Prevalence and factors associated with meconium stained amniotic fluid in a tertiary hospital, Northwest Ethiopia: A cross sectional study

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Research article

Keywords: Meconium stained amniotic fluid, MSAF, Felege Hiwot Referral Hospital, Ethiopia

Posted Date: December 17th, 2019

DOI: https://doi.org/10.21203/rs.2.18997/v1

Abstract

Background

Meconium is a green viscous fluid and its passage normally occurs within the first 24-48 hours after birth. However, fetuses could pass meconium before or during labor and mostly intrauterine passage was found to be associated with different feto-maternal stress factors resulting in increased risk of perinatal morbidity and mortality. In Ethiopia little is known about the proportion and associated factors for meconium stained amniotic fluid (MSAF). The aim of the study was to assess the proportion and associated factors of MSAF in women who came for labor and delivery service in a tertiary hospital in Ethiopia.

Methods

A cross sectional study was conducted from 1st June to 31 August, 2018 on 606 laboring mothers at Felege Hiwot Referral Hospital, northwest Ethiopia. Study participants were selected using a systematic random sampling technique. Data was collected using interviewer administered structured questionnaire. Data entry and analysis were made by using Epi-data v3.1 and SPSS v24, respectively. Both descriptive & analytical statistics were computed. Statistical significance was set at $P < 0.05$. Logistic regression was used to explore factors associated with MSAF.

Results

The proportion of MSAF was at 149 (24.6%) [95%CI: 21.3-28.2%]. Nonreassuring fetal heart rate pattern (AOR: 21.9,95% CI: 10.96-43.83), post term pregnancy (4.54,95% CI: 2.24-9.20), duration of labor more than 15 hours (AOR: 2.83,95% CI: 1.76-4.53), pregnancy induced hypertension (AOR: 2.43, 95% CI: 1.45-4.05), oligohydramnios (AOR: 2.53, 95% CI: 1.25-5.12) inter pregnancy interval less than 2 years (AOR: 2.24,95% CI: 1.12-4.51) and monthly family income less than 5000 Ethiopian Birr (185 United States Dollar) (AOR: 2.03, 95% CI:1.18-3.51) were significantly associated with MSAF.

Conclusions

The proportion of MSAF was at 24.6% which was higher than a previous study done in Ethiopia and elsewhere. Non-reassuring fetal heart rate pattern, post term pregnancy, duration of labor more than 15 hours, pregnancy induced hypertension, oligohydramnios, inter pregnancy interval less than 2 years and monthly family income less than 5000 Ethiopian Birr were factors associated with an increased risk for MSAF. Health professionals should assess laboring women for the presence of these factors and should stay alert to detect MSAF early and to act accordingly.

Background

Meconium is a green viscous fluid which consists of denuded intestinal epithelial cells, ingested lanugo hair, swallowed amniotic fluid, gastro-intestinal mucus, digestive enzymes, bile acids& drug metabolites,

blood group specific glycoproteins and water[1, 2].

Meconium passage in newborn infants is a developmentally programmed event normally occurring within the first 24 to 48 hours after birth. Intrauterine meconium passage in near-term or term fetuses has been associated with feto maternal stress factors and/or infection, whereas meconium passage in post term pregnancies has been attributed to gastrointestinal maturation[3].

Meconium is also a potential toxin if the fetus aspirates this particulate matter with a gasping breath in utero or when it takes its first breaths following birth. In addition intrauterine exposure to meconium is associated with inflammation of tissues of the lung, chorionic plate and umbilical vessels contributing to perinatal morbidity[4].

Neonates who are delivered with meconium stained amniotic fluid (MSAF) are high likely to be admitted to NICU, low Apgar score, meconium aspiration syndrome, early onset neonatal sepsis and perinatal asphyxia which will further increases the rate of perinatal mortality[5, 6–13]. In Ethiopia, MSAF is associated with increased risk of low 1st minute Apgar score and meconium aspiration syndrome[4]. MSAF can be found in 10–20% of laboring mothers[4]. A retrospective study done in Israel showed that 10.9% of women had MSAF [6] while a cross sectional study done in different parts of India showed that 8.3%, 9.1% and 18% of laboring women have MSAF[14–16]. According to the study done in Nigeria, the incidence of MSAF was 20.4% with male to female ratio of 1:1.1[17] and hospital based cross sectional study done in Jimma university hospital showed that 15.4% of women had MSAF[4].

A population-based cohort study conducted in women who gave birth to SGA neonates in Israel showed that gestational age at delivery, maternal age and non-progressive first stage of labor were all found to be independently associated with MSAF. SGA neonate with MSAF was independently associated with fetal distress[18]. A cross sectional study done in Carolina, USA showed increased risk of MSAF was found for advancing gestational age, fetal stress, fewer than five prenatal care visits and > 15 hours of labor[19].

However, a prospective case control study done in a tertiary care hospital in India indicated that gestational age and parity showed no statistical significance between the study and control groups but preeclampsia (32% vs 6%), fetal growth restriction (12% vs 2%), fetal distress (36% vs 6%) and labor dystocia (20% vs none) were found to be statistically significant[9]. A prospective study done in India showed that maternal age and parity did not influence MSAF but MSAF was more common in pregnancies with pregnancy induced hypertension, hepatitis and severe anemia but significant only in mothers with hepatitis and in pregnancies with fetal distress[10, 21]. But another similar study done in the same country showed that maternal age > 30 years, postdate pregnancy, cord problems, fetal distress, prim gravidity and fetal growth restriction are associated with MSAF[20]. Cross sectional studies done in Brazil and Iran showed that MSAF was significantly associated with primiparity, gestational age ≥ 41 weeks, women on oxytocin during labor[22, 23].

Researches done all over the world showed difference in proportion of MSAF with different determinant factors. Majority of the studies done were in developed countries and very little is known about the

situation in our country, Ethiopia. Therefore this study was conducted to assess the proportion and associated factors of MSAF at a tertiary hospital setup in Ethiopia.

Methods And Materials

Study setting, design, and population

The study was an institutional based cross-sectional study conducted in the period of 1 June to 31 August 2018 at Felege Hiwot Referral Hospital (FHRH), Bahir Dar, northwest Ethiopia. FHRH was a comprehensive specialized hospital serving the people of Bahir Dar and its surrounding. The study population comprises those mothers who gave birth at FHRH during the study period. Mothers who gave birth at FHRH were registered on the delivery registration log book. Systematic random sampling technique was used to select the required number of clients and the first woman was selected using lottery method. During the sampling procedure, if the selected woman didn't fulfill the inclusion criteria, the next woman was taken. The sample size was calculated with the single population proportion formula: at 95% CI, 3% marginal error[25] and using the proportion of MSAF done in Jimma, Southwest Ethiopia, at 15.4% [4]. Adding 10% non-response rate, the final sample size was at 612.

Inclusion and exclusion criteria

All women with singleton pregnancy who had delivered at FHRH were included in the study. Women who had breech presentation, pregnancy with unknown gestational age, intrauterine fetal death upon admission and congenital malformation of fetus were excluded from the study.

Data collection and analysis

Data on the socio-demographic characteristics, obstetric related factors and medical history of the study participates was collected through semi-structured questionnaire that were adopted and modified from different literature. Data were entered and cleaned using Epi-data version 3.1 and transported to SPSS version 24 where analysis was done. Descriptive analyses like frequencies and cross tabulations were performed. Binary logistic regression was done and Variables with p-values ≤ 0.25 remained in the model as potential confounders for for multi variable analysis. Multi-variable analysis was done with Hosmer-Lemeshow goodness of fit test with 95 % confidence interval. Upon analysis, backward conditional selection method was done until all the remaining variables were found to be significant with p value of < 0.05.

Results

Socio-demographic characteristics

A total of 606 women who gave birth at Felege Hiwot Comprehensive Specialized Hospital during the study period were participated in the study making the total response rate at 99.1%. Among the study participants, the majority of women were in their 20's with the highest percentage at 37.8% in the age group between 25–29 years. Most resided in urban areas, were married, were Orthodox Christian and had an average monthly income of < 5000 Ethiopian birr (185 USD). Among currently married women, around one third of their husband's attended school up to college or university level and 28.8% were government employees (Table 1).

Table 1
Sociodemographic characteristics of study participants in Felege Hiwot referral hospital from June-August 2018 (n = 606)

Variables	Category	Number	Percent
Age in years	≤ 19	28	4.6
	20–24	160	26.4
	25–29	229	37.8
	30–34	117	19.3
	≥ 35	72	11.9
Place of residence	Urban	421	69.5
	Rural	185	30.5
Current marital status	Married	597	98.5
	Unmarried	9	1.5
Religion	Orthodox	547	90.3
	Others	59	9.7
Client educational status	Can't read and write	174	28.7
	Primary school	154	25.4
	Secondary school	123	20.3
	College or university	155	25.6
Client's occupation	Government employee	103	17
	Self employed	35	5.8
	Merchant	69	11.4
	House wife	286	47.2
	Farmer	67	11.1
	Others	46	7.6
Monthly income in birr	< 5000	419	69.2
	≥ 5000	187	30.8
Client husband's educational status (*)	Can't read and write	137	22.9
	Primary school	120	20.1

Variables	Category	Number	Percent
	Secondary school	147	24.6
	College or university	193	32.3
Client husband's occupation (*)	Government employee	172	28.8
	Self employed	70	11.7
	Merchant	129	21.6
	Farmer	157	26.3
	Others	69	11.6

Previous and current obstetric and medical history

Among laboring women participated in the study, majority of the pregnancies were planned, wanted and supported. Majority of women were Para II-IV followed by primipara's, had antenatal care follow-up and were in the gestational age between 39–40 weeks and 6 days. Nearly half of study participants had antepartum obstetrics complications and about one sixth had two and above complications. Pregnancy induced hypertension was the leading complication followed by premature rupture of membrane. Polyhydramnios followed by gestational diabetes mellitus were the least obstetrics complications. Nearly a third of women had duration of labor more than 15 hours and one fifth had received oxytocin for augmentation or induction of labor. Nearly ten percent of women had NRFHRP during labor follow up, interpregnancy interval less than two years, interpregnancy interval greater than five years and previous history of perinatal death. One sixth had previous cesarean scar.

Chronic hypertension found in 2.1% patients and pre gestational diabetes mellitus was insignificant (0.5%). Anemia was reported in 11.7% of the study participants (Table 2).

Proportion of meconium stained amniotic fluid

The proportion of MSAF was at 149 (24.6%) [95%CI: 21.3–28.2%]. Among women with MSAF, 31.5% had thick liquor upon the first detection which has increased to 35.6% upon delivery. About two thirds of women with MSAF have delivered by cesarean section (CS) and instrumental vaginal delivery. The percentage of ENND, first minute Apgar score < 7 and fifth minute Apgar score < 7 were higher in newborns who were delivered with MSAF than those babies delivered with clear liquor. Similarly, there was an increased risk to undergo neonatal resuscitation and intubation, referral and admission to NICU in those babies who were delivered with MSAF than their counter types. Among newborns that were delivered with MSAF and were admitted to NICU, majorities were admitted with MAS followed by early onset neonatal sepsis and perinatal asphyxia (Table 3).

Table 2
Description of previous and current obstetrics and medical related factors of study participants in Felege Hiwot referral hospital, June-August, 2018(n = 606)

Variables	Category	Number	Percent
Parity	Primipara	244	40.3
	II-IV	291	48
	≥ V	71	11.7
Gestational age in weeks	< 34	46	7.6
	$34–36^{+6}$	60	9.9
	$37–38^{+6}$	182	30
	$39–40^{+6}$	215	35.5
	$41–41^{+6}$	46	7.6
	≥ 42	57	9.4
ANC follow up	Yes	577	95.2
	No	29	4.8
Number of antepartum complications	None	309	51
	One	211	34.8
	Two and above	86	14.2
Antepartum hemorrhage	Yes	51	8.4
	No	555	91.6
Premature rupture of the membranes	Yes	98	16.2
	No	508	83.8
Oligohydromnios	Yes	57	9.4
	No	549	90.6
Intrauterine growth restriction	Yes	49	8.1
	No	557	91.9
Pregnancy induced hypertension	Yes	136	22.4
	No	470	77.6
Duration of labor > 15 hrs	Yes	181	29.9

Variables	Category	Number	Percent
	No	425	70.1
Induction or augmentation	Yes	113	18.6
	No	493	81.4
Non reassuring fetal heart rate pattern	Yes	74	12.2
	No	532	87.8
Previous Cesarean scar	Yes	99	16.3
	No	507	83.7
Interpregnancy interval < 2 years	Yes	60	9.9
	No	546	90.1
Interpregnancy interval > 5 years	Yes	73	12
	No	533	88
Previous history of perinatal death	Yes	62	10.2
	No	544	89.8
Chronic hypertension	Yes	13	2.1
	No	593	97.9
Maternal anemia	Yes	71	11.7
	No	535	88.3

Table 3
Description of labor and delivery outcome variables of study participants in Felege Hiwot referral hospital, June-August 2018 (n = 606)

Variables	Meconium stained amniotic fluid		Clear amniotic fluid	
	Number	Percent	Number	Percent
Mode of delivery				
Spontaneous vaginal delivery	55	36.9	261	57.1
Instrumental delivery	10	6.7	19	4.2
Cesarean section	84	56.4	177	38.7
Newborn sex				
Male	77	51.7	239	52.3
Female	72	48.3	218	47.7
Birth weight in kilograms				
Less than 2.5	32	21.5	104	22.8
≥ 2.5	117	78.5	353	77.2
First minute Apgar score				
< 7	52	34.9	35	7.7
≥ 7	97	65.1	422	92.3
Fifth minute Apgar score				
0	3	2.0	6	1.3
1–3	0	0	0	0
4–6	11	7.4	6	1.3
≥ 7	135	90.6	445	97.4
Newborn resuscitated				
Yes	72	48.3	41	9.0
No	77	51.7	416	91.0
Newborn intubated				
Yes	16	10.7	10	2.2
No	133	89.3	447	97.8

Variables	Meconium stained amniotic fluid		Clear amniotic fluid	
	Number	Percent	Number	Percent
Referral to NICU				
Yes	80	53.7	104	22.8
No	69	46.3	353	77.2
Reason for referral				
Low birth weight	6	7.4	31	29.8
Perinatal asphyxia	7	8.6	5	4.8
Meconium aspiration syndrome	45	55.6	0	0
Early onset neonatal sepsis	12	14.8	22	21.2
Respiratory distress syndrome	4	4.9	10	9.6
Others	7	8.6	36	34.2
Proportion	149	24.9	457	75.4

Factors associated with meconium stained amniotic fluid

In this study the association between demographic, obstetrical, medical history and MSAF were assessed. The variables which showed association at the bivariate analysis were client educational status, monthly income, parity, gestational age, antenatal care status, premature rupture of the membranes, oligohydramnios, post term pregnancy, intrauterine growth restriction, pregnancy induced hypertension, previous CS scar, previous history of perinatal death, interpregnancy interval less than 2 years, maternal anemia, induction and augmentation of labor, NRFHRP and duration of labor > 15 hours. These variables were taken for multi variable analysis to adjust for confounding factors. The Adjusted Odds Ratio (AOR) revealed that presence of non-reassuring fetal heart pattern, post term pregnancy, duration of labor more than 15 hours, pregnancy induced hypertension, oligohydramnios, monthly income of the family and interpregnancy interval less than 2 years had a significant association with MSAF.

The odds of having MSAF among women whose monthly family income was < 5000 Ethiopian birr (ETB) were 2.03(95% CI: 1.18–3.51) times more likely than among women whose monthly income was 5000 ETB or more. Similarly, the occurrence of MSAF in women who had non-reassuring fetal heart rate pattern (NRFHRP) were 21.9(95% CI: 10.96–43.83) times more likely than among women who didn’t have NRFHRP. Likewise, the odd of presence of meconium stained liquor in women with post term pregnancy were 4.54(95% CI: 2.24–9.20) times more likely than those who weren’t post term and women who

labored for more than 15 hours were 2.83(95% CI: 1.76–4.53) times more likely those women whose labor had stayed less than 15 hours (Table 4).

Table 4
Maternal factors associated with meconium stained amniotic fluid, logistic regression analysis, Amhara region, Felege Hiwot referral hospital, Ethiopia, 2018.

Variables	Meconium stained amniotic fluid		COR (95% CI)	AOR (95% CI)	AOR p-value
	Yes	No			
Monthly income in birr					
< 5000	115(19)	304(50.2)	1.71(1.11, 2.62)	2.03(1.18, 3.51)	0.011
≥ 5000	34(5.6)	153(25.2)	1	1	
Oligohydramnios					
Yes	21(3.5)	36(5.9)	1.92(1.10, 3.40)	2.53(1.25, 5.12)	0.010
No	128(21.1)	421(69.5)	1	1	
Post term pregnancy					
Yes	31(5.1)	26(4.3)	4.34(2.49, 7.62)	4.54(2.24, 9.20)	< 0.001
No	118(19.5)	431(71.1)		1	
Pregnancy induced hypertension					
Yes	36(5.9)	100(16.5)	2.28(1.51, 3.44)	2.43(1.45, 4.05)	0.001
No	113(18.6)	357(58.9)	1	1	
Duration of labor > 15 hrs					
Yes	75(12.4)	106(17.5)	3.36(2.28, 4.95)	2.83(1.76, 4.53)	< 0.001
No	74(12.2)	351(57.9)	1	1	
Non reassuring fetal heart rate pattern					
Yes	61(10.1)	13(2.1)	23.68(12.47, 44.94)	21.91(10.96, 43.83)	< 0.001
No	88(14.5)	444(73.3)	1	1	
Interpregnancy interval < 2 years					

Variables	Meconium stained amniotic fluid		COR (95% CI)	AOR (95% CI)	AOR p-value
	Yes	No			
Yes	22(3.6)	38(6.3)	2.84(1.65, 4.91)	2.24(1.12, 4.51)	0.024
No	127(21.0)	419(69.1)	1	1	

Discussion

Meconium stained amniotic fluid is a frequent occurrence in daily obstetric practice. This cross sectional study was conducted to assess the proportion and factors associated with MSAF in women who came to FHRH for labor and delivery service. The proportion of MSAF in this study was at 24.6% [95%CI: 21.3–28.2%] which was higher than previous studies done in Israel (10.9%), India (8.3%), Nigeria (20.4%) and Jimma, Ethiopia (15.4%) [4, 14–17, 25]. This might be as a result of difference in study design, set-up and population. For instance the study in Israel used a retrospective design among women with low risk pregnancies and the one in India had also different incidences within the same population. However, the other study done in India, Kolkata reported MSAF at (30.6%) which was relatively higher than our study. The difference might be difference on the population in which this study included only term pregnancies [21] but in our study pre term women were also included.

With regard to factors associated with MSAF, monthly income of the family was one factor associated with presence of MSAF in laboring mothers. Those women whose monthly income was less than 5000 ETB (185 USD) were 2 times more likely to develop MSAF than those whose income was 5000 ETB (185 USD) and above. This might be explained by women who have low income tends to have delay in seeking medical care, tends to use public transport or may came later when labor prolongs[26]. Presence of oligohydramnios was another factor associated with occurrence of MSAF. In this study, those women who had oligohydramnios were 2.5 times more likely to have meconium stained liquor than those who didn’t have oligohydramnios. Similarly, studies done in India showed that oligohydramnios was significantly associated with MSAF [5, 27, 28]. Fetuses with oligohydramnios usually had low or inadequate energy reserve so when women go into labor there will be fetal intolerance to labor which will be manifested by passage of meconium as a result of hypoxia[29].

In our study, women with post term pregnancy were 4.5 times more likely to have passage of meconium than term and pre term pregnancies. Studies done across the globe including USA, India, Brazil, Israel, Iran, China and Australia showed similar findings [19, 20, 22, 23, 30–32]. This might be explained by maturation of the gastrointestinal tract and increased secretion of motilin by the fetus as gestational age advances which leads to increased fetal bowel peristalsis ending up in passage of meconium [12, 33].

Pregnancy induced hypertension was another factor associated with MSAF and fetuses of women with this disorder were 2.4 times more likely to pass meconium than those women who didn't have this disorder. This result is consistent with other studies[5, 9]. The association of pregnancy induced hypertension with meconium passage is caused by uteroplacental insufficiency which causes fetal hypoxia leading to passage of meconium[34].

Women who labored for more than 15 hours were 2.8 times more likely to develop MSAF than those women who labored for less than 15 hours. This study was similar with other studies done in Lithuania, India and South Korea [9, 35, 36]. The possible explanation for this might be an increased level of corticotrophin releasing hormone resulting in increased cortisol during labor which is a known mediator of colonic motility resulting in meconium passage[37, 38].Women with non-reassuring fetal heart rate pattern (NRFHRP) were nearly 22 times more likely to have meconium stained liquor. Similarly, this finding was consistent with studies done in Nigeria, India (Kolkata) and united states of America [17, 19–21, 30]. The explanation is oftentimes NRFHRP is a sign of hypoxia and hypoxia stimulates arginine vasopressin (AVP) release from the fetal pituitary gland and AVP stimulates colonic smooth muscle to contract, resulting in intra amniotic defecation[29].

The last factor associated with development of MSAF was interpregnancy interval less than 2 years. Women whose interpregnancy intervals less than 2 years were 2.2 times more likely to have meconium stained liquor than others. This might be explained by women who had short interpregnancy interval were high likely to have preeclampsia, increased risk fetal and neonatal death[39].

This was a single site study done in a referral hospital because of time constraint where generalization could be compromised. No direct studies were found to compare association of meconium stained liquor with monthly income and interpregnancy interval less than 2 years. Because of lack of research papers on this area in our country, we have used exploratory study intended to lay the groundwork for a more complete research in the future.

Conclusions

The proportion of MSAF was at 24.6% which was higher than previous study done in Ethiopia Non-reassuring fetal heart rate pattern, post term pregnancy, duration of labor more than 15 hours, pregnancy induced hypertension, oligohydramnios, inter pregnancy interval less than 2 years and monthly family income less than 5000 Ethiopian Birr were factors associated with an increased risk for MSAF. Health professionals should assess laboring women for the presence of these factors and should stay alert to detect MSAF early and to act accordingly.

List Of Abbreviations

APGAR Appearance, Pulse rate, Grimace, Activity, Respiratory rate,

EDHS Ethiopian Demographic Health Survey,

ENND Early Neonatal Death,

ETB Ethiopian Birr,

FHRH Felege Hiwot Referral Hospital,

MSAF Meconium Stained Amniotic Fluid,

NRFHRP Non Reassuring Fetal Heart Rate Pattern,

PNA Peri Natal Asphyxia, RDS: Respiratory Distress Syndrome,

TTN Transient Tachypnea of the Newborn,

WHO World Health Organization

Declarations

Ethics approval and consent to participate: Ethical clearance was obtained from the ethics review committee of the Bahir Dar University. Data collection was conducted after explaining the purpose of the study to the participants and a verbal consent was obtained from each study participant. Data confidentiality was maintained.

Availability of data and materials: All generated data are included in the manuscript.

Competing interests: The authors declare that they have no competing interests.

Funding: This study was funded by college of medicine and health sciences, Bahir Dar University.

Author's contributions: EnA: wrote the proposal, analyze and interpret the findings and write the manuscript. KA: was the major contributor in commenting and writing the manuscript.

ElA: was the major contributor in analyzing the data and also involved in writing the manuscript. AD: evaluated the MS critically for its scientific content. All authors read and approved the final manuscript for submission.

Acknowledgements: authors would like to thank Bahir Dar University and the study participants.

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