MAGNITUDE OF NEONATAL HYPOGLYCEMIA AND ITS ASSOCIATED FACTORS AMONG NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNIT AT HAWASSA CITY PUBLIC HOSPITALS, ETHIOPIA, 2023.

MSC IN PEDIATRICS AND CHILD HEALTH NURSING

SELAM TADELE MARKOS

HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA

NOVEMBER, 2023

MAGNITUDE OF NEONATAL HYPOGLYCEMIA AND ITS ASSOCIATED FACTORS AMONG NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNIT AT HAWASSA CITY PUBLIC HOSPITALS, ETHIOPIA, 2023.

SELAM TADELE MARKOS (BSc IN NURSING)

THESIS SUBMITTED TO SCHOOL OF NURSING, COLLEGE OF MEDICINE AND HEALTH SCIENCES, HAWASSA UNIVERSITY, HAWASSA, ETHIOPIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN PEDIATRICS AND CHILD HEALTH NURSING

MAJOR ADVISOR: Mr. WEGENE JEMBERE (ASSISTANT PROFESSOR, LECTURER)
CO-ADVISOR: Mrs. MASTEWAL ASCHALE (MSC, LECTURER)

NOVEMBER, 2023

SCHOOL OF GRADUATE STUDIES

HAWASSA UNIVERSITY

ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled **"**Magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to neonatal intensive care unit at Hawassa City Public Hospitals, Ethiopia.**"** submitted in partial fulfillment of the requirements for the degree of Masters with specialization in Pediatric and Child health nursing, the Graduate Program of the School of nursing, and has been carried out by Selam Tadele Markos ID No. 0009/2014 under our supervision. Therefore, we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

_____	_____	_____
Name of major advisor	Signature	Date

_____	_____	_____
Name of co-advisor	Signature	Date

SCHOOL OF GRADUATE STUDIES

HAWASSA UNIVERSITY

EXAMINERS' APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Selam Tadele Markos have read and evaluated his/her thesis entitled "Magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to neonatal intensive care unit at Hawassa City Public Hospitals, Ethiopia.", and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree.

Name of Major Advisor	Signature	Date
Name of Internal Examiner- I	Signature	Date
Name of Internal Examiner-II	Signature	Date
Name of External Examiner	Signature	Date
SGS Approval	Signature	Date

Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the School of Graduate Studies (SGS) through the Department/School Graduate Committee (DGC/SGC) of the candidate's department.

Stamp of SGS Date:_____

Declaration

I hereby declare that this MSc research is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged.

Name: _____

Signature: _____ _____

Date: _____

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

Major advisor:

Name: _____

Signature: _____

Date: _____

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

Co-advisor:

Name: _____

Signature: _____

Date: _____

Examiners 1:

Name: _____

Date: _____

Examiners 2:

Name: _____

Date: _____

Acknowledgment

I would like to forward my thanks to Hawassa University School of Nursing for providing the opportunity to carry out this research.

I would like to extend my appreciation and thanks to my advisers Mr. Wegene Jembere (assistant professor), and Mrs. Mastewal Aschale (MSc) who gave their critical comments to me to conduct this research.

My special thanks go to the Hawassa City Administration Health Bureau who gave me the necessary information and Hawassa City Public Hospitals who allowed me to conduct this research.

My special thanks go to Mr. Tewodros Mulugeta (Msc) and Mr. Migbar Sibhat (Msc) who provided their valuable comment to me on doing this research.

Table of Contents

List of Table

List of Figure

Abbreviations and acronyms

ANC	Antenatal Care
APGAR	Appearance, Pulse Rate, Grimace, Activity, Respiration Rate
BSc	Bachelor of Science
DM	Diabetes Mellitus
ETB	Ethiopian Birr
GDM	Gestational Diabetes Mellitus
IDM	Infant of Diabetic Mother
IV	Intra Venus
LGA	Large for Gestational Age
NICU	Neonatal Intensive Care Unit
OR	Odds Ratio
SGA	Small for Gestational Age
SVD	Spontaneous Vaginal Delivery
WHO	World Health Organization

Abstract

Background: Neonatal hypoglycemia is one of the most common metabolic abnormalities seen in newborns. If unrecognized or poorly treated it may result in poor neurologic development, motor deficits, poor intellectual function, seizure disorders, or even death. In Ethiopia, neonatal hypoglycemia is frequently diagnosed and one of the commonest causes of admission to the neonatal intensive care unit. Nevertheless, documented records regarding its magnitude and factors associated with hypoglycemia are scarce in the study area.

Objective: To assess the magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to the neonatal intensive care unit at Hawassa City Public Hospitals, Ethiopia.

Method: Institution-based cross-sectional study was conducted among 293 neonates admitted in Hawassa City Public Hospitals, Ethiopia from April 20 – June 20, 2023. The study participants were neonates with their mothers. A convenience sampling technique was used to reach the study subjects. A structured pretested questionnaire was adopted from different studies and the data was collected through face-to-face interviews and card review. Ethical clearance was taken from Hawassa University institutional review board and consent was taken from mothers of neonates. Then the collected data were checked, coded, and entered into Epi data version 3.1 and exported to SPSS software version 25 for cleaning and analysis. A Binary logistic regression model was used to determine the association. From bivariate analysis, variables with p-values <0.25 were taken for multivariable analysis. From multivariable analysis, variables with adjusted odds ratio, p-values <0.05 at 95% confidence interval (CI) were declared as factors significantly associated with neonatal hypoglycemia.

Result: In this study, from all neonate-mother pair the overall response rate was 92.5%. The magnitude of neonatal hypoglycemia was found 16.6%. Variables significantly associated with the occurrence of neonatal hypoglycemia were: Diabetes mellitus [AOR=9.8, 95%CI (3.08-31.37)], perinatal asphyxia [AOR=2.87, 95%CI (1.07-7.72)], delayed initiation of breastfeeding [AOR=2.63, 95%CI (1.04-6.6)] and hypothermia [AOR=3.8, 95%CI (1.6-9.1)].

Conclusion: the magnitude of neonatal hypoglycemia among neonates was high.

Neonates with hypothermia, perinatal asphyxia, and delayed initiation of breastfeeding and maternal history of diabetes mellitus have an increased risk of developing hypoglycemia. Hence, Health care providers who are working on delivery and neonatal care should focus on early identification and management of these identified factors.

Keywords: neonate, diabetes mellitus, hypoglycemia, Blood glucose

1. Introduction

1.1. Background

Neonatal hypoglycemia is defined as an abnormally low blood glucose level (stanford, 2023). There has been much controversy about the 'numerical' definition of neonatal hypoglycemia. Although the most often used definition of newborn hypoglycemia is a glucose concentration of 47 mg/dl (2.6 mmol/l), (Dixon et al., 2017, Harris et al., 2014), in Ethiopia it is clinically defined as a blood glucose level less than 40 mg/dl (EMOH, 2021).

During labor and delivery, catecholamines and glucocorticoids, which are released by the mother in reaction to stress, cause the concentrations of maternal and, consequently, fetal glucose to rise (Hillman et al., 2012). Neonatal glucose concentrations begin to decline as soon as the umbilical cord is clamped, reaching a low point 1-2 hours after delivery as a result of the disruption of the glucose supply. In consequence, glucagon and other counter-regulatory hormones such as catecholamines secretion rise as insulin secretion declines, boosting glycogenolysis and gluconeogenesis, and causing a progressive rise in glucose concentrations (Hillman et al., 2012). Nevertheless, they do not become concentrated at adult levels until 72 hours have passed (Srinivasan et al., 1986, Harris et al., 2020). Neonatal hypoglycemia comes from the delay or impairment of this postnatal metabolic transition.

After delivery, intermittent breastfeeding replaces the mother's constant supply of glucose as the primary source of energy. The lack of maturity of gluconeogenesis and the ketogenesis process among newborns also contributes to transient lower blood glucose concentrations which is termed hypoglycemia (Flores-le Roux et al., 2012).

Neonatal hypoglycemia symptoms vary from newborn to newborn, and it can cause a wide range of symptoms ranging from mild to severe. Patients with hypoglycemia may be asymptomatic or may present with severe central nervous system (CNS) and cardiopulmonary disturbances (Harris et al., 2014, Fong and Harvey, 2014). It usually occurs within 1–2 days after birth, especially in 6–12 hours, with most of the cases being asymptomatic. The most common clinical manifestations can include an altered level of consciousness, apnea, irritability, seizure, vomiting, unresponsiveness, and lethargy (Abramowski et al., 2021).

Varies factors were identified as risk factors for neonatal hypoglycemia which include Preterm birth, Infants of diabetic mothers (IDM), Small for gestational age (Dalsgaard et al.), Large for gestational age (LGA), Sick infants who require intensive care (e.g. sepsis, asphyxia, respiratory distress), Post exchange blood transfusion, Infants on intravenous fluids or parenteral fluids, Infants whose mothers were treated with beta-adrenergic or oral hypoglycemic agents(Kallem et al., 2017, Edwards and Harding, 2021).

Hypoglycemia has an impact on increased levels of mortality and morbidity (Yismaw et al., 2019, Kutamba et al., 2014). Still, the level or duration of hypoglycemia that is harmful to an infant's developing brain injury is not known. But if it is not treated early it can cause major long-term complications which include neurologic damage resulting in mental retardation, recurrent seizure activity, developmental delay, and personality disorders(Amponsah et al., 2015).

Currently, different prevention methods are being implemented. These are maintaining skin-to-skin contact at birth and early breastfeeding within the first hour, providing ongoing skin-to-skin contact to control the temperature of the baby and promote frequent breastfeeds, advising the mother to feed frequently at least 3 hourly and correct positioning and attachment must be established to ensure efficient milk transfer (Dalsgaard et al., 2019).

Management of neonatal hypoglycemia targets to treatment of acute symptomatic hypoglycemia, which can result in possible permanent brain damage and long-term adverse outcomes (Alsaleem et al., 2019). Initiation of intravenous (IV) dextrose therapy should be considered if blood glucose levels remain below the operational threshold after an enteral feed or if the infant is unable to tolerate oral intake(Thornton et al., 2015).

1.2. Statement of the problem

Neonatal hypoglycemia is the most prevalent metabolic abnormality in the newborn period (Stanescu and Stoicescu, 2014), which is a major contributing factor to neonatal morbidity and mortality(Mukunya et al., 2020). Globally, it affects around 5–15% of all babies (Hay et al., 2009, Harding et al., 2017) and approximately 50% of at-risk babies and is associated with a range of adverse consequences (Shah et al., 2019).

According to UNICEF 2020 data, our world neonatal mortality rate was 17 deaths per 1000 live births. However, Sub-Saharan Africa had the highest neonatal mortality rate at 27 deaths per 1000 live births. For this mortality rate, neonatal hypoglycemia is a major contributing factor. In Africa, the risk of death of neonates due to hypoglycemia is double as compared to normal neonates, and in Nigeria, the mortality rate of neonatal hypoglycemia is 23.3%(Dedeke et al., 2011).

It has a significant prevalence in at-risk neonates, with 47% in large-for-gestational-age (LGA) neonates, 52% in small-for-gestational-age (Dalsgaard et al.) neonates, 48% in neonates of diabetic mothers, and 54% in late preterm neonates (Harris et al., 2012). In neonates born before 33 weeks, the prevalence of hypoglycemia is nearly 34% (Mitchell et al., 2020).

In resource-limited settings, evidence shows there is widespread neonatal hypoglycemia, even though in some countries there is a shortage of advanced techniques for hypoglycemia detection and an absence of routine assessment for hypoglycemia. In African countries Nigeria and Uganda have an incidence of 32.7% and 2.2 % respectively (Dedeke et al., 2011, Mukunya et al., 2020). In Ethiopia, the magnitude ranges from 15%-25% (Sertsu et al., 2022, Fantahun and Nurussen, 2020).

If left untreated, severe and prolonged hypoglycemia can have a devastating neurologic and developmental outcome which includes cerebral palsy, long-term neurodevelopmental disabilities, mental retardation, epilepsy, personality disorders, and even death (Amponsah et al., 2015). The morbidity and mortality rates for infants with congenital causes of chronic hypoglycemia are substantially greater of which 25 to 50% have permanent brain damage due to

hypoxic ischemic encephalopathy (Thornton et al., 2015). Hence, early detection of hypoglycemia is crucial to improving the survival of neonates.

Identifying the risk factors of neonatal hypoglycemia is critical to find out the infant's 'at risk' to reduce their morbidity and mortality by appropriate timely intervention. Despite different interventions being undertaken, neonatal hypoglycemia has continued to be frequently diagnosed and remains among one of the commonest causes of admission to the neonatal intensive care unit (NICU). Despite these devastating health impacts, organized data regarding the magnitude of hypoglycemia and the factors that predict its occurrence were scarce in Ethiopia. Furthermore, we couldn't find a single study to investigate this issue in our study area. Hence, this study aims to determine the magnitude of neonatal hypoglycemia, and factors associated with it among neonates admitted to neonatal intensive care units at Hawassa City Public Hospitals, Sidama Regional State, Ethiopia.

1.4. Significance of the study

Studying the magnitude and factors associated with neonatal hypoglycemia is crucial for upward measures to prevent hypoglycemia and associated morbidity, mortality, and healthcare expenditure.

Determining the magnitude of hypoglycemia is important to show the burden of hypoglycemia among neonates and in the healthcare system, which is important for health service planning and delivery. Identifying the risk factors of hypoglycemia is essential for developing preventive strategies and treatment protocols.

For health professionals, this study is essential to identify newborns who are at high risk of developing hypoglycemia and afterward, important to identify possible areas for evidence based intervention to reduce the occurrence of neonatal hypoglycemia.

It also will provide an evidence for policymakers and other governmental and non-governmental organizations as input to plan resources for possible interventions to combat neonatal hypoglycemia and related consequences.

For study area public hospitals, it will give an alert about neonatal hypoglycemia. The findings of the study will also be used as benchmark information for individuals who are interested in carrying out further studies concerning neonatal hypoglycemia.

2. Literature review

2.1. Magnitude of neonatal hypoglycemia

Across the globe, significant variation in the prevalence of neonatal hypoglycemia is observed. This variation depends on the measurement method used, the diagnostic threshold, and the population studied (Harding et al., 2017). However, in newborns, the prevalence of hypoglycemia is estimated to be 5–15% (Hay et al., 2009, Bromiker et al., 2019), and in those who are at-risk, the incidence approximates 50% (Harris et al., 2014).

The variation in the magnitude of neonatal hypoglycemia is significantly observed among developed and developing countries which is lower in the USA 3.2% and higher in Nigeria(37.2%) (Hosagasi et al., 2018, Dedeke et al., 2011). In developed countries (Canada, China, and Israel) 33.7%, 33.3%, and 12.1% of neonates develop hypoglycemia respectively (Mitchell et al., 2020, Zhao et al., 2020, Bromiker et al., 2019, Hosagasi et al., 2018).

In developing countries, relatively similar proportions were observed. Varies cross-sectional studies have been done in India and the incidence rate ranges from 8.2%-33.3% (Somanathan et al., 2021, Kumar and Singh, Babu et al., 2016, Kumar et al., 2018). The prevalence of hypoglycemia in Indonesian newborns was 18.2% (Yunarto and Sarosa, 2019). In Bangladesh Out of 186 admitted newborns, 32 (17.2%) were found to be hypoglycemic(Hassan et al., 2020).

In Africa, different studies were conducted from which in Nigeria the prevalence ranges from (11%-32.7%) (Ochoga et al., 2018, Dedeke et al., 2011, West and Aitafo, 2020). Another study in Uganda shows that the prevalence of neonatal hypoglycemia was 2.2% (Mukunya et al., 2020).

In Ethiopia, A study done in Addis Ababa public hospitals and east Harerge, Hiwet Fana Hospital reflects it was 20.8 % and 21.2% respectively(Sertsu et al., 2022, Fikirte Kasaye, 2021).

2.2. Factors Associated with Neonatal Hypoglycemia

2.2.1. Maternal-related factors

Due to the metabolic adaptation process, most healthy newborns experience low blood glucose levels in the first hours of life. This temporary decline quickly improves within hours and reaches normal ranges. However, some newborns experience more prolonged, recurrent, and severe hypoglycemia, particularly in the presence of specific risk factors. These risk factors for neonatal hypoglycemia can be grouped into four main categories. They are socio-demographic factors (maternal age, occupation, educational status), obstetric factors (mode of delivery, ANC follow-up, parity,) neonatal factors (gestational age, sex, birth weight, being small for gestational age (SGA) or large for gestational age (LGA), IDM and hypothermia), and maternal factors like having chronic illness, parity and maternal drug use.

Despite several studies not showing a significant relationship between neonatal hypoglycemia and socio-demographic factors, some studies show that it has an association with maternal age. According to a study done in Japan and Ethiopia, maternal age has a significant association with neonatal hypoglycemia (Shimokawa et al., 2019, Patel et al., 2020, Fantahun and Nurussen, 2020).

A retrospective cohort study done in Japan shows that mothers with age over 35 are 3.3 times more likely to develop neonatal hypoglycemia than their counterparts (Shimokawa et al., 2019). Similarly in Ethiopia, a cross-sectional study done in St. Paulo revealed that newborns with mothers aged above 35 were at higher risk of developing neonatal hypoglycemia (Fantahun and Nurussen, 2020). However, those studies state that there is no significant association between maternal occupation, educational status, and marital status with hypoglycemia.

The fetus depends on maternal metabolism and placental circulation to provide the glucose that is necessary to meet its energy requirements(Tin, 2014). The placenta supplies fetal circulation with a direct source of glucose (Tin, 2014, Harding et al., 2017). Clamping the umbilical cord at birth abruptly disrupts this continuous source of glucose, resulting in a rapid decline in blood glucose levels in the first 2 to 3 hours of life(Harding et al., 2017, Tin, 2014). In addition to this several maternal-related factors which include diabetes mellitus (GDM), maternal hypertension, pre-eclampsia, and beta-blocker drug usage are associated with neonatal hypoglycemia.

Related to prolonged elevations in maternal glucose concentrations which is GDM may result in fetal hyperglycemia and pancreatic overstimulation to increase endogenous fetal insulin production (Sharma et al., 2017). Studies conducted in China, Bangladesh, India, and Ethiopia reveals that GDM was a risk factor for developing neonatal hypoglycemia (Zhao et al., 2020, Hassan et al., 2020, Kole et al., 2020, Sertsu et al., 2022). A study in China shows that neonates who are born from mother having GDM have twice the risk of developing hypoglycemia(Zhao et al., 2020) and in Bangladesh, the risk of developing hypoglycemia is 1.32 times more likely than their counterparts(Hassan et al., 2020).

Similarly, a cross-sectional study in India shows that 20-21% of hypoglycemic neonates were born from mothers having GDM (Somanathan et al., 2021, Kumar and Singh) While research in Alpert Medical School of brown university indicates 39% of women with GDM had a neonate with hypoglycemia(Kole et al., 2020). In Ethiopia, a study conducted in Addis Abeba and Harare neonates born from a mother with gestational DM were 7.79 and 2.34 times more likely to develop hypoglycemia compared to those neonates born from a non-diabetic mother respectively(Sertsu et al., 2022).

Infants experiencing perinatal stress (e.g., fetal distress, perinatal ischemia, maternal preeclampsia/eclampsia, sepsis, hypothermia) or those with congenital heart disease are at increased risk of neonatal hypoglycemia (Adamkin, 2017, Thornton et al., 2015, Sharma et al., 2017).

A cross-sectional study done in Canada and Colombia states that maternal hypertension was significantly associated with neonatal hypoglycemia with odds of 3.07 and 4.38 respectively (Mitchell et al., 2020, Cristo Colmenares et al., 2021). Also a study done in India and Bangladesh shows there is an association between neonatal hypoglycemia neonatal hypoglycemia and maternal hypertension (Hassan et al., 2020, Somanathan et al., 2021).

Another factor associated with neonatal hypoglycemia is maternal use of medication like beta-blockers. A study performed in China states maternal use of beta-blockers increases the occurrence of neonatal hypoglycemia by 2.6(Liu et al., 2019). Similarly a finding in United States reveals the risk of neonatal hypoglycemia was 4.3% in the βeta-blocker–exposed neonates versus 1.2% in the unexposed (Bateman et al., 2016). Others like antenatal magnesium sulfate

usage are also a significant risk factor for neonatal hypoglycemia with an odds of 2.53(Mitchell et al., 2020).

2.2.2. Obstetrics-related factors of neonatal hypoglycemia

Obstetric factors like parity, mode of delivery, the premature rapture of the membrane, and twin pregnancy have an association with neonatal hypoglycemia. According to a retrospective cohort study done in Michigan neonates who were delivered through cesarean section were 4.1 times more likely to be born with neonatal hypoglycemia than vaginal delivery. In this study, those neonates who delivered from prim parity mothers were 1.6 times more likely to be born with neonatal hypoglycemia than multiparty mothers. Likewise, macrosomia and lower gestational age were independent risk factors for neonatal hypoglycemia (Ogunyemi et al., 2017).

A cross-sectional study conducted in West Bengal states the magnitude of neonatal hypoglycemia among cesarean-section delivery at 48 hours was 16.3% (Meyur et al., 2014). As well the study conducted in Colombia showed that neonates born by cesarean section were found 2.5 times at higher risk of hypoglycemia than spontaneous vaginal delivery(Cristo Colmenares et al., 2021). In India neonates born by cesarean section and born from multigravida mothers were found with a higher risk of hypoglycemia (Patel et al., 2020).

Concerning the issue of parity, according to a study conducted in Denmark Primi-parity mothers had a 1.29 times increased risk of delivering a baby with hypoglycemia compared with multi para. In India and Nigeria, 1% and 28.2% of mothers with PROM deliver a baby with hypoglycemia respectively (West and Aitafo, 2020).

2.2.3. Neonatal-related factors of hypoglycemia

Most of the time neonatal hypoglycemia occurs due to neonatal-related factors which includes prematurity, hypothermia, LBW, SGA, LGA, delayed initiation of breastfeeding, and other comorbid illness.

The majority of the literature shows there was a strong association between prematurity and Hypoglycemia. Globally nearly 30–60% of these premature infants are hypoglycemic and require immediate intervention(Sharma et al., 2017). A cross-sectional study conducted in the USA, Netherlands, Indonesia, Bangladesh, Israel, and Ethiopia premature neonates have a high

risk of developing hypoglycemia with odds of 0.66, 1.84, 6.53, 2.44, 1.49, and 3 respectively(Sharma et al., 2017, Blank et al., 2018, Yunarto and Sarosa, 2019, Hassan et al., 2020, Bromiker et al., 2019, Sertsu et al., 2022). Also, research in India indicates that 27% of premature neonates have hypoglycemia (Kumar and Singh). In addition, studies in Turkey and Nigeria also have shown an association(Özge and Deniz, Ochoga et al., 2018).

In an observational study done in China low birth weight, preterm birth, and delay in initiation of breastfeeding have an association with hypoglycemia with odds of 1.91, 2.71, and 3.16 respectively(Zhao et al., 2020). Another study in Bangladesh also shows that low birth weight neonates have a 1.35 times higher risk of developing hypoglycemia than normal birth weight (Hassan et al., 2020), whereas the risk in Indonesia and Ethiopia is 2.94 and 4 respectively(Yunarto and Sarosa, 2019, Fantahun and Nurussen, 2020).

A study done in Bangladesh and Indonesia reveals that neonates with small and large for gestational age, have 2 times and 1.8 times having risk of developing hypoglycemia than those who are appropriate for gestational age respectively (Hassan et al., 2020, Yunarto and Sarosa, 2019). In India, 36% of neonates with SGA and LGA have the risk of developing hypoglycemia (Somanathan et al., 2021), also in Turkey SGA and LGA have an association with hypoglycemia(Özge and Deniz).

Neonatal hypoglycemia can be significantly caused by perinatal stress, including asphyxia. In Indonesia, research showed that those who have perinatal asphyxia have a 3.38 times risk of having hypoglycemia(Yunarto and Sarosa, 2019). There was evidence of a significant association with a low first-minute APGAR score (8.57%) and hypoglycemia(Cristo Colmenares et al., 2021).

After birth maintaining newborn body temperature is very important. When the baby gets cold the newborn uses up more glycogen to keep warm. Then the newborn must utilize glucose stores to keep warm, then the blood sugar drops and they become hypothermic along with hypoglycemic. Various evidence show that hypothermia is one of the major risk factor for hypoglycemia (Zhao et al., 2020, Hassan et al., 2020, Ochoga et al., 2018, Sertsu et al., 2022). In a cross-sectional study in Ethiopia, Hiwot Fana Hospital and St. Paulo's Hospital the odds of

developing risk of hypoglycemia in hypothermic neonates are 2.65 and 2 respectively(Sertsu et al., 2022, Fantahun and Nurussen, 2020).

Delayed initiation of breastfeeding is a major contributing factor to neonatal hypoglycemia. Research conducted in China, Uganda, and Ethiopia Harer late initiation of breastfeeding has shown that 3.2, 2.6, and 3.89 times higher risk of developing hypoglycemia (Sertsu et al., 2022, Mukunya et al., 2020, Zhao et al., 2020).

A cross-sectional study conducted in Iran and Ethiopia neonatal sepsis is indicated as a risk factor for hypoglycemia (Sertsu et al., 2022). Other factors shown as risk factors for hypoglycemia are twin pregnancy and female gender this is supported by a study conducted in Israel (Bromiker et al., 2019).

2.3. Conceptual Framework

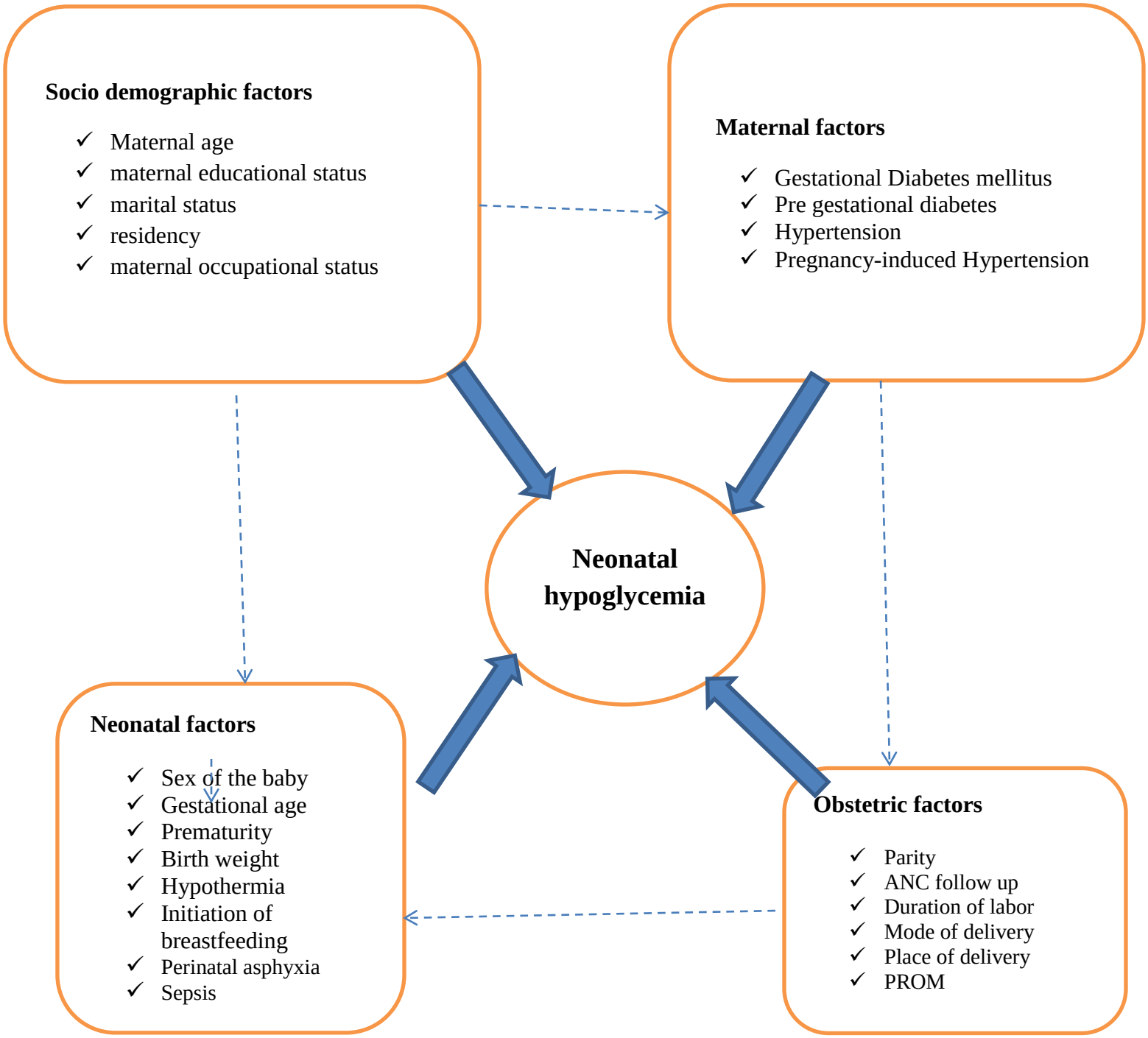

Figure 1: Conceptual framework adapted and modified from literature review (Kole et al., 2020, Hassan et al., 2020, Ochoga et al., 2018, Mitchell et al., 2020, Sertsu et al., 2022, Harris et al., 2014, Yunarto and Sarosa, 2019, Bromiker et al., 2019, West and Aitafo, 2020)

2.4. Research question

- What is the magnitude of neonatal hypoglycemia in Hawassa city public hospitals?
- What are factors associated with neonatal hypoglycemia in Hawassa city public hospitals?

3. Objectives

3.1. General Objective

- To assess the magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to the neonatal intensive care unit at Hawassa City Public Hospitals, Hawassa, Ethiopia, 2023.

3.2. Specific Objectives

- To determine the magnitude of neonatal hypoglycemia among neonates admitted in Hawassa City Public Hospitals, Hawassa, Ethiopia, 2023.
- To identify factors associated with neonatal hypoglycemia among neonates admitted in Hawassa City Public Hospitals, Hawassa, Ethiopia, 2023.

4. Methods and Materials

4.1. Study area

Hawassa City is the capital city of the newly emerged Sidama National Regional State and it is located 275 km south of far from Addis Ababa, Ethiopia. There are 9 hospitals (4 public and 5 private) in Hawassa City, as well as 12 public health centers and 18 health posts. The four public hospitals are Hawassa University Comprehensive Specialized Hospital (HUCSHHR), Adare General Hospital (AGHHR), Motite Furra Primary Hospital and Hawela Tula Primary Hospital (HTPH). Only the three hospitals have NICU. Hawassa University Comprehensive Specialized Hospital (HUCSHHR), the referral hospital, is anticipated to serve 10 to 18 million people with 406 nurses and it has an advanced NICU with average monthly admission of 148 neonates(HUCSHHR, 2023). The General Hospital, namely Adare General Hospital (AGHHR) has been serving about 1,260,458 people from this its NICU serves 109 neonates monthly and there are 195 nurses in it(AGHHR, 2023). Tulla Primary Hospital has been serving about 240,000 people. This NICU serves 42 neonates monthly and there are 64 nurses in it. All three hospitals follow Ethiopia's National Standard Treatment Guideline for Hospitals(TPHHR, 2023).

4.2. Study period

- The study was conducted from April 20- June 20, 2023

4.3. Study design

- An institutional-based cross-sectional study was conducted.

4.4. Source population and Study population

Source population

- All neonates who were admitted to the neonatal intensive care units of Hawassa city public hospitals are the source population

Study population

- All randomly selected neonates admitted to the neonatal intensive care unit of selected public hospitals during the study period were the study population

Study unit

- Each randomly selected neonates admitted to neonatal intensive care units of selected public hospitals during the study period were the study units.

4.5. Inclusion and Exclusion Criteria

Inclusion criteria

- All neonates who were admitted to NICU in the selected hospitals during the data collection period**.**

Exclusion criteria

- Neonates admitted without mothers or caregivers were excluded from the study

4.6. Sample size calculation

The sample size was determined for each specific objective and the highest was taken as the final sample size of the study. For the first objective single population proportion formula was used by taking the prevalence of neonatal hypoglycemia from the previous study done in Hiwot Fana Hospital, East Harerge, Ethiopia which is 21.2% (Sertsu et al., 2022). Considering the parameters of the single population proportion formula which are a marginal error of 0.05, a 95% confidence interval, and a p-value of 0.21 assuming a 15% non-response rate.

P=proportion hypoglycemia=21.2%
d = margin of error 5%
Z α/2= the corresponding Z score of 95% CI
N = Sample size

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

$$= \frac{(1.96)^2 * 0.21 * (1 - 0.21)}{0.0025} = 255$$

By adding a 15 % non-response rate, a total of 293 participants were included in the study.

- For the Second objective double population proportion was used. The sample size was calculated using factors associated with neonatal hypoglycemia which was taken from research done in Hiwot fana (Sertsu et al., 2022).

	Variable	Confidence level	Power	AOR	P2	non-response rate	N sample size
1	Preterm birth	95%	80%	3.06	17.7	15%	173
2	Hypothermia	95%	80%	2.65	14.1	15%	262
3	neonatal sepsis	95%	80%	2.61	18.9	15%	228
4	Diabetic mother	95%	80%	2.34	63.3	15%	283
5	delay in initiation of	95%	80%	3.89	19.7	15%	110

	breastfeeding for more than 1 h						

So the highest sample size was obtained by calculating using magnitude of neonatal hypoglycemia. Then after adding a 15% non-response rate the final sample size was **293**.

4.7. Sampling technique

Three public hospitals (Hawassa University Comprehensive Specialized Hospital, Adare General Hospital, and Tulla Primary Hospital) are found in Hawassa City which had NICU. Motite Furra Primary Hospital was excluded because it does not provide NICU service. To select the study participants from each hospital, the proportional allocation formula was used based on caseloads by fixing two months of admission before the survey. Finally to select each participants convenience sampling technique was used.

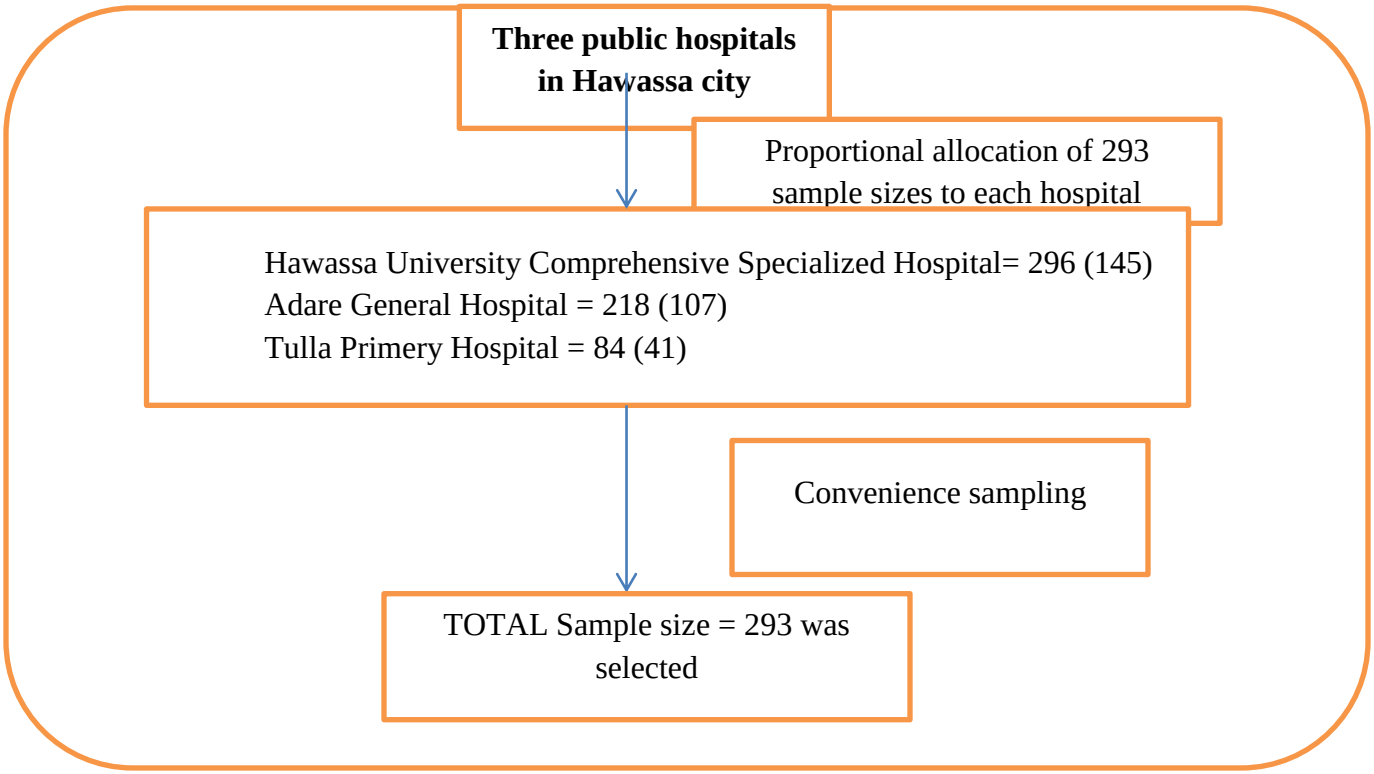

Figure 1: Schematic presentation of the sampling procedure in selected public Hospitals Hawassa, Ethiopia, 2023.

4.8. Variables of the study

Dependent variable

- Magnitude of Neonatal Hypoglycemia

Independent variables

Maternal related variables:

- maternal age
- marital status
- residency
- maternal education
- maternal occupation
- chronic illness

Obstetrics variables:

- Parity
- ANC follow-up
- Duration of labor
- Mode of delivery
- Place of delivery
- Type of pregnancy
- PROM
- The professional who conducts the delivery
- Gestational or pre-gestational DM
- Pregnancy-induced hypertension,(preeclampsia, Eclampsia

Neonatal-related variables:

- sex of the neonate
- Age at admission
- Gestational age
- Prematurity
- Birth weight
- Perinatal asphyxia
- Sepsis
- Jaundice
- RDS
- Birth Trauma

4.9. Operational definition

.

Neonatal hypoglycemia: - A measure of blood glucose level less than 40 mg/dl (EMOH, 2021).

Hypothermia: A neonate's axillary body temperature below 36.5 o C(EMOH, 2021).

Low birth weight: a newborn that weighs less than 2500 g.

Perinatal asphyxia: was considered when the 5th minute APGAR score is less than 7 or a neonate did not cry immediately at birth or resuscitation needed at birth and documented on the chart(EMOH, 2021).

4.10. Data collection tools and procedures

Both primary and secondary data (chart review) were used. The data collection tool was adopted from the previous study done at Addis Abeba (Tikur Anbessa and St., Paulos), and Harar, Hiwot Fana Hospital (Fikirte Kasaye, 2021). A structured interviewer-based questionnaire was used to collect data for maternal socio-demographic factors, such as age, marital status, educational, and occupational status, and for obstetric-related characteristics (parity, DM, hypertension, pregnancy-induced hypertension, and antenatal visits, 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 taken using a structured checklist from the medical records of a neonate during the data collection period.

Regarding the blood glucose level of the neonate, a blood sample was taken from the neonate, and their blood glucose level was measured using a glucometer. Blood glucose was determined using the Precisa Active Blood Glucose Meter at the admission. Blood glucose results were provided in mg/dl. Neonates who were found to be hypoglycemic were managed as per the NICU protocol.

For the data collection, three data collectors and one supervisor who were BSC nurses and who had research experience were chosen. Before data collection one-day training was given for data collectors and supervisors by principal investigators regarding the purpose of the study, the

contents of questionnaires, the method of data collection and how to keep confidentiality and privacy.

4.11. Data management and analysis

Data was checked for completeness and consistency and then it was cleaned, coded and entered using Epi data version 3.1 and it was exported to SPSS software version 25 for analysis. Cross-tabulation was done among dependent variables and independent variables. Frequencies, Percentage, mean and standard deviation were used to summarize descriptive statistics. Then to assess the variable that was significantly associated with neonatal hypoglycemia binary logistic regression and multiple logistic regression were done at p-value <0.25 and <0.05 respectively with a 95% Confidence interval. Hosmer and Lomenshow goodness of fit test was done to check model fitness and the model was fitted with a significance value 0.56. In addition, a multi-collinearity or tolerance test was done with all variables to solve the issue of confounding effects among independent variables. Finally tables and charts were used for data presentation.

4.12. Quality Assurance Technique

The questionnaire was prepared in English and translated to Amharic and sidammu-afu and then retranslated to English to check for inconsistency. The data collection tool was pretested on 5% (15 samples at Yirgalem Hospital two weeks before the actual data collection period and modifications were made accordingly. four data collectors were trained for one day and each was assigned to selected hospitals and they collected the data.

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

4.13. Ethical considerations

Ethical clearance was obtained from the Hawassa University College of Medicine and Health Science institutional review board. Then officials at different levels in the Hawassa city administration health office and hospitals were communicated through letters. The participants were informed about the purpose of the study and written informed consent was obtained from participants to confirm willingness. They were notified that they had the right to refuse or

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

4.14. Dissemination of the result

The result of the study will be submitted and presented to Hawassa University, College of Medicine and Health Science. The study result will also be submitted to Hawassa city public hospitals in which the study is conducted and the findings will also be presented in locally or internationally held seminars, workshops, conferences, and meetings and will be published in internationally or nationally recognized journals.

5. RESULT

5.1. Descriptive statistics of the result

5.1.1. Socio-demographic characteristics of the respondents

A total of 271 neonates were included with an overall response rate of 92.5%. Of those respondents, 163 (60.1%) of the mother's age were between 25 -34years and 58(21.4%) of their mothers were below the age of 24 years. The mean age of the mothers was 29.1 (±5.29) years. The majority of participants were living in urban areas 179(66.6%). Regarding the educational status of the mothers, a higher proportion of mothers 134(49.5%) completed secondary educational level. Concerning the marital status, 244 (90%) mothers were married. Whereas, five (1.8%) and thirteen (4.8%) mothers were widowed and divorced respectively. (Table 1)

Table 1:- Socio-demographic characteristics of the mothers of neonates on admission to the neonatal intensive care unit in Hawassa City Public Hospitals, Ethiopia 2023. (n=271)

Variable	Category	Frequency (n=271)	Percentage (%)
Age group (in a year)	≤24	58	21.4
	25-34	163	60.1
	≥35	50	18.5
Residence	Urban	179	66.1
	Rural	92	33.9
Educational status	No formal education	67	24.7
	Primary education	70	25.8
	Secondary education	75	27.7
	College and above	59	21.8
Occupation	Government employee	57	21.0
	private employee	51	18.8
	Merchant	50	18.5
	Daily Laborer	17	6.3
	Housewife	86	31.7
	Other*	10	3.7
Marital status	Single	7	2.6
	Married	246	90.8
	Widowed	5	1.8
	Divorced	13	4.8

Key: Others *= student, street women

5.1.2. Description of maternal and obstetric characteristics

In this study, the majority of 234(86.3%) of the mothers had ANC follow-up during the current pregnancy. Of these, 115(45.8%) had at least four ANC follow up. About 194 (71.9%) mothers had more than one child. Regarding the place of delivery, the majority of the neonates were delivered at health institutions of which 221(72.3%) were delivered at the hospital followed by 59(21.8%) at health centers. Concerning obstetrics history, 14(5.2%) of the mother had prolonged labor and higher proportions of the neonate 166(61.6%) were delivered through spontaneous vaginal delivery. Moreover, 121(44.6%) and 122(45%) of the delivery process were conducted by midwives and medical Doctors (general practitioners, residents and specialists) respectively (Table 2).

As shown in Table 2, Around 26(9.6%) of mothers had diabetes mellitus. Among those 13 (4.8%) of the mothers had gestational Diabetes mellitus and 13 (4.8%) of them had pre-gestational diabetes mellitus. Regarding pregnancy-induced hypertension, 41(15.1%) of mothers had developed it and 20(7.4%) of the mothers were preeclamptic. Regarding other chronic illnesses, 15(5.5%) of the mothers were hypertensive and 10(3.7%) were HIV/AIDs clients (Table 2).

Regarding the proportion of medical problems among exposed and non-exposed groups, higher proportion of neonates (53.8%) delivered from mothers with diabetes mellitus developed hypoglycemia than non-diabetic mothers (12.7%). On the same way, neonates delivered from mothers with hypertension have higher chance of (19.5%) developing neonatal hypoglycemia than non-hypertensive mothers (16.1%).

Table 2: Obstetric-related factors of neonatal hypoglycemia among neonates on admission to neonatal intensive care unit in Hawassa City public Hospitals, Ethiopia, 2023. (n=271)

Variable	Category	Frequency **(n=271)**	Percentage
ANC	Had no ANC follow-up	37	13.7
	Had 1-3 ANC follow-up	115	42.4
	Had >4 ANC follow-up	119	43.9
Number of children(parity)	1 child(Primi-parity)	77	28.4
	More than 1 children (Multi-parity)	194	71.9
Prolonged labor	Yes	14	5.2
	No	257	94.8
Place of delivery	Home	16	5.9
	Health Center	59	21.8
	Hospital	196	72.3
Position	Cephalic	221	81.5
	Non-cephalic	50	18.5
Mode of delivery	Spontaneous vaginal delivery	166	61.3
	Assisted vaginal delivery	31	11.4
	Cesarean Section	74	27.3
Premature rupture of membrane	Yes	58	21.4
	No	213	78.6
Type of pregnancy	Single	251	92.6
	Twin and above	20	7.4
Conducted by	Nurse	12	4.4
	Midwives	121	44.6
	Medical Doctor	122	45
	Traditional birth attendant	16	5.9
Diabetes Mellitus	Yes	26	9.6
	No	245	90.4
Pre-pregnancy DM	Yes	13	4.8
	No	258	95.2
Gestational DM	Yes	13	4.8
	No	258	95.2
Pregnancy-induced hypertension	Yes	41	15.1
	No	230	84.9
Preeclampsia	Yes	20	7.4
	No	251	92.6
Eclampsia	Yes	31	11.4
	No	240	88.6
Chronic Hypertension	Yes	15	5.5
	No	256	94.5
HIV/AIDs	Yes	10	3.7
	No	261	96.3

5.1.3. Neonatal-related variables

Among admitted neonates around 156 (57.6%) were male and more than half 171 (63.1%) were gestational age between 37-42 weeks. About 112 (41.3%) of them had birth weights between 2500gm - 4000gm. The majority of the neonates 216 (79.7%) were admitted within 24hr after delivery. Around, 119 (43.9%) of the neonates had hypothermia. Regarding feeding initiation time 99 (36.5%) of neonates started feeding within one hour (Table 3).

Concerning the neonatal-related comorbid illness, 241(88.9%) of neonates were admitted with comorbid illness. Among those 130(48%) had neonatal sepsis, 52(19.2%) had birth asphyxia, 38(14%) had respiratory distress syndrome, 30(11.1%) had Meconium Aspiration Syndrome and 53(19.6%) had jaundice.

Table 3. Neonatal-related predictors of hypoglycemia among neonates on admission to neonatal intensive care unit in Hawassa City public Hospitals, Ethiopia 2023. (n=271)

Variable	Category	Frequency (n=271)	Percentage
Sex	male	156	57.6
	female	115	42.4
GA	<37 weeks	96	35.4
	37-42 week	171	63.1
	>42 weeks	4	1.5
Birth weight	2500-3999	118	43.5
	<2500	112	41.3
	≥4000	28	10.3
Age at admission	<24 hours	213	78.6
	≥24 hours	58	21.4
Hypothermia	Yes	119	43.9
	No	152	56.1
Hypoglycemia	Yes	45	16.6
	No	226	83.4
Time of initiation of breast feeding	≤1 Hours	106	39.1
	>1 Hours	165	60.9
Is there any comorbid illness	Yes	241	88.9
	No	30	11.1
Neonatal sepsis	Yes	130	48.0
	No	141	52.0
Birth asphyxia	Yes	53	19.6
	No	218	80.4
Respiratory distress syndrome	Yes	38	14.0
	No	233	86.0
Meconium Aspiration Syndrome	Yes	30	11.1
	No	241	88.9
Jaundice	Yes	53	19.6
	No	218	80.4
Birth Trauma	Yes	25	9.2
	No	246	90.8
congenital anomaly	Yes	22	8.1
	No	249	91.9

5.2. The Magnitude of neonatal hypoglycemia

In this study, the overall magnitude of neonatal hypoglycemia was observed to be 45(16.6%) (Figure 2).

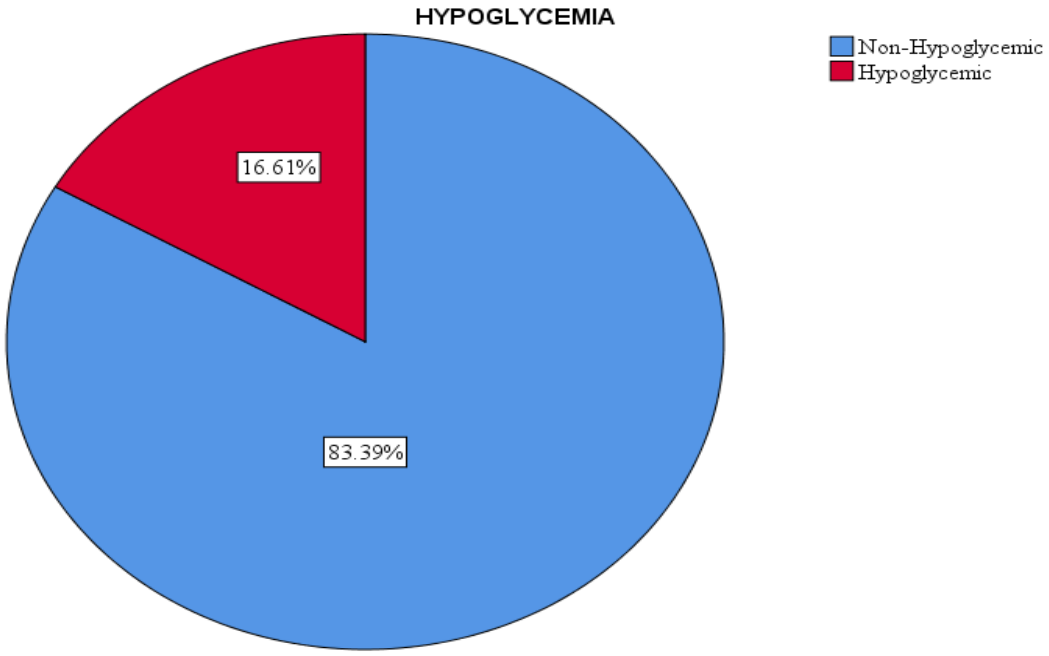

Figure 2. The magnitude of hypoglycemia among neonates on admission to neonatal intensive care unit in Hawassa City Public Hospitals, Ethiopia 2023. (n=271)

5.3. Factors associated with Neonatal Hypoglycemia

The bivariate logistic regression showed that diabetes mellitus, parity, antenatal care visits, prolonged labor, and preeclampsia were selected among maternal-related factors. In the same way, the age of the neonate, birth weight, neonatal sepsis, birth asphyxia, hypothermia, and time of initiation of breastfeeding were selected from neonatal-related risk factors.

After this, multiple logistic regression were done at p-value <0.05 with a 95% Confidence interval. Hosmer and Lomenshow goodness of fit test was done to check model fitness and the model was fitted. In addition, a multi-collinearity or tolerance test was done with all variables to solve the issue of confounding effects among independent variables.

After doing an adjustment for possible effects of confounding variables, diabetes mellitus, birth asphyxia, hypothermia and time of initiation of breastfeeding were independently associated with birth asphyxia.

The multivariable logistic regression result showed that those mothers who have had Diabetes mellitus were about ten times to have newborns suffering from neonatal hypoglycemia compared with those who had not [AOR=9.8, 95% CI(3.08-31.37)]. Neonates born with Birth asphyxia were nearly three times more likely to be hypoglycemic than their counterpart [AOR=2.87, 95% CI (1.07-7.72)]. Regarding the time of initiation of breastfeeding, neonates who start breastfeeding after one hour of delivery were approximately three times more likely to develop neonatal hypoglycemia than those who start within one hour [AOR=2.63, 95% CI(1.04-6.6)]. Similarly, neonates who develop neonatal hypothermia were nearly four times to be hypoglycemic than their counterparts [AOR=3.8, 95%CI (1.6-9.1)]. (Table-4)

Antenatal care visits, parity, prolonged labor, preeclampsia, birth weight, neonatal sepsis, and age at admission were not found to have statistically significant association with neonatal hypoglycemia in this study.

Table 4. Factors associated with Hypoglycemia among neonates on admission to neonatal intensive care unit in Hawassa public Hospitals, Ethiopia 2023. (n=271)

Variable	Category	Hypoglycemia (n=271)		COR	AOR
		Yes	No		
DM	1.Yes	14	12	8.05(3.4-18.99)	9.8(3.08-31.37)*
	2.No	31	214	1	1
Age of the neonate	1. < 24hr	32	181	1	1
	2. >24 hr	13	45	1.63(0.79-3.36)	2.407(0.92-6.30)
ANC follow up	1. No ANC followup	10	27	1.95(0.8-4.68)	2.35(0.73-7.62)
	2. 1-3 ANC follow up	16	99	0.85(0.4-1.75)	1.06(0.44-2.53)
	3. > 4 ANC follow up	19	100	1	1
Hypothermia	1. Yes	29	90	2.74(1.41-5.33)	3.8(1.6-9.1)*
	2. No	16	136	1	1
Birth weight	1. 2500-3999	16	102	1	1
	2. <2500	18	94	1.22(0.59-2.53)	0.82(0.32-2.1)
	3. ≥4000	9	19	3.02(1.16-7.83)	1.9(0.52-6.7)
Prolonged labor	1. Yes	4	10	0.48(0.14-1.59)	1.65(0.35-7.56)
	2. No	41	216	1	1
Number of children (parity)	1. 1 child	17	60	1.68(0.86-3.29)	1.34(0.56-3.2)
	2. More than 1 children	28	166	1	1
Preeclampsia	1. Yes	7	13	3.02(1.13-8.05)	2.2(0.64-7.3)
	2. No	38	213	1	1
Perinatal asphyxia	1. Yes	14	39	2.17(1.06-4.45)	2.87(1.07-7.72)*
	2. No	32	187	1	1
Sepsis	1. Yes	26	104	1.6(0.84-3.07)	1.76(0.77-4.05)
	2. No	19	122	1	1
Delayed initiation of breast feeding	1. Yes	37	128	3.54(1.58-7.9)	2.63(1.04-6.6)*
	2. No	8	98	1	1

-*p-value<0.05 significantly associated with neonatal hypoglycemia

6. Discussion

Hypoglycemia is one of a metabolic disturbance which occurs during the neonatal period. Screening at-risk infants and the management of low blood glucose levels in the first hours to days of life is a frequent issue in the care of newborn infants. If it is persistent and not detected early, it could lead to adverse neurological complications and poor prognosis. So this study was targeted to identify factors associated with neonatal hypoglycemia.

In this study, the prevalence of neonatal hypoglycemia at the admission point was 16.6% among neonates in the Neonatal intensive care unit, in Hawassa city. This study is in line with a study conducted in West Bengal and India which was 16.3% and 15.2% respectively (Meyur et al., 2014, Singh et al., 2014). On the other hand the finding was lower than the study carried out in Ethiopia St. Paul at 25% and Nigeria at 32.7 % (Fantahun and Nurussen, 2020, Dedeke et al., 2011). This might be due to that these two studies used a higher cut-off point to diagnose neonatal hypoglycemia which is 47mg/dl.

In contrast, the magnitude of neonatal hypoglycemia was higher than the study conducted in USA(3.2%)(Hosagasi et al., 2018), India(8.2%) (Babu et al., 2016), Nigeria (11%) (Ochoga et al., 2018), and Madagascar (3.1%) (Sambany et al., 2013). The possible reasons may be, because our study includes infants of diabetic mothers, neonates born from hypertensive mothers, and newborns with severe congenital malformation which were excluded in the above study areas. Another study done in Uganda showed a 2.2% prevalence, which is much lower compared to the current study (Mukunya et al., 2020). The possible explanation for this may be that the study conducted in Uganda was community-based which is different from institutional based and large number of study participants involved in the study.

Regarding factors associated with neonatal Hypoglycemia, Diabetes mellitus (gestational Diabetes mellitus Pre-diabetes mellitus), perinatal asphyxia, delayed initiation of breastfeeding and the presence of Hypothermia were independently associated with it.

The current study finding revealed that neonates born from mothers with diabetes mellitus were nearly ten times more likely to have hypoglycemia compared with non-diabetic mothers. This study finding was supported by the study done in Ethiopia (Addis Ababa Black Loin Hospital and Harer Hiwot Fana Hospital), South Africa, Bangladesh, and China (Fikirte Kasaye, 2021,

Sertsu et al., 2022, Zhao et al., 2020, Magadla et al., 2019, Hassan et al., 2020). This finding was can be justified by the fact that infants of diabetic mothers have hyper-insulinemia caused by high maternal glucose levels and after birth when maternal glucose is withdrawn the baby may develop hypoglycemia(Bamehrez, 2023).

In contrast, the study carried out in St. Paul's, Ethiopia, Indonesia and Israel, maternal DM was not found to be a contributing factor to neonatal hypoglycemia (Fantahun and Nurussen, 2020, Yunarto and Sarosa, 2019, Bromiker et al., 2019). The possible reason for maternal DM to be non-significant may be due to the intervention of early management of maternal DM. Another evidence for this variation may be due to absence or a small number of a mother with DM was found as a study participant.

Another factor that was found significantly associated with hypoglycemia was found to be perinatal asphyxia. Neonates born with perinatal asphyxia were nearly three times more likely to have hypoglycemia compared with non-asphyxia neonates. A similar result was also reported in Indonesia which showed that those who have perinatal asphyxia have a three times risk of having hypoglycemia(Yunarto and Sarosa, 2019). Evidence from china and Colombia suggests that hypoglycemia was significantly related to perinatal asphyxia (Zhou et al., 2015)(Cristo Colmenares et al., 2021). This may be due to the reason in perinatal asphyxia, increasing metabolic and energy demands are achieved transiently by increasing glucose production through glycogenolysis. Due to hypoxia, the infant switches to anaerobic metabolism, resulting in rapid exhaustion of glycogen stores, hypoglycemia, and lactic acedemia(Chandran et al., 2015).

Hypothermia was found to be one of the significant risk factors associated with hypoglycemia in this study. Neonates with hypothermia were four times more likely to have hypoglycemia than non-hypothermic. Various evidence show that hypothermia is one of the major risk factor for hypoglycemia (Zhao et al., 2020, Hassan et al., 2020, Ochoga et al., 2018, Sertsu et al., 2022). In a cross-sectional study in Ethiopia, Hiwot Fana Hospital and St. Paulo's Hospital the odds of developing risk of hypoglycemia in hypothermic neonates were three and two respectively (Sertsu et al., 2022, Fantahun and Nurussen, 2020). After birth maintaining newborn body temperature is very important. When the baby gets cold the newborn uses up more glycogen to

keep warm. Then the newborn must utilize glucose stores to keep warm, then the blood sugar drops and they become hypothermic along with hypoglycemic(Senadhi and Dutta, 2010).

Delayed initiation of breastfeeding is a major contributing factor to neonatal hypoglycemia. Newborns that started initial breastfeeding after one hour had a three times higher chance of developing neonatal hypoglycemia compared with those who started within one hour. Similarly, research conducted in China, Uganda and Ethiopia Harer, late initiation of breastfeeding has shown that three times higher risk of developing hypoglycemia (Sertsu et al., 2022, Zhao et al., 2020, Mukunya et al., 2020). This similarity can be due to the reason that neonates with delayed initiation of breastfeeding lacks the advantage early initiation of breastfeeding i.e. colostrum increases the blood glucose level within one hour and continuing breast feeding maintain infants at eu-glycemic state(Cordero et al., 2018).

7. Conclusion and Recommendations

7.1. Conclusion

In this study, the magnitude of hypoglycemia was high. The result of this study proved that maternal DM, delayed initiation feeding, hypothermia and perinatal asphyxia were associated with the increasing risk of neonatal hypoglycemia. Therefore, early initiation of feeding is an important factor to prevent hypoglycemia for all newborns. On the other hand, preventing, early detection and management of hypoglycemia should be done in neonates with hypothermia and perinatal asphyxia.

7.2. Recommendation

1. **Health care providers**
   - Health professionals should give emphasis on providing health education for mothers to improve the practice of early initiation of breastfeeding for all newborns and identify and take preventive measures for high-risk groups.
   - Health professionals should focus on early management of maternal DM, neonatal perinatal asphyxia and hypothermia.
2. **Policymakers**
   - Policymakers should focus on the provision of training on early detection, prevention and management of hypoglycemia and its risk factors for all health professionals who are attending delivery and working in neonatal intensive care units.
3. **Researchers**
   - Researchers should conduct further specific studies on high-risk groups like, infants of diabetic mothers, neonates with birth asphyxia, neonates with hypothermia and other risk groups.
   - To support the current evidence researchers should conduct community based research on neonatal hypoglycemia.

8. Strengths and Limitations of the Study

8.1. Strength of the study

- This study used primary data for blood glucose measurement, so it reduces information bias.

8.2. Limitation of the study

- Since this study is an institution based study it does not address the general community.
- The study doesn't incorporate laboratorial investigations like RFT, LFT, Bilirubin count etc.

9. Reference

ABRAMOWSKI, A., WARD, R. & HAMDAN, A. H. 2021. Neonatal hypoglycemia. *StatPearls [Internet]*. StatPearls Publishing.

ADAMKIN, D. H. Neonatal hypoglycemia. Seminars in Fetal and Neonatal Medicine, 2017. Elsevier, 36-41.

AGHHR, A. G. H. H. R. 2023. Number of serving population and staff profile.

ALSALEEM, M., SAADEH, L. & KAMAT, D. 2019. Neonatal Hypoglycemia: A Review. *Clin Pediatr (Phila),* 58**,** 1381-1386.

AMPONSAH, G., HAGAN, O. & OKAI, E. 2015. Neonatal Hypoglycaemia at Cape Coast Teaching Hospital. *Journal of the West African College of Surgeons,* 5**,** 100.

BABU, M., D'SOUZA, J. & SUSHEELA, C. 2016. Study of incidence, clinical profile and risk factors of neonatal hypoglycemia in a tertiary care hospital. *Int J Pediatr Res,* 3**,** 753.

BAMEHREZ, M. 2023. Hypoglycemia and associated comorbidities among newborns of mothers with diabetes in an academic tertiary care center. *Frontiers in Pediatrics,* 11.

BATEMAN, B. T., PATORNO, E., DESAI, R. J., SEELY, E. W., MOGUN, H., MAEDA, A., FISCHER, M. A., HERNANDEZ-DIAZ, S. & HUYBRECHTS, K. F. 2016. Late Pregnancy β Blocker Exposure and Risks of Neonatal Hypoglycemia and Bradycardia. *Pediatrics,* 138.

BLANK, C., VAN DILLEN, J. & HOGEVEEN, M. 2018. Primum non nocere: Earlier cessation of glucose monitoring is possible. *European Journal of Pediatrics,* 177**,** 1239-1245.

BROMIKER, R., PERRY, A., KASIRER, Y., EINAV, S., KLINGER, G. & LEVY-KHADEMI, F. 2019. Early neonatal hypoglycemia: incidence of and risk factors. A cohort study using universal point of care screening. *The Journal of Maternal-Fetal & Neonatal Medicine,* 32**,** 786-792.

CHANDRAN, S., SAMUEL RAJADURAI, V., ALIM ABDUL HAIUM, A. & HUSSAIN, K. 2015. Current perspectives on neonatal hypoglycemia, its management, and cerebral injury risk. *Research and reports in Neonatology***,** 17-30.

CORDERO, L., STENGER, M. R., LANDON, M. B. & NANKERVIS, C. A. 2018. Early feeding, hypoglycemia and breastfeeding initiation in infants born to women with pregestational diabetes mellitus. *J Neonatal Perinatal Med,* 11**,** 357-364.

CRISTO COLMENARES, J., BURBANO CAMACHO, E., ORTIZ, C. S. & GÓMEZ HOYOS, D. 2021. Risk factors for transient neonatal hypoglycemia in term individuals, case and control study in a hospital of Bogotá. *Revista Colombiana de Endocrinología, Diabetes & Metabolismo,* 7**,** 286-293.

DALSGAARD, B. T., RODRIGO-DOMINGO, M., KRONBORG, H. & HASLUND, H. 2019. Breastfeeding and skin-to-skin contact as non-pharmacological prevention of neonatal hypoglycemia in infants born to women with gestational diabetes; a Danish quasi-experimental study. *Sex Reprod Healthc,* 19**,** 1-8.

DEDEKE, I., OKENIYI, J., OWA, J. & OYEDEJI, G. 2011. Point-of-admission neonatal hypoglycaemia in a Nigerian tertiary hospital: incidence, risk factors and outcome. *Nigerian Journal of Paediatrics,* 38**,** 90-94.

DIXON, K. C., FERRIS, R. L., MARIKAR, D., CHONG, M., MITTAL, A., MANIKAM, L. & ROSE, P. J. 2017. Definition and monitoring of neonatal hypoglycaemia: a nationwide survey of NHS England Neonatal Units. *Archives of Disease in Childhood-Fetal and Neonatal Edition,* 102**,** F92-F93.

EDWARDS, T. & HARDING, J. E. 2021. Clinical aspects of neonatal hypoglycemia: a mini review. *Frontiers in pediatrics,* 8**,** 562251.

EMOH 2021. *neonatal intensive care unit management protocol*.

FANTAHUN, B. Y. & NURUSSEN, I. 2020. Prevalence and Risk factors of Hypoglycaemia in Neonates at St. Paul's Hospital Millennium Medical College Neonatal Intensive Care Unit, Ethiopia: A Cross Sectional Study.

FIKIRTE KASAYE, R. M., KEREBIH ABERE 2021. Prevalence and predictors of hypoglycemia among neonates on admission to NICU in Addis Ababa public Hospitals, Addis Ababa, Ethiopia, 2021. *Addis abeba university repository*

FLORES-LE ROUX, J. A., SAGARRA, E., BENAIGES, D., HERNANDEZ-RIVAS, E., CHILLARON, J. J., DE DOU, J. P., MUR, A., LOPEZ-VILCHEZ, M. A. & PEDRO-BOTET, J. 2012. A prospective evaluation of neonatal hypoglycaemia in infants of women with gestational diabetes mellitus. *Diabetes research and clinical practice,* 97**,** 217-222.

FONG, C. Y. & HARVEY, A. S. 2014. Variable outcome for epilepsy after neonatal hypoglycaemia. *Developmental Medicine & Child Neurology,* 56**,** 1093-1099.

HARDING, J. E., HARRIS, D. L., HEGARTY, J. E., ALSWEILER, J. M. & MCKINLAY, C. J. 2017. An emerging evidence base for the management of neonatal hypoglycaemia. *Early human development,* 104**,** 51-56.

HARRIS, D. L., WESTON, P. J., BATTIN, M. R. & HARDING, J. E. 2014. A survey of the management of neonatal hypoglycaemia within the Australian and New Zealand Neonatal Network. *Journal of Paediatrics and Child Health,* 50**,** E55-E62.

HARRIS, D. L., WESTON, P. J., GAMBLE, G. D. & HARDING, J. E. 2020. Glucose profiles in healthy term infants in the first 5 days: the Glucose in Well Babies (GLOW) Study. *The Journal of pediatrics,* 223**,** 34-41. e4.

HARRIS, D. L., WESTON, P. J. & HARDING, J. E. 2012. Incidence of neonatal hypoglycemia in babies identified as at risk. *The Journal of pediatrics,* 161**,** 787-791.

HASSAN, M., PERVEZ, A., BISWAS, R., DEBNATH, S. & SYFULLAH, K. 2020. Incidence and Risk Factors of Neonatal Hypoglycemia During the First 48 Hours of Life in a Tertiary Level Hospital. *Faridpur Medical College Journal,* 15**,** 12-15.

HAY, W. W., RAJU, T. N., HIGGINS, R. D., KALHAN, S. C. & DEVASKAR, S. U. 2009. Knowledge gaps and research needs for understanding and treating neonatal hypoglycemia: workshop report from Eunice Kennedy Shriver National Institute of Child Health and Human Development. *The Journal of pediatrics,* 155**,** 612-617.

HILLMAN, N. H., KALLAPUR, S. G. & JOBE, A. H. 2012. Physiology of transition from intrauterine to extrauterine life. *Clinics in perinatology,* 39**,** 769-783.

HOSAGASI, N. H., AYDIN, M., ZENCIROGLU, A., USTUN, N. & BEKEN, S. 2018. Incidence of hypoglycemia in newborns at risk and an audit of the 2011 American academy of pediatrics guideline for hypoglycemia. *Pediatrics & Neonatology,* 59**,** 368-374.

HUCSHHR, H. U. C. S. H. H. R. 2023. Number of serving population and staff profile.

KALLEM, V. R., PANDITA, A. & GUPTA, G. 2017. Hypoglycemia: when to treat? *Clinical Medicine Insights: Pediatrics,* 11**,** 1179556517748913.

KOLE, M. B., AYALA, N. K., CLARK, M. A., HAS, P., ESPOSITO, M. & WERNER, E. F. 2020. Factors associated with hypoglycemia among neonates born to mothers with gestational diabetes mellitus. *Diabetes Care,* 43**,** e194-e195.

KUMAR, T., VAIDEESWARAN, M. & SEERALAR, A. 2018. Incidence of hypoglycemia in newborns with risk factors. *Int J Contemp Pediatr,* 5**,** 1952-1955.

KUMAR, U. & SINGH, B. B. To determine the clinical profile of hypoglycemia in newborn and to determine the prevalence of hypoglycemia among neonates admitted in NICU. *European Journal of Molecular & Clinical Medicine (EJMCM),* 7**,** 2020.

KUTAMBA, E., LUBEGA, S., MUGALU, J., OUMA, J. & MUPERE, E. 2014. Dextrose boluses versus burette dextrose infusions in prevention of hypoglycemia among preterms admitted at Mulago Hospital: an open label randomized clinical trial. *African Health Sciences,* 14**,** 502-509.

LIU, Q., LING, G.-J., ZHANG, S.-Q., ZHAI, W.-Q. & CHEN, Y.-J. The effects on fetal outcome of the use of beta-blockers during pregnancy: a systematic review and meta-analysis. 2019.

MAGADLA, Y., VELAPHI, S. & MOOSA, F. 2019. Incidence of hypoglycaemia in late preterm and term infants born to women with diabetes mellitus. *South African Journal of Child Health,* 13**,** 78-83.

MEYUR, R., SADHU, A., BHAKTA, A., BANDYOPADHYAY, M., KUNDU, B., BHAUMIK, S., GHOSHAL, L. & PAL, B. 2014. INCIDENCE & CAUSES OF NEONATAL HYPOGLYCEMIA AFTER CESAREAN SECTION IN A RURAL SETUP OF WEST BENGAL. *Journal of Evolution of medical and Dental Sciences,* 3**,** 1191-1194.

MITCHELL, N. A., GRIMBLY, C., ROSOLOWSKY, E. T., O'REILLY, M., YASKINA, M., CHEUNG, P.-Y. & SCHMÖLZER, G. M. 2020. Incidence and risk factors for hypoglycemia during fetal-to-neonatal transition in premature infants. *Frontiers in pediatrics,* 8**,** 34.

MUKUNYA, D., ODONGKARA, B., PILOYA, T., NANKABIRWA, V., ACHORA, V., BATTE, C., DITAI, J., TYLLESKAR, T., NDEEZI, G. & KIGULI, S. 2020. Prevalence and factors associated with neonatal hypoglycemia in Northern Uganda: a community-based cross-sectional study. *Tropical Medicine and Health,* 48**,** 1-8.

OCHOGA, M. O., AONDOASEER, M., ABAH, R. O., OGBU, O., EJELIOGU, E. U. & TOLOUGH, G. I. 2018. Prevalence of Hypoglycaemia in Newborn at Benue State University Teaching Hospital, Makurdi, Benue State, Nigeria. *Open Journal of Pediatrics,* 8**,** 189-198.

OGUNYEMI, D., FRIEDMAN, P., BETCHER, K., WHITTEN, A., SUGIYAMA, N., QU, L., KOHN, A. & PAUL, H. 2017. Obstetrical correlates and perinatal consequences of neonatal hypoglycemia in term infants. *J Matern Fetal Neonatal Med,* 30**,** 1372-1377.

ÖZGE, Y. & DENIZ, A.-İ. Hypoglycemia Incidence in Babies Identified as at Risk. *Türkiye Çocuk Hastalıkları Dergisi,* 14**,** 512-517.

PATEL, P., GOGOI, P., DEB, S., PAUL, P. & YESMIN, S. 2020. Hypoglycemia in Exclusively Breast-fed High-Risk Neonates-A Hospital-Based Study. *Int J Pediatr Res,* 6**,** 066.

SAMBANY, E., PUSSARD, E., RAJAONARIVO, C., RAOBIJAONA, H. & BARENNES, H. 2013. Childhood dysglycemia: prevalence and outcome in a referral hospital. *PloS one,* 8**,** e65193.

SENADHI, V. & DUTTA, S. 2010. Recurrent Hypothermia and Hypoglycemia as the Initial Presentation of Hepatitis C: 724. *Official journal of the American College of Gastroenterology | ACG,* 105**,** S262.

SERTSU, A., NIGUSSIE, K., EYEBERU, A., TIBEBU, A., NEGASH, A., GETACHEW, T., DEBELLA, A. & DHERESA, M. 2022. Determinants of neonatal hypoglycemia among neonates admitted at Hiwot Fana Comprehensive Specialized University Hospital, Eastern Ethiopia: A retrospective cross-sectional study. *SAGE Open Medicine,* 10**,** 20503121221141801.

SHAH, R., HARDING, J., BROWN, J. & MCKINLAY, C. 2019. Neonatal Glycaemia and Neurodevelopmental Outcomes: A Systematic Review and Meta-Analysis. *Neonatology,* 115**,** 116-126.

SHARMA, A., DAVIS, A. & SHEKHAWAT, P. S. 2017. Hypoglycemia in the preterm neonate: etiopathogenesis, diagnosis, management and long-term outcomes. *Translational pediatrics,* 6**,** 335.

SHIMOKAWA, S., SAKATA, A., SUGA, Y., ISODA, K., ITAI, S., NAGASE, K., SHIMADA, T. & SAI, Y. 2019. Incidence and risk factors of neonatal hypoglycemia after ritodrine therapy in premature labor: a retrospective cohort study. *Journal of Pharmaceutical Health Care and Sciences,* 5**,** 1-7.

SINGH, Y. P., DEVI, T. R., GANGTE, D., DEVI, T. I., SINGH, N. N. & SINGH, M. A. 2014. Hypoglycemia in newborn in Manipur. *Journal of Medical Society,* 28**,** 108-111.

SOMANATHAN, S., POTHAPREGADA, S., VARADHAN, A. & MATHEW, R. 2021. Clinical profile of hypoglycemia in neonates admitted in neonatal intensive care unit of a tertiary care hospital. *International Journal of Contemporary Pediatrics,* 8**,** 341.

SRINIVASAN, G., PILDES, R., CATTAMANCHI, G., VOORA, S. & LILIEN, L. 1986. Plasma glucose values in normal neonates: a new look. *The Journal of pediatrics,* 109**,** 114-117.

STANESCU, A. & STOICESCU, S. 2014. Neonatal hypoglycemia screening in newborns from diabetic mothers-Arguments and controversies. *Journal of medicine and life,* 7**,** 51.

STANFORD, M. 2023. *Hypoglycemia in a Newborn Baby* [Online]. Available: https://www.stanfordchildrens.org/en/topic/default?id=hypoglycemia-in-the-newborn-90-P01961 [Accessed].

THORNTON, P. S., STANLEY, C. A., DE LEON, D. D., HARRIS, D., HAYMOND, M. W., HUSSAIN, K., LEVITSKY, L. L., MURAD, M. H., ROZANCE, P. J. & SIMMONS, R. A. 2015. Recommendations from the Pediatric Endocrine Society for evaluation and management of persistent hypoglycemia in neonates, infants, and children. *The Journal of pediatrics,* 167**,** 238-245.

TIN, W. Defining neonatal hypoglycaemia: a continuing debate. Seminars in Fetal and Neonatal Medicine, 2014. Elsevier, 27-32.

TPHHR, T. P. H. 2023. Number of serving population and staff profile.

WEST, B. & AITAFO, J. 2020. Prevalence and Clinical Outcome of Inborn Neonates with Hypoglycaemia at the Point of Admission as seen in Rivers State University Teaching Hospital, Nigeria. *Journal of Pediatrics, Perinatology and Child Health,* 4**,** 137-148.

YISMAW, A. E., GELAGAY, A. A. & SISAY, M. M. 2019. Survival and predictors among preterm neonates admitted at University of Gondar comprehensive specialized hospital neonatal intensive care unit, Northwest Ethiopia. *Italian journal of pediatrics,* 45**,** 1-11.

YUNARTO, Y. & SAROSA, G. I. 2019. Risk factors of neonatal hypoglycemia. *Paediatrica Indonesiana,* 59**,** 252-6.

ZHAO, T., LIU, Q., ZHOU, M., DAI, W., XU, Y., KUANG, L., MING, Y. & SUN, G. 2020. Identifying risk effectors involved in neonatal hypoglycemia occurrence. *Bioscience Reports,* 40.

ZHOU, W., YU, J., WU, Y. & ZHANG, H. 2015. Hypoglycemia incidence and risk factors assessment in hospitalized neonates. *The Journal of Maternal-Fetal & Neonatal Medicine,* 28**,** 422-425.

Appendix I: Information Sheet

Good morning/ afternoon?

My name is _____ Currently I am a graduate student at Hawassa University, College of medicine and Health Sciences School of nursing. And now I am conducting a study to assess magnitude of neonatal hypoglycemia and its associated factors among neonates admitted in Hawassa city Public Hospitals, Sidama region, Ethiopia, 2023.

Title of the research: Magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to neonatal intensive care unit at Hawassa city public hospitals, Ethiopia, 2023.

Objective: this study will be aimed to assess the magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to neonatal intensive care unit at Hawassa city public hospitals, Ethiopia.

Participants: All neonates admitted in Hawassa city public hospitals intensive care unit..

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 neonatal hypoglycemia. 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**:**

SelamTadele: Mobile: 0916604348, E-mail: selmesty1216@gmail.com

Appendix II: Consent Form

In signing this document, I am giving my consent to participate in the study entitled "Magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to neonatal intensive care unit at Hawassa city public hospitals, Ethiopia, 2023."

I have been informed that the purpose of this study is to assess the magnitude of neonatal hypoglycemia and its associated factors among neonates admitted to neonatal intensive care unit at Hawassa city public hospitals, Ethiopia. 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 Selam Tadele 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

Part I. Maternal-related Characteristics

s.no	Socio-demographic information	Possible responses	Remark
101	How old are you (mothers)?	-------- years	Interview
102	Where is your residence?	1. Urban 2. Rural	Interview
103	What is your marital status?	1. Single 2. Married 3. Divorced 4. Widowed	Interview
104	What is your educational level (status)?	1. no formal education 2. Primary Education 3. Secondary Education 4. College and above	Interview
105	What is your Occupation?	1. Government Employee 2. Private employee 3. Merchant 4. Daily labor 5. House Wife 6.Other,Specify _____	Interview
106	Does the mother have any medically diagnosed chronic illness?	1. Yes 2. No	Interview
107	IF yes which type do you have	1. DM 2. Hypertension 3. Heart failure 4. HIV/AIDs 5. If other specify_____	Interview

Part II. Obstetric characteristics

201	How many children does the mother have?	----------	Interview
202	Do you have ANC visit?	1. Yes 2. No	Interview
203	If yes how many times?	1. 1- 3 times 2. 4 and above	Interview
204	How long does labor stays?	--------hours	Interview/ Medical record
205	Where is the place of delivery?	1. Home 2. Health center 3. Hospital	Interview
206	Who conducted the delivery process?	1.nurse 2.Midwives 3. medical docter 4. Traditional birth attendant	Medical record/ Interview
207	What was the mode of delivery?	1.Spontaneous vaginal delivery 2. Assisted vaginal delivery 3. cesarean section	Interview/ Medical record
208	What was the position of the fetus during delivery?	1.cephalic 2. non cephalic	Interview/ Medical record
209	Type of pregnancy	1. Single 2. 2. Twin and above	Interview
210	Premature rupture of membrane	1. Yes 2. No	Interview/ Medical record
211	Does the mother have gestational diabetes mellitus?	1. Yes 2. No	Interview
212	Does the mothers had Pregnancy induced	1. yes 2. No	Interview

	hypertension?		
213	If yes which type	1. Preeclampsia	1. Yes 2. No
		2. eclampsia	3. Yes 3. No

Part III. Neonatal-related characteristics

301	Sex of the baby	1. male 2. female	Interview/ Medical record
302	Gestational age	-----week-------days	Medical record
303	Birth weight	-------gram	Medical record
304	Birth weight for gestational age	1. appropriate for gestational age 2. small for gestational age 3. Large for gestational age	Medical record
305	Age at admission	------hours /days	Medical record
306	Temperature at admission	----------	Medical record
307	Blood glucose level of the neonates at admission	_____	Measurement /Medical record
308	Time of initiation of feeding	1. with in1 hour 2. after 1 hour	Interview
309	Is there any comorbid illness	1. Yes 2. No	Medical record
310	If yes specify	1. Neonatal sepsis 2. Birth asphyxia 3. RDS 4. Neonatal Jaundice 5. MAS 6. Birth trauma 7. Congenital anomaly 8. Other specify _____	Medical record

Appendix IV፡ የአማርኛ መጠይቅ የተሳታፉዎች የመረጃ ቅፅ

ሰላም

ሥሜ **ሰላም ታደለ** ይባላል፤ በ ሀዋሳ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮላጅ፣ ነርሲንግ ትምህርት ክፍል የድህረ ምረቃ ተማሪ ስሆን ፡ በአሁኑ ሰዓት በ ሀዋሳ ከተማ ጥናቱ በሚካሄዴባቸው ሆስፒታልች ውስጥ በጨቅላ ህፃናት፡ ደም ዉስጥ የስኳር መጠን ማነስ እና አጋላጭ ሁኔታዎችን በመለየት የጥናትና ምርምር ስራ በመስራት ይ እገኛለሁ።

1. የጥናቱ ርዕስ፡ - በሀዋሳ ከተማ በሚገኙ መንግስት ሆስፒታሎች በጨቅላ ህፃናት ክፍል ውስጥ ተኝተው ለመታከም በሚመጡ ህፃናት ላይ የሚደረግ የጨቅሊ ህፃናት የደም ውስጥ የስኳር መጠን ማነስ እና አጋሊጭ ሁኔታዎች መለየት, 2015 ዓ.ም።

2. የጥናቱ አላማ፤ 2015 ዓ.ም በሀዋሳ ከተማ በሚገኙ መንግስት ሆስፒታሎች በጨቅሊ ህፃናት ክፍል ውስጥ ተኝተው ለመታከም በሚመጡ ህፃናት ሊይ የሚደረግ የጨቅሊ ህፃናት የደም ውስጥ የስኳር መጠን ማነስ እና አጋሊጭ ሁኔታዎችን መለየት ነው።

3. ተሳታፉዎች፡- ጥናቱ ወደሚደረግባቸዉ ሆስፒታሎች ተኝተው ለመታከም የሚመጡ ጨቅላ ህፃናት በሙሉ

4. የጎንዮሽ ጉዳት፡- በዚህ ጥናት መሳተፍ ምንም አይነት ጉዳት የለውም።

5. ጥቅማ ጥቅም፡- በጥናቱ ለሚሳተፈ ፍቃደኛ ተሳታፉዎች ምንም አይነት የገንዘብ ክፍያ የለም፣ ነገር ግን የጥናቱ ውጤት የህጻናት የደም ውስጥ የስኩር መጠን ማነስ ለመቆጣጠርና ለመከላከል ስለሚጠቅም በተዘዋዋሪ መንገድ ለሁሉም ህመምተኞች እንደሁም ለህብረተሰቡ የመጥቀም እድል ያኖረዋል። ስለዚህ የተወሰኑ ጥያቄዎችን ልጠይቅዎት እወዳለሁ። የእርስዎ በእውነት ሊይ የተመሰረተ መልስ ለዚህ ጥናት መሳካት አስተዋፅኦ ያደርጋሌል። እርስዎ የሚሰጡት መረጃ ከአጥኚውና ቃለመጠይቅ አድራጊው በስተቀር በማንኛውም መልኩ ለሌላኛው ወገን ተላልፎ አይሰጥም።

6. በጥናቱ የተከበረው መብት፡ ጥናቱ በእናትየው ሙሉ ፈቃደኝነት ሊይ የተመሰረተ ነው። በጥናቱ የመሳተፍም ያለመሳተፍም ሙሉ መብት አሎት።የጥናቱ አካል ለመሆን ፈቃደኛ ከሆነች መልስ ለመስጠት ፍቃደኛ ያልሆነችባቸውን ጥያቄ ያለመመለስ እንዱሁም ከጥናቱ በማንኛውም ጊዜ የማቋረጥ ሙሉ መብት ሲኖራት በዚህም ምክኒያት የሚደርስባት የተለየ ጥቅም መጓደል ወይም ጉዳት ፈጽሞ ሉኖር አይችልም።

7. የጥናቱ አድራሻ፡ ይህ ጥናት በሚካሄዴበት ማንኛውም ጊዜ የጥናቱን አካሄዴ በተመለከተ ወይም ሌላ ማንኛውም ጥያቄ ካሎት ከዚህ በታች በተሰጠው አድራሻ ማግኘት ይቻላል ። እስከ አሁን በነገርኮት ነገር ሊይ ጥያቄ ካሌት እኔን መጠየቅ ይችሊለ።

ስም፡ ሰላም ታደለ ስልክ 0916604348: + 251-916604348, ኢሜይል selmesty1216@gmail.com

Appendix V: የአማርኛ መጠይቅ ፎርም

የስምምነት መግለጫ ፎርም

ሀዋሳ ዩኒቨርሲቲ፤ጤና ሳይንስ ኮላጅ፤ነርሲንግ ትምህርት ክፍል፤ድህረ ምረቃ ፕሮግራም

እኔ ለዚህ ጥናት የስምምነት ፊርማዬን ስሰጥ፤የዚህ ጥናት ዓላማ በደንብ የተብራራልኝ ሲሆን የጥናቱንም ዓላማ ተረድቻለሁ። በዚሁ ጥናት ሊይ መሳተፍ በሙሉ ፈቃደኝነት ሊይ 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 በኔሊይ ምንም አይነት ጉዳት እንደሌለው በግልጽ ተረዴቻለሁ።በዚህ ጥናት ለመሳተፍ ስምምነቴን ስገልፅ ለምጠየቀው ጥያቄ በእውነት ሊይ የመሰረተ መልስ ለመስጠት የተስማማሁ መሆኔን አረጋግጣለሁ።በመብቴ ዙሪያም ሆነ ስለ ጥናቱ ማንኛውንም ያልገባኝን ጥያቄ መጠየቅ እንደምችል ተገልፆሌኛል። የመረጃ ሰጪ ፊርማ --_____------_____ ቀን _____

የተጀመረበት ሰአት _____የተጠናቀቀበት ሰዓት _____

የጠያቂውስም_____ፊርማ_____ቀን_____

_የተቆጣጣሪ፤ስም_____ፉርማ_____ ቀን_____

የመጠይቁ ውጤት፡

1. ሙሉ በሙለ የተሞላ

2. ያልተስማሙ

3. በከፊል የተሞላ

Appendix VI: የአማርኛ መጠይቅ ፎርም

በሀዋሳ ዩኒቨርሲቲ፤ ጤና ሳይንስ ኮሌጅ ፤ ነርሲንግ ትምህርት ክፍል፤ ድህረ ምረቃ ፕሮግራም ይህ መጠይቅ የተዘጋጀው በሀዋሳ ከተማ የህዝብ ሆስፒታሎች ውስጥ በጨቅላ ህፃናት የደም ውስጥ የስኳር መጠን ማነስ እና ችግሩን ሊያመጡ የሚችለ አጋሊጭ ሁኔታዎች ለመለየት ነው።

የመጠይቁ መለያ ቁጥር _____ የተቋሙ ስም _____

ክፍሌ 1፡ የወላጆች ማህበራዊ እና ስነ- ህዝብ መጠይቆች

ተ.	መጠይቆች	ምላሾች	ምርመራ
101	እዴሜዎ ስንት ነው?	------አመት	ቃለ መጠይቅ
102	የመኖሪያ ቦታዎ የት ነው?	1. ከተማ 2. ገጠር	ቃለ መጠይቅ
103	የጋብቻ ሁነታ	1. ያላገባች 2. ያገባች 3. የተፋታች 4. ባል የሞተባት	ቃለ መጠይቅ
104	የትምህርት ደረጃዎ ስንት ነው?	1.ማንበብም፡ሆነ፡መጻፍ የማይችሌ 2.የመጀመሪያ ደረጃ ትምህርት ያጠናቀቀች 3. የ2ኛ ደረጃ ያጠናቀቀች 4. ኮሌጅ እና ከዛ በሊይ	ቃለ መጠይቅ
105	የርስዎ የስራ ሁኔታ ምንድን	1.የመንግስት መ/ቤት፡ ተቀጣሪ	ቃለ መጠይቅ

	ነው?	2.የግል ድርጅት ተቀጣሪ 3. በንግድ ስራ ላይ ያለች 4. የቀን ሠራተኛ 5.የቤት እመቤት 6.ሌላ ካለ---------	
106	ከዚህ በፊት የቆየ የጤና ችግር አለዎት	1. አዎ 2. አይ	ቃለ መጠይቅ
107	ካለ ምን አይነት	1. የደም ግፊት 2. የስኩር በሽታ 3. የልብ ድካም 4. HIV/AIDs 5. ሌላ---------	ቃለ መጠይቅ

ክፍል 2፡- የእናትነት፤የወሊድ እና የስነ - ወሊድ መጠይቅ

201	ስንት ሌጆች አሎዎት?	--------	ቃለ መጠይቅ
202	የእርግዝና፡ክትትል ነበረዎት?	1. አዎ ------- አይ--------	ቃለ መጠይቅ
203	አዎ ከሀነ ምን ያክል ጊዜ	2. 1-3 ጊዜ 3. 4 እና ከዛ በሊይ	ቃለ መጠይቅ
204	በወሊዴ፡ጊዜ ምጡ የፈጀው ሰዓት	-------ሰአት	ቃለ መጠይቅ/ ከህክምና መዝገብ
205	ህፃኑ የተወለደበት ቦታ	1. ቤት ውስጥ 2. ጤና ጣቢያ 3. ሆስፒታል 4. ሌላ ይጥቀሱ_____._	ቃለ መጠይቅ

206	የወሊድ ሂደት የተከታተለው ባለሞያ ማን ነበር	1. ነርስ 2. ሚድዋይፍ 3. የህክምና ዶክተር 4. የለልምድ አዋላጅ	ቃለ መጠይቅ/ ከህክምና መዝገብ
207	የህፃኑ የአወላለድ ሁኔታ	1. በማህፀን 2. በመሳሪያ ድጋፍ 3. በቀዶጥገና	ቃለ መጠይቅ/ ከህክምና መዝገብ
208	በወሊድ ወቅት የህጻኑ አቀማመጥ ምን ነበር	1. በጭንቅላቱ ነበር 2. ከጭንቅላት ውጭ ባሉ	ቃለ መጠይቅ/ ከህክምና መዝገብ
209	ምን አይነት እርግዝና ነበር	1. ነጠላ 2. መንታ እና ከዛ በላይ	ቃለ መጠይቅ
210	የእንሽርት ውሃ ቀድሞ ፈሶ ነበር	1.አዎ 2. .አይ	ቃለ መጠይቅ
211	ከእርግዝናው፡ጋርተያይዞ፡የመጣ የስኳር፡ህመም አለብዎ	1.አዎ 2.አይ	ቃለ መጠይቅ
212	ከእርግዝናው፡ጋርተያይዞ፡የመጣ የደም፡ግፊት አለብዎ	1.አዎ 2.አይ	ቃለ መጠይቅ
212	አዎ ከሆን ምን አይነት ነበር	1. መካከለኛ	1.አዎ 2.አይ
		2. አደገኛ	1.አዎ 2.አይ

ክፍሌ 3፡ ህፃኑን፡የሚመለከቱ፡መጠይቆች

301	የ ህጻኑ ጾታ ምንድነው	1. ወንድ 2. ሴት	ቃለ መጠይቅ
302	ህጻኑ፡ሲወለድ፡የነበረው የእርግዝና፡እድሜ ስንት ነበር	-----ሳምንት----ቀን----	ከህክምና መዝገብ
303	ህፃኑ ሲወለድ የነበረው የክብደት	-----ግራም	ከህክምና መዝገብ

	መጠን ስንት ነበር		
304	የህጸቀኑ ክብደት ከእርግዝና እድሜው ሲነጻጸር ሰንት ነበር	1. ትክክለኛ ክብደት 2. አነስተኛ ክብደት 3. ትልቅ ክብደት	ከህክምና መዝገብ
305	ሆስፒታል ሲገባ የነበረው እድሜ	--------	ከህክምና መዝገብ
306	የህፃኑ የሰውነት የሙቀት መጠን	------	ከህክምና መዝገብ
307	የህፃኑ፡የደም-ውስጥ፡የስኳር፡መጠን	_____ሚ.ግ/ዴሲ ሊትር	ልኬት
308	ህፃኑ ለመጀመሪያ ጊዜ ጡት የጠባበት ሰዓት	1. በ1 ሰዓት፡ውስጥ 2. ከ1 ሰዓት፡በኋሊ	ከህክምና መዝገብ
309	ጎጻኑ ተጉዳኝ በሽታወች አሉት	1. አዎ ------- አይ--------	ከህክምና መዝገብ
310	ካለ ምን	1. ኢንፌክሽን 2. መታፈን 3. ትንፋሽ መጣት ችግር 4. ቢጫ መሆን 5. እንሽርት ውሀ መጠጣት 6. በወሊድ ወቅት የተከሰተ ጉዳት 7. ሲወለዱ ጀምሮ የተከሰተ ጉዳት 8. ሌላ----------	ከህክምና መዝገብ

Qa’miso I:Tase

Kerro galitta ?

Sumi’ya Salaam Taaddelete . Hawassi yuniversite fayyimmate sayinse kolleejena nersinge rosi mininni maasamammaraati, xa kayinni Hawassi katamu quchumira afantanno mootimmate hospitaalla giddo danqqullu qaaqquulli kiflera goxe xagisidhara dagganno qaaqquulli mundeete giddo sukkaarete bikki anjenna tennera reqeccishshanno ikkituba bada afate xiixallo assanni noomma.

Xiinxallote umo Hawassi katamu quchumira afantanno mootimmate hospitaalla giddo danqqullu qaaqquulli kiflera goxe xagisidhara dagganno qaaqquulli mundeete giddo sukkaarete bikki anjenna tennera reqeccishshanno ikkituba bada. 2015 M.D.

Xiinxallote mixo Hawassi katamu quchumira afantanno mootimmate hospitaalla giddo danqqullu qaaqquulli kiflera goxe xagisidhara dagganno qaaqquulli mundeete giddo sukkaarete bikki anjenna tennera reqeccishshanno ikkituba bada

Beeqqano tenne xiinxallo assinanni hospitaallara goxxe xagisi’rate dagganno danquulle qaaqquulle baala.

Ikkitaru daditanno dano tenne xiinxallo giddo beqqate balanxe hendoonni duno dino.

Afinanni horo tene xinxallo ledo afinanniti woxu horo dino kayinnilla tenne xiinxallo beeqqatete istraateejete qixxesate horo aanno . ikkinohura wole widoonni wole xagisi’raanno dagoomu tenne doogonni kaa’litinanni heedhinoonni.

Boode xa;muwa xa’mammahera hasireemma. Xa;mote leellishootta ammanama xiinxallo seeto gantanno tase afira dandiitannori qaru xiinxallaanchinna qaalu xa;mo xa;minoho callaho. Fassokkinni dawaro aatta gede ayirringunni wo’munni wo’ma beeqqa hoogate qoossokki agarintinote woy xiinxallote yannara injaa hoogihero aye yannara no qaali-xa’mo agura diindaatta . Atee yannirano xa’mo heedhuhero aante noo teesso horoonsidheenna hawassa dandiineemmo.

Selaam Taaddele bibila 0916604348; imeele selmesty1216@gmail.com

Qa’miso II: sumimmate qitse

Tenne sanadera malaatisate “Hawassi katamu quchumira afantanno mootimmate hospitaalla giddo danqqullu qaaqquulli kiflera goxe xagisidhara dagganno qaaqquulli mundeete giddo sukkaarete bikki anjenna tennera reqeccishshanno ikkituba bada, sidaamu qoqqowi ,itopia, 2023” yaanno uminni xiinxallote aano beqqate fajjaataamete .

Tenne xinxallo mixo Hawassi katamu quchumira afantanno mootimmate hospitaalla giddo danqqullu qaaqquulli kiflera goxe xagisidhara dagganno qaaqquulli mundeete giddo sukkaarete bikki anjenna tennera reqeccishshanno ikkituba bada keenate ikkinota kulloonnie .tenne xiinxallo giddo beeqqote assa wo’munni wo’ma banxe assinannite ikkinota buuxoomma xa’muwate ane dawaro wolu manniru uynannikkita kullonnie . konnira tenne xinxallo borro aye garinnino ane bade dileellishshanno. Ane beeqqo woy beeqqa hooga woy xa’muwate dawaro qola hoga ane aana mitto loyeno abbitanno kkita killonnie. Tenne xiinxallora beeqqa ayeenga

Mitte danono abbitannokkita buuxoomma xiinxallote daafira woy xiinxallote beqqaancho ikka’ya qoosso’ya daafira xa’mo heedhuero.

Salaam Taddelete dawaro qolite qixxabbinote .

Qaali-xa’mishshsu barra _____

Hananfoonui sa’aate _____

Jeefinsoonni sa’aate _____

Xa’maanchu su’ma _____mulaate _____barra_____

Qororaanchu su’ma _____malaate_____

Qaali xa’mote guma

1. Gumulamino
2. Fajjaataame diikkitino
3. Daratu gumulamino

Gafa 1 : dawaro qoltanno dagoomi akatta

A.k	Xa'muuwa	Dawaro
101	Dirikki me"ho	
102	Tessokki hikoyetti	1. Quchuma 2. Baadiyye
103	Adamate garu	1. assidhinote 2. di assidhinote 3. shiidhinote 4. gunnittete
104	Rosu derrikki	1. nabbawano borreessa no diidandaannokkiho 2. umi dirimi roso gudinohu 3. layinkki dirimi roso gudinohu 4. kolleejeejjenna hakkoyi aleenni
105	Loosikki maati	1. mootimmate loosaasinchote 2. hallanshu urrunsha loosaasinchote 3. daddaloho 4. barru loosaasinchote 5. mine amaati 6. wole
106	Rumuxxinohu fayyimmate qarri noohe	1. ee 2. deeni
107	Noohere hittohu	1. mundeete xiiwo 2. sukkaarete xibbi 3. HIV/AIDS 4. Wodanu daafuri 5. Wolu

Gafa 2 Amimmate ilatenna illanni gari xamuwa

201	Me”e higge illootta		
202	Godowinni heedhe ha’runso assiroo	1. Ee 2. Deeni	
203	Assiroottaro mageeshshi yannara	1. 1-3 geeshsha 2. 4nna haka aleenni	
204	Ilittawote gamgeeshshi yanno gamaamitto	------- saate	
205	Qaaqqu ilamino darga	1. Mine 2. Fayyimate agaro 3. Hospitaalete 4. Wolewaatiro kuuli	
206	Ilate yannaru harunsinohehu ayeeti	1. nersete 2. midwifereti 3. docteruho 4. rosichu ilshiiancho	
207	Qaaqqu ma garinni ilami	1. Niixote 2. irko assinenna 3. diireenna	
208	Qaaqqu ofollino gari hiittooti	1. Umiidinni 2. Umiidinni wolle	
209	Godowikki gari hittoho	1. mittoho 2. lakkuwahonna hakkuyi alenni	
210	Muxo raakee du;nantino	1. ee 2. deeini	
211	godowate ledo amadante daginno Sukkaarete dhibbe noohe	1. ee 2. deeini	
212	Godowate ledo amadante daggino mundeete xiiwo dhibba noohe	1. ee 2. deeini	
213	Nooheru hikoyeetti	Jaddonnite	1. ee

			2.deeini
		mereerimate	1.ee
			2.deeini

Gafa 3 qaaqqo la’anno xa’muwa

301	Koo/tee	1. Labbaaho 2. meyyaate
302	Qaaqqu godowa keeshshino yanna	
303	Qaaqqu ilamiwote bikka mageeshshiho	------ giramme
304	Hospitale eiwote magey yanna ikkinosi	-------
305	Qaaqunniha bisu iibbilli bikka	-------
306	Qaaqqunnniti mundee giddo sukkaare bikka	_____ mg/dl
307	Qaaqqu umo unuuna qana hanotino saate	1. mite sate giddo 2. mitte saate gedensaanni
308	Qaaqqoho dhibbu noosi	1. ee 2. dinosi
309	Noorono	1. infection 2. fugamate 3. foolu ta”a 4. muxo aga 5. dana baqqalu 6. ilate aananni iillinosi qarra 7. ilate aananni iillinosi qarra 8. wole