International Journal of Contemporary Pediatrics
Tiwari K et al. Int J Contemp Pediatr. 2026 Aug;13(8):1414-1424
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20262416

Original Research Article

Study on clinical profile, risk factors, morbidity and mortality pattern on intrauterine growth restricted babies admitted in sick newborn care unit in tertiary care hospital GRMCH, Ramanathapuram

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Received: 30 April 2026
Accepted: 08 June 2026

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ABSTRACT

Background: Intrauterine growth restriction (IUGR) is an important cause of neonatal morbidity and mortality. Infants with impaired foetal growth often develop metabolic, respiratory and haematological complications during the early neonatal period. Early recognition of risk factors and clinical patterns helps improve neonatal care and outcomes. The present study aimed to assess the clinical profile of IUGR babies admitted to the sick neonatal care unit and evaluate their outcomes during their hospitalization.

Methods: A descriptive cross-sectional study was conducted in the Sick Neonatal Care Unit of Government Ramanathapuram Medical College and Hospital, Ramanathapuram. A total of 119 neonates diagnosed with IUGR and admitted during the study period were included and evaluated using clinical examination, anthropometric measurements and laboratory investigations.

Results: Most neonates were male 67 (56.3%), with term births 88 (73.9%) and birth weight >2 kg in 71 (59.7%). Asymmetrical IUGR predominated 89 (74.8%). Hypoglycaemia was most frequent 62 (52.1%), followed by sepsis 37 (26.9%), perinatal depression 33 (27.7%) and hypothermia 31 (26.1%). Other complications included thrombocytopenia 27 (22.7%), hyperbilirubinemia 25 (21.1%), hypocalcaemia 24 (20.2%) and acute kidney injury 22 (18.5%). Mortality occurred in 17 (14.3%). Hyperglycaemia was associated with birth weight ($p<0.0001$), polycythaemia with ponderal index ($p=0.012$), respiratory distress syndrome with birth weight and gestational age ($p<0.0001$), pulmonary haemorrhage with gestational age ($p=0.005$), acute kidney injury with birth weight and gestational age ($p=0.008$, $p=0.005$) and sepsis with birth weight and gestational age ($p=0.01$, $p=0.008$). Other variables showed no significant association.

Conclusions: IUGR remains an important contributor to neonatal morbidity, particularly due to metabolic and infectious complications. Careful antenatal surveillance and early neonatal monitoring are essential for timely management and improved outcomes.

Keywords: Hypoglycemia, Infant, Intrauterine growth restriction, Low birth weight, Newborn, Neonatal intensive care unit, Sepsis

INTRODUCTION

IUGR is a major obstetric condition in which a foetus fails to achieve its physiological growth potential during pregnancy. The condition reflects an underlying pathological process that restricts intrauterine development rather than simply describing a foetus that is constitutionally small for gestational age (SGA). IUGR represents impaired foetal growth caused by maternal, placental or foetal pathology and requires careful clinical evaluation. Apart from long-term adverse health consequences, the condition is associated with an

increased probability of prenatal morbidity and mortality. Recognition of IUGR during pregnancy allows timely monitoring and clinical intervention, which can reduce neonatal complications and improve survival.[1,2]

IUGR is defined when the estimated foetal weight or abdominal circumference falls below the 10th percentile for gestational age. However, this definition includes several percentile cut-offs and does not always distinguish pathological growth restriction from constitutionally small foetuses. A small but healthy foetus may represent a normal biological variation, whereas IUGR reflects a disease process resulting in impaired intrauterine growth related to placental, maternal or foetal factors. Accurate differentiation between IUGR and normal SGA foetuses is necessary to guide appropriate clinical management.[1] Serial ultrasound examination of foetal biometric parameters, including head circumference, abdominal circumference and estimated foetal weight, is commonly used for diagnosis. Doppler velocimetry studies provide additional information regarding uteroplacental circulation. Placental insufficiency detected through abnormal umbilical artery Doppler flow is one of the most frequent mechanisms associated with restricted foetal growth.[2]

Growth restriction contributes significantly to adverse perinatal outcomes. Approximately 26% of term stillbirths and 53% of preterm stillbirths have been associated with foetal growth restriction. Surviving infants exposed to intrapartum hypoxia may develop complications affecting several organ systems. Neonates with IUGR frequently develop metabolic disturbances, respiratory problems, sepsis and impaired thermoregulation during the neonatal period. These complications often require specialised monitoring and management in neonatal intensive care settings. Long-term follow-up studies reported increased risk of chronic disorders such as hypertension, cardiovascular disease and diabetes among individuals born with growth restriction.[3-5]

IUGR remains an important public health problem, particularly in developing countries. The condition poses clinical challenges because of its diverse causes, variations in foetal adaptive responses and uncertainty regarding the optimal timing of delivery. Babies with growth restriction usually experience intrauterine hypoxia and nutritional deficiency, which contribute to neonatal complications after birth. Effective antenatal identification and appropriate neonatal care are essential for improving survival and reducing complications in these infants.[6]

The burden of IUGR is particularly significant in India. The estimated prevalence of IUGR in the country is around 20%, contributing significantly to neonatal and infant mortality. Globally in 2016, nearly 46% of deaths among children under five occurred during the neonatal period, with more than 2.6 million new-born deaths reported. Five countries including India, Pakistan, Nigeria, the Democratic Republic of the Congo and Ethiopia accounted for nearly half of these deaths. India alone contributes approximately 24% of global neonatal mortality, representing more than 640,000 deaths within the first four weeks of life.[7-10] Understanding the determinants of neonatal morbidity and mortality among growth-restricted infants is essential for improving neonatal outcomes.

Previous studies have described the causes and diagnosis of IUGR, limited data are available regarding the clinical profile, maternal risk factors and short-term morbidity and mortality patterns of IUGR neonates admitted to special newborn care units (SNCUs) in tertiary care hospitals. Therefore, the present study aimed to assess the clinical profile of IUGR babies admitted to the sick neonatal care unit and evaluate their outcomes during their hospitalisation.

METHODS

This cross-sectional study included 119 neonates diagnosed with IUGR who were admitted to the SNCU of Government Ramanathapuram Medical College and Hospital, Ramanathapuram and the data were collected for 18 months from September 2023 to March 2025. Ethical clearance for the study was obtained from the Institutional Ethics Committee of Government Ramanathapuram Medical College and Hospital and written informed consent was obtained from the parents or legal guardians of all neonates.

Sample size calculation

The number of participants required for the study was estimated using a standard formula based on disease prevalence. In this calculation, p represents the expected prevalence of IUGR in the population and q represents the remaining proportion (1 − p). The allowable error (d) was taken as 25% of the prevalence. Using this method, the required sample size was calculated and 119 neonates were included in the study. Formula: $n=4pq / d^2$.

Inclusion criteria

Neonates had IUGR, defined as birth weight below the 10th percentile for gestational age and were admitted to the SNCU for evaluation and treatment. The ponderal index was used to classify IUGR as symmetrical or asymmetrical.

Exclusion criteria

Neonates with chromosomal abnormalities and those with congenital anomalies were excluded.

Basic details of the neonates and maternal history were taken from case sheets and maternal records. Maternal details such as gravida status, haemoglobin level during

pregnancy, mode of delivery, history of infertility and maternal medical problems were recorded. Each neonate was examined on admission to the SNCU. Birth weight, length, head circumference and abdominal circumference were measured and the ponderal index was calculated to identify the type of growth restriction.

Nutritional status was assessed using the CAN score. The Lubchenco growth chart was used to classify the neonates according to gestational age and birth weight and to confirm IUGR. Gestational age was assessed using the New Ballard score. Apgar score at birth was noted and babies with low Apgar scores were assessed for perinatal depression using the Sarnat classification. Neurological examination was also done using Claudie Amiel-Tison's neurological assessment.

Blood samples were taken for haemoglobin, packed cell volume, total leukocyte count, differential count, platelet count and erythrocyte sedimentation rate. Blood glucose was checked and hypoglycaemia was considered when glucose was below 45 mg/dl. Blood urea and serum creatinine were measured to assess renal function and serum calcium was measured to detect hypocalcaemia.

Respiratory status was checked by clinical examination and chest X-ray to identify respiratory distress, meconium aspiration, pulmonary hypertension and pulmonary haemorrhage. Sepsis screening, including blood culture, cerebrospinal fluid analysis and peripheral smear, was done in suspected cases. Total and direct bilirubin levels were measured in neonates who developed jaundice.

Operational definitions

Neonatal sepsis was defined based on clinical features supported by laboratory parameters and/or positive blood culture. Respiratory distress syndrome (RDS) was diagnosed based on clinical features of respiratory distress with characteristic radiographic findings.

Acute kidney injury (AKI) was defined based on elevated serum creatinine levels for age. Hypothermia was defined as axillary temperature <36.5°C. Hyperbilirubinemia was defined based on age-specific serum bilirubin levels requiring clinical attention.

Persistent pulmonary hypertension (PPHN) was diagnosed based on clinical findings with supportive radiological or echocardiographic evidence where available.

Statistical analysis

Data were analysed using IBM SPSS Statistics v27. Continuous variables were expressed as mean and standard deviation, categorical variables were presented as frequencies and percentages. Comparative analysis between groups was performed to evaluate the association between maternal factors, neonatal characteristics and neonatal morbidities and outcomes. A p value ≤0.05 was considered statistically significant.

RESULTS

Among 119 mothers, primigravida were 71 (59.7%). Anaemia was present in 33 (27.7%). Normal vaginal delivery was most common 58 (48.7%), followed by LSCS 52 (43.7%) and assisted vaginal delivery 9 (7.6%). Long-standing infertility was reported in 5 (4.2%). Maternal risk factors were present in 31 (26.1%). Among neonates, males were 67 (56.3%). Birth weight >2 kg was observed in 71 (59.7%). Term births were 88 (73.9%). Asymmetrical IUGR was present in 89 (74.8%). Mortality occurred in 17 (14.3%) (Table 1).

Hypoglycaemia was the most frequent morbidity 62 (52.1%), followed by perinatal depression 33 (27.7%), sepsis 37 (26.9%) and hypothermia 31 (26.1%) (Table 2).

Perinatal depression was associated with long-standing infertility, with higher occurrence in mothers with infertility 4 (80.0%) compared to those without 29 (25.4%) (p=0.008). Hyperglycaemia was associated with mode of delivery and occurred only in LSCS 5 (9.6%) (p=0.035). Hypothermia was associated with maternal haemoglobin, with higher occurrence in mothers with low haemoglobin 13 (39.4%) compared to normal haemoglobin 18 (20.9%) (p=0.04). Pulmonary haemorrhage showed a borderline association with maternal risk factors 4 (12.9%) compared to 3 (3.4%) (p=0.053).

No significant associations were observed between maternal variables and hypoglycaemia, meconium aspiration, polycythaemia, thrombocytopenia, hyperbilirubinemia, persistent pulmonary hypertension, respiratory distress syndrome, acute kidney injury, sepsis or mortality (p>0.05) (Table 3).

Hyperglycaemia was associated with birth weight, with highest occurrence in <1000 g neonates 2 (50%) (p<0.0001). Polycythaemia was associated with ponderal index, with higher occurrence in symmetrical IUGR 5 (16.7%) compared to asymmetrical IUGR 3 (3.4%) (p=0.012). Respiratory distress syndrome was associated with birth weight and gestational age, with all cases in <1000 g neonates 4 (100%) and higher occurrence in preterm neonates 10 (32.3%) (p<0.0001). Pulmonary haemorrhage was associated with gestational age, with higher occurrence in preterm neonates 5 (16.1%) compared to term 2 (2.3%) (p=0.005). Acute kidney injury was associated with birth weight and gestational age, with higher occurrence in 1501–2000 g neonates 10 (37%) and preterm neonates 11 (35.5%) (p=0.008 and p=0.005).

Sepsis was associated with birth weight and gestational age, with higher occurrence in 1.6–2 kg neonates 13

(40.6%) and preterm neonates 14 (43.8%) (p=0.01 and p=0.008). Perinatal depression, hypocalcaemia, meconium aspiration, hypothermia, thrombocytopenia, hyperbilirubinemia, persistent pulmonary hypertension, hypoglycaemia and mortality showed no association with neonatal variables (p>0.05) (Table 4).

Table 1: Maternal characteristics and obstetric risk factors.

Variables		Category	N (%)
Maternal characteristics and obstetric risk factors	Gravida	Multi	48 (40.3)
		Primi	71 (59.7)
	Haemoglobin	Low	33 (27.7)
		Normal	86 (72.3)
	Mode of delivery	Assisted vaginal delivery	9 (7.6)
		LSCS	52 (43.7)
		Normal vaginal	58 (48.7)
	Multiple gestation	DCAD	1 (12.5)
		DCDA	3 (37.5)
		MCDA	4 (50.0)
	Long infertility	No	114 (95.8)
		Yes	5 (4.2)
	Maternal risk factors	No	88 (73.9)
		Yes	31 (26.1)
Neonatal characteristics	Gender	Female	52 (43.7)
		Male	67 (56.3)
	Birth weight	<1.5 kg	22 (18.5)
		1.6–2 kg	26 (21.8)
		>2 kg	71 (59.7)
	Gestational age	Preterm	31 (26.1)
		Term	88 (73.9)
	Ponderal index	<2 asymmetrical	89 (74.8)
		>2 symmetrical	30 (25.2)
	Neonatal mortality	Yes	17 (14.3)
		No	102 (85.7)

Table 2: Distribution of neonatal morbidity.

Complications	N (%)
Perinatal depression	33 (27.7)
Hyperglycaemia	5 (4.2)
Hypoglycaemia	62 (52.1)
Meconium aspiration	13 (10.9)
Hypothermia	31 (26.1)
Polycythaemia	8 (6.7)
Thrombocytopenia	27 (22.7)
Hyperbilirubinemia	25 (21.1)
Persistent pulmonary HTN	6 (5.0)
Hypocalcaemia	24 (20.2)
RDS	11 (9.2)
Pulmonary haemorrhage	7 (5.9)
AKI	22 (18.5)
Sepsis	37 (26.9)

Table 3: Association between maternal factors and neonatal morbidity.

Outcomes	Maternal variable	Category	Outcome status		P value
			No (%)	Yes (%)	
Perinatal depression	Gravida	Multi	34 (70.8)	14 (29.2)	0.774
		Primi	52 (73.2)	19 (26.8)	
	Haemoglobin	Low	24 (72.7)	9 (27.3)	0.945
		Normal	62 (72.1)	24 (27.9)	
	Mode of delivery	Assisted vaginal delivery	7 (77.8)	2 (22.2)	0.724
		LSCS	39 (75.0)	13 (25.0)	
		Normal vaginal	40 (69.0)	18 (31.0)	
	Maternal risk factors	No	65 (73.9)	23 (26.1)	0.513
		Yes	21 (67.7)	10 (32.3)	
	Long infertility	No	85 (74.6)	29 (25.4)	0.008
		Yes	1 (20.0)	4 (80.0)	
Hyperglycaemia	Gravida	Multi	46 (95.8)	2 (4.2)	0.988
		Primi	68 (95.8)	3 (4.2)	
	Haemoglobin	Low	32 (97)	1 (3.0)	0.693
		Normal	82 (95.3)	4 (4.7)	
	Mode of delivery	Assisted vaginal delivery	9 (100)	0	0.035
		LSCS	47 (90.4)	5 (9.6)	
		Normal vaginal	58 (100.0)	0	
	Maternal risk factors	No	83 (94.3)	5 (5.7)	0.175
		Yes	31 (100.0)	0	
	Long infertility	No	109 (95.6)	5 (4.4)	0.632
		Yes	5 (100.0)	0	
Hypoglycaemia	Gravida	Multi	21 (43.8)	27 (56.3)	0.456
		Primi	36 (50.7)	35 (49.3)	
	Haemoglobin	Low	17 (51.5)	16 (48.5)	0.625
		Normal	40 (46.5)	46 (53.5)	
	Mode of delivery	Assisted vaginal delivery	3 (33.3)	6 (66.7)	0.564
		LSCS	27 (51.9)	25 (48.1)	
		Normal vaginal	27 (46.6)	31 (53.4)	
	Maternal risk factors	No	43 (48.9)	45 (51.1)	0.723
		Yes	14 (45.2)	17 (54.8)	
	Long infertility	No	55 (48.2)	59 (51.8)	0.718
		Yes	2 (40.0)	3 (60.0)	
Meconium aspiration	Gravida	Multi	43 (89.6)	5 (10.4)	0.884
		Primi	63 (88.7)	8 (11.3)	
	Haemoglobin	Low	30 (90.9)	3 (9.1)	0.691
		Normal	76 (88.4)	10 (11.6)	
	Mode of delivery	Assisted vaginal delivery	8 (88.9)	1 (11.1)	0.719
		LSCS	45 (86.5)	7 (13.5)	
		Normal vaginal	53 (91.4)	5 (8.6)	
	Maternal risk factors	No	80 (90.9)	8 (9.1)	0.28
		Yes	26 (83.9)	5 (16.1)	
	Long infertility	No	102 (89.5)	12 (10.5)	0.506
		Yes	4 (80)	1 (20)	
Hypothermia	Gravida	Multi	36 (75.0)	12 (25.0)	0.83
		Primi	52 (73.2)	19 (26.8)	
	Haemoglobin	Low	20 (60.6)	13 (39.4)	0.04
		Normal	68 (79.1)	18 (20.9)	
	Mode of delivery	Assisted vaginal delivery	5 (55.6)	4 (44.4)	0.265
		LSCS	37 (71.2)	15 (28.8)	
		Normal vaginal	46 (79.3)	12 (20.7)	
	Maternal risk factors	No	63 (71.6)	25 (28.4)	0.323
		Yes	25 (80.6)	6 (19.4)	
	Long infertility	No	83 (72.8)	31 (27.2)	0.175
		Yes	5 (100.0)	0	

Continued.

Outcome	Maternal variable	Category	Outcome status		P value
			No (%)	Yes (%)	
Polycythaemia	Gravida	Multi	45 (93.8)	3 (6.3)	0.866
		Primi	66 (93)	5 (7)	
	Haemoglobin	Low	31 (93.9)	2 (6.1)	0.858
		Normal	80 (93)	6 (7)	
	Mode of delivery	Assisted vaginal delivery	8 (88.9)	1 (11.1)	0.75
		LSCS	48 (92.3)	4 (7.7)	
		Normal vaginal	55 (94.8)	3 (5.2)	
	Maternal risk factors	No	81 (92)	7 (8)	0.366
		Yes	30 (96.8)	1 (3.2)	
	Long infertility	No	106 (93)	8 (7)	0.54
		Yes	5 (100)	0	
Thrombocytopenia	Gravida	Multi	37 (77.1)	11 (22.9)	0.961
		Primi	55 (77.5)	16 (22.5)	
	Haemoglobin	Low	28 (84.8)	5 (15.2)	0.224
		Normal	64 (74.4)	22 (25.6)	
	Mode of delivery	Assisted vaginal delivery	6 (66.7)	3 (33.3)	0.228
		LSCS	44 (84.6)	8 (15.4)	
		Normal vaginal	42 (72.4)	16 (27.6)	
	Maternal risk factors	No	68 (77.3)	20 (22.7)	0.987
		Yes	24 (77.4)	7 (22.6)	
Hyperbilirubinemia	Gravida	Multi	38 (79.2)	10 (20.8)	0.826
		Primi	55 (77.5)	16 (22.5)	
	Haemoglobin	Low	28 (84.8)	5 (15.2)	0.273
		Normal	65 (75.6)	21 (24.4)	
	Mode of delivery	Assisted vaginal delivery	8 (88.9)	1 (11.1)	0.67
		LSCS	41 (78.8)	11 (21.2)	
		Normal vaginal	44 (75.9)	14 (24.1)	
	Maternal risk factors	No	70 (79.5)	18 (20.5)	0.535
		Yes	23 (74.2)	8 (25.8)	
	Long infertility	No	90 (78.9)	24 (21.1)	0.316
		Yes	3 (60)	2 (40)	
PPHN	Gravida	Multi	44 (91.7)	4 (8.3)	0.177
		Primi	69 (97.2)	2 (2.8)	
	Haemoglobin	Low	32 (97.0)	1 (3.0)	0.534
		Normal	81 (94.2)	5 (5.8)	
	Mode of delivery	Assisted vaginal delivery	8 (88.9)	1 (11.1)	0.589
		LSCS	49 (94.2)	3 (5.8)	
		Normal vaginal	56 (96.6)	2 (3.4)	
	Maternal risk factors	No	84 (95.5)	4 (4.5)	0.677
		Yes	29 (93.5)	2 (6.5)	
	Long infertility	No	109 (95.6)	5 (4.4)	0.118
		Yes	4 (80)	1 (20)	
RDS	Gravida	Multi	42 (87.5)	6 (12.5)	0.313
		Primi	66 (93)	5 (7)	
	Haemoglobin	Low	32 (97)	1 (3.0)	0.147
		Normal	76 (88.4)	10 (11.6)	
	Mode of delivery	Assisted vaginal delivery	9 (100)	0	0.213
		LSCS	49 (94.2)	3 (5.8)	
		Normal vaginal	50 (86.2)	8 (13.8)	
	Maternal risk factors	No	81 (92)	7 (8.0)	0.413
		Yes	27 (87.1)	4 (12.9)	
	Long infertility	No	103 (90.4)	11 (9.6)	0.466
		Yes	50 (100)	0	

Continued.

Outcome	Maternal variable	Category	Outcome status		P value
			No (%)	Yes (%)	
Pulmonary haemorrhage	Gravida	Multi	44 (91.7)	4 (8.3)	0.35
		Primi	68 (95.8)	3 (4.2)	
	Haemoglobin	Low	31 (93.9)	2 (6.1)	0.959
		Normal	81 (94.2)	5 (5.8)	
	Mode of delivery	Assisted vaginal delivery	9 (100)	0	0.127
		LSCS	51 (98.1)	1 (1.9)	
		Normal vaginal	52 (89.7)	6 (10.3)	
	Maternal risk factors	No	85 (96.6)	3 (3.4)	0.053
		Yes	27 (87.1)	4 (12.9)	
	Long infertility	No	108 (94.7)	6 (5.3)	0.17
		Yes	4 (80.0)	1 (20)	
AKI	Gravida	Multi	36 (75.0)	12 (25)	0.132
		Primi	61 (85.9)	10 (14.1)	
	Haemoglobin	Low	26 (78.8)	7 (21.2)	0.635
		Normal	71 (82.6)	15 (17.4)	
	Mode of delivery	Assisted vaginal delivery	7 (77.8)	2 (22.2)	0.461
		LSCS	45 (86.5)	7 (13.5)	
		Normal vaginal	45 (77.6)	13 (22.4)	
	Maternal risk factors	No	73 (83)	15 (17)	0.495
		Yes	24 (77.4)	7 (22.6)	
	Long infertility	No	93 (81.6)	21 (18.4)	0.929
		Yes	4 (80)	1 (20)	
Sepsis	Gravida	Multi	32 (36.8)	16 (50)	0.192
		Primi	55 (63.2)	16 (50)	
	Haemoglobin	Low	24 (27.6)	9 (28.1)	0.954
		Normal	63 (72.4)	23 (71.9)	
	Mode of delivery	Assisted vaginal delivery	8 (9.2)	1 (3.1)	0.534
		LSCS	37 (42.5)	15 (46.9)	
		Normal vaginal	42 (48.3)	16 (50)	
	Maternal risk factors	No	61 (70.1)	27 (84.4)	0.116
		Yes	26 (29.9)	5 (15.6)	
	Long infertility	No	83 (95.4)	31 (96.9)	0.723
		Yes	4 (4.6)	1 (3.1)	
Mortality	Gravida	Multi	38 (79.2)	10 (20.8)	0.093
		Primi	64 (90.1)	7 (9.9)	
	Haemoglobin	Low	28 (84.8)	5 (15.2)	0.867
		Normal	74 (86.0)	12 (14)	
	Mode of delivery	Assisted vaginal delivery	9 (100.0)	0	0.113
		LSCS	47 (90.4)	5 (9.6)	
		Normal vaginal	46 (79.3)	12 (20.7)	
	Maternal risk factors	No	76 (86.4)	12 (13.6)	0.733
		Yes	26 (83.9)	5 (16.1)	
	Long infertility	No	99 (86.8)	15 (13.2)	0.093
		Yes	3 (60.0)	2 (40)	

Table 4: Association of neonatal factors with morbidity.

Outcomes	Neonatal variable	Category	Outcome status		P value
			No (%)	Yes (%)	
Perinatal depression	Birth weight	<1000 g	3 (75)	1 (25)	0.228
		1001–1500 g	10 (55.6)	8 (44.4)	
		1501–2000 g	18 (66.7)	9 (33.3)	
		>2001 g	55 (78.6)	15 (21.4)	
	Gestational age	Preterm	22 (71)	9 (29)	0.851
		Term	64 (72.7)	24 (27.3)	
	Ponderal index	<2 asymmetrical	67 (75.3)	22 (24.7)	0.206
		>2 symmetrical	19 (63.3)	11 (36.7)	

Continued.

Outcomes	Neonatal variable	Category	Outcome status		P value
			No (%)	Yes (%)	
Hyperglycaemia	Birth weight	<1000 g	2 (50)	2 (50)	<0.0001
		1001–1500 g	17 (94.4)	1 (5.6)	
		1501–2000 g	26 (96.3)	1 (3.7)	
		>2001 g	69 (98.6)	1 (1.4)	
	Gestational age	Preterm	28 (90.3)	3 (9.7)	0.077
		Term	86 (97.7)	2 (2.3)	
	Ponderal index	<2 asymmetrical	85 (95.5)	4 (4.5)	0.784
		>2 symmetrical	29 (96.7)	1 (3.3)	
Hypocalcaemia	Birth weight	<1000 g	3 (75.0)	1 (25)	0.419
		1001–1500 g	17 (94.4)	1 (5.6)	
		1501–2000 g	21 (77.8)	6 (22.2)	
		>2001 g	54 (77.1)	16 (22.9)	
	Gestational age	Preterm	28 (90.3)	3 (9.7)	0.091
		Term	67 (76.1)	21 (23.9)	
	Ponderal index	<2 asymmetrical	72 (80.9)	17 (19.1)	0.617
		>2 symmetrical	23 (76.7)	7 (23.3)	
Meconium aspiration	Birth weight	<1000 g	2 (50)	2 (50)	0.067
		1001–1500 g	17 (94.4)	1 (5.6)	
		1501–2000 g	25 (92.6)	2 (7.4)	
		>2001 g	62 (88.6)	8 (11.4)	
	Gestational age	Preterm	27 (87.1)	4 (12.9)	0.681
		Term	79 (89.8)	9 (10.2)	
	Ponderal index	<2 asymmetrical	81 (91)	8 (9)	0.244
		>2 symmetrical	25 (83.3)	5 (16.7)	
Hypothermia	Birth weight	<1000 g	3 (75)	1 (25)	0.66
		1001–1500 g	15 (83.3)	3 (16.7)	
		1501–2000 g	21 (77.8)	6 (22.2)	
		>2001 g	49 (70)	21 (30)	
	Gestational age	Preterm	27 (87.1)	4 (12.9)	0.052
		Term	61 (69.3)	27 (30.7)	
	Ponderal Index	<2 asymmetrical	65 (73)	24 (27)	0.695
		>2 symmetrical	23 (76.7)	7 (23.3)	
Polycythaemia	Birth weight	<1000 g	4 (100)	0	0.366
		1001–1500 g	16 (88.9)	2 (11.1)	
		1501–2000 g	27 (100)	0	
		>2001 g	64 (91.4)	6 (8.6)	
	Gestational age	Preterm	28 (90.3)	3 (9.7)	0.445
		Term	83 (94.3)	5 (5.7)	
	Ponderal index	<2 asymmetrical	86 (96.6)	3 (3.4)	0.012
		>2 symmetrical	25 (83.3)	5 (16.7)	
Thrombocytopenia	Birth weight	<1000 g	2 (50)	2 (50.0)	0.248
		1001–1500 g	13 (72.2)	5 (27.8)	
		1501–2000 g	24 (88.9)	3 (11.1)	
		>2001 g	53 (75.7)	17 (24.3)	
	Gestational age	Preterm	21 (67.7)	10 (32.3)	0.139
		Term	71 (80.7)	17 (19.3)	
	Ponderal index	<2 asymmetrical	66 (74.2)	23 (25.8)	0.157
		>2 symmetrical	26 (86.7)	4 (13.3)	
Hyperbilirubinemia	Birth weight	<1000 g	2 (50)	2 (50.0)	0.162
		1001–1500 g	15 (83.3)	3 (16.7)	
		1501–2000 g	18 (66.7)	9 (33.3)	
		>2001 g	58 (82.9)	12 (17.1)	
	Gestational age	Preterm	21 (67.7)	10 (32.3)	0.103
		Term	72 (81.8)	16 (18.2)	
	Ponderal index	<2 asymmetrical	67 (75.3)	22 (24.7)	0.192
		>2 symmetrical	26 (86.7)	4 (13.3)	

Continued.

Outcomes	Neonatal variable	Category	Outcome status		P value
			No (%)	Yes (%)	
Persistent pulmonary HTN	Birth weight	<1000 g	2 (100)	0	0.377
		1001–1500 g	16 (88.9)	2 (11.1)	
		1501–2000 g	27 (100)	0	
		>2001 g	66 (94.3)	4 (5.7)	
	Gestational age	Preterm	30 (96.8)	1 (3.2)	0.591
		Term	83 (94.3)	5 (5.7)	
	Ponderal index	<2 asymmetrical	83 (93.3)	6 (6.7)	0.144
		>2 symmetrical	30 (100)	0	
Hypoglycaemia	Birth weight	<1000 g	3 (75)	1 (25)	0.402
		1001–1500 g	11 (61.1)	7 (38.9)	
		1501–2000 g	12 (44.4)	15 (55.6)	
		>2001 g	31 (44.3)	39 (55.7)	
	Gestational age	Preterm	19 (61.3)	12 (38.7)	0.083
		Term	38 (43.2)	50 (56.8)	
	Ponderal index	<2 asymmetrical	42 (47.2)	47 (52.8)	0.79
		>2 symmetrical	15 (50)	15 (50)	
RDS	Birth weight	<1000 g	0	4 (100)	<0.0001
		1001–1500 g	15 (83.3)	3 (16.7)	
		1501–2000 g	24 (88.9)	3 (11.1)	
		>2001 g	69 (98.6)	1 (1.4)	
	Gestational age	Preterm	21 (67.7)	10 (32.3)	<0.0001
		Term	87 (98.9)	1 (1.1)	
	Ponderal index	<2 asymmetrical	80 (89.9)	9 (10.1)	0.573
		>2 symmetrical	28 (93.3)	2 (6.7)	
Pulmonary haemorrhage	Birth weight	<1000 g	3 (75.0)	1 (25)	0.061
		1001–1500 g	16 (88.9)	2 (11.1)	
		1501–2000 g	24 (88.9)	3 (11.1)	
		>2001 g	69 (98.6)	1 (1.4)	
	Gestational age	Preterm	26 (83.9)	5 (16.1)	0.005
		Term	86 (97.7)	2 (2.3)	
	Ponderal index	<2 asymmetrical	84 (94.4)	5 (5.6)	0.833
		>2 symmetrical	28 (93.3)	2 (6.7)	
AKI	Birth weight	<1000 g	3 (75.0)	1 (25)	0.008
		1001–1500 g	13 (72.2)	5 (27.8)	
		1501–2000 g	17 (63.0)	10 (37)	
		>2001 g	64 (91.4)	6 (8.6)	
	Gestational age	Preterm	20 (64.5)	11 (35.5)	0.005
		Term	77 (87.5)	11 (12.5)	
	Ponderal index	<2 asymmetrical	75 (84.3)	14 (15.7)	0.182
		>2 symmetrical	22 (73.3)	8 (26.7)	
Sepsis	Birth weight	<1.5 kg	17 (19.5)	5 (15.6)	0.01
		1.6–2 kg	13 (14.9)	13 (40.6)	
		>2 kg	57 (65.5)	14 (43.8)	
	Gestational age	Preterm	17 (19.5)	14 (43.8)	0.008
		Term	70 (80.5)	18 (56.3)	
	Ponderal index	<2 asymmetrical	62 (71.3)	27 (84.4)	0.144
		>2 symmetrical	25 (28.7)	5 (15.6)	
Mortality	Birth weight	<1.5 kg	16 (72.7)	6 (27.3)	0.069
		1.6–2 kg	25 (96.20)	1 (3.80)	
		>2 kg	61 (85.90)	10 (14.10)	
	Gestational age	Preterm	26 (83.90)	5 (16.10)	0.733
		Term	76 (86.40)	12 (13.60)	
	Ponderal index	<2 asymmetrical	76 (85.40)	13 (14.60)	0.863
		>2 symmetrical	26 (86.70)	4 (13.30)	

DISCUSSION

Most neonates were term with predominance of asymmetrical IUGR. Hypoglycaemia was the most common neonatal complication, followed by sepsis, hypothermia, thrombocytopenia and hyperbilirubinemia. RDS and AKI were significantly associated with prematurity and low birth weight, whereas mortality showed no significant association.

Asymmetrical IUGR was the predominant pattern and maternal anaemia was a commonly observed risk factor. Similarly, Shenoy et al reported that approximately 70–75% of IUGR cases were asymmetrical.[11] Rajbhandary and Maskey reported maternal complications in about 28% of pregnancies complicated by IUGR, with hypertensive disorders and anaemia being the most frequent factors.[12] These findings are consistent with previous studies, as asymmetrical growth restriction is linked to placental insufficiency and maternal anaemia may affect placental circulation and foetal growth.

Most neonates were term, consistent with previous studies. Similarly, Ku et al reported that approximately 72% of growth-restricted neonates were born at term, while 28% were preterm, with preterm infants showing higher rates of neonatal complications.[13] Khade et al reported hypoglycaemia in about 48% of IUGR neonates.[14] Similarly, Bhalala et al reported thrombocytopenia in approximately 21% of IUGR neonates.[15] These findings are consistent with previous reports, as prematurity increases adverse outcomes, while growth restriction leads to metabolic disturbances and hypoxia-related haematological changes in affected neonates.

In our study, common neonatal complications included hyperbilirubinemia, RDS and AKI was observed, neonatal mortality was 17 (14.3%) and sepsis was observed in 37 (26.9%) neonates. Similarly, Hasmasanu et al reported respiratory distress in about 10–12% of growth-restricted neonates, particularly among those born preterm.[16] Ahmed et al reported neonatal jaundice in approximately 20–25% of IUGR infants.[17] Lubrano et al reported renal complications in approximately 16–20% of neonates with foetal growth restriction, particularly among those with low birth weight.[18] Arteaga-Mancera et al reported neonatal sepsis in about 25–30% of growth-restricted neonates admitted to neonatal intensive care units.[19] Bassetty et al reported neonatal mortality of approximately 13–15% among IUGR neonates admitted to tertiary care hospitals.[20] These findings support our results, complications may be related to physiological immaturity in IUGR neonates. In the study, perinatal depression was associated with infertility. Hyperglycaemia was associated with delivery mode and hypothermia with maternal haemoglobin. Polycythaemia associated with ponderal index. Respiratory distress, pulmonary haemorrhage, AKI and sepsis were associated with birth weight and gestational age. Hasmasanu et al reported similar findings that caesarean delivery occurred in 66.9% of cases. Hypoglycaemia occurred in 15.7%, hyperbilirubinemia in 14.6% and intraventricular hemorrhage in 7.25% of IUGR infants.[16] Lubrano et al showed early-FGR showed significantly lower gestational age at delivery (32 weeks) and lower birth weight (1252 g) compared with AGA (3330 g) ($p<0.001$). Caesarean delivery was higher (72%), Apgar < 7 at 1 min occurred in 33% and NICU admission reached 64%.[18]

Nickavar et al reported that AKI was associated with lower gestational age and birth weight. AKI infants had lower gestational age (33.5±3.9 vs 36.8±3.7 weeks, $p<0.001$) and lower birth weight (2005±816 vs 2669±820 g, $p<0.001$), with higher mortality (15.4% vs 4%).[21] These findings are consistent with previous studies that low birth weight, prematurity and growth restriction increase neonatal complications, NICU admission and mortality.

Limitations

This study was conducted in a single tertiary care centre with a limited sample size, which may restrict generalizability. The cross-sectional design prevented assessment of long-term outcomes. Maternal and environmental variables were not comprehensively analysed and data collection from hospital records may have introduced information bias.

CONCLUSION

Asymmetrical IUGR was the predominant pattern and hypoglycaemia, sepsis, hypothermia and haematological complications were common findings. Selected morbidities were associated with lower birth weight and prematurity, highlighting the need for close monitoring of these infants. Early identification and timely management may improve neonatal outcomes. Large multicentre studies and long-term follow-up are required.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Tiwari K, Nizamudeen JSH, Jagadeesan P. Study on clinical profile, risk factors, morbidity and mortality pattern on intrauterine growth restricted (IUGR) babies admitted in sick newborn care unit in tertiary care hospital GRMCH,Ramanathapuram. Int J Contemp Pediatr 2026;13:1414-24.