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COMPARISON OF BLOOD GLUCOSE LEVEL IN PRETERM AND FULL-TERM BABIES IN 1ST 48 HOURS OF LIFE IN A TERTIARY CARE HOSPITAL

Original Research

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ABSTRACT

Background: Neonatal glucose regulation is crucial for early metabolic adaptation, particularly in the first 48 hours of life when the transition from intrauterine to extrauterine environments occurs. Preterm neonates, due to their underdeveloped metabolic pathways, limited glycogen reserves, and increased energy demands, are at a higher risk of hypoglycemia, which can lead to severe neurological complications if untreated. Understanding the differences in blood glucose levels between preterm and full-term neonates is essential for optimizing clinical management and improving neonatal outcomes in tertiary care settings.

Objective: To compare blood glucose levels in preterm and full-term neonates during the first 48 hours of life in a tertiary care hospital.

Methods: This randomized controlled trial was conducted at the Department of Pediatrics, Sughra Shafi Medical Complex, Narowal, from February 20, 2023, to August 20, 2023. A total of 120 neonates were included, with an equal distribution of 60 preterm and 60 full-term newborns. Inclusion criteria consisted of neonates admitted to the NICU during the study period, classified as preterm (<37 weeks of gestation) or full-term (≥37 weeks). Exclusion criteria included major congenital anomalies and metabolic disorders. Blood glucose levels were measured using validated point-of-care glucose monitoring devices at predefined intervals over 48 hours. Statistical analysis was performed using IBM SPSS version 27.0, with a significance level set at $p<0.05$.

Results: Preterm neonates exhibited significantly lower blood glucose levels than full-term neonates across all time points ($p<0.05$). Mean glucose levels at birth were 49.4 ± 17.7 mg/dL in full-term neonates and 43.1 ± 15.1 mg/dL in preterm neonates ($p=0.038$). Hypoglycemia (<35 mg/dL) was significantly more prevalent in preterm neonates (43.3%) than in full-term neonates (18.3%) ($p=0.003$). Low birth weight (LBW <2.5 kg) was observed in 36.4% of hypoglycemic full-term neonates and 57.7% of hypoglycemic preterm neonates ($p=0.007$). Blood glucose levels were significantly lower in LBW neonates (65.3 ± 13.1 mg/dL) than in normal birth weight neonates (72.6 ± 14.8 mg/dL) ($p=0.005$).

Conclusion: This study highlights significant differences in blood glucose regulation between preterm and full-term neonates, emphasizing the heightened risk of hypoglycemia in preterm and LBW newborns. These findings underscore the importance of close glucose monitoring and timely interventions to optimize neonatal metabolic outcomes.

Keywords: Blood Glucose, Hypoglycemia, Infant, Newborn, Low Birth Weight, Neonatal Intensive Care Units, Preterm Infants.

INTRODUCTION

Neonatal glucose regulation is a critical determinant of early-life health, influencing metabolic stability and neurodevelopmental outcomes. The delicate interplay between glucose supply and demand is particularly crucial during the first 48 hours of life, as newborns transition from intrauterine to extrauterine existence. This metabolic shift is complex, requiring the activation of glycogenolysis and gluconeogenesis to maintain adequate blood glucose levels. While full-term neonates generally adapt well to this transition, preterm infants—born before 37 weeks of gestation—face distinctive challenges due to limited glycogen reserves, immature metabolic pathways, and higher energy demands. These vulnerabilities place them at increased risk of both hypoglycemia and hyperglycemia, each carrying significant clinical implications (1,2). Hypoglycemia, defined as abnormally low blood glucose levels, is a well-documented concern in neonatology, with an estimated global prevalence ranging from 1.3 to 5 per 1000 live births (3,4). It is particularly prevalent among preterm neonates, whose limited hepatic glycogen stores and reduced gluconeogenic capacity compromise their ability to sustain normoglycemia. If prolonged or severe, neonatal hypoglycemia can lead to neurological complications, including cognitive impairment, seizures, and long-term neurodevelopmental deficits. In contrast, hyperglycemia—though less frequently observed—is another metabolic disturbance that warrants attention. In full-term neonates, transient hyperglycemia may arise due to maternal diabetes, perinatal stress, or infection, while in preterm infants, it often indicates underlying metabolic immaturity or inadequate glycemic control (5,6). The dual challenges of hypo- and hyperglycemia underscore the necessity for vigilant glucose monitoring and tailored interventions, particularly in vulnerable preterm populations.

Recent advancements in neonatal glucose monitoring have provided deeper insights into glucose homeostasis in the immediate postnatal period. Continuous glucose monitoring systems are emerging as valuable tools in neonatal intensive care settings, offering real-time insights into glucose fluctuations and guiding targeted interventions to optimize metabolic stability (7,8). However, despite global research on neonatal glucose regulation, there remains a paucity of region-specific data, particularly in Pakistan. The scarcity of local studies leaves a critical gap in understanding the metabolic challenges faced by neonates in this setting, where healthcare practices, nutritional factors, and perinatal care protocols may differ from those in high-resource countries. This study aims to compare blood glucose levels in preterm and full-term newborns during the first 48 hours of life in a tertiary care hospital in Pakistan. By analyzing the metabolic patterns of these neonates, the research seeks to identify unique risk factors, clinical implications, and potential gaps in neonatal care within the local healthcare context. The findings will contribute to evidence-based neonatal management strategies, ultimately informing clinical protocols to reduce blood glucose-related morbidity and mortality among newborns in Pakistan.

METHODS

This randomized controlled trial was conducted in the Department of Paediatrics at Sughra Shafi Medical Complex, Narowal, from February 20, 2023, to August 20, 2023, after obtaining approval from the Institutional Review Board (IRB) of the hospital. Ethical clearance was granted in accordance with institutional and national research guidelines, and informed consent was obtained from the parents or legal guardians of all participants prior to enrollment. The study aimed to compare blood glucose levels in preterm and full-term neonates during the first 48 hours of life, ensuring a standardized and ethically sound methodology (9). The sample size was calculated using the WHO sample size calculator, based on an estimated prevalence of hypoglycemia of 12.8% in preterm neonates, with a power of 80% and a significance level of 0.05 (10). A total of 120 neonates were recruited, comprising both preterm infants (born before 37 weeks of gestation) and full-term infants (born at or beyond 37 weeks of gestation). Inclusion criteria encompassed all neonates admitted to the neonatal intensive care unit (NICU) within the study period who met the gestational age classifications. Exclusion criteria included neonates with major congenital anomalies, those diagnosed with known metabolic disorders, and any neonates with conditions that could significantly impact glucose metabolism, such as severe perinatal asphyxia or inborn errors of metabolism.

Blood glucose levels were measured using validated point-of-care glucose monitoring devices, with serial measurements taken at predefined intervals during the first 48 hours of life. Alongside glucose monitoring, detailed demographic and clinical data, including gestational age, birth weight, mode of delivery, maternal health history, and neonatal outcomes, were extracted from medical records. All data were recorded systematically to ensure consistency and accuracy in documentation. Statistical analysis was performed using

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IBM SPSS, version 27.0. Categorical variables were presented as frequencies and percentages and were compared using the Chi-square test. Continuous variables were expressed as mean and standard deviation (SD) and analyzed using the Student's t-test to determine statistically significant differences between preterm and full-term neonates. A p-value of <0.05 at a 95% confidence interval (CI) was considered statistically significant. Data visualization, where appropriate, was performed using bar charts to enhance interpretability of findings.

RESULTS

A total of 120 neonates were included in the study, evenly divided into preterm and full-term groups. Gender distribution was similar between the two groups, with 29 females (48.3%) and 31 males (51.7%) in the full-term group and 28 females (46.7%) and 32 males (53.3%) in the preterm group, showing no significant difference (p = 0.855). Blood glucose levels were significantly lower in preterm newborns compared to full-term newborns across all measured time points during the first 48 hours of life (p<0.05). At birth, the mean blood glucose levels were 49.4 ± 17.7 mg/dL in full-term neonates and 43.1 ± 15.1 mg/dL in preterm neonates (p = 0.038). By 3 hours, glucose levels increased to 56.4 ± 14.4 mg/dL in full-term neonates and 48.3 ± 14.7 mg/dL in preterm neonates (p = 0.003). The trend continued with significantly higher glucose levels in full-term newborns at 6 hours (61.6 ± 11.1 mg/dL vs. 49.3 ± 13.1 mg/dL, p<0.001), 12 hours (64.8 ± 13.9 mg/dL vs. 53.6 ± 14.4 mg/dL, p<0.001), 24 hours (68.0 ± 14.2 mg/dL vs. 56.8 ± 14.5 mg/dL, p<0.001), and 48 hours (71.7 ± 18.4 mg/dL vs. 59.8 ± 16.8 mg/dL, p<0.001). The incidence of hypoglycemia, defined as blood glucose levels below 35 mg/dL, was significantly higher in preterm newborns. At birth, 43.3% (n=26) of preterm neonates experienced hypoglycemia compared to 18.3% (n=11) of full-term neonates (p = 0.003). The frequency of hypoglycemia remained higher in preterm neonates at 3 hours (14 vs. 5 cases, p = 0.024), 6 hours (9 vs. 1 cases, p = 0.008), and 48 hours (12 vs. 4 cases, p = 0.032). No significant differences were noted at 12 and 24 hours (p > 0.05).

Birth weight was significantly associated with hypoglycemia. Among hypoglycemic neonates, 36.4% of full-term and 57.7% of preterm neonates had a birth weight <2.5 kg (p = 0.007). Similarly, small-for-gestational-age (SGA) neonates were more prone to hypoglycemia, with 42.3% of preterm and 27.3% of full-term hypoglycemic neonates classified as SGA (p = 0.009). Blood glucose levels were significantly lower in neonates with low birth weight (65.3 ± 13.1 mg/dL) compared to those with normal birth weight (72.6 ± 14.8 mg/dL, p = 0.005). Furthermore, SGA neonates had lower blood glucose levels (61.6 ± 12.5 mg/dL) than appropriate-for-gestational-age (AGA) neonates (69.6 ± 18.4 mg/dL, p = 0.006). Mode of delivery influenced neonatal glucose levels, with neonates delivered via normal vaginal delivery (NVD) having significantly lower glucose levels (63.8 ± 11.4 mg/dL) than those born via lower segment cesarean section (LSCS) (74.9 ± 11.1 mg/dL, p<0.001). Among hypoglycemic neonates, 63.6% of full-term neonates were delivered via LSCS, whereas 61.5% of preterm neonates were delivered via NVD (p = 0.005).

Table 1: Distribution of gender among term and preterm babies

Gender	Term		Preterm		p value[a]
	n	%	n	%	
Female	29	48.3%	28	46.7%	0.855
Male	31	51.7%	32	53.3%	

[a] Chi square test

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Table 2: Comparison of blood sugar levels between term and preterm babies at different hours of life

Blood Sugar Levels (mg/dl)	Term	Preterm	p value[a]
	Mean ± SD	Mean ± SD	
At Birth	49.4 ± 17.7	43.1 ± 15.1	0.038
At 3h	56.4 ± 14.4	48.3 ± 14.7	0.003
At 6h	61.6 ± 11.1	49.3 ± 13.1	<0.001
At 12h	64.8 ± 13.9	53.6 ± 14.4	<0.001
At 24h	68.0 ± 14.2	56.8 ± 14.5	<0.001
At 48h	71.7 ± 18.4	59.8 ± 16.8	<0.001
Hypoglycemia at birth			
Yes	11 (18.3%)	26 (43.3%)	.003
No	49 (81.7%)	34 (56.7%)	

[a] Unpaired t-test & [a] Chi square test

Table 3: Comparison of hypoglycemic babies at different hours of life

Hours of Life	Hypoglycemic Babies (n=37)		p value[a]
	Term	Preterm	
	N	n	
At Birth	11	26	0.003
At 3h	5	14	0.024
At 6h	1	9	0.008
At 12h	3	7	0.186
At 24h	3	7	0.186
At 48h	4	12	0.032

[a] Chi square test

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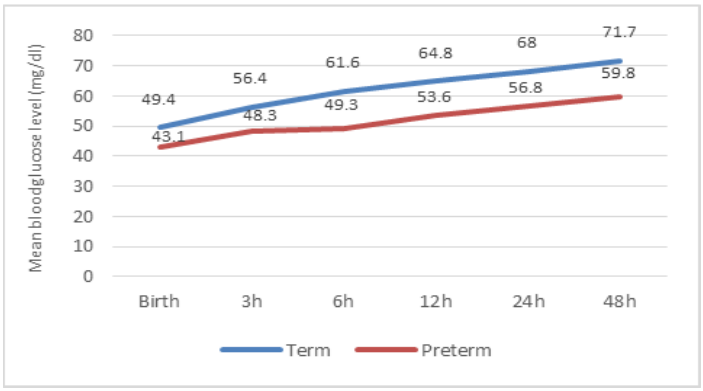

Figure 1: Mean blood sugar levels between term and preterm babies at different hours of life

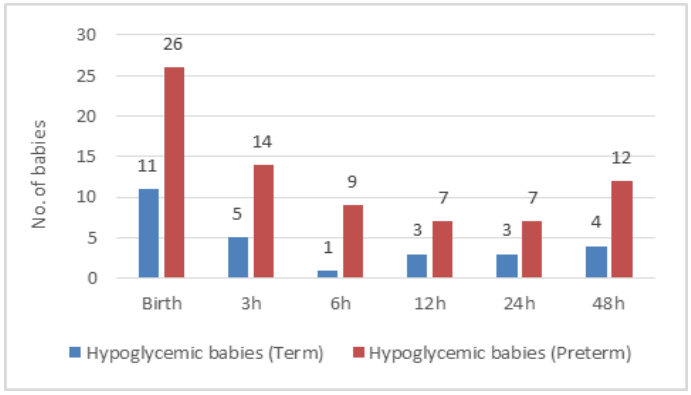

Figure 2: Hypoglycemic babies at different hours of life.

Table 4: Distribution of birth characteristics between study groups among hypoglycemic babies

Parameters	Hypoglycemic Babies (n=37)				p value[a]
	Term		Preterm		
	n	%	n	%	
Birth Weight					
Low (<2.5kg)	4	36.4%	15	57.7%	0.007[a]
Normal (≥2.5kg)	7	63.6%	11	42.3%	
Birth Weight Classification					
AGA	8	72.7%	15	57.7%	0.009[a]
SGA	3	27.3%	11	42.3%	
Mode of Delivery					0.005[a]
LSCS	7	63.6%	10	38.5%	
NVD	4	36.4%	16	61.5%	
Blood Glucose level (mg/dl), Mean ± SD	27.9 ± 4.7		28.3 ± 4.5		0.799[b]

[a] Chi square test; [b] Unpaired t-test

Table 5: Comparison of Blood Glucose Levels Based on Birth Weight, Birth Weight Classification, and Mode of Delivery

Parameter	Category	Blood Glucose Level (Mean ± SD)	p-valuea
Birth Weight	Normal (≥2.5 kg)	72.6 ± 14.8	0.005
	Low (<2.5 kg)	65.3 ± 13.1	
Birth Weight Classification	AGA	69.6 ± 18.4	0.006
	SGA	61.6 ± 12.5	
Mode of Delivery	NVD	63.8 ± 11.4	<0.001
	LSCS	74.9 ± 11.1	

*a Unpaired t-test

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DISCUSSION

The first 48 hours of life represent a critical period for neonatal metabolic adaptation, particularly in glucose regulation, as newborns transition from intrauterine to extrauterine environments. Maintaining adequate blood glucose levels during this time is essential for neonatal survival, with glucose serving as the primary energy source for vital organs, especially the brain. Preterm infants, born before 37 weeks of gestation, often struggle with glucose homeostasis due to immature metabolic pathways, inadequate glycogen stores, and increased energy demands. The comparison of blood glucose levels between preterm and full-term neonates in this study highlights significant metabolic differences, providing clinically relevant insights into the management of neonatal hypoglycemia (11). Blood glucose levels in preterm newborns were consistently lower than those in full-term newborns at all time points measured during the first 48 hours of life. The lowest values were observed at birth, with a significant difference between the two groups. This disparity persisted at subsequent time intervals, reinforcing the notion that preterm neonates exhibit an increased susceptibility to hypoglycemia due to their underdeveloped metabolic reserve. Similar trends have been reported in previous studies, further supporting the hypothesis that preterm infants require close glycemic monitoring and early intervention to prevent adverse neurological consequences. The present study findings align with previous research demonstrating that neonatal glucose levels in preterm newborns remain significantly lower than in full-term newborns during the early hours of life, emphasizing the need for vigilant metabolic surveillance and targeted clinical strategies (12).

Hypoglycemia was significantly more prevalent among preterm neonates than full-term neonates, particularly at birth, where nearly half of the preterm infants exhibited blood glucose levels below the defined threshold. The high incidence of neonatal hypoglycemia in preterm newborns can be attributed to multiple factors, including inadequate hepatic glucose production, limited adipose tissue stores, and an inability to efficiently mobilize alternative energy sources. Previous studies have reported similar trends, indicating that preterm neonates are at a considerably higher risk of metabolic instability than their full-term counterparts. The persistence of hypoglycemia beyond birth, with significantly more preterm infants experiencing hypoglycemic episodes at multiple time points, highlights the prolonged vulnerability of this group and underscores the importance of implementing standardized neonatal glucose monitoring protocols to mitigate the risk of long-term neurodevelopmental impairment (13,14). Birth weight played a crucial role in neonatal glucose regulation, with low birth weight (LBW) infants demonstrating a significantly higher predisposition to hypoglycemia. A greater proportion of preterm hypoglycemic neonates had a birth weight below 2.5 kg, suggesting a direct association between reduced fetal growth and impaired glucose homeostasis. Small-for-gestational-age (SGA) neonates also exhibited significantly lower blood glucose levels compared to appropriate-for-gestational-age (AGA) neonates, reinforcing the concept that intrauterine growth restriction compromises neonatal metabolic adaptation. These findings are consistent with prior research, which has established a strong link between fetal growth restriction and increased hypoglycemia risk. The increased metabolic demands of SGA neonates, coupled with insufficient energy reserves, place them at a heightened risk of developing hypoglycemia, necessitating early and aggressive intervention to maintain normoglycemia (15-17).

The mode of delivery influenced neonatal glucose levels, with neonates born via lower segment cesarean section (LSCS) exhibiting significantly higher blood glucose levels compared to those delivered by normal vaginal delivery (NVD). This difference may be attributed to the physiological stress response associated with vaginal delivery, leading to increased energy consumption and transient neonatal hypoglycemia. Previous literature has also reported a higher incidence of hypoglycemia in neonates born via NVD, potentially due to perinatal stress-induced metabolic alterations. While some studies have suggested a negligible association between delivery mode and neonatal glucose levels, the present findings indicate that delivery method plays a role in determining early neonatal glucose dynamics, warranting further investigation (18,19). Despite its clinical significance, this study has certain limitations. The single-center design may limit the generalizability of findings to broader populations, and the study period was restricted to the first 48 hours of life, precluding the assessment of long-term metabolic outcomes. Additionally, maternal glucose levels and antenatal factors influencing neonatal glucose regulation were not extensively analyzed, which may serve as potential confounding variables. Future research should incorporate multi-center studies with extended follow-up durations to explore the long-term neurodevelopmental impact of early neonatal glucose fluctuations. A more comprehensive evaluation of maternal metabolic status, including gestational diabetes and intrauterine glucose exposure, may also provide deeper insights into neonatal glucose regulation and its implications for perinatal care.

The study's strengths include its robust sample size, standardized glucose monitoring protocols, and comprehensive analysis of neonatal glucose trends across multiple time points. The prospective cohort design allowed for accurate data collection, reducing recall bias and ensuring reliable findings. Additionally, the study contributes valuable region-specific data on neonatal glucose regulation, addressing

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a critical gap in the literature and providing evidence-based recommendations for optimizing neonatal glycemic management in resource-limited settings. The findings of this study reinforce the need for vigilant glucose monitoring in preterm and LBW neonates, with an emphasis on early identification and management of hypoglycemia to prevent long-term complications. Given the substantial metabolic challenges faced by preterm and SGA neonates, standardized neonatal care protocols should incorporate targeted glucose screening and timely interventions. Future research should explore novel approaches to neonatal glucose stabilization, including continuous glucose monitoring systems and individualized nutritional strategies tailored to the metabolic needs of high-risk neonates.

CONCLUSION

This study underscores the significant differences in blood glucose regulation between preterm and full-term neonates during the critical first 48 hours of life, highlighting the unique metabolic vulnerabilities of preterm newborns. The findings emphasize the importance of vigilant glucose monitoring and early intervention to prevent complications associated with neonatal hypoglycemia. Understanding these metabolic differences can contribute to improved neonatal care protocols, ensuring timely and targeted management strategies to enhance short- and long-term health outcomes. By addressing these crucial aspects of neonatal glucose homeostasis, this research provides valuable insights that can inform clinical decision-making and optimize neonatal care practices.

Author Contribution

Author	Contribution
Nida Siddiquee*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aqsa Faiz	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Abdul Rehman Akram	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Amir Jalal	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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