

Post-Term Pregnancy as the Primary Significant Risk Factor for Meconium-Stained Amniotic Fluid

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ABSTRACT

Meconium-stained amniotic fluid (MSAF) is a condition in which amniotic fluid is contaminated with meconium and is associated with fetal distress and adverse perinatal outcomes, including neonatal asphyxia, meconium aspiration syndrome, infection, and perinatal mortality. This study aimed to analyze maternal age, gestational age, and parity as risk factors for MSAF among delivering mothers at Panekan Public Health Center from 2021 to 2025. This retrospective case-control study included 385 participants: 77 cases selected through total sampling and 308 controls selected using simple random sampling at a 1:4 ratio. Data were obtained from medical records and delivery registers and analyzed using binary logistic regression with a significance level of $\alpha = 0.05$. Gestational age ≥ 40 weeks was significantly associated with MSAF ($p = 0.005$; OR = 2.21), with ≥ 40 weeks occurring in 32.5% of cases and 17.9% of controls. High-risk maternal age (>35 years) occurred in 18.2% of both cases and controls and was not significant ($p = 0.818$). Primiparity occurred in 37.7% of cases and 33.8% of controls and was not significant ($p = 0.454$). In conclusion, gestational age ≥ 40 weeks was the primary significant factor associated with MSAF in this study. Enhanced gestational-age monitoring and regular antenatal care are important, particularly as pregnancy approaches or exceeds 40 weeks.

Keywords: risk factors; meconium-stained amniotic fluid; gestational age; post-term pregnancy

INTRODUCTION

Normal labor is fundamentally understood as a complex physiological process in which the products of conception are expelled from the uterus at term gestation, generally between 37 and 42 weeks, through a sequence of coordinated uterine contractions, cervical effacement and dilation, and fetal descent through the birth canal. This process ideally progresses spontaneously, efficiently, and without clinical complications, reflecting optimal maternal and fetal physiological readiness for birth [1]. Despite its physiological nature, labor may be disrupted by various obstetric complications, one of the most clinically significant being meconium-stained amniotic fluid (MSAF). MSAF refers to the contamination of amniotic fluid by meconium; the viscous, greenish to blackish first intestinal discharge of the fetus released either before the onset of labor or during the intrapartum period as a response to fetal stress or maturation of gastrointestinal function [2].

The presence of meconium in the amniotic cavity is clinically important because it is frequently associated with fetal distress, particularly hypoxia or acidosis, and may precipitate a cascade of adverse neonatal outcomes. These include meconium aspiration syndrome (MAS), neonatal asphyxia, respiratory infection, persistent pulmonary hypertension of the newborn (PPHN), and even perinatal mortality when not promptly recognized and managed with appropriate obstetric and neonatal interventions [3]. In addition to neonatal risks, MSAF also poses maternal health concerns. The presence of meconium increases the likelihood of intraamniotic infection, chorioamnionitis, puerperal endometritis, and postpartum hemorrhage due to uterine atony or infection-related complications, thereby underscoring its relevance as a dual maternal-fetal clinical issue [4].

Within the catchment area of Panekan Public Health Center, Magetan Regency, East Java, surveillance data over a five-year period (2021–2025) indicate that the prevalence of MSAF has fluctuated considerably. Recorded annual rates were 10.9% in 2021, decreasing to 6.1% in 2022, then rising sharply to 13.8% in 2023 and 15.4% in 2024, before declining again to 8.3% in 2025. These variations suggest that MSAF remains a persistent and clinically relevant concern in midwifery practice at the primary healthcare level. The fluctuating pattern may reflect changes in maternal risk profiles, variations in obstetric management practices, or shifts in the demographic characteristics of pregnant women seeking care at the facility.

Previous research has consistently demonstrated that MSAF is a multifactorial condition influenced by a wide range of maternal, obstetric, and fetal factors. It is not attributable to a single cause but rather emerges from the interplay of physiological, pathological, and environmental determinants [5]. Studies conducted in various settings have identified several significant predictors of MSAF, including late-term and post-term pregnancy, oligohydramnios, antepartum hemorrhage, premature rupture of membranes (PROM), and non-reassuring fetal heart rate patterns indicative of fetal compromise [6]. These findings highlight the importance of comprehensive antenatal and intrapartum monitoring to detect early signs of risk.

Despite the breadth of existing literature, research specifically focusing on routinely documented maternal characteristics; particularly maternal age, gestational age, and parity within primary healthcare facilities over extended periods remains limited. These three variables are consistently recorded in maternal health records, making them accessible, reliable, and highly relevant for risk stratification in community-based maternal health services. Maternal age is a well-established determinant of obstetric risk, with both younger (<20 years) and older (>35 years) mothers experiencing higher rates of complications. Gestational age is directly linked to fetal maturity and the likelihood of meconium passage, especially in late-term and post-term pregnancies. Parity influences the biomechanics of labor, with primiparous women often experiencing longer labor durations and higher susceptibility to intrapartum complications.

Given the clinical importance of these routinely collected variables, this study was designed to analyze the significance of maternal age, gestational age, and parity as risk factors for MSAF among women giving birth at Panekan Public Health Center during the 2021–2025 period. By focusing on variables that are consistently documented and directly relevant to antenatal risk assessment, the study aims to generate evidence that can be readily applied in primary healthcare settings to strengthen early detection, improve risk stratification, and enhance the quality of maternal and neonatal care.

METHODS

This study employed an analytical observational design with a retrospective case-control approach [7–11]. The study population comprised all 876 mothers who delivered at Panekan Public Health Center between 2021 and 2025, consisting of 77 MSAF cases and 779 deliveries without MSAF.

The study sample consisted of 77 case subjects selected through total sampling and 308 control subjects selected via simple random sampling at a 1:4 ratio, yielding a total sample of 385 participants. The 1:4 case-to-control ratio was used to increase the precision of the comparison while maintaining sampling efficiency given the available number of cases. Case subjects were defined as delivering mothers with MSAF documented in their medical records and complete data on all study variables. Control subjects were delivering mothers with clear amniotic fluid and equivalent eligibility criteria, without major obstetric complications documented as potential confounders [11].

Data were collected from medical records and delivery registers [12]. Independent variables included maternal age (high-risk: >35 years; low-risk: 20–35 years), gestational age (high-risk: ≥40 weeks; low-risk: 37–<40 weeks), and parity (high-risk: primiparous; low-risk: multiparous). The use of primiparity as the higher-risk category was based on its potential association with longer labor and intrapartum fetal stress, while acknowledging that parity may not independently predict MSAF. The dependent variable was the occurrence of MSAF.

Data analysis was conducted at the descriptive [13–15], bivariate, and multivariate levels. Multivariate analysis utilized binary logistic regression with a backward stepwise elimination approach [16]. A significance threshold of $\alpha = 0.05$ was applied throughout. Variables such as premature rupture of membranes, hypertension, and fetal distress were not included as independent variables in the regression model because the prespecified analysis focused on three routinely available maternal factors; their potential residual confounding was considered as a limitation. Records with incomplete study-variable data were not eligible for analysis, and no missing-data imputation was performed. Ethical approval for this study was obtained from the relevant health research ethics committee.

RESULTS

Study setting and sample characteristics

This study was conducted at Panekan Public Health Center, Magetan Regency, East Java, a primary healthcare facility providing normal delivery services. Based on Table 1, a total of 385 participants met the inclusion criteria, comprising 77 case subjects (MSAF) and 308 control subjects (non-MSAF).

Table 1. Sample distribution by case and control group

Group	Frequency	Percentage
Case (MSAF)	77	20,0
Control (Non-MSAF)	308	80,0

Descriptive analysis

Maternal age was categorized as high-risk (>35 years) or low-risk (20–35 years). The distribution of maternal age across both groups is presented in Figure 1. The proportion of high-risk maternal age was identical in the case group (18.2%; $n=14$) and the control group (18.2%; $n=56$). The corresponding regression analysis also showed no statistically significant association between maternal age and MSAF ($p = 0.818$).

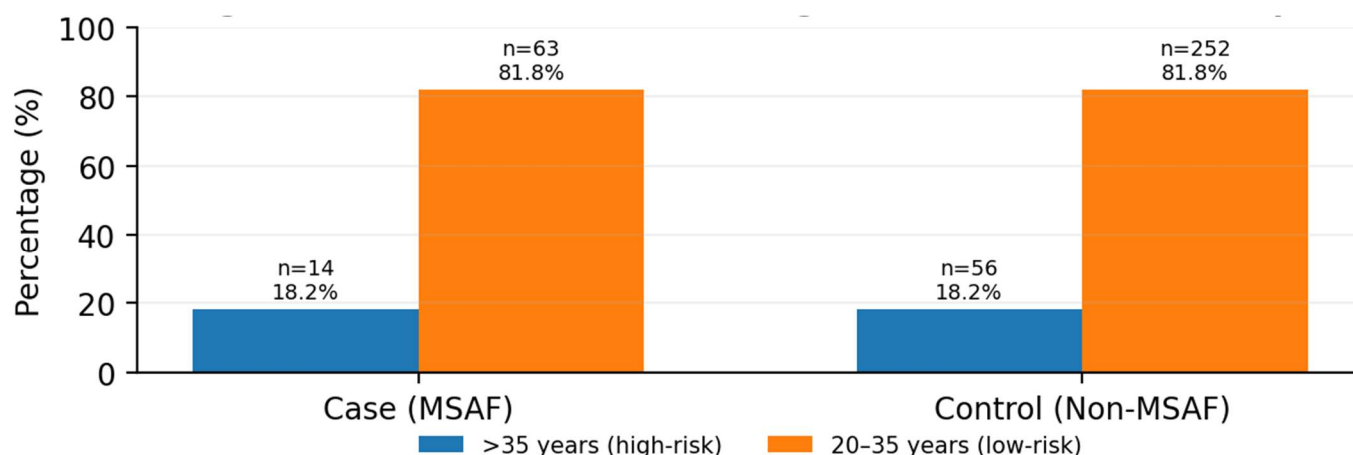


Figure 1. Distribution of maternal age in case and control groups

Parity was categorized as primiparous (study-defined higher-risk category) or multiparous (lower-risk category). The distribution of parity across both groups is presented in Figure 2. The proportion of primiparous mothers was 37.7% ($n=29$) in the case group and 33.8% ($n=104$) in the control group, a difference of 3.9 percentage points.

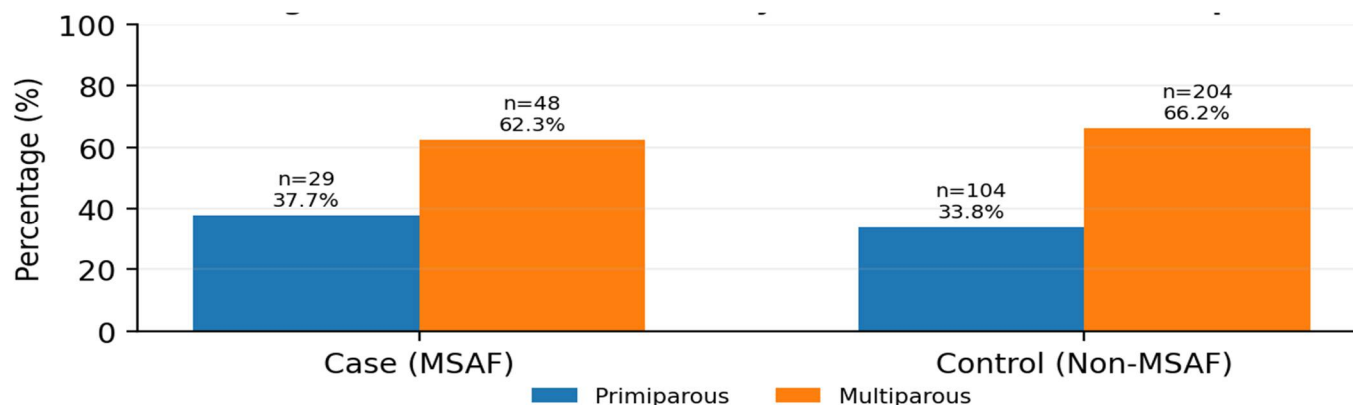


Figure 2. Distribution of parity in case and control groups

Gestational age was categorized as high-risk (≥ 40 weeks) or low-risk ($37 < 40$ weeks). The distribution of gestational age across both groups is presented in Figure 3. The proportion of mothers with gestational age ≥ 40 weeks was 32.5% ($n=25$) in the case group and 17.9% ($n=55$) in the control group. The higher prevalence among cases was consistent with the statistically significant association observed in the regression analysis.

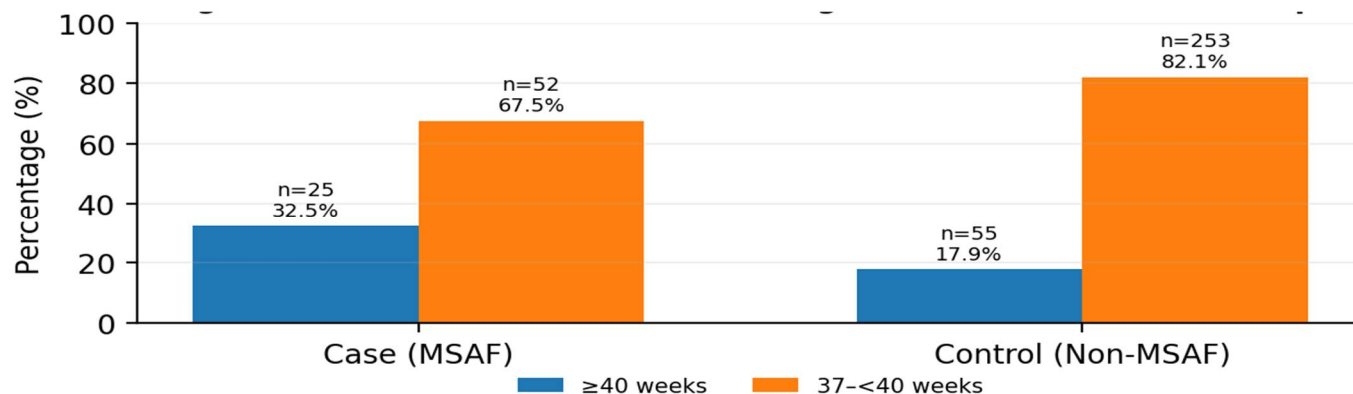


Figure 3. Distribution of gestational age in case and control groups

Binary logistic regression analysis results

Multivariate analysis was performed using binary logistic regression with a backward stepwise elimination approach. The analytical process yielded three sequential model stages. In Model 1 (Table 2), gestational age was statistically significant ($p = 0.005$), whereas maternal age ($p = 0.818$) and parity ($p = 0.454$) were not. Following the backward elimination procedure, maternal age, which had the highest p -value, was removed first, and analysis proceeded to Model 2. The OR values in the table are expressed for MSAF according to the model's coding direction.

In Model 2 (Table 3), gestational age remained statistically significant ($p = 0.005$), whereas parity did not ($p = 0.476$). Parity was subsequently removed from the model, yielding the final model. OR values are expressed for MSAF according to the model's coding direction ($OR = \exp[-B]$). The constant represents the baseline log-odds and is not interpreted as an exposure effect.

The final model (Table 4) showed that gestational age ≥ 40 weeks was statistically significantly associated with MSAF ($p = 0.005$; $OR = 2.21$; 95% CI: 1.26–3.87). Thus, mothers with gestational age ≥ 40 weeks had approximately 2.21 times the odds of MSAF compared with mothers at $37 < 40$ weeks.

Table 2. Binary logistic regression results – Model 1 (full model: gestational age + parity + maternal age)

Variable	B	SE	Z-stat	95% CI	p-value	OR
Constant (b_0)	1,6747	0,2093	8,0023	1,2645 – 2,0848	–	–
Gestational Age	-0,8000	0,2857	-2,8002	-1,3600 – -0,2401	0,005*	2.23
Maternal Age	-0,0819	0,3559	-0,7475	-0,7795 – 0,6158	0,818	1.09
Parity	-0,2129	0,2849	0,7475	-0,7713 – 0,3454	0,454	1.24

*Statistically significant ($p < 0.05$)

Table 3. Binary logistic regression results – Model 2 (gestational age + parity)

Variable	B	SE	Z-stat	95% CI	p-value	OR
Constant (b_0)	1,6518	0,1830	9,0238	1,2930 – 2,0105	–	–
Gestational Age	-0,7999	0,2857	-2,8000	-1,3598 – -0,2400	0,005*	2.23
Parity	-0,1907	0,2673	-0,7134	-0,7145 – 0,3332	0,476	1.21

*Statistically significant ($p < 0.05$)

Table 4. Binary logistic regression results – Final model (gestational age)

Variable	B	SE	Z-stat	95% CI	p-value	OR
Constant (b_0)	1,5821	0,1523	10,3910	1,2837 – 1,8806	–	–
Gestational Age	-0,7937	0,2852	-2,7825	-1,3528 – -0,234	0,005*	2.21

*Statistically significant ($p < 0.05$).

DISCUSSION

The maternal age as a risk factor for MSAF

Multivariate analysis revealed that maternal age did not significantly influence the occurrence of MSAF ($p = 0.818$). Descriptively, the proportion of high-risk maternal age was identical between the case group (18.2%) and the control group (18.2%), a finding consistent with the statistical results. These findings are in line with those of Bhinder *et al.* [5] and Sundaram and Murugesan [7], who similarly reported that maternal age had no significant effect on MSAF incidence.

Although advanced or extreme maternal age is theoretically linked to diminished reproductive function and heightened obstetric complications, this association was not borne out statistically in the present study. The lack of significance may be attributable to the relatively homogeneous age distribution within the study population, as well as the dominant predictive role of gestational age. Nevertheless, close surveillance of mothers aged > 35 years remains advisable given their susceptibility to complications such as anemia, preeclampsia, and fetal growth restriction.

Parity as a risk factor for MSAF

Parity showed no statistically significant effect on MSAF occurrence ($p = 0.454$ in Model 1; $p = 0.476$ in Model 2). Descriptively, the proportion of primiparous mothers was slightly higher in the case group (37.7%) than in the control group (33.8%); however, this difference did not attain statistical significance. These findings align with those of Negesa *et al.* [8] in Ethiopia and Mahapatra *et al.* [9], who similarly reported that parity did not independently influence MSAF incidence when analyzed in conjunction with other variables.

Although labor in primiparous women theoretically tends to be longer and may elevate the risk of fetal distress, this mechanism alone appears insufficient to independently account for MSAF occurrence. MSAF is a multifactorial condition influenced by gestational age, placental function, and the overall fetal condition [4]. Furthermore, standardized intrapartum monitoring through the partograph and cardiotocographic (CTG) surveillance at primary healthcare facilities may serve to minimize risk differences between parity groups.

Gestational age as the primary risk factor for MSAF

Gestational age ≥ 40 weeks was significantly associated with MSAF ($p = 0.005$; OR = 2.21; 95% CI approximately 1.26–3.87). The proportion of high-risk gestational age in the case group (32.5%) was nearly double that in the control group (17.9%), reinforcing the statistical finding. This result is consistent with those reported Aini *et al.* [10] and Asha & Sujatha [11], who identified post-term pregnancy as an important risk factor for MSAF. The finding indicates that gestational age may have greater explanatory value than the two other maternal variables assessed in this study, although the retrospective design does not establish causality and unmeasured factors may also contribute.

From a pathophysiological standpoint, post-term pregnancy is associated with declining placental function, leading to chronic fetal hypoxia. Hypoxia stimulates the fetal vagus nerve, augments intestinal peristalsis, and induces anal sphincter relaxation, collectively triggering the passage of meconium into the amniotic fluid [4]. In addition, the increasing maturity of the gastrointestinal system at gestational ages ≥ 40 weeks further facilitates intrauterine defecation [4]. Hormonal factors, particularly elevated levels of motilin and cortisol approaching term, are also known to stimulate fetal intestinal motility [4].

These findings carry important clinical implications for healthcare providers at primary care facilities. Pregnancies reaching ≥ 40 weeks of gestation warrant more intensive monitoring, encompassing periodic fetal well-being assessments through fetal heart rate auscultation, fetal movement evaluation, and amniotic fluid volume estimation. Patient education regarding the importance of regular check-ups during the late third trimester and awareness of warning signs associated with post-term pregnancy is equally essential.

This study has several limitations. First, its retrospective design depends on the completeness and accuracy of routinely recorded medical data and therefore may introduce information bias. Second, the study was conducted at a single primary healthcare facility, which may limit the generalizability of the findings to other settings. Third, potentially relevant factors such as premature rupture of membranes, hypertension, anemia, and fetal condition were not included in the multivariate model, so residual confounding cannot be excluded. Finally, the analysis was restricted to three maternal variables; future studies should use prospective or cohort designs and incorporate a broader set of maternal, obstetric, and fetal variables.

CONCLUSION

This study concludes that late-term gestational age was the only maternal factor showing a meaningful association with meconium-stained amniotic fluid (MSAF) among mothers delivering at Panekan Public Health Center during 2021–2025. Maternal age and parity did not demonstrate statistical significance in the multivariate model. These findings highlight the need for strengthened surveillance and high-quality antenatal care as pregnancy approaches or exceeds late-term gestation. However, interpretation should consider the retrospective single-center design and the possibility of unmeasured confounding. Future studies are recommended to use prospective or cohort designs and include additional variables such as hypertension, anemia, premature rupture of membranes, and fetal condition.

Ethical consideration, competing interest and source of funding

-This study was conducted in accordance with ethical principles governing research involving human subjects. Data were obtained from medical records while ensuring the confidentiality of participants' identities. Ethical approval was granted by the relevant ethics committee, with the number of EA/4502/KEPK-Poltekkes_Sby/V/2026.

-No conflicts of interest are declared in relation to the publication of this article.

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