ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF NURSING & MIDWIFERY

DEPARTMENT OF NURSING POSTGRADUATE PROGRAM

PREVALENCE OF BIRTH INJURIES AND ASSOCIATED FACTORS AMONG NEWBORNS DELIVERED IN PUBLIC HOSPITALS ADDIS ABABA, ETHIOPIA, 2021.

BY: ESUBALEW AMSALU (BSc)

A THESIS TO BE SUBMITTED TO THE DEPARTMENT OF NURSING, SCHOOL OF NURSING AND MIDWIFERY, COLLEGE OF HEALTH SCIENCE, ADDIS ABABA UNIVERSITY, FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS OF MASTERS OF SCIENCE IN NEONATAL NURSING.

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ADVISORS:

1. **Ms. KALKIDAN WONDWOSSEN (MSc, ASS. PROF)**
2. **Mrs. FEVEN MULUGETA (BSc, MSc)**

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ADDIS ABABA, ETHIOPIA

APPROVAL SHEET

I, the undersigned MSc student, declare that I have submitted my original work on prevalence of birth injury and associated factors among newborns delivered in public hospitals Addis Ababa, Ethiopia for the examination.

Submitted by:

Name: Esubalew Amsalu (BSc) Signature: _____ Date: _____

This thesis work has been submitted for examination with my approval as an advisor.

Examiner:

1. Name of examiner: _____ _____
   Signature Date

Advisors:

1. Ms. Kalkidan Wondwossen _____ _____
   Name of Major Advisor Signature Date

2. Mrs. Feven Mulugeta _____ _____
   Name of Co-Advisor Signature Date

STATEMENT OF DECLARATION

I, the undersigned, declare and affirm that this thesis is my own work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis and completion of this thesis. All scholarly matter that is included in the thesis has been given recognition through citation. I affirm that I have cited and referenced all source used in this document. Every effort has been made to avoid plagiarism in the preparation of this thesis.

This thesis is submitted in partial fulfillment of the requirement for graduate degree from Addis Ababa University at College of Health Science, School of Nursing and Midwifery. The thesis is deposited in the Addis Ababa University Digital Library and is made available to local and international scientific community. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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RESEARCH ADVISORS:

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APPROVAL BY THE BOARD OF EXAMINATION

This thesis by Esubalew Amsalu is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of Masters of Science in Neonatal Nursing.

EXAMINER:

_____	_____	_____	_____
NAME	RANK	SIGNATURE	DATE

RESEARCH ADVISORS:

_____	_____	_____	_____
NAME	RANK	SIGNATURE	DATE
_____	_____	_____	_____
NAME	RANK	SIGNATURE	DATE

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ABBREVIATIONS/ ACRONYMS

AAU	Addis Ababa University
ANC	Antenatal Care
APGAR	Appearance, Pulse rate, Grimace, Activity and Respiration
BMI	Body Mass Index
CI	Confident Interval
CNS	Central Nervous System
CPD	Cephalopelvic disproportion
C/S	Caesarian Section
DM	Diabetes Mellitus
EDHS	Ethiopian Demographic Health Survey
GA	Gestational Age
GDM	Gestational Diabetes Mellitus
GMH	Gandhi Memorial Hospital
ICD	International classification of disease
IRB	Institutional Review Board
LMICs	Low and Middle Income Countries
MRN	Medical Record Number
NGO	Non- Governmental Organization
OR	Odds Ratio
PI	Principal Investigator
PTSD	Post-Traumatic Stress Disorder
SPHMMC	St. Paul Hospital Millennium Medical College
TASH	Tikur Anbessa Specialized Hospital
WHO	World Health Organization
Y-12HMC	Yekatit 12 Hospital Medical College

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ABSTRACT

Background: Birth injury is harm/damage that a baby suffers during the entire birth process. It includes both birth asphyxia and physical trauma (birth trauma). In Ethiopia, intra-partum related complications' including birth injury has become the leading cause of neonatal morbidity and mortality, accounting around 28%-31.6 % of neonatal mortality. This study was done to assess the prevalence and factors associated with birth injuries among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021**.**

Methods: Institution based cross-sectional study was conducted on total of 373 samples from February 15th to April 20th, 2021 in selected public hospitals of Addis Ababa, Ethiopia. Random sampling (lottery method) and systematic random sampling were used to select study area and study participants respectively. Interview and chart review were used to collect data. Data was entered by using Epi data version 4.0.2 and exported in to SPSS Software version 25 for analysis. Both bivariate and multivariable logistic regressions analysis were used to analyze the data. Finally P-value <0.05 was used to claim statistically significant.

Result: In this study, the prevalence of birth injury was 24.7 %. Each birth asphyxia and birth trauma accounted 13.9 % and 12.9 % respectively. In the final model, birth asphyxia was significantly associated with the short height of the mothers (AOR=10.7, 95% CI: 3.59-32.4), intrapartal fetal distress (AOR=4.74, 95% CI: 1.81-12.4), cord prolapse (AOR=7.7. 95% CI: 1.45-34.0), tight nuchal cord (AOR=9.2. 95% CI: 4.9-35.3), birth attended by residents (AOR=0.19, 95% CI: 0.05-0.68), male sex of the newborns (AOR=3.84, 95% CI: 1.30-11.3) and low birth weight of the newborns (AOR= 5.28, 95% CI: 1.58-17.6). Whereas, birth trauma was significantly associated with gestational diabetic mellitus (AOR=5.01, 95% CI: 1.38-18.1), prolonged duration of labor (AOR= 3.74, 95% CI: 1.52-9.20), instrumental delivery (AOR=10.6, 95% CI: 3.45-32.7) and night time birth (AOR=4.82, 95% CI: 1.84-12.6).

Conclusion and recommendation: The prevalence of birth injury among newborns has continued to increases and become life-threatening issue in the delivery and neonatal intensive care unit in our study area**.** Therefore, considering the prevailing associated factors, robust effort has to be made to optimize the quality of ANC care, obstetric care and follow up and emergency obstetrics team has to be strengthened to reduce the prevalence of birth injury.

Key words: - *Births injury, Birth Asphyxia, Birth trauma, Newborns, Prevalence*

1. INTRODUCTION

1.1. Background

The process of birth, whether spontaneous or assisted, is naturally traumatic for the newborns. Birth injury is diminishing of body function due to adverse event that occur at birth. It is also defined as the structural destruction or functional deterioration of the neonate's body due to a traumatic event at birth(1). They can be avoidable or unavoidable. Birth related injuries encompass both those due to lack of oxygen (birth asphyxia) and physical trauma during the birth process (birth trauma). Both can occur separately or in combination(2–5).

Injuries to the newborns that result from mechanical forces (i.e. compression, traction) during the birth process are classified as mechanical birth trauma. Birth trauma was suggested to be mostly due to difficult vaginal delivery especially with abnormal fetal presentation and use of instruments during delivery like forceps and vacuum (6).

Another classification of birth injuries that occurs on the newborns were birth asphyxia. According to the World Health Organization (WHO), birth asphyxia defined as a "failure to initiate and sustain breathing at birth"(7). It's usually considered by low APGAR score: (Appearance, Pulse rate, Grimace, Activity and Respiration) <7 at 5^{th} minutes, arterial cord pH < 7 and base deficit >12, neonate did not cry at birth or needed resuscitation, acidosis, seizure and hypotonia (8). Study suggested that, birth asphyxia occur due to maternal antepartum, intra-partal and post partal factors (9). Intra-partum related factors accounts the highest proportion of risk factors for birth asphyxia 70%. Whereas, antepartum and post partal factors accounts 20% and 10% respectively (10).

Many babies suffer from minor injuries during the entire delivery process. Minor injuries do not need to be treated and often heal by themselves; the major ones are often fatal and require prompt recognition and intervention (11). According to international classification of disease 10^{th} revision (ICD-10) and different literature , the common types of birth injuries includes birth asphyxia and birth trauma (soft tissue injuries (bruises, petechial, subcutaneous fat necrosis, ulceration and perforation), extra cranial hemorrhages (cephalhaematoma, caput succedaneum, subgalial hemorrhage), intra-cranial hemorrhages, neurological injury (spinal

cord injury, facial nerve palsy, brachial plexus injury such as Erb's palsy and Klumpke's palsy), musculoskeletal injury (long bone and clavicular fracture)(12–15).

Identification of high risk deliveries by fetal and perinatal ultrasound prior to labor, the use of less harmful obstetrical instruments and techniques and timely caesarean section (C/S), becoming more and more accepted ways of preventing birth injuries(6,16). Birth injuries are commonly diagnosed by series of taste to examine which part of the body are affected .These are physical examination, APGAR score, brain imaging ,umbilical cord blood gas analysis and radiology like x-ray in case of fracture (17,18).

1.2. Statement of the problem

Birth injuries are the most preventable cause of neonatal mortality and morbidity worldwide(19). According to 2016 WHO reports, it is estimated that 662, 000 neonatal deaths and 1.3 million stillbirths occur annually due to intra-partum related complications, or complications during labor and delivery. Birth injuries are among the three leading cause of most neonatal death worldwide which accounts for 10% of deaths in children under 5 years of age(20).

The incidence of birth injuries varies from place to place and it is mostly determined by the standard of available obstetrical management. In developed countries like the United States, the incidence of birth trauma ranges from 20 to 37/1000 live birth (21). Whereas in India ranged from 3.2- 15.4/1000 live birth(22). In Africa, reports on birth injuries are limited, however studies done in some African countries like Mali and Morocco showed frequencies of 0.68% and 0.26% respectively, while report from Egypt showed prevalence of 17 % (14,23). In Ethiopia, there was insufficiency of literature done on birth injury; A study done in Jimma University Specialized Hospital, South Western Ethiopia reported that the magnitude of birth injury was 15.4 % (24). Whereas, the prevalence of birth asphyxia was estimated to be between 3.1-32.9 % in different study area (25).

In 2014 and 2015 intra-partum related complications (Birth asphyxia and birth trauma) were accounted 28% and 31.6 % of neonatal death respectively(10,26). Mechanical birth trauma may affect several organ systems of the newborns such as neurologic, musculoskeletal and visceral injuries. Injuries may be mild, transient or disabling and even it can be fatal (4). Birth asphyxia is a leading cause of brain damage and also survivors often experience lifelong health problems like disabilities, developmental delays, palsy, intellectual disabilities and behavioral problems (27,28).

Due to the birth injuries and its complication most mothers may develop negative traumatic birth experience. This can affect the next life of the mother and neonates by affecting lower self-esteem and poor mental health, Post-Traumatic Stress Disorder (PTSD), poor maternal-neonatal attachment, avoidance of breastfeeding and sexual malfunction(29,30). They are also more prone to develop acute stress reactions and postpartum depression(31,32).

In different literature, various factors were identified to be associated with birth injury such as maternal-related factors (Primigravida, short maternal stature, maternal pelvic anomalies, maternal infection, maternal diabetes, obesity, placental abruption and maternal age (very young and old). Labor-related factors (prolonged or extremely rapid labor, induced labor, abnormal presentation, use of forceps or vacuum extraction, version, and extraction). Infant-related factors (very low birth weight or extreme prematurity, fetal macrosomia, twin (particularly the second one) (33–36). However, it was not well studied whether these associated factors are similar to in our setup or not.

In developed countries, the occurrences of birth injury are decreased due to the improvements in obstetric practice and care. However, it has been estimated that only 25% of deliveries are supervised by skilled birth attendants in the developing countries which leads to increased incidence of birth injuries. Most of them are possibly avoidable with recognition and proactive management of the risk(37). In Ethiopia, according to 2019 mini EDHS (Ethiopia Demographic and Health Survey) reported, the percentages of delivery by skilled providers increased from 28% in 2016 to 50% in 2019. Despite of this, the number of neonatal death increased from 29 per 1000 live births to 30 per 1000 live births in Ethiopia (38).

The Federal Ministry Health of Ethiopia developed and implemented high impact interventions, including focused antenatal care, skilled birth service, post natal care and comprehensive National Child Survival Strategy (2015–2020) in 2015, aiming to decrease under-five mortality by two thirds (39,40). Despites of this efforts high number of newborn death reported due to birth injuries and related complication in our country Ethiopia. So, investigation of birth injuries is very important because it may show the possible associated factors and prevention of its occurrence.

Reports about the prevalence of birth injures among live birth newborns are limited in Ethiopia. As far as literature review revealed that, there is a limited research done on prevalence of birth injuries among live birth delivery especially in the study area. However, intra-partum related complications among newborns during the time of delivery are still the leading cause of neonatal morbidity and mortality in Addis Ababa public hospitals. Due to these reason, this study was carried out to assess the prevalence of birth injuries and associated factors among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.

1.3 Significance of the study

The result of this study was contributed to determine the prevalence of birth injuries among newborns and identify unaddressed associated factors which may fill the gap to decrease the occurrence of birth injuries and will be important for hospital manager to use data on neonatal birth injuries as an indicator to assess the quality and safety of delivery units in the study area.

It also helps different stake holder of federal and regional health officer to see important way to improve the prevention of birth injuries and appropriate methods of obstetric cares. The findings will be important for policy makers and program designers that work on prevention of birth injuries. It also increases the nursing body of knowledge, nursing education and promotes nursing research. Additionally it provides valuable information that will be used as a base line for future researchers.

2. LITERATURE REVIEW

2.1 Overview of Birth Injuries

Birth injuries are a damage suffered by the neonates during labor and delivery. Despite exact prenatal care, birth injuries usually occur. Injury to a fetus or neonate during labor and delivery can be due to different factors. The predisposing factors for birth injuries can be classified into socio-demographic, medical & obstetrics, intra-partum and early neonatal factors. Neonatal birth injuries are among the major cause of neonatal mortality in most developing countries(15).

2.2 Prevalence of Birth Injuries

The neonatal birth injuries occur occasionally with an incidence of a proximately 6-8 /1000 live births worldwide (33). A retrospective cross sectional study conducted in United States of America reported that, the incidence of birth trauma was 2.9 %. In this study the three most common birth traumas were injuries to the scalp 2%, injuries to the skeleton 0.37% and fracture of the clavicle 0.243 % (21).

Different studies conducted in India (south India, Kolkata and Bombay hospital) revealed that, the incidence of birth injuries were 11.76 %, 1.54% and 0.326 % respectively. The most prevalent types of birth injuries were birth asphyxia (5.29 %) and cephalhaematoma (3.76 %) in south India, whereas soft tissue injury (0.59%) and skull injury (0.51%) in Kolkata and clavicular fracture (9.6%) and extra cranial bleeding (51.16%) in Bombay hospital (15,22,33).

Different studies performed in Iran (Kashan and Ahvaz), reported that the incidence of birth injuries were 2.2 % and 1.96 % respectively. In their findings, the most common injuries were birth trauma (cephalhaematoma) (57.2%) and birth asphyxia (16.8%) in Kashan and clavicular 15(0.14%) and humeral 6(0.056%) fracture in Ahvaz (12,35). According to prospective cohort study conducted in Pakistan, the incidence of birth trauma was 41.16 per 1000 live birth. Among this, cephalhaematoma and clavicular fracture were the two most common birth trauma which accounts 2.14% and 1.56% respectively(37).

Prospective cross-sectional studies conducted in different part of Nigeria (Maiduguri and Lagos) reported that, the incidence of birth injuries were 5.7 % and 67.2 % respectively. The most prevalent cases were soft tissue injury (60.7%), sub-conjunctival hemorrhages (41.0%)

and severe birth asphyxia (39.3%) in Maiduguri. Similarly, caput succedaneum (22.2%) and sub-conjunctival hemorrhage (22.2%) were the most common cases in Lagos (14,41). Based on a retrospective descriptive study (2003-2014) conducted at the University Teaching Hospital Cameron, the incidence of birth injuries was 1.84%. In their study, the most common birth injuries were obstetric brachial plexus palsy (70.6%), fracture of the clavicle (22.5%) and fracture of the humerus (4.80%) (42).

A cross-sectional study done in South west Ethiopia at Jimma University Specialized Hospital, as they reported the magnitude of birth injury was 15.4%. Birth asphyxia and mechanical birth trauma were the two dominant injuries and each accounts 22 (8.1%). Two newborns developed both birth asphyxia and birth trauma and the most common mechanical birth trauma was scalp injury which contributed to 63.6% (24). Studies made in different part of Ethiopia (Dire Dawa, Hossana, north east Amhara ,Debre Tabor and Jimma) showed that, the prevalence of birth asphyxia were 2.5 %, 15.1%, 22.6% ,28.35% and 32.9 % respectively (9,43–46).

2.3 Associated factors of birth asphyxia and birth trauma

Different studies discussed that, the associated factors that affect birth asphyxia and birth trauma were socio demographic factors, medical and obstetrics factors, intra-partum factors and early neonatal factors.

2.3.1 Socio demographic factors

According to different studies maternal age, maternal weight, maternal height, body mass index (pre-pregnancy BMI), maternal educational status, marital status and place of residence were significantly associated with birth asphyxia and birth trauma (11,18,19,26,36,41–43,47,48,49-52).

Different studies performed in Iran, Cameroon and Nigeria showed that maternal age between 20-30 years old was significant factors contributing to birth trauma(12,41,42). Other studies also conducted in different part of Ethiopia (Dire Dawa, Hossana and Tigray) reported that, maternal age between 21-25 years old (37%), maternal age >35 years old (Adjusted OR=6.4) and maternal age between 25-35 years old (56.9%) were the factors significantly associated with birth asphyxia (9,43,49). A Case- control study done in Colombia revealed that, mothers

without a partner were 2.56 times more likely risky for the development of birth asphyxia as compared to mothers with partner (OR=2.56)(50)

A population-based retrospective cohort study done in the California and Sweden showed that, pre-pregnancy BMI was significantly associated with the occurrence of birth trauma. Women with class III obesity (pre-pregnancy BMI= >40 kg/m²) had more likely in giving birth macrosomic baby than women with a normal pre-pregnancy BMI in California and incidence of birth trauma like intracranial hemorrhages and shoulder dystocia were increased with increasing maternal pre-pregnancy BMI in Sweden (36,51). A Systematic Review and Meta-Analysis performed in Canada showed that, maternal obesity is associated with fetal overgrowth (>4000g) (OR=2.17) ,birth weight ≥4500 g (OR= 2.77) and birth weight ≥90% lie for gestational age (OR 2.42)(52) .

Studies done on Demographic and Health Survey (DHS) for the 34 Sub-Saharan African countries and Uganda revealed that, Short maternal stature was associated with low APGAR score and birth traumas such as clavicle fracture and brachial plexus in 34 Sub-Saharan African Countries, whereas maternal height (AOR= 0.97) and maternal pelvis height (AOR=0.73) were significantly associated with adverse pregnancy outcomes in Uganda (47,48).

Different studies conducted in Ethiopia (Gondar and Tigray) showed that maternal educational status was significantly associated with birth asphyxia. Illiterate women's were 2.76 and 1.82 times more likely to develop birth asphyxia when compared with mother who were literate in Gondar and Tigray respectively (19,49). Another study done in Jimma, South West Ethiopia reported that, maternal place of residence was a factor significantly associated with birth asphyxia, but maternal educational status was not significantly associated with birth asphyxia and birth trauma(24).

2.3.2 Medical and obstetric factors

Different studies reported that various medical and obstetrics factors were associated with birth asphyxia and birth trauma. Antenatal care (ANC), pregnancy type, parity, maternal diabetes, gestational diabetes, pregnancy induced hypertension, chronic hypertension and abruption placenta were factors associated with birth asphyxia (24,34,41,50,53–59). Factors

associated with birth trauma were antenatal care (ANC), parity, maternal diabetes and gestational diabetes(34,41,55,57,58).

A retrospective study conducted in Thailand reported that, women's with severe pre-eclampsia were giving birth with high risk of required neonatal resuscitation (19.0%), first minutes APGAR score <7 (15.5%) and fifth minutes APGAR score < 7 (5%) compared to normotensive women (54). Different studies conducted in India revealed that, primiparous womens carrying singleton pregnancies were at higher risk of developing both birth asphyxia and birth trauma (34,55). The findings from other studies conducted in India and Ethiopia revealed that, mothers with incomplete ANC follow up (<4) was significantly associated with birth asphyxia (55,56).

A study carried out in Nigeria reported that, mother who have ANC follow up at primary health care center gave birth around 44.4% babies with birth trauma compared to other health facility(41). On the other hand, a study conducted in Ethiopia showed that, ANC visit was not associated with birth asphyxia & birth trauma(24).

Crossectional study conducted in Nigeria showed that, mothers with diabetes mellitus were delivering newborns with birth trauma (6.7%)(41). A retrospective case- control study carried out in Ghana reported that, strong influence of baby's weight by gestational diabetes mellitus (OR=14.2;p<0.0001) indicating that women who developed GDM are 14.2 times more likely to deliver macrosomic babies compared to those did not develop GDM, that resulted in the occurrence of birth asphyxia and trauma (shoulder dystocia) (57).

According to the world journal of diabetes, one of the neonatal complication in mothers of gestational/chronic diabetes is macrosomia, which is risk factors for birth asphyxia and birth trauma (58). A prospective cohort study conducted in Tigray region, Ethiopia showed that women with pregnancy induced hypertension delivered babies with birth asphyxia (46.5%) higher than normotensive pregnant women (11.3%) (59).

According to the study conducted in China , among mothers who developed abruption placenta 19.4% of them delivered newborns with birth asphyxia, similarly a report from Colombia also showed that, mothers with history of abruption placenta were 41 times (AOR= 41.09) higher risk to develop birth asphyxia than mothers with no abruption palcenta (50,53).

2.3.3 Intra-partum factors

Several studies revealed that different intra-partum factors were associated independently with birth asphyxia and birth trauma. Factors associated with birth asphyxia includes fetal presentation, duration of labor, cephalopelvic disproportion (CPD), premature rupture of membrane, prolonged rupture of membrane, meconium stained amniotic fluids, cord prolapse, tight nuchal cord, mode of delivery, intra-partal fetal distress, induction of labor, time of birth and qualification of birth attendant. Whereas, factors associated with birth trauma are fetal presentation, duration of labor, cephalopelvic disproportion (CPD), mode of delivery, time of birth and qualification of birth attendant.

A retrospective study conducted in New work city reported that, forceps and vacuum assisted birth were the most common contributing factors of birth trauma. The odds of brachial plexus trauma and facial nerve palsy were 50.98 and 27.95 times more likely to occur during forceps-assisted vaginal delivery compared with cesarean delivery respectively. On the other hand, brachial plexus trauma and fracture were 49.92 and 6.55 times higher to occurs during vacuum-assisted vaginal delivery compared with cesarean delivery(60).

Studies conducted at Turkey (Ankara) and Nigeria (Maiduguri) reported that, newborns delivered by instrumental vaginal deliveries (vacuum and forceps) were the most common predisposing factors for birth trauma. In Ankara, 0.5 %, 0.06 % and 0.16 % of the newborns developed clavicular fracture, brachial plexus injury and shoulder dystocia respectively and in Maiduguri 18% of newborns developed birth trauma (14,61). In addition to this, different studies conducted in Indonesia, Indian and Ethiopia showed that, instrumental assisted delivery was significant contributing factors of birth asphyxia(25,43,45,55,62).

A systematic review and meta-analysis done in USA reported that, umbilical cord prolapse had significant impact on newborns by developing low APGAR score (<7 at 1^{st} and 5^{th} minutes) immediately after birth (63). Different studies conducted in Indonesia, India and Ethiopia revealed that prolonged rupture of membrane was significantly associated with birth asphyxia. Neonates born with prolonged rupture of membranes more than 18 hours were 10.61, 2.19 and 2.98 times higher likely experienced birth asphyxia than neonates born with normal duration of rupture of membranes respectively (49,55,62).

Different studies conducted in Nepal and Ethiopia revealed that, non-cephalic presentations had significantly associated with birth asphyxia and birth trauma(24,64).

A study conducted in India (Bijapur) showed that, out of 100 newborns who developed birth trauma, 87% and 9% of them were babies with vertex and breech presentation respectively(15). Another prospective crossectional study conducted in India revealed that prolonged labor and delivery time during (8:00 PM -2:00 AM) were factors significantly associated with birth trauma with AOR= 207.6 and AOR= 91.4 respectively(22).

Studies from Thailand and India reported that, newborns delivered with meconium stained amniotic fluids were 5.51 and 4.92 times more likely to encounter birth asphyxia than newborns delivered with clear amniotic fluids respectively(55,65). Another similar study conducted in Ethiopia revealed that, babies born with meconium stained amniotic fluids and tight nuchal cord were 7.5 times and 3 times have a greater chance of developing birth asphyxia respectively(9). A hospital-based cross sectional study conducted in Tanzania showed that night shift deliveries with (OR =1.62) was significantly associated with adverse birth outcome such as birth asphyxia, still birth and early neonatal death compared to morning shift and evening shift deliveries with (OR =0.58) (66).

Studies conducted in Iran and Nigeria reported that, delivery by residents (6%) were having high risk for developing birth trauma compared to deliveries done by specialists (2.1%), midwifes (2.5%) and the students (2.5%) in Iran. Whereas, in Nigeria those births attended by Midwives/Nurses were at higher risk of developing birth trauma (57.4%) compared to obstetrics resident (4.9%) and consultants (16.4%) (12,14). In our country, Ethiopia a study reported that among labors attended by Midwifes 56.2% were developed birth asphyxia and it was higher compared to labors attended by medical interns alone (22.2%) and Obstetrician(21.7%)(45).

Different studies conducted in Nigeria reported that, duration of labor, mode of delivery and delivery attended by obstetricians were significantly associated with birth trauma(41) and cephalopelvic disproportion (CPD) was a significant contributing factor for birth asphyxia(67). A crossectional study conducted in Jimma and Gondar revealed that, intrapartal fetal distress were significantly associated with birth asphyxia (19,24). Institutional based

crossectional study conducted in North East Amhara and Debre Tabor showed that, babies born from mothers with premature rupture of membrane were 3.8 times and 6.3 times having higher risks of developing birth asphyxia respectively (44,45).

2.3.4. Neonatal factors

As different literatures reported that early neonatal factors were significantly associated with birth asphyxia and birth trauma. These include sex, birth weight, head circumference, APGAR score, need of resuscitations and gestational age.

Reports from literatures in Iran and India showed that, neonatal sex was significantly associated with birth trauma. Male neonates were 1.8 times (AOR=1.8) more likely to develop birth trauma than female neonates in Iran (12). But study done in Indian shows that, male neonates were 85.9% (AOR=0.141) less likely to encounter birth trauma than female neonates(22). On the other hand, a study done in Nigeria reported that, neonatal sex was not associated with the occurrence of birth trauma(41) and birth asphyxia(67).

In different studies high birth weight (>4000 gram)/fetal macrosomia was associated with higher risks of developing birth trauma(37,68,69). A study conducted in Ethiopia showed that, low birth weight newborns were 7.72 times at higher risks of developing birth asphyxia than normal birth weight newborns(19). Other studies revealed that, neonatal head circumference was a significant predictor of birth trauma in Pakistan with p-value =0.001(37) and in Iran p-value <0.0001(12).

In a study from Nigeria showed that, gestational age at delivery (p-value= 0.89) have no any association with birth trauma(41). In different studies done in Iran and Gonder showed that, low first minutes and fifth minutes APGAR score were significantly associated with birth trauma and birth asphyxia respectively (12,70). In Ethiopia as studies indicated, gestational age less than 37 weeks was a significant determinant of birth asphyxia. Preterm delivery was approximately four times (AOR =3.98) (56) and five times (AOR=4.7) (9) more likely to develop birth asphyxia compared to term infant.

2.4. Conceptual framework

Below are the conceptual frame work of the study developed after reviewing different related literature (9,12,37,41–43,45). This conceptual framework shows the interaction between different independent variables with two dependent variables (birth asphyxia and birth trauma) (Fig.1).

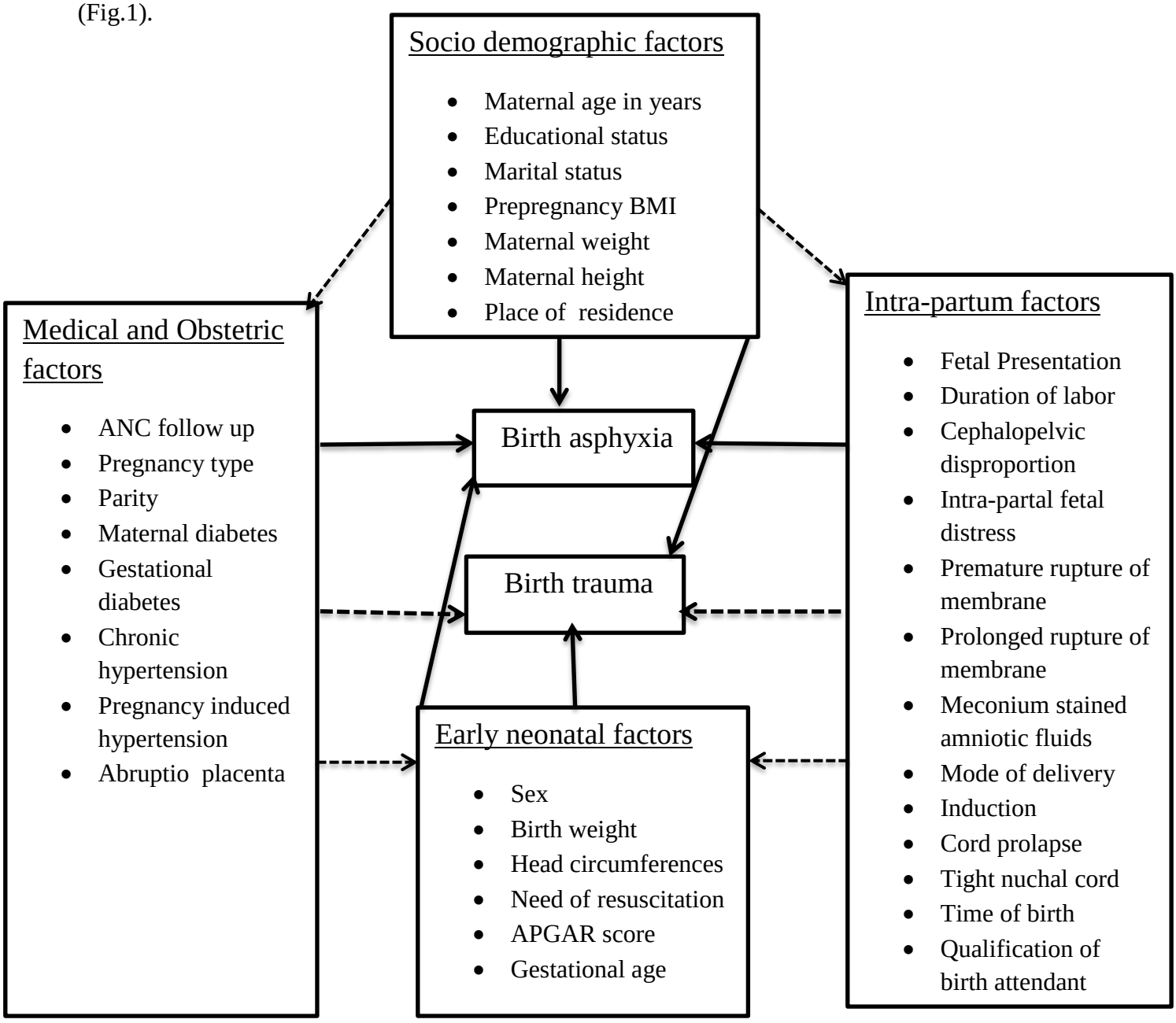

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Figure 1: Conceptual framework on prevalence of birth injuries and associated factors among Newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.

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3. OBJECTIVE

3.1. General objective

- ✓ To assess the prevalence and factors associated with birth injuries among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.

3.2. Specific objectives

- ✓ To determine the prevalence of birth asphyxia among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.
- ✓ To determine the prevalence of birth trauma among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.
- ✓ To identify the associated factors for birth asphyxia among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.
- ✓ To identify the associated factors for birth trauma among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.

4. MATERIALS AND METHODS

4.1 Study area

This study was conducted in Addis Ababa, the capital city of Ethiopia that is located in the central part of the country. The city resides in a total area of 527 km2 with a total population of 3,384,569 with an annual growth rate of 2.7%(71).The population in the near future expected to raise to exceed 6.5 million population. This region has an estimated density 5165 people per square kilometer. Its average elevation is 2,500 meters above sea level and has a fairly favorable climate and weather conditions(72).

The city has eleven sub city and 116 woredas. There are 12 public hospitals in the city, of which 6 are owned by Addis Ababa City Administration Health Bureau, 5 by Federal Ministry of Health, 1 by Addis Ababa University. Among these, one hospital was excluded (Amanuel Psychiatric Hospital) due to unavailability of delivery service. From the rest eleven (11) hospitals, four hospitals (TASH (Tikur Anbessa Specialized Hospital), Yekatit 12 Hospital Medical College (Y-12HMC), GMH (Gandhi Memorial Hospital) and SPHMMC (St. Paul Hospital Millennium Medical College) were selected by using simple random sampling (lottery method).

4.2 Study period

This study was carried out from February 15th to April 20th, 2021.

4.3 Study design

Institutional based cross- sectional study was conducted.

4.4 Population

4.4.1 Source population

All newborns delivered in public hospitals of Addis Ababa with in the study period.

4.4.2 Study population

All randomly selected newborns delivered in selected public hospitals in Addis Ababa, during the study period and fulfill the inclusion criteria’s.

4.5 Inclusions and Exclusions criteria

4.5.1 Inclusions criteria

- ✓ All live birth newborns delivered in selected public hospitals with gestational age of ≥ 28 weeks.

4.5.2 Exclusion criteria

- ✓ Neonates with major congenital anomalies were excluded.
- ✓ Newborns whose birth weight of <1000 g were excluded.
- ✓ Those who have incomplete documentation (has no appropriate data that measure both maternal and early neonatal parameter).
- ✓ Mothers who are seriously ill and unable to respond to the question.

4.6 Sample size determination

A single population proportion formula was used to determine the sample size based on the following assumption:

Where; **n**=Sample size

Z= 95 % confidence level (Z α/2 = 1.96)

α = Level of significance 5% (α= 0.05) and

d= Margin of error 5% (d = 0.05).

The following formula was applied to determine the sample size for each dependent variable.

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

The prevalence of birth trauma was (P) = 8.1% taken from the previous study done in Jimma University Specialized Hospital, South Western Ethiopia(24).

$$n = \frac{(1.96)^2 \times 0.081(1-0.081)}{(0.05)^2} = 114$$

After considering 10% non-response rate, the total sample size was **125**

The prevalence of birth asphyxia was (P) = 32.9 % taken from the previous study conducted in Jimma zone public Hospitals, South West Ethiopia (46) after comparing with other studies done in Ethiopia (9,43–45).

$$n = \frac{(1.96)^2 \text{x } 0.329(1\text{-}0.329)}{(0.05)^2} = 339$$

After considering 10% non-response rate, the total sample size was **373**

Finally, from the calculated sample size for the first and second dependent variables, the largest sample size was **373**

4.7 Sampling procedure

Simple random sampling technique (lottery method) was used to select four hospitals to be included in the study from 11 public hospitals. The number of study unit to be sampled from each selected hospital were determined by proportional to size allocation formula, based on three months report of delivery in each selected hospital. The study subject were selected from list of delivery registration book by using systematic random sampling technique every "K" value=20, which was obtained through dividing the total number of delivery in three month report from selected hospital to the required sample size. The first study participant was selected by randomly from 1 to 20, then the rest of the study subject were included every "20" value. Mothers that delivered more than one baby like twin, one of these babies was selected by using simple random sampling technique.

$$K = \frac{\text{Total number of delivery in three month report}}{\text{Required sample size}} = \frac{7500}{373} \approx 20$$

Proportional to size allocation formula was used to select study unit in each selected hospital.

$$\frac{nf \times ni}{N}$$

nf = the final sample size

ni = the number of three months delivery in each hospital

N= the total number of deliveries in the selected hospitals.

TASH= $\frac{373\times1500}{7500}$ = 74.6≈ 75

GMH = $\frac{373\times3300}{7500}$ = 164.12 ≈ 164

SPHMMC = $\frac{373\times1500}{7500}$ = 74.6 ≈ 75

Y-12HMC=$\frac{373\times1200}{7500}$ =59

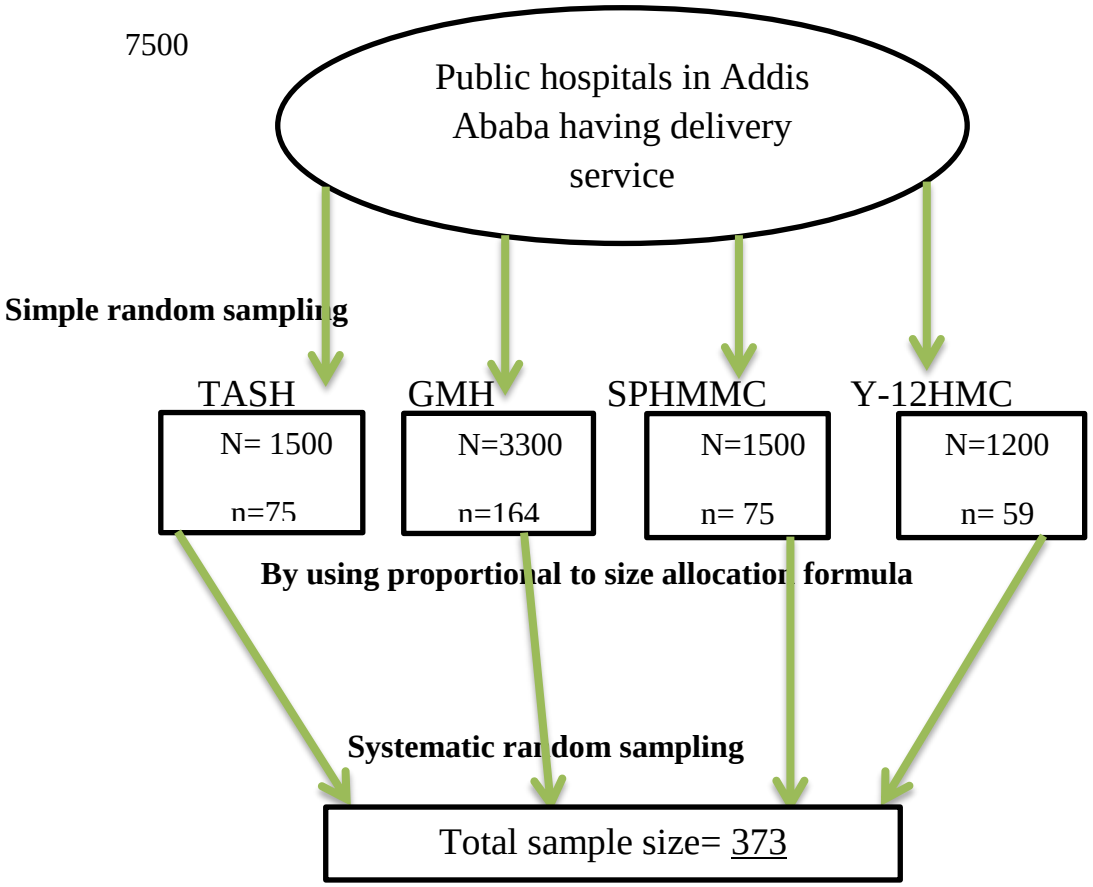

Figure 2: Diagrammatic presentation of sampling procedure for the newborns in selected four public hospitals in Addis Ababa, Ethiopia, 2021.

4.8. Study variables

4.8.1 Dependent variable

- Birth injuries categorized as
  - ✓ Birth asphyxia and
  - ✓ Birth trauma

4.8.2 Independent variables

Socio demographic variables

Maternal age in year's	Maternal weight
Maternal height	Pre-pregnancy BMI
Level of education	Place of residence
Marital status	

Medical and obstetrics variables

ANC follow up	Pregnancy type
Parity	Chronic DM
GDM	Chronic hypertension
Abruptio placenta	Pregnancy induced hypertension.

Intra-partum variables

Fetal presentation	Duration of labor
Cephalopelvic disproportion	Intra-partal fetal distress
Mode of delivery	Time of birth
Cord prolapse	Qualification of birth attendant
Nuchal cord	Induction of labor
Meconium stained amniotic fluids	Premature rupture of membrane
Prolonged rupture of membrane	

Early neonatal variables

Sex	Birth weight
Head circumferences	APGAR score
Need of resuscitation	Gestational age

4.9 Operational definitions/ Definition of terms

Birth injury: Injury to newborns that occur during labor and delivery who has diagnosis of birth trauma, birth asphyxia or both.

Birth trauma: Any physical injury to newborns during the entire birth process that can be recognized by clinical physical examination.

Birth Asphyxia: Failure to initiate, sustain breathing and not crying at birth and diagnosed based on Apgar score <7 at 5^{th} minutes.

Fetal distress: When the fetal heart rate is either <100 or >180 beat/minutes or if there is non-reassurance fetal heart rate pattern.

Major congenital anomalies: Are structural or functional abnormalities which are significance effect to reduce life expectancy of newborns such as hydrops, congenital heart disease and neural tube defects.

ANC follow up: A programmed clinical visits of a mother at least one during her pregnancy in this study**.**

Prolonged labor: Defined as when the combined duration of the first and the second stage of labor are more than 12 hours in primipara or 8 hours in multipara mothers.

Premature rupture of membrane: Rupture of membrane of the amniotic sac and chorion occurred one hour before onset of labor.

Prolonged rupture of membrane: Duration of rupture of membrane of the amniotic sac and chorion >18 hours till delivery.

Birth weight: This was categorized as low, normal and large if birth weight was <2500 g, 2500-3999 g and ≥4000 g respectively.

Gestation at delivery: This was classified as **'preterm'** if delivery was before 37 completed weeks of gestation, **'term delivery'** if baby was born 37 up to 42 completed weeks of gestation and **'post term'** if baby was born after 42 completed weeks of gestation.

Time of birth: This was categorized as **'day time birth'** if the delivery was occurs during 6:00 AM- 5:59 PM and **'night time birth'** if the delivery was occurs during 6:00 PM -5:59 AM.

4.10 Data collection tools and procedures

Data collection tools were developed by reviewing different related literatures (9,12,24,41,43,45). Data was collected by Nurses and Midwives at delivery and post-natal ward by using structured interviewer administered questionnaire and checklist. Both interview and chart reviews were done in this study. The questionnaire was consists of a total of 21 questions that used to assess maternal socio-demographic variables 5 question (such as, maternal age, maternal pre-pregnancy weight, residency, level of education and marital status). Medical and obstetrics variables includes 16 questions (such as, ANC care, parity, maternal diabetes, gestational diabetes, chronic hypertension, pregnancy induced hypertension) were taken by interviewing the mother.

The checklist was consists of a total of 22 questions that used to assess data on intra-partum variables 14 questions (such as, fetal presentation, duration of labor, prolonged rupture of membrane, premature rupture of membrane, cephalopelvic disproportion, intra-partal fetal distress, meconium stained amniotic fluids, mode of delivery, instrument use during delivery, cord prolapse, nuchal cord, time of birth and qualification of birth attendant). Data on early neonatal variables includes 8 questions (such as, sex, birth weight, gestational age, APGAR score, need of resuscitation, head circumference) were taken from chart review of pregnant women who delivered during data collection period by using structured checklist.

On maternal socio-demographic variables (maternal height) and neonatal variable (birth weight and head circumference) there are 3 questions and data was collected by either chart review if documented or by measurement. The remaining one variable pre-pregnancy BMI was obtained by either asking maternal pre-pregnancy weight if she remembers or it was taken from chart review during first trimester weight if she didn't remember her weight, then calculating by dividing her weight to height (Kg/m^2). Birth injuries diagnosis obtained from mothers medical record which was diagnosed by gynecologist/obstetricians and residents.

4.11 Data quality assurance

To assure the quality of data, the checklist was assessed for its completeness by external experts including gynecologists and midwifery professionals and the questioner were pretested on 5% (n=19 participants) of the total sample size similar newborns in another public hospital (St Peter Specialized Hospital) which is out of the study site in Addis Ababa, Ethiopia. Then,

the tool was modified based on the comments of expert in the field and pretest result. Four BSc midwife and nurses who are not staff members of the hospitals were assigned to collect the data. One supervisor was assigned to control the process of data collection. For data collectors, training was provided by the principal investigator about the aim of the study and the components of the questionnaires.

4.12 Data processing and analysis

After completing data collection, data were categorized, coded, cleaned and recorded. The data was entered by using Epi data version 4.0.2 and exported in to SPSS software version 25 for analysis. Descriptive statistical analysis such as frequencies, percentages, crosses tabulation and mean were done. To assess the factors independently associated with birth injury, two regression models (considering the dependent variables to be (i) birth asphyxia and (ii) birth trauma) were used.

Bivariate logistic regression analysis was used to check the association between each independent variable with dependent variable. Then those variables with p-value ≤ 0.25 were entered a multivariable logistic regression model analysis in order to control the confounding factors. In order to check the correlation between independent variables, multi-colinearity (colinearity diagnostic taste) was done by using the value of variance inflation factors and tolerance. Hosmer and Lemeshow goodness of fit test and omnibus tests of model coefficients were done to test the fitness of the logistic regression in the final model, then it was found good (statistically insignificant value, *P* value >0.05). The strength of association between dependent and independent variables was expressed by using adjusted odds ratio with 95% confidence interval. P-value <0.05 was considered as statistically significance. Eventually, the findings were presented by using text, tables and graph.

4.13 Ethical consideration

This study was conducted after it is ethically reviewed and approved by School of Nursing and Midwifery, Addis Ababa University, College of Health Science, Institutional Review Board (IRB). Permission was also sought from each hospital. Study participants were asked for their willingness to participate in the study after explaining the purpose of the study. Then written informed consent was obtained from each participant. The privacy and confidentiality of information was strictly maintained by not writing the name of study participants on data collection tool.

4.14 Dissemination of results

The result of this research was presented to the Department of Nursing, College of Health Sciences, Addis Ababa University. The result will also submit to each selected hospital. The findings will also be disseminated to concerned governmental and non-governmental organizations and soft copy of report will be available at College of Health Science library. Finally, the finding will be submitted to peer reviewed journals for publication.

5. RESULTS

5.1 Socio demographic characteristics of the mothers

In this study, all of the 373 mothers were give an informed consent to participate with a response rate of 100%. The mean maternal age was 27.28 ± 5.16 SD years of whom 141 (37.8%) of mothers belonged to age groups of 25-29 years. Besides, around 133 (35.7%) of mothers attended primary education. Almost all 358 (96%) of the participants were living in urban area. In addition, around 339 (90.9%) of the respondents were married. The mean of BMI and height of the mothers were 22.65 ± 3.34SD kg/m² and 156.8 ± 8.5 SD cm respectively. Majority of the mothers i.e. 264 (70.8%) were categorize in the range of normal body mass index (18.5-24.9). Regarding to the height of the mothers, about 322 (86.3%) of mothers had body height of ≥145 cm (Table 1).

Table 1:Socio-demographic characteristics of mother for the study of prevalence of birth injuries and associated factors among newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021 (n=373).

Variables	Category	Frequency (n)	Percentage (%)
Age group of the mothers	15-19	22	5.9
	20-24	88	23.6
	25-29	141	37.8
	30-34	73	19.6
	≥35	49	13.1
Educational status	No formal education	51	13.7
	Primary education	133	35.7
	Secondary education	108	29.0
	More than secondary	81	21.6
Residency	Urban	358	96
	Rural	15	4
Marital status	Married	339	90.9
	Divorced	18	4.8
	Single	16	4.3
Height of the mother (in cm)	<145	51	13.7
	≥145	322	86.3

BMI of the mothers (Kg/m²)	<18.5 (underweight)	30	8
	18.5-24.9 (Normal)	264	70.8
	25-29.9 (overweight)	68	18.2
	≥30 (obese)	11	2.9

5.2 Medical and obstetric characteristics of the mothers

Among 373 study subjects, 367 (98.4%) of mothers attended ANC follow up during their pregnancy period. Majority of the participants, 312 (83.6%) had four and above ANC follow up. Besides, nearly three quarter 266 (71.3%) of the respondents had ANC follow up at health center. Half 186 (49.9%) of the mothers were primipara. Regarding the chronic medical illness of the mothers, majority of the participants 364 (97.6%) and 369 (98.9%) did not have chronic DM and hypertension respectively. Pregnancy induced hypertension 52 (14%) and gestational diabetes mellitus 40 (10.7%) were the most common obstetrics complication during pregnancy. Around one-tenth 39 (10.5%) of the participants who had pregnancy induced hypertension developed pre-eclampsia. Majority of the mothers 341 (91.4%) had single type of pregnancy and only 32 (8.6%) of the mothers had twin types of pregnancy (Table 2).

Table 2: Medical and obstetrics characteristics of mother for the study of prevalence of birth injuries and associated factors among newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021 (n=373).

Variables	Category	Frequency (n)	Percentage (%)
ANC follow up	Yes	367	98.4
	No	6	1.6
Number of ANC follow up	1-3	55	14.7
	≥4	312	83.6
Facilities of ANC follow up	Health centers	262	70.2
	Government hospitals	78	20.9
	Private hospitals	19	5.1
	Private clinic	6	1.6
	NGO clinic	2	0.5
Parity	Primipara	186	49.9
	Multipara	187	50.1
Gravidity	Primigravida	160	42.9

	Multigravida	213	57.1
Types of pregnancy	Single	341	91.4
	Twins	32	8.6
	Medical illness of the mothers		
Chronic DM	Yes	9	2.4
	No	364	97.6
Chronic hypertension	Yes	4	1.1
	No	369	98.9
HIV test done	Yes	373	100
	No	0	0
HIV Status	Positive	8	2.1
	Negative	365	97.9
Others*		12	3.21
	Obstetric complication of the mothers		
Gestational DM	Yes	40	10.7
	No	333	89.3
Pregnancy induced	Yes	52	14
hypertension	No	321	86
Types of pregnancy	Pre-eclampsia	39	10.5
induced hypertension	Eclampsia	13	3.5
Abruptio placenta	Yes	8	2.1
	No	365	97.9
Others**		26	7

Key:*= Anemia, congestive heart failure, thrombocytopenia, asthma and hydronephrosis

**= Oligohydramnious and chorioamnionitis

5.3 Intrapartum related factors

According to the result of this study, majority 342 (91.7%) of the newborns were at vertex presentation. Around 88 (23.6%) of the newborns had intrapartum fetal distress. Among the total participated mothers, above two third 254 (68.1%) and 60 (16.1%) had spontaneous and induced onset of labor respectively. In addition to this, about 59 (15.8%) of the mothers did not experience any onset of labor during delivery i.e. delivered by elective cesarean section.

Nearly one third 119 (31.9%) of the mothers had prolonged duration of labor. Furthermore, one quarters 90 (24.1%), 54 (14.5%) and 81(21.7%) of the mothers faced premature rupture of membranes, prolonged rupture of membranes (≥18 hours) and meconium stained amniotic fluid respectively. More than half 217 (58.2%) and 37(9.9%) of the newborns delivered by cesarean section and instrumental delivery respectively. Regarding to cord problem, only 8 (2.1%) and 13 (3.5%) of the newborns developed cord prolapse and tight nuchal cord during delivery respectively. Majority of the delivery 184 (49.3 %) and 135 (36.2%) attended by residents and midwifes respectively (Table 3).

Table 3: Intra-partum factors of mother for the study of prevalence of birth injuries and associated factors among newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021 (n=373).

Variables	Category	Frequency	Percentages (%)
Fetal presentation	Vertex presentation	342	91.7
	Breech presentation	23	6.2
	Face presentation	5	1.3
	Brow presentation	3	0.8
Intrapartal fetal distress	Yes	88	23.6
	No	285	76.4
CPD	Yes	9	2.4
	No	364	97.6
Condition of labor	Spontaneous	254	68.1
	Induced	60	16.1
	No labor (elective c/s)	59	15.8
Duration of labor	Normal	195	52.3
	Prolonged	119	31.9
	No labor	59	15.8
Premature rupture of membrane	Yes	90	24.1
	No	283	75.9
Duration of rupture of membrane	<18 hours	317	85
	≥ 18 hours	56	15
Color of amniotic fluid	Clear	292	78.3
	Meconium stained	81	21.7
Mode of delivery	SVD	119	31.9
	Instrumental delivery	37	9.9

	C/S	217	58.2
Cord prolapse	Yes	8	2.1
	No	365	97.9
Tight nuchal cord	Yes	13	3.5
	No	360	96.5
Qualifications of birth attendant	Gynecologists/obstetricians	54	14.5
	Residents	184	49.3
	Midwifes	135	36.2
Time of birth	Day time birth	230	61.7
	Night time birth	143	38.3

5.4 Early neonatal related factors

Of the total newborn babies, 225 (60.3%) of them were males. More than three quarters 288 (77.2%) of the newborn babies' gestational age was in the range of 37-42 weeks at birth. The mean gestational age at the time of birth was 39.45 ± 2.52 SD weeks. Besides, majority 285 (76.4%) of the participants had normal birth weight (2500-3999) gram and the average birth weight of the newborn babies was 3119.09 ± 649.25 SD grams. 336 (90.1%) of the participants had normal head circumference (33-38 cm) respectively. Moreover, around 52 (13.9%) of the newborns were unable to cry immediately after birth. About 321 (86.1%) of the newborn babies had normal Apgar score at fifth minutes after birth (7-10). Additionally, 43(11.5%) and 9 (2.4%) of the participants had moderate (4-6) and low (0-3) APGAR score respectively. Out of the study population, 52 (13.9 %) of the newborns needed resuscitation after birth (Table 4).

Table 4: Early neonatal related factors of newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021 (n=373).

Variables	Category	Frequency	Percentages (%)
Sex	Male	225	60.3
	Female	148	39.7
Gestational age	<37 weeks (preterm)	44	11.8
	37-42 weeks (term)	288	77.2
	>42 weeks (post term)	41	11
Birth weight	<2500 gram	54	14.5
	2500-3999 gram	285	76.4
	≥4000 gram	34	9.1
Head circumference	<33 cm	21	5.6
	33-38 cm	336	90.1
	>38 cm	16	4.3
Cry after birth	Yes	321	86.1
	No	52	13.9
APGAR score (1st minutes)	0-3 (low)	17	4.6
	4-6 (moderate)	62	16.6
	7-10 (normal)	294	78.8
APGAR score (5th minutes)	0-3	9	2.4
	4-6	43	11.5
	7-10	321	86.1
Resuscitation after birth	Yes	52	13.9
	No	321	86.1

5.5. Prevalence of birth injuries

The overall prevalence of birth injury was found to be 92 (24.7%) of the total study participants in this study. Birth asphyxia and birth trauma were identified in 52 (13.9%) and 48 (12.9%) of these babies, respectively. A total of eight newborns (2.1%) suffered from both birth asphyxia and birth trauma (Fig.3).

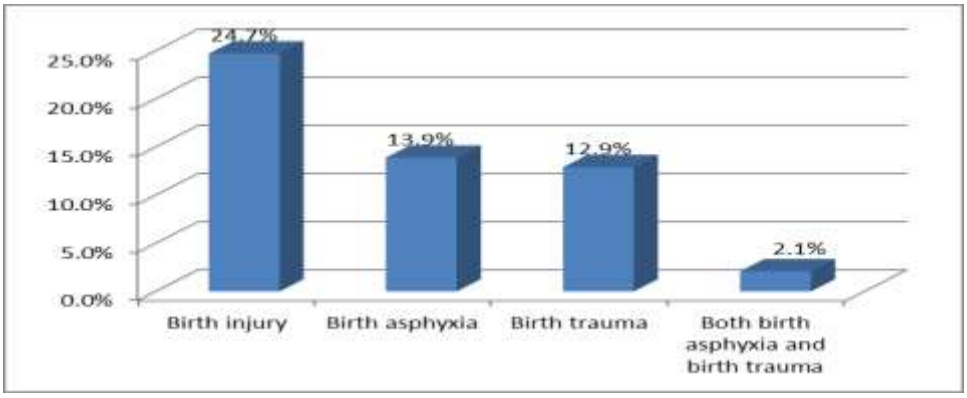

Figure 3: Prevalence of birth injury among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021.

Among those newborns who diagnosed with birth trauma, the most common types were extra cranial trauma 39 (81.2%), neurological trauma 13 (27 %) and soft tissue trauma 10 (21%). From extra cranial trauma, more than half, 20 (51.2%) and 10 (25.6%) of the newborn babies developed subgalial hemorrhage and cephalhaematoma respectively. Among neurological trauma and soft tissue trauma, the largest proportions contributed by facial palsy 8 (61.5%) and facial &skin bruises 5(50%) respectively. Furthermore, 14 (29.2%) newborns developed two types of birth trauma (Table 5).

Table 5: Common types of birth trauma among newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021.

Types of birth trauma	Frequency (n)	Percentages (%) from newborn with birth trauma (n=48)	Percentages (%) from study population (n=373)
Extra cranial trauma			
Caput succedaneum	9	18.8	2.41
Cephalhaematoma	10	20.8	2.68
Subgalial hemorrhage	20	41.7	5.36
Neurologic trauma			
Erb's palsy	5	10.4	1.3
Facial palsy	8	16.7	2.1
Soft tissue trauma			
Facial and skin bruises	5	10.4	1.3
Skin laceration	3	6.3	0.8
Sub-conjuctival hemorrhage	2	4.2	0.5

5.6. The associated factors of birth injuries

5.6.1. The associated factors of birth asphyxia

According to the results of bivariate logistic regression analysis, there were 20 factors associated with cruds odds ratio for birth asphyxia. Namely, age of the mothers, educational status of the mothers, BMI of the mothers, height of the mothers, parity, GDM, types of pregnancy, abruption placenta, intrapartal fetal distress, CPD, condition of labor, duration of labor, duration of rupture of membrane, color of amniotic fluid, cord prolapse, tight nuchal cord, qualifications of birth attendant, time of birth, sex and birth weight of the newborns. In multivariable logistic regression analysis, short height of the mothers, intrapartal fetal distress, cord prolapse, tight nuchal cord, birth attended by residents, male sex and low birth weight of the newborns were the most contributing factors of birth asphyxia (Table 6).

The occurrence of birth asphyxia was 10.7 times (AOR=10.7, 95% CI: 3.59-32.4) higher to occur among neonates born from mothers with short height (<145 cm) in relative to neonates born from mothers with height >145 cm. Similarly, the odds of birth asphyxia among mothers who had intrapartal fetal distress were nearly five times (AOR=4.74, 95% CI: 1.81-12.4) higher than their counterpart. Furthermore, newborns who had cord prolapse and nuchal cord during delivery were 7.7 times (AOR=7.7, 95% CI: 1.45-34.0) and 9.2 times (AOR=9.2, 95% CI: (4.9-35.3) more likely experienced birth asphyxia compared to those neonates born without cord prolapse and nuchal cord respectively.

Labor attended by residents were 81% less likely (AOR=0.19, 95% CI: 0.05-0.68) to encounter birth asphyxia among newborns compared to those labor attended by gynecologist/obstetricians. Besides, the odds of experiencing birth asphyxia was nearly four times higher (AOR=3.84, 95% CI: 1.30-11.3) among male newborns comparing to female newborns. In addition to this, low birth weight newborns were 5.28 more likely (AOR= 5.28, 95% CI: 1.58-17.6) to develop birth asphyxia relative to normal birth weight newborns (Table 6).

Table 6: Bivariate and multivariable logistic regression analysis for the associated factors of birth asphyxia among newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021 (n=373).

Variables	Category	Birth asphyxia		COR(95% CI)	AOR (95% CI)
		Yes(n=52)	No(n=321)		
Age groups of mothers	15-19	4(7.7%)	18(5.6%)	1	1
	20-24	14(26.9%)	74(23.1%)	0.85(0.25-0.28)	0.71(0.11-4.46)
	25-29	19(36.5)	122(38%)	0.70(0.21-2.29)	0.67(0.10-4.30)
	30-34	4(7.7%)	69(21.5%)	**0.26(0.05-1.14)***	0.59(0.06-5.48)
	≥35	11(21.2%)	38(11.8%)	1.30(0.36-4.65)	3.85(0.44-33.0)
Educational status of mothers	No formal education	9(17.3%)	42(13.1%)	**3.25(1.02-10.3)***	1.09(0.22-5.41)
	Primary	21(40.4%)	112(34.9%)	**2.85(1.03-7.88)***	1.38(0.37-5.03)
	Secondary	17(32.7%)	91(28.3%)	**2.84(1.00-8.05)***	1.33(0.32-5.51)
	Above secondary	5(9.6%)	76(23.7%)	1	1
BMI (Kg/m^2)	<18.5	4(7.7%)	26(8.1)	1	1
	18.5-24.9	26(50%)	238(74.1%)	0.71(0.23-2.19)	1.06(0.18-6.06)
	25-29.9	19(36.5%)	49(15.3%)	**2.52(0.77-8.18)***	2.08(0.31-13.5)
	≥30	3(5.8%)	8(2.5%)	2.43(0.44-13.2)	3.06(0.29-32.4)
Height of the mothers	<145 cm	22(42.3%)	29(9%)	**7.38(3.78-14.4)***	**10.7(3.59-32.4)****
	≥145 cm	30(57.7%)	292(91%)	1	1
Parity	Primipara	31(59.6%)	155(48.3%)	**1.58(0.87-2.86)***	2.04(0.72-5.77)
	Multipara	21(40.4%)	166(51.7%)	1	1
GDM	Yes	10(19.2%)	30(9.3%)	**2.31(1.05-5.06)***	2.24(0.52-9.67)
	No	42(80.8%)	291(90.7%)	1	1
Types of pregnancy	Single	50(96.2%)	291(90.7%)	**2.57(0.59-11.1)***	4.48(0.49-40.7)
	Twine	2(3.8%)	30(9.3%)	1	1
Abruptio placenta	Yes	4(7.7%)	4(1.2%)	**6.6(1.59-27.2)***	5.30(0.52-54.0)
	No	48(92.3%)	317(98.8%)	1	1
Intrapartal fetal distress	Yes	26(50%)	62(19.3%)	**4.17(2.26-7.68)***	**4.74(1.81-12.4)****
	No	26(50%)	259(80.7%)	1	1
CPD	Yes	4(7.7%)	5(1.6%)	**5.26(1.36-20.3)***	5.08(0.85-30.3)
	No	48(92.3%)	316(98.4%)	1	1
Condition of labor	Spontaneous	42(80.8%)	212(66%)	**3.78(1.13-12.6)***	6.73(0.88-51.2)
	Induced	7(13.5%)	53(16.5%)	**2.5(0.61-10.2)***	2.88(0.30-27.4)
	No labor	3(5.8%)	56(17.4%)	1	1
Duration of labor	Normal	24(49%)	171(64.5%)	1	1
	Prolonged	25(51%)	94(35.5%)	**1.89(1.02-3.5)***	1.80(0.70-4.62)
	No labor	3(5.8%)	56(17.4%)	**0.38(0.11-1.31)***	0.54(0.35-2.42)
Duration of rupture of membranes	<18 hours	41(78.8%)	276(86%)	1	1
	≥18 hours	11(21.2%)	45(14%)	**1.64(0.78-3.43)***	1.05(0.33-3.32)
Color of amniotic fluids	Clear	33(63.5%)	259(80.7%)	1	1
	Meconium stained	19(36.5)	62(19.3%)	**2.4(1.28-4.51)***	1.95(0.72-5.27)
Cord prolapse	Yes	4(7.7%)	4(1.2%)	**6.6(1.59-27.2)***	**7.7 (1.45-34.0)****
	No	48(92.3%)	317(98.8)	1	1
Tight nuchal cord	Yes	7(13.5%)	6(1.9%)	**8.16(2.62-25.3)***	**9.2 (4.9-35.3)****
	No	45(86.5%)	315(98.1%)	1	**1**

Continued

Qualification of birth attendant	Gynecologist	14(26.9%)	40(12.5%)	1	1
	Residents	25(48.1%)	159(49.5%)	**0.44(0.21-0.94)***	**0.19(0.05-0.68)****
	Midwifes	13(25%)	122(38%)	**0.3(0.13-0.7)***	0.62(0.15-2.56)
Time of birth	Day time	20(38.5%)	210(65.4%)	1	1
	Night time	32(61.5%)	111(34.6%)	**3.02(1.65-5.53)***	1.81(0.73-4.51)
Sex	Male	39(75%)	186(57.9%)	**2.17(1.11-4.23)***	**3.84(1.30-11.3)****
	Female	13(25%)	135(42.1%)	1	1
Birth weight	<2500 g	12(23.1%)	42(13.1%)	**2.10(1.01-4.39)***	**5.28(1.58-17.6)****
	2500-3999 g	34(65.4%)	251(78.2%)	1	1
	≥4000g	6(11.5%)	28(8.7%)	1.58(0.61-4.09)	0.29(0.04-1.75)

Hosmer and Lemeshow test, P-value=0.758. *statistically significant by COR at P-value ≤0.25.
** Statistically significant by AOR at P-value<0.05.
COR= Crude odds ratio. AOR= Adjusted odds ratio

5.6.2. The associated factors of birth trauma

The results of bivariate logistic regression analysis showed that, there were 11 factors associated by crudes odds ratio with birth trauma. These includes BMI of the mothers, height of the mothers, number of ANC follow up, GDM, fetal presentations, duration of labor, mode of delivery, time of birth, sex, birth weight and head circumference of the newborns. To control the effect of confounding, multivariate analysis were done and factors independently associated with birth trauma were GDM, prolonged duration of labor, instrumental delivery and night time birth (Table 7).

The odds of birth trauma were 5 times (AOR=5.01, 95% CI: 1.38-18.31) higher among neonates born from mothers with gestational diabetic mellitus compared to those born from mothers who did not experience gestational diabetic mellitus. Regarding duration of labor, neonates born from mothers who had prolonged labor were 3.74 times (AOR= 3.74, 95% CI: 1.52-9.20) more likely to develop birth trauma when compared to those born from mother with normal duration of labor. Those neonates born via instrumental assisted were nearly 10.6 times (AOR=10.6, 95% CI: 3.45-32.7) more susceptible to experience birth trauma than neonates delivered via caesarian section. Moreover, neonates delivered during the night time were nearly five times (AOR=4.82, 95% CI: 1.84-12.6) more likelihood of acquiring birth trauma than neonates born during the day time (Table 7).

Table 7: Bivariate and multivariable logistic regression analysis for the associated factors of birth trauma among newborns delivered in public hospitals, Addis Ababa, Ethiopia, 2021.

Variables	Category	Birth trauma		COR (95% CI)	AOR (95% CI)
		Yes (n=48)	No (n=325)		
BMI (Kg/m²)	<18.5	3(6.3%)	27(8.3%)	1	1
	18.5-24.9	24(50%)	240(73.8%)	0.90(0.25-3.18)	1.55(0.21-11.2)
	25-29.9	18(37.5%)	50(15.4%)	**3.24(0.87-11.9)***	1.59(0.17-14.5)
	≥30	3(6.3%)	8(2.5%)	**3.37(0.56-20.0)***	3.09(0.23-41.5)
Height of the mothers	<145 cm	13(27.1%)	38(11.7%)	**2.8(1.36-5.76)***	1.73(0.54-5.55)
	≥145 cm	35(72.9%)	287(88.3%)	1	1
Number of ANC follow up	1-3	10(20.8%)	45(13.8%)	1	1
	≥4	36(75%)	276(84.9%)	**0.58(0.27-1.26)***	0.37(0.13-1.10)
GDM	Yes	16(33.3%)	24(7.4%)	**6.27(3.02-13.0)***	**5.01(1.38-18.1)****
	No	32(66.7%)	301(92.6%)	1	1
Fetal presentation	Vertex	41(85.4%)	301(92.6%)	**0.06(0.006-0.76)***	0.04(0.002-1.08)
	Breech	1(2.1%)	22(6.8%)	**0.02(0.001-0.51)***	0.11(0.002-5.55)
	Face	4(8.3%)	1(0.3%)	2.00(0.07-51.5)	3.36(0.05-21.7)
	Brow	2(4.2%)	1(0.3%)	1	1
Duration of labor	Normal	19(36.6%)	176(54.2%)	1	1
	Prolonged	29(60.4%)	90(27.7%)	**2.98(1.58-5.61)***	**3.74(1.52-9.20)****
	No labor	0(0%)	59(18.2%)		
Mode of delivery	SVD	13(27.1%)	106(32.6%)	1.44(0.65-3.08)	1.15(0.39-3.32)
	Instrumental	18(37.5%)	19(5.8%)	**11.1(4.94-25.1)***	**10.6(3.45-32.7)****
	C/S	17(35.4%)	200(61.5%)	1	1
Time of birth	Day time	13(27.1%)	217(66.8%)	1	1
	Night time	35(72.9%)	108(33.2%)	**5.41(2.74-10.6)***	**4.82(1.84-12.6)****
Sex	Male	34(70.8%)	191(58.8%)	**1.7(0.88-3.29)***	0.99(0.39-2.51)
	Female	14(29.2%)	134(41.2%)	1	1
Birth weight	<2500 g	4(8.5%)	50(15.4%)	0.70(0.23-2.09)	0.36(0.06-2.21)
	2500-3999 g	29(60.4%)	256(78.8%)	1	1
	≥4000 g	15(31.3%)	19(5.8%)	**6.96(3.20-15.1)***	1.70(0.41-7.00)
Head circumference	<33 cm	3(6.3%)	18(5.5%)	1	1
	33-38 cm	36(75%)	300(92.3%)	0.72(0.20-2.56)	0.12(0.01-1.09)
	>38 cm	9(18.8%)	7(2.2%)	**7.71(1.60-37.1)***	1.25(0.09-17.1)

Hosmer and Lemeshow test, P-value =0.85. *= Statistically significant by COR at P-value ≤0.25.

**=Statistically significant by AOR at P-value<0.05. COR= Crude odds ratio, AOR= Adjusted odds ratio

6. DISCUSSION

Birth injury is the primary cause of morbidity and mortality among newborns. The prevalence of birth injury differs widely from place to place. The medical service provided to the mothers and newborns during delivery is important to reduce the overall prevalence of birth injury and its burden. In this study, it was tried to identify and report the prevalence and associated factors of birth injury among newborns delivered in public hospitals, Addis Ababa, Ethiopia.

6.1. Prevalence of birth injury

It was found that, the overall prevalence of birth injury among live birth newborns was 24.7% with 95% CI (20.1-29.0). The prevalence in this study was higher than studies conducted in Indian, Iran, Nigeria and Jimma (11.76%, 2.2 %, 5.7%, 15.4% respectively) (12,14,15,24). This variation might be due to difference in sample size and study area (this study conducted in referral hospitals where more complicated cases and referred from different setting that could increase the prevalence of birth injury in the study area).

In this study the prevalence of birth asphyxia was 13.9% with 95% CI (10.5-17.7). This finding was higher compared to studies conducted in Jimma university hospital 8.1% (24), Dire Dawa 2.5 % (43) and South Indian 5.29% (15). However, it was lower than the studies conducted in Jimma zone public hospitals 32.9% (46), Debre Tabor 28.35% (45), North East Amhara 22.6% (44) and Hossana 15.1% (9). Similarly, this finding also lower as compared to the studies conducted in Iran 16.8%(12) and Nigeria 39.3%(14). The possible reason might be difference in sample size, using different definition of birth asphyxia (some studies used 1^{st} minutes APGAR score, but this study used 5^{th} minutes APGAR score to define birth asphyxia), variation of the study area and variation in distribution of skilled birth attendant in different setting.

The current study showed that the prevalence of birth trauma was 12.9% with 95% CI (9.7-16.4). This finding was higher as compared to the studies done in USA 2.9% (21), Pakistan 4.11% (37), India 1.54% (22) and Jimma 8.1% (24), However, this result was lower than studies conducted in Nigeria 67.2% (41). This might be due to difference in study design, sample size, study population and variation in diagnosis of birth trauma, i.e. this study used birth trauma that was diagnosed only by physical examination but other studies included birth trauma diagnosed by both physical examination and radiological.

The most common birth trauma seen in the current study was extra cranial trauma 39 (81.2%), neurological trauma 13 (27%) and soft tissue trauma10 (21%). Subgalial hemorrhage 41.7 % and cephalhaematoma 20.8 % were the most common birth trauma. This finding was higher than studies done in Jimma and Nigeria, they were found that the most prevailing birth trauma was subgalial hemorrhage which accounts 20% and 13.1 % respectively. The possible reason might be in the current study, instrumental delivery is significantly associated with birth trauma but not in study conducted in Jimma (24). In addition to this, there was low rate of instrumental assisted delivery due to fear of cultural belief, so most women prefer to deliver by spontaneous vaginal delivery in study conducted in Nigeria (14).

Cephalhaematoma was the second most common types of birth trauma diagnosed in around 20.8% of the newborns, it was lower when compared to studies done in Iran (12) and India (33), they were found that the most common type of birth trauma was cephalhaematoma accounts 57.2% and 38.7% respectively. However this finding was higher than study done in Nigeria 16.4% (14) and Pakistan 2.14% (37). This might be due to differs in the skill of birth attendant and frequency of instrumental delivery.

In this study, facial palsy was the most prevailing among neurological trauma. This finding was supported by studies carried out in Iran (12), Indian (22), Bombay Hospital (33) and Nigeria (Maiduguri) (14). The possible reason may be the fact that facial palsy occur during difficult delivery when forceps are applied and leads to paralysis of seventh cranial nerve.

6.2. The associated factors of birth asphyxia

Factors independently associated with birth asphyxia were short height of the mothers, intrapartal fetal distress, cord prolapse, tight nuchal cord, birth attended by residents, male sex of the newborns and low birth weight of the newborns.

The occurrence of birth asphyxia was 10.7 times (AOR=10.7, 95% CI: 3.59-32.4) higher among neonates born from mothers with short height (<145 cm) in relative to neonates born from mothers with height >145 cm. This finding was supported by studies conducted in Swedish (73) and Uganda (48). This could be due to the fact that those mothers who had short height may have short stature that impair the progress of descent of the fetal head and leads to prolong the duration of labor. This predisposes the newborn for birth asphyxia.

This study also identified that intrapartal fetal distress was significantly associated with birth asphyxia. The odds of birth asphyxia among mothers who had intrapartal fetal distress were nearly five times (AOR=4.74, 95% CI: 1.81-12.4) higher as compared to those mothers without history of intrapartal fetal distress. This finding was almost similar to the previous studies conducted in Gonder (19) and Addis Ababa(25). The likely reason is either fetal tachycardia or fetal bradycardia is the main cause for fetal-placental oxygen deprivation that exposes the newborn for birth asphyxia. Usually it's an indication for emergency cesarean section. But this finding is lower than study conducted in Jimma, Ethiopia neonates with intrapartal fetal distress had 6.4 times more likely to develop birth asphyxia when compare to neonates without intrapartal fetal distress (24). This difference may be due to variation in study setting and quality of the obstetric care.

The occurrence of birth asphyxia was also independently associated with cord prolapse and tight nuchal cord. Newborns who had cord prolapse during delivery were 7.7 times (AOR=7.7, 95% CI: 1.45-34.0) and tight nuchal cord during delivery were 9.2 times (AOR=9.2, 95% CI: 4.9-35.3) more likely experienced birth asphyxia compared to their counterpart. This finding was supported with the previous studies conducted in USA (63), Hossana (9) and Jimma (46). This could be due to the fact that compression of the cord may impair blood flow to the fetus and compromise the fetal oxygenation; as a result the chance of occurrence of birth asphyxia will be more likely.

Labor attended by residents were 81% less likely (AOR=0.19, 95% CI: 0.05-0.68) to encounter birth asphyxia among newborns compared to those labor attended by gynecologist/obstetricians. This might be due to since the study was conducted in teaching hospitals; most labor was attended by residents, but labor attended by gynecologists/obstetricians was critical cases/ consulted case that was unable to handle by residents. This finding was inconsistent with study conducted in Debre Tabor, Ethiopia neonates delivered by Midwives 56.2% developed birth asphyxia (45). The difference may be due to variation in study setting and distribution of skilled birth attendant i.e. in Debre Tabor most of the birth was attended by Midwives.

The odds of experiencing birth asphyxia was nearly four times higher (AOR=3.84, 95% CI: 1.30-11.3) among male newborns comparing to female newborns. This finding was supported

by study conducted in Washington, American (74) and Ayder Hospital, Ethiopia (75). This might be due to biological difference makes male more at risk for birth asphyxia and it needs further investigation. In addition to this, low birth weight newborns were 5.28 more likely (AOR= 5.28, 95% CI: 1.58-17.6) to develop birth asphyxia relative to those who had normal birth weight. This finding was in agreement with study conducted in Addis Ababa (25), Gonder (19) and Jimma (46). This might be clarified by the fact that most low birth weight neonates delivered during preterm gestation that might have immature lung and unable to pass the transition period without difficulty of breathing.

In this study, age of the mothers, educational status of the mothers, BMI of the mothers, parity, GDM, types of pregnancy, abruption placenta, condition of labor, duration of labor, duration of rupture of membrane, color of amniotic fluid and time of birth were factors not significantly associated with birth asphyxia in multivariable logistic regression analysis. However, different studies revealed that these factors were associated with birth asphyxia (9,49,50,53,55,62,65–67). This variation might be due to difference in study setting, health care coverage, socio demography and methodology (study design i.e. case-control study was carried out in (50) but this study was crossectional study).

6.3. The associated factors of birth trauma

The other dependent variable is birth trauma and the associated factors were found to be GDM, prolonged duration of labor, instrumental delivery and night time birth. The odds of birth trauma were 5 times (AOR=5.01, 95% CI: 1.38-18.1) higher among neonates born from mothers with gestational diabetic mellitus compared to those born from mothers who did not experience gestational diabetic mellitus. This finding was consistent with the studies conducted in Nigeria (41) and Turkey (61). This might be due to the truth that, one of the complications of infant of diabetic mothers is macrosomia, and this will predispose the newborn for mechanical birth trauma that is why it's the main reason for emergency C/s.

Neonates born from mothers who had prolonged labor were 3.74 times (AOR= 3.74, 95% CI: 1.52-9.20) more likely to develop birth trauma when compared to those born from mother with normal duration of labor. This finding was supported by studies done in Nigeria (41), Indian (22) and Bombay hospital (33). This is due to the fact that when there is prolonged labor, the women may experience tiredness and unable to progress the labor. Therefore, to prevent fetal

distress, the birth attendant may apply forceps or vacuum to assist the labor. All these difficulty may leads to birth trauma.

Another contributing factor significantly associated with birth trauma was instrumental delivery. Those neonates born via instrumental assisted were 10.6 times (AOR=10.6, 95% CI: 3.45-32.7) more susceptible to experience birth trauma than neonates delivered via cesarean section. This finding was in agreement with studies conducted in Bombay Hospital (33), Indian(15) and Nigeria(14). The likely reason was due to the fact that, application of forceps and vacuum on the fetal head may expose to extra cranial hemorrhage, intra cranial hemorrhage and soft tissue abrasion/laceration. All these complication may leads to birth trauma. But, this finding was higher than study done in Pakistan(37), neonates delivered by instrument assisted were 2.14 times (AOR=2.14) more likely to develop birth trauma than neonates delivered via cesarean section. This difference might be due to variation in study setting and skill of birth attendant.

Night time delivery was also another contributing factor for birth trauma. Neonates delivered during the night time were nearly five times (AOR= 4.82, 95% CI: 1.84-12.6) more likelihood of acquiring birth trauma than neonates born during the day time. This finding was supported by study conducted Indian (22). This is possibly justified by the number of birth attendant assigned during duty hours were few that makes them unable to accomplish the overburden during night time, expert in the field/gynecologist may not arrived on time for consulted cases and it might be large proportion of referred cases during night time.

In this study, BMI of the mothers, height of the mothers, numbers of ANC follow up, fetal presentation, sex of the newborns, birth weight and head circumference of the newborns were factors not associated with birth trauma in multivariable logistic regression analysis. However, the finding of different studies show that these factors were associated with birth trauma (12,22,37,47,48,68,69). This difference might be due to variation study setting, socio demographic of the mothers and methodology (study design i.e. retrospective cohort study was conducted in (68), but this study was crossectional study).

7. LIMITATION OF THE STUDY

7.1 Strength of the study

- Data was obtained prospectively among live birth delivery by interviewing the mothers, chart review and measurement.
- The previous conducted research did not consider qualification of birth attendant and time of birth, but this study investigated this factors.

7.2 Limitation of the study

- In this study, the diagnosis of birth asphyxia was made by using 5^{th} minutes APGAR score <7 only due to unavailability of arterial blood gas analysis and umbilical cord PH in the laboratory facility. But according to American academy of pediatrics birth asphyxia diagnosed based on arterial blood gas analysis, cord blood PH, fifth minutes APGAR score <7 and altered CNS status.
- This study conducted in referral public hospitals, where most of the mothers admitted to labor ward were referral cases from different community; this may probably overestimate the prevalence of birth injury.
- This study was also share the disadvantage of crossectional study i.e. does not show cause and effect relationship between dependent variable with its own contributing factor.

8. CONCLUSION

The overall prevalence of birth injury in this study was 24.7%, which is still higher than the previous studies conducted in developing countries. Each birth asphyxia and birth trauma constitutes 13.9% and 12.9% respectively. Birth asphyxia was independently associated with short height of the mothers, intrapartal fetal distress, cord prolapse, tight nuchal cord, birth attended by residents, male sex of the newborns and low birth weight of the newborns. In addition to this, birth trauma was independently associated with GDM, prolonged duration of labor, instrumental delivery and night time birth. However, the finding of this study could only be generalized to this cohort womens – newborns in the study setting. Therefore, most of the above contributing factors are preventable strong effort must be done to improve prenatal care and the delivery service which are vital to reduce the occurrence of birth injury and its complications.

9. RECOMMENDATIONS

The increasing prevalence of birth injury can be reduced by active participation of the following concerned bodies in order to improve the quality of newborns health.

- For maternal and newborn health care professionals:
  - In the ANC follow up, give attention for early detection of obstetric complication and strict follow up. Besides, counseling the mothers about good glycemic control during pregnancy and its impact on the fetus during delivery if she had GDM.
  - Strong effort has to be made to improve the intrapartal obstetric care and in case of abnormalities occurs early decision of the obstetric team is mandatory.
  - Following the mothers strictly during labor to avoid the complications of prolonged labor.
  - In case of high risk delivery, birth asphyxia should be anticipated and neonatal health care professionals trained with neonatal resuscitation have to be there to prevent birth asphyxia.
  - Careful use of instrument (forceps and vacuum) during delivery and avoid traumatizing the newborns is recommended.
- For hospitals:
- The hospitals administration should assign enough number of staff during the night time and also assign night time supervision to solve the problem and improve delivery service.
- For the researchers:
- The researchers should conduct longitudinal study in order to assess the long term consequence of the newborns with birth injury. Furthermore, Qualitative studies should be done to know the quality of delivery service and assess challenges faced by health professional at delivery ward during their stays to improve newborns birth outcomes.

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8. ANNEXES

Annex I: Participant information sheet (to be translated in to Amharic)
Good morning/ after noon

My name is…….. I am coming here in order to collect data for the study of prevalence of birth injury and associated factors among newborns delivered in Addis Ababa public hospitals, 2021. This study is conducted by Esubalew Amsalu, who is masters of neonatal nursing students in AAU. Now I am kindly asking you to explain about this study and if you are willing, you will be a participant for this study

1. **Title of the research project:** Prevalence of birth injuries and associated factors among newborns delivered in public Hospitals Addis Ababa, Ethiopia, 2021.
2. **Aim of the study:** The purpose of this study is to assess the prevalence of birth injuries and associated factors among newborns at selected public Hospitals in Addis Ababa, Ethiopia, 2020/21.
3. **Benefits for participations:** Study participants will not have any financial incentives from participating on this study. The result of the study will be beneficial for policy makers and program designers that work on prevention of birth injuries. It will benefit the hospitals to identify gaps at delivery ward and used as reference for their quality improvement project.
4. **Risks and Complication**: There are no anticipated risks to your participation except taking little minutes from your time.
5. **Confidentiality:-** Any information about you will kept as confidential. The information collected about you will be coded using code numbers. At any time you have the right to stop or withdraw from the study.

   So, are you willing to be part of this study?

   If yes, please continue to the next page

   If no, thank you very much.

Annex II: Statement of informed consent from the mothers (English version)
Code No_____

I have read the information above. I have been given the opportunity to ask questions and my questions have been answered. I voluntarily consent that I would participate in this study. With full understanding of the situation I agree to give the entire necessary information. I understand that I have the right to withdraw from the study at any time.

Name of the researcher _____ Signature _____Date :_____(dd/mm/yy)

Date of interview: _____Time started _____ Time finished_____

Interviewer Name _____ Signature _____ Date _____

Supervisor Name : _____ Signature _____

We thank you for consenting to take part in the study

Annex III: English Version Questionnaires
Addis Ababa University, College of Health Sciences, School of Nursing and Midwifery.

This questionnaire was used to assess socio-demographic and medical and obstetrics factors of the mothers associated with birth injuries among newborns delivered in public hospital, Addis Ababa, Ethiopia, 2021.

Identification related information

Data collector Name---------- Date: ----------

Supervisor's Name: _____ Signature ----------

Questionnaire Code No: _____ MRN: ----------

Hospital name: ----------

Part I. Socio demographic characteristics of mothers

S. No	Question	Response	Skip
101	Age of the mother in completed year?	1. --------years	
102	What is your level of education?	1. No formal education 2. Primary 3. Secondary 4. More than secondary	
103	Where is your residence?	1. Urban 2. Rural	
104	What is your marital status?	1. Married 2. Divorced 3. Single 4. Widowed	
105	What is your pre-pregnancy weight?	1. …….. Kg	

Part II Medical and obstetric characteristics of mothers

S. No	Question	Response	Skip
201	Did you have ANC follow up during this pregnancy?	1. Yes 2. No	If no, skip to Q no 204
202	If yes, how many times you visited health	1. …….(put in No)	

	services for ANC?		
203	Facilities where you received ANC?	1. Health center 2. Governmental hospital 3. Private hospital 4. Private clinic 5. NGO clinic 6. Others……	
204	How many times you gave birth including this pregnancy (Parity)?	1. ……(put in No)	
205	How many times you become pregnant, including this one (Gravida)?	1……..(put in No)	
	Did you have any medically confirmed cases during this pregnancy?		
206	Chronic diabetes mellitus	1. Yes 2. No	If no, skip to Q no,207
207	Gestational diabetes?	1. Yes 2. No	If no, skip to Q no,208
208	Chronic hypertension?	1. Yes 2. No	If no, skip to Q no,209
209	Pregnancy induced hypertension?	1. Yes 2. No	If no, skip to Q no 210
210	If yes to question No 210, what was the diagnosis?	1. Pre-eclampsia 2. Eclampsia	
211	HIV test done?	1. Yes 2. No	If no, skip to Q no 213
212	HIV status?	1. Positive 2. Negative	
213	If others, specify?	……..	
214	What is the type of pregnancy?	1. Single 2. Twine 3. Triplet 4. Others.	
215	Did you get vaginal bleeding during this pregnancy?	1. Yes 2. No	

Annex IV Data Extraction Checklist

Title of research project: Prevalence of birth injuries and associated factors among newborns delivered in public hospitals, Addis Ababa, Ethiopia 2020/21.

Name of investigator: Esubalew Amsalu (BSc)

Name of organization: Addis Ababa University, College of Health Science, School of Nursing and Midwifery.

Name of sponsor: Addis Ababa University.

Introduction: This checklist is prepared for the collection of intra-partum and early neonatal factors that will be important for the assessment of associated factors of birth injuries among newborns delivered in public hospitals in Addis Ababa. This is prepared for head nurse/midwifes of the delivery and post natal unit in order to create awareness about the study and to get consent to perform the study.

Purpose of the research project: To assess the prevalence of birth injuries and associated factors among newborns delivered in public Hospitals Addis Ababa, Ethiopia, 2020/21.

Procedure: The information which is important for this study will be retrieved from maternal chart review.

Risk: Since this information will be conducted by taking necessary information from maternal chart review, it will not harm to the patient and the information obtained from mothers will kept confidential

Benefit: This research have no benefit to the study participant

Confidentiality: For confidentiality the data in the chart will be collected without recording the name of study participant and the information will kept in key and locked system with computer password.

Person to contact: If you have any question you want to ask, you can contact any of the following individuals (Investigators or Advisors)

PI: Esubalew Amsalu Email: esubemeklit2020@gmail.com , Tel: +251916507583

Advisors: Ms. Kalkidan Wondwossen (MSc, Assistant professor)

Tel: +251913634088

Mrs. Feven Mulugeta (MSc), Tel: +251910712396

Part III Intra-partum factors

S. No	Question	Response	Skip
301	Fetal presentation?	1. Vertex presentation 2. Breech presentation 3. Face presentation 4. Brow presentation 5. Shoulder presentation	
302	Intra-partal fetal distress?	1. Yes 2. No	If no, skip to Q no 303?
303	Cephalopelvic disproportion?	1. Yes 2. No	If no, skip to Q no 304
304	Is labor started?	1. Yes 2. No	If no, skip to Q no 307
305	Conditions of labor?	1. Spontaneous 2. Induced	
306	Duration of labor in hours?	1. ……	
307	Duration of rupture of membrane in hours till delivery?	1. …….	
308	Premature rupture of memberane?	1. Yes 2. No	
309	What is the color of the amniotic fluids?	1. Clear 2. Meconium stained	
310	Mode of delivery?	1. Normal Vaginal 2. Instrumental delivery 3. Cesarean section	
	Did the neonate suffer from cord problem during delivery?		
311	Cord prolapse?	1. Yes 2. No	
312	Nuchal cord?	1. Yes 2. No	
313	Qualification of birth attendant?	1. Gynecologist-obstetricians	

		2. Residents 3. General practitioner 4. Interns 5. Midwifery 6. Other (specify)……	
314	Time of birth?	1. _____Hours	

Part IV Neonatal factor

S. No	Question	Response	Skip
401	Baby sex?	1. Male 2. Female	
402	GA (wks.)	1. ……weeks	
403	Did the baby cry immediately after birth?	1. Yes 2. No	
404	Apgar score (1st and 5thminute)respectively	1. …… (Put in number?)	
405	Resuscitated at birth (Bag mask)	1. Yes 2. No	
406	Are there birth injuries after delivery?	1. Yes 2. No	If no, skip to Part IV
407	If yes to question No 405, What are the types of birth injuries present?	1. Birth asphyxia 2. Birth trauma 3. Both birth asphyxia and birth trauma	

408	If there is birth trauma, what are the types?	➢ Extra cranial injury 1. Caput succedaneum 2. Cephalhaematoma 3. Sub galial hemorrhage ➢ Fractures 4. Skull fracture 5. Clavicular fracture 6. Humeral fracture 7. Rib fracture 8. Femoral fracture ➢ Neurologic trauma 9. Facial palsy 10. Erb's palsy 11. Spinal cord injury ➢ Soft tissue injuries 12. Facial and skin bruises 13. Ecchymosis /bluish of skin 14. Skin laceration 15. Sub conjuctival hemorrhage Other birth injuries (specify)……..

Part V. Question to be filled by medical record or measurement

1. What is the height of the mother (measure or see card?)……(In cm)
2. Pre-pregnancy BMI (calculate?)……..(kg/m2)
3. What is the weight of the newborn at birth (measure or see card?)……(Ingram)
4. What is the head circumference of the newborn at birth (measure or see card?)… (In cm)

Annex V፡ የተሳታፊዎች የመረጃ ቅፅ በአማርኛ

ሥሜ _____ እባላለው ፤ በአዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ፣ ነርሲንግና ሚድዋይፍሪ ትምህርት ክፍል የ2ኛ ዓመት የማስትሬት ድግሪ ተመራቂ ተማሪ ነኝ። በአሁኑ ሰዓት በአዲስ አበባ ውስጥ በሚገኙ የመንግስት ሆስፒታሎቸ ውስት በወሊድ ወቅት ስለሚከሰት የጨቅላ ህጻናት አደጋ እና አጋላጭ ሁኔታዎችን ለመለየት በማጥናት ላይ ነኝ።

<u>የጥናቱ ርዕስ፡</u> - በአዲስ አበባ ውስጥ በሚገኙ የመንግስት ሆስፒታሎች ውስጥ በወሊድ ወቅት ስለሚከሰት የጨቅላ ህጻናት አደጋ እና አጋላጭ ሁኔታዎችን መለየት ፣ኢትዮጵያ፣ 2013 ዓ.ም።

<u>የጥናቱ አላማ፡-</u> በወሊድ ወቅት የሚከሰት የጨቅላ ህጻናት አደጋ እና የሚያጋልጡ ሁኔታዎችን ለመለየት።

<u>ተሳታፊዎች</u>፡ - በአዲስ አበባ በሚገኙ የመንግስት ሆስፒታሎቸ ውስጥ አዲስ የተወለዱ ጨቅላ ህፃናት

<u>የጎንዮሽ ጉዳት፡</u> - በዚህ ጥናት መሳተፍ ምንም አይነት ጉዳት የለውም።

<u>ጥቅማጥቅም</u>፡ - በጥናቱ ለሚሳተፉ ፍቃደኛ ተሳታፊዎች ምንም አይነት የገንዘብ ክፍያ የለም፣ነገር ግን የጥናቱ ውጤት በወሊድ ወቅት ስለሚከሰት የጨቅላ ህጻናት አደጋ ለመከላከል ስለሚጠቅም በተዘዋዋሪ መንገድ ሌላ ህመምተኛ እንዲሁም ህብረተሰቡን የመጥቀም እድል ያገኛሉ።ስለዚህ የተወሰኑ ጥያቄዎችን ልጠይቅዎት እወዳለሁ። የእርስዎ በእውነት ላይ የተመሰረተ መልስ ለዚህ ጥናት መሳካት አስተዋፅኦ ያደርጋል። እርስዎ የሚሰጡት መረጃ ከአጥኚውና ቃለመጠይቅ አድራጊው በስተቀር በማንኛውም መልኩ ለሌላ 3ኛ ወገን ተላልፎ አይሰጥም። በሙሉ ፈቃደኝት እንዲሳተፉ እየጠየቅሁ ያለመሳተፍ ወይም በማንኛውም ጊዜ ራስዎን ከጥናቱ የማግለል ሙሉ መብት አለዎት። ማንኛውም ጥያቄ ካለዎት በሚከተለው አድራሻዬ ማግኘት ይችላሉ።

የጥናቱ ባለቢት ሰም ፡ እሱባለው አምሳሉ

ስልክ፡ 0916507583

ኢሜል፡ esubemeklit2020@gmail.com

Annex VI: የስምምነት መግለጫ ፎርም - በአማርኛ

አዲስ አበባ ዩኒቨርሲቲ፤ጤና ሳይንስ ኮሌጅ፤ነርሲንግ ትምህርት ክፍል፤ድህረ ምረቃ ፕሮግራም

እኔ ለዚህ ጥናት የስምምነት ፊርማዬን ስሰጥ፤የዚህ ጥናት ዓላማ በደንብ የተብራራልኝ ሲሆን የጥናቱንም ዓላማ ተረድቻለሁ። በዚሁ ጥናት ላይ መሳተፍ በሙሉ ፈቃደኝነት ላይ የተመሰረተ መሆኑን በሚገባ የተረዳሁ ሲሆን በማንኛውም ጊዜ ከጥናቱ ራሴን የማግለል መብት እንዳለኝ አውቄአለሁ። ስለሆነም የምሰጠው መረጃ እስከተጠበቀ ድረስ በዚህ ጥናት ለመሳተፍ ተስማምቻለሁ። በጥናቱ ስሳተፍ በህጻኑ/ኗ ወይም በኔ ላይ ምንም አይነት ጉዳት እንደሌለው በግልጽ ተረድቻለሁ።በዚህ ጥናት ለመሳተፍ ስምምነቴን ስገልፅ ለምጠቀው ጥያቄ በእውነት ላይ የመሰረተ መልስ ለመስጠት የተስማማሁ መሆኔን አረጋግጣለሁ።በመብቴ ዙሪያም ሆነ ስለ ጥናቱ መንኛውንም ያልገባኝን ጥያቄ መጠየቅ እንደምችል ተገልጸልኛል።

የመረጃ ሰጪ ፊርማ _____ ቀን _____

የተጀመረበት ሰዓት _____ ያለቀበት ሰዓት_____

የጠያቂው ስም _____ ፊርማ_____ ቀን_____

የተቆጣጣሪ ስም_____ ፊርማ_____ ቀን_____

Annex VII: መጠይቅ - አማርኛ ቅጽ

አዲስ አበባ ዩኒቨርሲቲ፤ ጤና ሳይንስ ኮሌጅ ፤ነርሲንግ ዲፓርትመንት፤ ድህረ ምረቃ ፕሮግራም

ይህ መጠይቅ የተዘጋጀው በአዲስ አበባ በሚገኙ የህዝብ ሆስፒታሎች ውስጥ በወሊድ ወቅት

ለሚከሰት ለጨቅላ ህጻናት አደጋ እና የሚያጋልጡ ሁኔታዎችን ለመለየት ነው።

የጠያቂው ስም _____ ቀን_____

የተቆጣጣሪ ስም_____ ቀን_____

የመጠይቁ መለያ ቁጥር_____ የተቋሙ ስም_____

ክፍል አንድ፡- የወላጅ የጨቅላ ህጻኑ እናቱ አጠቃላይ ሁኔታ.

ተ.ቁ	ጥያቄ	መልስ	ይዝለሉ
101	እድሜዎ ስንት ነው (በአመት) ?	1.	
102	የትመህርት ደረጃዎ ስንት ነው?	1. ያልተማረች 2. የመጀመሪያ ደረጃ 3. ሁለተኛ ደረጃ የተማረች 4. ሁለተኛ ደረጃ በላይ	
103	የመኖሪያ ቦታዎ የት ነው?	1. ከተማ 2. ገጠር	
104	የጋብቻ ሁኒታ?	1. ያገባች 2. የፈታች 3. ያላገባች 4. ባሉዋ የሞተባት	
105	ከእርግዝና በፊት የነበረዉን ክብደትዎን ስንት ነው ?	1.	

ክፍል ሁለት፤ ከዉሰጥ ደውና ከቅድመ ወሊድ ጋር የተያያዙ አጋላጭ ሁኔታዎች

201	የቅድመ ወሊድ ክትትል አግኝተዋል?	1. አዎ 2. አላገኝሁም	አላገኝሁም ካሉ ወደ ጥያቄ 204 ይሂዱ
202	አዎ ከሆነ መልስዎ ስንት ጊዜ የቅድመ ወሊድ ክትትል አድርገዋል ?	1. ..... (በቁጥር)	
203	የት ነበር የቅድመ ወሊድ ክትትል ያደረጉት?	1. ጤና ጣቢያ 2. የመንግስት ሆስፒታል 3. የግል ጤና ተቓም	

		4. የግል ክልኒክ 5. NGO ክልኒክ	
204	በእድሜዎ ስንት ጊዜ ወልደው ያውቃሉ? (የአሁኑን ጨምሮ)	(በቁጠር ይገለጽ)	
205	በእድሜዎ ስንት ጊዜ ወልደው ያውቃሉ? (ሞተው የተወለደዉንም ጨምሮ)	(በቁጠር ይገለጽ)	
206	ከእርግዝና በፊት የነበረ የታወቀ የስካር ህመም አለብዎት?	1. አዎ 2. አልነበረም	አልነበረም ካሉ፣ ወደ ጥያቄ 207 ይሂዱ
207	በእርግዝና ወቅት የተከሰተ የስኩዋር በሽታ አለብዎት ተብለዋል? ?	1. አዎ 2. አልነበረም	አልነበረም ካሉ፣ ወደ ጥያቄ 208 ይሂዱ
208	ከእርግዝና በፊት የነበረ የደም ግፊት ህመም አለብዎት ተብለዋል?	1. አዎ 2. አልነበረም	አልነበረም ካሉ፣ ወደ ጥያቄ 209 ይሂዱ
209	በኣሁኑ እርግዝና ወቅት ከእርግዝናው ጋር በተያያዘ የደም ግፊት አለብዎት ተብለዋል?	1. አዎ 2. አልነበረም	አልነበረም ካሉ፣ ወደ ጥያቄ 211 ይሂዱ
210	አዎ ከሆነ ደረጃው ምን ነበር?	1.በእርግዝና ጊዜ የተባባሰ የደም ግፊት 2.በደምግፊት የሚመጣ መንቀጥቀጥ 3. አላውቅም	
211	HIV ምርመራ አድርገው ነበር	1. አዎ 2. አላደረኩም	አላደረኩም ካሉ፣ ወደ ጥያቄ 213 ይሂዱ
212	የምርመራዉ ዉጤት	1. HIV አለ 2. HIV የለም	
213	የእርግዝናሽ አየነት?	1. አንድ 2. መንታ 3. ሶስት 4. ከዛበላይ	
214	በዚህ እርግዝናዎ ወቅት የደም መፍሰስ (በወር አበባ ከተለመደው በላይ) አጋጥሞዎት ነበር?	1. አዎ 2. አልነበረም	