



DETERMINANTS OF BIRTH ASPHYXIA AT PUBLIC HOSPITALS IN EAST WOLLEGA ZONE, ETHIOPIA: A CASE CONTROL STUDY

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ABSTRACT

Background: Despite birth asphyxia is one of the most important causes of morbidity and mortality in new-borns; the determinants of birth asphyxia were no investigated according to the local context, especially in this a particular area. Therefore, this study aimed to identify the determinants in order to prevent the problem.

Objectives: To identify determinants of birth asphyxia at public Hospital in East Wollega Zone, Oromia Region, West Ethiopia, 2019

Methods: A case-control study was conducted from March 10 to April 15,2019. Systematic random sampling technique was used to select 308 (103 cases and 205 controls) newborn. Data were collected using checklist for record review and interviewer administered questionnaire. The data were entered in to Epi-data version 3.1 and analysed using SPSS version 24. Variables with P-value <0.25 were taken to multi-variable regression. Backward likelihood ratio with 0.1 probability removal was used to develop the model. Collinearity, goodness fit of final model using Hosmer Lemeshow test considering good fit at P-value ≥ 0.05 (0.208), omnibus likelihood test <0.05(0.000) and model classification of accuracy (77.9%) were checked. Odds Ratio estimated with 95% CI was used to show strength of association and P-value < 0.05 was used to declare statistical significance.

Result: A total of 308(103 cases and 205 controls) mothers of newborns were interviewed and record reviewed with response rate of 98%. Maternal factors like: being not educated (non-formal education) (AOR=2.44; [95%CI:1.37,4.34]), having antenatal care follow up <4 (AOR=2.30; [95% CI:1.17,4.53]), Prolonged duration of labour (AOR=4.12; [95% CI:1.78,9.50]), non-cephalic fetal presentation (AOR=4.35; [95%CI:1.77,10.67]) and being primi-parous (AOR=2.14; [95%CI:1.20,3.83]) were the predictors birth asphyxia. The neonatal factor such as: being preterm (AOR=5.77; [95%:2.62,12.69]) and low birth weight (AOR=4.43; [95%:1.94,10.13]) were also the predictors of birth asphyxia.






















Conclusion: non-formal education, having less antenatal care follow up, prolonged duration of labor, being non-cephalic presentation, prim parous, preterm and low birth weight were the independent predictors of birth asphyxia. Interventions focusing in this area should give priority for these identified determinants.

Key words: *birth asphyxia, determinants, newborn, East Wollega, public hospitals*

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List of Abbreviations and acronyms

 ANC	Antenatal Care
 AOR	Adjusted Odd Ratio
 APH	Antepartum Haemorrhage
 BA	Birth Asphyxia
 CI	Confidence Interval
 COR	Crude Odd Ratio
 CP	Cerebral Palsy
 CS	Caesarean Section
 CSA	Central Statistical Agency
 FMOH	Federal Ministry of Health
 HIE	Hypoxic Ischemic Encephalopathy
 HIV	Human Immunodeficiency Virus
 MDG	Millennium Development Goals
 MNCH	Maternal, Neonatal and Child Health
 NICU	Neonatal Intensive Care Unit
 OR	Odd Ratio
 RHB	Regional Health Bureaus
 SDGs	Sustainable Development Goals
 SVD	Spontaneous Vaginal Delivery
 UNICEF	United Nation Children's Fund
 WHO	World Health Organization

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CHAPTER ONE: INTRODUCTION

1.1 Background

Birth asphyxia is a common and serious neonatal problem globally and it significantly contributes to neonatal morbidity. It is when the baby receives too little oxygen because it does not begin or sustain adequate breathing at birth. Poorly breathing count in one minute less than 30 per minute is a sign of asphyxia (1). Birth asphyxia may be defined depends on the level of neonatal birthing at extramural babies per minute age. Accordingly, birth asphyxia classified as- moderate birth asphyxia that is slow gasping breathing at 1-minute of age, severe birth asphyxia-no breathing at 1-minute of age. For intramural babies, birth Asphyxia-Apgar score of less than 7 at 5 minute of age. Moderate birth asphyxia- Apgar score between 4 to 6 at 1-minute of age and severe birth asphyxia- Apgar score of 3 or less at 1-minute of age (2).

Birth asphyxia is sometimes unexpected, but often there are risk factors including antenatal factors such as hypertensive disorders, infections or bleeding; fetal causes like fetal growth restriction, breech presentation or chronic fetal distress; or intrapartum factors such as infections, placenta bleeding, uterine rupture, umbilical cord accidents or prolonged labour.

Birth asphyxia is a life-threatening event affecting 2/1000 infants, potentially psychologically traumatic for parents, mental health problems may impact on bonding with and development of the child. Birth asphyxia result for post traumatic syndrome to parents and poorer bonding in asphyxiated infants and mothers and the history of past trauma puts parents at increased risk of general psychological distress after perinatal asphyxia (3).

Birth asphyxia also may result in fetal demise, neonatal death, or a period of recovery during which there is organ dysfunction with possible long-term effects, particularly in neurological function. The antenatal and intrapartum asphyxia is higher in complicated pregnancies, particularly those associated with diminished placental reserve including: Hypertensive disease of pregnancy or pre-eclampsia, Intrauterine growth restriction, Placental abruption, Fetal anaemia (e.g. rhesus incompatibility), Post maturity, unphysiological labour (e.g. induction), and Malpresentation including vasa praevia (4). On basic principles the assessment should include a history of maternal and intrapartum risk factors for problems that may affect the infant including pre-existing medical conditions in the mother, problems of pregnancy, abnormalities identified antenatal in the fetus, the presence of meconium stained liquor, maternal indicators of infection, presentation and method of delivery (2).

The Apgar score was proposed by Dr Virginia Apgar in 1952 as an objective tool to assess the condition of newborns immediately after birth. The score consists of five characteristics of the newborn infant: skin colour (pink, blue or pale), heart rate (≥ 100 / minute, < 100 /minute or absent), respiratory effort (normal rate and effort, irregular gasping or absent), muscle tone (active, arms and legs flexed or 'floppy tone') and reflex irritability (pulls away, grimace or absent). All contribute equally to the total score each with rating of 0, 1 or 2 points (5). Known as the Apgar Score, it allows healthcare providers to rate the baby's heart rate, skin colour, reflexes, muscle tone, and breathing. An extremely low Apgar Score could be indicative of birth asphyxia. The Apgar score is a vitality index from 0 to 10 assigned to virtually every newborn infant at one, five, and 10 minutes after birth. The score is based on measures of heart rate, respiratory effort, skin colour, muscle tone, and reflex irritability. A total score of 7-10 is considered "normal," and a lower Apgar score indicates depressed vitality. However, several possible causes of low Apgar scores exist, such as perinatal asphyxia, congenital infections, maternal fever in labour, a diagnosis of chorioamnionitis, malformations, and preterm birth (6).

Prolonged asphyxia may lead to multiple organ systems dysfunction and new-borns who faced asphyxia at birth may sequence neurological complications including epilepsy, cerebral palsy and developmental delay (7). If birth asphyxia causes brain damage during birth, the baby usually develops hypoxic ischemic encephalopathy (HIE) shortly after being born. HIE is a neurological impairment caused by low oxygen or lack of oxygen. HIE is one of the leading causes of infant mortality or severe impairments after birth (8).

The consequences of perinatal asphyxia are devastating as survivor present various neurodevelopmental problems with heavy financial, emotional and physical burden on victims and their families. Epidemiological studies in developed countries indicate that perinatal asphyxia is the cause of 8%-15% of cerebral palsy. The occurrence of post-asphyxia neurological sequelae is high especially in children with severe Hypoxic-ischemic encephalopathy. The main sequelae were mental retardation, Cerebral Palsy and epilepsy (9).

1.2 Statement of the problem

According to United children's fund (UNICEF,2018) report the current burden of deaths, child survival remains an urgent concern. In 2017 alone, 5.4 million children died before reaching their fifth birthday 2.5 million of those children died in the first month of life. The neonatal period is the first 28 days of life but also the most vulnerable time for survival. Worldwide about one-quarter of all neonatal deaths are caused by perinatal asphyxia. Accordingly, Birth asphyxia is the cause of 23% of all neonatal deaths worldwide. It is the fifth largest cause of death of children younger than 5 years (8.5%) (2).

World Health Organization (WHO), showed Birth asphyxia is third major cause of neonatal death after infections and preterm births in developing countries accounting for an estimated 23% of the annual 4 million neonatal deaths. Each year approximately 24% of neonatal deaths occur due to birth asphyxia with serious neurological sequels, such as cerebral palsy, mental retardation and epilepsy leading to detrimental long term consequences for both child and family (3).

A multi-country prospective cohort study done in 11 community-based research sites in south Asia and sub-Saharan Africa (2012-2016) reported that the most common causes of neonatal deaths were perinatal asphyxia (40%, in south Asia; 34%, in sub-Saharan Africa) (10). According to study done (2016) in six low middle-income countries fetal asphyxia 46.6% was the major cause of stillbirth associated with prolonged or obstructed labour, pre-eclampsia and antepartum haemorrhage (11). The burden of neonatal deaths is also unevenly distributed across regions and countries (12). Many preconception, antepartum and intrapartum risk factors have been shown to be associated with birth asphyxia. A recently review showed that asphyxia is might be primarily antepartum in origin in 50% of cases, intrapartum in 40%, and postpartum in the remaining 10% of cases (13). Birth asphyxia was one of the contributors of early neonatal death with 34% and followed by 25% prematurity and 18% sepsis and other infectious conditions (9).

Birth asphyxia is a dangerous situation and if it is not managed correctly and promptly can be responsible for brain death, cardiac, lungs and kidneys failure and even death can occur (12). Neonatal intensive care unit is a highly technical specialized unit in a hospital that provide medical/nursing care and technologies support to sick and high risk infants and premature in emergency like birth asphyxia (15).

Despite declining neonatal mortality levels, marked disparities in neonatal mortality exist across regions and countries. In 23 countries in sub-Saharan Africa, the number of neonatal deaths did not decline from 1990 to 2017 even though the rates of neonatal mortality fell over the same period. At a time when the knowledge and technology for life-saving interventions are available, it is unacceptable that 7,000 neonates every day whom died in the first week after birth in 2017 mostly from preventable causes and treatable diseases (14).

Given the large numbers of newborn deaths and the commitment on past the Millennium Development Goals (MDGs), the global focus is on survival, but newborn deaths are only the tip of an unmeasured iceberg. There is little attention or information on the burden of newborn illnesses, or on long term disability arising from complications occurring. Estimates of the newborn deaths by major cause of death which could be prevented if essential maternal, newborn and child health (MNCH) packages were provided to 90 percent of women and newborns during birth and the neonatal period, especially in developing countries. In addition, there are missed opportunities to initiate or improve healthy behaviours, especially in the crucial period during and immediately following childbirth. The health and development outcomes that have long term consequences for individuals, communities, and national productivity and wellbeing (16).

Even though Ethiopia reached its child mortality reduction goal (MDG4), neonatal mortality remains high (17). According to World Health Organization in Ethiopia, the main causes of neonatal deaths in 2015 were birth asphyxia (31.6 percent), prematurity (21.8 percent) and sepsis (18.5 percent) (18). Guidelines are also well established in Ethiopia even for Health center level to assess by classifying to treat asphyxiated neonates at birth (19).

Many developing countries including Ethiopia targeted sustainable development goals (SDGs) to reduce neonatal mortality to at least as low as 12 per 1000 lives birth in their countries by 2030 (20). These strategies planned and moving towards solutions to address the main causes of newborn death: More than 80% of all newborn deaths result from three preventable and treatable conditions complications due to prematurity, intrapartum related deaths (including birth asphyxia) and neonatal infections; but UNICEF (2018) says 'world is failing new-borns' as global baby mortality rates remain 'alarmingly high'. Global deaths of newborn babies remain alarmingly high, particularly among the world's poorest countries. UNICEF said that some of these deaths could be prevented with access to well-trained midwives, However, a

shortage of well-trained health workers and midwives in many countries has meant that thousands don't receive the life-saving support they need to survive (21).

Though, millions of child deaths and stillbirths are attributable to birth asphyxia, yet limited information is available to guide policy and practice especially in developing countries it is considerably higher because of negligible antenatal care and poor perinatal services. In birth asphyxia, the infant needs immediate care in the neonatal intensive care unit. Children who survive birth asphyxia are at a higher risk of functional impairments, cerebral palsy (CP) or impaired vision and hearing (9). To reduce the impact of birth asphyxia on neonatal morbidity and mortality it needs further different study in diverse setting. Since the determinants commonly mentioned may depart across regions depending on contexts. In countries like Ethiopia, where birth asphyxia is the leading cause of neonatal mortality, recognizing and managing the determinants of the problem early is of a supreme importance to prevent its occurrence, reduce neonatal mortality rate, and improve neonate quality of life. According to the recent report by health monitoring and information system (HMIS 2018) of the hospitals, total delivery was 1084 from these 15.6% of newborn faced the birth asphyxia. Hence, studies are required to identify the determinants of birth asphyxia that can be educate and guide people about the determinants and management strategies. Therefore, this study aims to identify the determinant of birth asphyxia which produce broader implication on prevention of birth asphyxia.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview of birth asphyxia

Birth asphyxia is one of the most important causes of morbidity and mortality in neonates and it is occurring in association with maternal, fetal, and maternofetal factors (22). Asphyxia is a condition that occur when there is an impairment of blood-gas exchange, resulting in hypoxemia (lack of oxygen) and hypercapnia (accumulation of carbon dioxide). The combination of the decrease in oxygen supply (hypoxia) and blood supply (ischemia) results in a cascade of biochemical changes inside the body, whose events lead to neuronal cell death, brain damage (12). As this study birth asphyxia is categorized into five categories: socio-demographic, intra partum, past obstetrics history, medical history of mothers and neonatal related factors.

2.2 socio demographic determinants of birth asphyxia

There are numerous risk factors that can be linked to sequence of birth asphyxia and they may vary from one context to another. Socio-demographic risk factors of birth asphyxia included mother's age, education level and marital status. The study done in Pakistan (2014) at neonatal intensive care unit (NICU) among 240 total of neonates, 123 cases and 117 control showed that age of mother (20–25) and lack of educational status and were reported as maternal risk factors for birth asphyxia respectively (14). The study done in Sweden (47) also found that the risk for birth asphyxia decreased significantly with increasing maternal education. But in Cameroon (2013) among the socio-demographic factors studied only the marital status was statistically significant, with 54.4% of mothers of asphyxiated neonates were unmarried, against 38.8% as compared to married (23). Estimation in Iraq (2014) revealed that young (<18 years) mothers was not associated for birth asphyxia. In contrast study in Rwanda (2016) revealed that mothers aged more than 30 years were three times higher risk to delivered neonates with birth asphyxia as compared to younger mothers. And also the marital status of the mother, was found to be not related to an increased risk of birth asphyxia in this study area (24). Study done India showed the maternal age less than twenty was around three times a higher risk for birth asphyxia (25). Study done in Aksum, Ethiopia (2018), among a total of 264 (88 cases and 176 controls) revealed that socio demographics like educational status was determinants of birth asphyxia. Neonates born from mothers who unable to read and write were six times a higher risk to develop birth asphyxia compared with those at least a primary school (26).

2.3 Past obstetrics determinants of birth asphyxia

According to a matched case-control study done in India (2013) among 200 neonates with one cases to one controls ratio revealed that antenatal follow up was the risk factors of birth asphyxia (25). Similarly; retrospective case control study done in Pakistan (2014) in showed that decline in antenatal care of mother, was associated with development of birth asphyxia(14) and antenatal follow up were more than three times higher risk to develop birth asphyxia. In Rwanda (2016), at Gitwe District Hospital a case-control study done among total 248 neonates (54 were cases and 194 were control) reported that among those women who have no attended antenatal care adequately significantly associated the problem. Those who had not full antenatal follow up was above one times at high risk of developing birth asphyxia (24).

Study in Pakistan (2014) indicated that these past obstetrics history factors were risk factors for birth asphyxia, reproductive history including parity, child loss and also previous stillbirths, were more than three times higher risk to associated with birth asphyxia; As this study discussed child loss was highly significant to develop the disease. Those women who had previous history of asphyxia was four times more prone to birth asphyxia against as compare to those free from previous history of asphyxia (29). Study in Nigeria also indicated that primiparous as a significant determinant factor for severe birth asphyxia (30). Study done in northern part of Ethiopia disclosed that parity was significantly associated with birth asphyxia. As study in Aksum showed primiparous mothers were six times higher risk to birth asphyxia as compared to who had pregnancy experience before and in Gondor multiple para mothers were two times higher risk to birth asphyxia (28,31).

2.4 Medical problem determinants of birth asphyxia

Studies in different countries indicated that the medical history of mothers was significant to occurrences of birth asphyxia. In Pakistan complications during pregnancy including self-reported high blood pressure were two times high risk for the birth asphyxia and also gestational diabetes was significantly associated. In India history of maternal anaemia was more than three times higher risk to develop birth asphyxia (25). Study done in some area in Ethiopia showed that pregnancy induced hypertension have no association with birth asphyxia.

2.5 Intrapartum determinants of birth asphyxia

Study done in Indonesia (2016) with a retrospective case-control study among 70 neonates (35 cases and 35 control) at NICU showed that the prolonged rupture of membranes (>18 hours), instrumental delivery and meconium stained amniotic fluid were as the most significant risk factor for birth asphyxia. Neonates born from mothers who had prolonged ruptured membrane were above ten times higher risk to affect birth asphyxia than those with normal time rupture of membrane, those who born with stained amniotic fluid with meconium was more than seven times higher risks to develop birth asphyxia and also instrumental operative delivery was above five times higher risks for birth asphyxia (33). Study done in Mulago hospital and Uganda also reported that meconium stained amniotic fluid was significantly associated with development of birth asphyxia (34).

Study done in Pakistan and Rwanda, indicated that intrapartum risk factors such as malpresentation of fetus, long labour duration and cephalopelvic disproportion were significantly associated with risk of developing birth asphyxia (35). As a similar study design in Pakistan (2014), complications during labour and delivery including rupture of membrane before labour were two and half times a higher risk to birth asphyxia. Labour difficulty and fetal movement loss were five times a higher risk of to develop birth asphyxia. Malpresentation also more than six times a higher to affect birth asphyxia as compared to normal delivery. Similarly, a matched case control study in Iraq (2017) among 210 neonates with (85 cases and 125 controls) showed that maternal risk factors for asphyxia were; the medical problem, labour complication, assisted vaginal deliveries, complications of labour (like prolonged rupture of membrane, prolonged labour, cord prolapse, and meconium) and breech presentation were stated as risk factors of asphyxia (36). Study done in Nigeria (37) also report that Prolonged labour is associated with fetal and maternal exhaustion and also fetal distress which results in birth asphyxia.

Study in Aksum, Ethiopia (2018), among total of 264 neonates (88 cases and 176 controls) showed that status of meconium stained amniotic fluid was more than five times higher risk to increase birth asphyxia as compared to those who have no meconium stained and those gestational age less than 37 weeks were four times a higher risk to develop birth asphyxia as compared to those grater 37 weeks (26). Study in the Swedish also revealed that mothers with meconium stained was significantly associated with developing of birth asphyxia (38). Other study conducted in Gondor (2017) among total of 273 with 1:2 cases to control ratio (91 cases and 182 controls) discussed that neonates born from mothers with prolonged labour, delivered

by caesarean section (CS) and with meconium stained amniotic fluid were determinants of birth asphyxia. Babies born from mothers experienced from prolonged labour were 3 times higher risk to birth asphyxia as compared to normal delivered mothers (28). Study in Dessie Hospitals (2018) reported that prolonged labour had significantly associated with birth asphyxia (39).

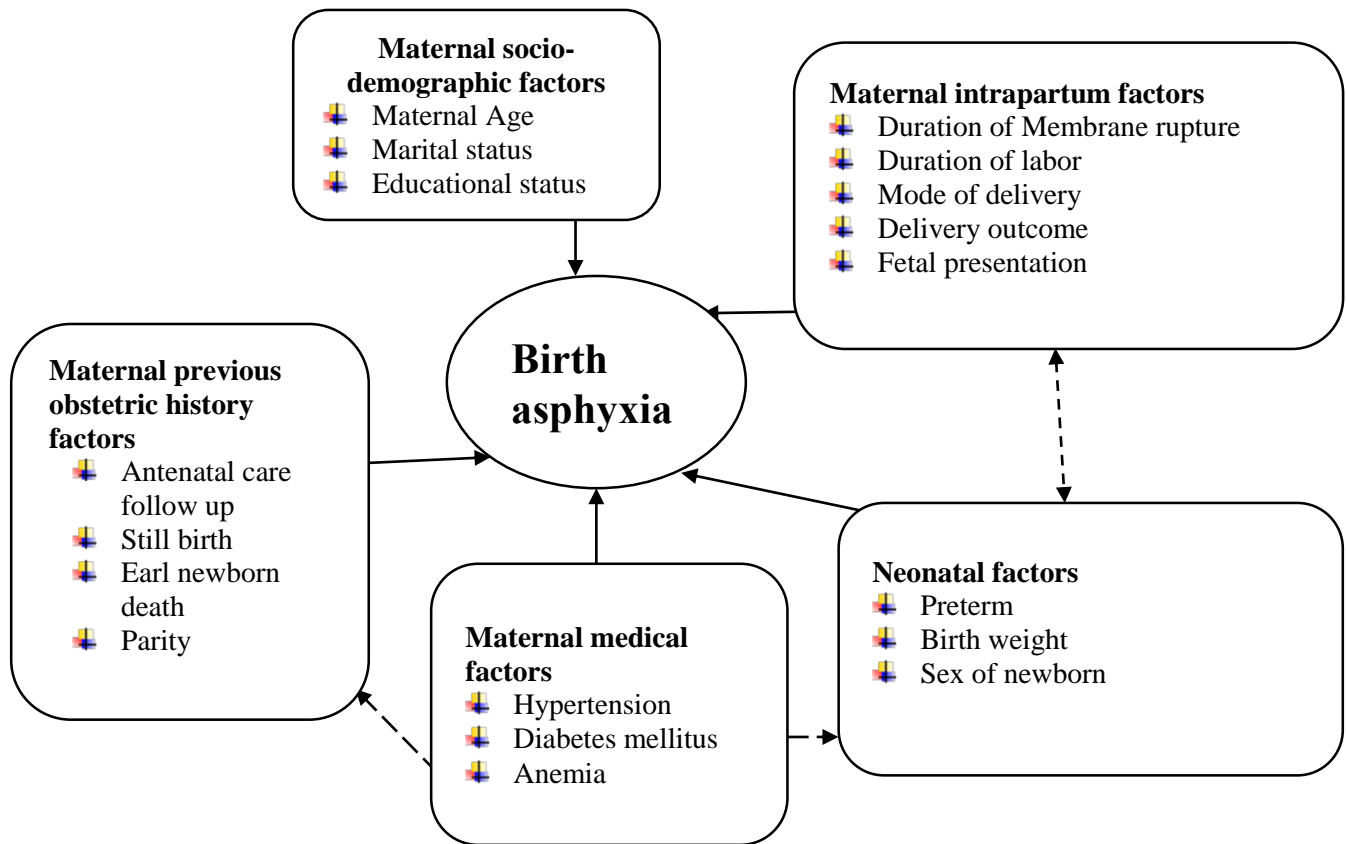
2.6 Neonatal determinants of birth asphyxia

Studies conducted in many setting with case control study indicated that small weight of the new-borns was determinant of birth asphyxia. Study in Rwanda and Pakistan showed birth asphyxia is related to low birth weight < 2.5kg. In Rwanda the risk for developing birth asphyxia was higher in the infant of lower birth weight 2.5 kg by five times as compared to the infant with the weight of >2.5 kg. However, sex of neonate, male and gestational age preterm was not associated with birth asphyxia (24). In Pakistan the risk for developing birth asphyxia was higher in the infant of weight 1-2kg as compared to the infant with weight of >2.5kg. Prematurity carried a substantially higher risk of developing birth asphyxia, with gestational age of 34-37 weeks, increasing the risk of asphyxia. Fetal conditions like, pre-mature delivery and fetal distress were significantly associated with increment in the risk of developing birth asphyxia(14).

Study done in Gondor also reported that neonates with low birth weight were eight times as likely to have birth asphyxia compared to those born with normal weight. Neonates with intrapartum fetal distress had 11 times higher risk of experiencing birth asphyxia than those born with normal foetal heart rate. This study indicated unlike the study in Rwanda neonatal sex and prematurity had no association with birth asphyxia (28). Also in Aksum (2018), Similarly, the weight of the neonate had also a significant association with birth asphyxia. Low birth weight neonates were 6.9 times higher at risk than normal weight as determinant of birth asphyxia preterm were four times higher risk than term developing birth asphyxia and low birth weight neonates were eight times higher at risk than normal weight as determinant of birth asphyxia(26).

Birth asphyxia is one of the most important causes of morbidity and mortality in neonates Worldwide. Perinatal asphyxia occurs in association with socio demographic, maternal, fetal, and maternofetal factors. From review of the existing evidences, the determinants of birth asphyxia were no more searched according to the local context, especially in a particular area. Therefore, this study aimed to identify these determinants in order to prevent the problem and reducing morbidity and mortality of newborn.

2.7 Conceptual Framework



Key: —→ Relationship was assessed in this study

---→ Relationship was not assessed in this study

Figure 1: Conceptual frame work of determinants for birth asphyxia developed from the literature review (26,28,40,41)

2.8 significance of the study

Perinatal asphyxia is a common clinical problem with a high morbidity and mortality rate and could lead to cerebral sequelae with a subsequent socio-economic burden on the families. In low-income countries 23% of all neonatal deaths occurred due to birth asphyxia Worldwide. In Ethiopia birth asphyxia also accounts 31.6%-34% causes of neonatal death. Developing countries including Ethiopia were prioritized Sustainable Development Goal, that reducing neonatal mortality. Despite neonatal mortality levels declining, across regions and countries Sub-Saharan Africa had the highest neonatal mortality rate caused by preventable problem including birth asphyxia. The findings of this study was specifically to identified the determinants of birth asphyxia aims to improve the neonatal surviving. Identifying these important determinants enable to minimize birth asphyxia and can serve as a support for further research. Show the determinants of birth asphyxia for health professionals and make them aware to early identify and prevent the problem by preventing these determinants. Also, this study will also benefit the community by informing on determinants related to birth asphyxia, which helps to create and increase awareness on birth asphyxia and its determinants and finally identify what things have to be done at community level to reduce the risk factors.

CHAPTER THREE: OBJECTIVE OF THE STUDY

- ❖ To identify the determinants of birth asphyxia in East Wollega at Public Hospitals, Oromia Region, West Ethiopia, 2019.

CHAPTER FOUR: METHODS

4.1. Study area and period

East Wollega is one of the zones in the Oromia Region of Ethiopia. This administrative division acquired its name from the former province of Wollega. Towns and cities in this zone include Nekemte. East Wollega is bounded on the southwest by Illubabor, on the west by the Didessa River which separates it from West Wollega, on the northwest and north by the Benishangul-Gumuz Region, on the northeast by Horo Guduru Wollega Zone, on the east by West Shewa, and on the southeast by the Gibe River which separates it from Jimma. Based on the 2007 Census conducted by the CSA, this Zone has a total population of 1,213,503, of whom 606,379 are men and 607,124 women; with an area of 12,579.77 square kilometres, East Wollega has a population density of 96.46. While 162,854 or 7.72% are urban inhabitants, a further 28 persons are pastoralists. A total of 255,534 households were counted in this Zone, which results in an average of 4.75 persons to a household, and 246,680 housing units (42).

Data were collected from five governmental hospitals found in the East Wollega zone. Nekemte referral hospital and Wollega University teaching referral hospitals are referral hospitals found in the zone which is about 332km west of Addis Ababa. Each of these referral hospitals give services for above 1.5 million populations. As monthly report maternal delivery from Nekemte referral hospital, was 320 and 280 deliveries on average at Wollega University teaching referral hospital. Of five hospitals Jimma Arjo, Gida Ayana and Sibu sire general hospitals are hospital that found in this region. Each of these general Hospital provides services for above 100,000 peoples. Monthly delivery report in Gida Ayana, Jimma Arjo and Sibu Sire district hospital were 155,142, 187 deliveries on average respectively and total 1084 deliveries.

4.2 Study design

A facility based case-control study was conducted.

4.3 Population

4.3.1 Sources population

Cases: The source population for cases were all neonates diagnosed as birth asphyxia

Controls: The source population for controls were all neonates free of birth asphyxia

4.3.2 Study participants

Cases: Newborns diagnosed as birth asphyxia by physician and those eligible for the study during data collection time.

Controls: Newborns without birth asphyxia and eligible for study during data collection time.

4.3.3 Case Definitions

Cases: Newborns with APGAR scores of <7 within 5 minutes and confirmed by physician were defined as having birth asphyxia (5,43).

Control: Newborns with APGAR scores of ≥ 7 within 5 minutes were considered as free from birth asphyxia.

4.4 Eligibility criteria

4.4.1 Exclusion Criteria

Newborns with anomalies like: congenital anomalies and congenital infections was excluded.

4.5 Sample size and Sampling technique

Sample size was determined by using Epi Info version 7 statistical software to determine two population proportion from the factors reviewed which gives maximum value by using 95% CI, power 80%, case to control ratio 1:2, Odds Ratio=2.21 which is the ratio of odds of cases among neonates with birth asphyxia to odds of controls among neonates free of birth asphyxia; exposure of controls 22.7% and exposure of cases as 39.3%.

Parameters used to calculate sample size were: -

- λ =ratio of free birth asphyxia to birth asphyxia
- P = exposed cases =39.3%.
- p_2 = exposed controls =22.7%
- n_1 =sample size for birth asphyxia=98
- n_2 = sample size for free of birth asphyxia=195
- $Z_{\alpha/2}$ =standard normal value at 95%CI=1.96
- $Z_{1-\beta}$ (power)=80%. The calculated sample is 293 (98 cases and 195 controls). By adding 5% nonresponse rate the total sample size is 308 (103 cases: 205 controls).

Table 1; Determinants that reviewed for maximum sample size.

Determinant reviewed	Ratio of exposure among cases	Ratio of exposure among controls	Odds ratio	Cases: control	Sample size				Reference
					Cases	Controls	Non-response(5%)	Total	
Unable to write and read	53	15.9	6	1:2	22	43	3.25	68.25	(26)
Prim parous	64	36.4	3.10	1:2	43	68	6.45	135.13	
Low birth weight	44.7	10.5	6.9	1:2	23	45	3.4	71.4	
Preterm	39.3	22.7	2.21	1:2	98	195	14.65	307.65	
Meconium stained AF	29.2	5.1	7.88	1:2	31	61	4.6	96.6	
Antepartum hemorrhage	17.2	1.7	12.03	1:2	46	91	5.35	112.35	

The schematic of proportion to sampling techniques:

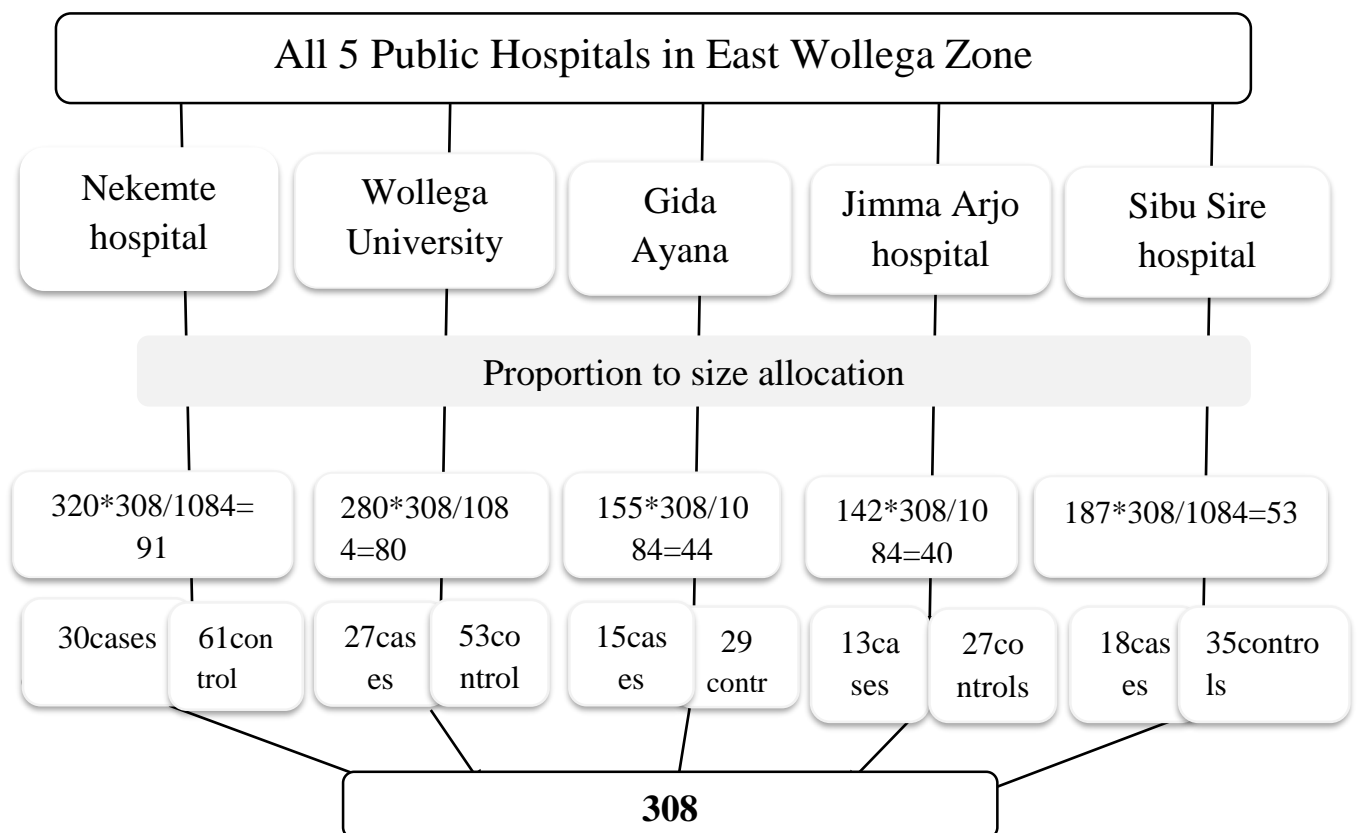


Figure 2; schematic of proportion to size allocation

4.6. Sampling procedures

Cases were recruited consecutively from asphyxiated neonates whereas controls were selected from non-asphyxiated newborn by Systematic random sampling using all delivered neonates in the study were as a sampling frame. By taking a monthly delivery report from the hospital and considering a 15.6% proportion of asphyxiated newborns from the health monitoring information system report in the hospitals, an average of 1084 deliveries and 169 asphyxiated newborns were expected during the data collection period. Every other asphyxiated baby was selected as a case, while every 3th non-asphyxiated newborn was enrolled as a control.

Case ascertainment

Cases were confirmed by physician that the neonates with Apgar score was <7 with in 5th minutes out of 10 score as BA (5) depending on:- **Skin color:** blue or pink=0, pink body & blue ex.=1 and pink=2, **Pulse/heart rate:** Absent=0, <100bpm= 1 & >100bpm=2, **Reflex:** no response=0, grimace=1 & sneeze=2, **Muscle tone:** limp=0, both ex.=1 & active=2 and **Respiration:** absent=0, slow=1 & crying=2

4.7. Data collection instruments/procedure

A structured questionnaire was adapted after reviewing literatures (26,28,40,41) that used to interview mothers and review record of mothers and neonates to identify factors. The questionnaire was prepared in English version, translated to local language in Afan Oromo and then translated back to English by linguist to check for inconsistency. After cases were confirmed by physicians (birth asphyxia) cases and controls were recorded by identification number. Then, cases and controls were differentiated and data were collected by reviewing delivery registration book/patient index card and the study participants were interviewed. The questionnaire had two parts and five sections:

Part I: the maternal interviewing part which contains three section; Section 1: Socio-demographic factors like: age of mothers, marital status of the mother and educational status
Section 2: past obstetrics history factors: antenatal care follow up, abortion, birth and loss of new-born history.

Part II: checklist which had three sections was used to collect information of intrapartum and neonatal factors from delivery registration book and medical factors from patient index cards of mothers and newborns: Section 1: Intrapartum factors: duration of labour, fetal presentation, duration of membrane rupture and mode of delivery membrane rupture.

Section 2: Neonatal factors: gestational age (Weeks), delivery outcome, birth weight, and sex.

Section 3: medical history of mothers: hypertension, diabetic mellitus.

Data were collected by health professionals (five BSc. nurses) and supervised by BSc midwives. Training was given for data collectors and supervisors for 1 day on clarification of some terms and assessment tools, aim of the study, concerning need for strict confidentiality of respondent's information, time of data collection, timely collection and reorganization of the collected data from respective hospitals and submission on due time.

4.8 Study variables

4.8.1 Dependent variables:

- **Birth asphyxia**

4.4.2 Independent variables:

- **Socio-demographic factors:** age of mothers, marital status of the mother, educational status and occupation
- **Past obstetrics history:** antenatal care, parity, neonatal loss and abortion
- **Intrapartum factors:** duration of labour, mode of delivery, fetal presentation and duration of membrane rupture
- **Neonatal risk factors:** gestational age (Weeks), delivery outcome and birth weight,
- **Medical factors:** hypertension, diabetic mellitus and anemia

4.9 Operational definitions and definition of terms

- **Birth asphyxia**-a neonate who had < 7 APGAR score.
- **Asphyxia**-the failure of a neonate to initiate and sustain respiration at birth
- **Apgar Score**-method of assessing fetal wellbeing immediately after delivery
- **Antenatal care follow up:** number of once which mothers followed during the pregnancy
- **Prolonged rupture of membrane:** rupture of membrane for greater than 18 hours
- **Duration of labour:** pattern of labor recorded on the partograph is >18hrs, it is considered as prolonged labor.
- **Still birth:** pregnancy loss that occurs after 7 months of gestation
- **Early newborn death:** deaths of live births within the first 7 days of life
- **Preterm:** When the newborn was born < 37 gestational age (14).

- **Birth weight:** neonates weighing <2500g at birth regardless of gestational age were considered as low birth weight (27).

4.10 Pre-test

One week prior to the actual data collection, the questionnaire and the checklist were pre-tested on 5% (16) of sample size at Metu Karl referral hospital. The purpose of the pre-test was to ensure the consistency of instrument, questions understandable by the respondents, wording, logic and skip order of the questions in a sensible way to the respondents. Amendments were made accordingly after the pre-test was done.

4.11 Data quality management

For data collection five BSc nurse from health centers were recruited to collect data from maternal delivery registration book, medical and neonatal index card after one-day training given focusing on the objective of the study. The principal investigator coordinated the overall activity of the study. During data collection supervisors checked how the data collectors were doing their task and solve on site problems. At the end of each data collection day, the questionnaire was reviewed and cross checked for completeness by the investigator and corrective discussion were under taken with all the data collectors. Template for data entry was developed into Epidata 3.1 version. Data were entered, cleaned and edited daily by the principal investigator.

4.12 Data analysis procedures

Collected data were edited, coded and entered into Epi-Data version 3.1 and then exported to SPSS version 24 for analysis. Checking data code and data cleaning were done before analysis. Frequencies and cross tabulations were used to summarize descriptive statistics. The association between birth asphyxia and each covariate was assessed first by bivariate logistic regression to identify candidate variable for final model. Variables with P-value <0.25 were taken to multi-variable regression. Backward likelihood ratio with 0.1 probability removal was used to develop the model. Collinearity diagnosis were checked. Goodness fit of the final model was checked using Hosmer Lemeshow test of goodness fit considering good fit at P-value ≥ 0.05 (0.208), omnibus likelihood test <0.05(0.000) and model classification of accuracy was checked (77.9%). Odds Ratio estimated with 95% CI was used to show strength of association and P-value < 0.05 was used to declare statistical significance.

4.13 Ethical consideration

Letter of ethical clearance was obtained from Institutional Review Board of Institute of Health, Jimma University and letter of cooperation from population and family health department. Informed consent was obtained after the purpose of the study was explained to participants. To ensure confidentiality the participants were informed that their data were coded and no need of writing their name. To ensure principle of beneficence the investigator ensured that mothers particularly had no harm by refused to participate and not obliged to give reason for refusal and was not had any consequences on subjects and the services provided for them. Record review and mothers interview permitted from hospital management.

4.14 Dissemination plan

The findings will be presented to the Jimma University scientific community (JUSC) and submitted to: Jimma University (JU) institute of health, faculty of public health, Population and family health department, East Wollega Zone Health bureau, Hospital administrations. Moreover, the findings will be presented on annual scientific meetings, seminars and conferences. Attempt will be made to publish it on peer reviewed reputable journal.

CHAPTER FIVE: RESULTS

5.1 Socio-demographic related characteristics

A total of 308 (103 cases and 205 controls) mothers of newborns were interviewed yielding a response rate of 98%. The mean age (\pm Standard deviation) of mothers for the cases and the controls were 25.97 (SD: \pm 4.47) and 25.52(SD: \pm 4.17), respectively. Concerning educational status, 74(71.8%) mothers of the cases and 171(83.4%) controls were educated (had formal education). Seventy-five (72.5%) of mothers for the cases and 143(69.8%) controls were married. Regarding occupation, 85(82.5%) mothers of the cases and 158(77.1%) controls were government employee (Table2).

Table 2. Socio demographic characteristics of mothers who delivered at East Wollega, in Public Hospitals, Ethiopia, 2019

Variable	Category	Cases n=103 (%)	Controls n=205 (%)	Total n= 308(%)
Age in years	18-29 years	58(56.31)	87(42.44)	145(47.08)
	<18 years	18(17.48)	38(18.54)	56(18.18)
	\geq 30 years	27(26.21)	80(39.02)	107(34.74)
Marital status	Married	75(72.8%)	143(69.8%)	218(70.78)
	Unmarried	28(27.2%)	62(30.2%)	90(29.22)
Educational status	Not educated	29(28.16)	34(16.59)	63(20.45)
	Educated	74(71.84)	171(83.41)	245(79.55)
Occupation	Government employer	85(82.52)	158(77.07)	243(78.90)
	Self-business	18(17.48)	47(22.93)	65(21.10)

5.2 Past obstetrics related characteristics

Connected the characteristics of past obstetrics history, twenty-eight (27.2%) mothers of the cases and ninety-one (44.4%) controls were prim parous. Fifteen (14.6%) mothers of the cases and 16(7.8%) controls had history of miscarriage while 13 (12.6%) mothers of the cases and 17 (8.3%) controls had history of child loss, Regarding the frequency of antenatal care follow up, 84(81.6%) mothers of the cases and 173(74.4%) of controls had antenatal care follow up more than four times (Table 3).

Table 3. Past obstetrics characteristics of mothers who delivered at East Wollega, in Public Hospitals, Ethiopia, 2019

Variable	Category	Cases n=103(%)	Controls n=205(%)	Total N =308(%)
Number of ANC	>=4	84(81.55)	173(84.39)	257(83.44)
Follow up	<4	19 (18.45)	32(15.61)	51(16.56)
Parity	Multipara	75(72.82)	114(55.61)	189(61.36)
	Primipara	28(27.18)	91(44.39)	119(38.64)
Miscarriage	Yes	15(14.56)	16(7.80)	31(10.06)
	No	88(85.44)	189(92.20)	277(89.94)
Child loss	Yes	13(12.62)	17(8.29)	30(9.74)
	No	90(87.38)	188(91.71)	278(90.26)

5.3 Intrapartum related characteristics

From the study participants, 20(19.4%) mothers of the cases and 13(6.4%) controls developed prolonged labor and 83(80.6%) mothers of the cases and 192(93.7%) controls gave birth through spontaneous vaginal delivery. Concerning rupture of membrane, 10(9.7%) mothers of the cases and 11(5.4%) controls had prolonged rupture of membrane whereas 17(16.5%) mothers of the cases and 11(4.5%) controls had non-cephalic presentation. Ninety-eight mothers of the cases (95.1%) and 201 (98.1%) controls had singleton baby (Table 4).

Table 4. Intrapartum characteristics of mothers who delivered at East Wollega, in Public Hospitals, Ethiopia, 2019

Variable	Category	Cases n=103(%)	Controls n=205(%)	Total N=308(%)
Duration of labour	Normal	83(80.58)	192(93.66)	275(89.29)
	Prolonged	20(19.42)	13(6.34)	33(10.71)
Mode of delivery	SVD	56(54.37)	166(80.98)	222(72.08)
	CS	17(16.50)	11(5.37)	28(9.09)
	Instrument	30(29.13)	28(13.65)	58(18.83)
Prolonged rupture of membrane	Yes	10(9.7%)	11(5.4%)	21(6.82)
	No	93(90.3%)	194(94.6%)	297(93.18)
Fetal presentation	Non-cephalic	17(16.51)	11(5.37)	28(9.09)
	Cephalic	86(83.49)	194(94.63)	280(90.91)
Delivery outcome	Single	98(95.15)	201(98.05)	299(97.08)
	Multiple	5 (4.85)	4(1.95)	9(2.92)

5.4 Medical related characteristics

Eleven (10.7%) mothers of the cases and fourteen (6.8%) controls had history of anemia during pregnancy. Nine (8.7%) mothers of the cases and 4 (2.0%) controls had history of hypertension, and 7 (6.8%) mothers of the cases and 3 (1.5%) controls had also history of diabetics mellitus during pregnancy (Table 5).

Table 5. Medical characteristics of mothers who delivered at East Wollega, in Public Hospitals, Ethiopia, 2019

Variable	Category	Cases n=103(%)	Controls n=205(%)	Total N=308(%)
Anemia	Yes	11(10.68)	14(6.83)	25(8.12)
	No	92(89.32)	191(93.17)	283(91.88)
Hypertension of mothers	Yes	9(8.73)	4(1.95)	13(4.22)
	No	94(91.27)	201 (98.05)	295(95.78)
Diabetics during pregnancy	Yes	7(6.80)	3(1.46)	10(3.25)
	No	96(93.20)	202(98.54)	298(97.75)

5.5 Neonatal related characteristics

Twenty-six (25.2%) of the cases and 15 (7.3%) of the controls had gestational age of less than 37 weeks (preterm) and 37(35.9%) of the cases and 93(45.4%) of the controls were females. Regarding weight of new born, 21(20.4%) of the cases and 14(6.8%) of the controls had birth weight less 2500gm (Table 6).

Table 6. Neonatal characteristics of newborn who delivered at East Wollega, in Public Hospitals, Ethiopia, 2019

Variable	Category	Cases n=103(%)	Controls n=205(%)	Total N=308(%)
Gestational age	<=37weeks	26(25.24)	15(7.32)	41(13.31)
	>37weeks	77(74.76)	190(92.68)	267(86.69)
Sex of neonate	Female	37(35.92)	93 (45.37)	130(42.21)
	Male	66 (64.08)	112(54.63)	178(57.79)
Newborn weight in gram	<=2500g	21(20.38)	14(6.83)	35(11.36)
	>2500g	82(79.62)	191(93.17)	273(88.64)

5.6 Determinants of birth asphyxia

In bivariate logistic regression analysis: maternal age, educational status, antenatal care, hypertension, duration of labor, prolonged rupture of membrane, fetal presentation, parity, gestational age at birth and newborn weight fulfilled the criteria and were potential candidates for the multiple logistic analysis.

In multi-variable logistic regression analysis: educational status of mothers, number of antenatal care follow up, duration of labor, fetal presentation, parity, gestational age and weight of newborn were significantly associated with birth asphyxia.

The odds of developing birth asphyxia were more than two times higher in neonates whose mothers not had formal education than educated ones (AOR=2.44; [95%CI:1.37,4.34]). Newborns delivered from mothers who had antenatal care follow up less four times were 2.30 times higher to develop birth asphyxia than those whose mothers had greater than four times antenatal care follow up (AOR=2.30; [95% CI:1.17,4.53]). Newborns of mothers who had prolonged labour were 4.12 times more likely to develop birth asphyxia as compared to those with normal labour (AOR=4.12; [95% CI:1.78,9.49]). Babies born with non-cephalic presentation were 4.35 times more likely to develop birth asphyxia than their counterparts (AOR=4.35; [95%CI:1.77,10.67]). Neonates delivered from prim parous mothers were 2.14 times higher to develop birth asphyxia than multiparous (AOR=2.14; [95%CI:1.20,3.83]). This study also revealed that newborns with low gestational age were 5.77 times more likely to develop birth asphyxia than their counterparts (AOR=5.77; [95%CI:2.62,12.69]). Low birth weight neonates were 4.43 times higher to develop birth asphyxia than normal one (AOR=4.43; [95% CI:1.94, 10.13]) (Table 7).

Table 7. Bivariate and Multi-variable logistic regression analysis of Birth asphyxia in East Wollega, at Public Hospitals, Ethiopia, 2019

Variable	Category	Cases n=103(%)	Controls n=205(%)	COR (95%CI)	AOR (95%CI)	P-Value
Maternal educational status	Not educated	29(28.2%)	34(16.6%)	1.97(1.32,3.67)	2.44(1.37,4.34)	0.006*
	Educated	74(71.8%)	171(83.4%)	1	1	
Age in years	18-30 years	58(56.3%)	87(42.4%)	1	1	0.870
	<18 years	18(17.5%)	38(18.5%)	0.71(0.37,1.37)	.93(.40,2.13)	
	≥ 30 years	27(26.2%)	80(39.1%)	0.51(0.41,0.88)	.65(.27,1.18)	
Number of ANC	≥4	84(81.6%)	173(84.4%)	1	1	
Follow up	<4	19 (18.4%)	32(15.6%)	1.22(.65,2.28)	2.30(1.17,4.53)	0.016*
Duration of labour	Normal	83(51.5%)	189(93.7%)	1	1	0.001*
	Prolonged	20(48.5%)	13(6.3%)	3.50(0.13,0.59)	4.12(1.79,9.49)	
Fetal presentation	Non-cephalic	17(16.5%)	11(4.5%)	3.49(1.57,7.75)	4.35(1.77,10.67)	0.001*
	Cephalic	86(83.5%)	194(94.6%)	1	1	
Mode of delivery	SVD	56(54.4%)	166(80.0%)	1	1	0.232
	CS	17(16.5%)	11(4.5%)	4.58(2.04,10.00)	1.79(.87,4.69)	
	Instrument	30(29.1%)	28(13.7%)	3.18(1.75,5.88)	1.47(.62,3.45)	
Prolonged rupture of membrane	Yes	10(9.7%)	11(5.4%)	1.9(0.78,4.62)	1.02(0.28,3.70)	0.970
	No	93(90.3%)	194(94.6%)	1	1	
Parity	Multipara	28(27.2%)	91(44.4%)	1	1	0.010*
	Primipara	75(72.8%)	114(55.6%)	2.14(1.28,3.58)	2.14(1.20,3.83)	
Hypertension	Yes	9(8.7%)	4(2.0%)	4.81(1.16,14.8)	3.13(0.69,14.17)	0.140
	No	94(91.3%)	201(98.0%)	1	1	
Gestational age at delivery	≤37weeks	26(20.4%)	15(40.0%)	4.07(2.15,8.51)	5.77(2.62,12.69)	0.000**
	>37weeks	77(79.6%)	181(60.0%)	1	1	
Newborn weight in gram	≤2500g	21(20.4%)	14(6.8%)	3.49(1.69,7.21)	4.43(1.94,10.13)	0.000*
	>2500g	82(79.6%)	191(93.2%)	1	1	

COR: Crude Odds Ratio, AOR: Adjusted Odds Ratio, CI: Confidence Interval, 1: reference category, *= p value < .05, **= p. value <0.001

CHAPTER SIX: DISCUSSION

Birth asphyxia is a major cause of death and acquired brain damage in newborn infants. There are different causes, including obstructed airway which can cause respiratory depression result to birth asphyxia (44). This study also identified different factors which should need timely identification and proper solutions which can prevent and reduce neonatal morbidity and mortality from birth asphyxia.

6.1 Determinants of birth asphyxia

The odds of developing birth asphyxia among neonates born from mothers of no formal education were 2.44 times higher than those born to mothers who had formal education. This finding is consistent with study done in Aksum (26), which revealed that mothers who not educated were more likely to develop birth asphyxia compared to those who were educated; Pakistan(14), Kenya (40), Nepal (46), Sweden (47) and Cameroon (32) where newborns who were born from mothers with no formal education had higher risk for birth asphyxia. This might be due to the non-educated mothers have poor socio-economic conditions associated with consequent malnutrition, frequent pregnancies and also influence care seeking behaviours during antepartum period. However, the study in Gondor (28) and Malawi (48) were reported that educational status not associated with birth asphyxia. The difference in the finding could be due to sample sizes differences, observer and measurement bias.

Maternal age at delivery did not be significant with the birth asphyxia in this study. This suggests that pregnancy and labour in all age groups cannot predict the occurrence of birth asphyxia if effectively managed. This study finding is similar to the study findings in Gondor (28), Pakistan (14), Kenya (49) and Thailand (13) which reported that that maternal age was not determinant factor for birth asphyxia. Other study in Iraq (50) showed that estimation of young (<18 years) mothers were not associated with birth asphyxia. However, this findings is inconsistent with study conducted in Kenya (40) which reported that maternal age was significant risk factor to develop birth asphyxia. This conflict could be due to the different sample size used or the nature of setting where the study was conducted.

Number of antenatal care follow up was significantly associated with birth asphyxia that the odds of developing birth asphyxia among babies of mothers who had antenatal care follow up less than four times were 2.30 times higher as compared to those had more than four times antenatal care follow up. This finding is in line with study done in Rwanda (24) evidenced that who had not full antenatal follow up was associated with developing birth asphyxia. This could

be described by the fact that antenatal care less than four (incomplete) affects the life and health of babies by providing integrated care, promoting healthy home practices, influencing care-seeking behavior, and referring women with pregnancy complications to a referral system.

In this study, neonates from mothers who had prolonged labor were 4.12 times more likely to develop birth asphyxia than those with normal labor. This finding is similar to studies done in Aksum (26), Gondor (28), Pakistan (14), Rwanda (24) and Iraq (51) where the odds of developing birth asphyxia was higher among neonates of mothers who had prolonged duration of labor. Study from Kenya (40) also indicated that labour duration was another important risk factor of asphyxia. This might be cause of mother's pelvis is not adequate for her new-born's head to pass through, or does not have adequate contraction, or effacement of the cervix and the new-born is big (46). Also it is clear that when labour is prolonged, there is a high probability for the fetus to become distressed and result to birth asphyxia. Study in Nigeria (37) also exposed that prolonged labour is associated with fetal and maternal exhaustion and also fetal distress which results in birth asphyxia.

Fetal presentation had significantly associated with birth asphyxia. This study found that neonates born with non-cephalic presentation were 4.35 times more likely to develop birth asphyxia than those with cephalic presentation. This study similar with study done in Pakistan (44) and Iraq (52) as fetal malpresentation was significantly associated with in occurrence of birth asphyxia. This could be due to the fact that, the fetus which experiences oxygen deprivation by change fetal heart rate, decreased fetal movements and increase meconium in the amniotic fluid. Fetal malpresentation increase the risk of numerous complications, such as umbilical cord prolapse /compression, which can cause severe birth asphyxia (49).

Prolonged rupture of membrane was not significantly associated with birth asphyxia in contrary with study in Indonesia (33) indicated the prolonged rupture of membranes (>18 hours), was the most significant risk factor for birth asphyxia. This contradiction might be since the sample size of this previous study in Indonesia was small sample size (70 participants). The other reason might be due to setting difference between this study and the compared studies.

Parity had significantly associated with birth asphyxia. The odds of developing birth asphyxia among newborn of primiparous mothers were 2.14 times more likely than newborns of multiparous. This finding is similar with study done in Aksum (31), Pakistan (45), Nigeria (30) and Kenya (40). This might be due to the prim parous are often unknowing of the demands of pregnancy and often neglect regular follow up to antenatal care and necessitate of pregnancy check-up (25). Furthermore, prim para mothers remain a high risk group due to factors which

are more common among them such as biologic immaturity, a higher chances of cephalo-pelvic disproportion and prolonged fetal hypoxic and low pre pregnancy weight, all these factors might be influence the birth asphyxia (36). In controversially, study in Dessie hospital (39) reported that parity had no significance association with birth asphyxia. This discrepancy might due to the decision of precision value of their study ($p \leq 0.2$) which different from this study ($p < 0.25$) that may result to lose this important variable.

Low birth weight was an important determinant of birth asphyxia in this study. Newborns less than 2.5kg were 4.43 times more likely to develop birth asphyxia than new born delivered with weight greater than 2.5kg. This finding is similar with the study done in Aksum (26), Gondor (28), Rwanda (25), Pakistan (14) and Kenya (40). This might be due to the consequence of low birth weight was developed from maternal complication like hypertension, diabetes mellitus that present pre-conception or antepartum (24). Low birth weight of newborn usually have pulmonary immaturity and limited respiratory muscle strength (53).

Preterm newborn were significantly associated with birth asphyxia. This study indicated that newborns with low gestational age were 5.77 times higher to develop birth asphyxia than their counterpart. This finding is consistent with the study findings in Pakistan (14) pointed that prematurity carried a substantially higher risk of developing birth asphyxia, with gestational age of lower than 37 weeks, increasing the risk of asphyxia. Study in Kenya (40) also reported that the low gestational age was more prone to birth asphyxia. This might be resulted from preterm babies face multiple morbidities including organ system, immaturity specially lung immaturities causing respiratory failure that cause to birth asphyxia (54). However, study in Dessie hospital (39) and Gondor (28) evidenced that age of newborn no significantly associated with birth asphyxia. This discrepancy also might be due to the decision of p-value ($p \leq 0.2$) which different from the study ($p < 0.25$) that might result to lose the important variable, measurement and observation bias.

The strength of the study: the cases and controls were taken from the same setting except the outcome difference, assessment of model fitness using by different measures and reliability test of the questionnaire.

Referral bias avoided by pooling the results across both referrals and general hospitals together

Limitation: Because of institutional-based nature the study cannot represent the whole community.

CHAPTER SEVEN: CONCLUSION

Birth asphyxia is one of the common worldwide problem that causes morbidity and mortality of newborn. It arises different complications, if the cases left untreated it leads to death and disability. There are different variables which committed to birth asphyxia. In this study, the determinants of birth asphyxia were mainly related to non-formal education, number of antenatal care follow up, prolonged duration of labour, non-cephalic fetal presentation, prim parous, preterm and low birth weight were the independent predictors of birth asphyxia.

CHAPTER EIGHT: RECOMMENDATION

Most determinants associated with birth asphyxia can be prevented. Giving more information community to increase antenatal care frequency, dedicating to give the correct, quick and accurate diagnosis and proper management of pathological disorders during pregnancy and delivery; more attention to low birth weights and preterm newborn at birth through providing good environment for delivery can reduce severe birth asphyxia.

The study recommends to the following concerned bodies specifically:

❖ **Hospitals:**

- The hospital should give attentions on caring of clients during intrapartum period particularly emergency obstetric care.

❖ **Health care professionals: -**

- Timely diagnosis and referring of high risk pregnancies should be emphasized.
- More attention given to low birth weights and preterm neonates at birth through providing good environment for delivery.

❖ **Community health workers**

- Community health workers should be encouraging mothers more antenatal care follow up and referral for early interventions

❖ **Researchers:**

- Further study using large sample size in different settings to demonstrate the true associations in the population so that the findings can be generalized to whole community.
- Large-scale population-based longitudinal studies are needed to examine the natural history of the development of birth asphyxia

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ANNEX -I

JIMMA UNIVERSITY

FACULTY OF PUBLIC HEALTH, DEPARTMENT OF POPULATION AND FAMILY HEALTH. Data collection tools on determinants of birth asphyxia in East Wolleg, West Ethiopia 2019.

Information Sheet

Introduction: Dear participant, my name is _____ from Jemma University, institute of health, faculty of public health, department of population and family health. I am carrying out the determinants of birth asphyxia among newborn delivered in East Wolleg at public hospitals in Obstetrics and Gynecology wards. The purpose of this study is to identify the determinants of birth asphyxia to make awareness for health care provider, mothers, programmers and policy makers.

Therefore, your participation and genuine response is extremely important to have a good understanding the presence of determinants of the birth asphyxia in this hospital and help to achieve the study objectives. Your name will not be asked instead your data will be coded. If you want to withdraw from the study any time along the interviewing process, you will not be obliged to continue or give reasons for doing so. Refusing to participate will not have any consequences on you and the services provided for you.

However, I encourage you to answer all questions. The questions may take not more than 15-25 minutes and I would like to appreciate your cooperation in responding to my questions. If you have any questions or anything that is not clear please feel free to ask.

Thank you!!

Consent form

I am informed all about the purpose of the study and my rights to decide not to participate or discontinue my participation at any time in the process of the interview, and I am volunteer to participate in this study.

Do you agree to participate? 1. Yes 2. No

Thank you for your cooperation!

Name of the data collector _____ Sign _____ Date of interview _____

Name of the supervisor _____ Sign _____ Date of approval _____

Questionnaire number _____

Result of interview: A) Completed B) Not completed C) Partially completed D) Refused

Checked by Supervisor: Name _____ Signature _____

Annex II

QUESTIONNAIRE

Study topic: Determinants of birth asphyxia among neonates delivered at public hospitals in East Wollega Zone, Ethiopia, 2019.

Part I: Questionnaire for interviewing face to face mother's individual information

Section 1: socio-demographic characteristics associated with birth asphyxia

Case <input type="checkbox"/>		Control <input type="checkbox"/>		MRN <input type="text"/>
S/no.	Question	Response		skip
Q100	Age of mothers	_____years		
Q102	Marital status	1= Married	3= widowed	
		2= single	4= departed	
Q103	Residence	1= urban	2= rural	
Q104	Religion	1= Orthodox	3= Protestant	
		2= Muslim	4= Wakefata	
		5= Others (specify)_____		
Q105	Educational status	1= cannot read and write		
		2= can read and write		
		3 =Primary school (1-8)		
		4=secondary school 9-12		
		5= diploma degree and above		
Q106	Occupation	1= student		
		2= merchant		
		3= farmer		
		4= government employee		
		5= self employed		
		6 =house wife		
		7= others, specify_____		

Section 2: Past Obstetric History factors /interviewing mother face to face/

S.no	Question	Response	Skip
Q201	How many pregnancies have you ever had, including current pregnancy, abortion and stillbirth?	_____times	

Q202	How many live born children have you ever had?	_____ children	
Q203	Have you ever lost a child due to death (including stillbirths)?	<input type="checkbox"/> 1=Yes <input type="checkbox"/> 0=No	If no.skip to Q205
Q204	If yes, how many?	_____ children	
Q205	Have you ever lost a child due to miscarriage(spontaneous abortion)?	<input type="checkbox"/> 1=Yes <input type="checkbox"/> 0=No	If no.skip to Q207
Q206	If yes, how many?	_____ children	
Q207	How long ago was your last pregnancy?	_____ Years and _____ months 99 = don't know	

Section 3: Antepartum factors/interviewing mothers face to face/

S. no	Questions	Responses	Skip
Q301	Had you attended ANC for your last delivery (for the previous pregnancy)?	<input type="checkbox"/> 1=Yes <input type="checkbox"/> 0= No	If no.skip to Q306
Q302	If Yes to Q301, at what gestation did she have first visit?	1= 1 st trimester 2= 2 nd trimester 3= 3 rd trimester	
Q303	If Yes to Q301, how many visits did you have?	__visits, If no, write 0 99=Don't know	
Q304	If Yes to Q301, where did you attend?	1= Hospital 3= Health post 2= Health center 4= Home 5= others (specify) ____	
Q305	What was her gestation at first of her antenatal attendance?	1= below 16 wks. 3= 28-32 wks. 2= 16-28 wks. 4= 32-40 wks.	

Q306	Have you had ANC for this pregnancy?	<input type="checkbox"/> 1=Yes <input type="checkbox"/> 0=No	If no.skip to Q401
Q307	How many times attended for antenatal care?	1= Once 3= Thrice 2= Twice 4= Four	
Q308	Which type of health facilities you attended?	1= public 2= private	

Part II: structured questionnaire checklist for mother's intrapartum, medical history and neonatal factors information.

Section 1: checklist of mother for medical history

s/no	Questions	Response	Skip
Q401	Did you encounter any health problem during this pregnancy?	<input type="checkbox"/> 1=Yes <input type="checkbox"/> 0=No	If no.skip to Q501
Q402	If yes to Q401 what /Condition did you encounter?	1=Hypertension 4=Preeclampsia 2= Diabetes 5= APH 3=Anaemia 6=Others specify__	

Section 2: Intrapartum determinants of birth asphyxia

S.no	Questions	Response	Skip
Q501	What was the Duration of labour ?	_____hours	
Q502	Who attended the labour?	1= Midwife 2= Emergency surgery 3=Obstetrician/gynaecologist 4= others specify_____	
Q503	What was the presentation of the foetus ?	1= cephalic 2= non cephalic	
Q507	Did the labour Obstructed?	<input type="checkbox"/> 1=Yes <input type="checkbox"/> 0=No	

Q508	What is the mode of delivery ?	1= spontaneous vaginal delivery (SVD) 2=emergency caesarean section 3= elective caesarean section 4= instrumental	
Q509	If the answer of Q508 is no.4 (instrumental), what types ?	1=Ventouse delivery 2=Forceps delivery	
Q510	If the answer of Q508 is 2 and/or 3, what type of anaesthesia she used?	1= General anaesthesia 2= Spinal anaesthesia	
Q511	What was the outcome of delivery ?	1= singleton 2= multiple	
Q512	What condition the mother's new born faced during labour?	1= Cord prolapse 3= PROM 2= CPD 4= Fetal distress	
Q513	What was the status of amniotic fluid?	1= Stained 2= Unstained	

Section 3: Neonatal determinants of birth asphyxia

S.no	Questions	Responses	Skip
Q601	Sex of neonate	1= Female 2= Male	
Q602	What was gestational age?	1= Term 2= Preterm 3= Post term	
Q603	What was the of APGAR Score of neonate within 5minutes?	_____minutes	
Q606	What was birth weight in milligram?	_____milligram	

Thank you for giving me this all time for the interview

UNIVERSIITII JIMMAA

FAAKALTII SAAAYINSII UUMMATAA MUUMMEE UUMMATAA FI FAYYAA MAATII Qorannoo ‘ Determinants of birth asphyxia ‘ Hospitaalota Godina Wallagga Bahaa keessatti argaman ,2019.

LATII

Yaada odeeffannoo

Seensa: Akkam bulte/akkam oolte? Ani-----jedhama. odeeffannoo tokko akkan funaanuuf kolleejjii saayinsii fayyaa,yuunivarsiitii Jimmaa tiin dhufe. kanaafuu har’a kanan assitti argame odeeffannoo dhukubaa daa’imman daqiiqaa shan keessaa jiran miidhan waliin walqabataniif kanneen rakkoon daa’imman kana akka miidhamuuhargansuf shoorra taphatan waliin qaban ilaalchiseeti.

Qarshii ati gaaffiif deebii kana irraa argattu homtu hin jiru garuu yaadaaf odeeffannoo ati amma naaf kennitu karooraaf daa’imman rakkoo kana qabaniif immoo odeeffannoon ani si biraa argadhu akka galtee guddatti na fayyada.

Yoo gaaffiif deebii kanarratti hirmaatteef daqiiqaa 15-25 caalaa hin fixxu. Maqaan kees asirratti hin galmaahu,hirmaattees dhistees namni sidirqisiisu hin jiru. Hirmaachuuf dhiisuun mirgakeeti jechuukooti. Akkati hirmattuuf deebii dhugaaf gaha ta’e akka naaf laattu si affeereera. Gaaffiif yaada ifaa siif hin taane yoo jiraate karaa teessoo kanaa nama barbaadde sana quunnamuu dandeessa.

Galatoomaa

Unka yaada waligalitee

Yaadaa amma ani siif kenneef hubannoo ati odeeffannoo sanarraa argatteen gaaffiif deebii irratti hirmaachuu barbaaddaaree?

1. eeyyee

2. lakki

Maqaa odeeffannoo funaanaa_____

Mallattoo odeeffannoo funaanaa_____

Guyyaa_____

Lakkoofsa gaaffii(koodii)_____

Lakkoofsa meedikaala dhukubsatichaa_____

Bu’aa gaaffiif deebichaa

A) guutuu B) kan guutuu hin taane C) Gartokko duwwaa kan guutame. D) ni dide.

Supervaayizeraan kan mirkanaa’e

Maqaa_____mallattoo_____

Gaaffileewwan (Questionnaires)

Kutaa tokko; gaaffilee hawaasummaa waliin wal qabate

Lakk	Gaaffilee	Deebbiwwan (itti mari ykn iddoo duwwaatti barreessi)	Irra utaali
G100	Umuriin kee meeqa?	Waggaa _____	
G101	Saala	1.dhiira 2.dhalaa	
G102	Eessa jiraatta?	1.magaala 2.baadiyyaa	
G103	Haala fuudhaaf heerumaa	1.kan fuudhe/heerumte 2.kan hin fuunees hin heerumnes 3.kan wal hiikan 4.kan abbaan manaa/haati manaa du'e/duute	
G104	Sadarkaa barumsaa	1.dubbisuuf barreessuu hin dandahu/ssu 2.dubbisuuf barreessuu dandaha/ssi 3. daree (1-8) 4. daree 9-12 5. diploomaa 6. digirii fi isaa ol	
G105	Hojiikee	1.barataa 2.daldalaa 3.qonnaan bulaa 4.hojjetaa mootummaa 5.hojii dhuunfaa 6.haadha warraa 7.kan biroo yoo jiraatee-----	
G106	Amantii kee	1.protestaantii 2.orthodoxii 3. kaatoolikii 4.muusliima 5.kan biroo yoo jiraatee-----	

Kutaa lammaffaa; gaaffilee da'umsa teroo darbeen waliin wal qabate

Lakk	Gaaffilee	Deebbiwwan (itti mari ykn iddoo duwwaatti barreessi)	Irra utaali
G200	Dayeroo meeqa ulfoofteea'imman meeqa qabda (ulfa sirraa bahe ykn kan si jalaa du'e dabalatee) ?	Yeroo _____	
G201	Kan lubbuun jiran meeqa ta'uu?	_____	
G202	Daa'ima lubbuun dhabde jiraa?	1=eeyyee 2=lakkii	G202 lakkii tahe G 204tti utaali
G203	Yoo eeyyee tahe meeqa	Daa'imman _____	

G204	Ulfi sirraa bahee jiraa?	1= eeyyee 2=lakkii	G204 yoo lakki tahe gaaffii itti aanutti utaali
G205	Yoo eeyyee tahe yeroo meeqa?		
G206	Ulfii kee kan duraa hangam tureraa?	1= Waggaa/ji'a _____ 9= hin beeku/hin yaadadhu	

Kutaa saddaffaa: Ragaalee da'umsaa duraa ilaalltu, haadholii fi gamlamee irraa fudhatmu

Lakk.	Gaaffillee	Deebbiwwan (itti mari ykn iddoo duwwaatti barreessi)	Irra utaali
G301	Ulfa kee kan duraaf Hordoffii qabdaa?	1=eeyyee 2= lakkii	G301 lakki yoo tahe gara G306 tti utaali
G302	Yoo eeyyee tahe ulfa jiha meeqaatiin jalqabde?	1= Jiha saddaffaatti 2= Jiha jahaaffatti 3= jiha torbaffaatti	
G303	Yoo eeyyee tahe yeroo meeqa?	Hordoffii____, yoo lakkii tahee 0 barreessi 99=hin beekuu/yaadadhu	
G304	Yoo eeyyee tahe eessatti hordoftee?	1= Hospitalatti 3= Health post 2=buufata fayyatti 4= manatti 5= kannen biroo ____	
G305	Hordoffiikee jalqabaattii torbee meeqa tur	1= torbee 16 gadi. 2= torbee 16-28. 3= torbee 28-32	

		4= torbee 32-40	
G306	Ulfakee ammaa kanaaf hordoffii ulfaa qabdaa	1= eeyyee 2= lakkii	Yoo lakkii tahe G401 utali
G307	Hordoffii ulfaa yeroo meeqa hordofte?	1= yeroo tokko 3= yeroo sadii 2= yeroo lama 4= yeroo afur	
Q308	Dhaabbilee fayyaa kamitti fayyadamtee?	1= kan uummataa 2= kan abbaa qabeenyaa	

Paartii lammaffaa: gaaffilee oddeeffannoo haadholii yeroo da'umsaa, seenaa rakkoo fayaa isaanii fi daa'immanii ilaalchisee.

Kutaa tokkoffaa: odeeffannoo rakkoo fayyaa haadholii

Lakk.	Gaaffilee	Deebbiwwan (itti mari ykn iddoo duwwaatti barreessi)	Irraa utaali
G401	Rakkoon fayyaa siquunnamee beekaa?	1= eeyyee 2= lakkii	Yoo lakkii tahe G501tti utaali
G402	Yoo eeyyee tahee rakkoo fayyaa kamtu simudate?	1=dhiibbaa dhiigaa 2= dhukkuba shukaraa ulfaa/ciniinsuun duraa 3=hir'ina dhiigaa 4= "Preeclampsia" 5= dhiigaa yeroo 6= kan biroo_____	

Kutaa lammaffaa: oddeeffannoo haadholii yeroo da'umsaa

Lakk.	Gaaffilee	Deebiiwwan (itti mari ykn iddoo duwwaatti barreessi)	Irra utaali
G501	Turtii yeroo ciniinsuu?	Sa'aatii _____	
G502	Oggeessa fayyaa kamtu si deessisee?	1= "midwiferii" 2= "Emergency surgery" 3=Ogeessa gadameessaa 4= kanneen biroo _____	
G503	Dhufaatiin mucaa akkamiin turee?	1= mataa dhaan 2= qaama biroodhaan	
G507	Ciniinsuun danqamee turee?	1=eeyyee 2= lakkii	
G508	Gosa da'umsa keeti maaliin turee?	1=ofiin miixatee kan deesse 2=gargaarsa hatattamaa baqaqsanii yaalutiin (CS) 3=gargaarsa fedhaan baqaqsanii yaalamuutii 4=gargaarsaa meeshaatiin	
G509	Yoo deebiin G508,lakk.4 tahe meeshaa gosa kamiin Fayyadamte?	1=" Ventouse delivery" 2="Forceps delivery"	
G510	Yoo deebiin G508, 2 fi/yookin 3, qoricha adoochaa kamiin fayyadamte?	1= adoochaa waliigala 2= adoochaa gartokkee	
G511	Daa'imni dhalatee meeqa turee?	1= tokko qofa 2= lamaa fi lamaa oli	
G512	Haati gaafa da'umsaa rakkoo maaltu ishee mudate?	1= handdhurri daa'ima gadi bahu 3= bishaan gubbe dhangala'ee ture 2= qaamni haadha daa'ima baasuu hin dandeenye 4= daa'imni akka malee dhufe	
G513	Sadarkaan bishaan gubbee dhangala'ee ?	1= bobba'aa mucaa garaa keessan kan dibame 2= kan hin dibamne	

Kutaa sadaffaa: odeeffannoon daa'imman ilaalatu

Lakk.	Gaafilee	Deebbiwwan (itti mari ykn iddoo duwwaatti barreessi)	Irra utaali
G601	Saala daa'ima dhalatee?	1= dhalaa 2= dhiira	
G602	Umurii daa'imni itti dhalate?	1= yeroodhaan 2= yeroo dursee 3= yeroo dabrsee	
G603	“APGAR” daa'ima dhalatee daqiiqaa 5n keessatti meeqa turee?	_____	
G606	Ulfaatin daa'ima dhalatee graaman meeqa ?	_____gm	

Yeroo qabdurraa turtii nawaliin dabarsiteef galatoomi!!

ANNEX III: DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

Name: _____

Signature: _____

Name of the institution: _____

Date of submission: _____

This thesis has been submitted for examination with my approval as University advisor

Name and Signature of the first advisor

Name and Signature of the second advisor
