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ORIGINAL RESEARCH

To assess the prevalence of neonatal hypoglycemia in full-term and preterm infants

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ABSTRACT

Aim: The study aims to assess the prevalence of neonatal hypoglycemia in full-term and preterm infants and examine the correlation between hypoglycemia and factors such as birth weight, mode of delivery, and Apgar score. **Material and Methods:** This hospital-based cross-sectional observational study included 80 neonates (40 full-term and 40 preterm) admitted to the NICU. Blood glucose levels were monitored within 24 hours of birth using a glucometer, with hypoglycemia defined as glucose levels below 40 mg/dL. Neonates were classified as full-term or preterm based on gestational age. **Results:** The prevalence of hypoglycemia was significantly higher in preterm infants (37.5%) compared to full-term infants (12.5%) ($p<0.01$). Low birth weight (<2.5 kg) was associated with a higher incidence of hypoglycemia (60%) ($p<0.01$). Cesarean section deliveries were significantly associated with hypoglycemia ($p<0.01$). Infants with Apgar scores ≤7 had a 70% prevalence of hypoglycemia ($p<0.01$). Preterm infants had a higher overall risk of hypoglycemia (75%) compared to full-term infants (25%) ($p<0.01$). **Conclusion:** Neonatal hypoglycemia is more prevalent in preterm infants and is strongly correlated with low birth weight, cesarean delivery, and low Apgar scores. Routine screening and early intervention are essential to prevent long-term complications in at-risk neonates.

Keywords: Neonatal hypoglycemia, Preterm infants, Full-term infants, Birth weight, Apgar score

INTRODUCTION

Neonatal hypoglycemia is one of the most common metabolic disturbances observed in newborns, affecting both full-term and preterm infants. It is a condition characterized by abnormally low blood glucose levels, which, if left untreated, can lead to serious long-term complications, including neurodevelopmental disorders, seizures, and even death. The definition of hypoglycemia in neonates varies slightly across different clinical guidelines, but it is generally accepted that blood glucose levels below 40 mg/dL (2.2 mmol/L) during the first 24 hours of life indicate hypoglycemia. Despite the critical nature of this condition, its exact prevalence and risk factors in both full-term and preterm infants remain areas of significant research interest and clinical importance.[1]Hypoglycemia in neonates arises from a failure to maintain adequate glucose homeostasis after birth. Before birth, the fetus relies on a constant supply of glucose from the mother through the placenta. However, after delivery, this supply is abruptly cut off, and the newborn must adapt to regulating its own glucose levels through various physiological processes. In many cases, this transition occurs smoothly, but in others, especially among preterm infants, the metabolic adaptation is inadequate, leading to hypoglycemia. Several factors contribute to the newborn's ability to maintain glucose levels, including glycogen stores, hormonal regulation, feeding practices, and the overall metabolic rate.[2,3]The risk factors for neonatal hypoglycemia are varied and multifactorial. Among them, prematurity plays a crucial role. Preterm infants are particularly vulnerable to hypoglycemia due to their underdeveloped metabolic systems. Their glycogen stores, which are essential for maintaining blood glucose levels in the early hours after birth, are often insufficient. Additionally, the hormonal and enzymatic mechanisms required for gluconeogenesis, the process by which the body produces glucose, are immature in preterm infants. This makes them more susceptible to rapid declines in blood glucose,

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especially when they experience stress or difficulty in initiating feeding.[4]

In full-term infants, the risk factors for hypoglycemia can include maternal conditions such as diabetes, where the infant may be exposed to high levels of glucose in utero, resulting in hyperinsulinism after birth. This condition causes the newborn's pancreas to produce excessive insulin, leading to a rapid drop in blood glucose once the maternal glucose supply is cut off. Other factors that can predispose full-term infants to hypoglycemia include intrauterine growth restriction (IUGR), where the infant has a low birth weight for its gestational age, and birth complications that might result in delayed feeding or oxygen deprivation.[5,6]While full-term infants have a more developed glucose regulation system, they are not immune to hypoglycemia. The early neonatal period, particularly the first 24 to 48 hours after birth, is a critical time for identifying and managing hypoglycemia. Delayed or missed diagnosis can result in permanent neurological damage, particularly since newborns often do not exhibit obvious symptoms. The subtlety of hypoglycemic symptoms in neonates, which can include lethargy, poor feeding, jitteriness, and hypotonia, makes routine blood glucose monitoring essential for at-risk infants.[7]Despite the widespread recognition of neonatal hypoglycemia as a serious clinical condition, there remains some debate over the exact threshold at which intervention should occur, as well as the long-term effects of transient episodes of low blood glucose. However, it is generally agreed that early detection and prompt treatment are essential for preventing adverse outcomes. The treatment strategies typically involve the administration of glucose, either orally or intravenously, depending on the severity of the hypoglycemia and the infant's ability to feed.[8]The prevalence of neonatal hypoglycemia varies considerably depending on the population studied and the diagnostic criteria used. In preterm infants, the incidence is significantly higher than in full-term infants, primarily due to the immaturity of the metabolic and endocrine systems in premature neonates. Studies have shown that up to 50% of very low birth weight or extremely preterm infants may experience hypoglycemia at some point during their early neonatal period. Among full-term infants, the prevalence is lower but still substantial, particularly among infants with risk factors such as maternal diabetes or those born small for gestational age.[9,10]Understanding the prevalence and risk factors for neonatal hypoglycemia is crucial for developing effective screening and treatment protocols. Given the potential for severe neurological consequences if left untreated, neonatal hypoglycemia remains a condition of paramount importance in neonatal care. By identifying infants at risk, whether full-term or preterm, clinicians can ensure timely intervention to prevent long-term complications, improving outcomes for affected newborns. This study aims to explore the prevalence of neonatal hypoglycemia in both full-term and preterm infants, examining the associated risk factors and comparing the incidence between these two groups.

MATERIAL AND METHODS

This is a hospital-based cross-sectional observational study designed to assess the prevalence of neonatal hypoglycemia in full-term and preterm infants. The study includes 80 neonates, both full-term and preterm, admitted to the neonatal intensive care unit (NICU) or delivered in the maternity ward of a tertiary care hospital.The study population included 80 neonates, with 40 full-term infants and 40 preterm infants. Inclusion criteria were infants born between 28 to 42 weeks of gestation, with no congenital anomalies. Exclusion criteria included neonates with severe birth asphyxia, metabolic disorders, or those receiving parenteral glucose at birth.The total sample size was 80 neonates, consisting of 40 full-term and 40 preterm infants. Participants were selected through a convenient sampling technique based on their admission to the NICU or delivery in the hospital during the study period.Ethical approval for the study was obtained from the Institutional Ethics Committee of Hospital, ensuring adherence to ethical guidelines for research involving human participants. Written informed consent was obtained from the parents or legal guardians of all neonates included in the study.

Methodology

Demographic and clinical data of neonates, including gestational age, birth weight, Apgar score, and mode of delivery, were collected from medical records. Blood glucose levels were monitored within the first 24 hours of life using the glucose oxidase-peroxidase method. Capillary blood samples were obtained from the neonates' heels using a glucometer, with hypoglycemia defined as blood glucose levels below 40 mg/dL. Hypoglycemia screening was performed at regular intervals—0, 6, 12, and 24 hours post-birth—or earlier if symptoms such as jitteriness, lethargy, poor feeding, or seizures were observed. Neonates were classified as full-term (≥37 weeks gestational age) or preterm (<37 weeks gestational age).The primary outcome measured in this study was the prevalence of hypoglycemia among full-term and preterm neonates. Secondary outcomes involved examining the correlation between hypoglycemia and variables such as gestational age, birth weight, and Apgar score.

Statistical Analysis

Data were entered and analyzed using SPSS version 25.0. Descriptive statistics were calculated for continuous variables (mean ± standard deviation) and categorical variables (frequencies and percentages). The prevalence of hypoglycemia was calculated for both full-term and preterm neonates. A chi-square test was used to compare the prevalence between the two

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groups. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Full-term and Preterm Neonates

This table highlights the significant differences in the demographic characteristics of full-term and preterm infants. The gestational age was found to be significantly different between the two groups, with full-term infants having a gestational age ≥37 weeks and preterm infants <37 weeks (p<0.001). The birth weight also showed a notable difference, with full-term infants having a mean birth weight of 3.2 ± 0.4 kg compared to 2.4 ± 0.3 kg for preterm infants (p<0.001).Apgar scores at 5 minutes were significantly lower in preterm infants (7.0 ± 1.2) compared to full-term infants (8.5 ± 1.0) with a p-value of <0.05. The mode of delivery also differed between the groups, with more preterm infants born via cesarean section (30, 75%) compared to full-term infants (15, 37.5%) (p<0.01). However, maternal age and maternal diabetes did not show statistically significant differences between the two groups, with p-values of 0.12 and 0.48, respectively.

Table 2: Clinical Parameters of Full-term and Preterm Neonates

The clinical parameters of full-term and preterm neonates showed significant differences in several categories. Respiratory distress was more prevalent in preterm infants (30%) compared to full-term infants (10%) (p<0.05). Hypothermia and feeding difficulties were also significantly higher in preterm infants, with hypothermia occurring in 20% of preterm infants versus 5% of full-term infants (p<0.05), and feeding difficulties in 35% of preterm infants compared to 12.5% of full-term infants (p<0.01).The duration of NICU admission was significantly longer for preterm infants (7.5 ± 2.3 days) compared to full-term infants (4.1 ± 1.2 days) (p<0.001). Although jaundice and sepsis were more prevalent in preterm infants (45% and 15%, respectively), the differences were not statistically significant, with p-values of 0.16 and 0.21.

Table 3: Prevalence of Neonatal Hypoglycemia

Neonatal hypoglycemia was significantly more prevalent in preterm infants compared to full-term infants. Hypoglycemia (defined as blood glucose <40 mg/dL) was observed in 37.5% of preterm infants and only 12.5% of full-term infants (p<0.01). This indicates a much higher risk of hypoglycemia in preterm neonates.

Table 4: Correlation of Hypoglycemia with Birth Weight

There was a strong correlation between birth weight and the occurrence of hypoglycemia. Neonates with a birth weight below 2.5 kg had a significantly higher incidence of hypoglycemia (60%) compared to those weighing ≥2.5 kg (40%) (p<0.01). Additionally, non-hypoglycemic infants were more likely to weigh ≥2.5 kg (83.3%) compared to hypoglycemic infants, of whom only 40% had a birth weight ≥2.5 kg (p<0.05). This suggests that lower birth weight is a significant risk factor for neonatal hypoglycemia.

Table 5: Hypoglycemia Based on Mode of Delivery

Hypoglycemia was more common in neonates delivered via cesarean section. Of the hypoglycemic infants, 80% were born via cesarean section compared to 20% born vaginally (p<0.01). In contrast, 51.7% of non-hypoglycemic infants were delivered vaginally, suggesting that cesarean delivery is associated with a higher incidence of hypoglycemia. This difference was statistically significant with a p-value of 0.03 for vaginal delivery and <0.01 for cesarean sections.

Table 6: Hypoglycemia Based on Apgar Score

The Apgar score at 5 minutes was strongly associated with the occurrence of hypoglycemia. Among hypoglycemic infants, 70% had an Apgar score of ≤7, while only 16.7% of non-hypoglycemic infants had an Apgar score of ≤7 (p<0.01). Conversely, 83.3% of non-hypoglycemic infants had an Apgar score >7, compared to 30% of hypoglycemic infants (p<0.05). These results suggest that a lower Apgar score is a predictor of neonatal hypoglycemia.

Table 7: Correlation of Gestational Age and Hypoglycemia

Gestational age was significantly correlated with the prevalence of hypoglycemia. Preterm infants (<37 weeks) had a much higher incidence of hypoglycemia (75%) compared to full-term infants (25%) (p<0.01). On the other hand, 58.3% of non-hypoglycemic infants were full-term, compared to only 41.7% of non-hypoglycemic preterm infants (p=0.04). This indicates that preterm birth is a significant risk factor for the development of neonatal hypoglycemia.

Table 1: Demographic Characteristics of Full-term and Preterm Neonates

Variable	Full-term Infants (n=40)	Preterm Infants (n=40)	p-value
Gestational Age (weeks)	≥37	<37	<0.001
Birth Weight (kg)	3.2 ± 0.4	2.4 ± 0.3	<0.001
Apgar Score (5 min)	8.5 ± 1.0	7.0 ± 1.2	<0.05
Mode of Delivery	Vaginal: 25, C-section: 15	Vaginal: 10, C-section: 30	<0.01
Maternal Age (years)	28.5 ± 5.1	27.2 ± 4.9	0.12
Maternal Diabetes	8 (20%)	10 (25%)	0.48

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Table 2: Clinical parameter of Full-term and Preterm Neonates

Clinical Data	Full-term Infants (n=40)	Preterm Infants (n=40)	p-value
Respiratory Distress	4 (10%)	12 (30%)	<0.05
Sepsis	3 (7.5%)	6 (15%)	0.21
Jaundice	12 (30%)	18 (45%)	0.16
NICU Admission Duration (days)	4.1 ± 1.2	7.5 ± 2.3	<0.001
Hypothermia	2 (5%)	8 (20%)	<0.05
Feeding Difficulties	5 (12.5%)	14 (35%)	<0.01

Table 3: Prevalence of Neonatal Hypoglycemia

Variable	Full-term Infants (n=40)	Preterm Infants (n=40)	p-value
Hypoglycemia (Blood Glucose <40 mg/dL)	5 (12.5%)	15 (37.5%)	<0.01

Table 4: Correlation of Hypoglycemia with Birth Weight

Birth Weight (kg)	Number of Hypoglycemic Infants (n=20)	Non-Hypoglycemic Infants (n=60)	p-value
<2.5 kg	12 (60%)	10 (16.7%)	<0.01
≥2.5 kg	8 (40%)	50 (83.3%)	<0.05

Table 5: Hypoglycemia Based on Mode of Delivery

Mode of Delivery	Number of Hypoglycemic Infants (n=20)	Non-Hypoglycemic Infants (n=60)	p-value
Vaginal Delivery	4 (20%)	31 (51.7%)	0.03
Cesarean Section	16 (80%)	29 (48.3%)	<0.01

Table 6: Hypoglycemia Based on Apgar Score

Apgar Score (5 min)	Number of Hypoglycemic Infants (n=20)	Non-Hypoglycemic Infants (n=60)	p-value
≤7	14 (70%)	10 (16.7%)	<0.01
>7	6 (30%)	50 (83.3%)	<0.05

Table 7: Correlation of Gestational Age and Hypoglycemia

Gestational Age	Number of Hypoglycemic Infants (n=20)	Non-Hypoglycemic Infants (n=60)	p-value
Preterm (<37 weeks)	15 (75%)	25 (41.7%)	<0.01
Full-term (≥37 weeks)	5 (25%)	35 (58.3%)	0.04

DISCUSSION

In this study, significant differences in the gestational age, birth weight, and mode of delivery between full-term and preterm infants were observed. Preterm infants had a mean gestational age of less than 37 weeks, which is consistent with the definition of preterm birth. Similarly, the significant difference in birth weight, with preterm infants averaging 2.4 ± 0.3 kg and full-term infants at 3.2 ± 0.4 kg ($p<0.001$), aligns with findings from studies such as the one by Stoll et al. (2010), where preterm infants had lower birth weights compared to full-term infants due to insufficient in-utero growth time.[11]The Apgar score was significantly lower in preterm infants ($p<0.05$). Similar findings were reported by Liu et al. (2019), where preterm infants had lower Apgar scores due to underdeveloped respiratory and cardiovascular systems.[12] The mode of delivery showed that preterm infants were more likely to be delivered via cesarean section (75%), similar to the findings of Ng et al. (2020), where cesarean deliveries were more frequent in preterm births due to complications associated with early labor.[13]Preterm infants showed significantly higher occurrences of respiratory distress (30% vs. 10%, $p<0.05$), consistent with findings from Jain and Dudell (2006), who noted that preterm infants are at a higher risk for respiratory complications due to immature lung development.[14] Feeding difficulties were also significantly more prevalent in preterm infants (35% vs. 12.5%, $p<0.01$), in agreement with the findings of Pados et al. (2016), who reported similar feeding difficulties due to underdeveloped sucking and swallowing reflexes in preterm neonates.[15]

The length of NICU stay was significantly longer for preterm infants (7.5 ± 2.3 days) compared to full-term infants (4.1 ± 1.2 days), which reflects the findings of Klinger et al. (2016), where preterm infants required longer NICU stays due to complications such as hypothermia and respiratory distress.[16] Hypothermia was also more prevalent in preterm neonates ($p<0.05$), correlating with their lower body fat and immature thermoregulatory systems, as reported by Bauer et al. (2013).[17]The prevalence of neonatal hypoglycemia

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was significantly higher in preterm infants (37.5%) compared to full-term infants (12.5%) ($p<0.01$). This finding is consistent with Stanley et al. (2015), who found that preterm neonates are at an increased risk for hypoglycemia due to immature glycogen stores and impaired gluconeogenesis.[18] Similar studies, such as Harris et al. (2017), also reported higher rates of hypoglycemia in preterm infants.[19]A strong correlation between birth weight and hypoglycemia was evident, with neonates weighing less than 2.5 kg showing a significantly higher incidence of hypoglycemia (60%) compared to those weighing more than 2.5 kg (40%) ($p<0.01$). This aligns with the findings of Rozance et al. (2016), where low birth weight was identified as a major risk factor for hypoglycemia due to reduced glycogen stores and energy reserves in smaller neonates.[20] This suggests that neonates with lower birth weights need more vigilant monitoring for hypoglycemia during the neonatal period.Hypoglycemia was more prevalent in neonates born via cesarean section (80%) compared to those born vaginally (20%) ($p<0.01$). Similar results were reported by Darendeliler et al. (2019), where cesarean section deliveries were associated with delayed initiation of breastfeeding and lower glucose levels due to decreased maternal-neonatal hormonal interplay during labor.[21] The lack of labor-associated stress hormones, such as catecholamines and cortisol, which play a role in neonatal glucose regulation, could explain this increased risk in cesarean-delivered infants.A lower Apgar score (≤ 7) was strongly associated with a higher incidence of hypoglycemia, with 70% of hypoglycemic infants having a score ≤ 7 ($p<0.01$). This is consistent with the findings of Dyer et al. (2016), who found that lower Apgar scores are associated with increased risk for metabolic disturbances, including hypoglycemia.[22]This may be due to compromised neonatal physiological functions in infants with low Apgar scores, leading to inadequate glucose regulation.Preterm infants had a significantly higher incidence of hypoglycemia (75%) compared to full-term infants (25%) ($p<0.01$), further confirming the findings of studies by Cornblath et al. (2000), where preterm birth was identified as a major risk factor for hypoglycemia.[23] Preterm infants have immature glucose homeostasis mechanisms, making them more vulnerable to hypoglycemia during the early neonatal period.

CONCLUSION

This study highlights the significant prevalence of neonatal hypoglycemia, particularly in preterm infants, who are at higher risk due to immature metabolic systems. Factors such as low birth weight, cesarean delivery, and low Apgar scores were strongly associated with hypoglycemia in both preterm and full-term neonates. Early identification and prompt management of hypoglycemia are essential to prevent long-term neurological complications. The findings underscore the importance of routine monitoring in at-risk neonates to improve outcomes and reduce morbidity associated with neonatal hypoglycemia.

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