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Induction of Labor: outcomes and Associated Factors in three Teaching Hospitals of Addis Ababa University, Ethiopia, 2023

BY

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DECLARATION

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POSTGRADUATE PROGRAM

I, Dr. Nahom Shibiru, hereby declare that this research report entitled “Induction of labor: outcomes and associated factors in three teaching hospitals of Addis Ababa University”, in line with the requirement of graduate studies was fully undertaken by me under the guidance of my advisors and that I have, to the best of my knowledge and effort, avoided plagiarism or duplication of materials unless and otherwise cited and/or acknowledged and that it has not been so far submitted for any form of research application or consideration.

Dr. Nahom Shibiru _____ _____

Principal investigator Signature Date

I hereby certify that I have read and evaluated this research report relating to— “Induction of labor: outcomes and associated factors in three teaching hospitals of Addis Ababa University” under my guidance from its inception up to in its current format that it can be submitted to the DRPC for final approval in partial fulfilment to the Degree of Specialty in Obstetrics and Gynecology.

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Abbreviation and Acronym

IOL	Induction of labor
PROM	pre-labor rupture of membrane
IUGR	Intrauterine growth restriction
IUFD	Intrauterine fetal death
PIOL	Pattern of induction of labor
AOR	Adjusted odd ratio
CI	Confidence interval
COR	Crude odd ratio
PPH	Postpartum hemorrhage
NRFHBP	Non reassuring fetal heart beat pattern
NRFS	Non-reassuring fetal status
OASIS	Obstetric Anal Sphincter Injuries
IAI	Intra-amniotic infections
MAS	meconium aspiration syndrome
PNA	Perinatal asphyxia
EONS	Early onset neonatal sepsis
APO	Adverse perinatal outcomes
TASH	Tikur Anbessa Specialized Hospital
ZMH	Zewditu Memorial Hospital
GMH	Gandhi Memorial Hospital

ABSTRACT

Background: - Induction of labor is an intervention designed to artificially initiate uterine contractions. Induction of labor may be less efficient and having more strain on labor wards than spontaneous labor, but has advantages like, reduce risk of intrauterine fetal death, stillbirth, sepsis and need of cesarean section. The most common reasons for induction of labor are hypertension/pre-eclampsia, postdate pregnancy, Premature rupture of membranes, and maternal disease such as or gestational or pre-existing diabetes.

Objective: - to investigate maternal and perinatal outcome and associated factors in mothers who were induced in three teaching hospitals of Addis Ababa University.

Method: - a facilitybased cross sectional prospective quantitative study was done with a sample size of 235 in three teaching hospital of Addis Ababa University for three months of study period. After assuring of ethical clearance data was collected in cases that were selected consecutively during the study period from medical records and using a structured questionnaire and entered and analyzed using SPSSS. After clearing the data, the descriptive statistics were explained in graph, tables and text. Logistic regression was done to measure its statistically significance between the independent and outcome variable. Then p-value less than 0.05 stated as statistically significant.

Result: - In this study 18(7.7%) of the induced women developed complications, majorly PPH followed by IAI and OASIS. The perinatal outcome, 20% of the neonate had adverse perinatal outcome and from those poor perinatal outcomes 4(1.7%) were intrapartum stillbirths, 8(3.5%) of them had an APGAR score of ≤7 at five minute, 44(18.7%) were admitted in NICU. The major diagnosis for NICU admission were EONS (50%) followed by PNA, MAS and TTN. From those of admitted in NICU, majority (59.1%) of them were discharged, and 5(11.9%) died at the seventh day follow up. The determinant factor affecting perinatal outcome were, Nulliparity (AOR=4.8, 95%CI=1.79, 13.29), MSAF(AOR=5.85, 95%CI=1.97, 17.40) and a longer duration of ROM (AOR=9.87,95%CI=2.58, 33.6) and induction without cervical ripening (AOR=6.75 95%CI=1.23, 36.93)

Conclusion: In this study we had a lower rate of failed inductions but a higher rate of NRFS and neonatal admissions and death. A longer duration of ROM and meconium staining, nulliparity were associated with APO and around 7.7% of mothers suffered complications.

We recommend vigilance in the presence of meconium and as much as possible, limiting the duration of ROM to 12 hours

1. INTRODUCTION

1.1 Background

Induction of labor (IOL) is an intervention designed to artificially initiate uterine contractions (1).IOL is done to achieve vaginal delivery before spontaneous labor starts, and it is recommended when the benefits of childbirth outweigh the risk of continuing the pregnancy (2). IOL is carried out in over 20% of pregnancies in developed countries (3). It is indicated when interrupting the pregnancy is thought to be advantageous for the mother or baby and is often carried out for postdate pregnancies (>41 weeks gestation), where it has been shown to decrease perinatal mortality (4).

Approximately four million fetuses annually are still born after the age of viability, similarly more than 500 women death as a result of birth. Majority of these deaths occur in poor resources setting countries. The prevention of these maternal and neonatal deaths sometimes requires prompt and early delivery after the age of viability but before the onset of labor through induction of labor (5).

Induction of labor may be less efficient and having more strain on labor wards than spontaneous labor, but has advantages like, reduce risk of intrauterine fetal death, stillbirth, sepsis and need of cesarean section (6). The incidence of induction of labor is ranging from approximately 6% in 3rd world countries and 20% in developed countries. More than 70% of women would prefer not to have induction of labor by any means (7-8).During induction of labour, the woman has restricted mobility and the procedure itself can cause discomfort to her. To avoid potential risks associated with the procedure, the woman and her baby need to be monitored closely. This can strain the limited health-care resources in under-resourced settings. (2)

IOL is one of the most common procedures in obstetrics and one of the fastest growing procedures in the world mainly in developed countries. The reason why it rises is unclear but there are some assumptions, like a growing use of labor induction for post term pregnancies, an increasing trend towards elective induction of labor and induction with mothers' request (9). IOL may reduce the emotional burden on the mother associated with carrying a dead fetus, the slight possibility of chorioamnionitis, and disseminated intravascular coagulation when a dead fetus is retained for more than 5 weeks in the 2nd or 3rd trimester (10).

The most common reasons for induction of labor are postdate pregnancy and maternal disease such as hypertension/pre-eclampsia or gestational or pre-existing diabetes. However, more recently, the indications have been continuously increasing due to a better understanding of the pathophysiology and of maternal and fetal conditions such as intrahepatic cholestasis of pregnancy (ICP), fetal growth restriction and placental insufficiency. Furthermore, there has been an increase in the number of women with pre-existing chronic medical problems including maternal cardiac disease and autoimmune amongst others, who are now supported through pregnancy, but may previously have been advised to avoid pregnancy or even to terminate (11).

Furthermore, researchers have found that post-term pregnancy, hypertensive disorders (pre-eclampsia/eclampsia) during pregnancy, pre-labor rupture of membrane (PROM) (12).,post-term pregnancy (13), intrauterine growth restriction (IUGR), intrauterine fetal death (IUFD) (14), abruption placenta, fetal congenital anomalies and other medical disorders are some indications for the intervention of induction of labor and may influence the success of induction of labor (15).

The main aim of initiation of labor without its true time is to help with the health of the mother and unborn fetus and to minimize severe obstetric complications related to unnecessary cesarean section (16). However, sometimes this artificial initiation of labor may result in uterotonic effect and fetal distress. This IOL is associated with an increased risk of numerous adverse maternal and perinatal outcomes (17-18).

1.2 Statement of the problem

The notion of induction of labor is still debatable, despite this it is one of the most commonly performed obstetric procedure worldwide. The IOL affects how the woman gives birth. In comparison to spontaneous labor, it can be less effective and often more unpleasant. IOL requires medical treatments, raises hospital expenses, and should only be used in circumstances when it is medically necessary. When induction attempts are unsuccessful, there is a greater chance of cesarean delivery, operative vaginal birth, excessive uterine activity, abnormal fetal heart rate patterns, uterine rupture, and perhaps maternal death.

IOL has an opportunity to benefit in minimizing maternal problems and enhancing pregnancy outcomes, while most of the time it is directly associated to lowering maternal mortality. When a deceased fetus is retained for more than 4 weeks in the third trimester, IOL may lessen the emotional toll on the mother associated with harboring a dead pregnancy, the

minor likelihood of chorioamnionitis, and disseminated intravascular coagulation. It is commonly recognized that post-term pregnancy increases the chance of fetal mortality. In order to prevent fetal or neonatal mortality, the IOL should be performed after 41 full weeks of pregnancy.

According to WHO secondary analysis study on unmet need for induction of labor, African rates of induction of labor are still very far from the expected, 60–80.2% unmet need for labor induction

IOL is a crucial procedure used in contemporary obstetrics and is essential to lowering maternal and perinatal morbidity and death. Although labor induction is routinely performed at both public and commercial health facilities in Ethiopia, there are several challenges in conducting research on its occurrence, outcomes, and related factors. Despite a wealth of research on several outcomes, the majority of studies focused solely on the success or failure rate of labor induction. Induction of labor, maternal and perinatal outcomes, and related variables will all be evaluated in this study.

1.3 Significance of the study

IOL has a critical role in lowering morbidity and mortality among pregnant women and newborns. It may have averted possible injury and rising expenditures for the nation's health systems, as well as, once again, it might have prevented poor maternal and newborn outcomes resulting from the continuation of pregnancy. In low-socioeconomic nations like Ethiopia, it is more pervasive. In light of this, it is very important to comprehend the scope, maternal and perinatal outcomes, and determining variables of IOL.

The results of this study will be crucial in developing the right programs, policies, and strategies to address the IOL vulnerabilities among study participants. It will help with the planning of the elective IOL prevention strategy for this population. The results of this study would also broaden our understanding of the impact of IOL on maternal and perinatal health and its magnitude and determinants for future improvement of the quality of care as well as an evidence based information for counseling of mothers for induction.

2. LITERATURE REVIEW

Induction implies stimulation of contractions before the spontaneous onset of labor, with or without ruptured membranes. When the cervix is closed and uneffaced, labor induction will often commence with cervical ripening, a process that generally employs prostaglandins to soften and open the cervix.(37)

Induction of labor for medical indications should not be delayed based on cervical exam status. Many accepted medical and obstetric indications for labor induction exist. Contraindications include those that preclude vaginal delivery like placenta Previa, vasa Previa, abnormal lie, and also malpresentations, previous uterine scar (e.g. myomectomy, C/S), contracted pelvis, macrosomia, twin pregnancy, invasive cervical cancer, active genital herpes infection, severe IUGR with confirmed fetal compromise(38)

The goal of induction is to achieve a successful vaginal delivery that is as natural as possible, although induction exposes women to a higher risk of a CS than spontaneous labour. Factors that have been shown to influence success rates include the Bishop score, parity (prior vaginal delivery), BMI, maternal age, estimated fetal weight, and diabetes(37).

Bishop showed that women with a score of > 9 were equally likely to deliver vaginally whether induced or allowed to labour spontaneously. Other non-modifiable factors in the pre-induction counselling period with the woman, Elevated BMI (> 40 kg/m2), maternal age > 35 years, estimated fetal weight > 4 kg, and diabetes mellitus have been shown to increase the CS rate when labour is induced.(37)

Compared with placebo or expectant management, the use of oxytocin alone was associated with fewer vaginal births not achieved within 24 hours of induction of labour (399 participants), fewer admissions to a neonatal intensive care unit (4387 participants), and increased risk of caesarean section (6620 participants).(2)

In an updated Cochrane review to assess the effects of a policy of labour induction at or beyond term compared with a policy of awaiting spontaneous labour or until an indication for birth induction of labour is identified on pregnancy outcomes for infant and mother that included 30 RCTs, Compared with a policy of expectant management, a policy of labour induction was

associated with fewer (all-cause) perinatal deaths. For women in the policy of induction arms of trials, there were fewer caesarean sections compared with expectant management (moderate-quality evidence); and a corresponding marginal increase in operative vaginal births with induction (moderate-quality evidence). Rates of neonatal intensive care unit (NICU) admission were lower (moderate-quality evidence) and fewer babies had Apgar scores less than seven at five minutes in the induction groups compared with expectant management (moderate-quality evidence).(28)

1.2. Patterns of indication

Study done in teaching hospitals of south west Ethiopia on outcomes of induction of labor showed that from the total induction, 41.7% for preeclampsia, (26.7%) for premature rupture of membranes (PROM), and (18.3%) for post-term pregnancy were the reasons mentioned for induction of labor. (29)

Study done in public Hospitals of Harari Regional State on induction of labor showed that the most common indication for induction of labor was pre-eclampsia/eclampsia which accounted for 335(46.70%), followed by pre-labor rupture of membrane 240 (33.50%) and intrauterine fetal death 54(7.5%) (31).

A cohort study of induction of labor and its Indications revealed that eighty-two (18%) women were induced for a primary indication of SGA or FGR. Seventy-eight (17%) women underwent IOL for prolonged spontaneous rupture of membranes (SROM). Seventy-two (16%) for reduced fetal movements as primary indication or in combination with other factors. Sixty-seven (15%) women were induced due to prolonged pregnancy (40+12 weeks). Fifty-seven (13%) underwent IOL for maternal diabetes and 28 (6%) for large for gestational age (LGA) fetus. (32).

Study was conducted in Addis Ababa, Ethiopia, at four teaching hospitals; TAH, GMH, ZMH and SPH. Preeclampsia was the leading indication for induction of labor accounting for 151 (44.5%), Pre-mature rupture of membranes 90(26.5), Post term 59(17.4), others 39(11.6)(36)

Study of IOL in university clinics of Kinshasa, DR Congo, indications for induction was: preeclampsia (52 = 54.1%), premature rupture of membranes (34 = 29.5%), post term (17 = 14.6%), gestational diabetes (5 = 4.3%), stillbirth (5 = 4.3%), polyhydramnios (3 = 2.6%) and cardiopathy (1 = 0.8%). Methods of induction included: oxytocin (86 = 74.7%), vaginal

misoprostol (20 = 17.3%), transcervical Foley catheter balloon (14 = 12.1%), and amniotomy (1 = 0.8%). (33).

1.3Outcome of induction of labor

A cross sectional prospective quantitative study done by R. Demissew, & Mesfin, E in Four Teaching Hospitals in Addis Ababa in 2016 GC to address the obstetric outcomes and determinants of the outcomes of induction of labor found thatthe rates of failed induction and Cesarean section were 25.4% and 37.8% respectively. Failed induction contributed to 66.7% of indications for cesarean section. Concerning perinatal outcomes of a total of 339 induced mothers, Forty-eight (16.5%) of the neonates were admitted to NICU, of which meconium aspiration syndrome is the leading cause of admission in 14 (28.6) of the time. And also 5^{th} min APGAR score <7 was in 7.7 % of the neonates Method of induction, gestational age, indication for induction and meconium staining do not have association with NICU admission. (36)

A hospital based cross sectional study conducted in 2017 by GDakjur Lueth and A. Kebede on 346 laboring mothers who delivered after induction of labor, to assess Prevalence, outcomes and associated factors of labor induction among women delivered at public hospitals of MEKELLE Town showed, 244 (70.5%) delivered spontaneously, 19 (5.5%) were assisted by instrumental delivery and 83 (24%) by Cesarean section. Out of those who were delivered by cesarean section, 25(30.1%) were done for failed induction, some of the observed adverse maternal outcomes of induction were 15(4.3%) PPH, 7 (2%) precipitated labor, 5 (1.4%) intrapartum placental abruptions, 3(0.9%) incomplete uterine ruptures, 1(0.3%) uterine over activity and 1 (0.3%) maternal death. Concerning the perinatal outcome 62 (17.9%) of the neonates had NRFHRP, 2 (0.6%) IUFD, 34 (10.9%) 5^{th} low Apgar score, and out of the induced 37 (11.9%) were admitted to the neonatal intensive care unit and half of them stayed for 4–7 days at the NICU and 4 neonates died within the first 7 days of life. The NICU admission reasons were 19 (51.4%) PNA and 10 (27%) EONS. Two of the four early neonatal deaths were due to Hyaline membrane disease secondary to prematurity, one due to congenital malformation and another one form perinatal asphyxia. (35).

A Study done byT. Yosef and D. Getachew in teaching hospitals of south west Ethiopia on outcomes of induction of labor showed that from the total induction, 16.7% of them had failed induction [cesarean section (CS) delivery]. Of the 60 induced women, 25 (41.7%) had maternal

complications. The commonest maternal complication was postpartum hemorrhage accounted for 52%, followed by 44% external genitalia tear. Perinatal outcomes were APGAR score<7 in 16.7%, Birth weight ofnewborns <2.5 kg 21.7% , 2.5–3.9 kg 58.3% , >4 kg20% .Admission to NICU was 19.3%, Reason for admission were Fetal distress 54.5%, Preterm 45.5% (29).

Another Study done in public Hospitals of Harari Regional State on induction of labor by Y.M Beshir, M.A Kure showed that, the proportion of success of induction of labor was 65% [95%CI (61.5, 68.6)Concerning the mode of delivery, of the seven-hundred-seventeen study participants included in the study, more than half 411(57.32%) of them gave birth through spontaneous vaginal delivery followed by cesarean section 251(35.01%) and operative vaginal delivery 51(7.67%) (31).

Predicting factors of failed induction of Labor by A. Genetu and S. H/mariam in south west Ethiopia showed that two hundred forty-three (55.1%) mothers gave normal vaginal birth, and 124 (28.1%) mothers gave birth through cesarean section. Nearly two-thirds (64.5%) of the cesarean section were done due to failed induction of labor.ninety-two (20.9%) of the study subjects had failed induction of labor (34).

Prospective cohort study of induction of labor: Indications, outcome and postpartum hemorrhage done by B. Kumar, S. Kumari, in the UK showed a total of 445 women needed IOL (incidence 33%). Common indications were: small for gestational age (SGA) or fetal growth restriction (FGR) (18%), spontaneous rupture of membrane (17%), reduced fetal movement (16%), prolonged pregnancy (15%), and diabetes (13%). 67% women achieved spontaneous vaginal delivery and 18% underwent C/S. With regard to blood loss, 62 women (14%) had postpartum hemorrhage (PPH) of >1000 mL and 22 women (4.9%) had a blood loss >1500 mL. The C/S rate was higher than the overall emergency caesarean section rate that year. Incidence of PPH in this cohort was higher than the normal incidence. (32)

Population-based case-control study of low-risk women who gave birth in 106 French maternity units between December 2004 and November 2006, assess association between induction of labor and postpartum hemorrhage (PPH) in low-risk parturient, and showed labor induction was associated with a significantly higher risk of PPH (AOR1.22, 95%CI 1.04–1.42). This excess risk was found for induction with both oxytocin (AOR 1.52, 95%CI 1.19–1.93 for all and 1.57, 95%CI 1.11–2.20 for severe PPH) and prostaglandins (AOR 1.21, 95%CI 0.97–1.51 for all and 1.42, 95%CI 1.04–1.94 for severe PPH). And concluded that even in low risk women, induction

of labor, regardless of the method used, is associated with a higher risk of PPH than spontaneous labor. (40)

A retrospective, observational study of women who were induced at 39 or more weeks of a singleton pregnancy with vertex presentation and intact membranes was done by H. Kim, S. Choo showed,among the 237 women, incidence of Cesarean delivery was 17.7 %, length of stay and blood loss during delivery were 4.3±1.5 days and 1.9±1.3 mg/sL, respectively;. Regarding neonatal outcomes, the rate of meconium-stained amniotic fluid, Apgar score <7 at 5 minutes, and intubation rate 18.9%, 7.9%, and 6.1% respectively and the neonatal intensive care unit admission rate was 28.0%.(25)

2.7 Conceptual framework

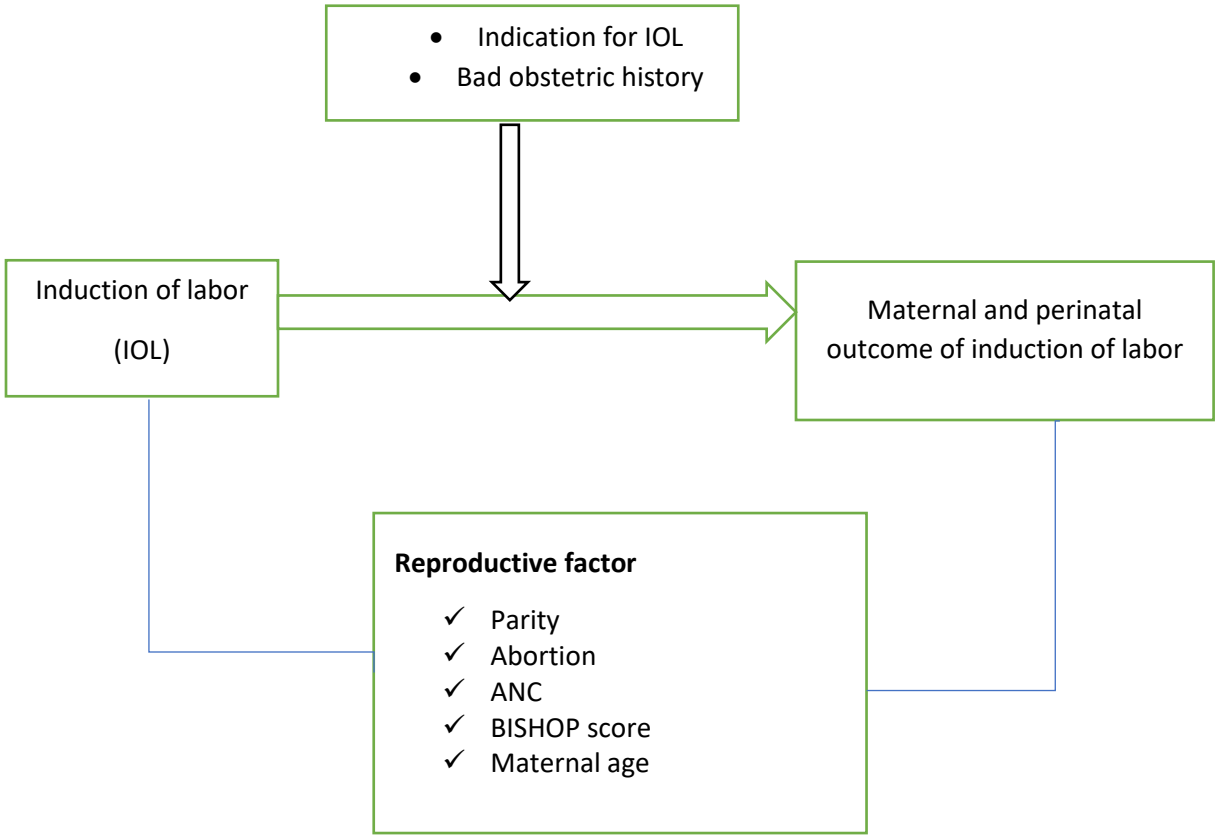


Figure 1 conceptual frame work adopted from the literature by the author

2. OBJECTIVE

2.1 General objective

- To assess outcomes and associated factors among women who come for labor induction and delivered in three teaching hospitals of Addis Ababa university

2.2 Specific objective

I. To assess selected composite maternal outcomes of the induction of labor in the three teaching hospitals.

II. To assess selected perinatal outcomes of the induction of labor and associated factors in the three teaching hospitals these are

   a. Perinatal asphyxia
   b. Early onset neonatal sepsis
   c. Still birth
   d. Meconium aspiration syndrome

4. METHOD

4.1. Study area

The study will be conducted the labor and neonatal wards of the three teaching hospitals under AAU, in Zewditu memorial hospital, Tikur Anbessa Specialized hospital, and Gandhi memorial hospital which, are found in Addis Ababa and cover a large maternity service in Addis Ababa. The capital city is 527 square Kilometers and an elevation of 2355 meters with a population of 5 million in 2021 according to United Nations urbanization prospect. The city has 12 public and more than 25 private hospitals. Of these hospitals the three hospitals were selected by convenience and all provide obstetric care. The hospitals as a whole have more than 200 inductions of labor in a month.

4.2. Study design and period

This is a prospective facility based cross-sectional study which will be employed from March l, 2023 up to May 30, 2023 for three month period in three teaching hospitals of Addis Ababa University by reviewing the mother's chart and interview held for cross checking and the neonatal charts will be reviewed for neonates admitted to the neonatology ward and followed for 7 days.

4.3. Source Population

All mothers who came for labor and delivered in the three teaching hospitals of Addis Ababa University during the study period

4.4. Study population

The mothers who underwent labor induction at $\geq$ 28 weeks of gestation and delivered in the three teaching hospitals of Addis Ababa Universityduring the study period

4.5 Eligibility criteria

4.5.1. Inclusion Criteria

All mothers who will come for labor induction and delivered in three teaching hospitals of Addis Ababa University.

4.5.2. Exclusion criteria

Mothers who are unable or unwilling to participate in the study

4.6. Sample size determination

The sample size required for this study will be calculated based on a single population proportions formula as follows.

$$n = \frac{(Z\ \alpha/2)^2\ P\ (1-P)}{d^2}$$

Where: n is sample size; Z α/2 is standard normal distribution corresponding to significance level at α = 0.05, which is 1.96 ;d is margin of error assumed to be 5%, and the proportion of NICU admission from a prior study done in the similar setting , P=16.5 % .(36)

Therefore, $n= (1.96)^2 \times 0.204\ (1-0.204)/\ (0.05)^2=212$

Therefore, after adding 10% non-response rate the final sample size will be 235

4.7 Sampling Procedure

The calculated sample size was allocated to the three hospitals based the sequential order of the induced mothers. The data was collected from all mothers that were admitted for induction of labor and delivered sequentially and recruitment continued until the allocated sample size was fulfilled.

4.8 Study Variables and measurement

4.8.1 Dependent variable

- Maternal outcome of induction of labor
- Perinatal outcome of induction of labor

4.8.2 Independent Variables

- **Socio-demographic factor**
  - ✓ Age
  - ✓ Residence
  - ✓ Education level
  - ✓ Income
  - ✓ Marital status
- **Reproductive factor**
  - ✓ Parity
  - ✓ Abortion
  - ✓ ANC

- ✓ BISHOP score
- ✓ Gestational age
- ✓ Past obstetric history
- ➢ **Methods of induction**
- ✓ Misoprostol
- ✓ Oxytocin
- ✓ ARM

4.9 operational definitions

Induction of labor	process of artificially stimulating the uterus to start labor, performed by administrating oxytocin, prostaglandins, mechanical methods or by rupturing the amniotic membrane
PPH	based on a clinician's diagnoses that was obtained from the card
IAI	based on a clinician's diagnoses that was obtained from the card
OASIS	severe form of perineal tear, known as 3rd or 4th degree tears
Failed induction	based on a clinician's diagnoses that was obtained from the card
Poor maternal outcome	Presence of PPH,OASIS, IAI and puerperal sepsis, uterine rupture, maternal death, and ICU admission
Adverse perinatal outcome	Presence of still birth, 5 min APGAR score <7, NICU admission, ENND
PNA	confirmed diagnosis of PNA by the clinician
MAS	respiratory distress with elevated oxygen dependence ; presence of meconium in the amniotic fluid
Stillborn	a newborn ≥ 28 weeks of gestation with no signs of life at birth
EONS	sepsis diagnosed at the NICU in the first six days of life

Table 1. Operational definitions

4.10 Method of data collection

A structured questionnaire was used to gather data in a face –to- face interview was held, after delivery when the mother was comfortable and before discharge, and chart review. The questionnaire was taken from different literature and modified and pretested in a health facility of the study area.

The data was gathered by interns, and junior residents, who were not following the labor and delivery to avoid authoritativeness and supervised by principal investigator. Both data collectors and supervisors were trained for 1 day about the contents of the questionnaire and on how to collect the data properly in order to minimize errors. Principal investigator was present on the

spot to check and review all the completed questionnaires; and to ensure completeness and consistency of the information collected.

4.11 Data quality control

All of the questionnaires were checked for completeness and accuracy before the period of data collection. Throughout the course of the data collection, interviewers supervised, regular meetings were held between the data collectors and the principal investigator together in which problematic issues arising from interviews during the data collection and mistakes found during editing were considered. The collected data was reviewed and checked for completeness before data entry. Data entry format template were prepared and programmed by principal investigator.

4.12 Data analysis and interpretation

The collected data was checked manually for completeness and any incomplete or misfiled questions were sent back to the field so that further corrections were made through re-interviewing. Then, the clean and complete data entered and analyzed by using SPSS version 25.0 software. Descriptive statistics were done and presented using tables and figures. Initially, chi square tests and, bivariate logistic regression was carried out to see the association of each of the independent variables with the outcome variable.

To examine the association of independent variables and perinatal outcomes IOL, the multivariable logistic regression was performed to control possible confounders. The variables that didn't show significant association with the outcome in the bivariate logistic regression at $p<0.25$ were not be considered for the multivariable logistic regression analysis. P- Value of <0.05 and 95% confidence level was used as a difference of statistical significance in the multivariable analysis. Odds ratio with 95% confidence interval was reported as a measure of association.

4.13 Ethical consideration

Ethical clearance was first obtained from Addis Ababa University, college of health science department of gynecology and obstetrics. Then, the ethical clearance and support letter was taken to the selected hospitals to obtain permission and cooperation during the data collection process.

Informed oral consent obtained from each study subject prior to the data collection process after the purpose of study has been explained and they become briefed about the confidentiality of their responses and the importance of providing the right information to help the study achieve its objective.

All participants were asked for their willingness to participate in the study and told that it will have minimal risk on them. Confidentiality of the information was assured and privacy of the respondent was maintained.

In the case where the perinatal outcome was worse like perinatal death the investigator limit the questions to the sociodemographic aspect and avoid asking the mother about the outcome as he/she collected it from the charts.

The consent taken and data collected after the delivery was completed and the mother was well and comfortable to give answers and before discharge of the mother.

4.14 Dissemination of the Result

The result of the study will be first presented in Addis Ababa University department of gynecology and obstetrics and Ethiopian Ministry of Health. It will also be presented in national as well as international seminars and will be published in reputable journals.

5. RESULTS

5.1 Sociodemographic characteristics of the study participants

In this study 235 study participants were involved making a response rate of 100%. The oldest and the youngest mothers were 40 years and 18 years old respectively. Forty one percent of the study participants were in the age group of 25-29 years with mean of 28.1±4.48 respectively. Almost all (89.4%) were from Addis Ababa and 95.7% were married. Thirty eight percent of the study participants had completed a secondary education level and 40.4% were house wife and, majority of the study participants had a house hold monthly income of 5000-10000ETB.

Variable	Frequency	Percent
Age of the study participants		
<20	3	1.3
20-24	43	18.3
25-29	97	41.3
30-34	71	30.2
≥35	21	8.9
place of residency		
Addis Ababa	210	89.4
out of Addis Ababa	25	10.6
marital status		
Unmarried	10	4.3
Married	225	95.7
Educational status		
No formal education	17	7.2
Primary	70	29.8
Secondary	90	38.3
College	58	24.7
Occupation		
Housewife	95	40.4
daily laborer	10	4.3
self-employed	81	34.5
governmental employee	45	19.1
Others	4	1.7
Household monthly income		
<5000	3	1.3
5000-10000	194	82.6
>10000	38	16.2

Table 2. The sociodemographic characteristics of the study participants

5.2 Reproductive characteristics of the study participants

Half (50.6%) of the study participants were nulliparous and 37.4% gave birth at a gestational age of 37-38^{+6} and the gestational age lowest was 33 weeks and highest was 42 weeks all of the study participants had antenatal care follow-up. Of the induced mothers almost all (93.2%) were primed and of those88% cervical ripening was done by transvaginal catheter. Half (51.5%) of the study participants had intermediate Bishop Score at the start of induction, and in 14.9% the membrane were rupture before starting of induction. Eighty percent of the participants delivered within 12 hours of membrane rupture. 74% of inductions were elective and 98.7% were induced by oxytocin. The mean induction to delivery time was 10.7 hours while the range was 3 to 24 hours. Majority (50.6%) of the study participants delivered within 12 hours of initiation of induction and two-third of the study participants had clear liquor

Variable	Frequency	Percent
Parity		
Nulliparous	119	50.6
Parous	116	49.4
Gestational age		
<36^{+6}	4	1.7
37-38^{+6}	88	37.4
39-40^{+6}	65	27.7
41-41^{+6}	26	11.1
≥42	52	22.1
cervical ripening		
Yes	219	93.2
No	16	6.8
cervical ripening method (n=219)		
Misoprostol	26	11.9
transcervical foley catheter	193	88.1
Bishop score		
Intermediate (5-8)	121	51.5
Favorable (≥9)	114	48.5
Rupture of membrane before induction		
Yes	35	14.9
No	200	85.1
Duration of ROM after rupture in hours		
<12	190	80.9
≥12	45	19.1

timing of induction		
Elective	174	74
Emergency	61	26
method of induction		
Oxytocin	232	98.7
oral misoprostol	3	1.3
Length of induction in hours		
<12	119	50.6
≥12	116	49.4
liquor status		
Clear	164	69.8
G-1 MSAF	28	11.9
G-2 MSAF	16	6.2
G-3 MSAF	14	6.0
Bloody	13	5.5
labor analgesia		
Given	3	1.3
not given	232	98.7

Table 3 Reproductive characteristics of the study participants

5.3 Indication for induction of labour

Majority (31.9%, n=75) of the induction indication were pregnancy induced hypertension followed by post term (22.1%), fetal compromise (which includes FGR and oligohydramnios) (21.7%), PROM (14.9%), abruption (5.5%) and maternal medical complication (3.8%) see figure 2 below.

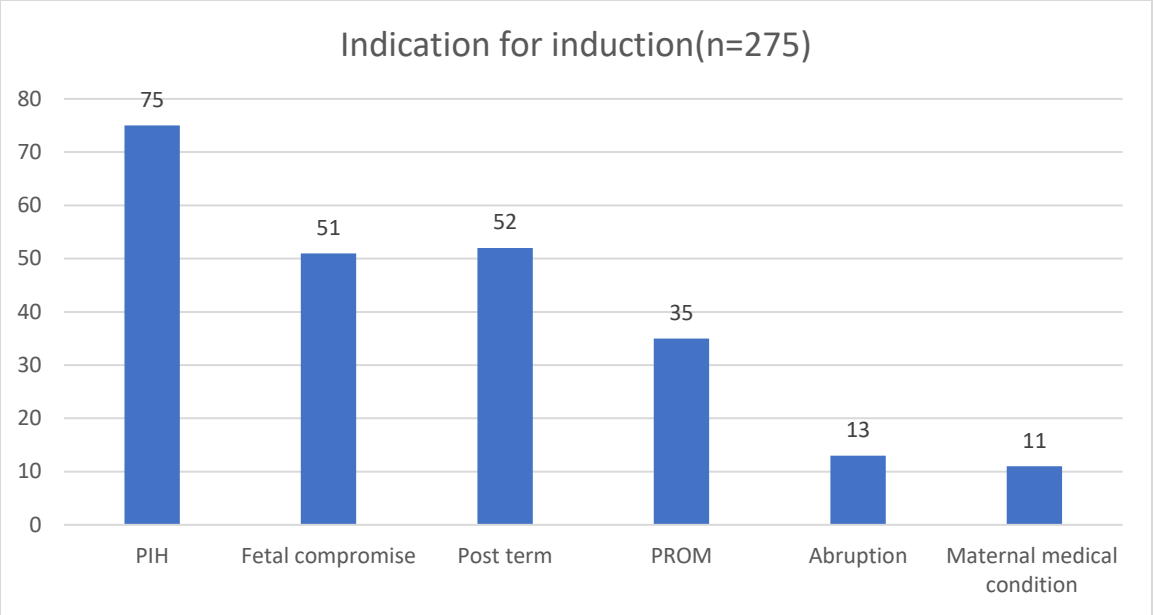


Figure 2 Indication for induction

5.4 Labour and delivery characteristics of the study participants

Two-third of the study participants delivered vaginally and 31.1% were by caesarean section. Majority (68.9%) of the caesarean section indication were NRFS followed by failed induction (28.8%) and CPD (12.3%). The finding also revealed that 7.7% had maternal complication and from those complications PPH accounts 55.6% of all complication.

Variable	frequency	Percent
mode of delivery		
Normal vaginal delivery	156	66.4
Operative vaginal delivery	6	2.6
Caesarean section	73	31.1
Indication for cesarean section (n=73)		
failed induction	21	28.8
CPD	9	12.3
NRFS	43	68.9
Maternal complication		
Yes	18	7.7
No	217	92.3
The list of maternal complication(n=18)		
PPH	10	55.6
IAI and sepsis	5	27.7
OASIS	3	16.6

Table 4. Labour and delivery characteristics of the study participants

5.5 Indication of induction Vs maternal complication

Majority of the PPH occurred in the mothers induced for abruption indication, all of the IAI and sepsis occur in PROM as shown in the figure below

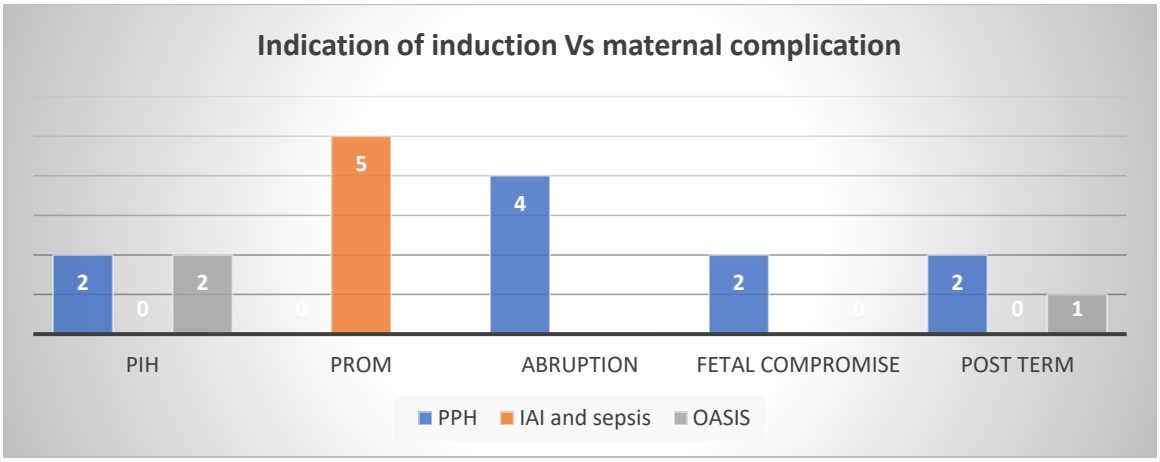


Figure 3 the relation between indication of induction and maternal complication

5.6 The relation between indication of induction and CS indication

The finding showed that 62% of the failed inductions occur in PIH followed by PROM (28%). Majority of the NRFS caesarean indication (34.8%) were from fetal compromise induction indication followed by PIH, PROM and post term.

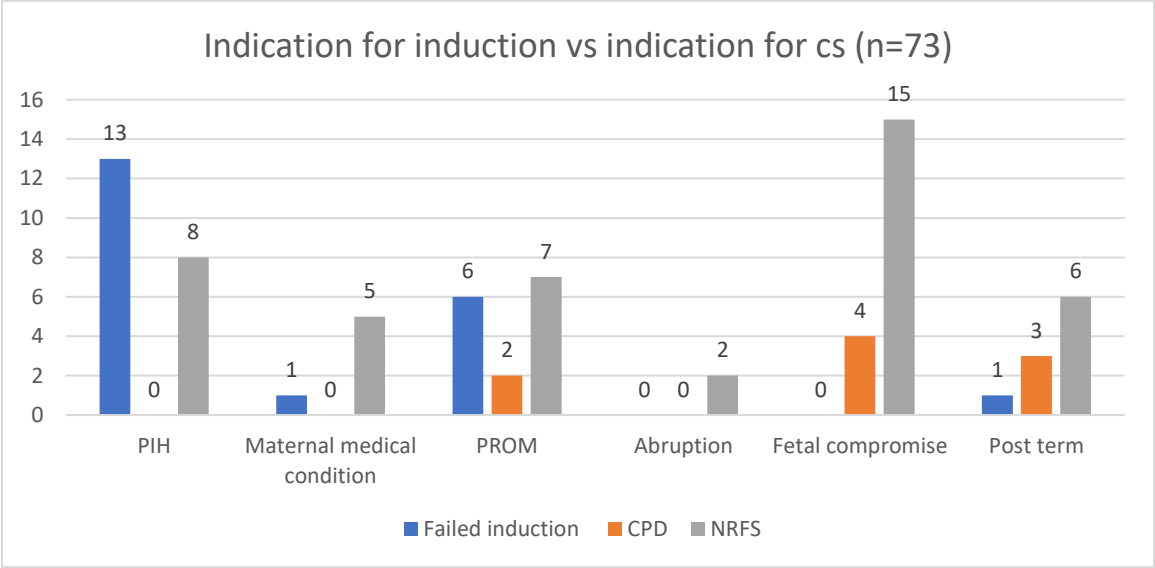


Figure 4. The relation between indication of induction and CS indication

5.7 Adverse perinatal outcome of the study participants

Of the neonates born to the induced mothers 48 of them had a poor perinatal outcome ,which include still birth, a 5 min APGAR score of <7 and NICU admissions

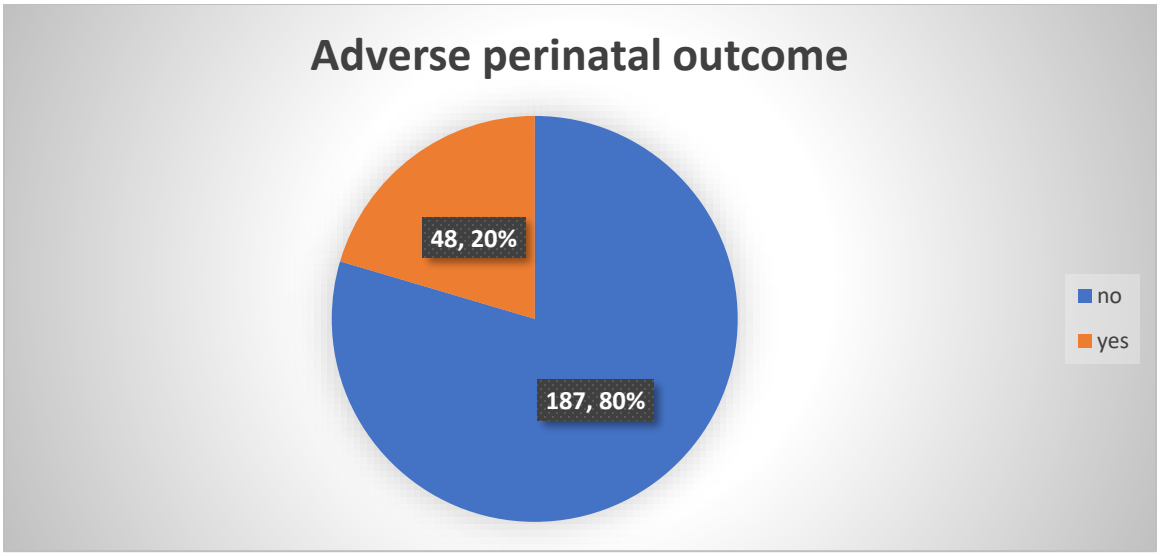


Figure 5 Adverse perinatal outcomes of the study participants

5.8 The perinatal outcome of the study participants

Almost all (98.3%) were live birth while 1.7% were stillbirths. All stillbirths were intrapartum losses and there were no antepartum IUFD that was induced. More than half (54%) were male and 96.5% had an APGAR score of ≥7 at five minute. Almost all (91.9%) of the neonate had normal birth weight. 68 (29.4%) of the neonate were referred to NICU and from those 64.7% (n=44) were admitted in NICU, which makes 18.7% of all deliveries. The major diagnosis for NICU admission were EONS (50%) followed by PNA, MAS and TTN. From those of admitted in NICU, majority (59.1%) of them were discharged, 29.5% were still in NICU and 11.4% died at the seventh day follow up. The major cause of death is PNA.

Variable	Frequency	Percent
Fetal outcome		
Alive	231	98.3
still birth	4	1.7
Sex of the newborn		
Male	127	54
Female	108	46
First minute APGAR score		
0	4	1.7
1-6	12	5.1
≥7	219	93.2
Fifth minute APGAR (n=231)		
1-6	8	3.5
≥7	223	96.5

Birth weight		
<2500	14	6
2500-3999	216	91.9
≥4000	6	2.1
Cause of still birth(n=4)		
Abruption	1	25
Unknown	2	50
UPI	1	25
NICU referral(n=231)		
Yes	68	29.4
No	165	70.6
Reason for NICU referral(n=68)		
septic workup	33	48.5
respiratory distress	16	23.5
IUGR evaluation	11	26.2
PNA	8	11.8
NICU admission(n=68)		
Yes	44	64.7
No	24	365.3
NICU neonatal Assessment(n=44)		
PNA	8	18.2
MAS	7	15.9
TTN	6	13.6
EONS	22	50.0
Others	1	2.3
NICU outcome at 7th day(n=44)		
Discharged	26	59.1
Died	5	11.4
still in admitted	13	29.5

Table 5. The perinatal outcome of the study participants

5.9 The Determinant Factor Affecting the Composite Perinatal Outcome

In this study the strength of association was measured using a Chi square test and odd ratio and 95% confidence interval. Therefore, marital status, parity,cervical ripening, bishop score,ROM before induction, ROM duration, liquor status, and timing of induction, and length of induction, were an associated with composite perinatal outcome by bivariate logistic regression.

The multivariate logistic regression revealed that, study participants who were nulliparous were 4.8 odds increase in the APO compared to parous women (AOR=4.8, 95%CI=1.79, 13.29). The study participants who had MSAF had 5.85 folds increase its APO compared to clear liquor

(AOR=5.85, 95%CI=1.97, 17.40). Participants whose induction was started without cervical ripening were 6.75 folds increase its PCPO compared to the primed (AOR=6.75, 95%CI=1.23, 36.93). Also a longer duration of ROM $\geq$ 12 hours has a 9.87 fold higher rate of APO than those < 12 hours (AOR=9.87, 95%CI=2.58, 33.6).

variable	Composite perinatal outcome		p-value	COR with 95%CI	p-value	AOR with 95%CI
	poor	Good				
Marital status						
Unmarried	5	5	0.028	4.2(1.17, 15.27)	0.135	4.2(0.63, 28.43)
Married	43	182	1		1	
Parity						
Nulliparous	38	81	0.000	4.9(2.34, 10.57)	0.002	**4.8(1.79, 13.29)**
Parous	10	106	1		1	
Cervical ripening done						
Yes	36	183	1		1	
No	12	4	0.000	15.2(4.6,49.9)	0.028	**6.75(1.23,36.93)**
Bishop at the start of induction						
5-8	37	84	0.000	4.1(1.98, 8.58)	0.269	1.7(0.65, 4.48)
≥9	11	103	1		1	
ROM before induction						
Yes	19	16	0.000	7.0(3.23, 15.16)	0.964	1.04(0.19,5.64)
No	29	171	1		1	
Duration of ROM after start of induction						
<12	20	170	1		1	
≥12	28	17	0.000	14(6.5,29.9)	0.001	**9.87(2.58,33.6)**
Liquor status						
Clear	24	140	1		1	
MSAF	21	37	0.001	3.3(1.66, 6.59)	0.001	**5.85(1.97, 17.40)**
Bloody	3	10	0.420	1.8(0.45, 6.82)	0.304	2.6(0.41, 16.54)
timing of induction						
Elective	20	154	1		1	
Emergency	28	33	0.000	6.5(3.29, 12.97)	0.162	2.44(0.69, 8.58)
Length induction in hours						
<12	13	106	1		1	
≥12	35	81	0.000	3.5(1.75, 7.09)	0.85	0.89(0.27, 2.88)

Table 6. The association of independent variables with composite perinatal outcome by bivariate and multivariate logistic regression

6. DISCUSSION

In our study majority of the indication for induction of labour werehypertensive disorder of pregnancy (32%) followed by post term (22.1%), fetal compromise (21.7%) and, PROM (14.9%), abruption (5.5%) and maternal medical complication. This finding was supported by the study done in teaching hospitals of south west Ethiopia and public Hospitals of Harari Regional State and Addis Ababa (29, 31, 36) but was different from UK study (32). This similarity was may be due to similarity of national guideline for induction of labour.

Almost all (93.2%) of the induced labour were primed and 88% the primed (cervical ripening) were done by transcervical Foley catheter and almost all of the induction were performed by oxytocin. This finding was different with the study done in 4 hospitals in Addis Ababa and public hospitals of MEKELLE town (36, 35). This may be explained by lack of the appropriate preparation of Misoprostol and Dinoprostol in the market at this time, and unwillingness of the provider in cutting the other preparations. But induction with oxytocin was the commonest and comparable method.

From the induced mothers two-third delivered vaginally and 31.1% were by caesarean section. This finding was similar with the study done in public Hospitals of Harari Regional State and Addis Ababa(31, 36) but higher than study in MEKELLE, SW Ethiopia, South Korea (35, 29, 41). This might be due to the different threshold for C-section practiced in different setups. The commonest indications were NRFS(68.9%) followed by failed induction (28.8%) which was similar compared to the study done in Mekelle town, but it was different from the study done previously in the same setting and SW Ethiopia which can be explained by the current consensus of giving a longer time before declaring a failed induction and the wide uses of CTG and an earlier identification of NRFHR patterns.

In this study 7.7% of the induced women developed maternal complication and major complication was PPH. This finding was supported by the study done in Mekelle town (35), but lower than studies done in teaching hospitals of SW Ethiopia and UK hospitals(29, 32). This may be due to the fact that oxytocin receptors in the women's body have been dulled by prolonged exposure to synthetic oxytocin due to induction.And some women also suffered an OASIS and sepsis. But in this study period there were no uterine rupture and maternal ICU admission or death associated with the induction of labor.

Concerning the perinatal outcome, 20% of the neonate had adverse perinatal outcome and from these outcomes 1.7% were intrapartum still birth, 3.5% of them had an APGAR score of ≤7 at five minute, 18.7% were admitted to NICU. These findings are higher previous study of Addis Ababaand Mekelle hospitals but lower than the SW Ethiopia and South Korea study. This might be due to the difference of NICU referral and admission criteria.

The commonest diagnosis for NICU admission were EONS (50%) followed by PNA, MAS and TTN. From those of admitted in NICU, majority (59.1%) of them were discharged, 29.5% were still in NICU and 11.4% died at the seventh day follow up. This finding was more or less supported by the study done inpublic hospitals of Addis Ababa and Mekelle town (35).

Study participants who were nulliparous were 4.8 odds increase in the APO compared to parous women (AOR=4.8, 95%CI=1.79, 13.29) which may be due to longer duration of labor and a higher dose of oxytocin used to achieve adequate contractions, which combined lead to poor perinatal outcome . The study participants who had MSAF had 5.85 folds increase its APO compared to clear liquor (AOR=5.85, 95%CI=1.97, 17.40) which was common in those induced for fetal compromise and post term pregnancy. Andthis might be because of the additional stress caused by the oxytocin induction on a compromised fetus leading to MAS.

Participants whose induction was started without cervical ripening were 6.75 folds increase its PCPO compared to the primed (AOR=6.75, 95%CI=1.23, 36.93), inductions in these group is going to be longer and use a higher concentration of oxytocin and also end up in C/S.Also duration of ROM ≥ 12 hours has a 9.87 fold higher rate of APO than those < 12 hours (AOR=9.87, 95%CI=2.58, 33.6), evidenced in this study by a higher NICU admission for EONS.

In our study duration of induction and indication for induction didn't show association with the APO which was similar with the studies previously don in the same setting and Mekelle hospital. It is difficult to comment on the different methods of induction and priming and their association to APO because of small sample size and a further research is needed.

7. CONCLUSION

Maternal and fetal complications are higher in those mothers who delivered through induction. In this study we had a lower rate of failed inductions but a higher rate of NRFS and neonatal admissions and death. A longer duration of ROM and meconium staining, nulliparity were associated with APO. And around 7.7% of the mothers also suffered complication. A longer duration of labor was not associated with poor neonatal outcome.

8. Recommendation

- vigilance in the presence of meconium during induction
- As much as possible limiting the duration of ROM to 12 hours and avoid early ARM.

9. Strengths and limitations

- Strengths
    - This study tried to review the outcomes of our inductions paving the way for further studies
    - High rate of respondents
- Limitations
    - The study was not powered enough to detect the pregnancy outcomes of different labor priming and induction methods used.
    - Referral hospitals deliveries might not be representative to the general population.

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ANNEX

I. Information Sheet and Consent form

Questionnaire Identification Number _____

My name is _____. I am working as a data collector in the research Conducted by Dr. Nahom Shibiru, who is conducting this research for the partial fulfillment of his specialty in Obstetrics and Gynecology in AAU

Title: Induction of labor: outcomes and associated factors in three teaching hospitals of Addis Ababa University, Ethiopia, 2022

Purpose of study: This study seeks to investigate perinatal and maternal outcome and associated factors in mothers who were induced. Information provided for the study will help provide an input and identify pitfalls in the provision of labor induction.

Study procedure: You are selected because you came to be induced for delivery. You will be interviewed and the questions may take about 15 minutes, and the charts review may take about 30 minutes.

Benefits: There is no direct benefit to you for participating other than the satisfaction because you are contributing to increase knowledge in in this area

Risks: There is very minimal in this study. Precaution has been taken to protect the information which you will provide. To prevent your identity such as name won't be noted.

Confidentiality: To protect your information, code numbers will be used to identify you and no names will be used. Information you provide will be treated as strictly confidential and will be used for the study.

Compensation: Your time and participation is appreciated. However, there is no compensation involved.

Withdrawal from study: Participating in this study is entirely voluntary and you are entitled to refuse to participate as this will not affect you in any way. There is no penalty for withdrawing.

Hence, your verbal consent, willingness and genuine response for the questions can make the data collections complete and the study achieve its goals

Do you have any questions?Are you willing to participate in the interview?

If the respondent does not agree to be interviewed thank her and go to the next respondent.

If the respondent says 'YES' continue.

If you need further clarity regarding this study, you may contact:

Principal Investigator: Dr Nahom Shibiru

Tel: +251-939719895

Email: Drnhmss@gmail.com

Data collector name: _____ signature_____

Supervisor name: _____signature_____

Date_____/_____/____E.C

Part one: ***Socio-demographic characteristics***

1.	Age in years	_____/
2.	Place of residency	1. In Addis Ababa 2. Out of Addis Ababa
3.	Marital status	1.Single 2.Married 3.Divorced 4. Widow/separated
4.	Educational level	1.No formal education 2.Primary school 3.Secondary or preparatory 4.College/University graduate
5.	Occupation	1.Housewife 2.Daily laborer 3.Self-employed 4.Government employed 6.Others (specify)_____
6.	Household income in ETB	----------

Part two: ***Indications for induction of labor***

7.	Indication for induction of labor	1) Hypertensive disorders of pregnancy (Preeclampsia/eclampsia, Gestational hypertension, Chronic Hypertension) 2) Maternal medical conditions (Diabetes mellitus, Renal disease, Chronic pulmonary disease, Cholestasis of pregnancy, Cardiac disease, Thyroid disease etc.) 3) Premature rupture of membranes (With or without Chorioamnionitis) 4) Abruptio placentae 5) Fetal compromise (Fetal growth restriction, Oligohydramnios) 6) Post term (≥42 week), 7) Rh Isoimmunization 8) Stillbirth 9) Others(specify)----------

Part three: Obstetrics Characteristics of induced pregnancy and induction process

8.	Parity	1. Nulliparous 2. Parous
9.	Gestational age in weeks	_____/
10.	ANC follow up	1. Yes 2. No
11.	Was cervical ripening done?	1. Yes 2. No
12.	If cervix was primed, which method was used?	1.Dinoprostone 2.Misoprostol 3.Transcervical foley catheter
13.	Bishop Score before the start of induction	----------/13
14.	Membrane ruptured before induction	1.Yes 2.No
15.	Total duration of rupture of membranes (after start of induction)	=----------hour(s)
16.	if membrane ruptured, liquor status at delivery	1. Clear 2. G-1 MSAF 3. G-2 MSAF 4. G-3 MSAF 5. Bloody
17.	Timing of induction	1.Elective 2.Emergency
18.	Methods of labor induction	1.Oxytocin infusion 2. Misoprostol oral solution
19.	Length of induction (initiation to delivery)	_____ hours
20.	Labor analgesia	1.Given 2.Not given

Part four: Outcomes of inductions of labor

21.	Mode of delivery	1.Normal vaginal delivery 2.Operative vaginal delivery 3. Caesarean section
22.	If Caesarean delivery, what is indication?	1.Failed induction 2.CPD 3.non-reassuring fetal status (non-reassuring fetal heart rate pattern or/and Meconium in Amniotic fluid) 4.Others(specify)----------
23.	Presence of maternal complications	1.Yes 2.No
24.	If there is maternal complication	1. PPH 2. Uterine rupture 3. IAI 4. 3rd or 4th degree perineal tear 5. Others (Specify)_____
25.	Presence of maternal death	1.Yes 2.No
26.	If maternal death, possible cause	_____
27.	Fetal outcome	1.alive 2. stillbirth
28.	APGAR score	1st min_____ / 5th min_____
29.	Birth weight	_____ Grams
30.	Sex of neonate	1. Male 2. Female
31.	If stillborn, possible cause of death	_____
32.	Neonate referred to NICU	1.YES 2. NO
33.	If yes, reason for referral	1 septic workup 2 respiratory distress 3 IUGR evaluation 4 Prematurity 5 PNA 6 others
34.	Neonate admitted to NICU	1.Yes 2.No

35.	If the neonate is admitted to the NICU, then the assessment	1. PNA 2. MAS 3. TTN 4. EONS 5. Others (Specify) _____
36.	If the neonate is admitted to the NICU, at 7th day the neonate	1. Discharged improved 2. Died 3. Still in the NICU
37.	**Maternal length of hospital stay**	**_____days**