ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF NURSING AND MIDWIFERY

RISK FACTORS OF BIRTH ASPHYXIA AMONG NEWBORNS DELIVERED AT PUBLIC HOSPITALS OF ADDIS ABABA, ETHIOPIA, 2019.

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This thesis by Tewodros Mulugeta is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of masters in pediatrics and child health nursing.

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LIST OF ABBREVIATION/ACRONYM

ANC	Antenatal Care
APH	Antepartum Hemorrhage
APGAR	Activity, Pulse, Grimace, Appearance, Respiration
CI	Confidence Interval
CSS	Child Survival Strategy
EDHS	Ethiopian Demographic and Health Survey
HSTP	Health Sector Transformation Plan
IVD	Instrumental Vaginal Delivery
LBW	Low Birth Weight
LMIC	Low and Middle Income Countries
MSAF	Meconium Stained Amniotic Fluid
MUAC	Mid Upper Arm Circumference
NMR	Neonatal Mortality Rate
OR	Odds Ratio
PROM	Prolonged Rupture Of Membrane
RR	Relative Risk
SVD	Spontaneous Vaginal Delivery
SDG	Sustainable Developmental Goal

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ABSTRACT

Background: - World Health Organization defined birth asphyxia as the failure to initiate and sustain breathing at birth. Globally, 23% of neonatal mortality occurs due to birth asphyxia and in Ethiopia, 31.6% of neonatal mortality occurs due to birth asphyxia. The effect of birth asphyxia is not limited only to death but also has a short and long term neurodevelopment sequel, including cognitive and motor disabilities which are almost untreatable.

Objective: - The objective of this study was to assess risk factors of birth asphyxia among newborns delivered at public hospitals of Addis Ababa, Ethiopia, 2019.

Methods: Institutional based unmatched case-control study was conducted with a total sample size of 213 (71 cases and 142 controls) in Addis Ababa public hospitals from March 1–April 30, 2019. Cases were selected consecutively using consecutive sampling technique and controls were selected by systematic random sampling method. Data was collected using structured questionnaire through face to face interview with index mothers, measurements and chart record review using checklist. The collected data was entered to Epi data version 4.4 and exported to SPSS version 25 for analysis. Finally, it was analyzed by binary logistic regression model. Variables with ($p < 0.25$) in bivariate analysis were entered to multivariable logistic regression. Statistical significance was declared at $P<0.05$.

Result: - In this study, 70 cases and 140 controls with their mothers were included with the overall response rate of 98.5%. After doing multivariable logistic regression analysis, significantly associated variables with birth asphyxia were: Anti-partum hemorrhage [AOR=7.17,95%CI(1.73-29.72)], low birth weight [AOR=2.87,95%CI(1.01-8.13)], preterm birth [AOR=3.4, 95%CI (1.04-11.16)], caesarean section delivery[AOR=2.75,95%CI (1.01-7.42)], instrumental delivery[AOR=4.88,95%CI(1.35-17.61)], fetal distress [AOR=4.77, 95%CI (1.52-14.92)] and meconium stained amniotic fluid [AOR=9.02,95% CI(2.96-30.24)].

Conclusion: Antepartum hemorrhage, cesarean section delivery, instrumental delivery, meconium stained amniotic fluid, fetal distress, preterm birth and low birth weight were found to be the risk factors of birth asphyxia. For thus, efforts should be made to improve the quality of antenatal care and intranatal care services to prevent those identified risk factors of birth asphyxia.

Key words: birth asphyxia, newborn, antenatal, intranatal, neonatal

1. INTRODUCTION

1.1. Background

World Health Organization(WHO) explains birth asphyxia as the failure of a newborn to initiate and maintain breathing immediately at birth(1). It can be also explained as placental and respiratory gas exchange impairment which leads to hypoxia and hypercarbia. It occurs when newborns brain and extra organs do not acquire sufficient oxygen & nutrients(2).

Globally, most of neonatal mortality (75%) happens within one week of neonatal period & about 1 million newborns die within the first 24 hours. According to 2016 UNICEF report preterm birth, infections and birth asphyxia are the top cause of neonatal deaths(3).

As stated in different literatures, birth asphyxia is caused by antenatal, intra-natal, and fetal factors. The intra-natal factors take the largest proportional risk factor (70%) for birth asphyxia, followed by antenatal (20%) and fetal factors (10%)(4).

Birth asphyxia mostly occurs due to placental blood flow interruption which further affects fetal circulation. Maternal diseases like diabetes mellitus, hypertension and pre-eclampsia may affect placental vasculature and will lead to decreased blood flow. Maternal hypotension which is caused by medications, maternal disease and anesthesia causes decrement in fetal circulation. Factors which reduce placental blood flow like abruption of placenta, antepartum hemorrhage and chorioaminionitis are also linked to birth asphyxia(5). Others like maternal age, Antenatal care, prim gravidity, breach presentation, home deliveries, maternal fever, resuscitation status, preterm baby, fetal distress and low birth weight (LBW) are also stated as risk factors (6-9).

The cardiovascular reaction to asphyxia comprises cardiac output redistribution in order to sustain oxygen delivery to some critical organs like to the adrenal glands, brain and heart, at the outflow of other organs for example gut, skin and kidneys. This causes in decreased perfusion and confined hypoxia/ischemia in critical organs, if severe it will cause multi-organ failure.(10).

Birth asphyxia is determined using APGAR score table. The score comprises such five components as appearance (color), heart rate, grimaces (reflexes), activity (muscle tone), and

respiration each of which is given a score of 0, 1, or 2(11). According to WHO's, International Classification of Disease (ICD 11) birth asphyxia is diagnosed as asphyxia with APGAR level at 5 minute is less than 7 by the two levels(12).

When newborns are failed to initiate or sustain breathing just after birth, effective neonatal resuscitation can help them to enable breathing and to reduce newborn death and complication due to asphyxia by establishing adequate breathing and circulation (1, 13). In low-resource settings neonatal resuscitation need is most urgent, at which access to sufficient intrapartum care is inadequate & the incidence, mortality and load of long term damage from intrapartum related neonatal events are highest(14, 15).

Globally, each year 5-10 % of babies require simple stimulation at birth to help them breathe (drying and stimulation, airway clearing or positioning), 3%–6% needs basic neonatal resuscitation (bag and mask ventilation), and <1% need advanced resuscitation (endotracheal intubation, chest compression and drugs)(15).

1.2. Statement of the problem

Globally, birth asphyxia is still one of the leading cause of neonatal mortality and morbidity, especially in the first week of life in low and middle-income countries(LMIC)(16). Twenty-three percent of the neonatal deaths each year around the world (16, 17)and about 29% of early neonatal deaths are accredited to birth asphyxia(18). In developed countries, birth asphyxia incidence has reduced significantly due to the advances in primary & obstetric care and it accounts for < 0.1% of newborn deaths. In developing countries, the prevalence of birth asphyxia is much higher, ranging from 5.1% in Kenya to 30.5 % in Nigeria and case fatality rates may be 40% or higher(19, 20).

In Sub Saharan Africa the NMR decline by 41% from 2000 to 2017. Despite the declining of NMR, the number of neonatal deaths increased by around 1 million deaths per year(21). In Sub-Saharan Africa around 338,000 under-five death occur due to birth asphyxia(16). Ethiopia is among the country with highest NMR in the world, which is responsible for 29 death per 1000 live birth(22) - over 9 times higher than that of highly developed countries, where the rate is 3 per 1,000 live births(21). In 2015, in Ethiopia, 31.6% of neonatal mortality was attributed to birth asphyxia(23). The prevalence of birth asphyxia in Ethiopia different regional research shows that the prevalence varies in the range between 3.1%- 32.9%(24, 25).

Children's who have had birth asphyxia develops short and long term neurodevelopment complications with cognitive and motor disabilities which are difficult to treat(26). Different studies showed that the neonates with of asphyxia developed HIE (22-35.5%) (27-29), post-traumatic stress disorders (PTSD) (56%) (30), neurologic disability(31), low cognitive functions (34.9%)(32), multi-organ failure 80.8(33)and a neurological sequel (28%)(34). On the other hand, the experimental study also revealed that nearly 25% of the newborns who survived birth asphyxia develops neurological disorders like cerebral palsy and certain neurodevelopment and learning disabilities (35).

The sustainable development goal (SDG) planed that by 2030, in all countries targeting to reduce NMR to at least as low as 12 deaths per 1,000 live births & under-five mortality to at least as low as 25 deaths per 1,000 live births(36). This could be achieved through better

prevention and treatment of the three leading causes, preterm births, severe infections and birth asphyxia as the key(37).

Different interventions are designed and applied to alleviate problems of child morbidly and mortality. Focused antenatal care service (FANC) is the crucial interventions to increase maternal & child health's and to reduces both deaths. Despite these efforts are being made to advance reproductive health service to minimize maternal and child mortality, still there is high neonatal mortality(38).

So this study is needed because of some reasons. Firstly, In Ethiopia, birth asphyxia is still assumed to be a major cause of mortality and morbidity. So that recognizing and managing the risk factors of the birth asphyxia early has importance to prevent its occurrence, to reduce NMR and to improve neonate quality of life. Secondly, even though some researches are done in Ethiopia, the prevalence of birth asphyxia varies in each setting because there might be a difference in risk factors from setting to setting. Thirdly, Despite the presence of few studies regarding risk factors of birth asphyxia, there are some contradicting or inconsistent findings on some risk factors for birth asphyxia, like prematurity, prolonged labor, low birth weight and fetal distress (7, 8, 39), which demands further exploration. Fourthly, As far as literature searching showed, there is no study conducted in Addis Ababa public hospitals regarding risk factors of birth asphyxia. Due to these reasons, the investigator believes that there is a need to further investigate the risk factors of birth asphyxia. So the aim of this study is to assess risk factors of birth asphyxia among newborns delivered at public hospitals in Addis Ababa, Ethiopia.

1.3. Significance of the study

Identification of risk factors contributing to birth asphyxia will go a long way in reducing the morbidity and mortality associated with this condition since asphyxia has been recognized to be preventable through sound antenatal care, skill management of labor and delivery as well as adequate and appropriate resuscitation.

Findings from this study will help health professionals working at antenatal care and labor and delivery to provide evidence-based preventive measures for risky newborns. In addition, it will be used as resource data for any concerned governmental or non-governmental organization for developing interventional projects.

This study will also increase the nursing body of knowledge and helps to promote nursing research, nursing education and even the practical aspect of the profession. Moreover, the result of this study will also help as an input for future researchers of other studies which will be conducted on the related subject matter.

2. LITERATURE REVIEW

2.1. Risk factors of birth asphyxia

2.1.1. Sociodemographic risk factors

In different studies, the age of the mother, maternal height, maternal educational status, and MUAC were significantly associated with birth asphyxia (6, 8, 24, 39, 40). A study from Dessie, Ethiopia identified that maternal height ≤153cm (short in stature) and MUAC <23 cm were a risk factor for the development of birth asphyxia(39). Another study from Dire Dawa, Ethiopia revealed that maternal age group 15-20 years and illiterate mother are at higher risk of getting asphyxiated newborn(24). The study at Karachi, Pakistan stated that mothers at age of 20–25 were at lower risk of causing birth asphyxia compared to younger or elder mothers (<20 or >25) (6). However, a study done at Tigray(8) and Jakarta(40) could not find a significant difference in maternal age with birth asphyxia.

Finding of a study in Tigray, Ethiopia shows that maternal illiteracy was a significant sociodemographic risk factor of asphyxia with an odds ratio of 6 compared to those with higher education level(8). Similarly in Jakarta, Pakistan mothers with low education level were at increased risk to get an asphyxiated baby(40).

This study conducted in Colombia revealed that being a mother without a partner was a significant maternal risk factor for the development of perinatal asphyxia(OR=2.56)(41). However in studies conducted at Dire Dawa(24), and Jakarta, Pakistan(40), showed that residence, marital status, ethnicity, religion, and occupational status were not associated with birth asphyxia.

2.1.2. Antepartum risk factors

Various studies show that antenatal care (ANC) visit, primiparity, Antepartum hemorrhage (APH), malaria, hypertension, and maternal anemia were a significantly associated with birth asphyxia (8, 25, 42-44). Finding of study in India states that mothers with incomplete ANC visits, prim parity, and hypertension were significant maternal risk factors with an odds of 3.073, 2.01 and 2.35 respectively(42). But according to study in Colombia, insufficient prenatal care showed non-significant association with the existence of the

condition(OR=0.33)(41). A cross-sectional study in Jimma showed that neonates whose mothers had no ANC follow up were six times more likely to develop birth asphyxia than those with complete ANC visit. In addition, those mothers who had incomplete ANC visit were at increased risk to deliver asphyxiated newborn with an odds of 4.58(25).

A case-control study done at Cameroon revealed that malaria during pregnancy, preeclamicia/eclampcia, and place of ANC were factors which determine the occurrence of birth asphyxia(44).

A study from Tigray, Ethiopia identified that mothers who were primiparity and had APH were also significantly associated with birth asphyxia with an odds of 3 and 12 respectively(8). In another study done Indonesia showed there was an association between Antepartum hemorrhage and birth asphyxia(45).

However HIV/AIDS, diabetes mellitus, place of antenatal care service, pregnancy induced hypertension, preeclampcia and history of abortion had no significant association in studies conducted at Gonder(7), Jimma(25), and Colombia(41).

2.1.3. Intrapartum risk factors

According to the study done in Colombia intrapartum factors like prolonged labor (OR=31.7) and placental abruption (OR=41) were factors which are determinant for birth asphyxia. The omission of a partograph during labor was also found to be a factor significantly associated with the incidence of perinatal asphyxia (OR=2.25)(41).

A study from Nigeria, the common intrapartum risk factors of asphyxia were identified as abnormal fetal presentation (breech) and obstructed labor due to cephalo-pelvic disproportion (CPD)(46). Another study at Karachi Pakistan shows that maternal fever and breech presentation were associated risk factors of birth asphyxia with an odds of 10 and 2.96(6).

A case-control study done in Gondar revealed that prolonged labor, meconium stained amniotic fluid and cesarean section (CS) delivery was significantly associative determinants of birth asphyxia with odds of 2.75, 7.69 and 3.58 respectively(7). Similarly according to a study conducted in Tigray, prolonged duration of labor was also statistically associated with perinatal asphyxia(47).

According to Case-control study in India revealed that neonates delivered by instrumental delivery were 6 times to cause birth asphyxia (AOR=6.007, 95% CI: 2.288-15.773) and neonate delivered from anemic mother is 4 times more to cause birth asphyxia than from non-anemic mother (AOR: 4.012 95%CI:1.588, 10.139)(42). Despite this the study done Hong Kong, China shown that there was a significant decrease in birth asphyxia related to instrumental delivery (RR 0.69, 95% CI 0.65–0.74)(48).

Based on the study in Dire Dewa: compared to CS neonate who delivered by vacuum (OR=0.042) and forceps delivery(OR=0.05) were less likely to develop birth asphyxia (24).

A retrospective case-control study at Indonesia revealed that APH, preeclampcia and caesarian section were significant risk factors which cause birth asphyxia with an odds of 2.67, 2.37 and 3.77 respectively(45).

In different studies, meconium-stained amniotic fluid (MSAF) had a significant association with birth asphyxia. According to a hospital-based study in Thailand(49), and India(42), MSAF was a significant associative risk factor of asphyxia with an odds of six times higher than clear amniotic fluid.

In different studies, the fetal presentation was a significant risk factor for birth asphyxia. According to the study in Jimma, newborns with the non-vertex presentation were seven times more susceptible to developing birth asphyxia than those with a cephalic presentation by adjusting others variable(25). Similarly in Gondar, fetuses who adapted non-vertex presentation were 4.46 times (AOR (CI) = 4.46 (1.41, 14.08)) more likely to have a low Apgar score than those who adapted vertex presentation and regarding the condition of labor, labor started through induction and augmentation are more likely to develop birth asphyxia than spontaneous labor (50). A study conducted at Phramongkutklao hospital, Thailand showed that breech presentation exhibited five times at higher risk of birth asphyxia than other presentations (49).

Concerning the nuchal cord, based on the study in Jimma, those newborns with nuchal cord were seven times more likely to develop birth asphyxia (AOR: 7.389, 95%CI: 1.599, 34.131) than those without this condition compared to non-asphyxiated infants (25). Similarly, the

study done in Tehran-Iran also shows that neonates who had nuchal cord were 40 times more likely to develop birth asphyxia(51). But in other studies conducted in Ethiopia, there was no significant association between nuchal cord and birth asphyxia (7, 8, 22, 47).

However labor attendant, type of labor, obstructed labor, duration of labor, polyhydramnios, oligohydramnios and PROM were not significantly associated with birth asphyxia in studies conducted at Iran(51), phramongkutklao, Thailand(49), Valie-Asr hospital, and Tehran, Iran(52), and Tigray(8).

2.1.4. Neonatal risk factors

According to the study done in Karachi, Pakistan shows that neonates with intrapartum fetal distress and low birth weight had a significant association to develop birth asphyxia(6). A similar result was obtained in a study done in Gondar, Neonates who had intrapartum fetal distress and LBW were at higher risk of developing birth asphyxia with the odds of 5.74 and 8 respectively(7). According to a cross-sectional study in Tehran-Iran LBW and preterm birth neonates had been 3 times more to have birth asphyxia than term neonates(51).

A descriptive cross-sectional study in India states that males were more likely to be affected by birth asphyxia when compared with females. On this study neonates who delivered post maturely were less likely to develop birth asphyxia(27). According to a study conducted in Tigray, Ethiopia: gestational age had a significant association which means that neonates born in gestation < 37 weeks had almost 2.2 times more to develop birth asphyxia compared to those neonates born in gestation≥37 weeks(8). Similarly the study done at Indonesia stats that those who had preterm births had 3.1-fold higher risk for birth asphyxia compared with those with full-term birth(40). However, the sex of neonate and birth type had no significant association with birth asphyxia in studies conducted at Gonder (7) and Karachi Pakistan(53).

There are identified risk factors of birth asphyxia in different studies however there are inconsistencies among research results and risk factors are not verified particularly in this study area. So, to reduce the influence of birth asphyxia on neonatal mortality and morbidity it needs further study. Therefore, the aim of this study is to identify the risk factors of birth asphyxia which yield wide-ranging implication on the prevention of birth asphyxia.

2.2. Conceptual frameworks

Below are the conceptual frameworks of the study which shows the interaction of different variables with outcome variables that contains sociodemographic factors, Antepartum related factors, intrapartum related factors and neonatal factors which is adapted in different researches.

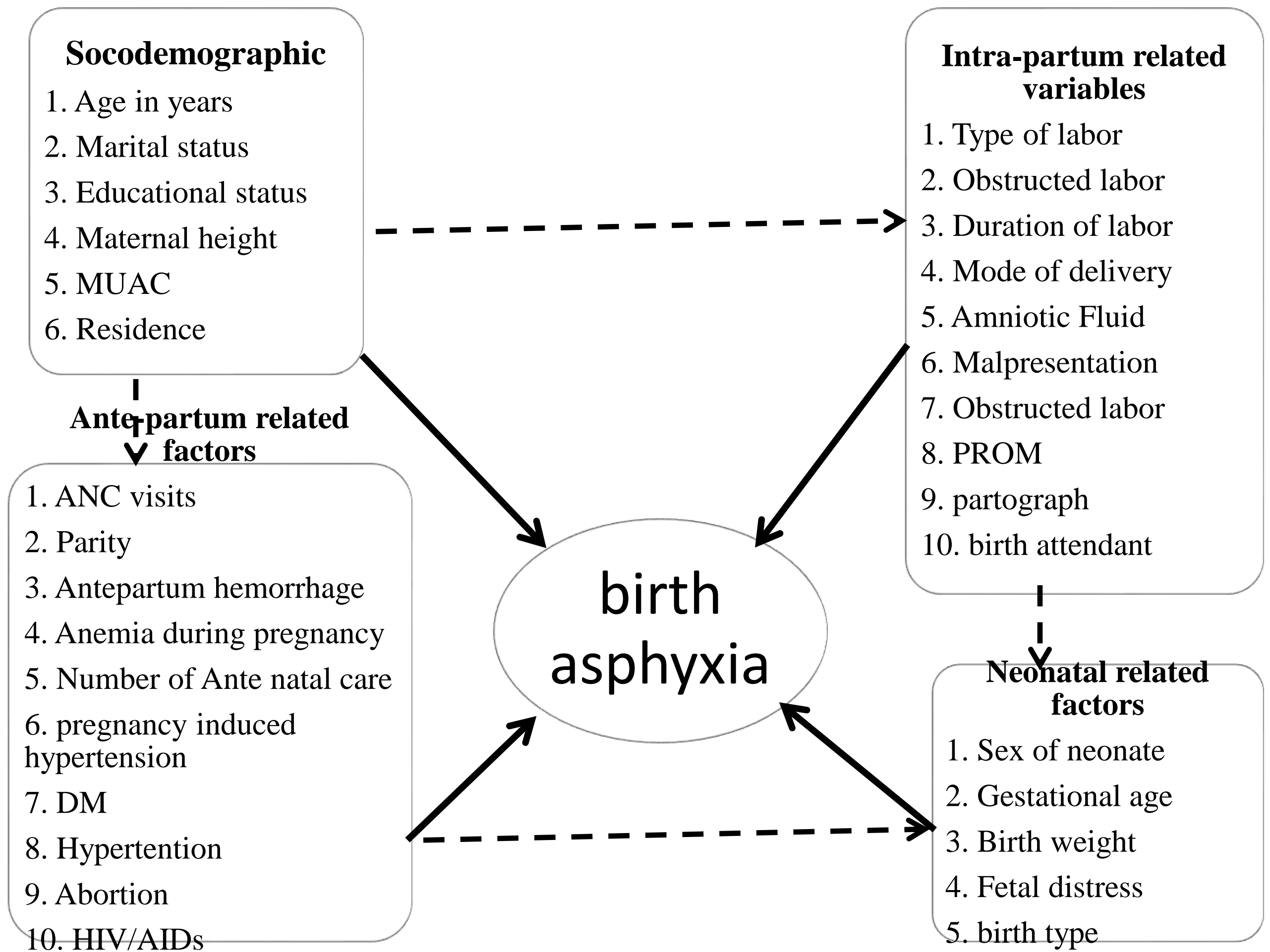

Figure 1: Schematic presentation of the risk factors of birth asphyxia (6-8, 19, 22, 24, 26, 29, 42, 44, 47, 51, 54).

3. OBJECTIVE

3.1. General objective

- ✓ To assess risk factors of birth asphyxia among newborns delivered at Addis Ababa public hospitals, Ethiopia, 2019.

3.2. Specific objectives

- ✓ To identify sociodemographic risk factors of birth asphyxia among newborns delivered at Addis Ababa public hospitals, Ethiopia, 2019
- ✓ To assess antepartum risk factors of birth asphyxia among newborns delivered at Addis Ababa public hospitals, Ethiopia, 2019
- ✓ To determine intrapartum risk factors of birth asphyxia among newborns delivered at Addis Ababa public hospitals, Ethiopia, 2019.
- ✓ To assess neonatal risk factors of birth asphyxia among newborns delivered at Addis Ababa public hospitals, Ethiopia, 2019.

4. METHODS AND MATERIALS

4.1. Study area and period

The study was carried out in four randomly selected public hospitals of Addis Ababa Ethiopia from March 1 to April 30, 2019. Addis Ababa is the capital city of Ethiopia. The city was divided into 10 sub-cities containing 116 woredas. It is also the largest city in the country by population, with a total population of 3,384,569 according to the 2007 census. Close to half of the population is of the ethnic group Amhara, while the majority of the remaining population is split among the groups Oromo, Gurage and Tigray(55). There are twelve governmental hospitals in Addis Ababa. Among those, the study was conducted Yekatit 12 hospital, Tirunesh Beijing hospital, Petros hospital and Gandhi memorial hospital which is selected by simple random sampling. From those four selected hospitals four of them give delivery service and have neonatal intensive care unit. According to data of Human resource management of each hospital, these hospitals accommodate more than 23000 deliveries per annual.

4.2. Study design

An institution based unmatched case–control study design was employed.

4.3. Population

4.3.1. Source population

All newborns who delivered in Addis Ababa public hospitals were the source population.

4.3.2. Study population:

For cases:

All newborns diagnosed as birth asphyxia in selected public hospitals of Addis Ababa during the study period.

For controls:

All newborns who had no diagnosis of birth asphyxia in selected public hospitals of Addis Ababa during the study period.

4.3.3. Study unit

Each selected newborns who born at the selected public hospitals during data collection time.

4.4. Inclusion and exclusion criteria

Birth asphyxia was diagnosed when a new born with any of the sign of impaired breathing (not breathing or not crying, gasping, and < 30 breaths per minute) at birth with an APGAR score less than 7 at 5 minute(12). The score comprised such five components as appearance (color), heart rate, grimaces (reflexes), activity (muscle tone), and respiration each of which is given a score of 0, 1, or 2.

Inclusion criteria

For cases

- ✓ All live newborns after viability (28 weeks of gestation) during the study period
- ✓ Asphyxiated newborns babies with APGAR scores of <7 at 5 minutes

For controls

- ✓ All live newborns above 28 weeks of gestation during the study period
- ✓ Newborn babies with APGAR scores of ≥7 at 5 minutes

Exclusion criteria for cases and controls

- ✓ Data with incomplete documentation
- ✓ Newborns whose mother was critically ill or died
- ✓ Newborns with congenital malformations
- ✓ In case of twin or triple newborns, one was taken by lottery method.

4.5. Sample size determinations and procedure

4.5.1. Sample size determinations

The sample size was determined using double population proportion exposure difference formula by using major determinant variables (maternal height, instrumental delivery, MUAC, prolonged labor and complication during labor) from another study(39). Considering instrumental delivery as independent predictor exposure variable since it gave the maximum sample size. By using the parameters of unmatched case-control in Epi-Info version 7.2 (one to two ratio of the case to control (1:2), 95% level of confidence and a power of 80%) the sample size was calculated. Finally by adding 10% non-response rate the total sample size was 213 with 71 cases and 142 controls.

Table 1: Sample size calculation to assess the risk factors of birth asphyxia among public referral hospitals in Addis Ababa, Ethiopia, 2019

Variable	**Proportion of control**	**Odds ratio(OR)**	**Power**	**Confidence level**	**Case to control ratio**	**Sub total**	**Add 10% non-response**	**Total sample size with 1:2 ratio**
Maternal height	12.5	6.43	80%	95%	1:2	66	73	73
Instrumental delivery	9.2	3.5	80%	95%	1:2	192	212	213 (71 case and 142 control)
MUAC	12.8	4.67	80%	95%	1:2	98	108	108
Prolonged labor	16.1	5.1	80%	95%	1:2	78	86	86
Complication during labor	9.86	3.42	80%	95%	1:2	191	211	211

For manual calculation, double population proportion difference formula

$$n = \left(\frac{r+1}{r}\right)\frac{(\bar{p})(1-\bar{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}$$

Where,

n= Sample size in the case group

$\left(\frac{r+1}{r}\right)$ = Ratio of control to case

$(\bar{p})(1-\bar{p})$=A measure of variability

Z_{β} = The desired power (0.84 for 80% power)

$Z_{\alpha/2}$ = The desired level of statistical significance (1.96)

(p_1-p_2) =Effect size (the difference in proportions)

To get proportion of exposure among cases will be obtained using a formula

$$p_{case\exp} = \frac{ORp_{controls\exp}}{p_{controls\exp}(OR-1)+1}$$

Then the largest sample size (n=213) is selected as a final sample size for the study.

4.5.2. Sampling procedure

Initially, among 12 governmental hospitals, 4 hospitals were selected using simple random sampling technique. Then the total sample size was proportionally allocated to each hospital with their respective previous delivery report. Then cases were selected consecutively using consecutive sampling technique and controls were selected using systematic random sampling technique by getting the K value which was obtained through dividing the total number of non-asphyxiated newborns from each hospital to the required number of control to the study.

$$K = \frac{\text{total number of control from each hospital monthly report}}{\text{The required number of control}} = 15$$

Table 2: Proportional allocation of the total sample size to hospital based on the monthly delivery report

Hospital name	Previous birth for 2 months			Proportional allocation		
	Case	Control	Total	Case	Control	Total
Gandhi H.	29	815	844	26	52	78
Tirunesh Beijing H.	18	501	519	16	32	48
Yekatit 12 H.	17	470	487	15	30	45
Petros TB H.	16	439	455	14	28	42
Total	80	2225	2305	71	142	213

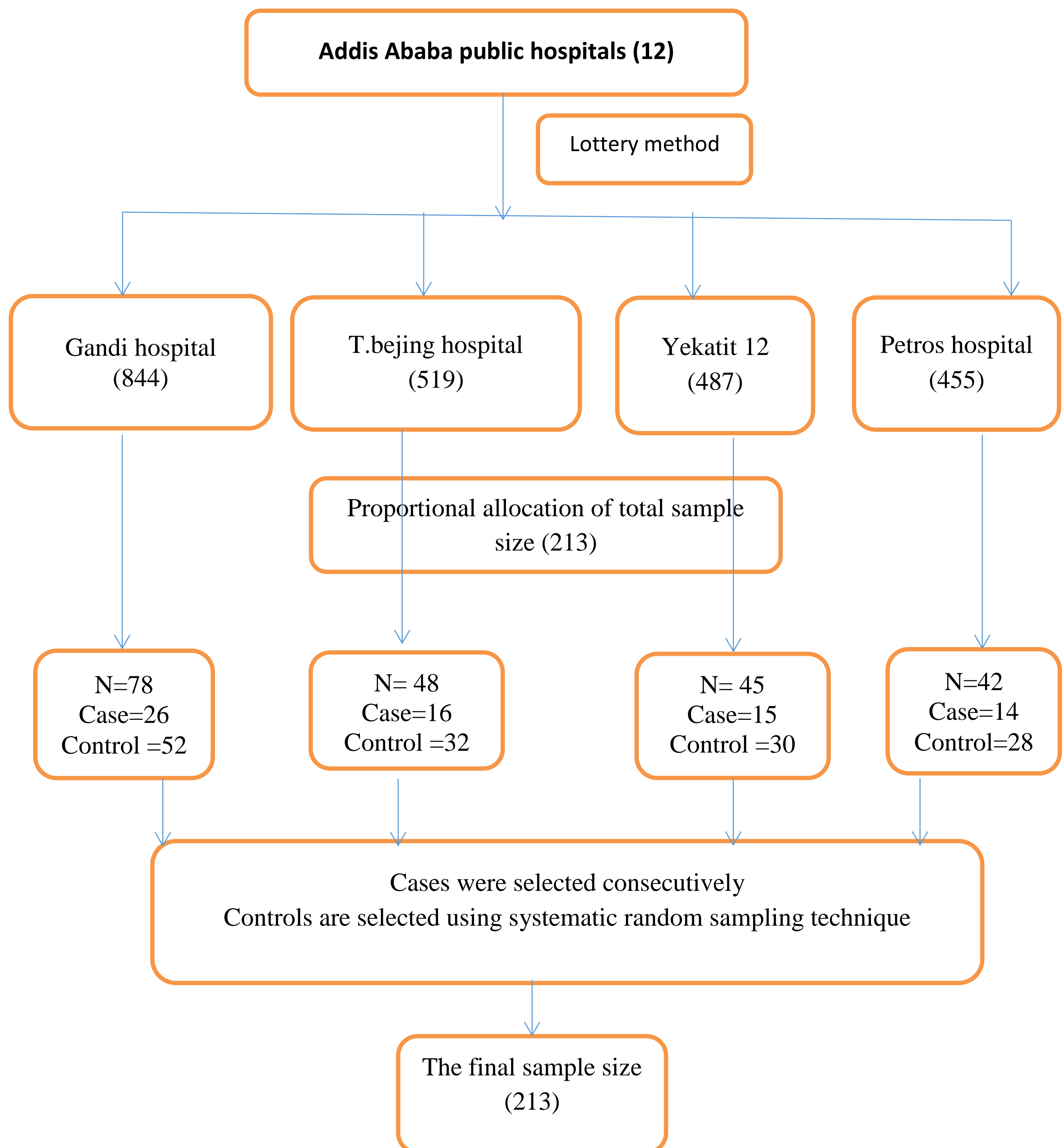

Figure 2: Schematic presentation of sampling procedure the risk factors of birth asphyxia among newborns delivered at public hospitals of Addis Ababa, Ethiopia, 2019.

4.6. Variables of the study

4.6.1. Dependent variable

- ✓ Birth asphyxia

4.6.2. Independent variables

Socio-demographic variables

Age in years
Marital status
Ethnicity
Religion
Residence
Educational status
Occupational status
Maternal height
MUAC

Ante-partum related variables

Chronic hypertension
HIV/AIDS
Diabetes mellitus
Anemia during pregnancy
Ante-partum hemorrhage
Ante natal care
Pregnancy induced hypertension
Gestational diabetes mellitus
Abortion
Parity
Gravidity

Intra-partum related variables

Labor attendant
Type of labor
Obstructed labor
Duration of labor
Mode of delivery
MSAF
Mal-presentation
Placental abruption
Premature rupture of membrane
Placenta Previa
Partograph use
Cord prolapse
Maternal fever
Oligohydramnios
Polyhydramnios

Neonatal related variables

APGAR score at 5 minute
Sex of the newborn
Birth weight
Gestational age
Birth type

4.7. Operational definition

- **Birth asphyxia:** it was diagnosed when a new born with any of the sign of impaired breathing (not breathing or not crying, gasping, and < 30 breaths per minute) at birth with an APGAR score less than 7 at 5 minute.
- **Meconium stained amniotic fluid** (MSAF): if the amniotic fluid was green/brown in color or mixed with meconium, or appears meconium stained on the baby.
- **Prolonged labor:** when the labor, after the latent phase of first stage of labor, exceeds 12 hours in prim gravida or 8 hours in multipara mothers.
- **Premature rupture of membranes** (PROM): if rupture of the membrane of the amniotic sac and chorion occurs for more than one hour before the onset of labor.
- **Birth weight**: Low birth weight (<2500 gm), normal birth weight (≥2500)
- **Multiparty:** Recorded parity of ≥2.
- **Preterm birth**: Any infant born before 37 weeks of gestational age.
- **Fetal distress**: Fetal heart rate <100 or >180

4.8. Data collection procedures

4.8.1. Data collection instrument

Both primary and secondary data (chart review) was used. The data collection tool was adapted from the previous study done at Tigray, Ethiopia(8). A structured interviewer based questionnaire was used to collect data for maternal sociodemographic factors, such as age, marital status, ethnicity, religion, residence, educational, and occupational status and for ante partum factors (parity, ante partum hemorrhage, DM, hypertension, pregnancy induced hypertension, and antenatal visits). Height and MUAC of the mothers were measured. Data on intrapartum (duration of labor, labor attendant, fetal presentation, mode of delivery, MSAF and PROM), and neonatal related factors (asphyxia, gestational age, birth weight, sex, and birth type) was abstracted using a structured checklist from the medical records of pregnant women who gave birth during the data collection period.

4.8.2. Data quality control

The questionnaire was prepared in English and translated to Amharic (national language) and retranslated to English to check for inconsistency. One week prior to the data collection, the questionnaire was tested in 12 newborns (5%) of the samples taken from Zewditu memorial hospital (4 Cases and 8 controls). The questioner reliability was checked using Cronbach's alpha. The clarity, understandability, and flow of each question and the time to fill the questionnaire were assessed. 8 BSC professional midwives and 2 supervisors had got training for 1 day and each was assigned in four hospitals and they collect the data.

During the data collection time, close supervision and monitoring were carried out by supervisors and investigator to ensure the quality of the data. Daily evaluation of the data for completeness and encountered difficulties on the time of data collection was attended accordingly. Finally, all the collected data were checked by supervisor and investigator for its completeness and consistency during the data management, storage, and analysis.

4.8.3. Data processing and analysis

Data were checked for completeness and consistencies and then it was cleaned, coded and entered using Epi data version 4.4 and it was exported to SPSS software version 25 for analysis. Cross-tabulation was done among the dependent variable and independent variables. Binary logistic regression was conducted. Variables with p-values of up to 0.25 in the bivariate analysis were identified and fitted to the multivariable analysis to identify the independent effects of each variable to the outcome variable. Goodness of fit test and multicollinearity test was checked. An Adjusted Odds Ratio with a 95% confidence intervals (CI) was computed to identify the presence and strength of associations, and statistical significance will be declared if $p < 0.05$. Finally, the result was presented in the form of text, table and graph.

4.8.4. Ethical consideration

Ethical clearance was obtained from Addis Ababa University College of Health Science School of Nursing and Midwifery ethical review board. Then officials at different levels in the hospitals had been communicated through letters. The responsible bodies at each postnatal ward were informed about the purpose of the study and written informed consent was obtained from participants to confirm willingness. They were notified that they have the right to refuse or

terminate at any point of the interview. Confidentiality of the information was secured throughout the study process.

4.8.5. Dissemination of the result

The result of the study will be submitted and presented to Addis Ababa University, School of Nursing and Midwifery as partial fulfillment of masters in pediatric and child health nursing. The study result will also be submitted to each hospital at which the study conducted and the finding will also be presented in locally or internationally held seminars, workshops, conferences and meetings including in Ethiopian nursing association and it will be published in internationally or nationally recognized journals.

5. RESULTS

5.1. Descriptive statistics results

5.1.1. Sociodemographic characteristics

This study was intended to assess risk factors of birth asphyxia among newborns delivered at public hospitals in Addis Ababa town. A total of 210 participants (70 cases and 140 controls) who delivered at public hospitals with their mothers were included with an overall response rate of 98.59%.

According to this study, the median age of the mothers of newborns were 27 years and 25% of the mother participants were below the age of 23 years and 25% of the mothers of participants were above 30 years. Concerning the marital status of the mothers 65 (92.9%) of cases and 126 (90%) of controls were married. Majority of participants were orthodox religion followers 157(74.8%). Regarding the height of the mother, mothers with short stature (<153) were higher in proportion among cases 9 (12.9%) than controls 11(7.9%)(table-3).

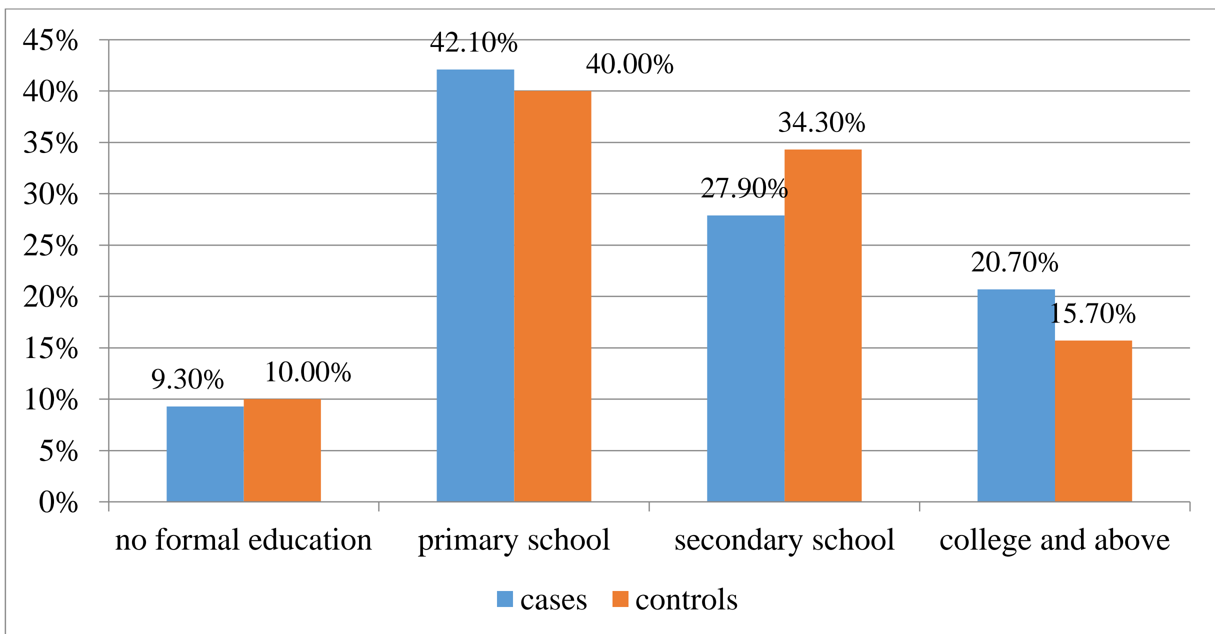

Figure 3: Maternal educational status for the study of risk factors of birth asphyxia in Addis Ababa public hospital, Ethiopia, 2019.

As shown in figure-3, newborns delivered from mothers with primary education level were at higher in a proportion of birth asphyxia in both case (42.1%) and controls (40%) compared to other educational levels.

Table 3: Socio-demographic characteristics of the mothers for the study of risk factors of birth asphyxia among newborns delivered at public hospitals in Addis Ababa, Ethiopia, 2019.

Variables	Category	Case(n=70)	Control(n=140)	Total(n=210)
		Frequency (%)	Frequency (%)	Frequency (%)
Age group	<20	9(12.9)	10(7.1)	19(9.0)
	20-24	14(20.0)	35(25.0)	49(23.3)
	25-29	28(40.0)	52(37.1)	80(38.1)
	≥30	19(27.1)	43(30.7)	62(29.5)
Marital status	Single	5(7.1)	14(10.0)	19(9.0)
	Married	65 (92.9)	126(90.0)	191(91.0)
Religion	Orthodox	53(75.7)	104(74.3)	157(74.8)
	Muslim	11(15.7)	25(17.9)	36(17.1)
	Protestant	6(8.6)	11(7.9)	17(8.1)
Ethnicity	Amhara	30(42.9)	62(44.3)	92(43.8)
	Oromo	20(28.6)	45(32.1)	65(31.0)
	Tigre	4(5.7)	7(5.0)	11(5.2)
	Gurage	10(14.3)	2014.3)	30(14.3)
	Others	6(8.6)	6(4.3)	12(5.7)
Residency	Urban	63(90.0)	12589.3)	188(89.5)
	Ruler	7(10.0)	15(10.7)	22(10.5)
Educational status	No formal education	7(10.0)	13(9.3)	20(9.5)
	Primary school	28(40.0)	59(42.1)	87(41.4)
	Secondary school	24(34.3)	39(27.9)	63(30.0)
	College and above	11(15.7)	29(20.7)	40(19.0)
Occupation	House wife	35(50.0)	79(56.4)	114(54.3)
	Governmental employ	12(17.1)	22(15.7)	34(16.2)
	Privet employ	18(25.7)	29(20.7)	47(22.4)
	Merchant	5(7.1)	10(7.1)	15(7.1)
MUAC	<23	29(41.4)	51(36.4)	80(38.1)
	≥23	41(58.6)	89(63.6)	130(61.9)
Height of the mother	<153	9(12.9)	11(7.9)	20(9.5)
	≥153	61(87.1)	129(92.1)	190(90.5)

5.1.2. Antepartum related characteristics

This study has shown that most of mothers 50(71.4) of cases and 114(81.4%) of controls had ever got ANC service whereas 20(28.6%) of cases and 26(18.6%) of controls had never got ANC service during their pregnancy of the current neonate. The proportion of women who got <4 ANC visit was higher in cases 25(50%) than controls 35(30.7%) and similarly the proportion of women with pregnancy-induced hypertension was higher in case 9(12.9%) than controls 10(7.1%). More than half of the mothers of cases 52(74.3%) and controls 115(82.1%) were multiparous (Table-4).

Regarding the medical illness that occurs during pregnancy, the proportion of mothers who had antepartum hemorrhage was seven times higher in cases 15(21.4) than in controls 5(3.6%). Besides, the proportion of anemia among mothers of cases 11(15.7%) was higher than those mothers of controls 12(8.6%) (Figure-4).

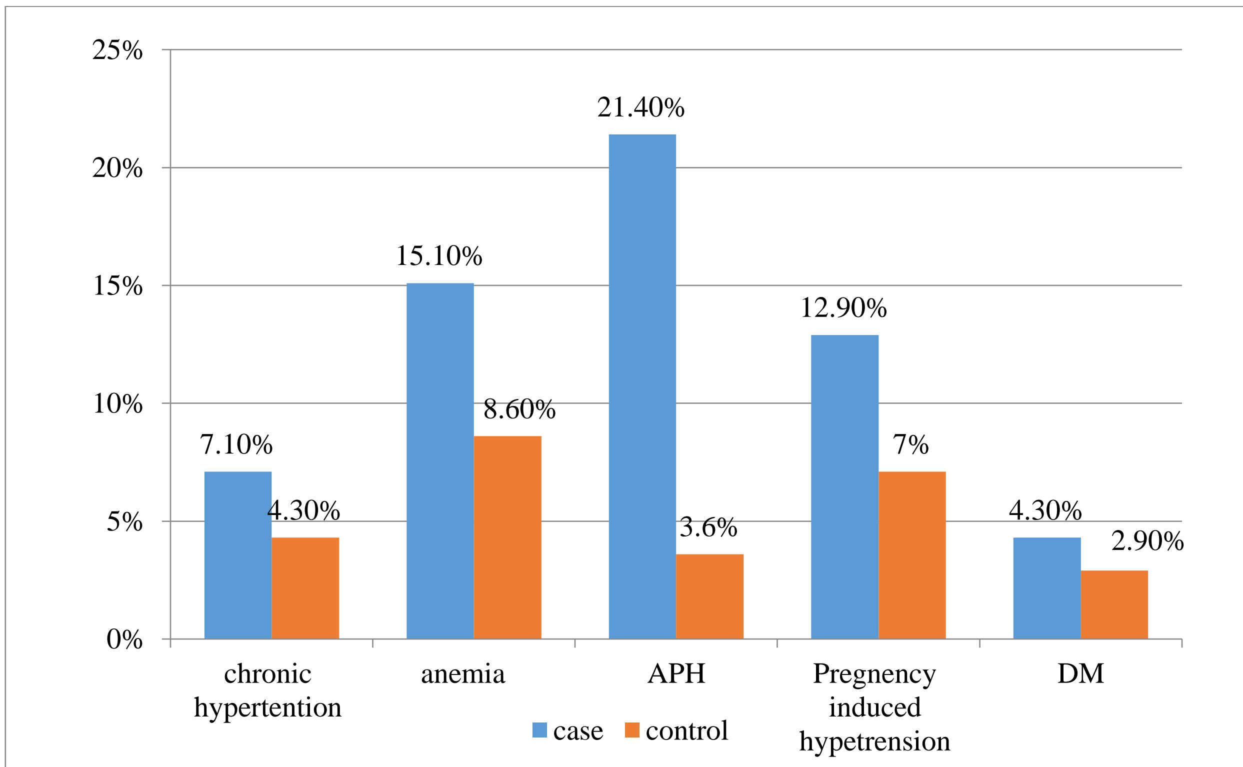

Figure 4: The distribution with history of medical illness during pregnancy among cases and controls for the study of risk factors of birth asphyxia in public hospitals in Addis Ababa, 2019.

Table 4: Antepartum related characteristics for the study of risk factors of birth asphyxia among newborns delivered at public hospitals in Addis Ababa, Ethiopia, 2019. (N=210)

Variables	Category	Cases(n=70)	Controls(n=140)	Total (n=210)
		Frequency(%)	Frequency (%)	Frequency(%)
ANC visit	Yes	50(71.4)	114(81.4)	164(78.1)
	No	20(28.6)	26(18.6)	46(21.9)
No of ANC	<4	25(50)	35(30.7)	60(37.1)
	>=4	25(50)	79(69.3)	104(62.9)
Place of ANC visit	health center	42(84)	92(80.7)	134(81.7)
	Governmental hospital	8(16)	22(19.3)	30(18.3)
Medical illness during pregnancy				
Maternal hypertension	Yes	5(7.1)	6(4.3)	11(5.2)
	No	65(92.9)	134(95.7)	199(94.8)
Anemia	Yes	11(15.7)	12(8.6)	23(11.0)
	No	59(84.3)	128(91.4)	187(89.0)
APH	Yes	15(21.4)	5(3.6)	20(9.5)
	No	55(78.6)	135(96.4)	190(90.5)
Pregnancy induced hypertension	Yes	9(12.90)	10(7.1)	19(9.0)
	No	61(87.10)	130(92.9)	191(91.0)
DM	Yes	3(4.3)	4(2.9)	7(3.3)
	No	67(95.7)	136(97.1)	203(96.7)
Gravida	Primigravida	11(15.7)	19(13.6)	30(14.3)
	Multigravida	59(84.3)	121(86.4)	180(85.7)
Parity	Primipara	18(25.7)	25(17.9)	48(22.9)
	Multipara	52(74.3)	115 (82.1)	162(77.1)
Abortion	Yes	14(20.0)	28 (20.0)	42(20.0)
	No	56(80.0)	112(80.0)	168(80.0)
No of abortion	One abortion	7(50)	17(60.72)	24(57.14)
	Two abortion	7(50)	9(32.14)	16(38.1)
	Three abortion	0(0.0)	2(7.14)	2(4.8)
HIV test done	Yes	66(94.3)	127(90.7)	193(91.9)
	No	4(5.7)	13(9.3)	17(8.1)
HIV status	Positive	1(1.5)	1(0.8)	2(1.0)
	Negative	64(98.5)	126(99.2)	190(99.0)

5.1.3. Intrapartum Related risk factors

Among the total newborn, more than half of their delivery was conducted by doctor's in both cases 54(77.1%) and controls 88(62.9%). Twenty-five (35.7%) of cases and Twenty-five (17.9%) of controls were delivered by induction. The proportion of non-vertex presentation among cases 17(24.3%) was more than three times higher than controls 10(7.1%)(Table-5). .

Regarding the mode of delivery, the proportion of newborns delivered through the cesarean section was higher in cases 27(38.6%) than controls 23(16.4%), similarly higher proportion of instrumental delivery was observed among cases 10(14.3%) than controls 8(5.7%)(Table-5). .

Maternal hypotension during labor was also observed as higher in cases 17(24.3%) compared to controls 18(12.9%). The proportion of prolonged labor was also more than twice higher in cases 17(24.3%) than in controls 15(10.7%) and similarly obstructed labor was three times higher in cases 13(18.6%) than in controls 9(6.4%). Mothers who had meconium-stained amniotic fluid were more in cases 22(31.4%) compared to controls 8(5.7%)(Table-5).

Table 5: Intrapartum related characteristics for the study of risk factors of birth asphyxia among newborns delivered at public hospitals in Addis Ababa, Ethiopia, 2019.(N = 210)

Variables	Response	Case (n=70)	Control(n=140)	Total(n=210)
		Frequency (%)	Frequency (%)	Frequency (%)
Labor attendant	Doctor	54(77.1)	88(62.9)	142(67.6)
	Midwifery	16(22.9)	52(37.1)	68(32.4)
Partograph used	Yes	32(45.7)	75(53.6)	107(51.0)
	No	38(54.3)	65(46.4)	103(49.0)
Condition of labor	Spontaneous	45(64.3)	115(82.1)	160(76.2)
	Induction	25(35.7)	25(17.9)	50(23.8)
Fetal presentation	Vertex	53(75.7)	130(92.9)	183(87.1)
	non vertex	17(24.3)	10(7.1)	27(12.9)
Mode of delivery	SVD	33(47.1)	109(77.9)	142(67.6)
	CS	27(38.6)	23(16.4)	50(23.8)
	Instrumental delivery	10(14.3)	8(5.7)	18(8.6)
Anesthesia provided through	General anesthesia	9(33.3)	3(13.0)	12(24.0)
	Spinal anesthesia	18(66.7)	20(87.0)	38(76.0)
Prolonged labor	Yes	17(24.3)	15(10.7)	32(15.2)
	No	53(75.7)	125(89.3)	178(84.8)
Obstructed labor	Yes	13(18.6)	9(6.4)	22(10.5)
	No	57(81.4)	131(93.6)	188(89.5)
Maternal hypotension	Yes	17(24.3)	18(12.9)	35(16.7)
	No	53(75.7)	122(87.1)	175(83.3)
PROM	Yes	13(18.6)	10(7.1)	23(11.0)
	No	57(81.4)	130(92.9)	187(89.0)
Maternal fever	Yes	7(10.0)	8(5.7)	15(7.1)
	No	63(90.0)	132(94.3)	195(92.9)
Cord strangulation	Yes	4(5.7)	3(2.1)	7(3.3)
	No	66(94.3)	137(97.9)	203(96.7)
MSAF	Yes	22(31.4)	8(5.7)	30(14.3)
	No	48(68.6)	132(94.3)	180(85.7)
Olygohydrominous	Yes	8(11.4)	5(3.6)	13(6.2)
	No	62(88.6)	135(96.4)	197(93.8)
Polyhydrominous	Yes	1(1.4)	3(2.1)	4(1.9)
	No	69(98.6)	137(97.9)	206(98.1)

5.1.4. Neonatal related risk factors

Out of the total newborn babies, more than half (51.4%) of the participants were females. The proportion of cases and controls by sex of the newborns was slightly different, where males were relatively higher in proportion among cases 37(52.9%) than controls 65(46.4%).

Regarding birth weight, the proportion of low birth weight among cases 27(38.6%) was over four times higher than controls 13(9.3%). Similarly, the proportion of preterm was approximately four times higher among cases 23(32.9%) than controls 10(7.1%). Sixty-three (90%) of the case and 137(97.9%) of control who were delivered are singletons.

Concerning the fetal heart rate, the proportion of fetal distress was five times higher in cases 20(28.6%) than in controls 8(5.7%).

5.2. Bivariate and multivariable analysis results

Bivariate analysis was done to select the possible risk factors of birth asphyxia and variables with p-value less than 0.25 were included in multivariable analysis. The bivariate logistic regression showed that age of the mother, parity, antenatal care visit, anemia, pregnancy-induced hypertension, and antepartum hemorrhage were selected among socio-demographic and antepartum related factors. On the same way, fatal presentation, mode of delivery, obstructed labor, duration of labor, prolonged rupture of membrane, meconium-stained amniotic fluid, maternal hypotension, fetal distress, birth weight, and gestational age were selected from intrapartum and neonatal related risk factors.

After doing an adjustment for possible effects of confounding variables, antepartum hemorrhage, low birth weight, preterm birth, cesarean section delivery, instrumental delivery, fetal distress and meconium-stained amniotic fluid were independently associated with birth asphyxia.

The multivariable analysis result showed that those mothers of newborns who have had antepartum hemorrhage were about 7.17 times to have newborns suffered from birth asphyxia compared with those who had not [AOR=7.17, 95%CI (1.73-29.72)]. Regarding the mode of delivery, newborns delivered through the cesarean section was approximately three times [AOR=2.75, 95%CI (1.02-7.42)] and through instrumental delivery was nearly five times [AOR=4.88, 95%CI (1.35-17.61)] more likely to develop birth asphyxia than those delivered through spontaneous vaginal delivery.

Intrapartum fetal distress was also significantly associated with birth asphyxia. Neonates with intrapartum fatal distress were 4.77 times more likely to have birth asphyxia when compared with neonates with normal fetal heart rate [AOR=4.77, 95%CI (1.53-14.92)]. Similarly, newborns delivered before 37 weeks of gestational age were prone to birth asphyxia with an odds of 3.4 [AOR=3.4, 95%CI (1.04-11.16)].

Neonates delivered with meconium-stained amniotic fluid were 9.02 times [AOR=9.02, 95% CI (2.69-30.25)] as more likely to have birth asphyxia as those who had not been meconium stained. Newborns birth weight of less than 2500 (low birth weight) increased the risk of having birth asphyxia 2.94 folds than those with normal birth weight [AOR=2.87,95%CI (1.01-8.13)] (Table-7).

Table 6: Bivariate and multivariable analysis for the risk factors of birth asphyxia among newborns delivered at public hospitals in Addis Ababa, Ethiopia, 2019.

Variables	Birth asphyxia		Crude OR	Adjusted OR
	Case(n=70)	Control(n=140)	(95% CI)	(95% CI)
Age of the mother				
≤19	9(12.9)	10(7.1)	2.04(0.71-5.82)	2.32(0.52-10.25)
20-24	14(20.0)	35(25.0)	0.91(0.398-2.06)	0.57(0.18-1.87)
25-29	28(40.0)	52(37.1)	1.22(0.6-2.48)	1.33(0.5-3.54)
≥30	19(27.1)	43(30.7)	1	1
ANC follow up				
Yes	50(71.4)	114(81.4)	1	1
No	20(28.6)	26(18.6)	1.75(0.896-3.43)	1.14(0.41-3.16)
Parity				
Primi-parity	18(25.7)	25(17.9)	1.59(0.8-3.17)	2.21(0.79-6.23)
Multiparty	52(74.3)	115 (82.1)	1	1
Anemia				
Yes	11(15.7)	12(8.6)	1.99(0.83-4.77)	2.07(0.61-7.06)
No	59(84.3)	128(91.4)	1	1
APH				
Yes	15(21.4)	5(3.6)	7.36(2.55-21.25)	7.17(1.73-29.72)**
No	55(78.6)	135(96.4)	1	1
PIH				
Yes	9(12.90)	10(7.1)	1.92(0.74-4.96)	1.79(0.44-7.25)
No	61(87.1)	130(92.9)	1	1
Fetal presentation				
vertex	53(75.7)	130(92.9)	1	1
Non vertex	17(24.3)	10(7.1)	4.17(1.79-9.69)	2.55(0.78-8.39)
Mode of delivery				
SVD	33(47.1)	109(77.9)	1	1
CS	27(38.6)	23(16.4)	3.88(1.97-7.65)	2.75(1.02-7.42)*
IVD	10(14.3)	8(5.7)	4.13(1.51-11.31)	4.88(1.35-17.61)*
Duration of labor				
Normal	53(75.7)	125(89.3)	1	1
Prolonged	17(24.3)	15(10.7)	2.67(1.24-5.74)	1.45(0.44-4.86)
Obstructed labor				
Yes	13(18.6)	9(6.4)	3.32(1.343-8.21)	2.22(0.68-7.32)
No	57(81.4)	131(93.6)	1	1
Maternal hypotension				
Yes	17(24.3)	18(12.9)	2.17(1.04-4.543)	2.2(0.76-6.39)
No	53(75.7)	122(87.1)	1	1
PROM				
Yes	13(18.6)	10(7.1)	2.97(1.23-7.16)	1.55(0.47-5.09)
No	57(81.4)	130(92.9)	1	1
MSAF				
Yes	22(31.4)	8(5.7)	2.97(1.23-7.16)	9.02(2.69-30.25)***
No	48(68.6)	132(94.3)	1	1
Birth weight				
<2500	27(38.6)	13(9.3)	6.13(2.91-12.94)	2.87(1.01-8.13)*
≥2500	43(61.4)	127(90.7)	1	1
Gestational age				
<37	23(32.9)	10(7.1)	6.36(2.82-14.36)	3.4(1.04-11.16)*
≥37	47(67.1)	130(92.9)	1	1
Fetal distress				
Yes	20(28.6)	8(5.7)	6.6 (2.73-15.95)	4.77(1.53-14.92)**
No	50(71.4)	132(94.3)	1	1

=statistically significant with P-value<0.05,=statistically significant with P-value<0.01,*

****=statistically significant with P-value<0.001*

6. DISCUSSION

Asphyxia is one of the leading causes of neonatal mortality because of hypoxic ischemic encephalopathy damage. Survivors of birth asphyxia also develop certain long term complications which are difficult to treat completely. The quality of medical and obstetric care which is provided during pregnancy, labor, and delivery is very crucial to reduce the whole neonatal mortality and related long term consequences. Prevention of perinatal asphyxia and its complications is dependent on the early identification of risk factors during pregnancies along with the appropriate provision of intervention. So, this study tries to identify risk factors of birth asphyxia among newborns who were delivered at public hospitals in Addis Ababa and discussed by comparing with other similar studies.

In this study antepartum hemorrhage, low birth weight, cesarean section delivery, instrumental delivery, fetal distress, preterm birth and meconium-stained amniotic fluid were identified as risk factors of birth asphyxia.

Antepartum hemorrhage was significantly associated with the risk of developing birth asphyxia. Newborns delivered from the mother with antepartum hemorrhage were approximately seven times more likely to have birth asphyxia compared with newborns delivered from mothers without antepartum hemorrhage. This finding is consistent with the study conducted at Tigray, Ethiopia(8) and Indonesia(45) with an odds of 12 and 2.6 respectively. The possible explanation could be because of the consequence of antepartum bleeding. If antepartum hemorrhage occurs there will be decreased blood flow from mother to fetus through the placenta, so the hypoxemia can occur in the fetus. This condition can lead to birth asphyxia. It may also be due to the delay to go to the nearby health institution after the happening of antepartum hemorrhage.

Newborns delivered through instrumental delivery were 4.88 times more at risk for birth asphyxia. This finding was similar with the study conducted at Dessie, Ethiopia(39) and India(42) where the odds of birth asphyxia among newborns delivered by instrumental delivery was 3.5 and 5 times higher when compared with spontaneous vaginal delivery respectively. This could be explained by the fact that instrumental delivery can cause birth trauma (skull fracture, intracranial hemorrhage, subgeleal hemorrhage) which can further leads to birth asphyxia(56). Despite this the study done Hong Kong, China shown that there was a significant decrease in

birth asphyxia related to instrumental delivery(48). This can be due to the effect of Hawthorne (tendency to improve performance because of awareness of being studied) in a study done in China.

Besides, newborns delivered through cesarean section had a significant association with birth asphyxia. Specifically, neonates delivered by cesarean section were nearly three times more likely to develop birth asphyxia compared with spontaneous vaginal delivery. This study is in line with the study done in Dr. Soetomo Hospital Surabaya, Indonesia(45) with an odds ratio of 3.8. Other studies done at Pakistan(26), Nigeria(19), and Iran (51) also showed there was an association between these factors . The possible explanation for this could be due to the reason that either the operation made lately after the mother develops complication or the mother might come after the occurrence of complication or it might be due to the factor related to the cesarean section indications or due to the extra effect of the anesthetic medications.

Meconium-stained amniotic fluid also had a significant association with the occurrence of birth asphyxia. Specifically, newborns delivered with meconium-stained amniotic fluid were nine times more likely to have birth asphyxia compared with that clear amniotic fluid. This finding is compatible with studies from Jimma(25), Thailand(49), Uganda(57) and India(42) with an odds ratio between 6-8.2, which revealed that meconium-stained amniotic fluid was an independent predictor of birth asphyxia. This might be due to the reason, newborns delivered from mothers with meconium-stained amniotic fluid are more predisposed to aspirate it and fill smaller airways and alveoli in the lung. This can further lead to lung inflammation, obstruction, and limited lung movement. Then due to limited gas exchange birth asphyxia could occur.

This study revealed that gestational age less than 37 weeks was significantly associated with birth asphyxia. Newborns delivered before 37 weeks of gestational age were 3.4 times more likely to suffer from birth asphyxia than term babies. This finding was supported by studies conducted at Tigray, Ethiopia(8), Karachi(6) and Jakarta (40) which revealed that preterm delivery as an independent risk factor with an odds ratio of 2.2, 3.07 and 3.1. This may be due to the fact that preterm babies are faced to multiple comorbidities and immaturity of the organ system especially lung immaturity which causes failure to inhale and exhale an adequate amount of air after birth. This leads to failure to breathe.

Another neonatal variable which was found to be significantly associated with birth asphyxia was low birth weight. Specifically, low birth weight newborns were three times more prone to develop birth asphyxia than newborns with normal birth weight. This finding was consistent with the studies conducted at Tigray(8) Ethiopia, Tehran-Iran(51), Thailand(49) and Indonesia(45) revealed that low birth weight was an independent risk factor of birth asphyxia with the odds ratio of 6.9, 3.13, 2.46 and 5.83. This might be due to the possibility that most of the low birth weight babies might be preterm babies that they might not able to produce enough amount of surfactant which further leads to difficulty of breathing and consequently birth asphyxia.

Besides, intrapartum fetal distress was found to be significantly associated with birth asphyxia. Newborns that had intrapartum fetal distress were about 4.77 times more likely to develop birth asphyxia. This finding was compatible with studies from Gonder, Ethiopia(7), Karachi(6) and Al-Diwaniya Maternity and Children Teaching Hospital(58) which showed that fetal distress was an independent risk factor of birth asphyxia. The possible explanation is fatal distress happens when the fetus does not receive adequate amounts of oxygen during pregnancy or labor so that this can further cause difficulty to initiate and sustain breathing after birth.

Despite different studies shows that pregnancy-induced hypertension, prolonged rupture of membrane, primiparity, non-vertex presentation, MUAC, maternal fever, height of the mother, maternal age, ANC visit and prolonged labor as an important risk factors of birth asphyxia(6-8, 24, 39-41, 53), this study could not found any significant association in multivariable logistic regression analysis with these factors. This difference might be due to methodological variation.

7. STRENGTH AND LIMITATION OF THIS STUDY

7.1. Strength of the study

- This study was conducted in a relatively larger area and data was collected through face to face interview, measurement and chart review which could be able to reduce information bias.
- In this study direct maternal anthropometric measurements were used.

7.2. Limitation of the study

- This study was only done at the governmental hospital. Private hospitals and health centers were not included.
- This study also subjected to recalling bias, when the mother remembers their previous history.
- The study was done at institution level but it was better if it was done at community level.

8. CONCLUSION AND RECOMMENDATION OF THE STUDY

8.1. Conclusion

Birth asphyxia is one of the worldwide problems of neonates. It raises different complications if the cases left untreated and lead to death. There are different factors which are the causes of birth asphyxia. The findings of this study suggest that among neonates delivered at public hospitals antepartum, intrapartum and neonatal variables were significantly associated with birth asphyxia. Antepartum hemorrhage was significantly associated with antepartum factors and cesarean section delivery, instrumental delivery, fetal distress, and meconium-stained amniotic fluid was significantly associated among intrapartum factors. Neonatal factors including low birth weight and preterm birth were also significantly associated with birth asphyxia.

8.2. Recommendation

According to the findings from this study, the following recommendations have been suggested to different stakeholders;

For health workers

- ✓ Health professionals who are working at ANC service would have better to increase their attention and their advice for the mother regarding the prevention and signs of antepartum hemorrhage and the necessity of immediate treatment to prevent birth asphyxia and other complications.
- ✓ During labor and delivery, for the fetus who is at risk for birth asphyxia (delivered from APH mothers, meconium stained amniotic fluid and fetal distress), the health professional better to improve their strict follow-up and be ready for neonatal resuscitation.
- ✓ Physicians and health Professionals better to make decision early and, further anticipate and be prepared for management of the case while carrying out cesarean and instrumental delivery.
- ✓ The health professionals would have to increase the monitoring of fetal heart rate and make an early decision while the fetus is in distress and they should provide follow up during labor, delivery and newborn care for the fetus at risk of preterm birth and low birth weight.

For mothers

Women, who faced antepartum hemorrhage, would go to the near health institution and would get prompt action in seeking medical help during obstetric emergencies.

For the Ministry of health and health service organizations

The government should improve the priority given to birth asphyxia by improving awareness of the medical, psychosocial and economic burden of birth asphyxia. Primary care organizations would better to increase their support towards antenatal care service, maternal education program and improve routine fetal heart rate counting.

For researchers

Researchers who are interested to conduct on birth asphyxia would better to include newborns in the community which may increase the efficacy of the study. It is also better to do meta-analysis since the previous findings of the factors of birth asphyxia were inconsistent.

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Appendix

Appendix I: Information Sheet

Good morning/ afternoon?

My name is **____________** Currently I am a graduate student at Addis Ababa University, College of Health Sciences, School of Nursing and Midwifery. And now I am conducting a study to assess risk factors of birth asphyxia in public hospitals of Addis Ababa, Ethiopia, 2019.

Title of the research: Risk factors of birth asphyxia among newborns delivered at public hospitals of Addis Ababa, Ethiopia.2019.

Objective: this study will be aimed to identify risk factors of birth asphyxia

Participants: newborns delivered at five public hospitals.

Potential Risks: There is no foreseen risk by being involved in this study.

Benefits: No financial benefits are related with this study. But by participating in this study, most importantly, the result of the study will be beneficial to design effective preventive and control measures for Birth asphyxia. Hence, you are indirectly benefiting other patients and the society in this respect.

I would like to ask you few questions. Your honest response to the questions can make the study to achieve its objective. All the information that you give will be kept confidential and private. Only the principal investigator and interviewer will have access to the information. You are kindly requested to respond voluntarily. You can also choose not to participate in this study totally or if you become uncomfortable during the study, you will be allowed to leave the interview at any time. At any time that you have questions, you can contact me by using the following Addresses**:**
Tewodros Mulugeta: Mobile: 09 49186594, E-mail: tedamulu@gmail.com

Appendix II: Consent form

In signing this document, I am giving my consent to participate in the study entitled “risk factors of birth asphyxia among newborns delivered at Addis Ababa public hospitals, Ethiopia”.

I have been informed that the purpose of this study is to identify risk factors of birth asphyxia. I have understood that participation in this study is entirely voluntarily. I have been told that my answers to the questions will not be given to anyone else and no reports of this study ever identify me in any way. I have also been informed that my participation or non-participation or my refusal to answer questions will have no effect on me. I understood that participation in this study does not involve risks. I understood that Tewodros Mulugeta is the contact person if I have questions about the study or about my rights as a study participant.

Respondent’s signature__________________________________

Date of interview: _______________ Time started: _________ Time finished: _________

Interviewer Name_________________________Signature___________Date____________

Supervisor’s name ________________ signature _____________

Results of interview questionnaire

1. Completed

2. Refused

3. Partially completed

Appendix III: English Version Questionnaire

Addis Ababa University, College of Health Sciences, School of Nursing and Midwifery

A questionnaire to determine sociodemographic, antenatal, intra-natal and neonatal risk factors associated with birth asphyxia among newborns in public referral hospitals of Addis Ababa.

1. Questionnaire ID number ____________________

2. Status 1. **Case** ☐ 2. **Control** ☐

3. Name of the hospital______________________

Note: Encircle from the given options and write if any other idea or answer is given

Part I: Socio demographic characteristics of the mother

Cods	Variables	Categories
101	Age of the mother	_____________(in year)
102	What is your marital status?	1. Single 2. Married 3. Divorced 4. Widowed
103	What is your religion?	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. If other specify……………
104	What is your ethnicity?	1. Amara 2. Oromo 3. Tigray 4. Gurage 5. If other specify……………
105	Where is your residence?	1. Urban 2. Rural
106	What is your educational status?	1. No formal education 2. Primary school 3. Secondary school 4. College and above
107	What is your occupation?	1. House wife 2. Governmental employ 3. Private employee 4. Merchant 5. Student
108	Height of the mother	_______________cm
109	MUAC	_______________cm

Part II: Antenatal related factors

201	Parity	________ in number	
202	Gravidity	________ in number	
203	Did you visit health facility for ANC during your pregnancy for this neonate?	1. Yes 2. 2. No	If 'no' skip to 205
204	If yes, how many times did you receive antenatal care during your time of pregnancy for this neonate?	_____ times	
205	Where was your ANC visit?	1. Governmental health center 2. Governmental hospital 3. Privet health institution	
206	Did the mother suffer from any of these conditions which is medically confirmed during pregnancy?		
	maternal hypertension	1. Yes 2. No	
	gestational diabetes	1. Yes 2. No	
	Anemia	1. Yes 2. No	
	antepartum hemorrhage	1. Yes 2. No	
	Pregnancy induced hypertension	1. Yes 2. No	
	diabetes mellitus	1. Yes 2. No	
	HIV	1. Yes 2. No	
	Malaria	1. Yes 2. No	
	Syphilis	1. Yes 2. No	
	If other, specify	__________	
207	Do you have history abortion	1. Yes 2. No	
208	If yes, how money times?	1. One abortion 2. Two abortions 3. Three abortions 4. Four and more abortions	

Appendix IV: Extraction checklist

Title of the Research Project: Risk factors of birth asphyxia among newborns delivered at public hospitals of Addis Ababa, Ethiopia.2019.

Name of Investigator: Tewodros mulugeta (Bsc in Nursing)

Name of the Organization: Addis Ababa University, school of nursing and midwifery, College of health science.

Name of the Sponsor: Addis Ababa University.

Introduction: This information sheet is prepared for administration and labor and delivery ward coordinating office. The aim of the form is to make the above-concerned office clear about the purpose of research, data collection procedures and get permission to conduct the research.

Purpose of the Research Project: to assess the Risk factors of birth asphyxia among newborns delivered at public hospitals of Addis Ababa, Ethiopia.2019.

Procedure: In order to achieve the above objective, information which is necessary for the study will be taken from preterm neonate medical record forms.

Risk and /or Discomfort: Since the study will be conducted by taking appropriate information from medical chart, it will not inflict any harm on the patients. The name or any other identifying information will not be recorded on the questionnaire and all information is taken from the chart will be kept strictly confidential and in a safe place. The information retrieved will only be used for the study purpose.

Benefits: The research have no direct benefit for one whose document/ record is included in this research and already died. But the indirect benefit of the research for the participant and other clients in the program is clear. This is because if program planners are preparing predicted plan there is a benefit for clients in the program of getting appropriate care and treatment services for those survived and other newly born ones. In all, the research work has a paramount direct benefit for health care planners and managers.

Confidentiality: To reassure confidentiality the data on the chart will be collected without the name of the clients and the information collected from this research project will be kept confidential and will be stored in a file cabinet. In addition, it will not be revealed to anyone except the investigator and it will be kept in a key and locked system with computer pass ward.

Person to contact: This research project will be reviewed and approved by the institutional review board of College of Health Science, school of nursing and midwifery, Addis Ababa

University. If you have any question you can contact any of the following individuals (Investigator and Advisors) and you may ask at any the time you want.

Principal investigator: Tewodros mulugeta, Addis Ababa University, College of Health Science, school of Nursing and midwifery. **Cell phone**:- 09 49186594, E-mail: tedamulu@gmail.com

Main Advisor: Mr. Girum Sebisibe (Ass.prof) Addis Ababa University, College of Health Science, school of nursing and midwifery:

This checklist is prepared for the collection of intra-partum and neonatal related information that are important for the assessment of risk factors of birth asphyxia among newborns delivered at public hospitals of Addis Ababa. All this information will be retrieved from the client's medical chart book without mentioning the name of the clients. This information will be collected by health care providers possibly working at labor and delivery ward of the hospitals.

Part I: Intrapartum related factors

301	Delivery conducted by whom?	1. Doctor 2. Midwife 3. Nurse
302	Was Partograph used	1. Yes 2. No
303	How was the labor started	1. Spontaneous 2. induction
304	What was the presentation of fetus	1. Vertex 2. Non-vertex
305	What was the mode of delivery	1. Spontaneous vaginal delivery 2. Delivered by Cesarean section 3. Instrumental delivery
306	If cesarean, anesthesia received by mother during C-section was?	1. General anesthesia 2. Spinal anesthesia
307	Is there any history of prolonged labor?	1. Yes 2. No
308	Did the mother suffer with any of the conditions which are diagnosed medically during labor/pregnancy?	
	Obstructed labor	1. Yes 2. No
	Maternal hypotension	1. Yes 2. No
	Spontaneous premature rupture of membranes (PROM)	1. Yes 2. No

	Artificial premature rupture of membranes (PROM)	1. Yes 2. No
	Maternal Fever	1. Yes 2. No
	If other, specify	___________
309	Did the neonate suffer from any of the conditions given below?	
	Cord strangulation around neck	1. Yes 2. No
	Meconium-stained amniotic fluid	1. Yes 2. No
	fetal heart rate	1. <100 or >180 2. 100-180
	Oligohydramnios	1. Yes 2. No
	Polyhydramnios	1. Yes 2. No
	If other, specify	_______________

Part II: neonatal related factors

401	Sex of new born	1. Male 2. Female.
402	Birth weight	--------------------
403	Gestational age (GA)	---------------------
404	Did the baby cry	1. Yes 2. No
405	APGAR score at one minute	1. <7 2. ≥7
406	APGAR score at five minutes	1. <7 2. ≥7
407	How was the pregnancy type?	1. Single 2. Twin 3. Triple and above

Appendix V፡ የተሳታፊዎች የመረጃ ቅፅ በአማረኛ

እንደምን አደሩ/ዋሉ?

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

<u>የጥናቱ ርዕስ</u>፡ - በአዲስ አበባ ውስጥ በሚገኙ የመንግስት ሆስፒታሎች ውስጥ በወሊድ ወቅት ስለሚከሰት የጨቅላ ህጻናት መታፈን አጋላጭ ሁኔታዎችን መለየት ፣ ኢትዮጵያ፣ 2011 ዓ.ም፡፡

<u>የጥናቱ አላማ</u>፡- በወሊድ ወቅት የሚከሰት የጨቅላ ህጻናት መታፈንን 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 የህጻናት መታፈንን 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፡፡

ቴዎድሮስ ሙሉጌታ

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Appendix 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 ተገልጾልኛል፡፡

የመረጃ ሰጪ ፊርማ ______________________________ቀን __________________

የተጀመረበት ሰዓት ________________________ ያለቀበት ሰዓት_________________

የጠያቂው ስም ________________________ፊርማ________________ቀን_________________

የተቆጣጣሪ፤ስም______________________ፊርማ____________________ቀን________________

የመጠይቁ ውጤት

1. ሙሉ በሙሉ የተሞላ

2. ያልተስማሙ

3. በከፊል የተሞላ

Appendix VII: መጠይቅ - አማርኛ ቅጽ

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

ይህ መጠይቅ የተዘጋጀው በአዲስ አበባ በሚገኙ የህዝብ ሪፈራል ሆስፒታሎች ውስጥ በወሊድ ወቅት ለሚከሰት ለጨቅላ ህጻናት መታፈን የሚያጋልጡ ሁኔታዎችን ለመለየት ነው፡፡

የመጠይቁ መለያ ቁጥር____________አድራሻ፤ቀበሌ_____________የተቋሙ ስም____________

Status 1. **Case** ☐ 2. **Control** ☐

ክፍል አንድ፡- የወላጅ የጨቅላ ህጻኑ እናቱ አጠቃላይ ሁኔታ

ተ.ቁ	ጥያቄ	መልስ	ይዝለሉ
101	እድሜዎ ስንት ነው?	________(በዓመት)	
102	የጋብቻ ሁኔታ?	1. ያላገባች 2. ያገባች 3. ባሏ የሞተባት 4. ባሏን የፈታች	
103	ሀይማኖትዎ ምንድን ነው?	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ካቶሊክ 5. ሌላ(ይጥቀሱ)________	
104	ብሄርዎ ምንድ ነው?	1. አማራ 2. ኦሮሞ 3. ትግሬ 4. ጉራጌ 5. ሌላ(ይጥቀሱ)_________	
105	የመኖሪያ ቦታዎ የት ነው?	1. ከተማ 2. ገጠር	

106	የትመህርት ደረጃዎ ስንት ነው?	1. ያልተማረች 2. የመጀመሪያ ደረጃ 3. ሁለተኛ ደረጃ የተማረች 4. ኮሌጅና ከዛ በላይ	
107	የርስዎ የስራ ሁኔታምንድነው?	1. የቤት እመቤት 2. የመንግስት ሰራተኛ 3. በግል ተቋም 4. ነጋዴ 5. ተማሪ	
108	ቁመት	______________cm	
109	MUAC	_______________cm	

ክፍል ሁለት፤ከቅድመ ወሊድ ጋር የተያያዙ አጋላጭ ሁኔታዎች

201	ስንት ህጻናት 7 ወር ከሞላቸው በኋላ ወልደዋል (ሞተው የተወለዱትንም ጨምሮ)?	_________(በቁጥር)	
202	**ስንተኛ እርግዝናሽ ነው?**	_________(በቁጥር)	
203	የቅድመ ወሊድ ክትትል አግኝተዋል?	1. አዎ 2. አላገኘሁም	አላገኘሁም ካሉ ወደ ጥያቄ 206 ይሂዱ
204	አዎ ከሆነ መልስዎ ስንት ጊዜ የቅድመ ወሊድ ክትትል አድርገዋል ?	______ ጊዜ	
205	የት ነበር የቅድመ ወሊድ ክትትል ያደረጉት?	1. ጤና ጣቢያ 2. የመንግስት ሆስፒታል 3. የግል ጤና ተቋም	
206	በእርግዝና ወቅት ከሚከተሉት ሁኔታወች ውስጥ በህክምና የተረጋገጠ ያጋጠመዎት ችግር አለ?		
	የደም ገፊት	2. አዎ 3. አልነበረም	
	በእርግዝና ወቅት የተከሰተ የስኩዋር በሽታ	1. አዎ 2. አልነበረም	
	የደም ማነስ	1. አዎ 2. አልነበረም	
	በእርግዝና ወቅት የደም መፍሰስ	1. አዎ 2. አልነበረም	
	በእርግዝና ወቅት የደም ገፊት መጨመር	1. አዎ 2. አልነበረም	
	የስኩዋር በሽታ	1. አዎ	

		2. አልነበረም	
	HIV	1. አዎ 2. አልነበረም	
	የወባ በሽታ ነበረብሽ	1. አዎ 2. አልነበረም	
	የጨብጥ በሽታ ነበረብሽ	1. አዎ 2. አልነበረም	
207	ውርጃ አጋጥሞሽ ያውቃል?	1) አዎ 2) አላጋጠመኝም	
208	ካጋጠመሽ ስንት?	1. አንድ ውርጃ 2. ሁለት ውርጃ 3. ሶስት ውርጃ 4. አራት እና ከዛ በላይ	