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Frequency of Hypoglycemia and Hypothermia amongst Newborns Admitted at Pediatrics Emergency of CLF Larkana

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ABSTRACT

Neonatal hypoglycemia is a prevalent metabolic disorder associated with acute neurological issues and long-term developmental complications. **Objectives:** To assess the frequency of hypoglycemia and hypothermia among newborns admitted to the Neonatal Emergency Department at Child Life Foundation (CLF), Larkana. **Methods:** The cross-sectional investigation was conducted from August 15, 2022, to February 15, 2024, involved 200 neonates of both genders in the Neonatal Emergency Department of CLF, SMBBMU, Larkana. Comprehensive demographic and clinical data—including age, gender, delivery mode, birth location, and maternal residence were collected. Axillary temperature was measured using a sterilized thermometer, and capillary glucose was assessed at five intervals (2, 6, 12, 24, and 48 hours' post-birth) before feeding using an Accu-Chek Glucometer. **Results:** In a study of 200 newborns, the average age was 3.2 ± 2.4 days, with a mean height of 48.3 ± 7.3 cm, weight of 2.7 ± 0.8 kg, and gestational age of 39.6 ± 6.3 weeks. Most participants were female, and 42.5% were appropriate for gestational age. Cesarean section was the most frequent delivery method (48%). Hypoglycemia occurred in 16% of cases, while hypothermia was more common, affecting 47.5% of newborns. Hypothermia showed significant associations with lower height (p=0.008), weight, gestational age, and cesarean/instrumental deliveries.Hypoglycemia was significantly linked to low birth weight, with gestational age and delivery location showing borderline significance. Gender and age had no notable effects. Data were analyzed using SPSS version 20.0. **Conclusions:** Hypothermia was more frequent than hypoglycemia among the admitted neonates. Further research is needed to validate and expand on these findings.

INTRODUCTION

Glucose is the primary fuel for brain metabolism, with infants and children experiencing higher glucose utilization rates than adults. Hypoglycemia in these groups should be considered a medical emergency, potentially leading to seizures, permanent neurological injury, and even death if not treated properly [1]. Severe hypoglycemia can result in long-term neurodevelopmental disorders, including cognitive deficits, motor impairments, behavioural challenges, and an increased risk of visual or auditory deficiencies [2]. Neonatal hypothermia prevalence varies by nation, ranging from 11% to 95%, with Sub-Saharan Africa having the highest rates [3, 4]. Neonatal hypoglycemia is a frequent metabolic condition in infants, sometimes presenting with nonspecific or no symptoms. Possible signs include jitteriness, rapid breathing, low muscle tone, poor feeding, apnea, unstable temperature, seizures, and lethargy [5, 6]. The American Academy of Pediatrics advises a target blood glucose level of 45 mg/dL

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or above before normal feedings, as well as blood glucose intervention [7]. Lower birth weight and gestational age are important risk factors for moderate/severe hypothermia, as are delivery before arrival, hemodynamic assistance during resuscitation, and ventilation support [8, 9]. In 2022, 2.3 million babies died in their first month of life, accounting for over half (47%) of all fatalities in children under the age of five, emphasizing the need for enhanced intrapartum and neonatal care [10]. Hypothermia, defined as an axillary temperature below 36.5°C, also significantly contributes to neonatal morbidity and mortality globally, affecting both developed and developing nations. "In particular, our setting presents several unique characteristics that may influence the presentation and management of neonatal hypoglycemia and hypothermia. Larkana is a semi-urban district in Sindh, Pakistan, with limited access to advanced neonatal care, frequent power outages affecting thermal regulation, high rates of home births, and socioeconomic challenges that may delay timely care-seeking. The patient population served by CLF often includes neonates from rural areas, presenting late or without adequate perinatal support. These contextual factors are underrepresented in existing research, particularly in comparison to Western or urban tertiary care environments."

Neonatal hypoglycemia and hypothermia are major preventable metabolic and thermal emergencies contributing significantly to neonatal morbidity and mortality, particularly in reource-limited settings. Despite their clinical importance, there is limited local evidence from semi-urban emergency care settings like Larkana that simultaneously evaluates the frequency and associated risk factors of both conditions in admitted newborns. Most existing studies are either hospital-based in tertiary urban centers or focus on a single condition, leading to incomplete understanding of their combined burden. This study aims to assess the frequency of neonatal hypoglycemia and hypothermia among newborns admitted to the neonatal emergency department of Child Life Foundation (CLF), Larkana. Accurate estimation of these disorders may assist clinicians and policymakers in allocating appropriate resources and management strategies to mitigate their impact.

METHODS

The cross-sectional investigation was conducted in the Neonatal Emergency Department at Shaheed Mohtarma Benazir Bhutto Medical University (SMBBMU) in Larkana from August 15, 2022, to February 15, 2024. The study received approval under Letter No. CPSP/REU/PED-2018-221-4697, dated. Its primary objective was to assess the frequency of hypoglycemia and hypothermia among newborns admitted to the neonatal emergency department. A non-probability, consecutive sampling method was applied. All parents or guardians of the enrolled babies were informed about the study, and written consent was obtained. The Neonatal Emergency Department evaluated the occurrence of hypoglycemia and hypothermia in admitted newborns, aiming to determine their frequency and associated risk factors. A detailed history and physical examination of each newborn was carried out. Data such as age (hours/days), gender, mode of delivery (spontaneous vaginal delivery, cesarean section, or instrumental), place of delivery (inborn: born within the institution where the study was conducted, or out born: born elsewhere), and maternal area of residence (urban: district-level city, or rural: below district level) were collected using a pre-designed proforma (annexure attached). Axillary temperature was measured following the operational definition. To prevent infection transmission, the thermometer was sanitized with 70% ethyl alcohol and a wet towel after each use. Glucometer (Accu-Chek Glucometer Roche) was used to monitor capillary blood glucose levels at 2, 6, 12, 24, and 48 hours before feeding, after a heel prick was performed under aseptic circumstances. Hypoglycemia was defined as a blood glucose level below 40 mg/dL. The institution's laboratory received a blood sample for confirmation that capillary glucose levels were less than 25 mg/dL. Neonatal hypoglycemia is a common metabolic disorder in newborns that may present with nonspecific clinical symptoms or remain entirely asymptomatic. Infants showing signs of hypoglycemia, such as jitteriness, tachypnea, hypotonia, poor feeding, apnea, temperature instability, seizures, or lethargy, were closely monitored and evaluated during the study. To determine the required sample size, the following statistical formula was used: $n = Z^2 \times p \times (1-p) \div e^2$, where Z = 1.96 (for 95% confidence level), p = 0.152 (15.2% expected prevalence of hypoglycemia), e = 0.05 (margin of error). Applying the values: $n = (1.96)^2 \times 0.152 \times (1 - 0.152) \div (0.05)^2 = 197$. Based on this calculation, a sample size of 197 neonates was estimated, and to ensure comprehensiveness, the number was rounded up to 200 participants. A non-probability, consecutive sampling technique was used to recruit eligible newborns for the study [11]. During sample collection, the inclusion criteria involved newborns of both genders admitted through the neonatal emergency department. The exclusion criteria included newborns whose mothers had diabetes, gestational diabetes, preeclampsia, eclampsia, hypertension, newborn infections, congenital malformations, or jaundice. The mother's blood glucose levels were also checked to rule out diabetes mellitus and gestational diabetes. Additionally, cases where parents or guardians were unwilling to enroll their baby in the study were excluded. The data were analyzed using SPSS version 20.0. Categorical variables like gender, birth weight (SGA / AGA / LGA), presence of hypoglycemia, presence of hypothermia, gestational age, mode, and place of delivery

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were represented in terms of frequencies and percentages. Quantitative variables like age and gestational age were represented as mean and standard deviation. Effect modifiers like gender, age, height, weight, gestational age, mode, and place of delivery were controlled through stratification. Post-stratification, a Chi-square test was applied to compare study variables amongst hypoglycemic and normoglycemic as well as normo-thermic and hypothermic newborns. A p-value less than or equal to 0.050 was considered statistically significant.

RESULTS

In this study, 200 patients were included to assess the hypoglycemia and hypothermia amongst newborns admitted at the neonatal emergency department of CLF, Larkana, and the results were analyzed. The mean ± SD of age was 3.2 ± 2.4 with C.I: 2.91, 3.58 days, height was 48.3 ± 7.3 with C.I: 47.28, 49.31) cm, weight was 2.7 ± 0.8 with C.I: 2.58, 2.81 kg and gestational age was 39.6 ± 6.3 with C.I: 38.72, 40.47 weeks (Table 1).

Table 1: Descriptive Statistics of Weight (n=200)

Variable	Mean ± SD	95% CONFID: Interval	Mini	Max	Range
Age	3.2 ± 2.4 Days	2.91-3.58	0.4	9.6	9.2
Weight	2.7 ± 0.8 Kgs	2.58-2.81	1.8	3.8	2.0
Height	48.3 ± 7.3(cm)	47.28-49.31	42	60	18
Gestation Age	39.6 ± 6.3 (Weeks)	38.72-40.47	37	44	7

In frequency distribution of gender, 77 (38.5%) were male while 123 (61.5%) were female while in frequency distribution for birth weight, small for gestational age (SGA) was noted in 45 (22.5%) children, appropriate for gestational age were 85 (42.5%) while large for gestational age were noted in 30 (15.0%) patients. In the distribution of gestational age, 37-39 weeks for maternal age was noted in 108 (54.0%) while >39 weeks was noted in 92 (46.0%) women, and frequencies of modes of delivery, spontaneous Vaginal Delivery (SVD) was documented in 73 (36.5%), cesarean section in 96 (48.0%) while instrumental mode of delivery was noted in 31 (15.5%). Inborn place of delivery was noted in 134 (67%) while out-born place of delivery was noted in 66 (33%), in addition to 61 (30.5%) were residents of urban areas, while 139 (69.5%) belonged to rural areas (Table 2).

Table 2: Frequency Distribution of Demographic and Other Variables

Variables		Frequency (%)
Age	Male	77 (38.5%)
	Female	123 (61.5%)
Birth Weight	SGA	45 (22.5%)
	AGA	85 (42.5%)
	LGA	30 (15.0%)
Gestational Age	37-39	108 (54.0%)
	>39	92 (46.0%)
Modes of Delivery	SVD	73 (36.5%)
	CS	96 (48.0%)
	Instrumental	31 (15.5%)
Place of Delivery	In Born	134 (67.0%)
	Out Born	66 (33.0%)
Residence Status	Urban	61 (30.5%)
	Rural	139 (69.5%)

Hypoglycemia was found in 32 (16%) (Figure 1).

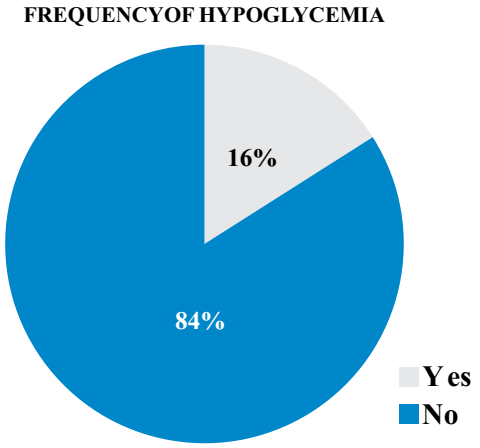


Figure 1: Frequency of Hypoglycemia (n=200)

Hypothermia was found to be in 95 (47.5%) (Figure 2).

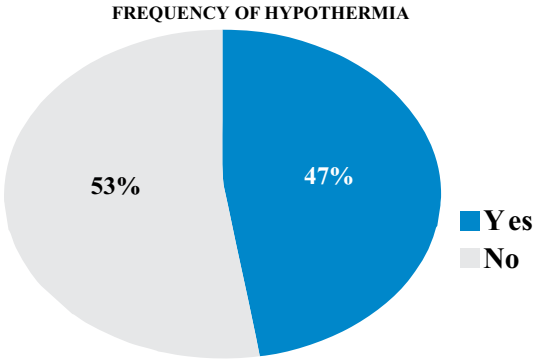


Figure 2: Frequency of Hypothermia (n=200)

These data imply that height (p=0.008), weight (p=0.0001), gestational age (p=0.0001), and method of delivery (p=0.032) are critical risk factors for hypothermia, with statistically significant associations, whereas age group (p=0.11), gender (p=0.454), and site of delivery (p=0.056). have no substantial effect on its prevalence (Table 3).

Table 3: Stratification of Different Variables with Hypothermia (n=200)

Variables		Hypothermia		p-value
		Yes	No	
Age Group (Days)	0.4-3	68 (34.0%)	64 (32.0%)	0.113
	>3	27 (13.5%)	41 (20.5%)	
Gender	Male	34 (17.0%)	43 (21.5%)	0.454
	Female	61 (30.5%)	62 (31.0%)	
Height (cm)	42-50	53 (26.5%)	39 (19.5%)	0.008
	>50	42 (21.0%)	66 (33.0%)	

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Weight (Kg)	1.8–2.5	44 (22.0%)	79 (39.5%)	0.001*
	>2.5	51 (25.5%)	26 (13.0%)	
Gestational Age (Weeks)	37–39	36 (18.0%)	72 (36.0%)	0.001
	>39	59 (29.5%)	33 (16.5%)	
Mode of Delivery	SVD	29 (14.5%)	44 (22.0%)	0.032
	CS	45 (22.5%)	51 (25.5%)	
	Instrumental	21 (10.5%)	10 (5.0%)	
Place of Delivery	In Born	70 (35.0%)	64 (32.0%)	0.056
	Out Born	25 (12.5%)	41 (20.5%)	

Applied Chi-Square test

In finding, a statistically significant association was observed between birth weight and hypoglycemia using the Chi-square test (p=0.035), indicating increased risk in low-birth-weight neonates. Borderline significance was observed in gestational age (p=0.068) and place of delivery (p=0.061). Meanwhile, non-significant factors included age group (p=0.648), gender (p=0.788), height (p=0.620), and mode of delivery (p=0.288), indicating that these variables did not have a substantial impact on hypoglycemia occurrence (Table 4).

Table 4: Stratification of Different Variables with Hypoglycemia (n=200)

Variables		Hypothermia		p-value
		Yes	No	
Age Group (Days)	0.4–3	20 (10.0%)	112 (56.0%)	0.648
	>3	12 (6.0%)	56 (28.0%)	
Gender	Male	13 (6.5%)	64 (32.0%)	0.788
	Female	19 (9.5%)	104 (52.0%)	
Height (cm)	42–50	16 (8.0%)	76 (38.0%)	0.620
	>50	16 (8.0%)	92 (46.0%)	
Weight (Kg)	1.8–2.5	25 (12.5%)	98 (49.0%)	0.035
	>2.5	7 (3.5%)	70 (35.0%)	
Gestational Age (Weeks)	37–39	22 (11.0%)	86 (43.0%)	0.068
	>39	10 (5.0%)	82 (41.0%)	
Mode of Delivery	SVD	13 (6.5%)	60 (30.0%)	0.288
	CS	17 (8.5%)	79 (39.5%)	
	Instrumental	2 (1.0%)	29 (14.5%)	
Place of Delivery	In born	26 (13.0%)	108 (54.0%)	0.061
	Out born	6 (3.0%)	60 (30.0%)	

DISCUSSION

Neonatal hypothermia is a prominent issue in low-resource settings [12]. Hypoglycemia has been reported in approximately 8% of large-for-gestational-age infants (mainly diabetic mothers' infants, or IDMs), preterm infants (15 percent), and intrauterine growth retardation infants (15%); the overall incidence of "high-risk" infants could reach 30% [13]. Neonatal hypoglycemia is a condition where infants experience symptoms such as hypoglycemia, lethargy, poor feeding, jitteriness, seizures, congestive heart failure, cyanosis, apnea, and hypothermia. Autonomic nervous system activation can cause anxiety, tremulousness, diaphoresis, tachycardia, pallor, hunger, nausea, and vomiting [14]. The fetus receives its glucose supply mostly from the mother in healthy pregnancies [15]. Glucose is transferred through the placenta by facilitated diffusion, and fetal plasma glucose levels are typically 8-15 mg/dL lower than maternal levels [16]. Serum glucose levels in newborns decrease after delivery until age 1-3 hours, at which point they rise spontaneously [17]. Infants at risk for hypoglycemia have higher postpartum insulin levels than children and adults, which exacerbates this decline [18]. The persistence of elevated insulin levels has been explained by several ideas. These include stress response before birth, pancreatic B-cell hypersensitivity, and Insulin is transferred from the mother to the fetus through the placenta. Lower blood ketones are associated with higher insulin levels [19]. Even in warm tropical environments, newborn hypothermia has been linked to mortality and morbidity in both low- and normal-birthweight neonates [20]. All babies should receive critical newborn care, a basic suite of therapies that includes the prevention of neonatal hypothermia [21]. Subsequent advancements in infant thermal care have mostly been restricted to industrialized nations, where strategies for preventing and efficiently managing hypothermia have been well investigated [22]. Globally, data on neonatal hypothermia is predominantly from hospitals, and prevalence has ranged between 32% to 85% soon after birth [23], and much of it is based on hospital-based statistics that thermal stress is widespread [24, 25], and over half of neonates suffer hypothermic episodes [20, 25], according to several hospital-based studies conducted in such circumstances. Our study's results are similar to those of several other researchers, who are mentioned below. Babies hospitalized with hypothermia, which is generally defined as any temperature reading below 36.0°C, have a greater mortality risk, according to some hospital-based research [26, 27]. Current study's results are similar to those of several other studies that are mentioned below. In our study, the mean age was 3.2 ± 2.4 days. Singh *et al.*, found the mean age to be 5 ± 4.65 days [11], while another study documented the mean age to be 67.4 ± 121.4 hours [26]. In the present study, the mean gestational age was 39.6 ± 6.3 weeks. The mean gestational age was 37.3 ± 2.9 weeks, found in the study of Ogunlesi *et al.*, [26]. In this study, 77 (38.5%) were male while 123 (61.5%) were female. 65 (52%) male babies and 60 (48%) female babies were part of the study findings of Singh *et al.*, [11]. In another study, 93 (62%) male and 57 (38%) female was reported [26]. In the current study, small for gestational age (SGA) was noted in 45 (22.5%) children, appropriate for gestational age was 85 (42.5%), while large for gestational age was noted in 30 (15%) patients. Singh *et al.*, reported small for gestational age 26 (20.8%) and appropriate for gestational age 99 (79.2%) [11]. While in the study of Ogunlesi *et al.*, 58% were small for gestational age (SGA)

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[26]. In a recent study, an inborn place of delivery was found in 134 (67%) patients, while an out-born place of delivery was noted in 66 (33%) patients. Ogunlesi *et al.*, found 60 (40%) inborn babies and 90 (60%) out-born babies [26]. This study found hypoglycemia in 32 (16%) patients. A study from Manipur, India, evaluating 125 newborns calculated that 19 (15.20%) were found to be hypoglycemic [11].In a recent study, stratifications were statistically not significant relation was observed about hypoglycemia was noted in age group (p=0.648), gender (p=0.788), height (p=0.620), gestational age (p=0.068), mode of delivery (p=0.288), place of delivery (p=0.061), while significant difference was noted in weight (p=0.035).

This study was conducted in a single tertiary care emergency unit, which may limit the generalizability of findings to other settings. The use of non-probability consecutive sampling may introduce selection bias, and short-term monitoring may not capture late-onset metabolic abnormalities. Future research should include multicenter, prospective cohort studies with larger sample sizes to improve external validity. Additionally, integrating continuous glucose and temperature monitoring along with long-term neurodevelopmental follow-up would provide stronger evidence for clinical outcomes and preventive strategies.

CONCLUSIONS

It was concluded that hypothermia was more common (47.5%) in neonates admitted to a tertiary care center's emergency department than hypoglycemia (16%). Factors like low birth weight, gestational age, and cesarean delivery were associated with hypothermia, while low birth weight was the only significant factor related to hypoglycemia. The study emphasizes the need for early detection protocols and urgent thermal care practices in neonatal units and calls for further large-scale, multicenter studies to confirm these associations.

Authors' Contribution

Conceptualization: A
Methodology: SL
Formal analysis: ARS
Writing and Drafting: VKG, DM, ABS
Review and Editing: VKG, DM, ABS, A, SL

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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