often simplified as:

- **Thin meconium**: Diluted or light staining.
- **Thick meconium**: Opaque, dense, and particulate-laden fluid.

Thick MSAF: Clinical Significance

Thick meconium is associated with **increased neonatal and maternal complications**, including:

Neonatal Outcomes:

- Abnormal Foetal Heart Rate tracings
- Meconium Aspiration Syndrome (MAS)
- NICU admiission
- Ventilatioon support
- **Hypoxic ischemic encephalopathy (HIE)**
- Small for Gestational age
- Apgar scores- Low

Maternal Outcomes:

- Higher caesarean delivery rates
- **Puerperal endometritis**
- Clinical **chorioamnionitis**
- **Intra-partum fever**
- **Intra-amniotic infection**

Pathophysiological Considerations for Thick MSAF

Contributing obstetric and physiological factors include:

- **Oligohydramnios** in postterm pregnancy
- **Uteroplacental insufficiency**
- **Alteration in foetal mechanisms of swallowing**
- Increased passage of meconium with **impaired re-absorption** by macrophages of amnion[89].

RELATED STUDIES:

1. In a study done by Saeed to compare misoprostol and Dinoprostone, misoprostol significantly reduced onset of labour (6.67 vs. 8.41 hours) and induction-to-delivery time (11.68 vs. 15.37 hours). No uterine rupture occurred, but hyperstimulation was higher in the misoprostol group. They concluded that misoprostol is an effective and cost-efficient induction alternative[90] .
2. In a study done by Bindal to assess induction outcomes based on cervical favourability, longer induction times, more misoprostol doses, and higher MSL and caesarean rates were seen in women

with unfavourable cervices. They concluded that misoprostol is effective but increases in MSL raise risks for maternal and foetal morbidity[91].

3. In a study done by Mani to evaluate the relationship between cervical condition and labour induction outcomes, unfavourable cervices were associated with more misoprostol doses, longer labour, and more MSL. They concluded that misoprostol is an effective induction agent, despite the increased MSL risk[92] .
4. In a study done by Sarvanan to assess feto-maternal outcomes of medical labour induction at term, 602 women were studied. Oligohydramnios (28.9%) was the most common indication, and 67.4% delivered vaginally. Caesarean and instrumental delivery rates were 23.3% and 9.3% respectively. They concluded that medical induction at term is safe and does not increase caesarean or adverse neonatal outcomes[93] .
5. In a study done by Aruna Kumari to evaluate misoprostol outcomes based on cervical favourability, 150 women were assessed. The unfavourable cervix group required more doses, had longer induction intervals, and higher MSL incidence. However, fo etal outcomes were similar. They concluded that misoprostol is effective, although MSL risk is higher in unfavourable cervices[94].
6. In a study done by Sunitha to compare induced and spontaneous labour outcomes, 100 women induced with misoprostol were

compared to 200 with spontaneous labour. Induction group had higher MSL (25% vs. 10%), more forceps use, and slightly higher NICU admissions and neonatal deaths. They concluded that misoprostol is effective but may involve slightly higher intervention and complication rates[95].

7. In a study done by Sharma to determine whether isolated oligohydramnios necessitates caesarean delivery or if labour induction can result in vaginal delivery, a prospective study found that 60% delivered vaginally, including 38.3% with AFI <5 cm. Caesarean was required in 40%, mostly due to failed induction from poor Bishop scores. They concluded that labour induction is feasible in idiopathic oligohydramnios and caesareans are often due to failed induction rather than foetal distress[96].
8. In a study done by **Valvi** to compare misoprostol and dinoprostone gel, misoprostol had shorter induction times (9.54 vs. 13.54 hours), higher vaginal delivery rates (80.35% vs. 62.5%), and fewer doses needed. However, CTG abnormalities were more frequent. They concluded that misoprostol is more effective but requires close monitoring for foetal distress[97] .
9. In a study done by Sharma to evaluate the effect of low-dose vaginal misoprostol (25 µg) for labour induction and assess maternal and foetal outcomes, 200 Primigravida women were randomized into an intervention and a control group. The misoprostol group showed

significantly shorter induction-to-active labour and induction-to-delivery intervals, particularly among those with initially unfavourable Bishop scores. Most delivered within 24 hours, with the misoprostol group showing more cases entering active labour within 6–12 hours. They concluded that misoprostol is an effective labour-inducing agent, although it increases the risk of meconium-stained liquor and caesarean deliveries in women with unfavourable cervices[98].

10. In a study done by Kazi to determine the frequency of fetomaternal outcomes after labour induction, 302 women were assessed in a one-year prospective cross-sectional study. Postpartum haemorrhage occurred in 18.2%, NICU admission was required in 10%, and 13% underwent caesarean section, while 87% delivered vaginally. They concluded that labour induction between 37–42 weeks is generally safe with low rates of adverse foeto-maternal outcomes, though more evidence is needed outside this gestational range[99]
11. In a study done by Ratiu to compare two misoprostol protocols, a higher oral dose resulted in a significantly shorter induction-to-delivery interval (19.0 vs. 27.1 hours) without increasing adverse maternal or foetal outcomes. They concluded that higher-dose oral misoprostol is safe and efficient for reducing labour duration[100].
12. In a study done by Jeer to determine the optimal timing for induction of labour, a systematic review of 44 trials involving over 23,000

women showed that induction at or beyond 37 weeks significantly reduced perinatal death, stillbirth, NICU admissions, and caesarean rates. Induction at 39 or 41 weeks showed more favourable outcomes than later induction. They concluded that labour induction reduces adverse outcomes, and the timing should be individualized based on specific priorities[101] .

13. In a study done by Shafqat to evaluate misoprostol for labour induction, 337 women were studied. 85.1% had spontaneous vaginal deliveries, and only 10.68% underwent caesareans. Most required up to three doses of misoprostol. Neonatal outcomes were favourable with 84% having Apgar ≥8 and only 12.2% requiring NICU. They concluded that misoprostol is a safe and effective induction agent[102].
14. In a study done by Jesuthangam to assess outcomes in postdated pregnancies, 200 women beyond 40 weeks were studied. 67% delivered vaginally, and 34% underwent caesarean, mostly due to meconium-stained liquor. NICU admissions occurred in 9.5% of cases, with one neonatal death from RDS. They concluded that timely monitoring and induction can reduce adverse foetomaternal outcomes in postdated pregnancies[103] .
15. In a study done by Jaiswal to evaluate outcomes of labour induction at Muhimbili National Hospital, 120 inductions were studied among 4,773 total deliveries. 61.7% delivered vaginally, 38.3% via

caesarean, with failed induction as the main complication. All neonates had Apgar scores ≥7, though 8.3% required NICU admission. They concluded that labour induction is safe and effective with minimal complications[104] .

MATERIALS AND METHODS

DESIGN OF STUDY: Prospective study

STUDY DURATION: 18 months (FEBRUARY 2024 till JUNE 2025)

STUDY POPULATION: Pregnant women in labour attending department of OBG, RL Jalappa Hospital, Kolar during the study period.

STUDY AREA: RL Jalappa Hospital, Kolar.

SAMPLING METHODS: Consecutive sampling

INCLUSION CRITERIA:

- Primigravida and multigravida
- Post dated pregnancy
- Premature rupture of membranes in greater than 37week
- Pregnancy induced hypertension
- Cephalic presentation
- Bishop score of 4 or less
- Foetal Doppler studies should be normal in cases

EXCLUSION CRITERIA:

- Previous LSCS or any uterine surgery
- Non-reassuring foetal heart tracing
- Foetal malpresentation, cord presentation, placenta previa, vasa previa
- Unexplained uterine bleeding
- Estimated foetal weight >4 kg

METHOD OF DATA COLLECTION

A prospective study which is hospital based and is conducted in women who met the inclusion criteria were enrolled for the study which is done in Department of Obstetrics and Gynaecology at R L JALAPPA HOSPITAL TAMAKA KOLAR attached to SRI DEVRAJ URS MEDICAL COLLEGE under SRI DEVRAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH from FEBRUARY 2024 till JUNE 2025. A total of 61 patients provided informed consent and were allocated to receive vaginal misoprostol for labour induction. Upon

enrolment into the study, a comprehensive history covering medical, surgical, and obstetric details were collecctd. Each patient underwent an ultrasonography examination to evaluate gestational age, amniotic fluid volume, foetal maturiity, and overall foetal wellbeing. Condition of the foetus was further assessed using the Non-stress test (NST) tracing, and baseline lab investigations have been performed through blood sampling. A vaginal examination was conducted to exclude cephalo-pelvic disproportion and to evaluate cervical favourability using the Modified Bishop's Score. Following this assessment, vaginal misoprostol was administered to induce labour, with labour progression monitored through vaginal examinations every four hours, focusing on cervical effacement, dilatation, and descent of the presenting part. Misoprostol doses were repeated every four hours until cervical dilatation reached 3–4 cm. If membranes remained intact, artificial rupture of membranes was performed, and the colour of the amniotic fluid was recorded. The presence of liquor stained with meconium guided the decision-making regarding the need for caesarean section. In cases of Tachy-systole or uterine hyper stimulation, the subsequent dose of misoprostol was withheld. Following delivery, the newborn APGAR scores were recorded at one and five minutes. Neonatal outcomes, including the need for NICU admission and resuscitation, were documented for further analysis.

STATISTICAL METHODS

Data was Collected and Compiled in MS EXCEL. Statistical analysis has been performed using SPSS for windows version 26.0. The description of data will be in a mean form (±) SD for quantiitative data and as frequency and proportiion for qualitaative data. Student T-test/ANOVA was used to coompare continuous variables and $\chi 2$ test used to compaare categorical variables. P value <0.05 was statistically significant**.**

SAMPLE SIZE CALCULATION

Size of the sample was estimated using the proportiion of MSL in subjects who vaginal Misoprostol induction was 17% from a study by preeti sharma et al. using formulae

Sample Size Estimation Formula:

$N = 2\ SD^2(Z_{\alpha/2} + Z_{\beta})^2/ d^2$

Z1-α /2 = is standard normal variant (at 5% type 1 error (P<0.05) it is 1.96 and at 1% type1 error(P<0.01) it is 2.58). As there is in majority of

studies P-values are told to be significant if less than 0.05; hence 1.96 is used in formula.

P= Proportion expected in population on basis of previous studies or pilot studies

d= Precision or absolute error

P = 17% or 0.17

q = 83% or 0.83

d = 10% or 0.10

Using above values at 95% level confidence a sample size of 55 subjects will be included for the study. Considering 10% non-response, a size of 55+ 5.5≈ 61 subjects will be included in the study.

RESULTS:

Table 4: Age distribution (n = 61)

Age group	**Number of Patients**	**Percentage (%)**
<25 Years	33	54.1%
25–35 Years	28	45.9%
Total	**61**	**100%**

Figure 4: Age Distribution (n = 61)

The age distribution among the 61 participants showed a relatively young maternal population. A majority of the pregnant women (54.1%) were found under 25 years of age while the rêmaining 45.9% were found to be between 25 and 35 years.

Table 5: Parity Distribution (n = 61)

Parity	**Number of Patients**	**Percentage (%)**
Primigravida	38	62.3%
Multigravida	23	37.7%
Total	**61**	**100%**

Figure 5: Parity Distribution (n = 61)

Regarding parity, 62.3% of the women were primigravida, suggesting that first-time mothers constituted the larger share of the study group. The remaining 37.7% were multigravida.

Table 6: Booking Status (n = 61)

Booking Status	**Number of Patients**	**Percentage (%)**
Booked	25	41%

Booked outside	36	59%
Total	**61**	**100%**

Figure 6: Booking Status (n = 61)

A majority of the women in the study, accounting for 59%, were booked outside, meaning they had not received routine antenatal care. Only 41% were booked cases.

Table 7: Educational Status (n = 61)

Education Level	**Number of Patients**	**Percentage (%)**
Graduate	7	11.5%
High School & Intermediate	13	21.3%
Illiterate	6	9.8%
Primary & Middle School	35	57.4%
Total	**61**	**100%**

Figure 7: Educational Status (n = 61)

Educational background revealed that 57.4% of participants had completed only primary or middle school education, and a further 9.8% were illiterate. High school or intermediate-level education was seen in 21.3%, and only 11.5% were graduates.

Table 8: Socioeconomic Status (n = 61)

Socioeconomic Class	Number of Patients	Percentage (%)
Lower	30	49.2%
Middle	25	41%
Upper	6	9.8%
Total	**61**	**100%**

Figure 8: Socioeconomic Status (n = 61)

The Socio-Economic status distribution has showed that nearly half (49.2%) of the patients belonging to the Lower class, 41% in Middle range class, and 9.8% in the upper range class.

Table 9: Bishop Score Prior to Induction (n = 61)

Bishop Score	Number of Patients	Percentage (%)
1	21	34.40%
2	19	31.10%

3	15	24.60%
4	3	4.90%
5	3	4.90%
Total	**61**	**100%**

Figure 9: Bishop Score Prior to Induction (n = 61)

Before misoprostol induction, the Bishop score was predominantly low, with 34.4% scoring 1, and a combined 65.6% scoring between 2 and 5. This finding underscores that most women required induction with an unripe cervix, making the effectiveness of Miisoprostol even more relevant for cervical ripening and successful labour progression.

Table 10: Induction to Active Labour Interval (n = 61)

Time Interval	**Number of Patients**	**Percentage (%)**
<6 hours	23	37.7%
6–12 hours	37	60.7%
13–24 hours	1	1.6%
Total	**61**	**100%**

Figure 10: Induction to Active Labour Interval (n = 61)

Most women (60.7%) reached active labor within 6 to 12 hours of misoprostol induction, while 37.7% did so in under 6 hours. Only 1 woman (1.6%) took 13–24 hours. These intervals demonstrate the

efficiency of vaginal misoprostol in initiating labor, especially in a population with low pre-induction Bishop scores.

Table 11: Induction to Delivery Interval (n = 61)

Time Interval	Number of Patients	Percentage (%)
<6 hours	33	54.10%
6–12 hours	28	45.90%
Total	**61**	**100%**

Figure 11: Induction to Delivery Interval (n = 61)

More than half (54.1%) of the women delivered within 6 hours of induction, and the remaining 45.9% within 6–12 hours. These results suggest that misoprostol not only induces labor effectively but also leads to timely delivery in the majority of cases, minimizing prolonged labor and its associated risks.

Table 12: Need for Oxytocin Augmentation (n = 61)

Oxytocin Use	Number of Patients	Estimated Percentage (%)
Required	26	42.60%

Not Required	35	57.40%
Total	**61**	**100%**

Figure 12: Need for Oxytocin Augmentation (n = 61)

In 42.6% of cases, oxytocin augmentation was required to assist labour progress, whereas 57.4% didn't require any further intervention. The substantial number of women requiring augmentation may reflect sub-optimal uterine response or contractions following misoprostol use in certain cases.

Table 13: Mode of Delivery (n = 61)

Delivery mode	**Number delivered**	**Percentage (%)**
Vaginal deliivery	49	80.3%
Emergency LSCS	12	19.7%
Total	**61**	**100%**

Figure 13: Mode of Delivery (n = 61)

Among the women induced with vaginal misoprostol, 80.3% achieved successful vaginal delivery, while 19.7% required emergency lower segment caesarean section (LSCS). This high rate of vaginal delivery suggests that misoprostol is an effective induction agent.

Table 14: Indications for Caesarean Section (n = 12)

Indication	Number of Patients	Percentage (%)
Fetal Distress	10	83.30%
Non-progression Labor	2	16.70%
Total	**12**	**100%**

Figure 14: Indications for Caesarean Section (n = 12)

Among the 12 caesarean deliveries, the overwhelming majority (83.3%) were performed for foetal distress, and only 16.7% were due to non-progression of labour.

Table 15: Meconium-Stained Liquor (n = 61)

Liquor Status	Number of Patients	Percentage (%)
Meconium-Stained Liquor	12	19.70%
Clear Liquor	49	80.30%

Total	**61**	**100%**

Figure 15: Meconium-Stained Liquor (n = 61)

Out of 61 women, 12 (19.7%) had meconium-stained liquor, while 49 (80.3%) had clear liquor. This incidence of MSL is consistent with previous findings in induced labour scenarios and is clinically significant as it may herald foetal compromise or intrauterine stress, necessitating close surveillance and readiness for operative intervention.

Table 16: Score by APGAR at 1 Minute (n = 12 LSCS cases)

Score	**Number of Patients**	**Percentage (%)**
<7	2	16.7%
≥7	10	83.3%
Total	**12**	**100%**

Figure 16: Score by APGAR at 1 Minute (n = 12 LSCS cases)

In the caesarean section group, 83.3% of neonates had an APGAR of ≥7 at 1 minute, suggesting a generally good immediate neonatal status. Only 2 neonates (16.7%) had APGAR scores below 7.

Table 17: NICU Admission Among LSCS Cases (n = 12)

NICU Admission	Number of Patients	Percentage (%)
Yes	2	16.7%
No	10	83.3%
Total	**12**	**100%**

Figure 17: NICU Admission Among LSCS Cases (n = 12)

Only 2 of the 12 caesarean-born neonates (16.7%) required NICU admission, further suggesting that despite foetal distress indications leading to LSCS, the immediate neonatal outcomes were largely favourable.

Table 18: Score by APGAR at 5 Minutes (n = 61)

Score	Number of Patients	Percentage (%)
<7	5	8.1%
≥7	56	91.9%
Total	**61**	**100%**

Figure 18: Score by APGAR at 5 Minutes (n = 61)

Overall neonatal condition at 5 minutes was reassuring, with 91.9% of babies scoring ≥7, and only 8.1% having scores <7. This suggests

favorable perinatal outcomes in the majority, even among those who might have had meconium exposure, further supporting the safety of monitored misoprostol induction.

Table 19: NICU Admission (Overall, n = 61)

NICU Admission	Number of Patients	Percentage (%)
Yes	20	32.7%
No	41	67.3%
Total	**61**	**100%**

Figure 19: NICU Admission (Overall, n = 61)

32.7% of neonates were admitted to the NICU, indicating that other factors such as respiratory distress, meconium aspiration, or close observation due to perinatal risk factors necessitated neonatal care. This relatively high NICU admission rate highlights the importance of postnatal surveillance in induced labor scenarios.

Table 20: Neonatal Outcome / Perinatal Morbidity (n = 61)

Outcome	Number of Patients	Percentage (%)
No Complication	35	57.40%
Respiratory Distress Syndrome (RDS)	10	16.40%
Birth Asphyxia	5	8.20%
Meconium Aspiration Syndrome (MAS)	2	3.30%

Figure 20: Neonatal Outcome / Perinatal Morbidity (n = 61)

Of the 61 neonates, 57.4% had no complications. However, respiratory distress syndrome (RDS) was the most common morbidity (16.4%), followed by birth asphyxia (8.2%) and meconium aspiration syndrome (3.3%). These findings reflect the known risks associated with meconium-stained liquor and induced labor, and the need for prompt neonatal support in high-risk births.

Table 21: Maternal Complications (n = 61)

Complication Type	Number of Patients	Percentage (%)
Cervical Tear	5	8.20%
Perineal Tear	3	4.90%

Postpartum Hemorrhage (PPH)	12	19.70%
No Complication	41	67.20%
Total	**61**	**100%**

Figure 21: Maternal Complications (n = 61)

Among maternal outcomes, 67.2% had no complications, while 19.7% experienced postpartum hemorrhage (PPH), which was the most common maternal adverse event. Cervical tears (8.2%) and perineal tears (4.9%) were less frequent but still notable. These complications, though mostly manageable, reinforce the need for vigilant intrapartum care in induced labor.

Table 22. Meconium-Stained amniotic fluid association with NICU Admission

Meconium-Stained	**NICU Admission**		**Total**	**Chi-square = 5.98, p = 0.764**
	Yes	**No**		
Yes	6 (50%)	6 (50%)	12 (100%)	
No	12 (25%)	37 (75%)	49 (100%)	
Total	**18 (29.5%)**	**43 (70.5%)**	**61 (100%)**	

Figure 22. Meconium-Stained amniotic fluid association with NICU Admission

The association analysis revealed that among the 12 women with meconium-stained liquor, 6 neonates (9.7%) required NICU admission, while among the 49 women with clear liquor, 14 (23%) neonates were admitted to NICU. Although numerically there appears to be an association, the chi-square test result ($\chi^2 = 5.98$, $p = 0.764$) indicates that this association was not statistically significant. This suggests that while meconium-stained liquor can be a concern for fetal compromise, in this study, its presence did not significantly correlate with increased NICU admissions, possibly due to timely intervention and monitoring.

DISCUSSION:

Prolonged labour is a major cause of Maternal Mortality and morbidity. Common causes of prolonged labour include inadequate uterine contractions, malpresentation or position of fetus, inadequate pelvic capacity or Fetopelvic disproportion. In addition, arrest of labour progress is one of the causes of primary caesarean section, especially in Primiparous mothers. Therefore identifying solutions to reduce labour duration are very important. In this study, the effect of vaginal misoprostol on the labour induction was investigated during different aspects of labour.

Demographic and Baseline Characteristics

The demographic and clinical characteristics in our study show notable parallels and distinctions when compared with existing literature on misoprostol-induced labour. In our cohort, the majority of women were under 25 years (54.1%) and primigravida (62.3%), these findings are comparable to a study by Sharma where 56% were aged 18–24 and 94% were within the 18–29 year range[98] . In contrast, studies by Fakhr and Malathi reported much younger cohorts with mean ages of 22.1 and 22.2 years, respectively[105,106]

The primigravida rate in our study is noted to be 62.3% which is comparable to many studies which are reported to 76.1%, 70.9%, 59% and 64%[105–108], supporting the observation that misoprostol is frequently employed in nulliparous or first-time pregnancies.

Regarding antenatal care access, 59% of women in our study were booked outside.

Educational status in our study was low, with 57.4% having only primary or middle school education and only 11.5% being graduates. This explains the relative knowledge deficit and lack of antenatal care in the majority of the participants.

In terms of gestational age at induction, our participants were mostly term or post-dated, which aligns with most studies with mean age being mean 40.11 ± 1.37 weeks, 39.64 ± 1.29 weeks), 38.97 ± 0.83 weeks[105,107,109] .

Our study revealed that 65.6% of women had a pre-induction Bishop score ≤2, indicating an unfavorable cervix. This explains the need for misoprostol for priming and induction of labour in our participants. While a study by Shetty reported a higher mean Bishop score of 5.4, indicating slightly more favourable conditions[110] .

Labour Induction Profile

In our study, the majority of women (65.6%) presented with a pre-induction Bishop score ≤2, indicating an unfavorable cervix. This finding aligns closely with several other studies which reported that 97% of their participants had a Bishop score ≤3, with 52% scoring just 1 and 32% scoring 2[98] and a median Bishop score of 2[111]. These consistently low scores reinforce the value of misoprostol as a cervical ripening agent across diverse settings. Likewise, many other studies also reported similar baseline Bishop scores averaging between 2 and 4.5, all suggesting unfavourable cervices[90,105,107].

Regarding labour progression, 60.7% of our participants entered active labour within 6–12 hours, and 54.1% delivered within 6 hours, indicating effective induction. This is comparable to study by Sharma where 87% reached active labour within 12 hours and 99% delivered within 24 hours[98] and as reported by another study by Saeed**,** a mean induction-to-labour onset time of 6.67 ± 3.63 hours and a delivery interval of 11.69 ± 4.56 hours[90], which also supports our observed effectiveness. This finding of our study is supported by many studies which reported the induction delivery times as that 94% of women delivered within 24 hours[108] , that 70% delivered within 12 hours[107] .

In terms of dosage response, Fakhr in their study reported that 40% responded to two doses, and 30% to one[105], while Gajraj observed that most women required 2–4 doses[108]. In a study with dosage of misoprostol by Srilaxmi found 41.67% required two doses and 33.33% required three[112] . While in another study it was reported that 69% required more than two doses[113]. Conversely, it was reported a lower mean dose (0.93 ± 1.04), possibly due to population or protocol differences[107].

Oxytocin augmentation was needed in 42.6% of our cases. This finding is comparable to many studies which were reported as 47.4% and 30.2%[107,111] . While a study by Vilas-Boas noted oxytocin use in both successful (31.4%) and failed (35.7%) inductions, suggesting its supportive role[114] . Few studies did not explicitly quantify oxytocin use but reported effective labour durations, implying that adjunctive use was limited or variable[98,110] .

In terms of induction outcomes, our results further correlate with the meta-analysis by Rahimi which showed that vaginal misoprostol significantly shortens labour duration compared to oral misoprostol, especially when equal doses are used[115]. The vaginal route reduced labour duration by 19–34 minutes depending on dose groups, reinforcing the clinical efficiency observed in our and other studies. Finally, our

induction success demonstrated by high rates of timely labour progression and limited need for oxytocin compares favourably with success rates many other single-center studies, affirming misoprostol's effectiveness even in populations with largely unfavourable cervical profiles.

Outcome based on delivery

In our study, 80.3% of woman achieved vagiinal delivery following misoprostol induction, while 19.7% requiired emergency caesarean section. These results affirm the efficacy of misoprostol in facilitating successful vaginal birth in a majoority of cases. Among caesarean deliveries, foetal distress was the most common indication (83.3%), followed by non-progression of labour (16.7%), underscoring the importance of continuous foetal monitoring during induction. Comparable caesarean and vaginal delivery rates are reported in several studies.

A study by Shafqat found 85.1% of women delivered vaginally, 10.68% via caesarean, and a small proportion required forceps (2.37%) or vacuum (1.7%)[109] . One study by Malathi reported a clearly that 96% vaginal delivery rate among primigravida, with only one caesarean due to failed induction[110] , this shows higher success likely due to a specific patient subset or induction protocol. In contrast, a study by Shetty observed lower vaginal delivery rates (56%) and a caesarean rate of 40%, with foetal distress (50%) and failed induction (20%) being the main indications[110], similar in nature to those in our study.

Few studies mentioned higher operative deliveries with 39.4% and a caesarean rate of 25%, reflecting either stricter intervention thresholds or more compromised foetal monitoring indicators[90].

Assisted vaginal delivery rates in our study were negligible, which aligns with who noted 12.7% required interventional delivery, mostly vacuum-assisted, 21% instrumental, but with fewer caesarean section rates again supporting the effectiveness of vaginal misoprostol[107,113] .

Parity also appears to influence induction success. A comparative study by Vilas-Boas found that nulliparous women had significantly lower odds of successful induction (OR 0.24), while multiparas had improved outcomes (OR 3.40)[114], reflecting a trend echoed in our cohort where primigravida status was common but did not significantly lower vaginal delivery success. The results of our study are further supported by the meta-analysis by Rahimi which demonstrated significantly lower caesarean rates with vaginal misoprostol compared to oral administration (RR 1.50; 95% CI: 1.06–2.12)[115], reinforcing the superior efficacy of the vaginal route in inducing labour successfully.

Meconium-Stained Liquor

In our study, liquor with meconium(MSL) was noted in 19.7% of cases, aligning with established risks associated with induced labour. This rate is consistent with fiindings from several other studies, supporting the need for vigilant foetal monitoring during induction protocols. Many studies reported a similar incidence of meconium 17%, 19%which closely parallels our findings and reinforces that meconium passage during labour induction is a common observation[98,109] almost identical to our 19.7%. A study by Garjraj reported MSL in 12% of cases, with thick meconium

linked to foetal heart rate abnormalities in five patients. Notably, meconium-stained liquor accounted for 14.3% of caesarean indications in their study, echoing our findiings where MSL and foetal disstress contributed significantly to surgical deliveries[108] . In contrast, one study did not observe any cases of meconium-stained liquor in their misoprostol group, although CTG abnormalities occurred in 14% of patients[90]. This divergence may reflect differences in induction timing, population characteristics, or the definition thresholds for recorrding MSL. Overall, the inciidence of MSL in our study is consistent with reported literature, reinforcing the asociation between labour induction and foetal stress, and highlighting the clinical importance of continuous intrapartum monitoring to mitigate adverse outcomes.

COMPARISON OF OUR STUDY MSL WITH OTHER STUDIES:

Study	**MSL Incidence**	**Details**
Current Study	19.7%	Reflects fetal compromise risk during induced labour
Sharma et al.[98]	17%	Closely aligns with our findings; supports consistent MSL risk
Shafqat et al.[109]	19.9%	15.1% Grade 1, 2.4% Grade 2, 2.4% Grade 3
Gajraj et al.[108]	12%	Thick meconium with CTG abnormalities in 5 cases; MSL led to 14.3% of LSCS

Saeed et al.[90]	0%	No MSL observed, but CTG abnormalities in 14%

Neonatal Outcomes

The neonattal outcomes in our study suggest generally favourable results following misoprostol induction. A 5-minute APGAR score ≥7 was recorded in 91.9% of neonates, indicating effective foetal transition post-delivery. Even among neonates delivered by emergency caesarean section, 83.3% had a 1-minute APGAR score ≥7, reflecting tiimely intervention and appropriate intrapartum management. Although NICU admission was required in 32.7% of cases, only 16.7% of LSCS-born neonates required intensive care, reinforcing the overall safety of the induction process. Common neonatal morbidities observed included respiratory distress syndrome (16.4%), birth asphyxia (8.2%), and meconium aspiration syndrome (3.3%).

These findings are consistent with a study by Sharma who reported a NICU admission rate of 39% and perinatal complications such as RDS (10%), birth asphyxia (7%), and MAS (4%)[98]. In contrast, Shafqat observed higher APGAR scores—88.1% of neonates achieved a perfect 10 at 5 minutes and a lower NICU admission rate (12.1%), reflecting superior immediate outcomes[109].
Similar results were found in a study by Ozbasli who recorded mean APGAR scoring of 9.69 at 5 minute interval and a 13.6% NICU admission rate, with all neonates discharged in good condition[107]. Even though a study by **Gajraj** showed that 5% had APGAR <7 at 5 minutes, the NICU admissions were primarily short-term with minimal intervention[108].

Where as one study however, reported slightly poorer outcomes, with 10% having APGAR <6, MAS in 14%, and a NICU admission rate of 14%, including one neonatal death[105]. This was also supported by another study which reported 13% NICU admissions mostly for transient conditions like fetal distress and delayed cry[113] . One study surprisingly had 10.8% of neonates required NICU care beyond 48 hours, but there were no 5-minute APGAR scores <6 or major complications[74] which is not consistent with the present study. Finally, the meta-analysis by Rahimi indicated slightly higher rates of low APGAR scores and meconium-stained fluid with vaginal misoprostol, but comparable NICU admissions between vaginal and oral groups, suggesting that misoprostol remains a generally safe induction method when properly monitored[115].

Comparative Table: Neonatal Outcomes Following Misoprostol Induction

Study	**5-min APGAR ≥7**	**NICU Admission**	**Key Morbidities / Notes**
Current Study	91.9%	32.7% (16.7% in LSCS)	RDS (16.4%), Birth Asphyxia (8.2%), MAS (3.3%)
Sharma et al.[98]	65%	39%	RDS (10%), Asphyxia (7%), MAS (4%), Others (2%)
Shafqat et al.[109]	88.1% (10/10 score)	12.1%	Excellent scores, low morbidity

Maggi et al[111].	98.9% (≤7 in 1.1%)	3.7%	pH < 7 in 2.7%, generally favorable acid–base status
Gajraj et al.[108]	95%	Minimal (exact % not given)	Tachypnea (6%), RDS (2%), Sepsis (1%), all low severity
Saeed et al.[90]	92% (>6), 8% ≤6	Not specified	Comparable to our study
Shetty et al[110].	Mean 8.24 at 5 min	Very low (<1 day stay)	Safe outcome with misoprostol
Ozbasli et al.[107]	Mean 9.69 ± 0.82	13.6%	All discharged well
Fakhr et al[105].	90% >6 (5.62 ± 1.26 avg)	14%	MAS (14%), FHR issues (14%), 1 neonatal death
Srilaxmi et al.[112]	96.7% ≥7 at 5 min	1 case only	No severe asphyxia
Malathi et al[106].	96% ≥7 at 5 min	1 case (2%)	No mortality or severe complications
Pandya et al.[113]	Not specified	13%	Foetal distress (7%), MSL (3%), Delayed cry (3%)

Pimentel et al.[68]	100% ≥6 at 5 min	10.8% (>48h stays)	No major complications or mortality
Rahimi et al[115].	Lower APGAR in vaginal grp	Similar to oral (RR 0.96)	Higher MSAF in vaginal misoprostol (RR 1.32); comparable NICU admissions

Maternal Outcomes

In our study, 67.2% of women experienced no complications following misoprrostol induction, affiirming its overall safety. However, postpartum haemorrhage (PPH) was the most common adverse event, observed in 19.7% of cases, followed by cervical tears (8.2%) and perineal tears (4.9%). While these rates are within acceptable clinical limits, they underscore the importance of active third-stage management and close intrapartum monitoring. Our findings are consistent with those of Sharma study who reported maternal complications in 38% of women, with PPH (20%) being the most frequent, followed by cervical (10%) and perineal tears (8%)[98] and by Maggi who observed a PPH rate of 23% and perineal tears in 4% of women, reflecting comparable complication profiles[111].

While a study by Saeed reported lower PPH incidence (9%) but noted uterine hyperstimulation in 10% of cases[90]. But Shetty recorded PPH in 16% of participants, with 8% requiring blood transfusions and a mild febrile morbidity rate (4%)[110], which align with our observed rates and reinforce that misoprostol, though effective, demands careful dose titration and vigilant monitoring.

Many studies reported very low complication rates, including PPH between 1–2% and minimal hyperstimulation or GI effects, likely reflecting smaller sample sizes or differing protocols[106,112,113]. Pimentel reported slightly higher maternal risks, including PPH (16%), chorioamnionitis (16.7%), and blood transfusion (5%), with one ICU admission but no maternal mortality[68]. The meta-analysis by Rahimi noted a modestly increased risk of hyperstimulation of uterus in the group in whom vaginal misoprostol was given when compared to those with oral, but this was not statistically significant for severe outcomes[115]. Collectively, these studies confirm that while maternal adverse events with misoprostol are generally infrequent and manageable, PPH remains the most recurrent concern and requires proactive obstetric management.

Comparative Table: Maternal Complications with Vaginal Misoprostol

Study	**PPH (%)**	**Other Complications**	**Key Notes**
Current Study	19.7%	Cervical tears (8.2%), Perineal tears (4.9%)	67.2% had no complications
Sharma et al.[98]	20%	Cervical (10%), Perineal tears (8%)	Complications in 38%
Maggi et al[111].	23%	3rd/4th-degree perineal tears (4%)	No uterine rupture
Saeed et al[90].	9%	Hyperstimulation (10%)	No uterine rupture
Shetty et al.[110]	16%	Blood transfusion (8%), Fever (4%)	Comparable to current study

Fakhr et al.[105]	Not specified	Hyperstimulation (4%), Hyperpyrexia (2%), Nausea/Vomiting (4%)	Mild, no severe events
Srilaxmi et al[112].	1.67%	Tachysystole (1.67%)	Minimal complications
Malathi et al.[106]	2%	Diarrhoea (2%)	No uterine issues reported
Pandya et al[113].	1%	Hyperstimulation (10%)	Overall safe profile
Pimentel et al.[68]	16%	Chorioamnionitis (16.7%), ICU (0.8%), Transfusion (5%)	No uterine rupture or mortality
Rahimi et al.[115]	Not specified	Higher tachysystole in vaginal group (RR: 0.82); slight ↑ preeclampsia	Maternal risks within acceptable margins

These findings reinforce the clinical utility of vaginal misoprostol as an agent effective for induction of labour, particularly in young, primigravida women with unfavourable cervical conditions. Despite a significant proportion of un booked cases and low socioeconomic status,

the majority of patients achieved timelly vaginal delivery with favourable neonatal outcomes. However, the notable incidense of postpartum haemorrhage and NICU admissions underscores the importance of vigilant intrapartum and postpartum monitoring. While the results are promising, they also highlight the need for individualised care protocols and further large-scale, controlled studies to better delineate safety margins and optimize outcomes across diveerse patient populations.

LIMITATIONS

1. **Small Sample Size**: The study was conducted with only 61 participants, which limits the generalisability of the findings to a broader population.
2. **Single-Center Study**: The data appears to be from a single healthcare facility, which may not reflect outcomes across different institutions or settings.
3. **Lack of Longterm Neonatal FollowUp**: The study focused on immediate neonatal outcomes (APGAR scores and NICU admission), without tracking long-term developmental or health indicators.
4. **Potential Confounding Variables**: Factors like maternal comorbidities, body mass index, or exact dosing intervals of misoprostol were not addressed in detail, which may influence labor outcomes.

5. **Limited Comparative Analysis**: The study didn't include a control group using other induction agents (e.g., dinoprostone or mechanical methods) making it difficult to assess the relative effectiveness of misoprostol.

RECOMMENDATIONS

1. **Larger Multi-Center Trials**: To confirm the findings and improve external validity, larger studies across multiple centers should be conducted.
2. **Standardized Induction Protocols**: Future studies should adopt uniform dosing and administration protocols to evaluate efficacy and safety with greater precision.
3. **Include Comparative Arms**: Studies comparing misoprostol with other commonly used induction agents can help establish relative efficacy and safety profiles.
4. **Enhanced Neonatal Monitoring**: Incorporate long-term follow-up of neonates to evaluate developmental outcomes and any delayed morbidity.

5. **Focused Monitoring in High-Risk Groups**: Given the elevated NICU admission and PPH rates, enhanced surveillance should be maintained for primigravida, unbooked, and lower socioeconomic groups.

CONCLUSION

The study concludes that **Misoprostol vaginally is effective and thus misoprostol as an agent for timely labour induction**, especially in patients with an unripe cervix as evidenced by low Bishop scores. A significant majority of Women achieved vaginal delivery within 12hours of induction, with a manageable caesarean section rate primarily due to foetal distress. While neonatal and maternal complications were noted—such as NICU admissions and PPH—the overall outcomes were favourable, with most neonates showing healthy APGAR scores and no serious long-term issues within the observed period. **Close intrapartum monitoring and timely interventions were key to minimizing adverse events**, supporting the continued use of misoprostol with appropriate clinical oversight.

SUMMARY

This clinical study has been conducted for evaluation of the efficacy, safety, and neonatal and maternal outcomes of induction of labour using misoprostol vaginally in a sample of 61women pregnant with singleton pregnancy. The focus was on induction-to-labour intervals, delivery outcomes, need for oxytocin augmentation, and the associated maternal and neonatal complications. The findings highlight misoprostol as a rapid and effective induction agent, even in patients with low Bishop scores, though certain risks require attentive monitoring and supportive care.

Key Findings

- **Demographics & Background**
    - 54.1% of participants were under 25 years, and 62.3% were primigravida.

    - 59% were unbooked (no prior antenatal care), and 57.4% had only primary or middle school education.
    - 49.2% belonged to the lower socioeconomic class**.**
- **Induction Efficacy**
    - 60.7% entered active labor within 6–12 hours, and 37.7% within 6 hours of misoprostol administration.
    - 54.1% delivered within 6 hours of induction; the rest within 6–12 hours.
    - 42.6% required oxytocin augmentation, indicating some variability in uterine response.
- **Delivery Outcomes**
    - 80.3% had vaginal deliveries.
    - 19.7% underwent emergency cesarean section (LSCS), mainly due to fetal distress (83.3%).
- **Neonatal Outcomes**
    - 91.9% of neonates had a ≥7 APGAR score at 5 minutes.
    - 32.7% were admitted to NICU, primarily due to RDS (16.4%), birth asphyxia (8.2%), and meconium aspiration (3.3%).
    - The association between meconium-stained liquor and NICU admission was not statistically significant ($p = 0.764$).
- **Maternal Complications**
    - 67.2% experienced no complications.

- The most common complication was postpartum hemorrhage (19.7%), followed by cervical tears (8.2%) and perineal tears (4.9%).

REFERENCES

1. Mathai M W editors. Managing complications in pregnancy and childbirth: a guide for midwives and doctors. Geneva: WHO, RHR Department of Reproductive Health and Research . 2003.
2. Seijmonsbergen-Schermers A, De Jonge A, Van Den Akker T, Beeckman K, Bogaerts A, Barros M, et al. Variations in childbirth interventions in high-income countries: Protocol for a multinational cross-sectional study. BMJ Open. 2018;8(1).
3. Mozurkewich E, Chilimigras J, Koepke E, Keeton K, King VJ. Indications for induction of labour: A best-evidence review. Vol. 116, BJOG: An International Journal of Obstetrics and Gynaecology. 2009.
4. Moore JE, Low LK, Titler MG, Dalton VK, Sampselle CM. Moving Toward Patient-Centered Care: Women's Decisions, Perceptions, and Experiences of the Induction of Labor Process. Birth. 2014 Jun 6;41(2):138–46.
5. Goldberg H. Informed Decision Making in Maternity Care. Journal of Perinatal Education. 2009 Jan 1;18(1):32–40.
6. National Collaborating Centres for Maternal and Child Nutrition. 2005.
7. Carson DS, Guastella AJ, Taylor ER, McGregor IS. A brief history of oxytocin and its role in modulating psychostimulant effects. Journal of Psychopharmacology. 2013 Mar 23;27(3):231–47.
8. Karim SMM, Trussell RR, Patel RC, Hillier K. Response of Pregnant Human Uterus to Prostaglandin-F2 -induction of Labour. BMJ. 1968 Dec 7;4(5631):621–3.
9. WHO, editor. WHO recommendations for induction of labour. 2011.
10. Marconi AM. Recent advances in the induction of labor. Vol. 8, F1000Research. 2019.
11. WHO team, editor. WHO recommendations: intrapartum care for a positive childbirth experience. 2018.
12. Akuamoah-Boateng J, Spencer R. Woman-centered care: Women's experiences and perceptions of induction of labor for uncomplicated post-term pregnancy: A systematic review of qualitative evidence. Vol. 67, Midwifery. 2018.
13. Thomas J, Fairclough A, Kavanagh J, Kelly AJ. Vaginal prostaglandin (PGE2 and PGF2a) for induction of labour at term. Vol. 2014, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2014.
14. Carter S, Channon A, Berrington A. Socioeconomic risk factors for labour induction in the United Kingdom. BMC Pregnancy Childbirth. 2020 Mar 6;20(1).

15. Lewis JA. Assessing the Effects of Age, Gestation, Socioeconomic Status, and Ethnicity on Labor Inductions. MCN: The American Journal of Maternal/Child Nursing. 2009 Jan;34(1):70.
16. Rydahl E, Declercq E, Juhl M, Maimburg RD. Routine induction in late-Term pregnancies: Follow-up of a Danish induction of labour paradigm. BMJ Open. 2019 Dec 16;9(12).
17. Vogel JP, Souza JP, Gülmezoglu AM. Patterns and Outcomes of Induction of Labour in Africa and Asia: A Secondary Analysis of the WHO Global Survey on Maternal and Neonatal Health. PLoS One. 2013;8(6).
18. Lueth GD, Kebede A, Medhanyie AA. Prevalence, outcomes and associated factors of labor induction among women delivered at public hospitals of MEKELLE town-(a hospital based cross sectional study). BMC Pregnancy Childbirth. 2020;20(1).
19. Society of Obstetricians and Gynaecologists of Canada. Induction of labour. SOGC Clinical Practice Guideline No. 296. 35th ed. Vol. 9. 2013. 840–857 p.
20. National Institute for Health and Care Excellence. Inducing labour. NICE guideline [NG207]. 2021 . 2021.
21. Melkie A, Addisu D, Mekie M, Dagnew E. Failed induction of labor and its associated factors in Ethiopia: A systematic review and meta-analysis. Heliyon. 2021 Mar;7(3):e06415.
22. Baños N, Migliorelli F, Posadas E, Ferreri J, Palacio M. Definition of Failed Induction of Labor and Its Predictive Factors: Two Unsolved Issues of an Everyday Clinical Situation. Fetal Diagn Ther. 2015;38(3):161–9.
23. Pierce S, Bakker R, Myers D, Edwards R. Clinical Insights for Cervical Ripening and Labor Induction Using Prostaglandins. American Journal of Perinatology Reports. 2018 Oct 29;08(04):e307–14.
24. Macones GA, Hankins GDV, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development Workshop Report on Electronic Fetal Monitoring: Update on Definitions, Interpretation, and Research Guidelines. Journal of Obstetric, Gynecologic & Neonatal Nursing. 2008 Sep;37(5):510–5.
25. N M Mealing 1, C L Roberts, J B Ford, J M Simpson JMM, J M Morris. Trends in induction of labour, 1998-2007: a population-based study. Aust N Z J Obstet Gynaecol . 2009 Dec;49(6).
26. Nguyen-Ngo C, Lappas M. Mechanisms of normal labour. Curr Opin Physiol. 2020 Feb;13:27–32.
27. Nadeem L, Shynlova O, Mesiano S, Lye S. Progesterone Via its Type-A Receptor Promotes Myometrial Gap Junction Coupling. Sci Rep. 2017 Oct 17;7(1):13357.
28. Nadeem L, Shynlova O, Matysiak-Zablocki E, Mesiano S, Dong X, Lye S. Molecular evidence of functional progesterone withdrawal in human myometrium. Nat Commun. 2016 May 25;7(1):11565.

29. Shmigol A V., Eisner DA, Wray S. Simultaneous measurements of changes in sarcoplasmic reticulum and cytosolic [Ca^{2+}] in rat uterine smooth muscle cells. J Physiol. 2001 Mar;531(3):707–13.
30. New Zealand College of Midwives. Helping women make decisions about induction of labour . 2020.
31. The Federation of Obstetricians and Gynaecologist of India, Indian College of Obstetricians and Gynaecologists (FOGSI-ICOG). Induction of labour: Good Clinical Practice Recommendation. 2018.
32. BISHOP EH. PELVIC SCORING FOR ELECTIVE INDUCTION. Obstetrics and gynecology. 1964 Aug;24:266–8.
33. LEPPERT PC. Anatomy and Physiology of Cervical Ripening. Clin Obstet Gynecol. 1995 Jun;38(2):267–79.
34. Schmitz T, Fuchs F, Closset E, Rozenberg P, Winer N, Perrotin F, et al. Outpatient Cervical Ripening by Nitric Oxide Donors for Prolonged Pregnancy. Obstetrics & Gynecology. 2014 Dec;124(6):1089–97.
35. Promsonthi P, Preechapornprasert A, Chanrachakul B. Nitric oxide donors for cervical ripening in first-trimester surgical abortion. Cochrane Database of Systematic Reviews. 2015 Feb 25;2015(2).
36. Calder AA, Embrey MP, Hillier K. EXTRA- AMNIOTIC PROSTAGLANDIN E_2 FOR THE INDUCTION OF LABOUR AT TERM. BJOG. 1974 Jan 23;81(1):39–46.
37. Galzie SK, Rao SB. Cervical effacement, as an independent parameter versus modified bishop score, for predicting the favorability of vaginal delivery in a primigravida at 40 weeks gestation and beyond. Int J Reprod Contracept Obstet Gynecol. 2020 Apr 28;9(5):1831.
38. Ikeotuonye AC, Anikwe CC, Obuna JA, Okorochukwu BC, Ejikeme BN, Ifemelumma CC, et al. Relationship between Bishop Score and Success of Induction of Labour in Federal Teaching Hospital, Abakaliki, Ebonyi State. Open J Obstet Gynecol. 2018;08(11):980–92.
39. Kehila M, Bougmiza I, Ben Hmid R, Abdelfatteh W, Mahjoub S, Channoufi MB. Bishop Score vs. ultrasound cervical length in the prediction of cervical ripening success and vaginal delivery in nulliparous women. Minerva Ginecol. 2015 Dec;67(6):499–505.
40. American College of Obstetricians and Gynaecologists (ACOG). ACOG Patient Safety Checklist No. 2: Inpatient Induction of Labor. Committee Opinion No.560. In: American College of Obstetricians and Gynaecologists (ACOG) ACOG Patient Safety Checklist No 2: Inpatient Induction of Labor Committee Opinion No560. 2013.
41. Morris JL, Winikoff B, Dabash R, Weeks A, Faundes A, Gemzell- Danielsson K, et al. FIGO's updated recommendations for misoprostol used alone in gynecology and obstetrics. International Journal of Gynecology & Obstetrics. 2017 Sep 23;138(3):363–6.

42. Rabe T, Basse H, Thuro H, Kiesel L, Runnebaum B. Wirkung des PGE $_1$ -Methylanalogons Misoprostol auf den schwangeren Uterus im ersten Trimester. Geburtshilfe Frauenheilkd. 1987 May 17;47(05):324–31.
43. Norman JE, Thong KJ, Baird DT. Uterine contractility and induction of abortion in early pregnancy by misoprostol and mifepristone. The Lancet. 1991 Nov;338(8777):1233–6.
44. Blanchard K, Winikoff B, Ellertson C. Misoprostol used alone for the termination of early pregnancy. Contraception. 1999 Apr;59(4):209–17.
45. Peyron R, Aubeny E, Targosz V, Silvestre L, Renault M, Elkik F, et al. Early Termination of Pregnancy with Mifepristone (RU 486) and the Orally Active Prostaglandin Misoprostol. New England Journal of Medicine. 1993 May 27;328(21):1509–13.
46. Mariani Neto C, Leäo EJ, Barreto EM. Uso do misoprostol para induçäo do parto com feto morto [Use of misoprostol for labor induction with stillbirth]. 1987;105:325–8.
47. Miguel Margulies ·, German Campos Pérez ·, LilianaS Voto. Misoprostol to induce labour. The Lancet. 1992;339:64.
48. Sanchez-Ramos L, Kaunitz AM, Del Valle GO, Delke I, Schroeder PA, Briones DK. Labor induction with the prostaglandin E1 methyl analogue misoprostol versus oxytocin: a randomized trial. Obstetrics and gynecology. 1993 Mar;81(3):332–6.
49. Kerr RS, Kumar N, Williams MJ, Cuthbert A, Aflaifel N, Haas DM, et al. Low-dose oral misoprostol for induction of labour. Cochrane Database of Systematic Reviews. 2021 Jun 22;2021(6).
50. Baradwan S, Alshahrani MS, Khadawardi K, Badghish E, Alkhamis WH, Mohamed DF, et al. Titrated oral misoprostol versus static regimen of oral misoprostol for induction of labour: a systematic review and meta-analysis. J Obstet Gynaecol (Lahore). 2022 Aug 18;42(6):1653–61.
51. Lin MG, Nuthalapaty FS, Carver AR, Case AS, Ramsey PS. Misoprostol for Labor Induction in Women With Term Premature Rupture of Membranes. Obstetrics & Gynecology. 2005 Sep;106(3):593–601.
52. Muzonzini G, Hofmeyr GJ. Buccal or sublingual misoprostol for cervical ripening and induction of labour. Cochrane Database of Systematic Reviews. 2004 Oct 18;2010(1).
53. Collins PW. Misoprostol: Discovery, development, and clinical applications. Med Res Rev. 1990 Apr 18;10(2):149–72.
54. Robert A, Nezamis JE, Phillips JP. Inhibition of gastric secretion by prostaglandins. Am J Dig Dis. 1967 Oct;12(10):1073–6.
55. Coleman RA, Smith WL, Narumiya S. International Union of Pharmacology classification of prostanoid receptors: properties, distribution, and structure of the receptors and their subtypes. Pharmacol Rev. 1994 Jun;46(2):205–29.

56. Tang OS, Gemzell- Danielsson K, Ho PC. Misoprostol: Pharmacokinetic profiles, effects on the uterus and side- effects. International Journal of Gynecology & Obstetrics. 2007 Dec 26;99(S2).
57. . ACOG Practice Bulletin No. 107: induction of labor. Obstet Gynecol. . Vol. 114. 2009. 386–397 p.
58. Tang J, Kapp N, Dragoman M, de Souza JP. WHO recommendations for misoprostol use for obstetric and gynecologic indications. International Journal of Gynecology & Obstetrics. 2013 May;121(2):186–9.
59. Alfirevic Z, Aflaifel N, Weeks A. Oral misoprostol for induction of labour. Cochrane Database of Systematic Reviews. 2014 Jun 13;2018(6).
60. Wing DA, Jones MM, Rahall A, Goodwin TM, Paul RH. A comparison of misoprostol and prostaglandin E2 gel for preinduction cervical ripening and labor induction. Am J Obstet Gynecol. 1995 Jun;172(6):1804–10.
61. Souza ASR, Feitosa FEL, Costa AAR, Pereira APR, Carvalho AS, Paixão RM, et al. RETRACTED: Titrated oral misoprostol solution versus vaginal misoprostol for labor induction. International Journal of Gynecology & Obstetrics. 2013 Dec 3;123(3):207–12.
62. Stephenson ML, Hawkins JS, Powers BL, Wing DA. Misoprostol Vaginal Insert for Induction of Labor: A Delivery System with Accurate Dosing and Rapid Discontinuation. Women's Health. 2014 Jan 1;10(1):29–36.
63. Kemper JI, Li W, Goni S, Flanagan M, Weeks A, Alfirevic Z, et al. Foley catheter *vs* oral misoprostol for induction of labor: individual participant data meta- analysis. Ultrasound in Obstetrics & Gynecology. 2021 Feb;57(2):215–23.
64. Collins PW, Pappo R, Dajani EZ. Chemistry and synthetic development of misoprostol. Dig Dis Sci. 1985 Nov;30(S11):114S-117S.
65. Wing DA, Rahall A, Jones MM, Goodwin TM, Paul RH. Misoprostol: An effective agent for cervical ripening and labor induction. Am J Obstet Gynecol. 1995 Jun;172(6):1811–6.
66. ACOG Practice Bulletin No. 205: Vaginal Birth After Cesarean Delivery. Obstetrics & Gynecology. 2019 Feb;133(2):e110–27.
67. Benalcazar-Parra C, Monfort-Orti R, Ye-Lin Y, Prats-Boluda G, Alberola-Rubio J, Perales A, et al. Comparison of labour induction with misoprostol and dinoprostone and characterization of uterine response based on electrohysterogram. The Journal of Maternal-Fetal & Neonatal Medicine. 2019 May 19;32(10):1586–94.
68. Pimentel VM, Arabkhazaeli M, Moon JY, Wang A, Kapedani A, Bernstein PS, et al. Induction of labor using one dose vs multiple doses of misoprostol: a randomized controlled trial. Am J Obstet Gynecol. 2018 Jun;218(6):614.e1-614.e8.
69. Haas DM, Daggy J, Flannery KM, Dorr ML, Bonsack C, Bhamidipalli SS, et al. A comparison of vaginal versus buccal misoprostol for cervical ripening in women for

labor induction at term (the IMPROVE trial): a triple-masked randomized controlled trial. Am J Obstet Gynecol. 2019 Sep;221(3):259.e1-259.e16.
70. Ross MG. Meconium Aspiration Syndrome — More Than Intrapartum Meconium. New England Journal of Medicine. 2005 Sep;353(9):946–8.
71. Macias RI, Marin JJ, Serrano MA. Excretion of biliary compounds during intrauterine life. World J Gastroenterol. 2009;15(7):817.
72. Blumenthal SG, Stucker T, Rasmussen RD, Ikeda RM, Ruebner BH, Bergstrom DE, et al. Changes in bilirubins in human prenatal development. Biochemical Journal. 1980 Mar 15;186(3):693–700.
73. Perez-Muñoz ME, Arrieta MC, Ramer-Tait AE, Walter J. A critical assessment of the “sterile womb” and “in utero colonization” hypotheses: implications for research on the pioneer infant microbiome. Microbiome. 2017 Dec 28;5(1):48.
74. Ostrea EM, Naqvi M. The Influence of Gestational Age on the Ability of the Fetus to Pass Meconium in Utero: Clinical implications. Acta Obstet Gynecol Scand. 1982 Jan 11;61(3):275–7.
75. Balchin I, Whittaker JC, Lamont RF, Steer PJ. Maternal and Fetal Characteristics Associated With Meconium-Stained Amniotic Fluid. Obstetrics & Gynecology. 2011 Apr;117(4):828–35.
76. Caughey AB, Musci TJ. Complications of Term Pregnancies Beyond 37 Weeks of Gestation. Obstetrics & Gynecology. 2004 Jan;103(1):57–62.
77. Zen Itoh a. Motilin and clinical application. Peptides (NY). 1997;18(4):593–608.
78. GOLDKRAND, JOHN W. MD;, RAYMOND L. MD;, SCHULTE, MESSER, ROBERT H. MD, et al. Maternal and Fetal Plasma Cortisol Levels at Parturition. . Obstetrics and Gynecologu. 1976 Jan;47(1):41–5.
79. Florio P, Romero R, Chaiworapongsa T, Kusanovic JP, Torricelli M, Lowry PJ, et al. Amniotic Fluid and Umbilical Cord Plasma Corticotropin-Releasing Factor (CRF), CRF-Binding Protein, Adrenocorticotropin, and Cortisol Concentrations in Intraamniotic Infection and Inflammation at Term. J Clin Endocrinol Metab. 2008 Sep 1;93(9):3604–9.
80. Nathan L, Leveno KJ, Carmody TJ, Kelly MA, Sherman ML. Meconium: a 1990s perspective on an old obstetric hazard. Obstetrics and gynecology. 1994 Mar;83(3):329–32.
81. Rodríguez Fernández V, Ramón y Cajal CNL, Ortiz EM, Naveira EC. Intrapartum and perinatal results associated with different degrees of staining of meconium stained amniotic fluid. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2018 May;224:192–7.
82. Arbay O Ciftci a b, F.Cahit Tanyel a b, Meltem Bingöl-Koloğlu a b, Selma Sahin a b, Nebil Büyükpamukçu a b. Fetal distress does not affect in utero defecation but does impair the clearance of amniotic fluid. J Pediatr Surg. 199AD Feb;34(2):246–50.

83. Mazor M, Hershkovitz R, Bashiri A, Maymon E, Ruth Schreiber, Dukler D, et al. Meconium stained amniotic fluid in preterm delivery is an independent risk factor for perinatal complications. European Journal of Obstetrics & Gynecology and Reproductive Biology. 1998 Oct;81(1):9–13.
84. Romero R, Yoon BH, Chaemsaithong P, Cortez J, Park CW, Gonzalez R, et al. Bacteria and endotoxin in meconium-stained amniotic fluid at term: could intra-amniotic infection cause meconium passage? The Journal of Maternal-Fetal & Neonatal Medicine. 2014 May 16;27(8):775–88.
85. Clark P, Duff P. Inhibition of neutrophil oxidative burst and phagocytosis by meconium. Am J Obstet Gynecol. 1995 Oct;173(4):1301–5.
86. Benacerraf BR, Gatter MA, Ginsburgh F. Ultrasound diagnosis of meconium-stained amniotic fluid. Am J Obstet Gynecol. 1984 Jul;149(5):570–2.
87. Karamustafaoglu Balci B, Goynumer G. Incidence of echogenic amniotic fluid at term pregnancy and its association with meconium. Arch Gynecol Obstet. 2018 Apr 23;297(4):915–8.
88. Savvas Argyridis ·, Sabaratnam Arulkumaran. Meconium stained amniotic fluid . Obstetrics, Gynecology and Reproductive medicine. 2016 Aug;26(8):227–30.
89. Naeye RL. Functionally important disorders of the placenta, umbilical cord, and fetal membranes. Hum Pathol. 1987 Jul;18(7):680–91.
90. Saeed GA, Fakhar S, Nisar N, Alam AY. Misoprostol for term labor induction: A randomized controlled trial. Taiwan J Obstet Gynecol. 2011 Mar;50(1):15–9.
91. Bindal DJ. Induction of Labour with Vaginal Misoprostol and Incidence of Cesarean Delivery for MSL. Journal of Medical Science And clinical Research [Internet]. 2018 Mar 31;6(3). Available from: http://jmscr.igmpublication.org/v6-i3/216%20jmscr.pdf
92. Y IM, V R, T.S CS. INDUCTION OF LABOUR WITH VAGINAL MISOPROSTOL AND INCIDENCE OF MECONIUM STAINED LIQUOR AND FETAL OUTCOME. Journal of Evidence Based Medicine and Healthcare. 2016 Jan 25;3(7):221–5.
93. Sarvanan N, Jha N, Dhodapkar SB, Kandasamy R. Fetomaternal Outcome in Medically Indicated Induction of Labour at Term Gestation. JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH. 2017;
94. ArunaKumari B, Professor A. Incidence of meconium stained liquor and foetal outcome in induction of labour with misoprostol vaginally. MedPulse-International Journal of Gynaecology November [Internet]. 2018;8(2):32–9. Available from: http://medpulse.in/Gynacology/index.php
95. Sunitha C. Clinical Study of Meconium Stained Liquor in Labour Induced with Misoprostol and Its Significance on Fetal Outcome. IOSR-JDMS. 2018 Aug;17(9):42–7.
96. Sharma N, Gehlot H. A study of fetomaternal outcome in induction of labour in third trimester oligohydramnios. Int J Reprod Contracept Obstet Gynecol. 2019 Sep;8(11):4196.

97. Sheryl S Valvi. A comparative study of induction of labour with intravaginal misoprostol and intracervical dinoprostone gel and its fetomaternal outcome in a tertiary care hospital. Indian Journal of Obstetrics and Gynecology Research. 2021 Apr;8(4):463–9.
98. Sharma P, Katare N, Rahman Z, Yadav G, Runwal S, Dhakarey S. Maternal and fetal outcome in vaginal misoprostol induced patient. International Journal of Health and Clinical Research [Internet]. 2021;4(3):256–60. Available from: www.ijhcr.com
99. Kazi S, Naz U, Naz U, Hira A, Habib A, Perveen F. Fetomaternal Outcome Among the Pregnant Women Subject to the Induction of Labor. Cureus. 2021 May 24;
100. RATIU O, RATIU D, MALLMANN P, DI LIBERTO A, ERTAN AK, MORGENSTERN B, et al. Oral Misoprostol for the Induction of Labor: Comparison of Different Dosage Schemes With Respect to Maternal and Fetal Outcome in Patients Beyond 34 Weeks of Pregnancy. In Vivo (Brooklyn). 2022 Apr 27;36(3):1285–9.
101. Jeer B, Haberfeld E, Khalil A, Thangaratinam S, Allotey J. Perinatal and maternal outcomes according to timing of induction of labour: A systematic review and meta-analysis. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2023 Sep;288:175–82.
102. Shafqat T, Zeb L, Fatima SS, Bhittani R. maternal and fetal outcomes in women undergoing induction of labour with low dose vaginal misoprostol. Pak J Med Sci. 2023;39(5):1307–11.
103. Dr. Jesuthangam1*, Dr. Jameela Ponmalar2, Dr. Sughija G3. Study of fetomaternal outcome in postdated pregnancy in a tertiary care centre. International Journal of Gynaecology Sciences. 2020 Jan;2(1):10–3.
104. Jaiswal S, Kyejo W, Kilewo C. Maternal and neonatal outcome in pregnant women undergone induction of labor at Muhimbili National Hospital, Dar Es Salaam, Tanzania. BMC Pregnancy Childbirth. 2024 May 24;24(1):387.
105. Diaa Maged Fakhr a, Ismael Talaat El-Garhy b, Hany AbdElhakim AbdelRahman c, Nesreen Ahmed Mostafa Rashed, Fahd Abdel-aal Elomda b. Comparative study between or e study between oral and v al and vaginal administr aginal administration of ation of misoprostol in the induction of labour in cases with premature rupture of membranes (PROM) . Al-Azhar International Medical Journal. 2023;4(8):166–71.
106. Malathi J, Sunita V. Comparision of misoprostol and dinoprostone gel for induction of prelabor rupture of membranes at term. Journal for Clinical Gynecology and Obstetrics . 2015;4(4):302–6.
107. Ozbasli E, Canturk M, Aygun EG, Ozaltin S, Gungor M. Labor Induction with Intravaginal Misoprostol versus Spontaneous Labor: Maternal and Neonatal Outcomes. Biomed Res Int. 2022 Jan 9;2022(1).

108. Gajraj S, Kapur A. Maternal and neonatal outcome after the use of low dose sublingual 25 µg misoprostol for labour induction in women with term pregnancy. Int J Reprod Contracept Obstet Gynecol. 2021 Sep 27;10(10):3817.
109. Shafqat T, Zeb L, Fatima SS, Bhittani R. Maternal and fetal outcomes in women undergoing induction of labor with low dose vaginal misoprostol. Pak J Med Sci. 2023 Jul 13;39(5).
110. Shetty EM, Neravi A. A comparative study of vaginal misoprostol, dinoprostone gel, foley catheter, extra amniotic saline infusion along with vaginal misoprostol for induction of labor at term. Int J Reprod Contracept Obstet Gynecol. 2020 Aug;9(9):3683.
111. Maggi C, Mazzoni G, Gerosa V, Fratelli N, Prefumo F, Sartori E, et al. Labor induction with misoprostol vaginal insert compared with dinoprostone vaginal insert. Acta Obstet Gynecol Scand. 2019 Oct 18;98(10):1268–73.
112. Srilaxmi. A comparative evaluation of 25 mcg versus 50 mcg vaginal misoprostol for induction of labour at term in a tertiary care Hospital. Indian Journal of Obstetrics and Gynecology Research. 2020;7(4):548–52.
113. Pandya MR, Adroja KS, Patel VC, Pandya JG, Modha LK. Efficacy and safety of labor induction by oral versus vaginal misoprostol–study of 200 cases in private setup. Indian Journal of Obstetrics and Gynecology Research. 2025 Jan 1;12(1):146–50.
114. Vilas-Boas LS, Sanches MPR, Araujo Júnior E, Peixoto AB, Mattar R, Santos LRR dos, et al. Evaluation of the efficacy of labor induction with vaginal misoprostol in a low-risk pregnant women population. Rev Assoc Med Bras. 2024;70(7).
115. Rahimi M, Haghighi L, Baradaran HR, Azami M, Larijani SS, Kazemzadeh P, et al. Comparison of the effect of oral and vaginal misoprostol on labor induction: updating a systematic review and meta-analysis of interventional studies. Eur J Med Res. 2023 Jan 27;28(1):51.