http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v14i05.03

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Study of Hypoglycemia in Neonates with Low Birth Weight and Very Low Birth Weight in A Tertiary Care Center

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Abstract

Background: *Neonatal hypoglycemia is one of the most common metabolic disorders affecting newborns, particularly those with low birth weight (LBW), very low birth weight (VLBW), small for gestational age (SGA), prematurity, and infants born to diabetic mothers. Following birth, neonates experience an abrupt interruption in maternal glucose supply. This metabolic transition, coupled with immature gluconeogenesis, limited glycogen stores, and increased cerebral glucose demand, predisposes high-risk neonates to hypoglycemia.*

Methods: *This prospective observational study was conducted over 20 months in a tertiary care center and included 150 high-risk neonates, predominantly from socioeconomically disadvantaged tribal populations. Serial blood glucose monitoring was performed at predefined intervals.*

Results: *Among the study population, 30% of neonates developed hypoglycemia, while 70% remained normoglycemic. Extremely low birth weight (ELBW ≤1000 g) infants demonstrated a 100% incidence of hypoglycemia. Significant associations were observed between hypoglycemia and birth weight ($p = 0.006$), gestational size ($p = 0.0028$), and neonatal sepsis ($p < 0.0001$). Sepsis was present in 38.46% of neonates and showed a strong correlation with hypoglycemic episodes. No significant association was found with maternal gravida status.*

Conclusion: *Neonatal hypoglycemia remains a significant concern in LBW and VLBW neonates, particularly among ELBW, SGA, and septic infants. Early identification, routine glucose monitoring, and timely intervention in high-risk groups are essential to prevent adverse neurological outcomes and improve neonatal survival.*

Keywords: *Neonatal hypoglycemia; Low birth weight (LBW); Very low birth weight (VLBW); Extremely low birth weight (ELBW); Small for gestational age (SGA); Preterm neonates; Sepsis; Glucose homeostasis; Intrauterine growth restriction (IUGR); Neonatal outcomes.*

Introduction

Low birth weight (LBW) remains a significant global public health concern. According to the World Health Organization (WHO), a newborn is classified as having LBW if the birth weight is less than 2500 grams, measured within the first few hours after birth

to minimize the effects of postnatal weight loss. This definition was adopted by the 29th World Health Assembly in 1976.

LBW is further categorized as:

- **Very Low Birth Weight (VLBW):** <1500 grams
- **Extremely Low Birth Weight (ELBW):** <1000 grams

Globally, LBW accounts for approximately 15–20% of all live births, representing more than 20 million births annually. More than 95% of these occur in low- and middle-income countries, with South Asia contributing nearly half of the global burden. In resource-limited settings, inadequate documentation and the lack of universal birth weight recording often lead to underestimation of the true prevalence.

The principal causes of LBW include preterm birth (PTB) and intrauterine growth restriction (IUGR). While LBW is defined purely by weight, **small for gestational age (SGA)** refers to neonates with birth weight below the 10th percentile for gestational age. IUGR may be symmetrical or asymmetrical, with uteroplacental insufficiency being a common underlying mechanism.

Neonates with LBW are at substantially increased risk of morbidity and mortality, with mortality rates more than 20 times higher compared to infants weighing over 2500 grams. Common complications include respiratory distress syndrome, intraventricular hemorrhage, sepsis, necrotizing enterocolitis, retinopathy of prematurity, and metabolic disturbances such as hypoglycemia.

Neonatal hypoglycemia is of particular concern, as the neonatal brain relies heavily on glucose as its primary energy substrate. Premature and growth-restricted infants have limited glycogen stores, immature enzymatic pathways, and reduced capacity for gluconeogenesis and glycogenolysis, impairing metabolic adaptation after birth.

Therefore, early identification of high-risk neonates and implementation of structured glucose monitoring protocols are essential to improve both short-term and long-term outcomes.

Materials and Methods

Study Design

This was a prospective observational study conducted to evaluate the incidence and risk factors of neonatal hypoglycemia among low birth weight (LBW) and very low birth weight (VLBW) neonates.

Study Duration

The study was carried out over a period of 20 months to ensure adequate sample size and to account for potential seasonal variations.

Study Setting and Population

The study was conducted in a tertiary care center. The study population included neonates presenting to the Outpatient Department (OPD) or Emergency Department who fulfilled the inclusion criteria. The majority of participants belonged to socioeconomically disadvantaged tribal communities. Informed written consent was obtained from parents or legal guardians prior to enrollment.

Sample Size

A total of 150 neonates were included in the study. The sample size was calculated using the following parameters:

- Alpha level: 0.05
- Statistical power: 80%
- Estimated sample size: 148 (rounded to 150 for feasibility)

Data Collection

Clinical History and Examination

Detailed maternal and neonatal histories were recorded, including:

- Mode of delivery
- Birth weight
- Gestational age
- APGAR scores
- Perinatal complications
- Maternal conditions (e.g., diabetes mellitus, hypertension, infections)
- Maternal drug exposure (e.g., beta-agonists, beta-blockers, oral hypoglycemic agents)

A thorough clinical examination was performed for each neonate, with special attention to signs suggestive of hypoglycemia.

Laboratory Investigations

The following investigations were performed:

- Blood glucose levels (at 2, 4, 6, 12, 24, 48, and 72 hours of life)
- Complete blood count (CBC)
- C-reactive protein (CRP)
- Serum electrolytes

Hypoglycemia was defined according to standard operational thresholds.

Radiological Investigations

Chest X-ray was performed in selected cases based on clinical indications.

Inclusion Criteria

- Low birth weight (<2.5 kg)
- Very low birth weight (<1.5 kg)
- Preterm neonates (<35 weeks gestation)
- Small for gestational age (SGA)
- Infants of diabetic mothers
- Intrauterine growth restriction (IUGR)
- Neonates with sepsis, hypoxia, or polycythemia

Exclusion Criteria

- Healthy appropriate for gestational age (AGA) neonates >2.5 kg
- Large for gestational age (LGA) neonates
- Neonates with major congenital anomalies

Statistical Analysis

Data were entered and analyzed using Microsoft Excel and Epi Info software.

- Categorical variables were analyzed using the **Chi-square test**
- Continuous variables were analyzed using the **Student's t-test**
- Relative Risk (RR) with 95% confidence interval was calculated where applicable A **p-value <0.05** was considered statistically significant.

Results and Discussion

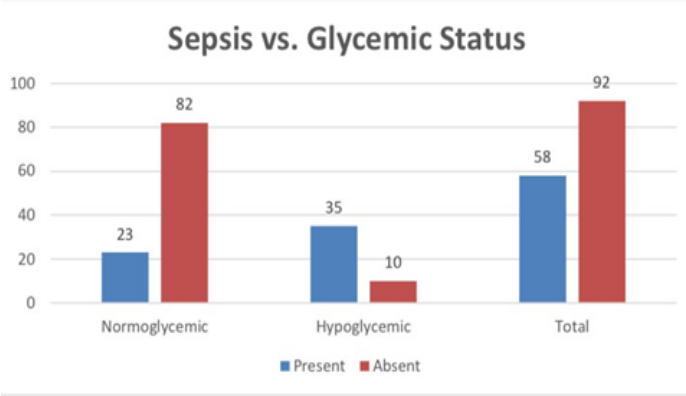
Baseline Characteristics

A total of 150 neonates were included in the study. Of these, 52.56% were male and 47.44% were female. The mean APGAR score at 1 minute was **6.01 ± 1.07**, while 80.77% of neonates achieved an APGAR score of 9 at 5 minutes.

Glycemic Status

Out of 150 neonates:

- **Normoglycemic:** 105 (70%)
- **Hypoglycemic:** 45 (30%)

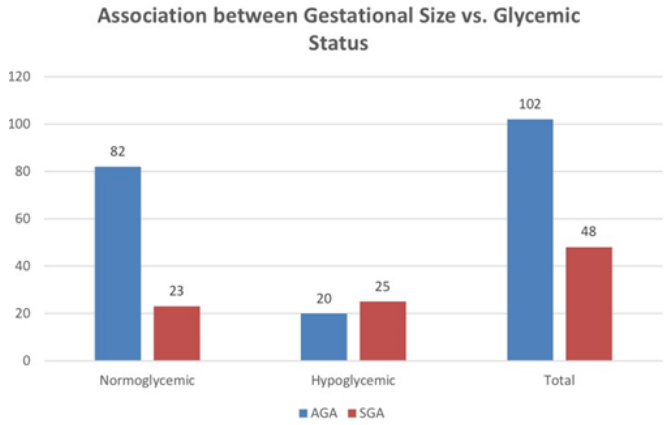


Nearly one-third of the neonates developed hypoglycemia, underscoring its clinical significance in high-risk groups.

Birth Weight and Hypoglycemia

Birth Weight Category	Hypoglycemia (%)
≤ 1000 g (ELBW)	**100%**
1001–1500 g (VLBW)	**31%**
1501–2500 g (LBW)	**26.1%**

A statistically significant association was observed between birth weight and hypoglycemia (**p = 0.006**). The risk of hypoglycemia decreased with increasing birth weight. All ELBW neonates developed hypoglycemia, indicating extreme vulnerability in this group.



Gestational Size and Glycemic Status

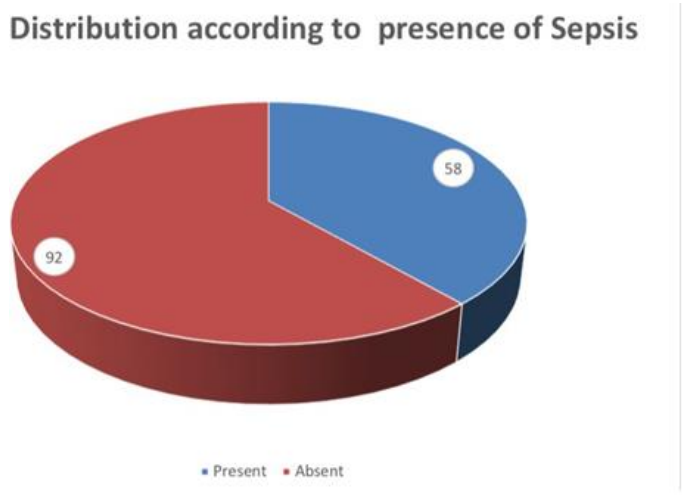
Category	Hypoglycemia (%)
AGA	19.6%
SGA	52.1%

There was a significant association between gestational size and hypoglycemia (**Chi-square = 8.95, p = 0.0028**). SGA neonates demonstrated a markedly higher risk, likely due to reduced glycogen reserves and chronic intrauterine malnutrition.

Sepsis and Hypoglycemia

- **Sepsis prevalence:** 38.46%
- Among septic neonates: **60.3% were hypoglycemic**
- Among non-septic neonates: **10.9% were hypoglycemic**

This association was highly significant (**p < 0.0001**), indicating that neonatal sepsis is a major risk factor for hypoglycemia. The increased metabolic demand and inflammatory response during infection likely contribute to impaired glucose homeostasis.



Gravida Status

No statistically significant association was found between maternal gravida status and neonatal hypoglycemia (**p = 0.917**).

Discussion

The present study demonstrates a **30% incidence of hypoglycemia** among LBW and VLBW neonates, consistent with previously reported data in high-risk neonatal populations.

Birth weight emerged as a key determinant, with ELBW neonates exhibiting a **100% incidence**, emphasizing the need for intensive monitoring in this subgroup. Similarly, SGA neonates showed a significantly higher risk compared to AGA infants, likely due to limited glycogen stores and impaired metabolic adaptation.

Neonatal sepsis was identified as the **strongest associated factor**, with a markedly higher prevalence of hypoglycemia among septic neonates. This finding highlights the importance of vigilant glucose monitoring in neonates with suspected or confirmed infection.

No association was observed with maternal parity, suggesting that neonatal factors play a more critical role in the development of hypoglycemia.

Overall, these findings support the implementation of **targeted glucose monitoring protocols** in high-risk neonates, particularly in resource-limited settings, to enable early detection and timely intervention.

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