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ETIOLOGY OF NEONATAL MECONIUM-STAINED AMNIOTIC FLUID IN BAGHDAD: A CASE–CONTROL STUDY

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ABSTRACT

Background: Meconium-stained amniotic fluid is a common obstetric finding that signals potential fetal compromise and is associated with adverse perinatal outcomes, including meconium aspiration syndrome and neonatal intensive care admission.

Objective: To identify risk factors associated with meconium-stained amniotic fluid in neonates delivered at a tertiary maternity and children's hospital in Baghdad.

Methods: A hospital-based case–control study was conducted from 1 January to 31 December 2023. A total of 100 neonates were enrolled: 50 with meconium staining of the amniotic fluid at birth (cases) and 50 without staining (controls). Data on gestational age, mode and duration of labour, fetal distress, maternal illness, ruptured membranes and obstructed labour were recorded using a structured questionnaire and analyzed with SPSS version 24.0. Odds ratios with 95% confidence intervals, Fisher's exact test and descriptive statistics were used.

Results: Fetal distress was present in 60% of cases versus 4% of controls (odds ratio 36.0, 95% CI 7.9–165.2, $p < 0.001$). Caesarean delivery occurred in 80% of cases versus 50% of controls (odds ratio 4.0, 95% CI 1.7–9.7, $p = 0.003$) and prolonged labour in 90% versus 60% (odds ratio 6.0, 95% CI 2.0–17.7, $p = 0.001$). No statistically significant association was found with maternal illness, premature rupture of membranes, obstructed labour or maternal age. Four neonates died.

Conclusions: Fetal distress, caesarean delivery and prolonged labour are significant risk factors for meconium-stained amniotic fluid. Early recognition of these factors may improve surveillance and neonatal outcome.

Keywords: Meconium-stained amniotic fluid; Meconium aspiration syndrome; Risk factors; Fetal distress; Neonate; Case–control study.

1 INTRODUCTION

Meconium-stained amniotic fluid (MSAF) is defined by the presence of fetal meconium in the amniotic cavity, which imparts a characteristic greenish or pitch-black discolouration to the liquor. It is one of the most frequently encountered obstetric findings at term, occurring in up to 20% of pregnancies, and its frequency rises steadily as gestational age advances beyond 39 weeks [1,2]. The finding is clinically important because it serves as a marker of a fetus that has been exposed to intrauterine hypoxia or other stressors, and roughly 5–10% of exposed neonates develop meconium aspiration syndrome (MAS), the most serious respiratory complication associated with this condition [3,4].

The passage of meconium is rare before 34 weeks of gestation and increases in prevalence with advancing gestational age. Because the normal fetus rarely defecates in utero, antepartum passage of meconium is widely regarded as a sign of fetal compromise, frequently precipitated by transient hypoxia, umbilical cord compression, placental insufficiency or intra-amniotic infection [1,5]. When meconium is aspirated into the lower airways, either in utero through fetal gasping or with the first postnatal breaths, it can obstruct the airways, inactivate surfactant and trigger a chemical pneumonitis that manifests as the meconium aspiration syndrome [4].

Meconium aspiration syndrome is associated with substantial perinatal morbidity. Infants who aspirate meconium frequently require resuscitation at birth, prolonged hospitalisation and intensive care support, and the syndrome contributes meaningfully to neonatal mortality, particularly in settings with limited respiratory support [2,3]. Even in the absence of established aspiration, the presence of MSAF has been linked to lower Apgar scores, an increased risk of chorioamnionitis, neonatal sepsis and admission to the neonatal intensive care unit [1,3].

A broad range of maternal and intrapartum factors has been implicated in meconium passage. Fetal distress, prolonged and obstructed labour, caesarean delivery, gestational age beyond 40 weeks, premature rupture of membranes, hypertensive disorders of pregnancy, diabetes and high maternal age have all been reported as determinants of MSAF, although the strength and consistency of these associations vary across populations [6,7,8,9]. In particular, several recent African studies have identified post-term gestation, obstructed labour, prolonged labour of more than 24 hours and premature rupture of membranes as independent predictors [6,7,8].

In Iraq, data on the epidemiology of MSAF and its risk factors are limited, and most existing evidence derives from other regional and global settings where obstetric care and referral pathways differ. Given that MSAF is a potentially preventable contributor to neonatal morbidity, a local understanding of its determinants is essential for antenatal surveillance and delivery-room preparedness. The present case–control study was therefore undertaken to evaluate the risk factors associated with meconium-stained amniotic fluid among neonates delivered at Fatima al-Zahra Hospital for Maternity and Children in Baghdad, Iraq.

2 METHODS

2.1 Study design and setting

This was a hospital-based, unmatched case–control study conducted in the Pediatric Room of Fatima al-Zahra Hospital for Maternity and Children, Baghdad, Iraq, between 1 January and 31 December 2023.

2.2 Study population and sampling

A total of 100 neonates were enrolled purposively for the study. Consecutive neonates born with meconium staining of the amniotic fluid at birth constituted the case group (n = 50), and neonates born without meconium staining during the same period constituted the control group (n = 50). Neonates with birth injuries, congenital anomalies and multiple gestations were excluded.

2.3 Data collection and variables

For both groups, information on the duration of labour, mode of delivery and maternal medication during pregnancy was recorded. The presence of maternal illness, including gestational diabetes mellitus, pregnancy-induced hypertension, anaemia and jaundice, was documented. Additional obstetric complications, such as obstructed labour, a history of premature rupture of membranes and reduced fetal movements, were obtained from parents and available medical records. Data were collected using a predefined questionnaire, which also captured gestational age, birth weight, sex, fetal distress, degree of meconium staining and neonatal outcome.

Meconium-stained neonates were categorised into three severity groups: staining limited to the skin, umbilicus and nails; staining accompanied by ingestion; and staining with clinical features of aspiration.

2.4 Ethical considerations

Parents and guardians of the enrolled neonates were fully informed about the study, and written consent was obtained. The study protocol was approved by the ethical review committee of the participating hospital.

2.5 Statistical analysis

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS), version 24.0. Descriptive statistics were used to summarise the characteristics of the study population. The odds ratio (OR) with its 95% confidence interval (CI) was calculated to quantify the association between each exposure and meconium staining, and Fisher's exact test was used to assess statistical significance, with a p value of less than 0.05 considered significant.

3 RESULTS

3.1 Characteristics of the study population

A total of 100 neonates were enrolled: 50 with meconium staining of the amniotic fluid at birth (cases) and 50 without meconium staining (controls). Among the cases, 8 neonates (16%) had staining confined to the skin, umbilicus and nails, 37 (74%) had staining with ingestion, and the remaining 5 (10%) showed features of aspiration in addition to staining (Figure 1). The gestational age of the majority of participants was between 38 and 41 weeks, and the mean birth weight was 2.7 ± 0.2 kg. Of the total sample, 52 neonates (52%) were male and 48 (48%) were female (Table 1).

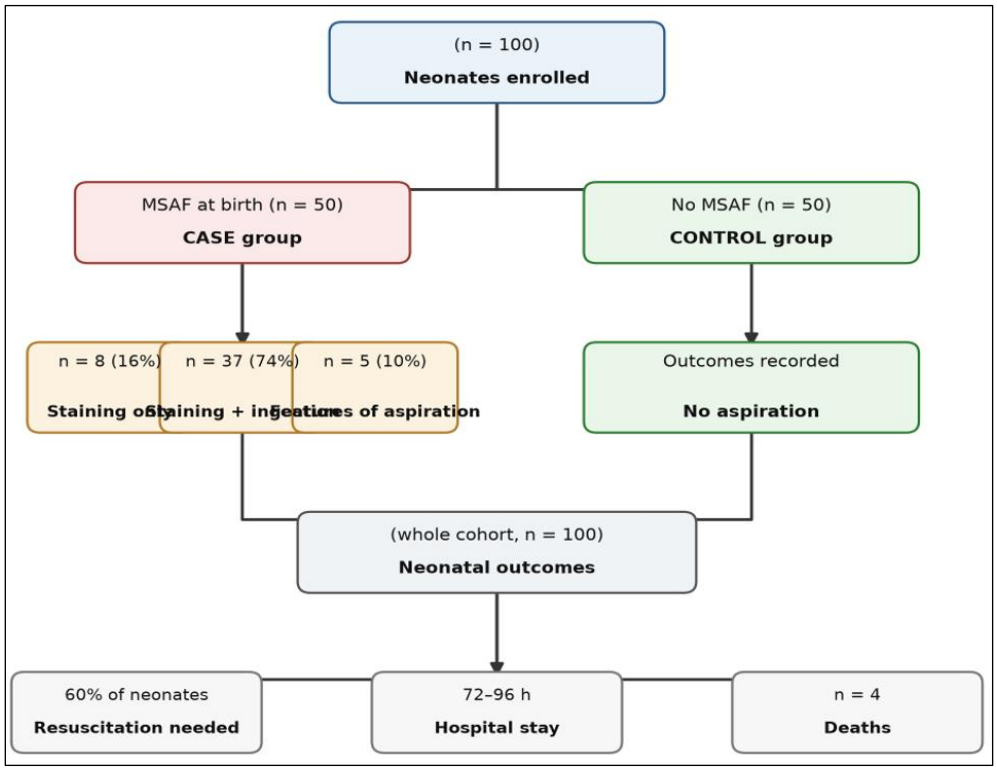


Figure 1: Participant selection flowchart. MSAF, meconium-stained amniotic fluid.

Table 1: Baseline neonatal characteristics and outcomes

Characteristic	n	%
Total	100	—
Male sex	52	52
Female sex	48	48
Birth weight (kg), mean ± SD	2.7 ± 0.2	—
Gestational age 38–41 weeks (majority)	>50	—
Resuscitation required	60	60

Hospital stay 72–96 h	all cases	—
Deaths	4	4

3.2 Risk factor analysis

Fetal distress, caesarean delivery and prolonged duration of labour were significantly more frequent among cases than among controls (Figure 2). Fetal distress was recorded in 30 cases (60%) but in only 2 controls (4%), corresponding to an odds ratio of 36.0 (95% CI 7.9–165.2; $p < 0.001$). Caesarean delivery was used in 40 cases (80%) versus 25 controls (50%) (OR 4.0, 95% CI 1.7–9.7; $p = 0.003$). Prolonged labour was present in 45 cases (90%) versus 30 controls (60%) (OR 6.0, 95% CI 2.0–17.7; $p = 0.001$) (Table 2).

Table 2: Risk factors associated with meconium-stained amniotic fluid

Risk factor	Cases n (%)	Controls n (%)	OR (95% CI)	p value
Fetal distress	30 (60)	2 (4)	36.0 (7.9–165.2)	< 0.001
Caesarean delivery	40 (80)	25 (50)	4.0 (1.7–9.7)	0.003
Prolonged labour	45 (90)	30 (60)	6.0 (2.0–17.7)	0.001

3.3 Maternal and intrapartum factors

The majority of mothers in both groups had no history of obstructed labour, and premature rupture of membranes was uncommon in both groups. There was no statistically significant association between the presence of maternal illness (gestational diabetes mellitus, pregnancy-induced hypertension, jaundice and others) and meconium staining. Only 7% of mothers were older than 30 years, and no significant association between maternal age and meconium staining was observed.

3.4 Neonatal outcome

Sixty neonates (60%) required one or more forms of resuscitation at birth, and all affected neonates were hospitalised for 72 to 96 hours on average. Four neonates died; among them, two had staining with ingestion, one had aspiration features with staining, and one was recorded among the remaining cases.

4 DISCUSSION

This case–control study identified fetal distress, caesarean delivery and prolonged labour as significant risk factors for meconium-stained amniotic fluid among neonates delivered in a Baghdad maternity hospital. These findings are consistent with a substantial body of international evidence and support the view that MSAF frequently signals an intrapartum compromise that warrants close fetal monitoring and delivery-room preparedness.

Fetal distress was the strongest risk factor identified, with an odds ratio of 36.0. This is in keeping with the observations of Shukla and Swapna, who reported fetal distress in 23.7% of deliveries complicated by MSAF [10], and with a recent cross-sectional study by Karpe and colleagues that found a significant association between MSAF and fetal distress and linked this to higher caesarean rates [3]. Mechanistically, transient intrauterine hypoxia triggers meconium passage through vagal stimulation and enhanced gastrointestinal motility, so the coexistence of abnormal fetal heart-rate patterns with MSAF is biologically plausible [1,3].

Delivery by caesarean section was significantly more frequent in the case group, echoing earlier reports by Erum and colleagues, who found that 205 of 250 women with MSAF delivered by caesarean section [13], and by Khatun [12] and Chaudhary and colleagues [14]. The association between MSAF and caesarean delivery is, however, bidirectional: fetal distress frequently dictates operative delivery, and the resulting operative rates partly reflect the clinical response to an abnormal fetal state rather than a direct causal effect. This should be taken into account when interpreting the observed odds ratio.

Prolonged duration of labour was associated with an approximately six-fold higher odds of MSAF in the present study. This agrees with the work of Saunders [11], who reported poorer outcomes in the presence of prolonged labour with MSAF, and with recent multi-centre data indicating that labour exceeding 24 hours is a significant determinant of MSAF [8]. Prolonged labour exposes the fetus to repeated cord compression and episodic hypoxia, which are recognised precipitants of meconium passage.

Consistent with earlier findings [1,15], meconium staining increased with advancing gestational age; nine babies in this cohort were born after 40 weeks, of whom five had meconium staining at birth, in line with reports by Sunoo and colleagues [15] and Chhetri and Aryal [16]. In addition, recent studies from low-resource settings have highlighted post-term gestation, obstructed labour, premature rupture of membranes and maternal hypertensive disorders as independent determinants of MSAF [6,7,8]. In the present analysis, however, we found no significant association between maternal illness, premature rupture of membranes, obstructed labour or maternal age and meconium staining, possibly reflecting the comparatively small sample and the low prevalence of these exposures in our population.

This study has several limitations. It was conducted at a single centre with a relatively small sample, which limits statistical power and the precision of effect estimates, as reflected in the wide confidence intervals. The purposive sampling approach and reliance on parental recall and medical records create a potential for selection and information bias. In addition, the case–control design precludes causal inference, and unmeasured confounders, including the severity of fetal distress and the threshold for caesarean delivery, could not be fully accounted for. Finally, follow-up was restricted to the neonatal period, and long-term neurodevelopmental outcomes were not assessed.

Despite these limitations, the findings have practical relevance for obstetric and neonatal care in Iraq. Because fetal distress, caesarean delivery and prolonged labour are identifiable at the time of delivery, heightened vigilance in these situations—including continuous electronic fetal monitoring, prompt recognition of abnormal labour progress and availability of skilled personnel at birth—may permit earlier intervention and reduce the morbidity and mortality associated with meconium-stained amniotic fluid [2,9].

5 CONCLUSION

Fetal distress, caesarean delivery, advanced gestational age and prolonged duration of labour were significant risk factors for meconium staining of the amniotic fluid in this Iraqi cohort. Identification of these factors may facilitate early detection of fetal compromise and guide the management and monitoring of neonates born through meconium-stained liquor, thereby contributing to improved perinatal outcome.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The author declares no conflict of interest regarding this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Authors' Contributions

Hanaa Nahim Jihad: Conceptualization; data curation; investigation; methodology; project administration; resources; software; validation; visualization; writing — original draft and writing — review & editing.

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