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Original Article

Paediatrics Section

Screening of Hypoglycaemia in Low Birth Weight Neonates Admitted in Postnatal Ward: A Prospective Cohort Study

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ABSTRACT

Introduction: Low Birth Weight (LBW) neonates show minimal signs of hypoglycaemia, with immature compensatory mechanisms and nonspecific symptoms complicating the diagnosis. Both symptomatic and asymptomatic cases risk neurological damage, stressing the need for prompt detection and treatment.

Aim: The aim of this study was to determine the incidence of hypoglycaemia in LBW neonates within the first 48 hours of life, assess mean glucose levels at the 1st, 24th, and 48th hours, identify etiological factors, and evaluate treatment response and immediate outcomes.

Materials and Methods: This prospective cohort study was conducted at BJ Medical College and Civil Hospital, Ahmedabad, India, over a one-year period from January 2023 to December 2023. The study included 2,143 LBW neonates (birth weight between 1.8 kg and 2.5 kg) admitted to the postnatal ward. Blood glucose levels were screened at the 1st, 24th, and 48th hours of life. In neonates identified with hypoglycaemia, venous blood samples were collected and sent to the laboratory for confirmation. The Chi-square test was applied for comparison, and a p-value of <0.05 was considered statistically significant.

Results: During the study, 2,143 neonates were screened, with a nearly equal male-to-female ratio: 1,080 (50.39%) were male and 1,063 (49.6%) were female. The mean gestational age was 37.5±1.18 weeks. The overall incidence of hypoglycaemia was 6.9%, significantly higher among preterm neonates, Small-for-Gestational-Age (SGA) infants, those with a birth weight below 2 kg, those receiving mixed feeding, those breastfed fewer than eight times in the first 24 hours, and those delivered via caesarean section. Most hypoglycemic episodes occurred within the first 24 hours after birth.

Conclusion: In LBW neonates, hypoglycaemia was more commonly observed in preterm infants, those classified as SGA, those delivered by caesarean section, and those on mixed feeding. Inadequate breastfeeding was the most important cause, followed by sepsis, hypothermia, and polycythemia.

Keywords: Blood-glucose monitoring, Breastfeeding, Caesarean section, Mixed-feeding, Preterm

INTRODUCTION

A neonate undergoes a significant metabolic shift after birth, transitioning from a continuous maternal glucose supply to self-regulating glucose levels. Glucose is the primary energy source, especially for the brain, where uptake occurs through facilitated diffusion, independent of insulin, relying on arterial glucose levels [1]. By five weeks of age, infants utilise 71% to 93% of adult cerebral glucose rates, with peak usage in regions such as the sensorimotor cortex, thalamus, brainstem, and cerebellar vermis [1]. Term neonates with adequate weight typically maintain euglycemia with frequent feeding, despite lacking adult-level homeostatic mechanisms [2].

However, LBW and preterm neonates face greater challenges due to limited glycogen stores, immature regulatory systems, feeding difficulties, and a higher risk of associated morbidities, increasing their susceptibility to hypoglycaemia. Reported incidence varies widely: 0.6%-27% in all neonates [3,4], 16.9%-51% in high-risk neonates [5,6], 15%-30% in LBW neonates [7-9], and around 30% in preterm infants [10].

Although regular glucose monitoring is routine in Neonatal Intensive Care Units (NICUs), many healthy LBW neonates outside intensive care may go unscreened, especially when asymptomatic. In these cases, hypoglycaemia may be missed despite screening guidelines, posing a risk for serious outcomes. Both symptomatic and asymptomatic hypoglycaemia can lead to long-term neurological damage, including visual-motor impairment, cognitive deficits, and reduced academic performance [11]. One study even reported an 8% incidence of cerebral palsy at 12 months in hypoglycemic neonates [12]. Premature and LBW neonates often exhibit minimal manifestations of hypoglycaemia, with immature compensatory mechanisms and non-specific symptoms, complicating diagnosis and treatment [13]. These outcomes underscore the importance of early detection and treatment, particularly in neonates who appear healthy but may still be at risk due to LBW alone.

While several studies have examined hypoglycaemia in high-risk or critically ill neonates [3,5,6], there is a scarcity of studies focusing specifically on healthy LBW infants without additional risk factors. The literature also lacks consensus on hypoglycaemia thresholds, with varying definitions and blood glucose cut-offs across studies and time points in early life. As a result, clinical practice remains inconsistent, and potentially at-risk neonates in routine care may be overlooked.

This study aimed to address this gap by determining the incidence of hypoglycaemia in healthy LBW neonates without co-morbidities and assessing the need for routine glucose screening in this population. The present study was conducted to find the incidence of hypoglycaemia in LBW neonates within 48 hours of life, to analyse mean glucose levels at the 1st, 24th, and 48th hours of life, and to identify etiological factors, evaluate treatment responses, and assess immediate outcomes. By focusing on this underrepresented group, the study adds valuable insight into neonatal glucose monitoring practices and may support changes in current screening protocols.

MATERIALS AND METHODS

A prospective cohort study was conducted in the postnatal ward of a tertiary care hospital, BJ Medical College and Civil Hospital, Ahmedabad, India. from January 2023 to December 2023. Ethical approval (Reference no. 86/2023) was obtained from the Institutional Ethics Committee (Registration no. ECR/72/Inst/GJ/2013/RR-2019) prior to the study. Informed written consent was obtained from parents, and the confidentiality of all participants was strictly maintained.

Inclusion criteria: The study included healthy preterm and full-term neonates with a Low Birth Weight (LBW) between 1.8 kg and 2.5 kg.

Exclusion criteria: Neonates who were sick, weighed less than 1.8 kg or more than 2.5 kg, or were born to diabetic mothers were excluded.

Study Procedure

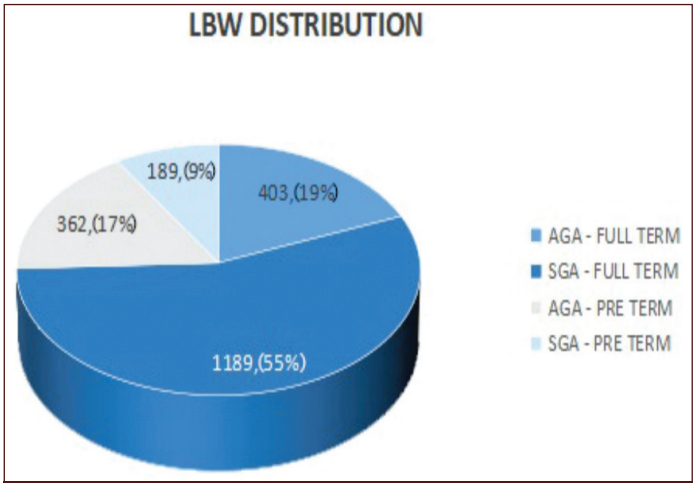
A detailed antenatal, natal, and postnatal history was obtained and documented in a predesigned proforma. Capillary blood glucose levels were measured at the 1st, 24th, and 48th hours of life using the Akray Glucocard glucometer, which complies with International Organization for Standardization (ISO) 15197:2013 accuracy standards. Neonates with a glucometer reading of less than 45 mg/dL, based on the Facility-Based Newborn Care (FBNC) guidelines of the Government of India [14], were considered hypoglycaemic. Venous blood samples from these neonates were sent for laboratory confirmation, and management was initiated according to FBNC protocols. The response to breastfeeding, formula feeding, or intravenous glucose was monitored. Treatment failure was defined as a persistent blood glucose level of less than 45 mg/dL after 60 minutes of feeding or 30 minutes of intravenous glucose administration, as per FBNC guidelines [14].

STATISTICAL ANALYSIS

All data were recorded in Microsoft Excel and analysed using Jamovi software, employing appropriate statistical methods, including the Chi-square test. The incidence of hypoglycaemia, associated risk factors, maternal and neonatal variables, aetiologies, treatment responses, and immediate outcomes were systematically evaluated.

RESULTS

A total of 2,143 neonates were screened; 1,592 (74.29%) were full-term (403 Appropriate for Gestational Age (AGA), 1,189 SGA) and 551 (25.7%) were preterm (362 AGA, 189 SGA) [Table/Fig-1]. The mean gestational age was 37.5±1.18 weeks. The sex distribution was nearly equal (1,080 males and 1,063 females).



[Table/Fig-1]: Distribution of low birth rate neonates based on weight and gestational age.

The overall incidence of hypoglycaemia was 6.91%. In full-term neonates, it was 6.2% (AGA 0.99%, SGA 7.99%), and in preterm neonates, 8.89% (AGA 3.87%, SGA 18.52%). Hypoglycaemia was significantly higher in SGA neonates compared to AGA (p <0.01) and in preterm compared to full-term neonates (p=0.033) [Table/Fig-2]. Birth weight less than 2 kg was significantly associated with higher hypoglycaemia (13.19%) compared to 2-2.5 kg (4.13%).

Gestational age	AGA/ SGA	Hypoglycaemic neonates	Euglycaemic neonates	Test statistics
Full term N=1592	AGA n=403	4 (0.99%)	399 (99.1%)	χ^2=36.1 df=1 p <0.01
	SGA n=1189	95 (7.99%)	1094 (92.01%)	
Total full term hypoglycaemic neonates		99 (6.2%)		
Preterm N=551	AGA n=362	14 (3.87%)	348 (96.13%)	χ^2=4.55 df=1 p=0.033
	SGA n=189	35 (18.52%)	154 (81.48%)	
Total preterm hypoglycaemic neonates		49 (8.89%)		
Total	2143	148 (6.91%)	1995 (95.1%)	

[Table/Fig-2]: Incidence of hypoglycaemia according to gestational age and growth status.

Exclusively breastfed neonates had a lower incidence (5.79%) than those with mixed feeds (12.68%; χ^2=21.5, df=1, p <0.001). Feeding less than 8 times per 24 hours was associated with higher hypoglycaemia (21.34%) compared to ≥8 times (2.87%; χ^2=161, df=1, p <0.001). Caesarean-delivered neonates had significantly more hypoglycaemia (14.72%) compared to vaginally delivered neonates (3.49%; χ^2=88.8, df=1, p <0.001) [Table/Fig-3].

Parameters	Hypoglycaemic neonates N=148	Euglycaemic neonates N=1995	Total N=2143
Birth weight (kg)			
1.8-2	78 (13.19%)	513 (86.8)	591
2-2.5	70 (4.51%)	1482 (95.4)	1552
p-value	<0.001(χ^2= 50.2, df=1)		
Feeding			
Exclusively breastfed neonates	104 (5.79%)	1692 (94.21%)	1796
mixed feeds	44 (12.68%)	303 (87.32%)	347
p-value	<0.001 (χ^2=21.5, df=1)		
Feeding frequency			
Feeding <8 times/24 h	98 (21.34%)	305 (75.68%)	403
Feeding >8 times/24 h	50 (2.87%)	1690 (97.12%)	1740
p-value	<0.001 (χ^2=161, df=1)		
Mode of delivery			
Caesarean delivery	96 (14.72%)	556 (85.28%)	652
NVD	52 (3.49%)	1439 (96.51%)	1491
p-value	<0.001 (χ^2=88.8, df=1)		

[Table/Fig-3]: Distribution of hypoglycaemic neonates according to weight and other parameters.
NVD: Normal vaginal delivery

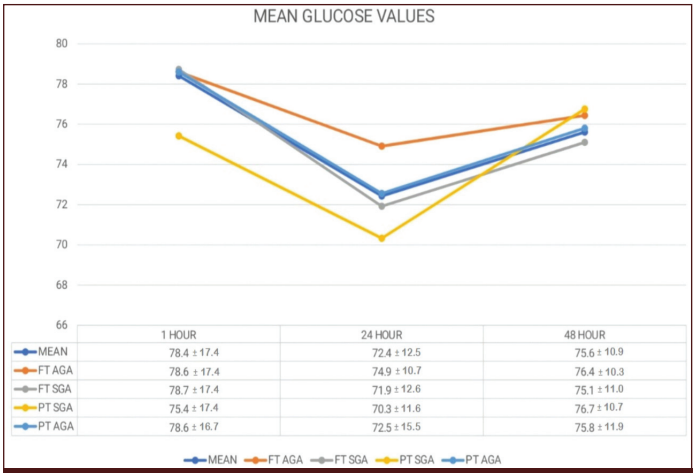
Among 148 hypoglycaemic neonates, 99 were full-term (4 AGA: 1 symptomatic, 3 asymptomatic; 95 SGA: 31 symptomatic, 64 asymptomatic), and 49 were preterm (14 AGA: 3 symptomatic, 11 asymptomatic; 35 SGA: 6 symptomatic, 29 asymptomatic). Of these,

41 (27.7%) were symptomatic. Symptoms were more frequent in full-term (68.89%) than preterm (33.10%) and in SGA (87.83%) than AGA (12.16%), though not statistically significant (χ^2=0.307, p=0.579 for size; χ^2=3.19, p=0.074 for maturity) [Table/Fig-4].

Gestational age	AGA/SGA	Symptomatic neonates	Asymptomatic neonates
Full term n=99	AGA n=4	1 (25%)	3 (75%)
	SGA n=95	31 (32.63%)	64 (67.37%)
Preterm n=49	AGA n=14	3 (21.43%)	11 (78.57%)
	SGA n=35	6 (17.14%)	29 (82.86%)
Total N=148		41 (27.7%)	107 (72.29%)

[Table/Fig-4]: Distribution of hypoglycaemic neonates according to presence of symptoms.

The mean capillary glucose levels were 78.4 mg/dL at one hour, 72.4 mg/dL at 24 hours, and 75.6 mg/dL at 48 hours. Most hypoglycaemia occurred at 24 hours (n=138), with four cases at one hour and six at 48 hours. The mean glucose values by subgroup were as follows: full-term AGA (78.6, 74.9, 76.4 mg/dL), full-term SGA (78.7, 71.9, 75.1 mg/dL), preterm AGA (78.6, 72.5, 75.8 mg/dL), and preterm SGA (75.4, 70.3, 76.7 mg/dL) [Table/Fig-5].



[Table/Fig-5]: Mean glucose values.

Common symptoms included refusal to feed (27 cases, 18.24%), jitteriness (22 cases, 14.86%), irritability (21 cases, 14.19%), hypothermia (10 cases, 6.76%), lethargy (10 cases, 6.76%), sweating (4.73%), and convulsions (2 cases, 1.35%) [Table/Fig-6].

Symptoms	No. of neonates	Percentage
Neurological		
Refusal to feed	27	18.24%
Jitteriness	22	14.86%
Irritability	21	14.19%
Convulsion	2	1.35%
Autonomic		
Lethargy	10	6.76%
Hypothermia	10	6.76%
Sweating	7	4.73%

[Table/Fig-6]: Distribution of hypoglycaemic neonates according to symptoms.

Identified causes included feeding issues (50.68%), inadequate breast milk (33.11%), hypothermia (10.81%), sepsis (4.05%), and polycythemia (1.35%) [Table/Fig-7]. In neonates with proven sepsis or polycythemia, although poor feeding was present, hypoglycaemia was attributed to the underlying condition based on definitive diagnosis. Similarly, in neonates with hypothermia and feeding difficulties, hypothermia was considered the primary cause since poor feeding was likely secondary to lethargy. The category of feeding issues includes only those cases where no other identifiable cause was present.

Causes of hypoglycaemia	Number of neonates	Percentage
Feeding issues	75	50.68%
Inadequate breastmilk	49	33.11%
Hypothermia	16	10.81%
Sepsis	6	4.05%
Polycythemia	2	1.35%

[Table/Fig-7]: Probable aetiological factors of hypoglycaemia in neonates (n=148).

Management included breastfeeding or spoon feeding in 80 neonates (54.05%), tube feeding in 58 (39.19%), and intravenous (i.v.) glucose in 10 (6.7%), as per FBNC guidelines [Table/Fig-8]. Treatment failure (glucose <45 mg/dL after 60 minutes of feeding or 30 minutes of i.v. glucose) was rare, with only one case where the patient succumbed to sepsis. Most cases (144, or 97.3%) were mild (35-45 mg/dL), and 147 recovered without deficits at the time of discharge; one neonate with severe sepsis expired.

Modalities of treatment	n=148	Treatment failure
Breastfeeding/katori spoon feeding	80 (54.5%)	0.00%
RTF	58 (39.19%)	0.00%
Glucose intravenous infusion	10 (6.71%)	1 (Expired)

[Table/Fig-8]: Treatment modalities used and response in hypoglycaemic neonates.
RTF: Ryles/ infant tube feeding

DISCUSSION

This study evaluated the incidence, risk factors, etiologies, and early outcomes of hypoglycaemia in LBW neonates within the first 48 hours of life. The overall incidence was 6.91%, which is lower than previously reported rates of 10-30% in other studies (Mitchell NA et al., 33.7%; Siddhique AA and Sridhar NL, 30%) [9,10,15]. This difference may be attributed to the inclusion of stable neonates, early initiation of feeding, and structured monitoring practices. A significantly higher incidence was noted among preterm and SGA neonates, especially preterm-SGA, which aligns with findings from other studies [16-18]. Among neonates weighing <2 kg, the incidence was significantly higher (13.19%) than in those weighing ≥2 kg (4.51%, p<0.01), likely due to a higher representation of preterm and SGA neonates in the <2 kg group.

Most hypoglycemic episodes (95.9%) occurred within the first 24 hours, consistent with previous studies [Table/Fig-9] [9,10,13,15]. This is likely due to hepatic glycogen depletion and delayed lactogenesis. Blood glucose was highest at one hour (reflecting maternal glucose), lowest at 24 hours, and showed recovery by 48 hours as feeding was established.

Asymptomatic hypoglycaemia was observed in 72.3%, while 27.7% were symptomatic. This percentage is slightly higher than reports by Hotayana NA et al., (20%) and Bhat R et al., (17.4%) [Table/Fig-9] [13,17]. The difference may stem from broader symptom inclusion and a larger sample size in the present study. Hotayana NA et al., considered only refusal to feed as a symptom, which may have led to underreporting.

Authors name [ref no]	Place/year of the study	Sample size	Incidence of hypoglycaemia	Conclusion
Siddhique AA and Sridhar NL [9]	Hyderabad/2018	50	30%	Hypoglycaemia was frequent among LBW babies more so in SGA babies in the first 24 hours
Mitchell NA et al., [10]	Canada/2020	175	33.7%	Premature infants <33 weeks' gestation have increased risk of hypoglycaemia. Maternal hypertension increases hypoglycaemia risk. Antenatal magnesium sulfate administration or labor at time of delivery decrease hypoglycaemia risk.
Bhat MA et al., [15]	Chandigarh/2008	127	25.2%	SGA newborns are highly prone to early hypoglycemia, especially within the first 24 hours. Maternal dextrose infusion, delayed feeding, and neonatal illness increase this risk, underscoring the need for early feeds and close monitoring.
Bhat R et al., [13]	Manipal/2021	320	32.5%	About a third of LBW neonates had hypoglycaemia; mostly on the first hour and day one of life. Asymptomatic nature of hypoglycaemia in the large majority and recurrent hypoglycaemia in 25% cases warrants glucose monitoring in this subgroup.
Present study	Ahmadabad/2025	2143	6.91	In LBW neonates, hypoglycaemia was more commonly observed in preterm, small for gestational age infants, those delivered by caesarean section, and those on mixed feeding, with inadequate breastfeeding being the most important cause, followed by sepsis, hypothermia, and polycythemia.

[Table/Fig-9]: Comparative studies [9,10,13,15].

Refusal to feed was the most common symptom, followed by jitteriness, irritability, and lethargy. Jitteriness and irritability were more common in term neonates, while lethargy predominated in preterm neonates, possibly due to immature neurological responses. Feeding practices played a key role. Exclusive breastfeeding was associated with a lower incidence (5.79%) compared to mixed feeding (12.68%, p<0.001). Infrequent feeds (<8/day) were also associated with a significantly higher risk (p<0.001), confirming the protective role of optimal breastfeeding frequency [18].

Most episodes occurred at glucose levels between 31-45 mg/dL, with severe cases (<30 mg/dL) being rare. These were primarily due to feeding inadequacy, emphasising the need for lactation support and early maternal counseling. Hypoglycaemia was significantly associated with cesarean delivery (14.7%) compared to vaginal birth (3.45%, p<0.001), likely due to delayed feeding initiation and lower milk output postoperatively. No significant association was found with parity. Most neonates responded well to oral feeds; only a few required intravenous glucose. One neonate with sepsis expired, while all others recovered without neurological complications. This suggests that early detection and supportive feeding are typically sufficient for management [19].

Limitation(s)

Multivariate analysis was not performed to control for confounding variables such as gestational age, birth weight, and feeding practices. Additionally, long-term follow-up to assess neurodevelopmental outcomes in hypoglycemic neonates was not conducted. Future studies with extended follow-up and robust statistical modeling are needed to establish causality and evaluate long-term sequelae.

CONCLUSION(S)

Hypoglycaemia remains an important early neonatal concern, particularly among preterm, SGA, low-birth-weight (<2 kg), and cesarean-delivered infants, with most episodes noted within the first 24 hours of life. A considerable proportion of cases (72.3%) were asymptomatic, emphasizing the need for routine screening at 6, 12, and 24 hours in at-risk neonates. Refusal to feed was the most frequent symptom, while jitteriness and irritability were more common in term infants, and lethargy was more common in preterms. Infrequent or inadequate breastfeeding emerged as the predominant contributing factor, whereas frequent exclusive breastfeeding was associated with a lower risk. Early breastfeeding counseling and structured lactation support are therefore essential strategies to mitigate hypoglycaemia in this vulnerable population.

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