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Meconium- Stained Amniotic Fluid and Fetomaternal Outcome: Original Article

Fetomaternal outcome in term labour with meconium-stained amniotic fluid: A prospective observational study from a tertiary care centre in Gujarat, India

Running Title: Meconium Grade and Fetomaternal Outcome

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Abstract: ***Background: Meconium-stained amniotic fluid (MSAF) signals possible fetal compromise, but local data linking its grade to intrapartum and neonatal outcomes are scarce. We examined these links in a tertiary hospital in Gujarat, India. Methods: This prospective observational study ran from January 2024 to January 2026. We enrolled 140 women with singleton pregnancies at 37 weeks or more and MSAF in labour. Liquor was graded 1 (thin), 2 (moderate) or 3 (thick). We recorded cardiotocography (CTG), mode of delivery, and maternal and neonatal outcomes. Associations were tested with the chi-square test. Results: Grades 1, 2 and 3 accounted for 13.6%, 42.1% and 44.3% of cases. Non-reassuring CTG rose across grades (10.5%, 28.8%, 50.0%; p = 0.003), as did gestation beyond 40 weeks (5.3%, 10.2%, 29.0%; p = 0.008) and caesarean delivery (47.4%, 74.6%, 93.5%; p < 0.001). Neonatal intervention was needed in 21.1%, 44.1% and 69.4% (p < 0.001); CPAP or ventilation in 0%, 13.6% and 35.5%. Apgar below 7 at 5 minutes occurred in 0, 2 and 17 neonates. One antepartum intrauterine fetal death (IUFD) and one intrapartum stillbirth occurred; both were associated with grade 3 liquor. Parity and membrane rupture were not associated with grade. Of the women, 82.9% had no complication; wound infection (7.1%) and postpartum haemorrhage (5.0%) were commonest. Conclusion: Thicker meconium was associated with fetal compromise, caesarean delivery and greater neonatal morbidity. Grade should prompt continuous fetal monitoring and neonatal readiness, and caesarean decisions for thick meconium alone merit audit.***

Keywords: meconium; amniotic fluid; cardiotocography; cesarean section; meconium aspiration syndrome; infant, newborn; India

1. Introduction

Meconium-stained amniotic fluid (MSAF) complicates roughly 5% to 20% of labours and is a recognised marker of possible fetal compromise.[1] Its frequency rises with advancing gestation, particularly beyond 40 weeks. [2, 3] A minority of exposed neonates develop meconium aspiration syndrome (MAS), which can cause respiratory failure, persistent pulmonary hypertension of the newborn and death. [4, 5]

Meconium may be passed because the fetal gut has matured, or because hypoxia and vagal stimulation drive colonic activity. Thick meconium and abnormal fetal heart rate patterns point towards compromise, and severe MAS is thought to reflect chronic intrauterine hypoxia rather than aspiration alone. [5,6] The amount of meconium therefore matters. Indian hospital studies report more fetal distress, operative delivery and NICU admission with thick than with thin meconium. [7, 8]

In tertiary centres, obstetricians must decide quickly how to deliver and how to prepare the neonatal team. We studied 140 term women with MSAF in a tertiary hospital in Gujarat to relate the grade of meconium to maternal risk factors, intrapartum fetal status, mode of delivery, and maternal and neonatal outcomes.

2. Materials and Methods

Study Design and Setting: This prospective observational study was conducted in the Department of Obstetrics and Gynaecology, GCS Medical College, Hospital and Research Centre, Ahmedabad, a tertiary care centre in Gujarat, India, from 1 January 2024 to 1 January 2026.

Participants: Term pregnant women (gestation of 37 weeks or more) with a singleton pregnancy and meconium-stained amniotic fluid (MSAF) during labour, who delivered vaginally or by caesarean section, were enrolled. Women with spontaneous or artificial rupture of membranes were eligible. We excluded pregnancies below 37 weeks, malpresentation, twin pregnancy and fetuses with congenital anomalies. The final sample was 140 women.

Ethics and Consent: The Institutional Ethics Committee of GCS Medical College, Hospital and Research Centre approved the study (ref. GCSMC/ EC/ Dissertation/ APPROVE/ 2024/48). Written informed consent was taken in English, Gujarati or Hindi. All information was used only for this study.

Management and Data Collection: Women diagnosed with MSAF in the latent or active phase of labour, and their relatives, were counselled about possible neonatal complications, NICU admission, morbidity and mortality.

The mode of delivery (trial of labour or caesarean section) was decided jointly with the family. Fetal heart rate was monitored continuously by cardiotocography (CTG), interpreted using NICE categories (normal, suspicious, pathological).[9] Data were recorded on a structured, pretested proforma.

Definitions

MSAF was graded by appearance at membrane rupture:

- Grade 1 (thin): small amount of meconium diluted in plentiful liquor, giving a slight greenish or yellowish tinge.
- Grade 2 (moderate): clearly stained, khaki-green or brownish liquor with a fair amount of fluid.
- Grade 3 (thick): heavy staining with reduced liquor and 'pea-soup' consistency.

Neonatal condition was assessed by the Apgar score (0 to 10) at birth and at five minutes.

Statistical Analysis: Data were entered in a spreadsheet. Categorical variables are given as frequencies and percentages and continuous variables as mean ± SD. Associations were tested with the chi-square test, and $p < 0.05$ was taken as significant. Analysis was done with SPSS (IBM Corp.; version 32).

3. Results

Thicker meconium went with more non-reassuring CTG, more caesareans and more neonatal intervention. Of 140 women, 19 (13.6%) had grade 1, 59 (42.1%) grade 2 and 62 (44.3%) grade 3 liquor. Table 1 gives the baseline profile.

Table 1: Baseline characteristics (n = 140)

Characteristic	n (%)
Age, years, mean ± SD	26.3 ± 3.7
Age	
< 20	1 (0.7)
20–25	61 (43.6)
26–30	58 (41.4)
> 30 years	20 (14.3)
Primigravida	101 (72.1)
Previous vaginal birth	26 (18.6)
Previous caesarean	13 (9.3)
Gestation	
37–40 weeks	115 (82.1)
> 40 weeks	25 (17.9)
Spontaneous Rupture	118 (84.3)
ARM	16 (11.4)
Intact membranes	6 (4.3)
Labour induced	61 (43.6)
Phase at diagnosis	
Latent	48 (34.3)
Active	60 (42.9)
Second stage	32 (22.9)
No identified maternal risk factor	64 (45.7)
Pregnancy-induced hypertension	15 (10.7)
Post-dated pregnancy	14 (10.0)
Oligohydramnios	12 (8.6)
Prolonged rupture of membranes	11 (7.9)
Intrauterine growth restriction	7 (5.0)

Labour phase and grade were linked in primigravidae ($\chi^2 = 15.6$, $p = 0.004$). Grade 3 liquor dominated the latent (20 of 35) and active (21 of 41) phases, while grade 1 was commoner in the second stage (8 of 25). No such link was seen in multigravidae with a previous vaginal birth ($p = 0.83$). Parity did not predict grade (primigravidae vs multigravidae, $\chi^2 = 4.70$, $p = 0.095$), nor did the mode of membrane rupture ($p = 0.19$).

Intrapartum findings: Table 2 shows that gestation beyond 40 weeks, non-reassuring CTG and caesarean delivery all rose with grade. Among the 50 women with a non-reassuring trace, bradycardia was 25 and tachycardia 25; bradycardia was concentrated in grade 3 (20 of 25; $\chi^2 = 6.25$, $p = 0.043$). Inadequate liquor volume rose from 5.3% to 17.7% but not significantly.

Table 2: Intrapartum findings by meconium grade

Finding	Grade 1 (n = 19)	Grade 2 (n = 59)	Grade 3 (n = 62)	p
Gestation > 40 weeks	1 (5.3)	6 (10.2)	18 (29.0)	0.008
Non-reassuring CTG	2 (10.5)	17 (28.8)	31 (50.0)	0.003
Fetal bradycardia	0	5 (8.5)	20 (32.3)	0.043
Inadequate liquor	1 (5.3)	6 (10.2)	11 (17.7)	0.26
Caesarean delivery	9 (47.4)	44 (74.6)	58 (93.5)	< 0.001

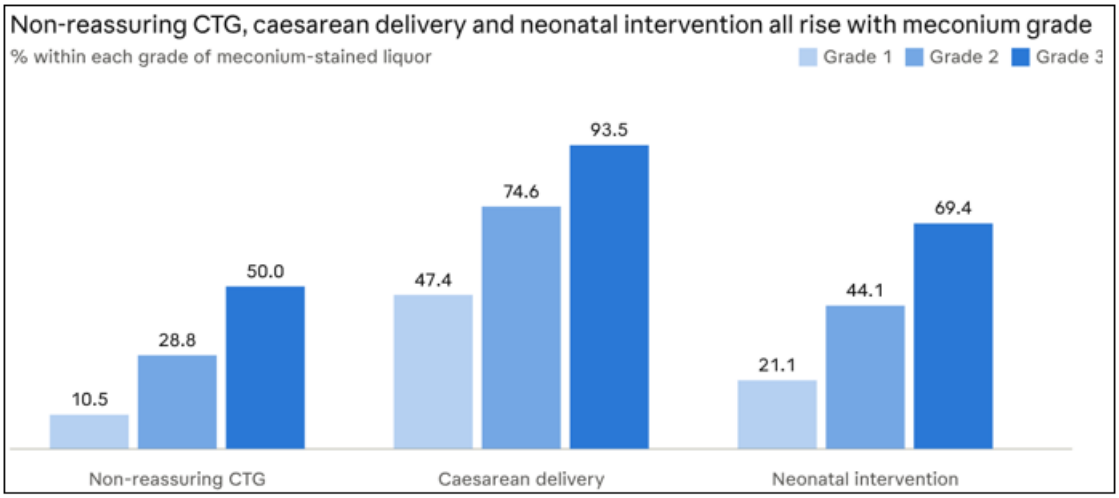


Figure 1: Master chart, 140 term deliveries with MSAF, GCS Hospital, Ahmedabad

Mode of delivery: Overall 111 women (79.3%) had a lower segment caesarean section (LSCS), 28 (20.0%) a vaginal birth and 1 (0.7%) an assisted vaginal birth. Thick meconium alone was the indication in 45 caesareans (40.5%), thick meconium with fetal distress in 24 (21.6%), moderate meconium in 22 (19.8%), thin meconium with fetal distress in 2 (1.8%), previous caesarean in labour in 11 (9.9%) and other causes in 7 (6.3%). In primigravidae the caesarean rate was 36.4% (4 of 11), 87.5% (35 of 40) and 100% (50 of 50) for grades 1 to 3 ($p < 0.001$). In multigravidae grade did not predict mode of delivery ($p = 0.53$); all 13 women with a previous caesarean were delivered by caesarean. Parity strongly predicted mode of delivery ($\chi^2 = 42.2$, $p < 0.001$), with caesarean in 88.1% of primigravidae, 34.6% of women with a previous vaginal birth and 100% of those with a previous caesarean. In primigravidae, caesarean was done in all 35 latent-phase cases and in 90.2% of active-phase cases ($p = 0.004$).

Neonatal outcomes. Of 140 neonates, 66 (47.1%) had no complication. The commonest were transient tachypnoea (33; 23.6%) and respiratory distress (19; 13.6%), followed by sepsis (6; 4.3%), birth asphyxia (6; 4.3%) and persistent pulmonary hypertension (5; 3.6%). There was one neonatal seizure (0.7%). One antepartum intrauterine fetal death (IUFD) and one intrapartum stillbirth were recorded; both occurred with grade 3 liquor. Male neonates numbered 90 (64.3%). Mean birth weight was 3.08 kg and 138 neonates (98.6%) weighed 2.5 kg or more.

Table 3 shows that morbidity climbed steeply with grade. Neonatal intervention was needed in 73 neonates (52.1%) and rose from 21.1% to 44.1% to 69.4% ($\chi^2 = 27.8$, $p < 0.001$). CPAP or mechanical ventilation was needed by none in grade 1, 13.6% in grade 2 and 35.5% in grade 3. An Apgar score below 7 at 5 minutes occurred in 19 neonates, all but two in grade 3 ($p < 0.001$).

Table 3: Neonatal outcomes by meconium grade

Outcome	Grade 1 (n = 19)	Grade 2 (n = 59)	Grade 3 (n = 62)
No complication	15 (78.9)	33 (55.9)	17 (27.4)
Transient tachypnoea	1 (5.3)	13 (22.0)	19 (30.6)
Respiratory distress	0	6 (10.2)	19 (30.6)
Birth asphyxia	0	2 (3.4)	4 (6.5)
Intrapartum stillbirth	0	0	1 (1.6)
Antepartum IUFD	0	0	1 (1.6)
Any neonatal intervention	4 (21.1)	26 (44.1)	43 (69.4)
CPAP or mechanical ventilation	0	8 (13.6)	22 (35.5)
Apgar < 7 at 5 minutes	0	2 (3.4)	17 (27.4)

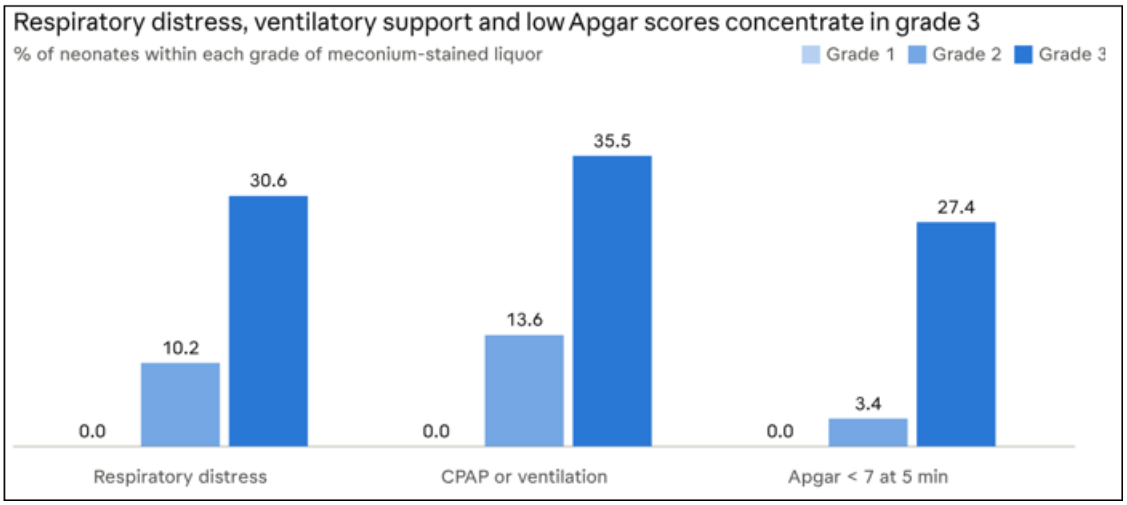


Figure 2: Master chart, 140 term deliveries with MSAF, GCS Hospital, Ahmedabad

Maternal outcomes: Recovery was uncomplicated in 116 women (82.9%). Wound infection occurred in 10 (7.1%), postpartum haemorrhage in 7 (5.0%), perineal tear in 4 (2.9%), and vulval haematoma, atrial fibrillation and postpartum cardiomyopathy in 1 woman each (0.7%).

4. Discussion

In this series, the grade of meconium tracked fetal compromise, delivery route and neonatal need for care. Grade 2 and 3 liquor made up 86.4% of cases, so most women reached us with clinically significant staining.

Fetal status: Non-reassuring CTG rose from 10.5% in grade 1 to 50.0% in grade 3, and fetal bradycardia occurred almost only with grade 3 liquor. This agrees with the view that thick meconium accompanies fetal hypoxia, and with the report that fetal distress is more frequent with thick meconium.[8] Half of the grade 3 traces were still reassuring, however, so the colour of the liquor cannot replace continuous monitoring.

Gestation and risk factors: Grade 3 liquor was commoner beyond 40 weeks (72.0% of pregnancies beyond 40 weeks versus 38.3% at 37 to 40 weeks), in line with the known rise of MSAF with gestation.[2,3] Nearly half of the women had no identifiable risk factor, which fits meconium passage as a maturational event in many term pregnancies. Among those with a risk factor, hypertension, post-dated pregnancy, oligohydramnios and prolonged membrane rupture predominated, conditions that reduce uteroplacental reserve. Parity and membrane rupture did not predict grade.

Mode of delivery: The caesarean rate was 79.3% overall and reached 93.5% with grade 3 liquor, higher than the 65.5% reported from another Indian centre.[7] Primigravidae drove this pattern: every primigravida with grade 3 liquor

had a caesarean. In 45 caesareans (40.5%) thick meconium alone was the recorded indication. The American College of Obstetricians and Gynecologists states that MSAF alone is not an indication for caesarean,[1] so some of these operations may reflect a low threshold for intervention in a referral hospital rather than fetal need. An audit of decision-to-delivery reasoning, with CTG category and cervical status recorded, would separate the two. Amnioinfusion may lower operative delivery where perinatal surveillance is limited, but it is not established where standard monitoring is available.[12]

Neonatal outcome. Almost half of the neonates (47.1%) had no complication, but the gradient was steep: 78.9%, 55.9% and 27.4% were complication-free in grades 1 to 3. Transient tachypnoea and respiratory distress dominated grade 3, and the need for CPAP or ventilation rose from none to 35.5%. Higher NICU admission with thicker meconium matches an earlier Indian report.[7] Birth weight was normal in 98.6%, so prematurity does not explain the morbidity. A 5-minute Apgar score below 7 was largely confined to grade 3 (17 of 19 neonates). The antepartum IUFD and intrapartum stillbirth both occurred with grade 3 liquor.

Management implications: Neonatal teams should expect respiratory support when liquor is thick, and delivery planning should consider CTG findings and gestation, not colour alone. Current guidance does not support routine intubation and suction of vigorous meconium-stained neonates,[10] or routine suctioning before delivery of the shoulders.[11] Antibiotics are reserved for neonates with signs of infection.

Strengths and Limits: Strengths are prospective recruitment, a defined grading scheme and outcome data for all 140 women. The study is single-centre and has no comparison group with clear liquor. Grading is visual and may vary between observers. Cord blood pH or lactate was not routinely measured, and follow-up ended at discharge. Subgroup tests had small cells, and no adjustment for confounders was made, so associations should not be read as causal.

5. Conclusion

In term labour with meconium-stained amniotic fluid, thicker meconium was linked to non-reassuring CTG, advanced gestation, caesarean delivery and greater neonatal need for respiratory support, while most mothers recovered without complication. Grade should prompt continuous fetal monitoring, planning for neonatal resuscitation and a review of why caesarean is chosen when thick meconium is the only indication.

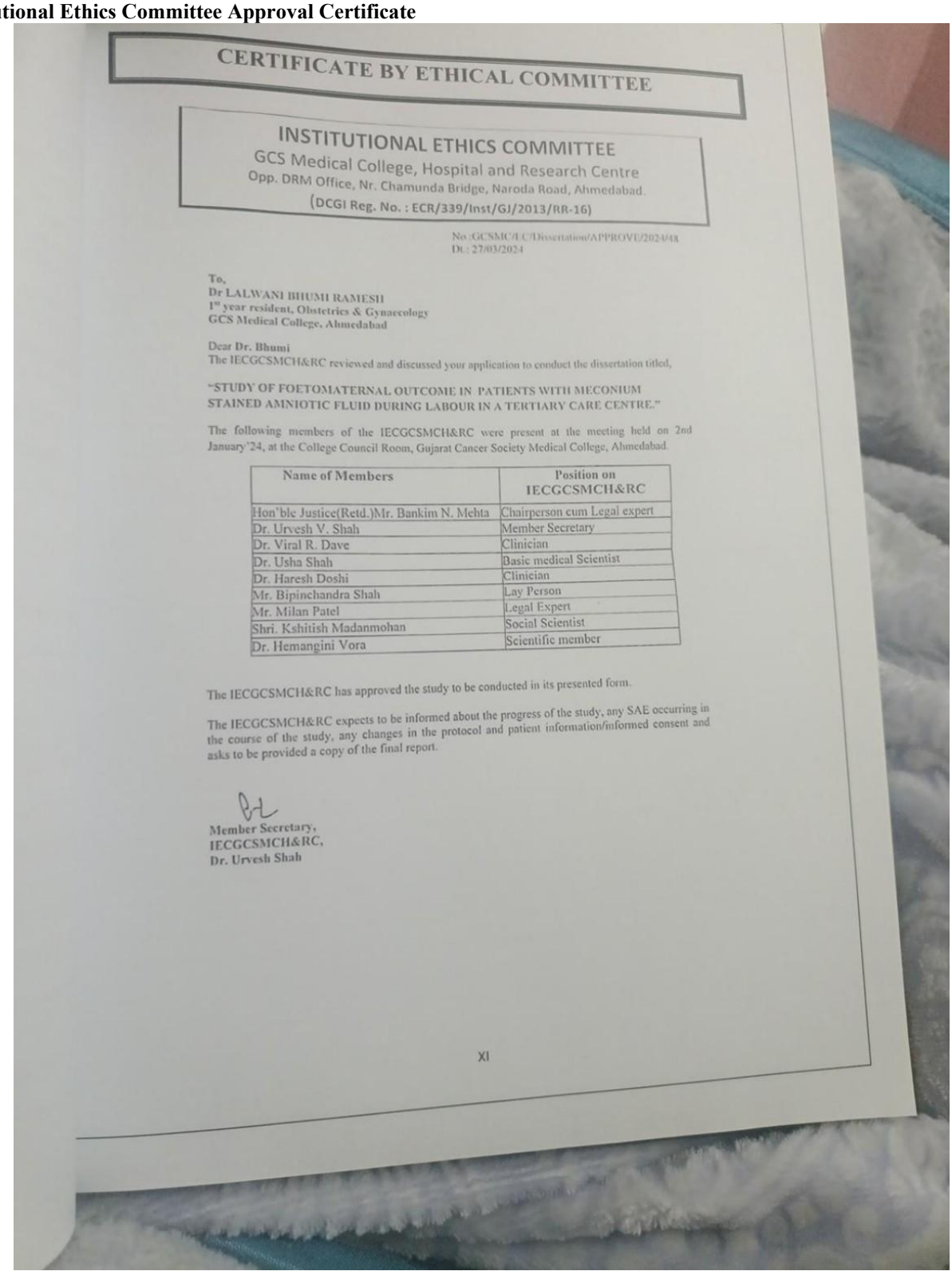
Declarations

- **Ethics approval:** Institutional Ethics Committee, GCS Medical College, Hospital and Research Centre, Ahmedabad (ref. GCSMC/EC/Dissertation/APPROVE/2024/48).
- **Consent:** Written informed consent was obtained from all participants.
- **Funding:** None.
- **Conflict of interest:** The authors declare no conflict of interest.
- **Data availability:** Data are available from the Department of Obstetrics and Gynaecology, GCS Hospital, Ahmedabad.
- **Author contributions:** BRL designed the study, collected and analysed the data and wrote the manuscript. KS guided and supervised the study and reviewed the manuscript.
- **Acknowledgements: The authors thank the labour room staff of GCS Hospital and the women who took part.**

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Institutional Ethics Committee Approval Certificate



CERTIFICATE BY ETHICAL COMMITTEE

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(DCGI Reg. No. : ECR/339/Inst/GJ/2013/RR-16)

No :GCSMC/EC/Dissertation/APPROVE/2024/48
Dt.: 27/03/2024

To,
Dr LALWANI BHUMI RAMESH
1st year resident, Obstetrics & Gynaecology
GCS Medical College, Ahmedabad

Dear Dr. Bhumi
The IECGCSMCH&RC reviewed and discussed your application to conduct the dissertation titled,

"STUDY OF FOETOMATERNAL OUTCOME IN PATIENTS WITH MECONIUM STAINED AMNIOTIC FLUID DURING LABOUR IN A TERTIARY CARE CENTRE."

The following members of the IECGCSMCH&RC were present at the meeting held on 2nd January'24, at the College Council Room, Gujarat Cancer Society Medical College, Ahmedabad.

Name of Members	Position on IECGCSMCH&RC
Hon'ble Justice(Retd.)Mr. Bankim N. Mehta	Chairperson cum Legal expert
Dr. Urvesh V. Shah	Member Secretary
Dr. Viral R. Dave	Clinician
Dr. Usha Shah	Basic medical Scientist
Dr. Haresh Doshi	Clinician
Mr. Bipinchandra Shah	Lay Person
Mr. Milan Patel	Legal Expert
Shri. Kshitish Madanmohan	Social Scientist
Dr. Hemangini Vora	Scientific member

The IECGCSMCH&RC has approved the study to be conducted in its presented form.

The IECGCSMCH&RC expects to be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent and asks to be provided a copy of the final report.

Member Secretary,
IECGCSMCH&RC,
Dr. Urvesh Shah

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