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Immediate neonatal outcome of diabetic pregnant mothers admitted in a tertiary care hospital in Rajshahi

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Abstract
Background: Diabetes during pregnancy is a prevalent metabolic disorder associated with increased maternal and neonatal morbidity. Infants of diabetic mothers are at higher risk of metabolic disturbances, perinatal complications, and altered anthropometric outcomes. Despite advances in management, data from Bangladesh on immediate neonatal outcomes remain limited.
Aim of the study: To evaluate the immediate clinical and biochemical outcomes of neonates born to diabetic mothers admitted to a tertiary care hospital in Rajshahi, Bangladesh.
Methods: This cross-sectional descriptive study enrolled 95 neonates of diabetic mothers admitted to the Department of Pediatrics, Rajshahi Medical College Hospital, from January 2017 to June 2018. Data on demographics, maternal therapy, neonatal anthropometrics, clinical findings, and biochemical parameters were collected using structured forms. Blood glucose, serum calcium, hemoglobin, hematocrit, and bilirubin levels were measured, and SPSS version 26 was used for statistical analysis. Categorical variables were summarized as frequencies and percentages, continuous variables as mean ± SD, and associations were assessed using chi-square tests and odds ratios with corresponding p-values.
Result: Male neonates predominated (62.0%). Perinatal asphyxia (26.3%) and jaundice (23.2%) were common. Biochemical complications included hypoglycemia (53.7% at 0.5 h), hypocalcemia (21.1%), hyperbilirubinemia (18.9%), and polycythemia (25.3%). Macrosomia occurred in 31.6% of neonates, while low birth weight was 3.2%. Neonatal hypoglycemia was most prevalent within the first hour of life and decreased over 72 hours. No significant association was observed between maternal insulin therapy and neonatal hypoglycemia (p=0.59; OR=0.73).
Conclusion: Neonates of diabetic mothers are at high risk of early metabolic disturbances, perinatal complications, and macrosomia. Early identification, continuous monitoring, and adherence to standardized neonatal care protocols are essential to optimize outcomes in this population.

Keywords: Diabetic pregnancy, neonates, hypoglycemia, hypocalcemia, macrosomia

1. Introduction
Diabetes is one of the most common and important metabolic disorders that affects the health of pregnant women and infants [1]. About 3-10% of all pregnancies are complicated by diabetes [2, 3]. Diabetes has long been related to maternal and perinatal morbidity. Before the discovery of insulin in 1922, diabetic women rarely reached reproductive age or survived during pregnancy; in fact, pregnancy termination was recommended routinely for pregnant diabetic patients because of high mortality rates. Infants born to mothers with glucose intolerance are at an increased risk of mortality and morbidity. The level of risk is related to gestational age at the appearance of an abnormal oral glucose tolerance test (OGTT) [4]. Currently, 3% to 8% of pregnancies are complicated by abnormal glycemic control. Of these, 80% are caused by gestational diabetes mellitus as opposed to pre-gestational diabetes mellitus [5]. Infants of diabetic mothers have a 47% risk of significant hypoglycemia, 22% risk of hypocalcemia, 19% risk of hyperbilirubinemia, and 34% risk of polycythaemia [6]. Infants of diabetic mothers have hyperinsulinism at birth due to increased placental transfer of glucose and other nutrients, stimulating hyperplasia of islets of Langerhans in the fetus and increased insulin secretion, raised amount of C-peptide and free insulin in cord blood [7]. Hypoglycaemia is defined as a blood glucose level less than 2.6mmol/L [8]. Symptoms of hypoglycaemia are nonspecific, such as lethargy, apathy, limpness, apnoea, cyanosis,

weak or high-pitched cry, poor feeding, vomiting, tremor, jitteriness, irritability, seizures, coma [9]. Neonatal hypocalcaemia may be due to hypoparathyroidism, abnormal vitamin D metabolism, and hyperphosphataemia. Neonatal hypocalcaemia is defined as a total serum calcium concentration of less than 7mg/dl and an ionized calcium concentration of less than 4 mg/dl. Polycythaemia (haematocrit more than 65%) occurs in 30 to 60% of neonates of diabetic pregnant mothers, causing the neonatal hyperviscosity syndrome. Macrosomia (birth weight >4000g) may be associated with increased incidence of primary caesarean section or obstetric trauma such as a fractured clavicle. Hypertrophic cardiomyopathy with asymmetric septal hypertrophy has been extensively documented [10]. The babies may also develop small left colon syndrome, a transient delay in the development of the left side of the colon [11]. Predominant causes of mortality are congenital anomaly, birth trauma, respiratory distress syndrome, prematurity, and unexplained stillbirth [12]. Although in developed countries there has been significant improvement in the outcome of diabetic pregnancies, largely due to better metabolic control before and during pregnancy and vigorous neonatal care, the management in our country still poses a major challenge. In Bangladesh, there is no recent study on the immediate outcome of neonates of diabetic pregnant mothers. So, this present study was to assess the immediate outcome of neonates of diabetic mothers in Rajshahi Medical College Hospital.

Methodology and Materials

This cross-sectional descriptive study was conducted in the Department of Pediatrics at Rajshahi Medical College Hospital, Bangladesh, from January 2017 to June 2018. The study aimed to evaluate clinical characteristics and immediate outcomes among neonates born to diabetic mothers. All eligible neonates admitted during the study period were enrolled consecutively to ensure complete case capture. A total of 95 newborns met the inclusion criteria.

Inclusion Criteria

- Neonates born to diabetic mothers
- Age within the first 7 days of life

Exclusion Criteria:

- Age > 7 days
- Neonates of diabetic mothers presenting with septicemia
- Newborns requiring emergency surgical intervention.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board. Written informed consent was secured from parents or caregivers before participation. As the study involved direct clinical evaluation and review of hospital records, confidentiality was ensured, and all data were anonymized for analysis.

Data Collection

Data were collected using a structured questionnaire and standardized clinical assessment. Information included demographic details, presenting symptoms, physical examination findings, and immediate neonatal outcomes such as hypoglycemia, perinatal asphyxia, macrosomia, and congenital anomalies. All biochemical investigations were performed under aseptic conditions. Initial capillary blood glucose was measured using a glucometer upon admission. Subsequently, 3 mL of peripheral venous blood was drawn for laboratory tests including random blood sugar, serum calcium, hemoglobin level, hematocrit, and bilirubin. RBS and serum calcium were measured by the end-point method using Human® reagents on a Humalyzer 3000 analyzer. Serum bilirubin was analyzed by the bilirubin urethane method using the Biogen 5500 system. Hemoglobin and hematocrit were measured using the acid haematin and Wintrobe/autoanalyzer methods on the Biocell-83 hematology analyzer. All tests were performed in the Department of Pathology, RMCH. Clinical management adhered to the BSMMU Newborn Management Protocol (January 2016).

Statistical Analysis

Data were reviewed, cleaned, and compiled before analysis. Statistical analyses were performed using SPSS version 26. Categorical variables were summarized as frequencies and percentages, while continuous variables were described using appropriate descriptive statistics. Analytical tests were applied based on variable type, and findings were interpreted according to study objectives.

Result

Figure 1 showed a right-skewed age distribution, with most neonates presenting immediately after birth. Over 60 cases occurred within 0-0.75 hours, followed by steep declines and minor peaks at 2.25 and 4.25 hours. The mean age of 1.15 hours (SD 1.142) confirmed strong early clustering within the first hour. Figure 2 revealed a male predominance. Males constituted 62.0% of the study, while females accounted for the remaining 38.0%. Most mothers were aged 26-35 years, accounting for two-thirds of the study, while 18-25-year-olds made up nearly one-third, and only a small proportion were 36-45 years (Table 1). Table 2 indicated that perinatal asphyxia was the most frequent clinical finding, affecting over a quarter of neonates, followed by jaundice in nearly one-fourth. Birth injuries occurred in fewer than 10%, while meconium aspiration syndrome was rare. Congenital malformations were uncommon, with isolated cases of cleft lip/palate and anorectal malformations (~2% each) and a single case of patent ductus arteriosus. Birth weight ranged from 1.0 to 4.8 kg (mean 3.15±0.76 kg), and length varied from 30 to 54 cm (mean 49.08±4.25 cm) (Table 3). Occipitofrontal circumference averaged 34.68±2.43 cm (range 26–49 cm). Biochemical parameters included mean serum calcium 8.13±1.77 mg/dL and bilirubin 8.48±5.08 mg/dL. Hemoglobin and hematocrit averaged 16.51±1.68 g/dL and 51.51±7.40%, respectively, while mean heart rate was 145.81±9.29 bpm. Figure 3 showed that a large majority of the study (65.28%) was characterized by a normal birth weight. However, the data revealed a significant prevalence of macrosomia, accounting for 31.57% of the neonates. In contrast, low birth weight constituted only a small proportion of the total births, specifically 3.15%. Polycythemia was the most frequently observed complication, affecting approximately one-quarter of neonates (Table 4). Hypocalcaemia was present in just over 21% of cases, while hyperbilirubinaemia was documented in nearly 19% of the study. Figure 4 showed mean neonatal blood glucose rising from 2.72 mmol/L at 0.5 hours to 5.39

mmol/L at 24 hours, peaking at 11.33 mmol/L at 36 hours, then declining to 5.77 mmol/L at 48 hours and 5.27 mmol/L at 72 hours. Hypoglycemia was most common at 0.5 hours post-birth, affecting 53.7% of neonates, and declined over time: 33% at 2 hours, 23.9% at 4 hours, 11.1% at 6 hours, under 9% at 12 hours, and 2.4% by 72 hours (Table 5).

Table 6 presented that Among neonates of mothers on insulin therapy, 52.5% developed hypoglycemia versus 60.0% in those whose mothers received non-insulin therapy, with no significant association observed (P=0.59; OR=0.73).

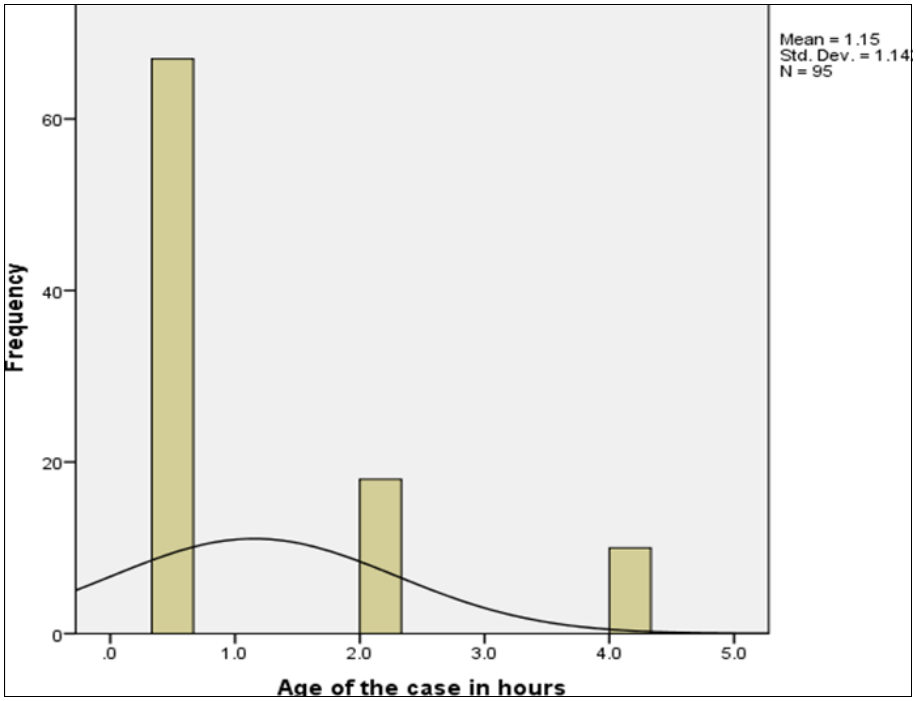

Fig 1: Histogram of age distribution of neonate

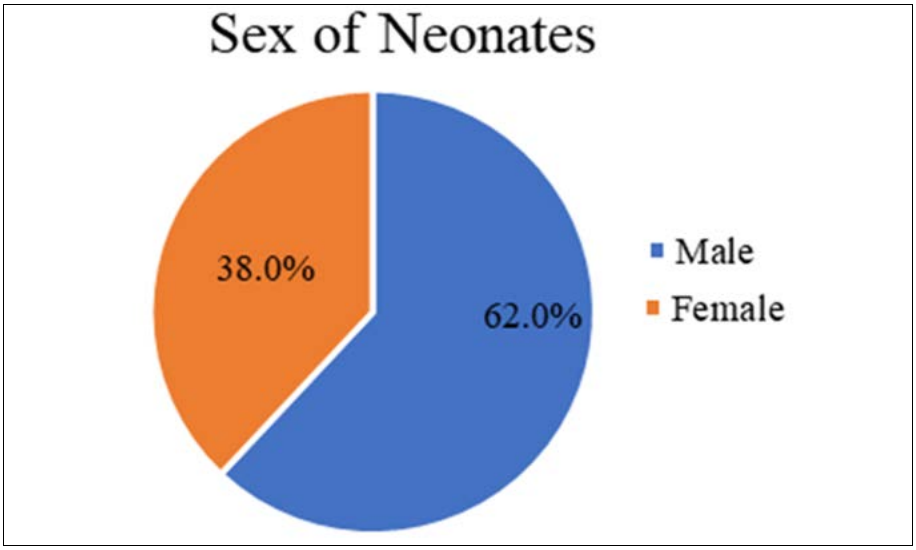

Fig 2: Sex distribution of the neonates (n=95)

Table 1: Baseline characteristics of the study participants (n=95)

Variables	Frequency (n)	Percentage (%)
Maternal Age (years)		
26–35	63	66.30
18–25	28	29.50
36–45	4	4.20
Maternal Drug History		
Insulin	80	84.00
No drug (Non-Insulin Therapy)	15	16.00
Maternal HTN during Pregnancy		
Absent	64	67.40
Present	31	32.60

Table 2: Findings of physical examination and congenital malformation of neonates (n=95)

Variables	Frequency (n)	Percentage (%)
Clinical Findings		
Perinatal asphyxia	25	26.32
Jaundice	22	23.16
Birth injury	9	9.47
Meconium aspiration syndrome	1	1.05
Malformation		
Cleft palate or cleft lip	2	2.11
Anorectal malformation	2	2.11
Congenital heart disease (PDA)	1	1.05

Table 3: Neonates parameter of the study

Parameters	Minimum	Maximum	Mean ± SD
Anthropometric Measurements			
Birth weight in kg	1	4.8	3.15 ± 0.76
Length in cm	30	54	49.08 ± 4.25
OFC measurement in cm	26	49	34.68 ± 2.43
Biochemical Parameters			
Serum Calcium (mg/dL)	4.1	18.5	8.13 ± 1.77
Serum Bilirubin (mg/dL)	1.2	23	8.48 ± 5.08
Hb% (Hemoglobin, g/dL)	12.9	22.1	16.51 ± 1.68
Haematocrit (%)	48	67.5	51.51 ± 7.40
Cardiovascular findings			
Heart rate	110	163	145.81 ± 9.29

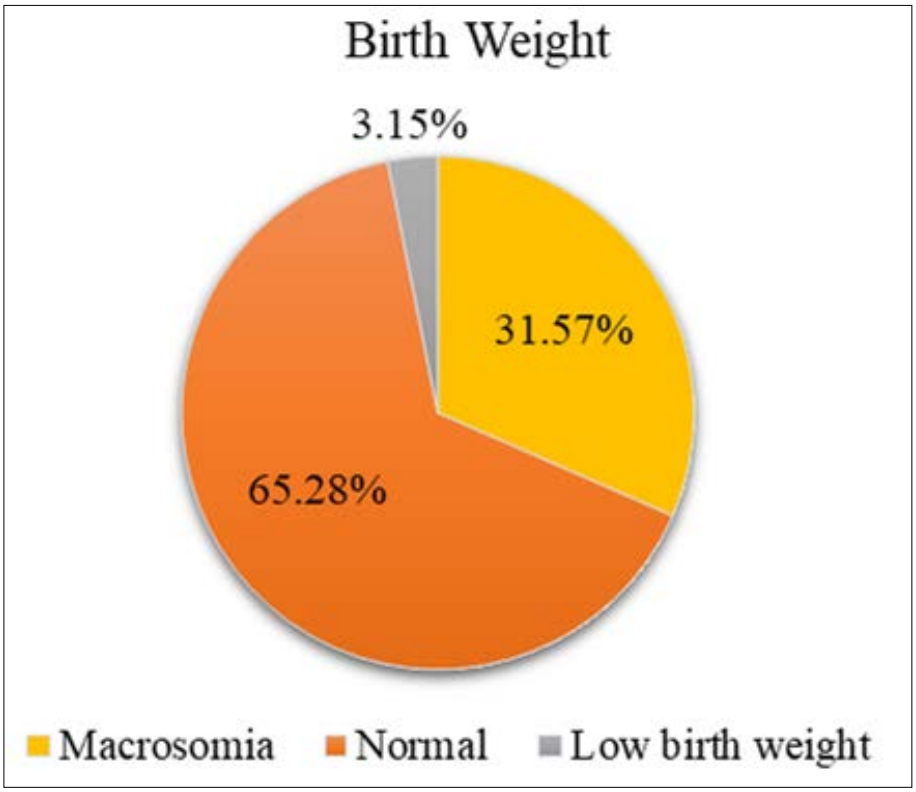

Fig 3: Birth weight of the neonates (n= 95)

Table 4: Biochemical Complications of neonates (n=95)

Complications	Frequency (n)	Percentage (%)
Hypocalcaemia	20	21.05
Hyperbilirubinaemia	18	18.95
Polycythemia	24	25.26

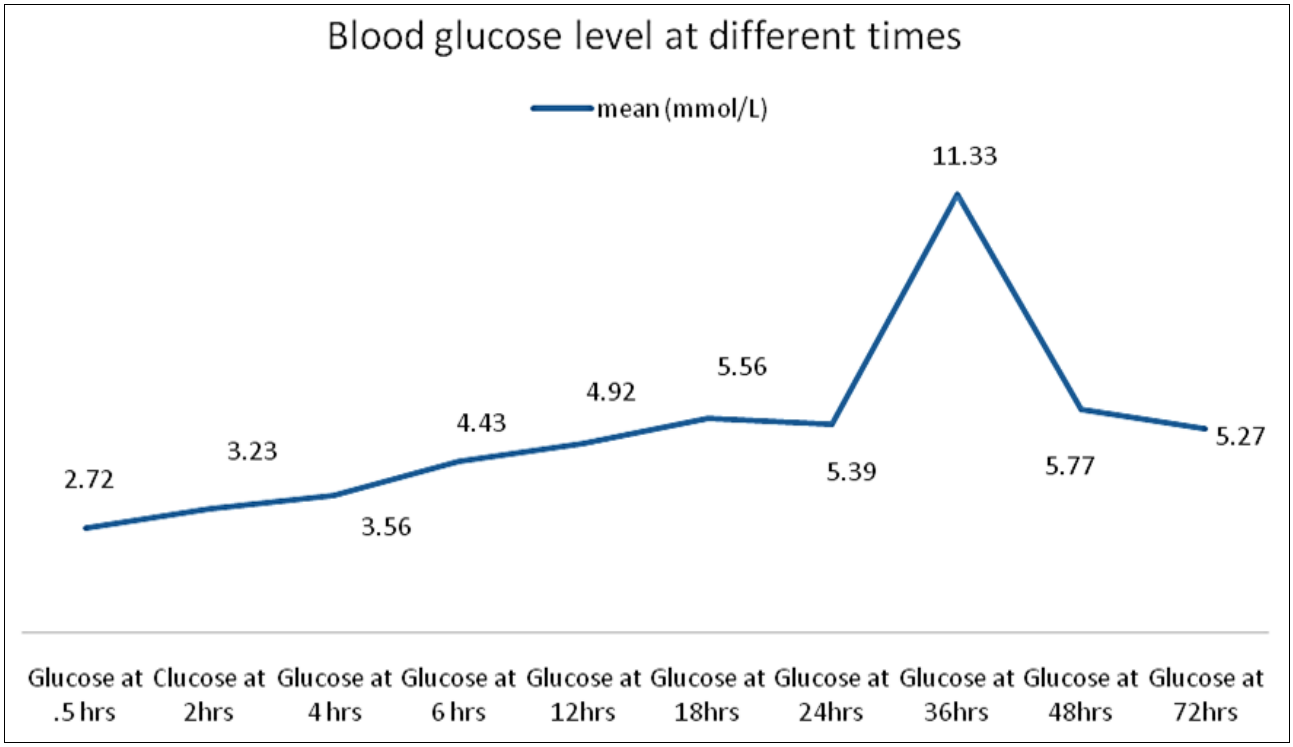

Figure 4: Blood glucose level (mean) at different point of times of the neonates

Table 5: Presence of hypoglycemia at different points of time

Time point	Frequency (n)	Percentage (%)
0.5 hrs		
Present	51	53.68
Absent	44	46.32
Total	95	100.00
2 hrs		
Present	30	32.26
Absent	63	67.74
Total	93	100.00
4 hrs		
Present	21	23.86
Absent	67	76.14
Total	88	100.00
6 hrs		
Present	10	11.11
Absent	80	88.89
Total	90	100.00
12 hrs		
Present	7	8.75
Absent	73	91.25
Total	80	100.00
24 hrs		
Present	5	6.94
Absent	67	93.06
Total	72	100.00
36 hrs		
Present	4	6.35
Absent	59	93.65
Total	63	100.00
48 hrs		
Present	5	9.09
Absent	50	90.91
Total	55	100.00
72 hrs		
Present	1	2.38
Absent	41	97.62
Total	42	100.00

Table 6: Association of hypoglycemia in neonates with insulin use by mother

Drug use	Hypoglycemia in neonates, n (%)		P-value	Odds ratio
	Hypoglycemic	Not Hypoglycemic		
Insulin therapy (during pregnancy)	42 (52.5)	38 (47.5)	0.59	0.73
Non- Insulin therapy	9 (60.0)	6 (40.0)		
Total	51 (53.7)	44 (46.3)		

Discussion

Diabetes remains one of the most common and clinically significant metabolic disorders affecting both maternal and neonatal health [1]. In this study, the mean age of the neonates at the time of clinical evaluation was 1.15 ± 1.14 hours, with a minimum age of 0.5 hours and a maximum age of 4 hours, as all neonates were assessed shortly after birth. Among the 95 neonates included, 62.1% were male and 37.9% were female. This distribution is comparable to the findings of Shazia Imdad *et al*., who reported 57.5% male and 42.5% female neonates [13]. Regarding maternal treatment, 84% of mothers received insulin therapy during pregnancy, whereas 16% did not receive insulin or any pharmacological intervention. The incidence of perinatal asphyxia in infants of diabetic mothers (IDMs) was 26.3%, which aligns with previous reports [14]. Perinatal asphyxia in IDMs is often multifactorial, including maternal hypertension with reduced placental perfusion, premature labor, fetal macrosomia, and maternal hyperglycemia within 6–8 hours before delivery, potentially impairing placental blood flow. Metabolic complications in IDMs were notable. Hypoglycemia was observed in 53.7% of neonates, consistent with Ranade *et al*., who reported an incidence of 50% [15]. Hypocalcemia, often attributed to functional hypoparathyroidism in neonates of diabetic mothers, occurred in 21.1% of neonates in this cohort, similar to the 14% reported by Ranade *et al*. [15, 16]. Serial blood glucose monitoring from the first half-hour post-delivery up to 72 hours demonstrated an initial low glucose level in many neonates, followed by a gradual increase to normal levels. Hyperbilirubinemia was identified in 18.94% of neonates, comparable to the 19% incidence reported by Hussain *et al*. [17]. Polycythemia was observed in 25.26% of neonates, while Alam *et al*. reported a slightly higher rate of 30% [18]. Congenital malformations were present in five neonates (5.3%), reflecting the continued risk of structural anomalies in IDMs. Meconium aspiration syndrome occurred in only 1.1% of neonates, aligning with Mahmood and Kayes [14]. Birth injuries were documented in 9.5% of cases, including Erb's palsy and clavicle fractures, similar to a previously reported 5% incidence [13]. Clinical evaluations revealed that 86.3% of neonates exhibited plethora and 52.6% developed jaundice. Cardiovascular assessment showed a mean heart rate of 145.81 beats per minute, with 4.2% of neonates demonstrating a cardiac murmur. Anthropometric measurements indicated a significantly elevated mean birth weight of 3.15 ± 0.76 kg, consistent with previous studies reporting mean weights of 3.212 ± 0.563 kg [14]. Macrosomia, defined as birth weight above the 90th percentile or >4000 g, was observed in 31.57% of neonates, within the reported range of 15–45% [19]. Biochemical analyses revealed a mean serum calcium of 8.13 ± 1.77 mg/dL, mean serum bilirubin of 8.48 ± 5.08 mg/dL, mean hemoglobin of 16.51 ± 1.68 g/dL, and mean hematocrit of 51.51 ± 7.40%. 21.1% of neonates developed hypocalcemia, 18.94% exhibited hyperbilirubinemia, and 25.26% demonstrated polycythemia. These results are comparable to Hussain *et al*., who reported incidences of 16.6%, 19%, and 12%, respectively [17].

Limitations of the study: This study was conducted in a single tertiary care hospital, limiting the generalizability of the findings to other regions or healthcare settings. The sample size was relatively small, which may reduce statistical power for detecting fewer common outcomes. Long-term follow-up of neonates was not performed, preventing assessment of delayed complications. Data on maternal glycemic control throughout pregnancy were limited, restricting evaluation of its correlation with neonatal outcomes. Additionally, potential confounding factors such as maternal comorbidities and socioeconomic status were not fully accounted for.

Conclusion

This study highlights that neonate born to diabetic mothers in a tertiary care setting exhibit a spectrum of immediate metabolic and clinical complications. Perinatal asphyxia and jaundice were the most common clinical presentations, while biochemical disturbances such as hypoglycemia, hypocalcemia, hyperbilirubinemia, and polycythemia were frequently observed. Macrosomia affected nearly one-third of the cohort, reflecting the impact of maternal hyperglycemia on fetal growth. Early-onset hypoglycemia was particularly prevalent within the first hour of life, gradually declining over 72 hours, irrespective of maternal insulin therapy. Overall, vigilant monitoring, timely biochemical assessment, and adherence to standardized neonatal management protocols are crucial for improving early outcomes in infants of diabetic mothers in resource-limited settings.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee.

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