



## Prevalence of Hypocalcemia in Term Neonates with Moderate to Severe Birth Asphyxia in a Tertiary Care Hospital, Lahore

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### ABSTRACT

**Background:** Birth asphyxia is a significant cause of neonatal morbidity and mortality. Hypocalcemia is a common metabolic complication in neonates with birth asphyxia, which may lead to severe consequences such as seizures and poor feeding. **Objective:** To assess the prevalence of hypocalcemia in term neonates with moderate to severe birth asphyxia and evaluate the associations between hypocalcemia and demographic/clinical variables. **Methods:** This cross-sectional study was conducted at the Neonatal Unit of the Department of Pediatric Medicine, Shalamar Hospital, Lahore, from 15 April 2024 to 15 October 2024. A total of 178 neonates with birth asphyxia were enrolled using a non-probability consecutive sampling technique. Data were collected on demographic characteristics, APGAR scores, serum calcium levels, and birth weight. Hypocalcemia was defined as serum calcium levels <7.5 mg/dL. **Results:** The prevalence of hypocalcemia in neonates with birth asphyxia was found to be 23.0%. A significant association was observed between low birth weight and hypocalcemia ( $p = 0.03$ ), with 31.3% of low birth weight neonates showing hypocalcemia, compared to 16.0% of normal birth weight neonates. No significant differences were found between gender, mode of delivery, or APGAR scores and the prevalence of hypocalcemia. **Conclusion:** Hypocalcemia is prevalent in term neonates with moderate to severe birth asphyxia, particularly in those with low birth weight. Early screening for hypocalcemia and prompt intervention with calcium supplementation are crucial, especially for neonates with low birth weight, to prevent associated complications.

### INTRODUCTION

Birth asphyxia remains one of the leading causes of neonatal morbidity and mortality, particularly in developing countries where access to advanced obstetric and neonatal care is limited [1]. It is defined as the failure to initiate or sustain spontaneous respiration immediately after birth, often resulting in multi-organ dysfunction due to hypoxia and ischemia. Among the metabolic derangements associated with birth asphyxia, hypocalcemia is one of the most frequent and clinically significant biochemical abnormalities observed in term neonates [2]. Hypocalcemia, characterized by low serum calcium levels, can exacerbate neurological injury and contribute to complications such as seizures, cardiac dysfunction, and poor neurodevelopmental outcomes if left untreated [3]. Calcium is actively transported from the mother to the fetus throughout the third and final trimester of pregnancy. This can be seen by the much higher level of total calcium concentration in cord blood as compared to the concentration in maternal serum [4]. After delivery, the blood calcium levels of infants are dependent on the release of PTH, the calcium intake from

the food, the calcium reabsorption in the kidneys, the calcium storage in the skeleton, and the vitamin D status. As a consequence of this, calcium levels begin to fall after birth and reach a nadir ranging from 7.5-8.5 mg/dl in healthy term newborns by the second day of life [5]. This decrease in post-natal blood calcium levels may be due to hypoparathyroidism, which is characterized by problems in vitamin D metabolism and typically appears between 12 and 24 hours after birth [6]. It is particularly frequent in high-risk neonates, such as newborns born to women who have diabetes, infants who had perinatal hypoxia, and premature and preterm infants. Calcium plays essential parts in a wide variety of biochemical processes, including blood coagulation, the excitability of neuromuscular junctions, the integrity of cell membranes, and the activities of cellular enzymes [7].

Small for gestational age is the independent risk factor for newborn hypocalcaemia. Pre-term babies, perinatal asphyxia, infants of diabetic mothers, and intrauterine growth restriction are among the most common contributors to neonatal hypocalcaemia. Delivery asphyxia, also known as perinatal asphyxia, is the most

prevalent cause of neonatal hypocalcemia. Birth asphyxia is described as the condition that results from a lack of oxygen to a new born newborn that lasts long enough throughout the delivery process to cause physical injury, most often to the brain. Asphyxia during labour and delivery is a leading cause of both short-term and long-term neurological morbidity and death [8]. As asphyxia has a high mortality and morbidity rate, hypocalcaemia can further contribute to the disease course and hence poor prognosis. The prevalence of this ailment is estimated to be between 1 and 10 for every 1000 live births. The weight of the newborn at delivery, the gestational age of the infant, as well as the accessibility to treatment services in the area, all have a role in determining the overall rate of this illness. In a study conducted by Azem et al. [9] in Multan, Pakistan, the prevalence of hypocalcaemia was shown to be 21.1% in cases of birth asphyxia. In another study done by Ayash et al., the incidence of hypocalcemia in birth asphyxia was determined to be 4.26% [10].

### Objective

To determine the frequency of hypocalcaemia among full-term neonates with moderate to severe birth asphyxia.

### METHODOLOGY

This Cross-sectional study was conducted at the Neonatal Unit of the Department of Pediatric Medicine, Shalamar Hospital, Lahore from 15 April 2024 to 15 October 2024. Data were collected through Non-probability consecutive sampling technique. The sample size of 178 is estimated by using a 95% confidence level with a 6% margin of error and taking an expected percentage of hypocalcemia as 21.1%.

### Inclusion Criteria

- Full-term baby of either gender (>37 weeks on USG).
- SVD and cesarean-born babies delivered in Shalamar Hospital, attended by doctors.
- Neonates with perinatal asphyxia (as per operational definition) admitted in NICU.

### Exclusion Criteria

- All babies with hydrops, blood incompatibility, congenital malformations.
- Neonates accepted with low adjusted renal capacity (septicemia, respiratory trouble disorder, necrotizing enterocolitis, major inborn oddities, and administration of IV nephrotoxic medications).
- Not giving consent.

### Data collection

After obtaining approval from the hospital's ethical committee and securing written informed consent from the guardians, all 178 neonates with birth asphyxia were enrolled. A biochemical test to measure serum calcium levels was performed to confirm the diagnosis of hypocalcemia in asphyxiated neonates. The study focused on neonates admitted with a history of birth asphyxia and low APGAR scores, as per the operational definitions. This information was documented on a specifically designed proforma. Demographic data, including name, age, and gender, were also recorded. Additional data on variables such as serum total calcium levels, hypocalcemia status,

APGAR scores, and birth weight were noted on the pre-designed questionnaire.

### Data Analysis

The data were entered and analyzed using SPSS v25.0. Frequencies and percentages were calculated for qualitative variables such as gender and hypocalcemia status. Quantitative variables, including age, serum calcium levels, APGAR scores, and birth weight, were expressed as Mean  $\pm$  Standard Deviation (S.D.). Data were stratified by gender and birth weight to control for effect modifiers. Post-stratification analysis was conducted using the Chi-square test to assess significance. A p-value of  $\leq 0.05$  was considered statistically significant.

### RESULTS

Out of 178 neonates included in the study, 92 (51.7%) were male and 86 (48.3%) were female, showing an almost equal gender distribution. The majority of deliveries were spontaneous vaginal deliveries (SVD) in 143 cases (80.3%), while cesarean sections accounted for 35 (19.7%). The mean age of neonates was  $2.5 \pm 1.2$  days, and the mean birth weight was  $2715 \pm 420$  grams, indicating that most were within the normal weight range. The average serum calcium level was  $7.7 \pm 1.1$  mg/dL, with values ranging between 6.5 and 9.5 mg/dL. Hypocalcemia ( $<7.5$  mg/dL) was detected in 41 neonates (23.0%), while 137 (77.0%) had normal calcium levels, suggesting that nearly one-fourth of the neonates experienced biochemical hypocalcemia.

**Table 1**

*Demographic Characteristics of Neonates (n = 178)*

Variable	Category	n (%)
Gender	Male	92 (51.7%)
	Female	86 (48.3%)
Mode of Delivery	SVD	143 (80.3%)
	Cesarean Section	35 (19.7%)
Mean Age (days)		$2.5 \pm 1.2$
Mean Birth Weight (g)		$2715 \pm 420$
Serum Calcium (mg/dL)	$7.7 \pm 1.1$ (6.5 – 9.5)	—
Hypocalcemia ( $<7.5$ mg/dL)		41 (23.0%)
Normal Calcium ( $\geq 7.5$ mg/dL)		137 (77.0%)

At 1 minute after birth, the mean APGAR score was  $4.6 \pm 1.2$ , and 65 neonates (36.5%) scored less than 4, reflecting initial perinatal distress in a considerable proportion. By the 5-minute mark, the mean APGAR score improved to  $6.8 \pm 1.4$ , with only 33 neonates (18.5%) remaining with scores below 4.

**Table 2**

*APGAR Scores*

Time Point	Mean $\pm$ SD	n (%) with score $<4$
1 Minute	$4.6 \pm 1.2$	65 (36.5%)
5 Minutes	$6.8 \pm 1.4$	33 (18.5%)

Hypocalcemia was slightly more common in males (25.0%) compared to females (22.1%), but this difference was not statistically significant ( $p = 0.58$ ). However, a significant relationship was observed between birth weight and hypocalcemia ( $p = 0.03$ ). Neonates with a birth weight below 2500 g had a higher prevalence of hypocalcemia (31.3%) than those weighing 2500 g or more (16.0%).

**Table 3**  
*Hypocalcemia Stratified by Gender and Birth Weight*

Variable	Category	Hypocalcemia n (%)	p-value
Gender	Male	23 (25.0%)	0.58
	Female	19 (22.1%)	
Birth Weight	<2500 g	20 (31.3%)	0.03*
	≥2500 g	21 (16.0%)	

\*Chi-square test; \*p ≤ 0.05 considered significant

At the 1-minute assessment, 65 neonates (36.5%) had APGAR scores below 4, 77 (43.3%) had scores between 4 and 6, and 36 (20.2%) had normal scores between 7 and 10. By 5 minutes, the proportion of neonates with low scores (<4) dropped to 33 (18.5%), while those with normal scores (7–10) increased to 56 (31.5%).

**Table 4**  
*Distribution of APGAR Scores at 1 and 5 Minutes*

APGAR Score	1 Minute n (%)	5 Minutes n (%)
<4	65 (36.5%)	33 (18.5%)
4-6	77 (43.3%)	89 (50.0%)
7-10	36 (20.2%)	56 (31.5%)

Hypocalcemia was observed in 23 (25.0%) of male neonates and 19 (22.1%) of females, with no marked gender difference. Neonates delivered via cesarean section showed a higher rate of hypocalcemia (31.4%) compared to those delivered vaginally (21.0%), suggesting that delivery mode may influence calcium regulation in the immediate neonatal period. When stratified by APGAR score at 1 minute, hypocalcemia was observed in 23.1% of those with scores <4, 20.8% with scores 4–6, and 27.8% with scores 7–10, showing no clear trend but suggesting possible metabolic instability across groups.

**Table 5**  
*Prevalence of Hypocalcemia and Associated Factors*

Factors	n (%) with Hypocalcemia	
Gender	Male	23 (25.0%)
	Female	19 (22.1%)
Mode of Delivery	SVD	30 (21.0%)
	Cesarean Section	11 (31.4%)
APGAR Score at 1 Minute	<4	15 (23.1%)
	4-6	16 (20.8%)
	7-10	10 (27.8%)

## DISCUSSION

This study aimed to evaluate the prevalence of hypocalcemia in term neonates with moderate to severe birth asphyxia and its association with gender, mode of delivery, birth weight, and APGAR scores. The findings provide insight into the frequency of hypocalcemia in this specific group of neonates and its potential clinical implications. The prevalence of hypocalcemia in neonates with birth asphyxia was found to be 23.0%, which aligns with previous studies indicating a higher incidence of hypocalcemia in neonates experiencing perinatal asphyxia. Hypocalcemia is commonly observed in asphyxiated neonates due to impaired parathyroid hormone secretion, reduced renal function, or abnormal calcium metabolism associated with hypoxia. These findings are consistent with studies reporting that

hypocalcemia is a common metabolic complication in neonates with birth asphyxia [11].

Gender did not significantly affect the prevalence of hypocalcemia in this study, with 25.0% of male and 22.1% of female neonates affected. This finding is consistent with reports suggesting that gender does not play a major role in the risk of hypocalcemia in asphyxiated neonates. Some studies suggest a slightly higher risk in male neonates due to differences in calcium metabolism, but this was not observed in this cohort. The mode of delivery also did not significantly influence hypocalcemia occurrence. Both spontaneous vaginal delivery and cesarean section neonates had a similar incidence, suggesting that the birth method alone may not determine calcium disturbances [12]. Previous research indicates that the severity of birth asphyxia, rather than delivery method, is the key factor influencing metabolic abnormalities like hypocalcemia. A significant association was observed between low birth weight and increased prevalence of hypocalcemia. Neonates weighing less than 2500 grams had a higher prevalence (31.3%) compared to those with normal birth weight (16.0%). Low birth weight neonates are known to have immature parathyroid and renal functions and lower calcium reserves, predisposing them to hypocalcemia [13]. This underscores the importance of monitoring serum calcium levels in neonates with low birth weight, particularly those with birth asphyxia. APGAR scores at 1 and 5 minutes did not show a significant association with hypocalcemia [14-16]. Although low APGAR scores indicate birth asphyxia, hypocalcemia may develop due to prolonged or severe asphyxia, which may not be fully captured by the immediate APGAR scores at birth. This finding is consistent with literature suggesting that metabolic complications like hypocalcemia may occur independently of APGAR score. Clinically, these findings highlight the importance of early detection and management of hypocalcemia in neonates with birth asphyxia [17]. Hypocalcemia can lead to complications such as neonatal seizures, poor feeding, lethargy, and, in severe cases, neurological deficits. Routine screening and early intervention with calcium supplementation are crucial to prevent adverse outcomes [18]. The study has limitations. Its cross-sectional design limits the ability to establish causality, and being a single-center study may reduce the generalizability of the findings. Factors such as maternal calcium status, perinatal complications, and other biochemical markers were not analyzed but could influence hypocalcemia development.

## CONCLUSION

It is concluded that hypocalcemia is a prevalent condition in term neonates with moderate to severe birth asphyxia, with a significant association between low birth weight and increased risk of hypocalcemia. Gender, mode of delivery, and APGAR scores did not show significant associations with the prevalence of hypocalcemia in this study. Early screening and monitoring of serum calcium levels, particularly in neonates with low birth weight, are essential for preventing complications associated with hypocalcemia, such as neonatal seizures and poor feeding.

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