

Original Article

Outcome of Small for Gestational Age Babies Admitted At BPKIHS

Sushmita Mishra ^{1*}

1. B.P. Koirala institute of health sciences, Nepal

* Correspondence: dr.sushmita.mishra@gmail.com

Abstract: Small for gestational age (SGA) has been defined as birth weight less than the 10th percentile for gestational age since the studies of Lubchenco and Battaglia in the 1960s, which characterized size for gestational age and the risk associated with smaller size at each gestational age. Small for gestational age has been defined by WHO as being below the 10% percentile of the recommended gender-specific birth weight for gestational age reference curves. This Hospital based Cross Sectional Study was done in Department of Pediatrics and Adolescent Medicine – Division of Neonatology (NICU/Nursery/Neonatal ward/Pediatric Ward), BPKIHS, Dharan, Nepal. For a period of One year, small for gestational age neonates admitted at BPKIHS in one year duration. Sample size for the study was N=264, study concluded that the greater proportion of SGA babies is contributed by term and male babies. Approx. 66.3% of the included neonates were male and 33.7% were female, among them 54.9% were term SGA and 45.1% were preterm SGA. Mean observed length, weight and head circumference were 40.9cm, 1.6kg and 29.9cm respectively. On comparison between term and preterm SGA neonates' significant difference was found with preterm SGA having lower values. The common problems observed in the SGA newborn were sepsis (51.1%), hyperbilirubinemia (30.3%), perinatal asphyxia (30.3%), shock (25.4%), hypoglycaemia (12.9%) and hypothermia (8.3%). Less common morbidities were Apnoea (2.3%), NEC (3.8%) and polycythaemia (6.4%). On logistic regression hypothermia was observed as only independent co-morbidity factor. Among the 135 SGA neonates with Sepsis 44 of them had LP proven meningitis, 37 had blood culture positive sepsis and 54 had culture sterile sepsis. We were able to discharge 87.9% of SGA babies and 12.1% had adverse outcome. On applying chi-square test no significant difference in the outcome of term and preterm SGA neonates was observed.

Keywords: outcome, small for gestational age, babies, sterile sepsis

1. INTRODUCTION

Small for gestational age (SGA) has been defined as birth weight less than the 10th percentile for gestational age since the studies of Lubchenco and Battaglia in the 1960s, which characterized size for gestational age and the risk associated with smaller size at each gestational age [1]. Small for gestational age has been defined by WHO as being below the 10% percentile of the recommended gender-specific birth weight for gestational age reference curves. In 2010, 32.4 million SGA infants were born worldwide, of which 2.8 million were preterm. More than half of SGA births occurred in South Asia, where the prevalence of SGA was 44.5 % and the prevalence of preterm SGA births was 2.9 %. Approximately 706,200 deaths were attributable to SGA, globally [2]. Nepal, a low-income country in South Asia, has a neonatal mortality rate of 24 per thousand live births, with more than half of these deaths caused by preterm birth related complications [3]. In 2010, it was estimated that 14 % of babies born were preterm and 39.3 % were SGA at birth in Nepal. There are various causes leading to SGA which has been categorized in following two groups, Symmetric IUGR (Height, weight, and head

circumference are about equally affected) and Asymmetric IUGR (Weight is most affected, with a relative sparing of growth of the brain, cranium, and long bones) [4]. Symmetric growth restriction usually results from a fetal problem that begins early in gestation, often during the 1st trimester. When the cause begins relatively early in gestation, all of the body is affected, resulting in fewer cells of all types. The most common causes of symmetric IUGR includes Genetic disorders and First-trimester congenital infections (e.g., with cytomegalovirus, rubella virus, or *Toxoplasma gondii*) [5]. Similarly, Asymmetric growth restriction usually results from placental or maternal problems that typically manifest in the late 2nd or the 3rd trimester. When the cause begins relatively late in gestation, organs and tissues are not equally affected, resulting in asymmetric growth restriction [6]. Leading causes of asymmetric IUGR includes, Placental insufficiency resulting from maternal disease involving the small blood vessels (e.g., preeclampsia, hypertension, antiphospholipid antibody syndrome long-standing diabetes), Relative placental insufficiency caused by multiple gestation, Placental involution accompanying post maturity, Chronic maternal hypoxemia caused by pulmonary or cardiac disease, Maternal malnutrition, and Conception using assisted reproductive technology [7]. An infant may also have asymmetric growth restriction and be small for gestational age if the mother is a heavy user of opioids, cocaine, alcohol, and/or tobacco during pregnancy. Other Maternal risk factors associated with an increased risk of an SGA neonate are maternal age ≥ 35 years, with a further increase in those ≥ 40 years old, African American or Indian/Asian ethnicity, nulliparity, social deprivation, unmarried status, body mass index (BMI) < 20 , daily vigorous exercise, a short (< 6 months) or long (> 60 months) inter-pregnancy interval and heavy vaginal bleeding during the first trimester [8]. Maternal exposure to domestic violence during pregnancy and poor maternal weight gain during pregnancy has also been associated with SGA neonate. In low-income countries, a larger percent of LBW is due to IUGR than preterm. SGA can arise from a genetic predisposition to small size or could be due to factors such as low maternal height, malnutrition, and/or infection during pregnancy [9]. The genetic and constitutional contributions to SGA are generally felt to be small relative to these other factors, particularly in low- and middle-income contexts. Nepal has, however, yet to meet the NMR target of 17. Though it has been reduced from 33 deaths per 1,000 live births in 2011 to 23 [10]. In order to meet this goal, the current proportion of neonatal deaths due to preterm- and/or SGA-related complications has to be reduced by half. Even then, the NMR accounts for 61 percent of under-five mortality rate. Until the NMR is reduced significantly, the improvements in the overall child mortality rate will suffer. A recent study conducted in Nepal showed prevalence of low birth weight was high as 39% with a high burden of intrauterine growth restriction, one of the contributors of LBW as reflected in SGA (55%) [11]. With SGA being strongly associated with negative consequences for outcomes of general intelligence and executive and motor function in this environment. Neonatal complications were found in 42% of SGA neonates compared to 18% of control infants. Hypoglycaemia, polycythaemia and abnormal neurologic symptoms were more frequently found in SGA neonates than in control neonates. Asphyxia was found in 16% of SGA infants and in 8.5% of control infants [12]. A five-fold risk for hypoglycaemia and an eight-fold risk for abnormal neonatal neurologic signs in SGA infants were found. Short term adverse outcome with SGA were higher morbidity, associated with hypoglycaemia, birth asphyxia, and brain injury, including hypoxic-ischemic encephalopathy, intracranial haemorrhage, periventricular leukomalacia, gastrointestinal bleeding, congenital malformations, polycythaemia, pulmonary haemorrhage, apnoea, disseminated intravascular coagulation, and hyperbilirubinemia [13]. However as stated by Barker's hypothesis, prenatal and postnatal periods are exquisitely sensitive to any factor that can affect growth as these are periods of exponential cell replication, division, and growth. Infants born SGA are at increased risk for developing obesity, Type-2 diabetes mellitus, coronary artery disease, hypertension, kidney disease, premature pubarche, and polycystic ovarian syndrome (PCOS), dyslipidaemia, short stature and osteoporosis. Long term adverse outcome associated were delayed in physical growth and neurosensory limitations, but eventually reached that

of control group in following years [14]. Most neonates who fall 2 standard deviations below the growth curve for length, however, are likely to catch-up to their peers during childhood [15]. At 1 year and 18 years of age, respectively, only 13.4% and 7.9% of short babies remain stunted. SGA status and slow growth during the first year of life predict decreased adult bone mass even after adjustment for other predictors of osteoporosis and osteopenia. It is unclear if the link between precocious puberty and polycystic ovarian syndrome with SGA is secondary to early alterations of endocrine set points and/or a consequence of rapid weight gain during childhood [16]. In an Australian cohort of children with precocious puberty, 65% were obese and 35% were SGA. When the models for SGA in term and preterm live singletons were contrasted, a few obvious differences emerge. Induced labor, congenital abnormalities, and previous maternal history of infant death are all more strongly associated with SGA in preterm birth. On the other hand, maternal prenatal smoking, parity of one, and interactions including these factors are all more strongly associated with SGA in term births [17]. By determining the level of risk for neonatal death in babies born SGA in a hospital setting in Nepal, we can provide evidence of the need for improved quality of care of these infants through investments in evidence-based, low-cost interventions to increase survival. Nepal has a high neonatal mortality rate (24 per 1000 live births) and there has been little change between 2006-2011. SGA has been found to be significantly associated with neonatal deaths in developing countries like Nepal [18]. The weight of the infant at birth in relation to its gestational age, portrays to some extent, the effects of intrauterine environment and maternal factors such as nutrition, toxemia, chronic illness, etc. The birth weight of the baby is the most crucial determinant of its chances for survival and freedom from morbidity. SGA babies are at a higher risk for neonatal mortality, morbidity and have a poor neurological outcome and it continues to be a major health problem in our part of world. With limited data available in our setup this prospective study is aimed to determine the morbidity pattern and the outcome of small for gestational age babies in a tertiary care hospital of Nepal [19].

2. MATERIALS & METHOD

This Hospital based Cross Sectional Study was done in Department of Pediatrics and Adolescent Medicine – Division of Neonatology (NICU/Nursery/Neonatal ward/Pediatric Ward), BPKIHS, Dharan, Nepal. For a period of One year. Small for gestational age neonates admitted at BPKIHS in one year duration. This study considered 95% Confidence Interval and 80% power to estimate the sample size. This was a descriptive cross-sectional study. Sample size was calculated on the basis of prevalence of SGA reported in Nepal Demographic & Health Survey data 2011, which is 9%.

Using formula,

$$\text{Sample Size (N)} = Z^2 PQ / L^2$$

Where $Z=1.96$, $P=0.09$, $Q=0.9$, $L=20\%$ of $p=0.018$

Putting the value in formula, $N = 1.96 \times 1.96 \times 0.09 \times 0.91 / (0.018)^2 = 1100$

But according to study conducted in BPKIHS total admitted SGA was 30% of the total neonates admitted. So, this study considered corrected sample size formula for finite population. Corrected Sample size = calculated sample size / $1 + (\text{calculated sample size} / \text{estimated population})$. So, Corrected sample size = 240. Adding 10% of calculated sample size to reduce various biases, Final sample size = 264. All inborn neonates with the diagnosis of Small for gestational age (SGA) was included in this study. Small for gestational age (SGA): A neonate whose birthweight is $<10^{\text{th}}$ percentile for gestational age according to Lubchenco's growth chart. Gestational age was computed on the basis of Nagele's formula. If 1st day of LMP was not recalled then it was calculated on the basis of ultrasonic evaluation during first trimester, or by using New Ballard scoring (NBS), with priority given to ultrasonic evaluation.

A detailed anthropometric assessment was performed in all neonates within 48hrs of admission, along with daily anthropometric evaluation till their hospital stay. In which length, weight & head circumference was taken. The weight of the newborn was taken at time of birth within 1hr, in naked condition with lever type of weighing scale with child placed in the middle of the pan, with variation of +/-5grams. The length of the baby was recorded by keeping baby supine in infant meter with head held firmly in position against a fixed upright headboard, legs straightened keeping feet at right angle to legs with toes pointing upward, to the nearest 1.0mm. The head circumference was measured using locally available non-stretchable measuring tape between the glabella anteriorly and along the most prominent point posteriorly by cross-over technique, measured over the parietal eminence. More detailed data including birthweight, APGAR score, prenatal record, pregnancy history & mode of delivery was recorded.

Ponderal index was calculated in all SGA babies included in this study, by the Formula

$$\text{Weight (in grams)} \times 100 / \text{Height}^3 \text{ (in cm)}$$

Where <2 is asymmetrically growth retarded

>2 is symmetrically growth retarded

Neonates were treated and investigated as per management protocol. Monitoring of the child from the time of admission till the hospital stay was done. The outcome of the SGA babies was evaluated on the basis of mortality & morbidity. Where the morbidity includes: Hypothermia was defined as axillary temperature of the baby <36.5°C. Temperature was recorded every 2 hourly & hypothermia was managed accordingly. Hyperbilirubinemia All the SGA babies to have a yellow staining of the skin beyond the legs/estimated clinically in high-risk zone had a confirmatory serum bilirubin level done. Hyperbilirubinemia was described according to Bhutani chart. Cessation of respiration for longer than 20sec or shorter duration in presence of cyanosis or bradycardia was defined as apnoea. All SGA neonates admitted were monitored for apnoeic spells. Hypoglycaemia was defined as a blood glucose value of less than 40mg/dl. Daily screening was done with bed side reagent strips & any low values was confirmed by formal laboratory analysis. All SGA newborns admitted were monitored on the 2nd, 6th, 12th, 24th, 48th & 72nd hours of life for hypoglycaemia. In the presence of other comorbidities blood glucose was monitored every 8hrly. Polycythaemia was defined as presence of venous haematocrit more than 65% or a venous haemoglobin concentration in excess of 22mg/dl. Haematocrit was evaluated at the time of admission in all SGA babies & was monitored accordingly. Sepsis was characterized by signs & symptoms of infection with or without accompanying bacteraemia. It encompassed various infection of newborn such as septicaemia, meningitis, pneumonia, Arthritis, Osteomyelitis & Urinary tract infection. NEC was defined as association of abdominal distension, bradycardia, instability of temperature, vomiting & lethargies. Suspected neonates were staged according to Bell's staging and diagnosis was confirmed by plain abdominal radiographs & Stool for occult blood analysis. Perinatal asphyxia was defined according to the essential criteria suggested by The American Academy of paediatrics. Neurological pattern of hypoxic-ischemic encephalopathy was staged according to Sarnat & Sarnat stages. Shock was defined clinically in presence of cold and pale skin, delayed capillary refill time, weak peripheral pulse, tachycardia and oliguria, A record of Discharged /Discharged on persistent request (DOPR)/leave against medical advice (LAMA) /referred to specialised centre were kept. Collected data was entered in Microsoft excel 2007 and converted into SPSS 16.0 for statistical analysis. Descriptive data was analysed using

Percentages

Graphical and tabular representations

Mean and standard deviation for parametric data

Median, minimum, maximum and interquartile range for nonparametric data.

For inference:

Independent t test was used to assess the relation between period of gestation and length, weight and head circumference. Chi square test was used to assess the relation between period of gestation and recovery and to assess the relation between morbidity pattern and period of gestation. Man, Whitney U test was used to assess the relation between duration of stay and outcome. Multiple logistic regressions were applied in the Morbidity pattern with p-value less than 0.2 in binomial analysis. Significance was assessed at 5% level of significance. Informed assent will be taken from Parents. Confidentiality of data will be maintained. Ethical approval will be taken from the Institutional Ethical Review Board (IERB) of BPKIHS prior to conduct the study.

3. RESULTS & DISCUSSION

A hospital based cross sectional study was carried out in 264 inborn neonates with diagnosis of Small for gestational age. All the neonates were analysed throughout the hospital stay for the mortality or morbidity associated with gestational age. Among the Small for gestational age neonates included in study 175 of them were male and 89 of them were female, 66.3% and 33.7% respectively.

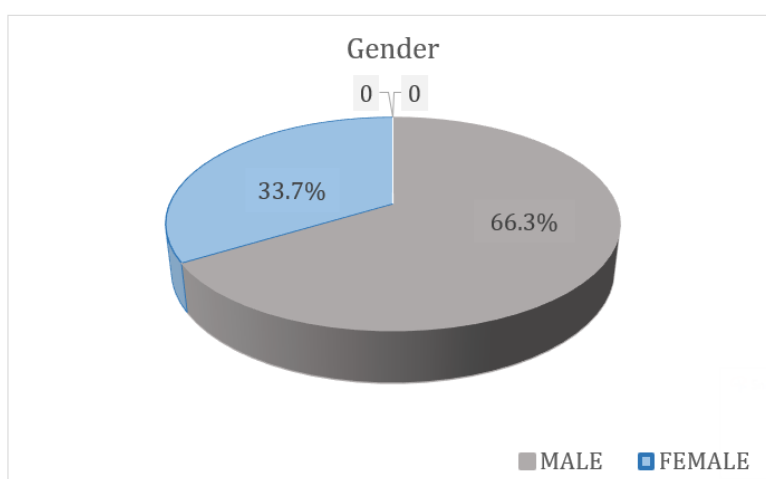


Figure 01: distribution of gender

Most of the Small for gestational age neonates were term by gestation. With total 145 term and 119 preterm neonates, 54.9% and 45.1% respectively [20].

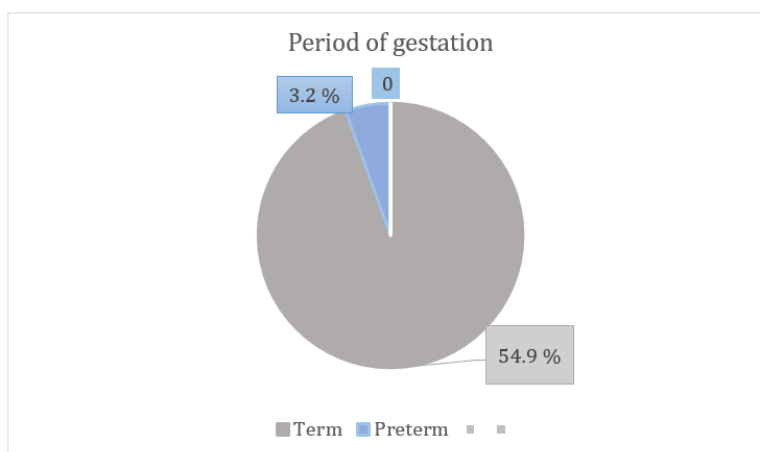


Figure 02: period of gestation

Table 01: Average Observed length, weight and head circumference

Category	Mean	SD
Length	40.966	1.75
Weight	1.671023	0.34
Head circumference	29.960	2.10

Table shows the mean length, weight and head circumference of the SGA babies included in study. A comparison among term and preterm SGA showed a significant difference in length, weight and head circumference, with term SGA having higher values [21].

Table 02: Morbidity Pattern

Category		No.	Percentage
Hypothermia	Yes	22	8.3
	No	242	91.7
Hypoglycaemia	Yes	34	12.9
	No	230	87.1
Hyperbilirubinemia	Yes	80	30.3
	No	184	69.7
Polycythaemia	Yes	17	6.4
	No	247	93.6
Perinatal depression / birth asphyxia	Yes	80	30.3
	No	184	69.7
NEC	Yes	10	3.8
	No	254	96.2
Apnoea	Yes	6	2.3
	No	258	97.7
Sepsis	Yes	135	51.1
	No	129	48.9
Shock	Yes	67	25.4
	No	197	74.6

The most common problem observed was Sepsis (51.1%), this was followed by Hyperbilirubinemia (30.3%), Perinatal asphyxia/Birth Asphyxia (30.3%) and Shock (25.4%). Least common encountered

problems were Polycythaemia (6.4%), NEC (3.8%) and Apnoea (2.3%). On applying multiple Logistic regression [22], only independent variable observed was Hypothermia (OR=0.295, 95% CI=0.107-0.806, $p=0.017$). This implies that presence of hypothermia was not affected by other morbidities.

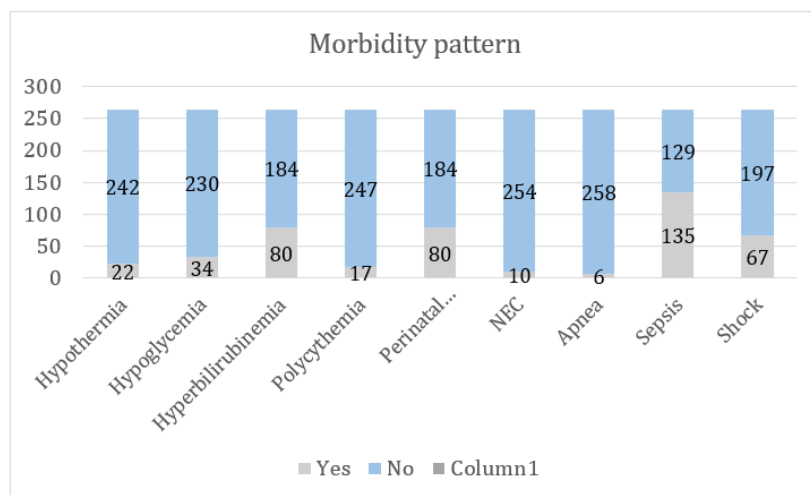


Figure 03: morbidity pattern for the study

Among the 264 SGA neonates included in study, 232 neonates were discharged without any complications whereas 32 neonates had poor outcome due to various reasons.

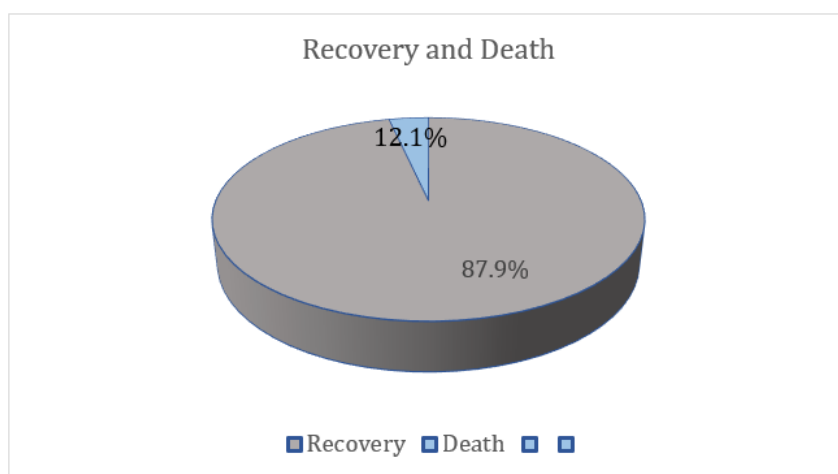


Figure 04: Outcome Pattern Including Recovery and Death

Table 03: Recovery in Term and Preterm

Category		POG		P-Value	Remarks
		Term	Pre-term		
Discharged	Yes	130	102	0.349	NS
	No	15	17		
Death	Yes	15	17	0.349	NS
	No	130	102		

Out of the total 145 term SGA, we were able to discharge 130 neonates and adverse outcome was observed in 15 neonates. Similarly, among 119 pre-term SGA babies, recovery was seen in 102 neonates

and poor outcome was observed in 17 neonates. As shown in table, no significant correlation was observed between the period of gestation and recovery [23].

Table 04: Co-Relation of Morbidity Pattern and Period of Gestation

Category		POG		P value	Remarks
		Term (%)	Pre-term (%)		
Hypothermia	Yes	6(27.2)	16(72.8)	0.007	S
	No	139(57.4)	103(42.6)		
Hypoglycaemia	Yes	18(52.9)	16(47.1)	0.855	NS
	No	127(55.2)	103(44.8)		
Hyperbilirubinemia	Yes	38(47.5)	42((52.5)	0.072	NS
	No	107(58.1)	77(41.9)		
Polycythaemia	Yes	4(23.5)	13(76.5)	0.010	S
	No	141(57)	106(43)		
Perinatal depression/ birth asphyxia	Yes	51(63.7)	29(36.3)	0.061	NS
	No	94(51)	90(49)		
NEC	Yes	2(20)	8(80)	0.046	S
	No	143(56.2)	111(43.8)		
Apnoea	Yes	2(33.3)	4(66.7)	0.414	NS
	No	143(55.4)	115(44.6)		
Sepsis	Yes	69(51)	66(49)	0.218	NS
	No	76(59)	53(41)		
Shock	Yes	29(43.2)	38(56.8)	0.033	S
	No	116(58.8)	81(41.2)		

As shown in table, a significant correlation was observed between hypothermia, polycythaemia, NEC & shock with period of gestation. Preterm SGA neonates had a higher chance of developing hypothermia, polycythaemia, NEC and shock in comparison to term SGA. While other morbidities had no significant correlation with period of gestation, i.e., their occurrence was irrespective of the term or preterm gestation. Among the 135 SGA neonates with Sepsis, 44 of them had LP proven meningitis, 37 had blood culture positive sepsis and 54 had culture sterile sepsis. [24]

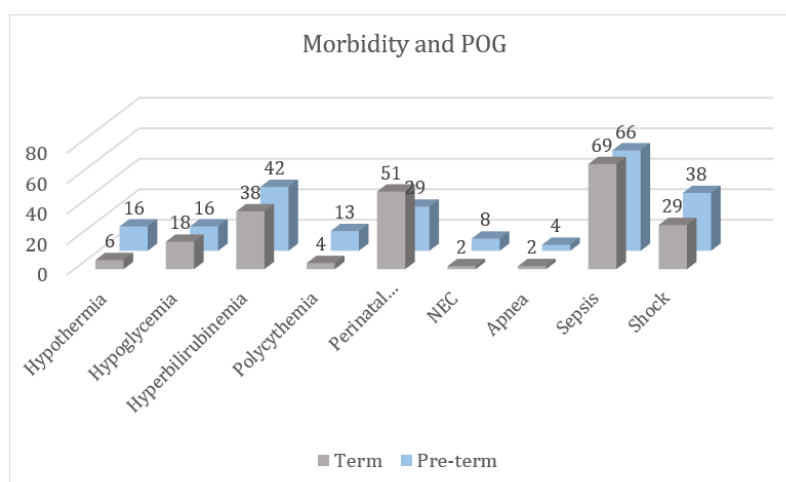


Figure 05: Morbidity and POG of the Study

Table 05: Co-Relation Between Duration of Stay and Outcome

Category		Median duration of hospital stays in days (Min – Max) (Interquartile range)	P value	Remarks
Hypothermia	Present	8.50 (2-24) (9.25)	0.168	NS
	Absent	7.00 (1-43) (8.25)		
Hypoglycaemia	Present	8.50 (2-23) (10.00)	0.047	S
	Absent	7.00 (1-43) (7.00)		
Hyperbilirubinemia	Present	7.00 (2–32) (7.75)	0.119	NS
	Absent	7.00 (1-43) (8.75)		
Polycythaemia	Present	7.00 (3-32) (15.5)	0.030	S
	Absent	7.00 (1-43) (7.00)		
Perinatal depression	Present	7.00 (1 43) (7.75)	0.886	NS
	Absent	7.00 (1-32) (9.00)		
NEC	Present	13.50 (3-24) (12)	0.010	S
	Absent	7.00 (1-43) (7.00)		
Apnoea	Present	11.00 (3-20) (10.25)	0.229	NS
	Absent	7.00 (1-43) (8.00)		
Sepsis	Present	7.00 (1-43) (9.00)	<0.001	S
	Absent	5.00 (1-32) (7.00)		
Shock	Present	10.00 (1 – 43) (11.00)	<0.001	S
	Absent	5.00 (1-32) (5.50)		

On analysing the relationships between the morbidities and length of hospital stay, a strong correlation was observed with hypoglycaemia, polycythaemia, NEC, sepsis and shock. Any SGA neonates, whether born at term or preterm, with above morbidities had a longer hospital stay [25].

4. CONCLUSIONS

The hospital-based cross-sectional study was the first of its kind in Nepal, provides valuable insights into the morbidity and outcome patterns of inborn small for gestational age (SGA) neonates. The findings demonstrated that a greater proportion of SGA neonates were term and male, with significant anthropometric differences between term and preterm groups. Sepsis, hyperbilirubinemia, perinatal asphyxia, and shock emerged as the most common morbidities, while hypothermia, polycythaemia, NEC, and shock were significantly more prevalent among preterm SGA neonates. Logistic regression identified hypothermia as an independent co-morbidity factor, emphasizing its clinical importance. The majority (87.9%) of SGA neonates were successfully discharged, yet 12.1% faced adverse outcomes, underscoring the vulnerability of this group. Morbidities such as sepsis, hypoglycemia, polycythaemia, NEC, and shock were associated with prolonged hospital stay, indicating a considerable burden on neonatal care resources. These findings highlight the need for improved perinatal care to both prevent SGA births and effectively manage their complications. Special attention should be directed towards early recognition and management of infections, hypothermia, and metabolic complications, particularly in preterm SGA neonates. Strengthening neonatal care protocols and preventive strategies could play a pivotal role in reducing morbidity and improving survival outcomes among this high-risk group.

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