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Prevalence and Factors Associated with Dysglycemia Among Preterm Babies Admitted in Nicu Kayunga Regional Referral Hospital

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Abstract

Introduction: Dysglycemia is a critical metabolic disturbance in preterm babies, contributing significantly to morbidity and mortality. Preterm babies are particularly vulnerable due to their immature physiological systems, limited glycogen stores, and heightened metabolic demands. While the global prevalence of dysglycemia in preterm babies is high, there is a scarcity of data on this issue in Uganda. This study aimed to determine the prevalence of dysglycemia and identify its associated factors among preterm babies admitted to Neonatal Intensive Care Unit (NICU) at Kayunga Regional Referral Hospital.

Methods: This was hospital-based cross-sectional analytical study at NICU of Kayunga Regional Referral Hospital among 151 preterm neonates admitted to NICU. Data was collected by using structural questionnaire. Blood glucose levels were measured at admission and monitored during the first 24 hours. Dysglycemia was defined as a blood glucose level < 45 mg/dl (hypoglycemia) or > 150 mg/dl (hyperglycemia). Multivariate logistic regression analyses were performed to identify factors associated with hypoglycemia and hyperglycemia.

Results: Prevalence of dysglycemia was 15.9%, hypoglycemia was in 10.6% of the study participants and hyperglycemia was in 5.3%. Preterm neonate whose mothers received corticosteroids during pregnancy were over five times more likely to develop hypoglycemia (AOR = 5.22, 95% CI: 1.10–24.79, p = 0.04). Preterm babies who experienced neonatal convulsions had a significantly higher likelihood of hypoglycemia, with a sevenfold increase in odds(AOR = 7.08, 95% CI: 1.19–18.65, p = 0.02).Preterm whose parents resided in urban areas had significantly higher odds of developing hyperglycemia (AOR = 8.99, 95% CI: 1.63–49.53, p = 0.012). Babies born to mothers with gestational hypertension were more likely to experience hyperglycemia (AOR = 6.90, 95%

Conclusion: Dysglycemia is a common metabolic problem among preterm neonate, with hypoglycemia being more frequent than hyperglycemia.Maternal corticosteroid exposure.

Bacground

Preterm birth is the leading cause of neonatal mortality (1). While rates are lower in upper-middle-class and high-income countries (9.4% and 9.3%, respectively), the neonatal mortality rate is higher in low-income and lower-middle-income countries (11.8% and 11.3%, on average). Over 60% of preterm births globally take place in low-resource, high-fertility nations in South Asia and Sub-Saharan Africa(2).In low-income countries, the second most common cause of infant mortality is prematurity, a serious public health issue. Prematurity, when combined with intrauterine growth retardation, is now a crucial factor in determining a child's survival, health, and development as well as a predictor of the newborn's overall health. Prematurity rates range from 5% to 9% in some Western nations, but they are reported to be more than 15% in Africa (3).

For the fetus and baby to grow and develop their brains, glucose metabolism is crucial. A biochemical condition known as dysglycemia, which encompasses both hypoglycemia and hyperglycemia, is caused

by an imbalance between the concentration of accessible glucose and the tissue's consumption of glucose (4). Prolonged or recurrent episodes of hypoglycemia during crucial neurodevelopmental windows might alter the structure and function of the brain permanently(5).

One known factor contributing to newborn death and morbidity is hyperglycemia. About 45% to 80% of premature newborns have this condition. Although various potential explanations have been proposed, the mechanism underlying preterm infants' higher risk of hyperglycemia is not fully understood. More than 180–200 mg/dl (10–11.1 mmol) of plasma glucose is concerning because it may cause complications (6). A number of risk factors, such as gestational age, low birth weight, stress, excessive glucose administration, parenteral feeding, and the use of certain medications, such as corticosteroids, phenytoin, or theophylline, can cause hyperglycemia in premature newborns (7)

Because preterm delivery is becoming more common and because maternal conditions like diabetes and obesity can make babies more susceptible to hypoglycemia, the prevalence of hypoglycemia is rising (8).However, the definition, demographic, feeding technique, time, and kind of glucose test all affect the prevalence of newborn hypoglycemia(9).

On the other hand, neonatal hyperglycemia is another common metabolic condition that is more prevalent in low birth weight, preterm, and critically sick babies. According to published research, the condition's estimated occurrence ranges from 45% to 80% (6). In the case of premature infants, it is inversely related to birth weight. Approximately 80% of extremely preterm infants weighing less than 750 g, 45% of infants weighing less than 1000 g, and 2% of infants weighing more than 2000 g are reported to have hyperglycemia (6).

METHODOLOGY

Study design and study population

This study employed a cross-sectional design to assess the prevalence of dysglycemia among preterm babies admitted in NICU at Kayunga Regional Referral Hospital. This design is appropriate as it allows for the collection of data at a single point in time, providing a snapshot of the prevalence and associated factors.

All preterm babies born at less than 37 weeks of gestational age area of KRRH

Study Site

The study was conducted from Kayunga Regional Referral Hospital (KRRH) which is located in the City of Kayunga in Kayunga District in the central region of Uganda.

KRRH is a referral hospital for the districts in the vicinity. KRRH also serves as a satellite hospital for Kampala International University. The study was conducted from the Neonatal intensive unit(NICU) of

department of Pediatrics and child health which is composed of Pediatricians, senior house officers (SHO's), medical officers, intern doctors and nurses. When a premature newborn presents to NICU, they were first stabilized, blood samples are then picked to do laboratory blood investigations such as random blood glucose and other tests deemed necessary. The neonate was then treated according to the findings of laboratory investigations coupled with physical examination and history findings.

- Sample Size Determination

For objective one, Daniel's formula has been used to determine the sample size.

Using findings by (8) who reported that hypoglycemia was found in 19 (11.0%) of the neonates, P = 0.11, d = 0.

05 and Z = 1.96 for 95% level of significance. Substituting, n = 151.

Sampling Technique

Consecutive enrolment for all the eligible participants was done till the sample size was attained.

Data collection procedure

The principal investigator requested the team at NICU to be informed incase the team receives a premature neonate.

If the neonate was found to satisfy the eligibility criteria, their mother or guardian was then explained to the purpose of the study and subsequently asked to consent.

Mothers or guardians of neonates who consented to participate in the study were administered the questionnaires by the principal investigator and the information regarding sociodemographic and medical characteristics of their neonates were documented.

The neonates were examined by the principal investigator and the findings were recorded in the respective questionnaire of each neonate Blood glucose levels was measured using a point-of-care glucometer device (On Call Plus® glucometer).

Plasma blood glucose testing was done for those found to have abnormal glucose reading with the point-of-care glucometer device to confirm hypoglycemia or hyperglycemia.

A glucose level below 45 mg/dl for preterm baby was used as the cutoff for diagnosing hypoglycemia (American Diabetes Association, 2024).

A blood glucose level above 150mg/dl was considered hyperglycemia (American Diabetes Association, 2024).

Measurements were taken at the time of admission.

- Data quality Control

The inclusion and exclusion criteria were strictly followed. The same questionnaire was applied to all participants. All the study protocols were printed to guide the principal investigator during the study period. The principal investigator double-checked all questionnaires each day before closure of the study to ensure that all the data collection tools were fully completed

- Data management

The principal investigator approved storage, and the questionnaires were stored under lock and key in safety lockers, while data were entered into password-protected computers. Only approved individuals had access to the data as necessary. Using an Excel data sheet, the data were entered and then exported to SPSS version 26 for analysis. To determine the amounts of missing values, significant outliers, independence of errors, multi-collinearity, and normalcy, exploratory data analysis was conducted.

Data analysis

For objective one, the percentage of participants with dysglycemia out of the total number of participants in the study was calculated, and the 95% confidence interval was reported. In addition, the specific percentages of participants with hyperglycemia and hypoglycemia were reported.

Binary logistic regression analysis was employed for objectives two and three. Both bivariate and multivariate regression analyses were conducted. A multivariate regression was performed using the components with p-values less than 0.2 in order to identify the factors that were independently linked. The final multivariate analysis model was selected manually using a backward stepwise procedure, taking into account components that showed an independent significant correlation. Using this approach, the researcher eliminated variables from the model if they no longer had a relevant link after accounting for the impact of other variables.

The interaction effect between the covariates was examined. To verify multi-collinearity, the Variance Inflation Factor (VIF) was employed. A variable was deemed collinear if the VIF was greater than 5. Confounding and interaction were examined using changes in the regression coefficient; if the change was greater than 15% and the interaction term was significant, it was regarded as an effect modifier; if not, it was regarded as a confounder. Lastly, the model's fitness was evaluated. The components included in the final multivariate model were presented together with their 95% confidence intervals and adjusted rate ratios. In this analysis, a variable was deemed significant if its p-value was less than 0.05.

Ethical Consideration

Ethical approval

was obtained from the Kampala International University Research and Ethics Committee. Informed consent and assent was obtained from all participants after explaining the purpose and procedures of the study. Confidentiality was maintained by anonymizing data, and participation was entirely voluntary, with the right to withdraw at any time without consequence.

Results

Socio-demographic characteristics of study participants

Majority of the study participants 42.4% (64/151) were age 12–24 hours, 58.3% (88/151) were female and 81.5% (123/151) resided in rural areas. Additionally, 88.7% (134/151) of the mothers stopped in primary or below and 66.2% (100/151) are unemployment. Furthermore, 58.9% (89/151) had a birth weight of 1600g to 2500g (Table 1).

Table 1
Socio-demographic characteristics of study participants

Variable	Frequencies (N = 151)	Percentages (%)
Age (hrs)		
< 12	47	31.1
12–24	64	42.4
> 24	40	26.5
Sex		
Female	88	58.3
Male	63	41.7
Residence		
Rural	123	81.5
Urban	28	18.5
Mother’s education level		
≤Primary	134	88.7
≥Secondary	17	11.3
Occupation		
Unemployment	100	66.2
Emploment	51	33.8
Neonatal birth weight		
< 1.0kg	24	15.9
1.0-1.5kg	38	25.2
1.6-2.5kg	89	58.9

- Medical characteristics of study participants

Regarding the medical characteristics of the neonate, 3.3% (5/151) reported neonatal alternation of consciousness, 4.0% (6/151) reported neonatal convulsions, 29.3% (44/151) had a APGAR score of less than 7, 6.6% (10/151) reported excessive sweating and 13.2% (20/151) of the preterm babies had hypothermia, 11.9% (18/151) of the babies were irritable, 87.4% (132/151) had difficulty in breathing, 37.8% (57/151) had a gestational age of less than 28 weeks, 7.9% (12/151) had neonatal fever (Table 2).

Table 2
Medical characteristics of the neonates

Variable	Frequencies (N = 151)	Percentages (%)
Neonatal alternal consciousness		
No	146	96.7
Yes	5	3.3
Neonatal convulsions		
No	145	96.0
Yes	6	4.0
Neonatal 5th minute APGAR		
< 7	45	29.3
≥ 7	106	70.7
Excessive sweating		
No	141	93.4
Yes	10	6.6
Neonatal hypothermia		
No	131	86.8
Yes	20	13.2
Baby irritable		
No	133	88.1
Yes	18	11.9
Difficulty in breathing		
No	19	12.6
Yes	132	87.4
Gestational age		
< 28 weeks	57	37.8
28–33	19	12.6
34–36 weeks	75	49.6
Neonatal fever		
No	139	92.1

Variable	Frequencies (N = 151)	Percentages (%)
Yes	12	7.9

Regarding the medical characteristics of the mothers, 7.3% (11/151) of the mothers reported to have received corticosteroids in pregnancy, 11.3% (17.2/151) had maternal diabetes, 28.5% (43/151) had gestational hypertension and above, 7.3% (11/151) of the deliveries were cesarean(Table3).

Table 3
Medical characteristics of the mothers

Variable	Frequencies (N = 151)	Percentages (%)
Received corticosteroids in pregnancy		
No	140	92.7
Yes	11	7.3
Maternal diabetes		
No	125	82.8
Yes	26	17.2
Gestational hypertension		
No	108	71.5
Yes	43	28.5
Type of delivery		
CS	11	7.3
Vaginal	140	92.7

- Prevalence of dysglycemia among preterm babies admitted in NICU at Kayunga Regional Referral Hospital.

Prevalence of dysglycemia was 15.9% with a 95% confidence interval of 10.8%-22.7% (Fig. 1).

Prevalence of hypoglycemia and hyperglycemia among preterm babies

Hypoglycemia was in 10.6% (16/151) of the study participants and hyperglycemia was in 5.3% (8/151) of the study participants (Table 4).

Table 4
Prevalence of hypoglycemia and hyperglycemia among preterm babies

Variable	Frequencies (N = 151)	Percentages (%)	95% CI
Hypoglycemia			
Yes	16	10.6	6.6–16.7
No	135	89.4	83.3–93.4
Hyperglycemia			
Yes	8	5.3	2.7–10.3
No	143	94.7	89.7–97.3

Bivariate analysis of the neonatal factors associated with hypoglycemia among preterm babies.

Regarding to the bivariate analysis of neonatal factors, convulsions were strongly associated with hypoglycemia, with affected babies having a markedly higher likelihood of hypoglycemia (COR = 10.15, 95% CI: 1.86–55.51, p = 0.007). Babies who were reported to have hypothermia were also more likely to experience hypoglycemia (COR = 3.64, 95% CI: 1.11–11.90, p = 0.03). Neonatal irritability showed a borderline association (COR = 2.88, 95% CI: 0.82–10.15, p = 0.10) (Table 5)

Table 5
Bivariate analysis of the neonatal factors associated with hypoglycemia among preterm babies

Variable	Hypoglycemia		COR(95% CI)	P-value
	No 135(89.4%)	Yes 16(10.6%)		
Age (hrs)				
< 12	41(87.2)	6(12.8)	1.41(0.43–4.69)	0.57
12–24	58(90.6)	6(9.4)	Ref	
> 24	36(90.0)	4(10.0)	1.07(0.28–4.07)	0.92
Sex				
Female	77(87.5)	11(12.5)	1.66(0.55–5.03)	0.37
Male	58(92.1)	5(7.9)	Ref	
Neonatal birth weight				
< 1.0kg	19(79.2)	5(20.8)	4.42(0.54–9.21)	0.51
1.0-1.5kg	32(84.2)	6(15.8)	3.15(0.61–7.69)	0.28
1.6-2.5kg	84(94.4)	5(5.6)	Ref	
Neonatal altered consciousness				
No	131(89.7)	15(10.3)		
Yes	4(80.0)	1(20.0)	2.18(0.23–20.83)	0.50
Neonatal convulsions				
No	132(91.0)	13(9.0)		
Yes	3(50.0)	3(50.0)	10.15(1.86–55.51)	0.007*
Neonatal 5th minute APGAR				
< 7	39(88.6)	5(11.4)	1.12(0.36–3.43)	0.84
≥ 7	96(89.7)	11(10.3)	Ref	
Excessive sweating				
No	127(90.1)	14(9.9)		
Yes	8(80.0)	2(20.0)	2.27(0.44–11.75)	0.33
Neonatal hypothermia				

Variable	Hypoglycemia		COR(95% CI)	P-value
	No 135(89.4%)	Yes 16(10.6%)		
No	120(91.6)	11(8.4)		
Yes	15(75.0)	5(25.0)	3.64(1.11–11.90)	0.03*
Baby irritable				
No	121(91.0)	12(9.0)		
Yes	14(77.8)	4(22.2)	2.88(0.82–10.15)	0.10*
Gestational age at delivery				
< 28 weeks	47(82.5)	10(17.5)	3.78(0.62–9.17)	0.29
28–33	17(89.5)	2(10.5)	2.09(0.54–7.63)	0.37
34–36 weeks	71(94.7)	4(5.3)	Ref	
Neonatal fever				
No	125(89.9)	14(10.1)	Ref	
Yes	10(83.3)	2(16.7)	1.79(0.35–8.98)	0.48

Bivariate analysis of the maternal factors associated with hypoglycemia among preterm babies

Regarding to bivariate analysis of maternal factors showed an association with hypoglycemia among preterm babies. Preterm neonates whose mothers received corticosteroids during pregnancy were significantly more likely to have hypoglycemia (COR = 6.10, 95% CI: 1.56–23.83, p = 0.009) compared to those whose mothers did not. And maternal gestational diabetes also demonstrated a weak association with hypoglycemia (COR = 3.45, 95% CI: 0.79–8.42, p = 0.12) (Table 6).

Table 6
Bivariate analysis of the maternal factors associated with hypoglycemia among preterm babies

Variable	Hypoglycemia		COR(95% CI)	P-value
	No 135(89.4%)	Yes 16(10.6%)		
Residence				
Rural	111(90.2)	12(9.8)	Ref	
Urban	24(85.7)	4(14.3)	1.54(0.46–5.19)	0.49
Mother's education level				
≤ Primary	119(88.9)	15(11.1)	2.02(0.24–5.53)	0.87
≥Secondary	16(94.1)	1(5.9)	Ref	
Occupation				
Unemployment	89(89.0)	11(11.0)	1.14(0.37–3.47)	0.82
Employment	46(90.2)	5(9.8)	Ref	
Recieved corticosteroids in pregnancy				
No	128(91.4)	12(8.6)		
Yes	7(63.6)	4(36.4)	6.10(1.56–23.83)	0.009*
Maternal gestational diabetes				
No	115(92.0)	10(8.0)	Ref	
Yes	20(76.9)	6(23.1)	3.45(0.79–8.42)	0.12*
Gestational hypertension				
No	97(89.8)	11(10.2)	Ref	
Yes	38(88.4)	5(11.6)	1.16(0.38–3.56)	0.79
Type of delivery				
CS	9(81.8)	2(18.2)	2.17(0.39–10.19)	0.40
Vaginal	126(90.0)	14(10.0)	Ref	

- Bivariate analysis of the neonatal factors associated with hyperglycemia among preterm babies

Regarding to the bivariate analysis of Preterm neonates aged more than 24 hours had a higher likelihood of developing hyperglycemia compared to those aged 12–24 hours (COR = 3.44; 95% CI: 0.60–19.74, p = 0.17),neonatal fever was associated with increased odds of hyperglycemia (COR = 8.93; 95% CI: 1.84–43.48, p = 0.007),(Table 7)

Table 7
Bivariate analysis of the neonatal factors associated with hyperglycemia among preterm babies

Variable	Hyperglycemia		COR(95% CI)	P-value
	No 143(94.7%)	Yes 8(5.3%)		
Age (hrs)				
< 12	45(95.7)	2(4.3)	1.38(0.19–10.15)	0.75
12–24	62(96.9)	2(3.1)	Ref	
> 24	36(90.0)	4(10.0)	3.44(0.60-19.74)	0.17*
Sex				
Female	83(94.3)	5(5.7)	Ref	
Male	60(95.2)	3(4.8)	1.20(0.28–5.24)	0.80
Neonatal birthweight				
< 1.0kg	20(83.3)	4(16.7)	8.70(0.74–13.76)	0.54
1.0-1.5kg	36(94.7)	2(5.3)	2.42(0.28–7.10)	0.29
1.6-2.5kg	87(97.8)	2(2.2)	Ref	
Neonatal altered consciousness				
No	138(95.2)	7(4.8)	Ref	
Yes	5(83.3)	1(16.7)	3.94(0.40-38.45)	0.24
Neonatal convulsions				
No	137(95.1)	7(4.9)	Ref	
Yes	6(85.7)	1(14.3)	3.26(0.34–30.92)	0.30
Neonatal 5th minute APGAR				
< 7	42(95.5)	2(4.5)	Ref	
≥ 7	101(94.4)	6(5.6)	1.25(0.24–6.43)	0.79
Excessive sweating				
No	133(95.0)	7(5.0)	Ref	
Yes	10(90.9)	1(9.1)	1.90(0.21-17.00)	0.57
Neonatal hypothermia				
No	123(94.6)	7(5.4)	1.14(0.13–9.75)	0.91

Variable	Hyperglycemia		COR(95% CI)	P-value
	No 143(94.7%)	Yes 8(5.3%)		
Yes	20(95.2)	1(4.8)	Ref	
Baby irritable				
No	126(94.7)	7(5.3)	Ref	
Yes	17(94.4)	1(5.6)	1.06(0.12–9.14)	0.96
Maternal gestational diabetes				
No	119(95.2)	6(4.8)	Ref	
Yes	24(92.3)	2(7.7)	1.65(0.47–12.45)	0.29
Gestational age at delivery				
< 28 weeks	53(93.0)	4(7.0)	2.75(0.51–5.91)	0.29
28–33	17(89.5)	2(10.5)	4.29(0.65–8.80)	0.58
34–36 weeks	73(97.3)	2(2.7)	Ref	
Neonatal fever				
No	134(96.4)	5(3.6)	Ref	
Yes	9(75.0)	3(25.0)	8.93(1.84–43.48)	0.007*

Bivariate analysis of the maternal factors associated with hyperglycemia among preterm babies

Regarding to the bivariate analysis of the maternal factors Residence was also notable, with mothers from urban areas exhibiting significantly higher odds of hyperglycemia compared to their rural counterparts (COR = 8.70; 95% CI: 1.94–38.94, p = 0.005), neonates born to hypertensive mothers had higher odds of hyperglycemia than those born to normotensive mothers (COR = 4.61; 95% CI: 1.05–20.20, p = 0.043), gestational hypertension likewise showed a borderline association.(Table 8).

Table 8
Bivariate analysis of the maternal factors associated with hyperglycemia among preterm babies

Variable	Hyperglycemia		COR(95% CI)	P-value
	No 143(94.7%)	Yes 8(5.3%)		
Residence				
Rural	120(97.6)	3(2.4)	Ref	
Urban	23(82.1)	5(17.9)	8.70(1.94–38.94)	0.005*
Mother's education level				
≤Primary	127(94.8)	7(5.2)	Ref	
≥Secondary	16(94.1)	1(5.9)	1.13(0.76–6.59)	0.46
Occupation				
Unemployment	94(94.0)	6(6.0)	1.56(0.30–8.04)	0.59
Employment	49(96.1)	2(3.9)	Ref	
Experienced corticosteroids in pregnancy				
No	133(95.0)	7(5.0)		
Yes	10(90.9)	1(9.1)	1.90(0.21-17.00)	0.57
Gestational hypertension				
No	105(97.2)	3(2.8)	Ref	
Yes	38(88.4)	5(11.6)	4.61(1.05–20.20)	0.043*
Type of delivery				
CS	11(91.7)	1(8.3)	1.71(0.19–15.22)	0.63
Vaginal	132(95.0)	7(5.0)	Ref	

Multivariate analysis of the factors associated with hypoglycemia among preterm babies.

After adjusting for potential confounders, two factors remained significantly associated with hypoglycemia among preterm babies. Preterm neonate whose mothers received corticosteroids during pregnancy were over five times more likely to have hypoglycemia compared to those whose mothers did not receive corticosteroids (AOR = 5.22, 95% CI: 1.10–24.79, p = 0.04). In addition, preterm babies who experienced neonatal convulsions had a significantly higher likelihood of hypoglycemia, with a sevenfold increase in odds compared to those without convulsions (AOR = 7.08, 95% CI: 1.19–18.65, p = 0.02)

Table 9Multivariate analysis of the factors associated with hypoglycemia among preterm babies. .(Table 9).

Table 9
Multivariate analysis of the factors associated with hypoglycemia among preterm babies.

Variable	COR(95% CI)	P-value	AOR(95%CI)	P-value
Received corticosteroids in pregnancy				
No	Ref		Ref	
Yes	6.10(1.56–23.83)	0.009*	5.22(1.10-24.79)	0.04*
Neonatal convulsions				
No	Ref		Ref	
Yes	10.15(1.86–55.51)	0.007*	7.08(1.19–18.65)	0.02*
Neonatal hypothermia				
No	Ref		Ref	
Yes	3.64(1.11–11.90)	0.03*	1.33(0.25–7.11)	0.74
Baby irritable				
No	Ref		Ref	
Yes	2.88(0.82–10.15)	0.10*	1.07(0.19–6.20)	0.94
Maternal gestational diabetes				
No	Ref		Ref	
Yes	3.45(0.79–8.42)	0.12*	2.08(0.60–7.21)	0.25
*Statistically significant, p < 0.05				

- Multivariate analysis of the factors associated with hyperglycemia among preterm babies

In the multivariate analysis, three factors remained independently associated with hyperglycemia among preterm babies. Preterm whose parents resided in urban areas had significantly higher odds of developing hyperglycemia compared to those from rural residences (AOR = 8.99, 95% CI: 1.63–49.53, p = 0.012). Similarly, babies born to mothers with gestational hypertension were more likely to experience hyperglycemia than their counterparts born to normotensive mothers (AOR = 6.90, 95% CI: 1.03–46.13, p = 0.046). Additionally, neonatal fever emerged as a strong independent predictor, with febrile neonates having a markedly increased likelihood of hyperglycemia (AOR = 17.49, 95% CI: 2.32–24.89, p < 0.001). . (Table 10).

Table 10
Multivariate analysis of the factors associated with hyperglycemia among preterm babies

Variable	COR(95% CI)	P-value	AOR(95% CI)	P-value
Age (hrs)				
< 12	1.38(0.19–10.15)	0.75	2.02(0.23–17.87)	0.53
12–24	Ref		Ref	
> 24	3.44(0.60-19.74)	0.17*	5.30(0.68–41.12)	0.11
Residence				
Rural	Ref		Ref	
Urban	8.70(1.94–38.94)	0.005*	8.99(1.63–49.53)	0.012*
Gestational hypertension				
No	Ref		Ref	
Yes	4.61(1.05–20.20)	0.043*	6.90(1.03–46.13)	0.046*
Neonatal fever				
No	Ref			
Yes	8.93(1.84–43.48)	0.007*	17.49(2.32–24.89)	< 0.001*

***Statistically significant, P < 0.05**

DISCUSSION

The overall dysglycemia prevalence was high at 15.9%. Similar studies conducted in Indonesia, Croatia, and Ethiopia have reported dysglycemia prevalence ranging between 13% and 16% among hospitalized preterm infants (Ahel et al., 2022; Angelika et al., 2023; Sertsu et al., 2022). These comparable estimates may reflect common risk factors across low-resource neonatal units, including hypothermia, sepsis, feeding difficulties, and limited glycogen stores.

However, the prevalence observed in this study is lower than the 20–25% reported in some high-income settings (Mitchell et al., 2020; Yunarto&Sarosa, 2019). These higher rates may be attributed to routine continuous glucose monitoring and stricter diagnostic thresholds used in advanced NICUs, which may capture transient glucose abnormalities that are often missed in resource-limited units.

Additionally, the dysglycemia prevalence in the current study is higher than the 2.2% reported in the Ugandan community-based study by Mukunya et al. (2020). This difference is expected because that study included neonates from the community, most of whom were healthy term infants, whereas our study focused specifically on preterm babies population inherently at higher metabolic risk.

Hypoglycemia prevalence in this study was 10.6%, which is consistent with findings from Nigeria (11%) and Taiwan (11.82%) (Chen et al., 2022; Ochoga et al., 2018). The similarity may be due to shared challenges in early feeding or high rates of maternal obstetric complications in these settings. The finding is also close to the 13.5% reported in India among at-risk infants (Kumar et al., 2021).

The finding is, however, lower than several studies that documented higher rates ranging from 20% to over 30% (Ahel et al., 2022; Khan et al., 2024; Mitchell et al., 2020; Chanie et al., 2023). The difference in study findings could be attributed to the fact that the latter studies monitored glucose at multiple time points including within the first hour, 4 hours, and 6 hours capturing both transient and persistent hypoglycemia. In contrast, our study recorded glucose at a single point in time, which may have missed early episodes that resolved spontaneously. Studies with larger sample sizes and continuous glucose monitoring also tend to record higher hypoglycemia burden.

Findings from our study are however higher than the 2.2% reported in Lira District, Uganda (Mukunya et al., 2020). This discrepancy is expected because their study included mostly term neonates, whereas preterm neonate, such as those in our study, are known to possess limited glycogen stores, immature gluconeogenesis, and higher brain glucose demands (Mazari et al., 2020; Kalhan et al., 2009). The prevalence observed supports the path physiological understanding that preterm neonates have reduced metabolic reserves, impaired counter-regulatory hormone responses, and feeding difficulties, making hypoglycemia common in this population.

This study found a hyperglycemia prevalence of 5.3%, which is within the lower range of what has been reported worldwide. For example, hyperglycemia prevalence in preterm neonates has been reported at 9.9% in Croatia, 13.3% in Indonesia, and 14% in some NICUs in Europe (Ahel et al., 2022; Angelika et al., 2023; Hussain et al., 2022). The lower prevalence in our study may be due to fewer extremely low birth weight neonates and less aggressive parenteral glucose infusion compared to advanced NICUs.

However, our findings contrast sharply with the very high hyperglycemia prevalence of 45–80% documented among extremely low birth weight neonates in high-income countries (Hussain et al., 2022). These higher rates are typically observed in neonates < 1000 g receiving early aggressive parenteral nutrition, mechanical ventilation, or high-dose steroids. In our setting, most neonates weighed ≥ 1500 g, and parenteral nutrition is rarely used, which may explain the lower burden. Additionally, the lower hyperglycemia prevalence may also reflect under-detection due to single-time glucose measurement. Hyperglycemia is known to fluctuate rapidly with stress, sepsis, and glucose infusion rates, necessitating repeated monitoring to accurately diagnose (Cornbath& Schwartz, 1991).

Preterm neonates whose mothers received corticosteroids during pregnancy were over five times more likely to have hypoglycemia compared to those whose mothers did not. This finding aligns with evidence from previous studies that have documented an increased risk of hypoglycemia following antenatal corticosteroid administration. For instance a cross sectional study in Ethiopia also found antenatal steroid exposure to be an independent predictor of hypoglycemia in very preterm neonates(Koolen et al.

2023). Similarly, another study in the US reported that neonates exposed to antenatal corticosteroids exhibited lower glucose levels in the early neonatal period(Mitchell et al. 2020).

The biological mechanism behind this association is grounded in the metabolic effects of corticosteroids. Antenatal steroids accelerate fetal organ maturation, particularly the lungs, but may also stimulate fetal insulin secretion, resulting in transient hyperinsulinemia, which predisposes the neonates to postnatal hypoglycemia. Additionally, corticosteroids increase glucose utilization and may suppress counter-regulatory hormonal responses especially cortisol making preterm neonates more vulnerable to glucose instability immediately after birth.

However, contrasting findings exist. Some studies did not report a significant association between antenatal corticosteroid exposure and hypoglycemia(Ahel et al. 2022). These inconsistencies may reflect differences in timing of steroid administration, dosage regimens, gestational age distribution, or clinical monitoring practices. Nevertheless, the strong association observed in the present study reinforces the need for rigorous glucose monitoring among steroid-exposed preterm neonates.

The study also demonstrated that preterm neonates who experienced neonatal convulsions were seven times more likely to develop hypoglycemia compared to those without convulsions. This finding is in line with studies from Ethiopia and Tanzania, where seizures were reported as significant predictors of hypoglycemia (Chanie et al., 2023; Sertsu et al., 2022). Additionally, neonatal seizures have long been recognized as both a symptom and a risk factor associated with severe hypoglycemia.

The relationship between hypoglycemia and seizures is bidirectional. Hypoglycemia deprives the neonatal brain of its primary energy substrate, leading to neuronal dysfunction and provocation of seizures. Seizures themselves increase cerebral metabolic demand and glucose utilization, which may worsen hypoglycemia in a vulnerable preterm neonate with already limited glycogen reserves. The immature counter-regulatory mechanisms in preterm neonates further exacerbate this cycle, making seizure-prone neonates particularly susceptible to hypoglycemic episodes.

Some literature, however, suggests that convulsions may be more a **c**linical manifestation of hypoglycemia rather than a predisposing factor (Kumar et al., 2021). This distinction can be challenging in cross-sectional studies, where temporal relationships are difficult to establish. Nonetheless, the strong association observed in this study underscores the importance of routine glucose assessment in any preterm neonate presenting with seizures, regardless of the suspected cause.

Preterm neonates whose parents resided in urban areas were nine times more likely to have hyperglycemia (AOR = 8.99). This association has been observed indirectly in previous studies where urban residence was linked to higher maternal stress, increased prevalence of metabolic conditions, and greater likelihood of complicated pregnancies (Rehman et al., 2022).

Urban populations also tend to have higher rates of maternal diabetes, obesity, and exposure to processed diets, all of which predispose neonates to impaired glucose regulation.

Urban mothers may have more pregnancy-related complications requiring medical interventions, including intravenous fluids or corticosteroids, which increase neonatal hyperglycemia risk. Additionally, urban-born neonate may have higher illness severity on admission due to delayed care-seeking or referral gaps, thus increasing stress-induced hyperglycemia. This finding suggests the need for closer metabolic monitoring of urban-born preterm neonates.

Preterm neonates born to mothers with gestational hypertension were almost seven times more likely to have hyperglycemia.

Similar findings were reported by another study which showed that newborn of hypertensive mothers had significantly increased odds of both hypoglycemia and hyperglycemia(Ahel et al. 2022). Hypertensive disorders impair placental perfusion, resulting in fetal stress, intrauterine growth restriction, and adaptive metabolic responses that lead to insulin resistance and elevated catecholamine levels after birth.

Gestational hypertension also increases the likelihood of receiving medications such as corticosteroids, magnesium sulfate, and vasopressors; all known contributors to neonatal hyperglycemia (Angelika et al., 2023).

The compromised intrauterine environment in hypertensive pregnancies may therefore disrupt fetal endocrine maturation, predisposing preterm neonate to postnatal glucose instability.

Neonatal fever emerged as the strongest independent predictor of hyperglycemia, with febrile neonate being 17 times more likely to have hyperglycemia. This is consistent with literature showing that infection and inflammation markedly increase glucose levels due to catecholamine release, cortisol surge, cytokine activity, and heightened metabolic demand (Ahel et al., 2022).

Stress hyperglycemia is a well-documented response in sick neonates, particularly in the presence of sepsis.

Studies from Indonesia and Croatia also found neonatal sepsis to be a significant risk factor for hyperglycemia(Angelika et al., 2023, Ahel et al., 2022).

Fever, being a hallmark of infection, implies systemic stress that stimulates hepatic gluconeogenesis and reduces insulin sensitivity.

In preterm neonate with immature pancreatic function and reduced insulin response the likelihood of hyperglycemia becomes even greater.

This finding highlights the need for routine glucose monitoring in febrile preterm neonates to prevent complications such as osmotic diuresis, electrolyte imbalance, and increased mortality.

Conclusion

This study assessed the burden and determinants of dysglycemia among preterm neonates admitted to the NICU at Kayunga Regional Referral Hospital.

The prevalence of dysglycemia was 15.9%, with hypoglycemia (10.6%) occurring more frequently than hyperglycemia (5.3%), highlighting that abnormal glucose regulation remains a common metabolic challenge in this vulnerable population.

Regarding factors associated with hypoglycemia, maternal corticosteroid exposure and neonatal convulsions were independently associated with increased odds of hypoglycemia, suggesting that both prenatal interventions and neonatal neurological instability significantly influence glucose homeostasis.

For hyperglycemia, urban residence, maternal gestational hypertension, and neonatal fever were significant predictors, indicating that both maternal health conditions and neonatal systemic stress play critical roles.

Collectively, these findings underscore the need for routine glucose monitoring, early identification of at-risk neonates, and the strengthening of antenatal and neonatal care practices to reduce the burden of dysglycemia and its associated complications among preterm neonates.

- Recommendations

1. Strengthen routine glucose monitoring for all preterm neonates at admission and during the first 24 hours in order to promptly detect both hypoglycemia and hyperglycemia.
2. Enhance targeted monitoring and early intervention for high-risk groups, including preterm babies whose mothers received corticosteroids, those presenting with convulsions (risk for hypoglycemia), neonates from urban settings, those born to mothers with gestational hypertension, and neonates with fever.
3. Improve thermal regulation and infection prevention practices in the NICU, including strict temperature monitoring, early detection and management of neonatal fever, and reinforcing infection control measures, as these factors were significantly associated with hyperglycemia.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Kampala International University Research Ethics Committee (KIU-REC-1723) and the Faculty Research Ethics Committee (FREC). Written informed consent was obtained from all participants. For participants below the age 16, additional consent was obtained from a parent or legal guardian in accordance with ethical guidelines). Mothers prior to data collection and confidentiality and anonymity were strictly maintained throughout the research process.

Consent for publication:

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Competing interests:

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Conflict of interest

The authors declare no conflict interests.

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Author Contribution

MAA led the study, designed the research, collected and analyzed the data, and wrote the first draft of the manuscript, WE, BK, SO supervised and validated the study. TH, AAO, AH, NOM, MAI, MAA and MAA participated data collection and analysis. All authors contributed to the discussion of the study results and approved manuscript

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Data availability

The datasets generated and analyzed during the study are available from the corresponding upon reasonable request

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Figures

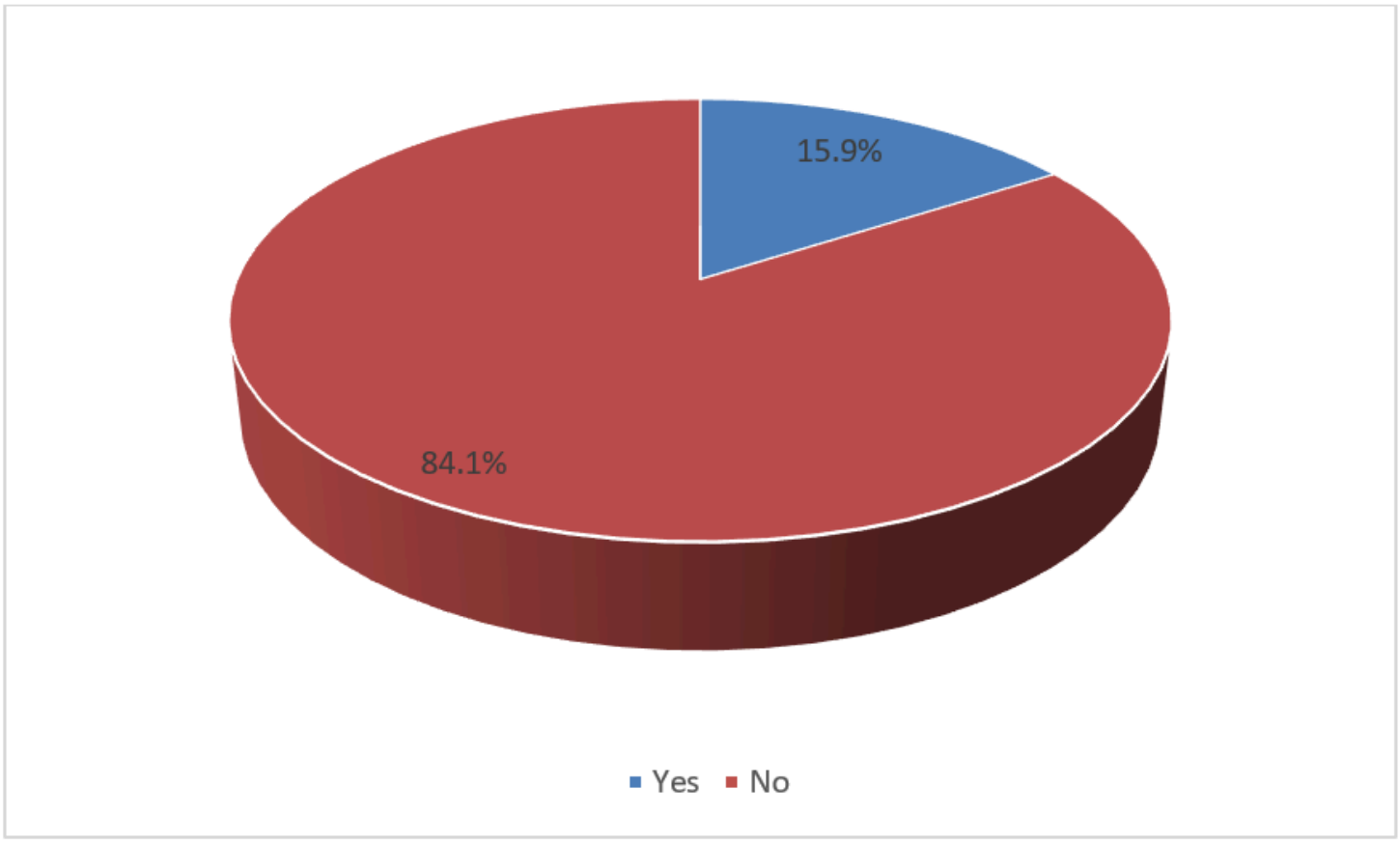


Figure 1

Prevalence of dysglycemia among preterm babies