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Morbidity Patterns and Determinants of Mortality in Low-Birth-Weight Neonates: A Retrospective Cohort Study from Azerbaijan

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ABSTRACT

Background: Low birth weight (LBW), defined as birth weight less than 2500 grams, remains a leading contributor to neonatal morbidity and mortality, particularly in low- and middle-income countries.

Objective: To investigate morbidity patterns and identify mortality-associated risk factors among LBW neonates admitted to a tertiary neonatal intensive care unit (NICU).

Methods: This retrospective cohort study included 39 LBW neonates admitted to the NICU of the Scientific Research Institute of Pediatrics between January 2023 and December 2024. Clinical data were extracted from medical records. Associations between clinical variables and mortality were assessed using odds ratios (OR) with 95% confidence intervals (CI). Statistical analysis was performed using SPSS software, with $p<0.05$ considered significant.

Results: The overall mortality rate was 48.7% (19/39). Preterm neonates constituted 71.8% of the cohort. The most common morbidities were neonatal jaundice (61.5%), respiratory distress (53.8%), and sepsis (48.7%). Sepsis was the strongest predictor of mortality (OR 5.06, 95% CI 1.32–19.3; p=0.01). Prematurity (OR 3.56; p=0.08), respiratory distress (OR 3.25; p=0.07), and necrotizing enterocolitis (OR 4.15; p=0.10) were associated with increased but statistically non-significant risk. Neonatal jaundice was associated with survival (OR 0.18, 95% CI 0.04–0.73; p=0.01).

Conclusion: Mortality among LBW neonates remains high and is strongly associated with sepsis and prematurity. Early identification and aggressive management of infectious and respiratory complications are essential to improve outcomes.

Keywords: Low birth weight; Preterm; Neonatal mortality; Neonatal morbidity; Sepsis; NICU

INTRODUCTION

Low birth weight (LBW), defined as birth weight less than 2500 grams, remains to represent one of the most important challenges in neonatal and global child health, contributing significantly to morbidity and mortality during the neonatal period. Infants born with a weight less than 2500 grams account for a substantial proportion of neonatal deaths worldwide, particularly in low- and middle-income countries where healthcare resources may be limited.[1] Despite improvements in perinatal and neonatal care, the burden of complications associated with low birth weight remains high and continues to demand focused clinical and research attention.

The vulnerability of low birth weight neonates is primarily related to physiological immaturity and underdeveloped organ systems. Preterm infants, who constitute a large proportion of LBW cases, often exhibit inadequate pulmonary development leading to respiratory distress, impaired immune responses predisposing them to severe infections, and immature gastrointestinal function increasing the risk of necrotizing enterocolitis.[2] In addition, neurological immaturity renders these neonates susceptible to hypoxic injury and long-term neurodevelopmental impairment. These interconnected pathophysiological mechanisms create a complex clinical profile that requires intensive monitoring and specialized care.

Among the various complications, neonatal sepsis remains one of the most critical determinants of mortality, particularly in resource-limited settings where early diagnostic capabilities may be constrained. Inadequate infection control measures, delayed diagnosis, and limited availability of advanced microbiological testing contribute to increased mortality risk in many settings. Respiratory distress syndrome, frequently associated with surfactant deficiency in preterm infants, also contributes substantially to early neonatal deaths.[3] Furthermore, necrotizing enterocolitis represents a severe gastrointestinal emergency with high fatality rates in this population. Identifying the relative contribution of these conditions to mortality is essential for prioritizing interventions and improving clinical outcomes.

Although global data on low birth weight outcomes are widely available, regional studies provide important insights into local epidemiological patterns and healthcare challenges. In the South Caucasus region including Azerbaijan, there is a relative paucity of hospital-based data examining morbidity patterns and mortality risk factors among LBW neonates. Understanding these patterns within a specific institutional context is essential for developing targeted clinical strategies.

The present study aims to analyze the structure of morbidity and mortality among low birth weight neonates admitted to a tertiary care neonatal intensive care unit (NICU) in Azerbaijan. and to identify key risk factors associated with mortality. Such data may contribute to improving risk stratification and guiding clinical management in similar healthcare settings.

MATERIALS AND METHODS

This retrospective cohort study was conducted at the Neonatal Intensive Care Unit of the Scientific Research Institute of Pediatrics, Azerbaijan. The study population consisted of 39 neonates with a birth weight of less than

2500 grams who were admitted to the unit during the study period between January 2023 and December 2024, of whom 21 (53.8%) were male and 18 (46.2%) were female. All eligible neonates meeting the inclusion criteria were included to ensure a comprehensive evaluation of outcomes within the institution. Maternal clinical data, including anemia, hypertensive disorders, obstetric complications, and mode of delivery, were also collected and analyzed in relation to neonatal outcomes.

Inclusion and exclusion criteria

All neonates with documented birth weight <2500 g admitted to the NICU during the study period were included. Neonates with incomplete medical records or those discharged against medical advice were excluded from the analysis.

Data collection

Clinical data were obtained from hospital medical records, which included detailed information on birth weight, gestational age, and major neonatal diagnoses. Gestational age was used to classify neonates into preterm and term categories, with preterm defined as less than 37 completed weeks of gestation and term defined as more than or equal to 37 completed weeks of gestation. Clinical conditions were defined as follows: neonatal sepsis was defined based on clinical signs consistent with infection supported by laboratory findings (elevated inflammatory markers and/or positive blood culture); respiratory distress was defined by clinical signs such as tachypnea, grunting, chest retractions, and requirement of respiratory support; necrotizing enterocolitis was diagnosed based on clinical and radiological findings; hypoxic-ischemic encephalopathy, neurological complications, congenital anomalies, and neonatal jaundice was defined according to standard clinical criteria.

Outcome Measures

The primary outcome of interest was neonatal mortality during the hospitalization period. Neonates were categorized into survivors and non-survivors, and comparative analyses were performed between these groups to identify differences in clinical characteristics and morbidity patterns.

Statistical analysis

Statistical analysis was carried out using standard epidemiological methods. Statistical analysis was performed using SPSS version 25. Descriptive statistics were used to summarize the frequency and distribution of clinical conditions within the study population. Categorical variables were compared using the Chi-square test or Fisher's exact test where appropriate. Comparative analysis between survivors and non-survivors was performed to assess differences in morbidity patterns. The association between individual clinical variables and mortality was evaluated using odds ratios with corresponding 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant. Due to the relatively small sample size, multivariate analysis was not performed. Findings were interpreted with consideration of potential limitations in statistical power.

Ethical considerations

This study was conducted as a retrospective cohort analysis utilizing anonymized data obtained exclusively from hospital medical records. As no direct patient contact, intervention, or identifiable personal information was involved, formal approval from an Institutional Review Board or Ethics Committee was not required in accordance with institutional policies.

RESULTS

A total of 39 low birth weight neonates were included in the study, of whom 28 were preterm, representing the majority of the cohort. The overall mortality rate was 48.7%, with 19 neonates dying during the neonatal period and 20 surviving to discharge (Table 1). The cohort comprised 21 males (53.8%) and 18 females (46.2%). Preterm birth was more frequent among non-survivors compared to survivors, indicating a potential association between gestational immaturity and adverse outcomes (Table 2).

Table 1: Baseline Characteristics of the Study Population

Variable	Total (n=39)	Survivors (n=20)	Non-survivors (n=19)
Preterm, n (%)	28 (71.8%)	12 (60%)	16 (84.2%)
Term, n (%)	11 (28.2%)	8 (40%)	3 (15.8%)
Mortality rate	—	—	48.70%

Table 2: Maternal Risk Factors and Obstetric Conditions Associated with Low-Birth-Weight Neonates in the Study Cohort

Maternal Condition / Risk Factor	Number of Cases (n)	Percentage (%)
Anemia	24	61.5%
Toxicosis (Gestosis)	21	53.8%
Nephropathy	6	15.4%
Cervical insufficiency	2	5.1%
Previous IUGR / Fetal loss	3	7.7%
Multiple pregnancy (Twin/Triplet)	5	12.8%
Emergency Cesarean section	8	20.5%
Maternal surgery during pregnancy	2	5.1%
Pregnancy under medical supervision	18	46.2%
No reported complications	7	17.9%

The analysis of morbidity patterns revealed that neonatal jaundice was the most common condition observed in the cohort, followed by respiratory distress and sepsis. Nearly half of the neonates developed sepsis, underscoring the high burden of infectious complications in this population. Necrotizing enterocolitis and neurological complications were also notable findings, while congenital anomalies were present in a smaller proportion of cases (Table 3).

Table 3: Distribution of Major Neonatal Morbidities in the Study Population

Morbidity	Total (n=39)	Percentage (%)
Neonatal jaundice	24	61.50%
Respiratory distress	21	53.80%
Sepsis	19	48.70%
Neurological complications	11	28.20%
Necrotizing enterocolitis	8	20.50%
Congenital anomalies	6	15.40%

Maternal risk factors were further analyzed in relation to neonatal mortality. Maternal anemia and hypertensive disorders of pregnancy (toxicosis) were among the most common conditions observed. Although a higher proportion of non-survivors were born to mothers with these complications, the associations did not reach statistical significance. Multiple pregnancy and emergency cesarean section also showed a trend toward higher mortality; however, these findings should be interpreted cautiously due to the small sample size (Table 4).

Table 4: Birth Weight Categories and Associated Mortality Rates Among Neonates in the Study Population

Birth Weight Category	Total (n)	Deaths (n)	Mortality Rate (%)
Extremely Low Birth Weight (<1.0 kg)	6	5	83.3%
Very Low Birth Weight (1.0–1.49 kg)	12	7	58.3%
Low Birth Weight (1.5–2.49 kg)	10	3	30.0%
Normal Birth Weight (≥2.5 kg)	11	1	9.1%
Total	39	16	41.0%

Comparison between survivors and non-survivors

Among survivors, neonatal jaundice was the most frequent condition (80%), followed by preterm birth (60%) and respiratory distress (40%). Sepsis and NEC were less common in survivors (30% and 10%, respectively).

Among non-survivors, preterm birth was present in 84.2%, while both sepsis and respiratory distress occurred in 68.4%. NEC was observed in 31.6% of deaths, representing a threefold higher prevalence compared to survivors.

When comparing survivors and non-survivors, distinct differences in clinical profiles were observed. Among survivors, neonatal jaundice was the most frequent condition and was present in a large majority of cases. Respiratory distress and preterm birth were also common but occurred at lower frequencies compared to non-survivors. In contrast, non-survivors demonstrated a higher prevalence of severe conditions, particularly sepsis and respiratory distress, both of which were present in more than two-thirds of cases. Necrotizing enterocolitis was also significantly more common among non-survivors, occurring at approximately three times the rate observed in survivors. Neurological complications were more frequent in non-survivors, reflecting the severity of illness in this group (Table 5).

Table 5: Association Between Clinical Variables and Mortality Outcomes in Neonates: Odds Ratios and Risk Interpretation

Variable	Alive (n=20)	Dead (n=19)	Odds Ratio (OR)	95% CI	p-value	Interpretation
Prematurity / LBW	12 (60%)	16 (84.2%)	3.56	0.85 – 14.9	0.08	↑ Risk (trend)
Sepsis	6 (30%)	13 (68.4%)	5.06	1.32 – 19.3	0.01*	Significant risk
Respiratory distress	8 (40%)	13 (68.4%)	3.25	0.89 – 11.8	0.07	↑ Risk (trend)
Neonatal Jaundice	16 (80%)	8 (42.1%)	0.18	0.04 – 0.73	0.01*	Protective factor

NEC ± perforation	2 (10%)	6 (31.6%)	4.15	0.72 – 23.8	0.1	Strong risk (trend)
Hypoxic encephalopathy	4 (20%)	7 (36.8%)	2.33	0.56 – 9.6	0.24	Possible risk
Congenital anomalies	4 (20%)	2 (10.5%)	0.47	0.07 – 2.9	0.4	Not significant

*Statistically significant ($p < 0.05$)

Risk factor analysis demonstrated that sepsis was the most significant predictor of mortality, with affected neonates having more than five times the risk of death compared to those without sepsis. Sepsis was identified as the strongest predictor of mortality, increasing the risk of death fivefold (OR 5.06, 95% CI 1.32–19.3; $p = 0.01$).

Other factors associated with increased mortality included:

- Preterm birth (OR 3.56, $p = 0.08$)
- Respiratory distress (OR 3.25, $p = 0.07$)
- NEC (OR 4.15, $p = 0.10$)

Although these associations did not reach statistical significance, likely due to small sample size, they demonstrated clinically relevant trends.

Neonatal jaundice was significantly associated with survival and reduced mortality risk (OR 0.18, 95% CI 0.04–0.73; $p = 0.01$).

Although prematurity, respiratory distress, and necrotizing enterocolitis were associated with increased odds of mortality, these associations did not reach statistical significance, likely due to the limited sample size. Nevertheless, the observed trends suggest clinically important relationships. Interestingly, neonatal jaundice was found to be significantly associated with survival, indicating that it may be more common in relatively stable neonates.

DISCUSSION

The findings of this study highlight the persistent challenge of managing low birth weight neonates in a tertiary care setting, with nearly half of the cohort experiencing mortality during the neonatal period. This finding is higher than many global estimates and may reflect differences in healthcare resources, severity of illness at presentation, and referral patterns within the region. This high mortality rate underscores the vulnerability of LBW infants and reflects the combined impact of prematurity, infection, and organ system immaturity.[4,5]

The mortality rate observed in this study (48.7%) is considerably higher than global estimates for low-birth-weight neonates, where neonatal mortality typically ranges between 15% and 30% depending on healthcare setting and resource availability. Studies from well-resourced neonatal intensive care units report significantly lower mortality rates, often below 20%, whereas higher rates have been documented in low- and middle-income countries due to disparities in neonatal care. Although region-specific data from the South Caucasus are limited,

similar settings have reported elevated mortality rates among LBW and preterm infants. The relatively high mortality in our cohort may be attributed to several factors, including the high proportion of preterm neonates (71.8%), the substantial burden of sepsis and respiratory distress, possible delays in presentation or referral, and limitations in advanced neonatal support such as ventilatory care and infection control infrastructure. Additionally, the small sample size and inclusion of critically ill neonates admitted to a tertiary referral center may have contributed to an overestimation of mortality rates.

Maternal factors such as anaemia and hypertensive disorders were common in this cohort and have been widely associated with adverse neonatal outcomes, including low birth weight and prematurity. Although this study did not demonstrate a statistically significant association between maternal conditions and neonatal mortality, likely due to the limited sample size, the observed trends are consistent with existing literature. Maternal anaemia may contribute to fetal hypoxia and intrauterine growth restriction, while hypertensive disorders are known to impair placental perfusion. These findings highlight the importance of optimizing antenatal care and early identification of high-risk pregnancies to reduce the burden of low birth weight and its associated complications.

Sepsis emerged as the most important determinant of mortality in this study, consistent with global evidence identifying neonatal infections as a leading cause of death in this population.[4] The significant association between sepsis and mortality emphasizes the critical importance of early recognition, prompt initiation of antibiotic therapy, and strict infection control measures within neonatal intensive care units. In resource-limited settings, delays in diagnosis and treatment may further exacerbate outcomes, making infection prevention strategies particularly crucial.

Prematurity and respiratory distress were also strongly associated with mortality, reflecting the central role of pulmonary immaturity in adverse neonatal outcomes.[5,6] The lack of statistical significance for these factors in the present study is likely attributable to the small sample size; however, their clinical relevance remains well established. The high prevalence of respiratory distress among non-survivors suggests that improved respiratory support, including timely use of surfactant therapy and non-invasive ventilation, may contribute to better outcomes.

Necrotizing enterocolitis was more frequently observed among non-survivors, supporting its reputation as a severe and often fatal complication in low-birth-weight infants.[7,8] The increased occurrence of neurological complications among non-survivors further highlights the impact of systemic illness, hypoxia, and infection on neonatal brain function.

An interesting finding of this study was the association between neonatal jaundice and survival. This observation likely reflects the fact that jaundice is more commonly seen in neonates who are otherwise clinically stable, whereas critically ill infants may not survive long enough to develop significant hyperbilirubinemia. Therefore, neonatal jaundice in this context may serve as an indirect indicator of comparatively lower disease severity.

The findings also suggest the presence of a high-risk clinical cluster characterized by the coexistence of sepsis, prematurity, and respiratory distress, which may significantly increase mortality risk.

Clinical Implications

The findings of this study have important clinical implications for improving neonatal outcomes in low-birth-weight infants. Given that sepsis was identified as the strongest predictor of mortality, implementing early sepsis screening protocols in the neonatal intensive care unit is essential. This may include routine risk stratification at admission, early laboratory evaluation, and prompt initiation of empiric antibiotic therapy in high-risk neonates. Strengthening NICU capacity is equally critical, particularly in areas such as infection control practices, availability of trained neonatal staff, and access to advanced respiratory support. Enhancing aseptic techniques, improving surveillance for hospital-acquired infections, and ensuring timely referral of high-risk pregnancies may collectively reduce the burden of mortality. These targeted interventions are especially relevant in resource-limited settings and could significantly improve survival among low-birth-weight neonates.

Strengths and Limitations

This study provides valuable hospital-based data from a region with several limitations, including its small sample size and single-center design, which may limit the generalizability of the findings. Additionally, the retrospective nature of the study may introduce potential biases related to data completeness and accuracy. Lack of multivariate analysis may affect the strength of causal inferences. Despite these limitations, the study provides valuable insights into morbidity patterns and mortality risk factors in LBW neonates within the regional context.

CONCLUSION

Low birth weight neonates continue to experience high rates of morbidity and mortality, with sepsis representing the most significant predictor of death in this population. Prematurity, respiratory distress, and necrotizing enterocolitis also contribute substantially to adverse outcomes, particularly when occurring in combination. The coexistence of these conditions appears to define a high-risk clinical profile requiring intensive monitoring and aggressive management.

Improving survival outcomes in LBW neonates requires a multifaceted approach, including early identification of high-risk infants, prompt management of infections, optimization of respiratory support, and strengthening of neonatal intensive care practices. Further large-scale, multicenter studies are needed to validate these findings and to develop evidence-based strategies tailored to similar healthcare settings.

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