College of health Science School of medicine Department of pediatrics and child health

Magnitude , associated Factors, and Outcome of Neonatal Hyperglycemia among neonates admitted to NICU at TASH : cross sectional study

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Acronyms and abbreviations:

CPAP – Continuous positive air pressure
ELBW– Extremely low birth weight
EPT – Extremely preterm
GLUT – Glucose transporter
IUGR – Intrauterine growth retardation
IVH – Intraventricular hemorrhage
NEC – Necrotizing enterocolitis
NICU – Neonatal intensive care unit
ROP – Retinopathy of prematurity
SGA – Small for gestational age
VLBW – Very low birth weight
NHG- neonatal hyperglycemia

Abstract

Background
Hyperglycemia in neonates is a common metabolic disorder among preterm and critically ill newborns, occurring in one-third of preterm and small-for-gestational-age (SGA) infants. Hyperglycemia is most common in extremely preterm infants during the first week of life, with prevalence rates between 20-88%; in very low birth weight (VLBW) infants, prevalence is 40-80%. Multiple clinical determinants contribute to increased risk, particularly preterm delivery, low birth weight, disease progression, bloodstream infections, hypoxic events, depressed APGAR results, surgical stress, and metabolic stressors.

Acute consequences of neonatal hyperglycemia encompass fluid depletion, electrolyte imbalances, cerebral hemorrhage, and elevated mortality risk. Potential long-term sequelae involve neurodevelopmental impairments and vision-threatening retinopathy.

Method:
This facility-based study utilized a cross-sectional approach in the neonatal intensive care unit (NICU) of Tikur Anbesa Specialized Hospital (1/11/24 to 30/1/25) among 87 neonates (gestational age ≥28 weeks, ≤28 days of age). Participants were enrolled through consecutive sampling. A structured questionnaire was employed as the primary data collection instrument and review of medical records, measuring socio-demographics, maternal/neonatal clinical factors, and blood glucose levels. Prevalence of hyperglycemia was ascertained using descriptive statistics and chi-square tests (SPSS v26) for factors ($p<0.05$) and outcomes. Ethical approval was secured from Addis Ababa University.

Results:
Neonatal hyperglycemia prevalence was 9.1% (95% CI: 3.4–16.1). Preterm neonates (<37 weeks) were 1.7-fold more likely to have hyperglycemia (OR=1.7, 95% CI: 1.03–32.9, p=0.023), and maternal conditions (e.g., diabetes and PROM) increased the odds 43-fold (OR=43.1, 95% CI: 4.8–386.6, p=0.001). Jaundice was present in 31% of hyperglycemic neonates. Most neonates (97.7%) survived, with 87.5% survival in cases of hyperglycemia. Most common was normal birth weight (71.3%) and maternal age 25–34 years (71.3%).

1 Introduction

1.1 Background

Neonatal hyperglycemia (NHG) is a pathologic metabolic condition that occurs primarily in preterm and critically ill neonates, particularly those with extremely low birth weight (ELBW). In extremely low birth weight and preterm neonates, the incidence may be as great as 80% (1, 2). The high incidence is mainly due to the advances in newborn care, which have raised the incidence of NHG and its complications while at the same time improving survival in these high-risk neonates. As they need sufficient glycogen stores, the maturation of gluconeogenic pathways, and an integrated endocrine response—all of which may be compromised—achieving and maintaining normoglycemia in such infants is especially difficult.

Preterm labor, low birth weight, gestational or maternal diabetes, intrauterine growth retardation, neonatal infection, perinatal asphyxia, and the use of specific medications, i.e., systemic glucocorticoids, are some of the significant risk factors for NHG (1,2). Low income and inadequate prenatal care are also linked with hyperglycemia among other socioeconomic characteristics.

Both short-term and long-term, neonatal hyperglycemia (NHG) is accompanied by a number of adverse effects. Dehydration, electrolyte imbalance, intraventricular hemorrhage, and excessive mortality are some of the short-term effects that are implicated in NHG (1, 2). Retinopathy, neurological abnormalities, and a heightened risk of metabolic disease in later life are a few of the long-term consequences (1-4). Hyperglycemia secondary to parenteral nutrition has been associated with poor neurodevelopmental outcomes at 24 months, with infants having significant delays in the cognitive and motor domains (6). Hyperglycemic newborns, according to research, have a higher chance of death and also develop issues in comparison to their euglycemic counterparts.

1.2 Statement of the problem

Few studies have been conducted on NHG in low-income countries, although it is increasingly common and has serious consequences for infant health [5]. But from evidence available to date, the NHG is associated with poor morbidities, such as higher mortality, neurodevelopmental impairment, and long-term metabolic changes (1, 2).

We know very little, though, about how these determinants are actually present in Ethiopia, whose health care system and economic conditions differ greatly from the more industrialized nations. Since Tikur Anbessa Specialized Hospital is a teaching tertiary hospital in Addis Ababa, Ethiopia, studies should be conducted to determine the status of NHG, its prevalence there, risk factors for developing it, and information on the outcome of affected neonates at discharge.

Mother's socioeconomic status, prenatal traits, and ease of access to health care are all factors that lend to the greater risk of NHG (5). Such kinds of information do not exist abundantly and could not be generalized, particularly to Ethiopia.

A newborn with impacted conditions can also have long-lasting effects from untreated NHG, such as compromised intellectual ability and increased healthcare costs. [1—2] With the advancements in neonatal care, which have increased the survival rate of preterm and LBW infants, there is a necessity to determine the prevalence and risk factors of NHG in this high-risk group. Determination of these risk factors will facilitate an improvement in clinical management and provision of information required for the development of targeted therapy designed to reduce the adverse effects of NHG.

1.3 Significance of the study

The study is to fill some gaps in the existing literature and experience in Ethiopia and particularly at Tikur Anbessa Specialized Hospital about neonatal hyperglycemia.

Through systematically identifying the prevalence of NHG, associated risk factors, and discharged outcomes in the neonatal intensive care unit (NICU) at Tikur Anbessa Specialized Hospital (TASH) in Ethiopia.

By addressing NHG, the research provides evidence-based findings that can be used to inform interventions and health policies, ultimately contributing to the health and well-being of susceptible newborn populations.

The results of this research constitute the foundation for subsequent research studies regarding neonatal hyperglycemia in Ethiopia.

2 LITERATURE REVIEW

Definition of Neonatal Hyperglycemia:

Neonatal hyperglycemia (NHG) is defined as a condition characterized by elevated blood glucose levels in neonates. While there is no universally accepted threshold for what constitutes "high" blood glucose in this population, most standard textbooks and studies agree that levels exceeding 150 mg/dL (8.3 mmol/L) are indicative of hyperglycemia. [1, 2, 5] Understanding NHG is crucial, as it poses significant health risks for affected neonates and represents a major obstacle to their overall well-being.

Prevalence and incidence of Neonatal Hyperglycemia:

Studies on the incidence of neonatal hyperglycemia among neonates admitted to NICUs indicate varying rates of incidence between 20 and 88%. Such conditions are more easily observed in preterm and VLBW babies, with incidences ranging up to 80% in the high-risk populations (1, 2). The degree of this variation speaks to the importance of standardizing the assessment criteria and enshrining the monitoring processes.

This variation in prevalence rates shows that there are deficits in existing modes of surveillance as well as methods of glucose monitoring used in NICUs. Continuous monitoring and reporting of neonatal hyperglycemia as an epidemiological entity is critical for such groups of populations; hence, the idea of effective surveillance systems (3, 4). Improved surveillance could allow for early identification of such infants and ensure that appropriate interventions are instituted that would improve their health.

The study by Adamkin et al. in Pediatrics in 1986 provides an overview of the incidence and patterns of hyperglycemia and hypoglycemia in very low birth weight (VLBW) babies. The prospective study enrolled 102 VLBW infants. Mean gestational age was 29 weeks. Mean birth weight was 1136 grams. Hyperglycemia was characterized by the researchers as blood glucose >150 mg/dL. For the subjects of the study, 58% of them developed hyperglycemia while they were admitted to NICU. The median duration of the episode of hyperglycemia lasted for 2 days. In some infants, there was a maximum duration of 16 days. The present study highlighted the high incidence of hyperglycemia in VLBW infants. It emphasized the need for careful monitoring. Maintenance of normal blood glucose in this group of individuals is imperative. [7]

The 2006 retrospective analysis by Kao et al. published in the American Journal of Perinatology was used to determine the prevalence of hyperglycemia in extremely low birth weight (ELBW) neonates admitted to NICU. There were 100 ELBW neonates studied. The gestational age was 25 weeks as a mean. The average birth weight was 753 grams. Hyperglycemia was defined as a blood glucose level greater than 150 mg/dL. Researchers found an astounding 70% of ELBW babies developed hyperglycemia during their NICU stay. The median duration of hyperglycemic courses was 3 days. The maximum duration found was 36 days. This study proves to have a high prevalence of neonatal hyperglycemia in the ELBW population. It stresses the importance of early diagnosis. It stresses the treatment of such a metabolic disorder. Early treatment is vital for these severely ill newborns.

Alsweiler et al.'s retrospective study in the 2012 Journal of Pediatrics aimed to determine the incidence of neonatal hyperglycemia and its association with adverse outcomes in extremely low birth weight (ELBW) infants. The study comprised 413 ELBW infants. They also had a mean gestational age of 26 weeks. The calculated average birth mass was 806 grams across subjects. Hyperglycemia was diagnosed if the blood glucose concentration exceeded 180 mg/dL. Scientists determined that 53% of patients had neonatal hyperglycemia during NICU. The median duration was 3 days. The longest duration was 21 days. This study determined the high incidence of neonatal hyperglycemia in ELBW neonates. It also examined its association with increased risks. Intraventricular hemorrhage. Retinopathy of prematurity and mortality were utilized. Early identification was emphasized as being required. Adequate management of the hyperglycemia was also important in this vulnerable population. [9]

Müller and Schneider, in their 2020 cross-sectional study, pointed to the prevalence as well as neonatal hyperglycemia's risk factors for preterm babies admitted to one neonatal intensive care unit. The population involved 300 babies, and results indicated that hyperglycemia was present in 40% of the baby population during their stay in the hospital, with an impressive 70% rate found in those having very low birth weight (VLBW). The study determined intravenous glucose administration and gestational age as the primary causes of the condition. It was the authors' opinion that the widespread prevalence of hyperglycemia among VLBW infants necessitated having elevated monitoring and managing practices geared towards avoiding associated health complications. [3]

Risk factors associated with the development of neonatal hyperglycemia:

NNH is more common among preterm and VLBW infants because their glucose control mechanisms are still in their developmental stage, and their pancreatic function is not fully developed. Such an impairment affects their capability and efficiency in regulating blood glucose levels (1, 2). Non-nutritive pathogens affecting neonates often present with critical diseases like sepsis and respiratory distress, leading to metabolic stresses, thus worsening glucose homeostasis (2, 3, 4). Moreover, the administration of drugs such as glucocorticoids, especially when combined with parenteral nutrition, can exacerbate the glucose imbalance in these infants.

Maternal factors are also known to contribute to the development of NHG, and those include the following. These include diabetes, obesity, and gestational diabetes, as they exert a direct impact on fetal metabolism. In addition, some infants born with congenital hyperinsulinism have inherent genetic susceptibility to hyperglycemia as well (3, 4, 5). This is because factors such as a high level of glucose or lack of adequate nutrition also play a role in metabolisms. It is crucial to recognize the multiple interactions of these risk factors in the development of NHG and therefore indicate the need for the appropriate approaches to the organization of neonatal care.

A 2017 cross-sectional study of 60 VLBW infants in an Egyptian NICU identified that 66.7% of the children presented with hyperglycemia in the first week of life. Of all hyperglycemic patients, 50% presented with severe hyperglycemia, the remaining had moderate hyperglycemia (40%), and mild hyperglycemia (10%). The authors learned that conditions associated with an increased risk included low birth weight, low gestational age, placental insufficiency, inotropic support, and delayed milk feeding initiation. Interestingly, neonatal hyperglycemia was significantly related to unfavorable clinical outcomes such as intraventricular hemorrhage, prolonged NICU stay, and increased mortality.

A cross-sectional study in 2020 among neonates admitted to a tertiary hospital in Ibadan, Nigeria, with 500 participants. The researchers found that 6 % of neonates had hyperglycemia, i.e., blood glucose levels in excess of 150 mg/dL (8.3 mmol/L). Notably, the research found some maternal and newborn factors that were linked to hyperglycemia, including low income, no antenatal care, vaginal delivery, grand multiparity, RD, suspected sepsis, and neonatal anemia. Most significantly, neonatal hyperglycemia had a forceful correlation with a very high probability of death. These findings emphasize the high frequency of this condition and the necessity for targeted interventions to address the known risk factors and improve the care of neonatal hyperglycemia, especially in the group at risk [5].

In their systematic review in 2019, Harris and Jones sought to determine the risk factors for neonatal hyperglycemia through the synthesis of evidence from various neonatal intensive care units. The review included 25 studies with more than 5,000 preterm infants. Findings indicated that preterm birth was associated with a 2.5 times increased risk for the development of hyperglycemia, and low birth weight infants were at 3 times greater risk than normal weight infants. In addition, maternal diabetes was largely responsible for the development of hyperglycemia in newborns. The authors believed that by managing these identified risk factors with targeted interventions, the prevalence of neonatal hyperglycemia could be significantly reduced and the outcomes of at-risk infants improved. [1]
Pathophysiology of neonatal hyperglycemia

Neonatal hyperglycemia (NNH) is seen primarily in preterm and low birth weight infants due to disturbed equilibrium between glucose production and utilization in neonates with less mature pancreatic beta cells. Such neonates possess impaired insulin sensitivity and insufficient hormonal regulation for glucose homeostasis (1, 2). Because their endocrine processes are not well established, they are more vulnerable to having their glucose metabolism poorly controlled, a situation worsened by such processes as severe illness and inflammation that makes the body less responsive to insulin. Some medications, such as glucocorticoids, also have a profound influence on insulin sensitivity, which leads to hyperglycemia (3, 4).

Disruptions in glucose production and utilization, particularly due to impaired gluconeogenesis and dysfunctional glucose transport, further highlight metabolic dysfunction as a critical concern in high-risk neonates. When placed in a state of parenteral or enteral glucose infusion, the glucose load will abruptly overwhelm the neonate's glucose metabolic control. Glucagon, catecholamine, and cortisol deficiencies are prevalent during states of acute illness or stress, thus causing further instability in patients' glucose control (3, 5). Rarely inherited illnesses such as congenital hyperinsulinism would disrupt insulin biosynthesis and secretion, resulting in chronic hyperglycemia. These pathophysiologic processes are all worthy of note when coming up with sufficient strategies in managing NHG.

Baker et al. covered the pathophysiology of hyperglycemia (HG) in neonates admitted to the ICU in a 2021 Journal of Pediatric Endocrinology & Metabolism. They conducted the research on neonates in the NICU cohort of 120 neonates of gestational age less than 32 weeks and birth weight less than 1500g. 58% of the infants were also found to be experiencing hyperglycemia, particularly those infants who were experiencing sepsis or respiratory distress. In conclusion, this research found that HG is of a multifactorial nature and impacts several factors such as pancreatic beta cell maturation, insulin resistance, osmotic stress, oxidative stress, and hormonal disorders.
The authors had indicated the need for optimal monitoring of the blood glucose level and therapeutic control of the glycemia in the NICU and suggested the guidelines for the subsequent glycemic control in this high-risk group of patients.

Morbidity, mortality, and long-term complications associated with neonatal hyperglycemia:

NNH has been associated with several clinical complications that directly relate to morbidity and mortality (1, 2). These NNH infants are susceptible to complications such as IVH, ROP, and NEC that prolong hospitalization. This is because mortality is much greater in very low birth weight and preterm infants with NHG, and some studies demonstrate that hyperglycemic newborns are at additional risk of death compared to euglycemic ones (4, 5). Essentially, such correlation highlights the importance of early diagnosis and intervention on neonatal wards.

Long-term effects of NNH of non-sustained hypoglycemia can be a spectrum of serious neurodevelopmental disorders and metabolic dysfunction during insulin resistance and the development of type II diabetes in later life (2, 5). Proposed mechanisms for these complications include osmotic injury, changes in cerebral blood flow, oxidative injury, and impaired gastrointestinal circulation, all of which can have lasting effects on health (1). In consideration of these compelling arguments for the influence of NHG on various short-term and long-term risks in patient care, the concept of early identification of the risk factors, prevention, and management strategies in clinical practice becomes an urgent task.

A retrospective study for 2002-2006 carried out by the Leiden University Medical Centre sought to establish the effect of neonatal hyperglycemia on the 859 very preterm infants born at ≤32 weeks gestation. Of these, 66 (8%) developed hyperglycemia requiring insulin therapy. Infants with hyperglycemia showed a 41% mortality rate, whereas those without hyperglycemia had only an 8% mortality rate. In 2-year corrected-age survivors of neonatal hyperglycemia, the growth was appropriate, but neurological and behavioral morbidity was greater compared to the control group. The researchers observed that sepsis risk was higher in infants with hyperglycemia, particularly those weighing over 1000 grams or born at 29–32 weeks of gestation. They emphasize the serious short- and long-term consequences of neonatal hyperglycemia in very preterm babies and the need to urgently implement more effective modes of prevention and treatment of this metabolic derangement in these vulnerable subjects. [10]

There was a prospective cohort study conducted in Italy in 2021 with the aim of assessing the effect of parenteral nutrition (PN) induced hyperglycemia (HG) on neurodevelopmental (NDV) in preterm infants. Researchers randomized 108 infants with gestational age <32 weeks or birth weight <1500g into two groups: infants who were exposed to moderate to severe HG (glucose >180 mg/dL) during Infants who experienced neonatal hyperglycemia (HG) in the first week of life were more likely to exhibit cognitive and motor developmental impairments at 24 months than those without HG exposure than the control group (44% vs. 22%, p= 0.024; 38% vs. 8%, p<0.001, respectively). Therefore, after adjusting

After controlling for environmental factors, neonatal HG was still a strong predictor of motor delay. The findings suggest that hyperglycemia induced by the high nutritional level of PN during early postnatal life can have negative influences on neurodevelopmental outcomes in preterm infants. It is perhaps necessary to take special caution with glycemic control during this phase to ensure optimal results in this vulnerable group [11].

In a 2022 longitudinal cohort study, Harris et al. examined the influence of neonatal hyperglycemia on short- and long-term outcomes in a group of 200 infants who were diagnosed with hyperglycemia. Two years of health outcomes were tracked using standard measures to quantify neurodevelopmental improvement. Outcome results indicated that 25% of the hyperglycemic infants experienced heightened mortality rates in comparison to merely 5% in the euglycemic infant cohort. In addition, 30% of the hyperglycemic group also developed neurodevelopmental disabilities at 24 months, which comprised cognitive and motor delay. Another conclusion of the same study was that neonatal hyperglycemia is linked with very poor adverse outcomes, highlighting the necessity for early intervention and frequent follow-up to enhance the affected infants' health course. [12]

3 Objective of the study

3.1 General objective

To assess prevalence, risk factors, and outcomes at discharge of neonatal hyperglycemia at TASH

3.2 Specific objectives

To determine the prevalence of neonatal hyperglycemia at TASH

To determine risk factors for neonatal hyperglycemia at TASH

To determine the outcome at discharge of neonatal hyperglycemia at TASH

4 Materials and method

4.1 Study area

The research took place at Tikur Anbesa Specialized Hospital's Neonatal Intensive Care Unit (NICU) in Addis Ababa, Ethiopia. As Ethiopia's leading tertiary hospital, Tikur Anbesa Specialized Hospital has provided advanced medical care since its establishment in 1974. It is Addis Ababa University's teaching hospital. The university holds distinction as Ethiopia's oldest and most prestigious higher education institution.

The NICU of the hospital is under the Department of Pediatrics and Child Health. The NICU renders specialized care to sick neonates from all over the country. The NICU is 60 beds. There is one neonatologist and two neonatology fellows working there presently. The NICU, on average, takes care of about 150 neonates per month.

As a premier tertiary care hospital in Ethiopia, Tikur Anbesa Specialized Hospital's NICU is central. As the country's main tertiary care unit, it receives critically ill newborns referred from all regions of Ethiopia. An ideal place to conduct research on the prevalence and risk factors of neonatal hyperglycemia, a significant but understudied condition locally. The availability of specialized neonatal expertise and a large patient load at this center will facilitate strong data collection and analysis required for the proposed research.

4.2 Study design and period

This study was conducted using a hospital-based cross-sectional study design from November 1, 2024, to January 1, 2025, G.C.

4.3 Source Population

The study population comprised every neonate admitted to TASH's neonatal intensive care facility

4.4 Study population

All neonates who were visiting the NICU of TASH during the data collection period

4.5 Sampling method:

consecutive sampling method until sample size is achieved

Sample Size Determination

The sample size is determined using a single population proportion formula by considering 6 % with NICU service from a previous study conducted in selected public hospitals in Nigeria in 2020.

Sample size was calculated using a simple population formula.

N = total sample size

Z = 1.96

P = 6 % was taken because a similar study was found. q = 1 - p

d = Margin of error 5% (0.05)

The final sample size calculated is 87.

4.6 Inclusion criteria

The study population comprised NICU-admitted neonates (aged ≤28 days) at Tikur Anbesa Specialized Hospital, all born at ≥28 weeks gestation.

Exclusion criteria

Parental refusal of consent

Neonates with known congenital anomalies or genetic syndromes Neonates transferred from other hospitals with ongoing treatment for hyperglycemia

Neonates with missing data on key variables (e.g., gestational age, birth weight, blood glucose values)

4.7 Study variables:

Dependent variable:

The incidence or prevalence of neonatal hyperglycemia

Independent variable:

Gestational age of the newborn (e.g., preterm vs. term)

Birth weight

Maternal diabetes status (gestational diabetes, pre-existing diabetes) Maternal use of medications during pregnancy (e.g., steroids) Presence of neonatal infections or sepsis

Feeding method (breastfeeding, formula, parenteral nutrition) Demographic factors (e.g., maternal age, race/ethnicity, socioeconomic status)

4.8 Data collection and measurements

The study used a multifaceted data collection strategy. This includes a thorough study of medical records as well as interviews with the neonates' parents or guardians. The medical record review includes demographic information. Additional components include clinical history, laboratory data, which was taken as a part of newborn care, therapy actions, and neonatal outcomes. Parent/guardian interviews provide additional information on the mother's medical history.

For the purpose of standardized data collection. A standard questionnaire was prepared by researchers. Which address a range of fields. Data categories will encompass demographic information, obstetric background, and medical records. Neonatal hyperglycemia risk factors and neonatal clinical features.

4.9- 4.10 Data Handling and Data Quality Assurance

Data cleanliness and completeness were checked by the principal researcher. The hard copies were converted to soft copies, stored on a hard drive, and will be prepared for analysis, and a backup copy will be stored on a separate drive.

Then moved to a soft copy and was again cross-checked with the hard copy for completeness and its consistency before undertaking any statistical analysis.

4.11 Data analysis

After data collection, questionnaires were all reviewed thoroughly for completeness and consistency. Following data entry in EpiData, all statistical analyses will be performed using SPSS software, version 25.

Descriptive statistics like means, frequencies, and percentages will be calculated so as to summarize the study variables. Frequency tables and graphs will be utilized to present the data graphically.

. Bivariate regression analysis was conducted to analyze the variable relations by chi-square tests. Statistical significance for all the tests will be p-values of less than 0.05.

5 Ethical consideration

This study took ethical clearance from the Research and Publications Committee, School of Medicine, Addis Ababa University, Pediatrics and Child Health Department. The informed consent process was developed for parents/guardians of neonatal participants to explain the purpose of the study and the benefits and risks, as well as highlighting the fact that their participation is voluntary.

Specific measures include the anonymization of data and limiting access to the participants' information to the research team only, and no personally identifiable information was presented in the final presentation.

Dissemination of findings

The finding of the study was presented on the research defense day, and a formal report will be submitted to the Department of Pediatrics and Child Health with a soft and hard copy.

For publication purposes, the abstract of this thesis will be submitted to national or international peer-reviewed publishers.

6 Results

Socio-Demographic Characteristics

The evaluation of demographic and social aspects related to neonates and their mothers in TASH's Neonatal Intensive Care Unit (NICU) in Addis Ababa demonstrates important discoveries about this patient group. Among these 87 neonates, premature births accounted for 37.9% of cases, but normal birth weight was reported in 71.3% of cases, therefore demonstrating strong interest in infant health care at this facility. Data shows that the majority of mothers (71.3 percent) belong to the productivity-focused age range of 25-34 years, which supports maternal health interventions. The population's financial state was indicated by the large number (51.7%) of mothers who earned less than 7000 ETB monthly. The study data showed a slight predominance of male neonates over females because 56.3% of newborns were boys.

Table 1. Socio-demographic characteristics of neonates and mothers at NICU of TASH, Addis Ababa, Ethiopia, 2024.

Variables	Frequency(n=87)	Percentage (%)
Birth Weight		
1000 - 1499 g: Very low birth weight (VLBW)	4	4.6
1500 - 2499 g: Low birth weight (LBW)	19	21.8
2500 - 3999 g: Normal birth weight (NBW)	62	71.3
≥ 4000 g : High birth weight (HBW)	2	2.3
1000 - 1499 g: Very low birth weight (VLBW)	4	4.6
Gestational Age		
<37 weeks	33	37.9
>=37 weeks	54	62.1
Maternal Age		
19-24	18	20.7
25-34	62	71.3
>=35	6	6.9
Sex of neonates		
Male	49	56.3
Female	38	43.7

Risk factors

Analysis of risk factors that contribute to neonatal hyperglycemia at TASH NICU in Addis Ababa demonstrates key health issues affecting this particular patient population. A substantial number of 37.9% of neonates received premature birth care, while nearly one-fifth (18.3%) of these cases fell under the category of late preterm between 34 and 36 weeks of gestation. Neonatal resuscitation occurred in only 5.7% of cases, but sepsis proved the most common critical illness, affecting 52.3% of critically unwell neonates admitted to the NICU.

The research determined that maternal hyperglycemia risk factors during pregnancy played an important role because 19.7% of mothers had conditions while PROM occurred in 52.9% of these patients. Most expectant women received antenatal care through at least one visit, but the rate of women who attended five or more times stood at only 29.3%. Among all study subjects, 73.6 percent stayed less than 7.5 days in the hospital, while 55.2 percent experienced direct hospital births at Tikur Anbessa Hospital. The health status of neonates born early or with maternal conditions relies heavily on well-rounded maternal care and treatment launched at the beginning of the pregnancy.

Table 1Risk factors to Neonatal Hyperglycemia among neonates at NICU of TASH, Addis Ababa, Ethiopia, 2024.

Variables	Frequency(n=87)	Percentage (%)
Length of stay in the Hospital		
<7.5 days	64	73.6
>=7.5days	23	26.4
Did the neonate born in TASH or referred from other hospital		
a. Referred from another facility	38	43.7
b. Born at Tikur Anbessa Hospital	48	55.2
ANC received?		
Yes	82	94.7
No	5	5.3
Did the neonate was a preterm?		
Yes	33	37.9
No	54	62.1
Neonatal resuscitation		
Yes		
No	82	94.3
Maternal conditions during pregnancy which will predispose to hyperglycaemia		
Yes	17	19.7
No	70	81.3

Variables	Frequency(n=8)	Percentage (%)
Length of stay in the Hospital		
<7.5 days	3	37.5
>=7.5days	5	62.5
Did the neonate born in TASH or referred from other hospital		
a. Referred from another facility	2	25
b. Born at Tikur Anbessa Hospital	6	75
ANC received?		
Yes	7	87.5
No	1	12.5
Did the neonate was a preterm?		
Yes	6	75
No	2	25
Neonatal resuscitation		
Yes	1	12.5
No	7	87.5
Maternal conditions during pregnancy which will predispose to hyperglycaemia		
Yes	7	87.5
No	1	12.5

Prevalence of Neonatal Hyperglycemia

This study found a neonatal hyperglycemia prevalence of 9.1% (95% CI: 3.4-16.1). (See figure 1 below). Also, 27 (31%) developed jaundice as a complication associated with neonatal hyperglycemia. (See figure 2 below)

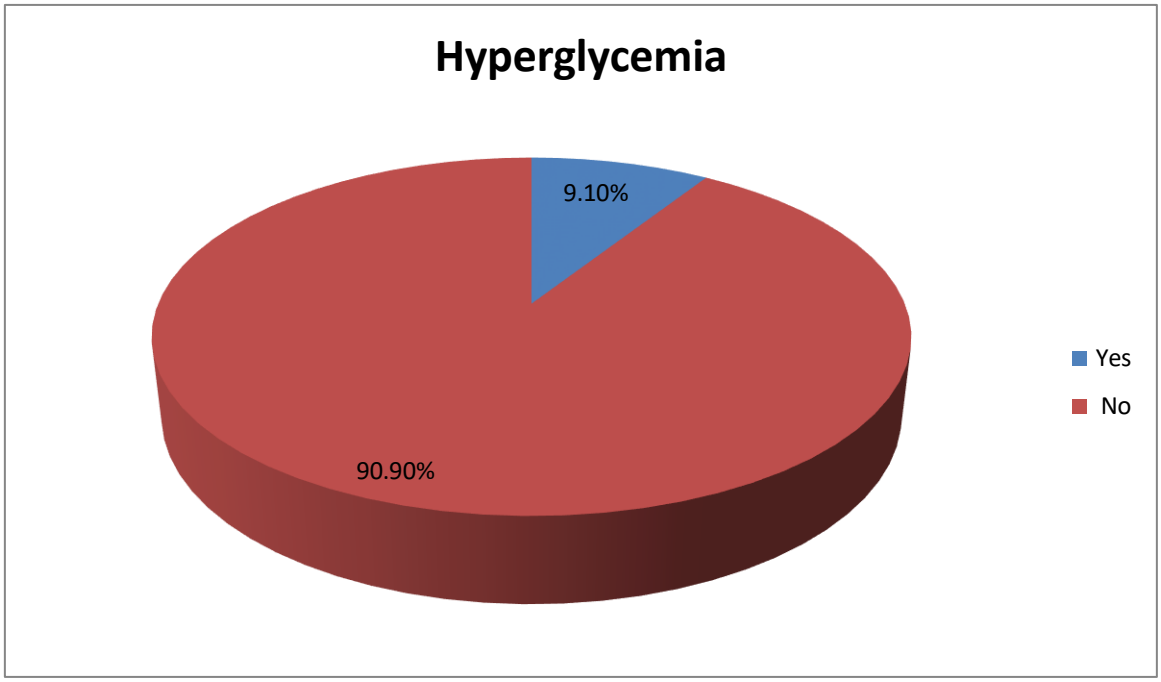


Figure 1. Prevalence of Neonatal Hyperglycemia among neonates at NICU of TASH, Addis Ababa, Ethiopia, 2024.

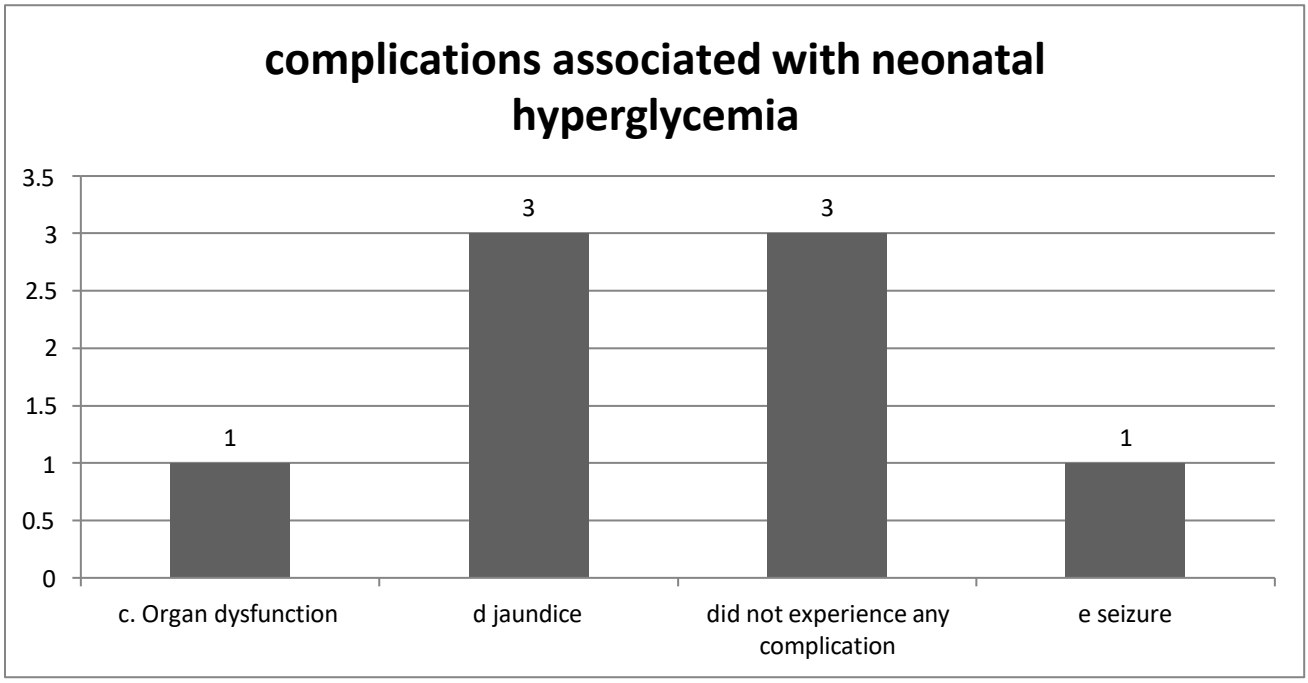


Figure 2. Complications of Neonatal Hyperglycemia among neonates at NICU of TASH, Addis Ababa, Ethiopia, 2024.

Outcome hyperglycemia

In this study 85(97.7%) had survived (See Figure 3 below).

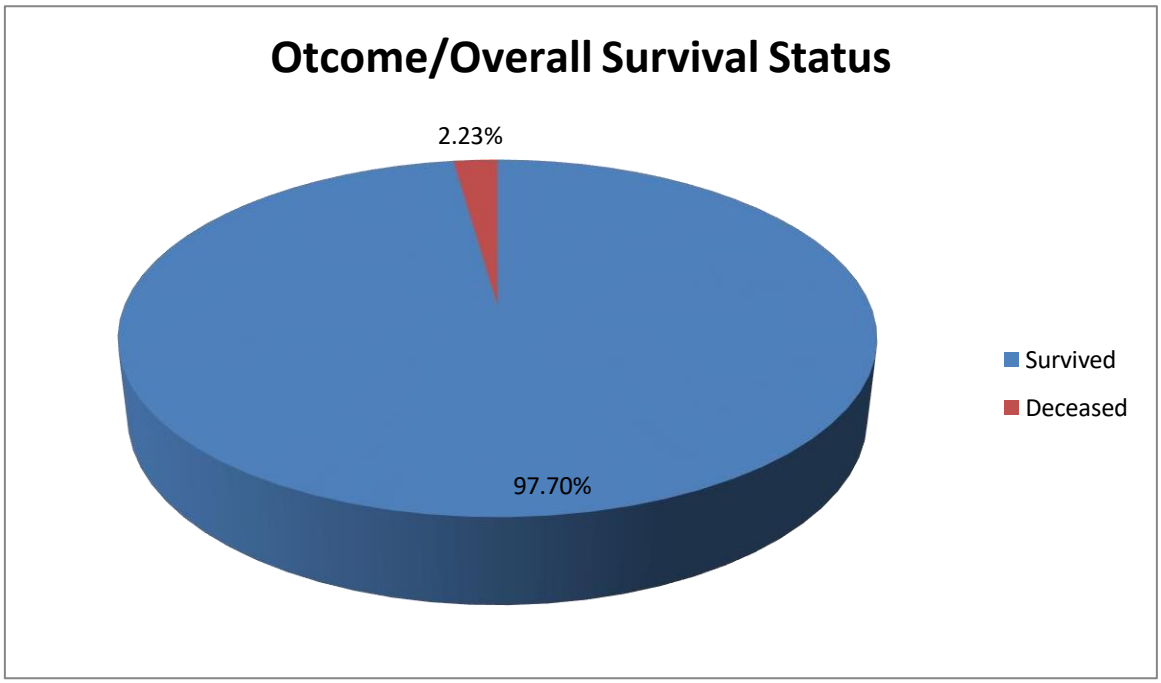
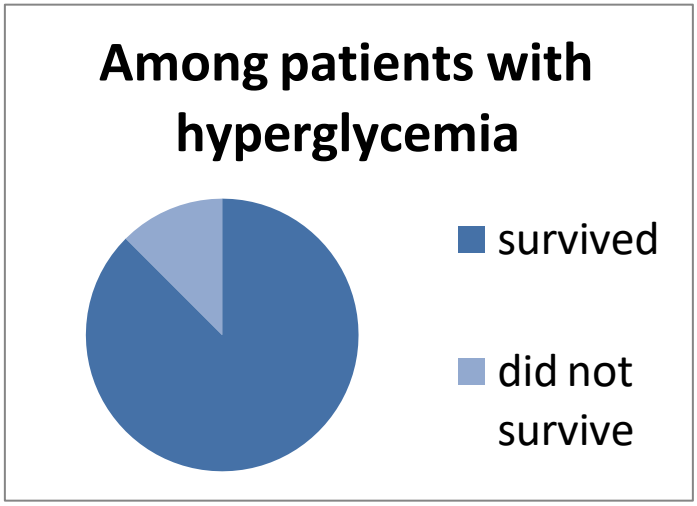


Figure 3. Outcome of Hyperglycemia among neonates at NICU of TASH, Addis Ababa, Ethiopia, 2024.

from those with hyperglycemia 7 (87.5 %)



Factors Associated with Neonatal Hyperglycemia

Cross-tabulation with a chi-square test was performed to assess the risk factors towards neonatal hyperglycemia. Thus, four potential risk factors were assessed to see if they are statistically significantly associated with hyperglycemia, which are gestational age, birth weight, and maternal conditions during pregnancy, and neonatal critical illness. Accordingly, the study revealed, neonates born before term had a 1.7 times increased odds of developing hyperglycemia as compared to those who were born at term (OR=1.7, 95% CI, (1.03, 32.935). Also, neonates who were born from mothers with maternal conditions had a 43 times increased odds of developing hyperglycemia as compared to their counterparts (95 % CI, OR=43.1, (4.843, 386.638)). See the tables below

Table 3. Chi square test to identify Risk factors to Neonatal Hyperglycemia among neonates at Admitted to NICU of TASH, Addis Ababa, Ethiopia, 2024.

Variables	Neonatal Hyperglycaemia		OR(95%CI)	P-Valu e
Gestational Age	No (0)	Yes (1)		
<37 weeks	27	6	1.7 (1.03, 32.9)*	0.02 3
>=37 weeks	52	2	1	1
Did the neonate develop critical Illness? (Fishers Exact test)				
no	1	0	1	1
yes	78	8	1.1 (0.03, 1.180)	0.11 2
Maternal Illness During Pregnancy (Fishers Exact test)				
no	68	1	1	1
yes	11	7	43.2(4.84,386. 6)*	0.01 *
Birth weight (Fishers Exact test)				
b. 1000 - 1499 g: Very low birth weight (VLBW)	2	2	2.1 (0.734, 4.352)	0.21
c. 1500 - 2499 g: Low birth weight (LBW)	15	4	1.726(.331, 89.94)	0.14

d. 2500 - 3999 g: Normal birth weight (NBW)	60	2	1	1
e. ≥ 4000 g : High birth weight (HBW)	2	0	1.95(0.7811,19.9)	0.16

7 Discussion

Among the studied patients with neonatal hyperglycemia, the prevalence measured 9.1% (95% CI: 3.4, 16.1), with results showing a lower prevalence compared to previous studies. Relevant studies showed extremely low birth weight infants had NHG rates of 53% based on Alsweiler et al. While Kao and colleagues (2006) documented a 70% prevalence, later findings in 2012 showed an 80% rate. The investigation by Adamkin et al. (1986) study reported a 58% prevalence of neonatal hyperglycemia (NHG) among very low birth weight infants. Prevalence differences exist because research participants and diagnostic criteria of blood glucose thresholds and study population sizes differ between studies. Research studies examining exclusively ELBW and VLBW infants led to higher identified prevalence rates than this study because it included wider birth weight groups.

NHG risk is established by preterm birth combined with maternal health problems that occur during pregnancy, according to the study findings. The research showed preterm neonates had 1.7 times more risk for hyperglycemia compared to term infants, similar to the 2.5-fold increased risk preterm infants presented according to Harris and Jones (2019). Neonates born to mothers with maternal conditions during pregnancy (e.g., PROM, chorioamnionitis, and gestational diabetes) had 43 times higher odds of developing NHG compared to those without such conditions (OR=43.1, 95% CI: 4.84, 386.6).

This finding aligns with existing evidence that maternal metabolic conditions can significantly impact fetal glucose metabolism, leading to hyperglycemia in the newborn. Specifically, maternal diabetes and gestational diabetes are well-documented risk factors for NHG, as they result in elevated glucose levels in the fetal bloodstream, which can persist after birth.

Among neonates who had NHG jaundice, it developed as a major complication, which affected 31% of the cases. The available research indicates metabolic problems and worsening health status exist among patients with NHG. The survival rate for neonates with NHG at Tikur Anbessa Hospital demonstrated successful medical management since it reached 87.5 %. The research requires additional examination of long-term neurological outcomes in these infants because untreated NHG leads to lifelong complications, including cognitive impairment and metabolic disease conditions.

8 strength and limitation

Strengths

Key Risk Factors: Identifies preterm birth and maternal conditions

Local Relevance: Actionable insights for resource-limited settings.

Integrated Care: Highlights need for a multidisciplinary approach

Limitations

The study's small sample size may reduce the generalizability of the findings.

Single-Centre Study: Conducted at one tertiary hospital

Short-Term Focus: Lacks long-term outcome data

Resource Constraints: Limited access to advanced diagnostics

9 Recommendations

Enhanced Maternal Care:

The strengthening of Antenatal Care (ANC) services needs to detect maternal conditions, including diabetes and PROM, at the beginning of pregnancy.

Education programs for mothers should teach them about the necessity of timely antenatal care checkups combined with appropriate pregnancy nutrition practices.

Targeted Neonatal Screening:

All high-risk neonates, including preterm and low-birth-weight infants, need routine glucose monitoring for timely detection and treatment of NHG.

Health organizations must create uniform management approaches for NHG while operating with limited resources.

Research and Policy Advocacy:

Researchers should conduct extended observations of NHG-affected infants to measure their growth and health development as well as their metabolic and nervous system health.

Community Awareness:

Community health programs should educate people about preterm birth dangers with maternal hyperglycemia risks.

10 Conclusion

This study highlights a 9.1% prevalence of neonatal hyperglycemia (NHG) among neonates admitted to the NICU at Tikur Anbessa Specialized Hospital, with preterm birth and maternal conditions during pregnancy identified as significant risk factors.

Complications such as jaundice affected 31% of NHG cases with a survival rate of 87.5%.

These findings emphasize the need for enhanced maternal care, targeted neonatal screening, and multidisciplinary approaches to improve outcomes for high-risk neonates in resource-limited settings.

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12 Annex

Questionnaire on Neonatal Hyperglycemia
Participant Information:

1. **MRN Number:** _____
2. **Date of Birth:** _____
3. **Gestational Age at Birth:** _____weeks
4. **Birth Weight:** _____grams
5. **Sex:** Male / Female
6. **Maternal Age:** _____years
7. **Monthly income**

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9. **Neonatal Hyperglycemia Assessment:**
10. **Has the neonate been diagnosed with hyperglycemia (blood glucose level > 150 mg/dL) during NICU stay?**
    Yes / No
11. If yes, **on what date was the hyperglycemia first detected?** _____
    What is the blood glucose number_____

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12. **Risk Factors:**

13. **What was the birth weight of the neonate?**
    a. **< 1000 g:** Extremely low birth weight (ELBW)
    b. **1000 - 1499 g:** Very low birth weight (VLBW)
    c. **1500 - 2499 g:** Low birth weight (LBW)
    d. **2500 - 3999 g:** Normal birth weight (NBW)
    e. **≥ 4000 g:** High birth weight (HBW)

14. **Was the neonate born preterm (< 37 weeks gestation)?**
    Yes / No
    a. If yes, please specify:
        i. **Very Preterm:** Less than 32 weeks
        ii. **Moderately Preterm:** 32 to 34 weeks
        iii. **Late Preterm:** 34 to 36 weeks
15. **Has the neonate experienced critical illnesses during their NICU stay?**
    Yes / No
    a. If yes, please specify the type of critical illness (e.g., sepsis,

respiratory distress, necrotizing enterocolitis, etc.):

Has the neonate been exposed to medications that may contribute to hyperglycemia prior to admission?
Yes / No
If yes, please specify the medication(s) and duration of exposure: _
Were there maternal conditions present during pregnancy that may have influenced neonatal hyperglycemia?
Yes / No
If yes, please specify maternal condition(s) (e.g., gestational diabetes, preexisting diabetes, hypertension, obesity, infections, etc.): ____
Did the mother receive antenatal care (ANC) during pregnancy?
Yes / No
If yes, how many visits? __
Was the neonate referred from another healthcare facility or born at Tikur Anbessa Hospital?
Referred from another facility
Born at Tikur Anbessa Hospital
a. If referred, please specify the referral place