MATERNAL AND PERINATAL OUTCOMES OF LABORING MOTHERS WITH MECONIUM STAINED AMNIOTIC FLUID (MSAF) IN JUMC LABOR WARD, SOUTHWEST ETHIOPIA

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A RESEARCH THESIS SUBMITTED TO JIMMA UNIVERSITY COLLEGE OF PUBLIC HEALTH AND MEDICAL SCIENCES, DEPARTMENT OF OBSTETRICS AND GYNECOLOGY SCHOOL OF GRADUATE STUDIES IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE SPECIALTY CERTIFICATE ON OBSTETRICS AND GYNECOLOGY.

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ABSTRACT

Background: Meconium in the amniotic fluid at birth is a common event which has been estimated to occur in up to 25% of births at term and 23–52% among post-term gestations. It may be a normal physiologic event reflecting fetal maturity or it mayreflect fetal hypoxia.

Objectives: To determine maternal and perinatal outcomes of laboring mothers with meconium stained amniotic fluid in Jimma University Medical Center labor ward, Southwest Ethiopia from July 1, 2016 to June 30, 2017.

Methods: A Hospital based prospective cohort study was conducted among 428 laboring mothers. Data was edited and entered into Epi data version 3.1 and then exported to SPSS version 20 for cleaning and analysis. Bivariate logistic regression was conducted to identify explanatory variables for multivariable regression at p-value <0.25. The findings were presented using crude and adjusted odds ratio (OR), 95%CIs of OR . A p-value less than 0.05 was taken to declare statistical significance.

Results: There were 40.7% cases of non reassuring fetal heart rate status, 18.7% neonatal intensive care unit admissions, 14% cases of meconium aspiration syndrme among mothers with meconium stained amniotic fluid. It was found that there was a significant increased risk of unfavorable fetal and neonatal outcomes, as the thickness of meconium increased (grade1: AOR=1.84, 95%CI; 0.94-3.62, Grade 2: AOR=2.81, 95%CI; 1.52-5.2 and Grade 3: AOR=7.36, 95%CI; 3.62-14.99) compared to mothers who had CAF. There was 39.7% cesarean section rate, 15.9% instrumenal deliveries, 19.6% puerperal fever, 3.7% surgical site infectios among mothers with meconium stained amniotic fluid. Mothers with grade 3 meconium stained amniotic fluid were 3 times more likely to have unfavorable maternal outcome compared to those with clear amniotic fluid (AOR=2.59,95CI:1.42-4.73).

Conclusion: Presence of grade 2 and above meconium stained amniotic fluid warrants close fetal monitoring as there are increased risk maternal, fetal and neonatal morbidities in this group. And Presence of non reassuring fetal heart rate status in Grade 2 and above meconium stained amniotic fluid may be considered as a red light to shorten the threshold for intervention. In addition Mothers who delivered through grade 2 and above meconium stained amniotic fluid needs close follow-up after delivery as they are at high risk of having puerperal infections.

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Table of Contents

List of tables

ACRNOMY AND ABBREVATIONS

APH----------antepartum hemorrhage

CAF----------Clear Amniotic fluid

C/S---------- cesarean section

EONS----------early onset neonatal sepsis

JUMC----------jimma university medical center

LFSOL---------- latent first stage of labor

MSAF--- meconium stained amniotic fluid

MAS-----meconium aspiration syndrome

NICU----------neonatal intensive care unit

NRFHRS----------non reassuring fetal heart Status

ONPS----------oronasopharrngeal suctioning

ROM----------rapture of membrane

SVD----------spontaneousvaginaldelivary

INTRODUCTION

The name meconium is derived from the name meconium-arion, meaning “opium-like”, and has been linked with Aristotle’s belief that it induced sleep in the fetus. It first appears within the fetal gastrointestinal tract at 10-12 weeks gestation as a viscous substance made up primarily of water (70-80%). Other constituents include intestinal epithelial cells, squamous cells, lanugo, amniotic fluid, bile acids and salts (giving the characteristic green color), phospholipase A2, interleukin-8, mucus glycoproteins, lipids and proteases. Meconium stained amniotic fluid is graded based on the thickness and accordingly; grade 1(thin) refers to light green or flecking of otherwise clear amniotic fluid, grade 2 refers to brown but thin uniform staining of the amniotic fluid and grade 3 (thick) refers to Bright green or brown thick uniform staining of the amniotic fluid (1).

Meconium in the amniotic fluid (MSAF) at birth is a common event which has been estimated to occur in up to 5% prior to 37 weeks' gestation, 25% of births at term and 23–52% among post-term gestations (2, 3). Passage of meconium in labor is continuing to be a challenge to an attending physician as to the optimal management of these cases. The passage of meconium may be a normal physiologic event reflecting fetal maturity. It may, on the other hand, reflect fetal hypoxia or increased vagal activity from cord compression particularly when there is a transition during labor from clear to meconium (secondary) MSAF (4-8).

A literature review has been done into the pathophysiology of meconium release. Some authors claim the association between fetal distress and meconium release and therefore suggest that it is a pathologic event, whilst others have found only an association between gestational age and MSAF and not with fetal distress, suggesting a more physiological role. Different theories have been proposed in the last years, including impaired swallowing of meconium after physiologic defecation in utero. Furthermore, meconium has been associated with higher levels of intra-amniotic infections (9).

In a literature review done, research from a number of studies support the view that intrauterine exposure to meconium is associated with inflammation of tissues of the lung, chorionic plate and umbilical vessels and through various mechanisms may contribute to neonatal morbidity, independent of MAS. Few studies reported that, in the presence of MSAF, both early and late-onset neonatal sepsis increased however, it is unclear if these infections were the consequence of MSAF, or whether pre-existing intrauterine infection contributed to the MSAF and subsequent neonatal infection (10).

MSAF in labor is thought to be associated with different maternal morbidities: chorioamnionitis, postpartum infections, high rate of cesarean section and instrumental deliveries and fetal and neonatal morbidity: non reassuring fetal heart patter, meconium aspiration syndrome (MAS), low first and fifth minutes Apgar scores, high neonatal sepsis, neonatal intensive care unit admission (NICU) (10-13).

STATEMENT OF THE PROBLEM

Although in utero passage of meconium may represent normal gastrointestinal tract maturation under neuronal control, it may be a potential sign of fetal hypoxia and a potential toxin if the fetus aspirates particulate matters with a gasping breath in utero or when it takes its first breaths following birth (14-18). In addition to this the condition of the mother who gives birth in such circumstances is a concern. The significance of meconium in amniotic fluid is a widely debated subject. Traditionally meconium has been viewed as a harbinger of impending or ongoing fetal compromise; however some investigators believe that it is not associated with fetal hypoxia, acidosis or fetal distress (19).

Although 12 to 22 percent of labors are complicated by meconium , only a few are linked to Infant morbidity and mortality (20). Globally, the optimal Management of laboring mothers with Meconium stained amniotic fluid remained controversial despite different research results for the managing health provider and varies from center to center (21). The same is true in Ethiopia in general and in Jimma University Specialized Hospital (JUSH) in particular where there is no evidence about maternal and perinatal outcomes of laboring mothers with MSAF. Furthermore, globally there is no clear guideline as to the optimal management of laboring mothers with MSAF and it is very crucial to generate local evidence considering the local context of optimal management of these cases.

This research is, therefore, aimed at determining the maternal, intra-partum fetal and early neonatal outcomes of mothers with MSAF who will be managed in JUSH during the study period.

SIGNIFICANCE OF THE STUDY

Although Meconium stained amniotic fluid (MSAF) is a common event at term and post term pregnancy, there is continuing concern about the risk of adverse event especially to the fetus. As a result attending health provider at labor and delivery is always in a dilemma whether the fetus will be in danger or not if the labor is allowed to progressing. There are different researches done to see the effect of meconium on perinatal and fetal outcomes. However, none came out with consistent evidence and the understanding and the optimal management of these cases remained controversial. There is very limited study in developing countries/black races where MSAF is said to be common compared to white people. To the knowledge of the authors, there is no study published in Ethiopia to see the magnitude of the problem, related complications or maternal and perinatal outcomes. The same is true in Jimma university teaching Hospital (JUMC) where the management of MSAF in labor is controversial and depends on individual experiences. Thus, this gap is enough reason to conduct this research in JUMC and come up with robust evidence which is local as to the management of MSAF in labor.

LITERATURE REVIEW

Meconium stained amniotic fluid

In different researches MSAF is related to poorer neonatal outcome (22-28). This includes lower APGAR-scores and lower cord blood pH levels. In addition, in some studies more neonatal admission to intensive care units (ICU) and more perinatal death (22, 25, and 27). This association is seen as a proof that hypoxia leads to more intrauterine meconium release. One of the known risks of MSAF is the meconium aspiration syndrome (MAS). About 5% of the infants with MSAF develop MAS, which still has a mortality rate of 2.5% in the developed world and up to 35% in the developing world (29, 30). The lower APGAR-scores, the more admission to a neonatal ICU and the higher perinatal death figures could therefore be an effect of MAS rather than that it supports the theory that fetal hypoxia leads to more MSAF.

Lower pH-levels and thus more acidosis on the other hand cannot be related to MAS only and supports the theory of fetal hypoxia leading to MSAF. However, in some studies no differences in pH levels are found in the case of MSAF (31, 32). Furthermore researchers performed sympathectomy in animal models and then put those animals in a hypoxic environment. Compared to controls, there was no meconium release in the sympathectomised animals, but all animals in the control group did defecate after the hypoxic event. In addition, meconium by itself can have a vaso-constrictive effect on the umbilical cord and lead to necrosis and ulceration of the cord (34) which can result in more fetal hypoxia. This does not necessarily mean that more hypoxia leads to fetal meconium release. Therefore, researchers couldn’t determine the exact pathophysiologic mechanism underlying the association between MSAF and fetal hypoxia. In a small study, placentas from neonates with MSAF have been pathologically examined and placenta's thickening of the basal membrane was observed and more apoptosis was found (28). These findings have also been described in growth-restricted infants and placentas of infants with fetal distress and are therefore suggested to be ultra-structural changes to hypoxia. Small for gestational age is also an independent risk factor for meconium-stained amniotic fluid (35). In an experimental animal study it has been indicated that hypoxemic stress leads to reduced swallowing of meconium-stained amniotic fluid, instead of more meconium release [33]. This might explain the association between more meconium stained amniotic fluid and poor perinatal outcome, but not in the pathophysiologic way as previously proposed.

The “thickness” of meconium had a direct bearing on the neonatal outcome. Various studies have been carried out to detrmine the relation of MSAF with the perinatal outcome. It was seen that perinatal outcome was similar in thin meconium stained and clear amniotic fluid. While the moderate to thick MSAF are associated with meconium aspiration syndrome (MAS). All cases of MAS were seen in thick meconium compared to thin meconium and Incidence of birth asphyxia was significantly higher in thick meconium compared to thin meconium. (54,55,56). There was a 16 times increased risk of low 5th minute Apgar score for those newborns delivered with thick meconium stained liquor (OR=15.74, 95% CI: 1.893-130.908) after controlling the effect of confounding variables (52). The significant association between the thickness of meconium stained liquor and the fifth minute Apgar score can be explained by the high incidence of MAS in this study, MAS as a cause rather than an effect.

The management strategies can generally be divided in two categories: preventive intervention and “wait and watch” strategy. The first group again can be divided in two categories: the prevention of MSAF to occur and the prevention of any fetal or neonatal complication once MSAF is diagnosed. The possible benefit of the “wait and watch” strategy, in which neonatal complications when they occur after a MSAF delivery are vigorously monitored and treated, is largely dependent on the level of peripartum facilities. The conservative therapy, carefully monitoring of the neonate born after MSAF followed by “aggressive” intervention when problems occur, seems to be the most appropriate attitude towards the management of MSAF. However, it is obvious that the level of peripartum surveillance dramatically will influence the figures of neonatal complications. Amnio-infusion might reduce perinatal complications in MSAF cases treated in a center with limited peripartum facilities while there is sufficient evidence that “wait and watch” in normal peripartum surveillance centers adequately meet the attitude towards adequate handling of MSAF (53)

Meconium stained amniotic fluid: maternal and perinatal outcomes (intra-partum fetal and early perinatal outcomes).

A study showed that MSAF at term was associated with an increased incidence of microbial invasion of the amniotic cavity (MIAC). Therefore, the index of suspicion for an infection-related process in postpartum women and their neonates should be increased in the presence of MSAF (36). Furthermore, a comparative cross sectional study estimated

whether the presence of meconium increased the risk of adverse neonatal outcomes (37). In this study meconium is associated with respiratory morbidity (Respiratory distress, transient tachypnea of the newborn infant, or need for ventilatory support) (4.9% vs 2.3%; aOR, 2.16 95% CI 1.37-3.42), suspected sepsis (6.1% vs 2.8%; 2.33; 95% CI, 1.55-3.51), neonatal intensive care unit admission (2.5% vs 0.8% aOR 2.84; 95% CI, 1.48-5.44), Apgar <7 at 5 minutes (3.9% vs 1.2%; aOR, 2.76 95% CI 1.62-4.86).

In addition, the presence of non-reassuring fetal heart rate pattern (NRFHRP) in labor was associated with an increased risk of perinatal mortality and/or neonatal morbidity (moderately abnormal: adjusted odds ratio (OR), 1.67; 95% confidence interval [CI], 1.18-2.37; markedly abnormal: adjusted OR, 2.97; 95% CI, 1.88-4.67). Specific abnormalities that were associated with the risk of perinatal mortality and/or neonatal morbidity included prolonged decelerations (OR, 1.22; 95% CI, 1.02-1.48), severe variable decelerations (OR, 1.08; 95% CI, 1.00-1.16), bradycardia (OR, 2.49; 95% CI, 1.02-6.11), and tachycardia (OR, 2.43; 95% CI, 1.49-3.94). This implies that the presence of abnormal NRFHRP in meconium-stained amniotic fluid patients is associated with an increased risk of adverse perinatal outcomes (38, 39).

Meconium aspiration syndrome (MAS) may develop in 5% of infants born with meconium-stained amniotic fluid. Intra-partum suctioning of the airway after delivery of the head/intra-partum oropharyngeal suctioning (IP-OP) but before delivery of the shoulders has been advocated as a means of reducing the incidence of MAS. However, current evidences no longer recommend routine intra-partum suctioning of the oropharynx and nasopharynx of neonates delivered following labors complicated by MSAF (40-42). In Cochrane review, Curtailment of post-term pregnancy reduces the occurrence of meconium-stained amniotic fluid, and meconium aspiration syndrome. Uterine stimulants, particularly misoprostol, are associated with occurrence of meconium-stained amniotic fluid. Amniotomy during labor may be a risk factor for meconium aspiration syndrome. There is little research evidence on the benefits or otherwise of obstetric interventions such as expedited delivery for meconium-stained liquor without other evidence of fetal distress. Amnio infusion for meconium stained amniotic fluid improves neonatal outcome only in settings with limited peripartum surveillance. There is insufficient evidence to support the use of amnioin fusion for meconium-stained liquor in settings with adequate peripartum surveillance (43).

Many studies have shown that Meconium may be passed in response to fetal distress. The presence of meconium-stained amniotic fluid is thus commonly taken as an indication of possible fetal distress [44, 45]. However, the predictive values of meconium-stained amniotic fluid for fetal distress are poor [46–49]. As with any diagnostic test with low predictive values, the potential exists for medical interventions in response to meconium-stained amniotic fluid to do more harm than good. In the absence of direct evidence from clinical trials, a balanced response to meconium-stained amniotic fluid would be to assess fetal wellbeing by other means, but not to expedite delivery on the basis of meconium-stained amniotic fluid alone. There is also no evidence to support the use of amniotomy specifically to check for meconium staining of the amniotic fluid

Regarding the maternal outcomes, in a retrospective cohort study, the presence of MSAF has been shown to increase cesarean section rate in labor 16% vs 9% ($p<0.01$), operative vaginal delivery 13.9% vs 6.2% ($p< 0.01$) (50). Chorioamnionitis is more likely to occur when meconium-stained amniotic fluid (MSAF) is present. Meconium may enhance the growth of bacteria in amniotic fluid by serving as a growth factor, inhibiting bacteriostatic properties of amniotic fluid. Many adverse neonatal outcomes related to MSAF result from Meconium Aspiration Syndrome (MAS). MSAF is associated with both maternal and newborn infections. Antibiotics may be an effective option to reduce such morbidity. Prophylactic antibiotics appeared to have no statistically significant reduction in the incidence of neonatal sepsis (risk ratio (RR) 1.00, 95% CI 0.21 to 4.76), neonatal intensive care unit (NICU) admission (RR 0.83, 95% CI 0.39 to 1.78) and postpartum endometritis (RR= 0.50, 95% CI 0.18 to 1.38). However, significant decrease in the risk of chorioamnionitis (RR= 0.29, 95% CI 0.10 to 0.82). No serious adverse effects were reported (51). Study found Presence of meconium was strongly associated with increased severe form of SSIs ($p = 0.009$) and Meconium-stained amniotic fluid is associated with increased postpartum infection independent of other risk factors for infection. (57,58)

OBJECTIVES

General objectives

To determine maternal and perinatal outcomes of laboring mothers with meconium stained amniotic fluid (MSAF) in Jimma University Medical center, labor ward, Southwest Ethiopia from July 1, 2016 to June 30, 2017.

Specific objectives

1. To determine maternal outcomes in laboring mothers with MSAF
2. To determine intrapartum fetal outcomes in laboring mothers with MSAF
3. To determine early neonatal outcomes in laboring mothers with MSAF
4. To compare maternal outcomes in laboring mothers with MSAF and no MSAF
5. To compare perinatal outcomes in laboring mothers with MSAF and no MSAF
6. To assess risk factors associated with poor maternal and perinatal outcomes

METHODS AND PARTICIPANTS

Study area and period:.

The study was conducted in Oromia Region, Jimma Zone, Jimma Town, at Jimma University Medical centers, Obstetrics and Gynecology Department, Obstetrics ward from July 1, 2016–June 30, 2017

Study design:

Prospective cohort study design was used on all laboring mothers who were coming to JUMC labor ward for delivery during the study period and fulfilling the criteria

Source population:

All laboring mothers who came to JUMC, labor ward for delivery

Study population:

Sample of laboring mothers who came to JUMC labor ward during the study period and fulfilling the inclusion criteria.

- Exposed group: laboring mothers and their fetuses and newborns with MSAF
- Non-exposed: laboring mothers and their fetuses and newborns without MSAF

Inclusion criteria: Laboring mothers with singleton, term, cephalic presentation, and spontaneous onset of labor with and without MSAF on spontaneous rupture of membranes or artificial rupture of membranes regardless of their labor stage were included in the study.

Exclusion criteria: Laboring mothers with MSAF who had operative deliveries on arrival for other indications, those with intrauterine fetal deaths, chorioamnionitis,, APH and those who had medical complications were excluded.

Sample size determination and sampling technique

Sample size determination: Sample size was determined based on two population proportion formula as n1=$\left[\frac{Z\alpha}{2}\sqrt{pq\left(1+\frac{1}{r}\right)}+Z\beta\sqrt{p1q1+\frac{p2q2}{r}}\right]^2/[p1-p2]^2$,

Where,

- p=(p1+rp2)/(1+r)
- r=n_2/n_1=1
- Zα/2= Standardized normal distribution at 5% significance level α=1.96
- Zβ= power (1-β) =80%=0.84
- p2= expected prevalence of cesarean delivery (outcome) among un-exposed)=18%
- Risk ratio (RR)= 1.667
- n_1=exposed groups =214
- n_2 =un-exposed groups=214 (calculated from n2=n1r)

To calculate the sample size outcomes of MASF like Apgar score, neonatal admission, Meconium aspiration syndrome, neonatal death and mode of delivery was considered. Mode of delivery (C/S), however, yield the maximum sample size and it was taken as main explanatory variable to calculate sample size.

In the above formula, p2 is the expected prevalence of cesarean delivery (outcome) among non-MSAF which was taken from other study (13). As per this study, mothers who had MASF had higher risk of C/S compared to mothers who had clear liquor. Considering this, this study is aimed to detect 1.667 risk ratio (calculated from 18% expected prevalence of cesarean delivery difference between exposed and un-exposed) of having C/S delivery among exposed groups when compared to non-exposed groups. As a result, in this study, for every exposed participant (n1=214) there was one un-exposed participant (n2=214) that was included in this prospective cohort. Therefore, the total sample size was 428 laboring mothers who fulfilled the inclusion criteria.

Sampling techniques: Eligible laboring mothers attending labor ward of JUMC were recruited consecutively in the study until the required sample was achieved.

Study variables

- Socio-demographic characteristics: marital status, religion, ethnicity, income, residence, occupation, family size

- Obstetrics: parity, duration of labor, labor stage, gestation age, previous still birth, previous abortion
- Maternal: maternal education, age at marriage, Risky behaviors (alcohol drinking, cigarette smoking, khat chewing, multiple sexual partner)
- Prenatal: birth weight, birth order, Meconium related (grade), , fetal tachycardia, bradycardia,
- Maternal and perinatal outcomes: mode of delivery (C/S, vaginal, instrumental), mortality, morbidities(surgical site infections, endomyometritis) Meconium aspiration syndrome, chemical pneumonitis, Apgar score, respiratory distress

Dependent Variables:

- Unfavorable fetal and Neonatal outcome
- Favorable fetal and Neonatal outcome
- Unfavorable Maternal Outcome
- Favorable Maternal outcome

Data collection plan: An interviewer-administered structured English version questionnaire was used to collect data on socio-demographic characteristics, obstetrics, maternal and perinatal exposures and maternal and perinatal outcomes of MASF. Data was collected by two midwiferies and four gyn-obs residents after they were trained on how to collect data with demonstration of few cases. The laboring mothers were admitted to labor ward and feto-maternal conditions were followed as per the routine labor ward protocol until delivery. The maternal and newborn outcomes were followed for the 1st seven days postpartum. Clinical records of the newborns that were referred to neonatology was reviewed for the possible neonatal outcomes. Mothers discharged before 7 days were followed using phone call for the possible maternal and neonatal outcomes. The mothers were called on phone at least two times in those periods.

Data analysis plan:

The collected data was edited and entered into Epi data version 3.1 and then exported to SPSS version 20 for cleaning and analysis. Data was explored first to cleaned (check for outliers, missing values and normality) using descriptive statistics. Descriptive statistics (for mothers and newborn) such as percentages and frequency counts was produced

Incidence of the outcomes of MSAF was determined after the end of the study for mothers and their respective newborns. Cross-tabulation result was conducted and simple relationship was checked between dependent and independent variables. Validity of chi-

squared test was checked for the binary logistic regression analysis. Variables for which chi-squared was not valid, fissure exact test was used. Assumptions of logistic regression was checked and bivariate logistic regression was conducted to identify explanatory variables for multivariable regression at p-value <0.25.

Biologically plausible explanatory variables were entered in to multivariable logistic regression to identify independent predictors of outcome variable. The findings were presented using crude and adjusted risk ratio (RR), 95%CIs of RR and p-values. A p-value less than 0.05 was taken to declare statistical significance and all variables with p-value less than 0.05 was considered as independent predictors of outcome variable.

Data quality assurance:

The study protocol was approved by the ethical Review Board of Jimma University. The study participants were informed about the objective and benefits of the study following which informed consent was taken. All the information accessed during the study was used for the purpose of this study alone.

Operational definition:

In this study, the following operational definitions were used.

1. Perinatal period: Intrapartum pus early neonatal period is considered in this context
2. Perinatal mortality rate: the number of still births plus early neonatal deaths per 1000 total births.
3. Primary MSAF: meconium stained amniotic fluid detected with the onset of labor
4. Secondary MSAF: considered when clear amniotic fluid is changed to meconium stained amniotic fluid through the course of labor
5. Non reassuring fetal heart pattern (NRFHRP): (Fetal Tachycardia, Fetal bradycardia, late deceleration, variable deceleration, no variability)
6. Unfavorable fetal and neonatal outcomes: NRFHRP, intrapartum fetal death, low APGAR scores, need for neonatal resuscitation, NICU admission, MAS, EONS and neonatal death within 7days of life,

7. Unfavorable maternal outcomes: operative deliveries (C/S and operative vaginal deliveries), puerperal sepsis, endometritis, surgical wound infection and maternal death.

Ethical consideration:

Ethical clearance was obtained from the Ethics Review Committee of the College of Public Health and Medical Sciences of Jimma University. Letter of permission was given to Jimma University Medical center administration body to commence study at labor ward. The objective of the study was explained to study participants. Verbal informed consent of participation was obtained from study participants.

The participation in study was on voluntary basis and the participants can withdraw from the study at time of follow up. Participants were ensured that all data collected from them will be used only for the research purpose. The confidentiality of participants' data was ensured by using unique registration codes. Participants' identifier (name) was not written on questionnaire. Data collectors were strongly advised not to disclose any study participants' data.

Dissemination plan:

The findings of this study will be communicated to Jimma University Specialized Hospital. The study will also be presented on different national and international conferences. The study findings will also be communicated to national and international community's by submitting to national or international reputable journals for publication.

RESULTS:

SOCIO-DEMOGRAPHIC CHARACTERTICS

Most of the respondents were Oromo by Ethnicity 311(72.7%) and Muslims by religion 258(60.3%). Three hundred ninety three (91.8%) were in the age group 18-35 years and 99 (23.1%) of mothers were grade 9-12, while 97 (22.7%) were illiterate. Majority (99.3%) of the laboring mothers, were married and nearly two third of mothers' occupation was house wife. Majority, 373(87.1%) of them earns 1000 ETB and above per a month which was above the poverty line as per scale of the country and 55 (12.9%) of mothers earns below the poverty line (Table 1)

Table 1. Socio-demographic characteristics of laboring mothers with meconium stained amniotic fluid and clear amniotic fluid in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

Demographic variables		Frequency (N=428)	%
Age of mothers in years	<18	21	4.9
	18- 35	393	91.8
	>35	14	(3.3
Ethnicity	Oromo	311	72.7
	Amhara	73	17.1
	Tigre	7	1.6
	Gurage	17	4
	Dawro	15	3.5
	Others*	5	1.2
Religion	Muslim	258	60.3
	Orthodox	102	23.8
	Protestant	66	15.4
	Others**	2	0.5
Educational status	illiterate	97	22.7
	Read and write only	50	11.7
	Grade 1-8	90	21
	Grade 9-12	99	23.1
	>grade 12	92	21.5
Occupation	Housewife	275	64.3
	Civil servant	89	20.8
	Farmer	29	6.8
	Merchant	29	6.8
	Others ***	6	1.4
Marital status	Married	425	99.3
	Divorced	3	0.7
Household monthly income	<1000ETB	55	12.9
	≥1000ETB	373	87.1

Others*-----Yem, Kafcho; Others** ------- waqefata, Catholic; Others*** nurse

One hundred twenty (56.1%) study participants with Meconium Stained Amniotic Fluid (MSAF) and Clear Amniotic Fluid (CAF) were primiparous. Ninety nine percent of exposed and 213 (99.5%) of non-exposed had ANC follow up. Hundred twenty six (58.9%) of exposed and 125 (57.9%) of non- exposed were in latent phase of first stage of labor at time of admission. Seventy five (35%) of exposed and 57(26.6%) of non- exposed mothers labored for a total of 20 hours and above. Hundred sixty two (75.7%) of exposed and 186 (86.9%) of non- exposed had spontaneous rupture of membrane.

Considering the mode of deliveries, 85 (39.7%) of exposed and 35 (16.4%) of non-exposed underwent cesarean section (C/S), and in 49 (22.9%) of exposed groups and 23(10.7%) of non-exposed groups cesarean section was indicated for non-reassuring fetal heart status (NRFHRS). Instrumental vaginal deliveries were applied for 34(15.9%) of exposed and 31(14.5%) of non- exposed, being NRFRS was the most common indication- in 31(14.5%) of exposed and in 19(8.9%) of non-exposed. In hundred eighty eight (87.9%) of exposed and in 186(86.9%) of non-exposed birth weight was 2500-4000grams. (Table 2)

Table 2: Obstetric conditions of laboring mothers with MSAF and CAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

Variables		Frequency(N=428)	With MSAF (N=214)	With CAF (N=214)
Parity	Primipara	240(56.1%)	120(56.1)	120(56.1)
	Multipara	188(43.9%)	94(43.9)	94(43.9)
ANC follow up	Yes	424(99.1%)	213(99.5)	211(98.6)
	No	4(0.9%)	1(0.5)	3(1.4)
Length of labor in hrs	Less than 20	296(69.2%)	139(65)	157(73.4)
	20 and above	132(30.8%)	75(35)	57(26.6)
stage of labor at admission	Latent phase	250(58.4%)	126(58.9)	124(57.9)
	active phase	178(41.6%)	88(41.1)	90(42.1)
Rapture of membrane	spontaneous	348(81.3%)	162(75.7)	186(86.9)
	Artificial rapture	80(18.7%)	52(24.3)	28(13.1)
Mode of delivery	SVD	243(56.8%)	95(44.4)	148(69.2)
	C/s	120(28%)	85(39.7)	35(16.4)
	Instrumental delivery	65(15.2%)	34(15.9)	31(14.5)
Indication for C/S	NRFHRP	72(16.8%)	49(22.9)	23(10.7)
	CPD	13(3%)	9(4.2)	4(1.9)
	failed augmentation	12(2.8)	9(4.2)	3(1.4)
	G3MSAF + prolonged LFSOL	16(3.7%)	16(7.5)	0
	Other indication	7(1.6%)	2(0.9)	5(2.3)
Instrumental indication	NRFHRS	50(11.7%)	31(14.5)	19(8.9)
	Pronged second stage 2ry to poor maternal effort	4(0.9%)	3(1.4)	1(0.5)
	for shortening second stage	3(0.7)	0	3(1.9)
	Other indication	8(1.7)	0	8(3.7)
Birth weight in grams	2500-4000	374(87.4%)	188(87.9%)	186(86.9%)
	<2500	23(5.4%)	12(5.6%)	11(5.1%)
	≥4000	31(7.2%)	14(6.5%)	17(7.9%)

Cesarean section was the mode of delivery in 85(39.7%) of mothers with MSAF while operative vaginal deliveries were in 34(15.9%) of cases with MSAF. Forty two (19.6%) of mothers with MSAF developed puerperal sepsis and 8(3.7%) developed surgical site infection. One mother with MSAF had episiotomy site infection. Forty (18.7%) of mothers with MSAF stayed in hospital for 4-7 days in hospital.(Table 3)

Table 3. Maternal outcomes of mothers with MSAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017

Variables		Total(N=214)	%
Mode of delivery	SVD	95	44.4
	C/s	85	39.7
	Instrumental delivery	34	15.9
post-op/post partum condition	puerperal sepsis	42	19.6
	SSI	8	3.7
	episiotomy site infection	1	0.5
	no morbidity	163	76.2
hospital stay in days	up to 3days	174	81.3
	4-7 days	40	18.7

Eighty seven (40.7%) of mothers with MSAF had NRFHRS. There was one still birth among laboring mothers with MSAF. Mothers with MSAF had APGAR scores lower than 7 in one 128 (59.8%), 52 (24.3%) and 9 (4.2%) of cases at 1^{st}, 5^{th} and 10^{th} minute respectively. One hundred twenty eight (59.8%) of neonate delivered to mothers with MSAF required resuscitation upon delivery. Drying and rapping plus ONPS was the types of resuscitation given for 52(24.3%) of neonates born to mothers with MSAF. ONPS + bag ventilation given to 4(0.9%) neonates delivered to mothers with MSAF. There were 40 (18.7%) neonatal intensive care unit (NICU) admission among neonates delivered through MSAF of which 30 (14%) diagnosed with meconium aspirtion syndrome (MAS) and one neonate diagnosed with EONS. Sixteen (7.5%) of neonates born to mothers with MSAF died within seven days of life. (Table 4)

Table 4. Fetal and neonatal outcomes of laboring mothers with MSAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

Variables		Total (N=214)	%
Fetal heart rate status	NRFHRS	87	40.7
	normal FHR	127	59.3
Fetus status at delivery	alive	213	99.5
	dead	1	0.5
APGAR at 1st minute	<7	128	59.8
	≥7	86	40.2
APGAR at 5th minute	<7	52	24.3
	≥7	162	75.7
APGAR at 10th minute	<7	9	4.2
	≥7	205	95.6
Need for resuscitation	yes	128	59.8
	no	86	40.2
Types of neonatal resuscitation	Drying and rapping + ONPS	52	24.3
	ONPS + bag ventilation	4	0.9
NICU admission	yes	40	18.7
	no	174	81.3
Diagnosis at NICU	MAS	30	14
	EONS	1	0.5
	OTHER*	7	3.3
Hospital(NICU) stay in days	Up to 3 days	14	6.5
	4-7 days	26	12.1
Fetal outcomes in those admitted to NICU	Dead	14	6.5
	Discharged improved	26	12.1
Condition of newborn at discharge and till 7th day of life	alive	198	92.5
	dead	16	7.5

Eighty seven (40.7%) of mothers with MSAF and 45 (21%) of mothers with CAF had NRFHRS. The presence of MSAF increased the risk of having NRFHRS around 3 times compared to CAF (COR=2.57, 95%CI=1.68-3.94). Hundred twenty eight (59.8%) of cases with MSAF and 61 (28.5%) of cases with CAF had APGAR scores <7 at 1st minute. Fifty five ((25.7%) of neonates born through MSAF and 15 (7%) of neonates born through CAF had APGAR scores <7 at 5th minute. Nine (4.2%) of neonates born to mothers with MSAF and one neonate born to mother with CAF had APGAR scores <7 at 10th minute. It showed MSAF increased the risk of low APGAR scores (<7) among mothers with MSAF 4 times at 1st minute, 5 times at 5th minute and 8 times at 10th minute compared to those with CAF. Hundred twenty eight (59.8%) of neonates born to mothers with MSAF and 61 (28.5%) of neonates born to mothers with CAF required resuscitation. It showed neonates born to mothers with MSAF were around 4 times chance to require resuscitation compared to those born to mothers with CAF. Forty (18.7%) of neonates born to mothers with MSAF and 7 (3.3%) of neonates born to mothers with CAF were admitted NICU. The risk for NICU admission was 7 times in neonates born to mothers with MSAF compared to those born mothers with CAF. Sixteen (7.5%) of neonates born to mothers with MSAF and 3 (1.4%) of neonates born to mothers with CAF died within seven days of life. Risk for early neonatal death increased about 6 times for neonates born to mothers with MSAF compared neonates born to mothers with CAF. (Table 5)

Table 5: Fetal and neonatal outcome in laboring mothers with MSAF versus mothers with CAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

variables		With MSAF N=214	CAF N=214	*COR (95%CI)	P.V
Fetal heart rate	NRFHRS	87(40.7)	45(21)	2.57(1.68-3.94)	0.00
	normal FHR	127(59.3)	169(79)	1	
Fetus status at delivery	alive	213(99.5)	213(99.5)	1	
	dead	1(0.5)	1(0.5)	1(0.062-16.09)	1
APGAR score at 1st minute	<7	128(59.8)	61(28.5)	3.9(2.6-5.84)	0.00
	≥7	86(40.2)	153(71.5)	1	
APGAR score at 5th minute	<7	55(25.7)	15(7)	4.59(2.5-8.43)	0.00
	≥7	159(74.3)	199(93)	1	
APGAR score at 10th minute	<7	9(4.2)	1(0.5)	8.27(1.03-66.72)	0.047
	≥7	205(95.6)	213(99.5)	1	
Need for resuscitation	yes	128(59.8)	61(28.5)	3.73(2.49-5.59)	0.00
	no	86(40.2)	153(71.5)	1	
NICU admission	yes	40(18.7)	7(3.3)	6.8(2.97-15.56)	0.00
	no	174(81.3)	207(96.7)	1	
Condition of newborn at discharge and till 7th day of life	alive	198(92.5)	211(98.6)	1	
	dead	16(7.5)	3(1.4)	5.68(1.63-19.8)	0.006

Others* ----transient tachypnea of new-born, hypoglycemia, hypothermia

*Reference Group is those with CAF.

Regarding maternal complications, 51 (23.8%) mothers with MSAF and 30 (14%) mothers with CAF developed one of the morbidities like puerperal sepsis, surgical site infection (SSI) and episiotomy site infection. The risk to develop one of the morbidities was about 2 times for mothers with MSAF compared to mothers with CAF. Forty (18.7%) of mothers with MSAF and 17 (7.9%) of mothers with CAF stayed in hospital after delivery for 4-7days. The chance to stay 4-7days in hospital after delivery was 3 times for mothers with MSAF compared to mothers with CAF. Hundred nineteen (55.6%) of mothers with MSAF and 66 (30.8%) of mothers with CAF had operative deliveries. The chance to have operative deliveries was about 3 times in mothers with MSAF compared to those with CAF. (Table 6)

Table 6. Outcomes of laboring mothers with MSAF versus those with CAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

Variables		MSAF(N=214)	CAF(N=214)	*COR(95%CI)	P.V
Maternal postpartum/post op condition	no morbidity	163(76.2)	184(86)	1	
	with morbidity	51(23.8)	30(14)	1.91(1.17-3.16)	0.01
Duration of hospital stay for	Up to 3 days	174(81.3)	197(92.1)	1	
	4-7 days	40(18.7)	17(7.9)	2.66(1.46-4.87)	0.00
Mode of deliveries	SVD	95(44.4)	148(69.2)	1	
	Operative	119(55.6)	66(30.8)	2.8(1.89-4.17)	0.00

*Reference Group is those with CAF

A binary logistic regression analysis found there was 3 times and 12 times increased risk of unfavorable fetal and neonatal outcomes in grade 2 MSAF (COR=3.19,95%CI;1.82-5.58) and grade 3 MSAF (COR=11.68,95%CI;5.99-22.77) respectively compared to those with CAF. The chance to have unfavorable fetal and neonatal outcome was 9 times higher among mothers who underwent operative deliveries compared to those delivered by spontaneous vaginal delivery (SVD) (COR=8.57; 95%CI; 5.44-13.5). Neonates with birth weight ≥4000grams had 62% more likely to have favorable outcomes compared to neonates with normal birth weight (COR=0.38, 95%CI; 0.17-0.83) (table 7)

Table 7: Factors affecting fetal and neonatal outcomes, among laboring mothers with MSAF and with CAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017..

Variables		Neonatal and fetal outcomes		Bivariate results	
		Favorable N=197	Unfavorable N=231	COR (95%CI)	P.V
Status of amniotic fluid	Clear	135(68.5)	79(34.2)	1	
	Grade 1	25(12.7)	25(10.8)	1.71(0.92-3.18)	0.061*
	Grade 2	25(12.7)	46(19.9)	3.14(1.8-5.5)	0.000*
	Grade 3	12(6.1)	81(35.1)	11.54(5.92-22.47)	0.000*
Mode of deliveries	SVD	162(82.2)	81(35.1)	1	
	Operative	35(17.8)	150(64.9)	8.57(5.44-13.5)	0.000*
Duration of ROM	<12hr	139(70.6)	153(66.2)	1	
	≥12hrs	58(29.4)	78(33.8)	1.43(0.93-2.18)	0.1*
Duration of labor	< 20hrs	141(71.6)	155(67.1)	1	
	≥20hrs	56(28.4)	76(32.9)	1.24(0.82-1.87)	0.318
Parity	Primipara	115(58.4)	125(54.1)	1	
	Multipara	82(41.6)	106(45.9)	1.19(0.81-1.75)	0.38
Age in years	18-35	175(88.8)	219(94.8)	1	
	<18	13(6.6)	7(3)	0.43(0.17-1.102)	0.079*
	≥35	9(4.6)	5(2.2)	0.44(0.15-1.34)	0.152*
Income per month(ETB	<1000	27(13.7)	28(12.1)	0.87(0.49-1.53)	0.628
	≥1000	170(86.3)	203(87.9)	1	
Birth weight in grams	2500-4000	166(84.3)	208(90)	1	
	<2500	10(5)	13(5.6)	1.04(0.44-2.43)	0.932
	≥4000	21(10.7)	10(4.3)	0.38(0.17-0.83)	0.015
Time when meconium detected	No meconium	134(68)	79(34.2)	1	
	Upon admission	54(27.4)	109(47.2)	1.08(0.65-1.77)	0.776
	After admission	9(4.6)	43(18.6)	2.32(1.05-5.12)	0.036*

*variable with p-value <0.25 is a candidate for multivariable regression

Eighty one (35.1%) of neonates with at least one unfavorable outcome and 12 (6.1%) of neonate with favorable outcomes were born to mothers with grade-3 MSAF. A stepwise multiple logistic regression analysis revealed that, there was 8 times increased risk of unfavorable fetal and neonatal outcomes among mothers with grade-3 MSAF compared to those mothers with CAF (AOR=7.54,95%CI:3.67-15.47).

It was found there was a significant increased risk of unfavorable fetal and neonatal outcome, as the grade of MSAF increased (grade1: AOR=1.84, 95% CI; 0.92-3.66, Grade 2: AOR=2.94, 95% CI 1.58-5.47 and Grade 3: AOR=7.54, 95% CI; 3.67-15.47) compared to those mothers who had CAF.

Mothers who underwent either of the operative deliveries were 7 times more likely to have new-born with unfavorable outcomes compared to mothers who delivered by spontaneous vaginal delivery (AOR=6.6, 95%CI; 4.06-10.74).hundred fifty (64.9%) of neonates with unfavorable outcomes and 35 (17.8%) of neonates with favorable outcomes were delivered by either of operative deliveries. Mothers whose age was 35 and above had 72% more likely to have neonates with favorable outcomes. It was found there was no statistically significant association between duration of labor, duration of ROM, parity, family income and neonatal outcomes. (Table 8)

Table 8: Factors affecting fetal and neonatal outcomes, among laboring mothers with MSAF and with CAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

Variables		Neonatal and fetal outcomes		Multivariate results	
		Favorable N=197	Unfavorable N=231	AOR(95%CI)	P.V
Status of amniotic fluid	clear	135(68.5)	79(34.2)	1	
	Grade 1	25(12.7)	25(10.8)	1.84(0.92-3.66)	0.083
	Grade 2	25(12.7)	46(19.9)	2.94(1.58-5.47)	0.001
	Grade 3	12(6.1)	81(35.1)	7.54(3.67-15.47)	0.000
Mode of deliveries	SVD	162(82.2)	81(35.1)	1	
	operative	35(17.8)	150(64.9)	6.6(4.06-10.74)	0.000 *
Duration of ROM	<12hr	139(70.6)	153(66.2)	1	
	≥12hrs	58(29.4)	78(33.8)	1.08(0.65-1.77)	0.776
Age in years	18-35	175(88.8)	219(94.8)	1	
	<18	13(6.6)	7(3)	0.44(0.13-1.52)	0.195
	≥35	9(4.6)	5(2.2)	0.28(0.08-0.98)	0.046

*variables with p-value < 0,05 is a statistically significant

With binary logistic analysis, there was 3 times increased risk of unfavorable maternal outcome in mothers with grade 3 MSAF compared to those with CAF (COR=2.91, 95%CI, 1.62-5.2). But there was no statistically significant association between grade1 MSAF (COR=0.97, 95%CI 0.4-2.35), grade2 MSAF (COR=1.5, 95%CI, 0.74-3.02) and maternal outcomes. Mothers who stayed in labor for 20hours and above were 3 times more likely to develop unfavorable maternal outcome compared to those who labored for shorter time(COR=3.28,95%CI, 1.99-5.4). There was around 3 times increased unfavorable maternal outcome among mothers whose duration of rupture of membrane was 12hours and more compared to those whose duration of rupture of membrane was less(COR=2.55,95%CI, 1.56-4.19).

Mothers with grade 3 meconium stained liquor were 3 times more likely to have unfavorable maternal outcome as compared to those with CAF(AOR=2.59,95CI:1.42-4.73).Likewise, there was 3 times increased risk of having unfavorable outcome among mothers who labored for 20hours and more as compared to those who labored for shorter period (AOR=2.84,95%CI:1.31-6.15). There was no statistically significant association between duration of ROM, and maternal outcome after controlling the effect of confounding variables (p>0.05). (Table 6)

Table 9: Factors affecting maternal outcomes, in laboring mothers with MSAF and with CAF in Jimma University Medical Center, Southwest Ethiopia, from July 1, 2016 to June 30, 2017.

Variables		Maternal outcomes		Bivariate result		Multivariate result	
		Favorable N=222	Unfavorable N=206	COR (95% CI)	P.V	AOR (95% CI)	P.V
Status of amniotic fluid	Clear	135(60.8)	79(38.3)	1		1	
	Grade 1	32(14.4)	18(8.7)	0.96(0.5-1.82)	0.90	0.97(0.5-1.86)	0.92
	Grade 2	36(16.2)	35(17)	1.66(0.97-2.86)	0.066	1.64(0.95-2.84)	0.079
	Grade 3	19(8.6)	74(35.9)	6.66(3.74-11.83)	0.00	6.44(3.59-11.54)	0.000
Total duration of labor	<20hrs	171(77)	125(60.7)	1		1	
	≥20hrs	51(23)	81(39.3)	2.17(1.43-3.3)	0.00	2.66(1.67-5.61)	0.01
Duration of ROM	<12hrs	167(72.3)	125(50.6)	1		1	
	≥12hrs	55(27.7)	81(49.4)	1.97(1.3-2.98)	0.00	1.22(0.58-2.57)	0.658

DISCUSION:

In our study the incidence of MSAF was 18.8%(n=796/4230) which is comprable with study done in Beer-Sheva, Israel [11] and review done by Jeffrey Unsworth and Sarah Vause stating MSAF occurs in approximately 15-20% of term pregnancies[1] however higher compared to study done by Uday Rajput, and Anu Jain [39]. It is probably because this study was included preterm pregnancies in which incidence of MSAF is low compared to term pregnancy as our study conducted among term pregnancies.

MSAF is associated with a higher rate of adverse neonatal outcome even in cases of low risk pregnancies at term[23]. In our study there was 8 times increased risk of unfavorable fetal and neonatal outcomes among mothers with grade 3 MSAF compared to those mothers with CAF (AOR=7.36, 95%CI: 3.62-14.99). Our finding is a bit higher compared to a study done by Liran Hiersch et.al [23] MSAF was associated with adverse neonatal outcome (AOR=3.72, 95%CI:3.13-4.43, P<0.001). The lower finding compared to our study was may be it was a retrospective study in which under report of adverse neonatal outcomes was there. From the total of 47(11%) neonates who were admitted to NICU, 40(18.7%) neonates delivered through MSAF(one with grade1, ten with grade 2 and twenty nine with grade3 MSAF) and 7(3.3%) were delivered through clear liquor. And from the total of nineteen neonatal deaths, 16(7.5%) were among exposed (four delivered through grade2 MSAF, twelve delivered through grade3 MSAF) and 3 (1.4%) were among non-exposed groups. It is comparable with the study done by Hiremath PB et.al[55] and Erum Majid Shaikh et.al [13].

It was found there was a significant increased risk of unfavorable fetal and neonatal outcome, as the grade of MSAF increased (grade1: AOR=1.84, 95% CI; 0.92-3.66, Grade 2: AOR=2.94, 95% CI 1.58-5.47 and Grade 3: AOR=7.54, 95% CI; 3.67-15.47) compared to those mothers who had CAF. These findings are similar to the study conducted by Vineeta Gupta et.al [56] showing as the grade of MSAF increased, the probability of unfavorable fetal and neonatal outcome also increased. Our findings support other researchers' findings; "thickness" of meconium had a direct bearing on the neonatal outcome [13, 23,54]. Further, the findings of our study is comparable with other studies [1, 10, 11]

The presence of abnormal NRFHRP in meconium-stained amniotic fluid patients is associated with an increased risk of adverse perinatal outcomes [38, 39]. According to our study, from the total of 88 mothers who developed NRFHRP in the presence of MSAF, all delivered neonates were at least with one unfavorable outcome. The major ones were, still born, low APGAR at 1st, 5th and 10th minute, need for neonatal resuscitation, and admission to neonatal ICU, meconium aspiration syndrome (MAS), early onset neonatal sepsis(EONS), and neonatal death within 7 days of life. These findings are supported by a review done by Jeffrey Unsworth and Sarah Vause [1] and also comparable with research conducted at Jimma medical center, south west Ethiopia [52]

Previous studies had shown that about 5% of the infants with MSAF develop MAS, which still has a mortality rate of 2.5% in the developed world and up to 35% in the developing world [29, 30]. In our study, however, 30(14%) of neonates with MSAF developed MAS, and 19 were those with NRFHRP in the presence of MSAF and the mortality rate was 12(38.7%). This is comparable with study done in Israel by E. Maymon et al [11]. Drying and rapping plus ONPS were the types of resuscitation given for 52(24.3%) neonates among exposed and 18(8.4%) neonates among non-exposed groups. ONPS + bag ventilation given to 4(0.9%) neonates delivered to mothers with MSAF. The significant association between the thickness of meconium stained liquor and presence of unfavorable neonatal outcome can be explained by the high incidence of MAS, 31(7.2%) in this study, MAS as a cause rather than an effect and the association between MSAF and poor neonatal outcome might be due to a reduced clearance of meconium, rather than due to increased meconium release [9, 13, 23]. These findings are also consistent with previous study done in Ethiopia [52]

In previous study the presence of MSAF has been shown to increase cesarean section rate in labor 16% vs 9% ($p<0.01$), operative vaginal delivery 13.9% vs 6.2% ($p< 0.01$) [50]. In our study it was found MSAF increased the rate of operative deliveries about 3 times compared to those with CAF (AOR= 2.8,95%CI, 1.89-4.17). Cesarean section rate 39.7% vs 16.4%, operative vaginal deliveries rate 15.9 vs 14.5%. The higher cesarean section rate may be due to a lower threshold for obstetric intervention because there was no best way to follow fetal status intrapartum during the study period. Many western authors suggest immediate surgery for thick meconium stained amniotic fluid irrespective of parity if vaginal delivery is not imminent [55]. Mothers who underwent either of the operative

deliveries were 7 times more likely to have new-born with unfavorable outcomes compared to mothers who delivered by spontaneous vaginal delivery (AOR=6.6, 95%CI; 4.06-10.74).hundred fifty (64.9%) of neonates with unfavorable outcomes and 35(17.8%) of neonates with fovarable outcomes were delivered by either of operative deliveries. This study showed that operative deliveries did not improve neonatal outcome which may be because of the high rate of NRFHRP among exposed. Studies have shown that, it is not the mode of delivery; rather it is early intervention which is the predictor for favorable fetal outcome in MSAF. These findings are consistent with other studies [53, 54]

In previous studies MSAF in labor is thought to be associated with different maternal morbidities [10-13]. In our study 30(37%) of mother with grade 3 MSAF had at least one of the unfavorable maternal outcomes (cesarean section, operative vaginal delivery, puerperal sepsis, post-partum endometritis, and surgical site infections).

A step wise multiple logistic regressions found there were two independent predictors for maternal outcomes: status of liquor and total duration of labor.

In our study it was found that mothers with grade 3 meconium stained liquor were 3 times more likely to have unfavorable maternal outcome compared to those with CAF (AOR=2.59,95%CI:1.42-4.73). It is closely consistent with a study done by Tran, Caughey, and Musci [12] moderate-thick MSAF as a predictor for puerperal infection, it was found moderate-thick MSAF was significantly associated with increases in chorioamnionitis (odds ratio, 1.39; 95% CI, 1.20-1.61) and endomyometritis (odds ratio, 1.51; 95% CI, 1.19-1.93). It is comparable with the study done by Demisew A. et al [57] which stated Presence of meconium was strongly associated with increased severe form of SSIs ($p = 0.009$). Similarly in another study [11] clinical chorioamnionitis and major puerperal fever (endometritis and wound infections) were significantly higher in the MSAF group than that observed in the clear amniotic fluid group. Our findings are supported by the study done by F. Rahimi-Sharbaf and F. Davary-Tanha [58] Meconium-stained amniotic fluid is associated with increased postpartum infection independent of other risk factors for infection. For this several mechanisms have been proposed for meconium-associated puerperal infections, which include alteration in the antibacterial properties of amniotic fluid and enhanced bacterial growth. Additionally, impaired host immune response through the inhibition of phagocytosis and neutrophil oxidative burst by meconium was reported, [51].

Forty three (53.1%) of mothers who labored for 20 hrs and more had unfavorable maternal outcomes. There was 3 times increased risk of having unfavorable maternal outcomes among mothers who labored for 20 hours and more compared to those who labored for less than 20 hours (AOR=2.84,95%CI:1.31-6.15). This may be due to, the longer the duration of labor (first stage, second stage, or total), the higher the frequency of MSAF which in turn is a risk factor for infection. In addition prolonged rupture of membranes in labor is a well-known risk factor for intrauterine infection which could exist with long duration of labor. this finding is consistent with study done by KA Lee etal [27]..

Conclusion:

The study revealed that grade 2 and grade 3 meconium stained amniotic fluid was associated with unfavorable fetal, neonatal and maternal outcome. Majority of laboring mothers with MSAF had grade 2 and above. MSAF and thickness of meconium was found to be a significant predictor of most of the neonatal and maternal outcome evaluated in this study. MSAF increased the rate of operative deliveries about 3 times compared to those with CAF. NRFHRP was the commonest indication for operative deliveries among MSAF cases. Neonates who were delivered by operative deliveries were seven times more likely to have at least one of the unfavorable neonatal outcomes (low APGAR scores at 1st, 5th and 10th minute, and need for resuscitation, NICU admission or early neonatal death).

As the grade of MSAF increases from grade 2 to 3, there is an increase in the risk of unfavorable maternal, fetal and neonatal outcomes.

Recommendations:

Presence of grade 2 and above MSAF warrants close fetal monitoring using electronic fetal monitor as there are increased risk maternal, fetal and neonatal morbidities in this group. Thus JUMC's health professionals attending labor should follow these cases preferably with continuous electronic monitor and JUMC has to avail electronic fetal monitor for every laboring mother with grade 2 and above MSAF.

Presence of NRFHRP in Grade 2 and above MSAF may be considered as a red light to shorten the threshold for intervention. Thus professionals following these cases should be aware of the need to prepare required staffs, instruments and supplies beforehand for immediate intervention when needed.

Preparation for neonatal resuscitation should be given emphasis in the presence of grade 2 and above MSAF at delivery and the most senior skilled professional in neonatal resuscitation should be available for these cases.

Mothers who delivered through grade 2 and above MSAF needs close follow-up after delivery as they are at high risk of having puerperal infections.

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Annexes

I. Participant information sheet form

Name of the principal investigator: Dr Tufa Bobe

Name of study area: Jimma University Medical Center

Research budget covered by: Jimma university

Research objective: To determine maternal and perinatal outcomes of laboring mothers with meconium stained amniotic fluid (MSAF) in Jimma University Medical center, labor ward, Southwest Ethiopia from July 1, 2016 to June 30, 2017..

Significance of the study: result of the study will be utilized by practitioners and help to guide future management of cases.

Data collection procedure: The data collectors interviewed after obtaining informed consent from the participants. All data were accessible to supervisors and research team members. Only research team members had access to full data of study participants.

Risks: There was no risks to participants as this is observational study.

Beneficial: The study is beneficial for participants' health and future similar populations with risk factors

Participants' right: The participants have a right to stop the interview at any time, or to skip any question that he/she does not want to answer or withdraw interviews without having any consequences to study participant.

Incentives: The participants were not provided any specific incentive for taking part in the research other than acknowledgment.

Confidentialities: The study result was not include participants name and address.

Agreement: All Participants were fully voluntary and informed verbal consent was taken to participate in the study.

Whom to contact: for any queries, anybody can contact : Dr. Tufa Bobe

Informed Consent

1. I confirm that I understand the information sheet for the above study and have had the opportunity to ask questions.
2. I understand that my participation is completely voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.
3. Do you agree to participate in this study? 1. Yes 2. No.
4. If yes, kindly confirm your agreement by your signature in the space provided below:

Signature_____date_____

Name of the data collector: _____Signature: _____date_____

Thank you!

QUESTIONNAIRE

I. Socio-demographic characteristics of laboring mothers with MSAF and clear amniotic fluid (CAF).

1. Card number_____Date_____
2. Age in years _____Card number_____
3. Address _____ Day of operation……
4. Ethnicity

   a) Oromo b) Amhara c) Tigrie d) Guragie e) Dawro f) others (specify)…
5. Religion

   a) Orthodox Christian b) Protestant c) Muslim d) others (specify)…
6. 5. Occupation

   a) House wife b) Civil servant (employee) c) Farmer

   d) Merchant e) Others (specify)…….
7. Educational status

   a) Illiterate (can't read & write) b) Read & write only c)

   Grade 1-8 d) Grade 9-12 e) Grade >12 (specify)……
8. Marital status a) Married b) Separated c) Divorced d) Widowed
9. Income of the family in birr per month_____in Birr

II. OBSTETRIC CONDITIONS

10. Parity_____
11. Gravidity _____
12. Gestational age in **weeks** by LNMP or first trimester/early second trimester ultrasound_____
13. ANC follow-up a] Yes b) No
14. Onset of labor a) spontaneous b) induced
15. If induced what is the indication _____
16. Duration of labor in hours_____
17. Cervical dilatation in centimeters_____
18. Rupture of membranes a) spontaneous b) artificial rupture
19. Status of amniotic fluid a) MSAF b) clear amniotic fluid
20. If MSAF is detected what is the grade? a) grade I b) grade II c) grade III
21. What time was the MSAF detected?

a) up on admission to labor ward on spontaneous or artificial rupture of membranes (primary MSAF)
b) clear amniotic fluid changed to MSAF through the course of labor (secondary MSAF)

22. What is the duration of stay in hours from admission to delivery?_____
23. What is the mode of delivery? a) spontaneous vaginal b) cesarean section c) instrumental vaginal delivery
24. If cesarean section is the mode of delivery, what is/are the indication/s…..
25. If instrumental delivery is the mode of delivery what was the type of instrument?_____
26. What was the indication for instrumental delivery _____
27. What is the condition of the fetus at delivery? a) alive b) dead
28. What is the first minute Apgar score _____
29. What is the fifth minute Apgar score_____
30. What is he tenth minute Apgar score_____
31. What is the birth weight in grams_____
32. Was there a need for new born resuscitation (NBR)? a) yes b) No
33. If there was a need for NBR what type of resuscitation is made?_____
34. Was there a need for neonatal intensive care unit admission? A) Yes b) No
35. If yes what is/are the admission diagnosis?_____
36. If admitted to NICU what was duration of stay in days?_____
37. What were the fetal outcomes in those admitted to NICU? A) Dead b)Discharged improved c) discharged with some morbidity
38. If there is morbidity at discharge, specify_____
39. What postpartum/postop maternal mortality/morbidity is/are identified? a) maternal death b) maternal morbidity
40. If there is any maternal morbidity, specify_____
41. What is the total duration of hospital stay for mother in days_____
42. What is the condition of the newborn at discharge? A) alive b) dead
43. If the mother and newborn is discharged before seven days of delivery, what is their telephone address?_____

Name of data collector_____Signature_____Date __