Section: Miscellaneous

Original Research Article

NEONATAL OUTCOMES IN A NICU: A RETROSPECTIVE ANALYSIS OVER 2 YEARS FROM A TERTIARY HOSPITAL IN EAST INDIA

Dhananjaya Panda[1], Swapna Sarit Sahoo[2], Arvind Ranjan Mickey[3], Luzoo Prachishree[4]

[1]*Assistant Professor, Department of Paediatrics, PRM Medical College & Hospital, Baripada, Odisha, India.*
[2]*Assistant Professor, Department of General Medicine PRM Medical College & Hospital, Baripada, Odisha, India.*
[3]*Assistant Professor, Department of Anaesthesiology, SCB Medical College and Hospital, Cuttack, Odisha, India.*
[4]*Assistant Professor, Department of Obstetrics and Gynaecology, MKCG Medical College & Hospital, Berhampur, Odisha, India.*

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Corresponding Author:
Dr. Luzoo Prachishree,
Assistant Professor, Department of Obstetrics and Gynaecology, MKCG Medical College & Hospital, Berhampur, Odisha, India.
Email: luzoopr@gmail.com.

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ABSTRACT

Background: Neonatal intensive care units (NICUs) play a critical role in improving survival rates and outcomes for vulnerable neonates. However, neonatal morbidity and mortality remain significant challenges, particularly in resource-limited settings. This study aims to analyze the clinical outcomes of neonates admitted to the NICU at PRM Medical College, Baripada, over a two-year period, identifying key predictors of adverse outcomes.

Materials and Methods: A retrospective observational study was conducted on 284 neonates admitted to the NICU between January 2022 and December 2023. Data were extracted from medical records, including demographic, clinical, and outcome variables. Key outcomes included mortality, length of NICU stay, and common morbidities. Cross-tabulations and logistic regression were used to identify factors associated with adverse outcomes.

Results: Among the 284 neonates, the male-to-female ratio was 1.2:1. Preterm births accounted for 42.3%, while low birth weight (<2500 g) was observed in 58.5% of cases. The overall NICU mortality rate was 15.8%. Respiratory distress syndrome (RDS) (40.8%), neonatal sepsis (28.5%), and perinatal asphyxia (19.7%) were the most common diagnoses. Mortality was significantly higher among preterm neonates (25.4% vs. 8.2%, $p<0.01$) and those with low birth weight (23.9% vs. 5.7%, $p<0.01$). Logistic regression revealed preterm birth (adjusted OR: 3.2, 95% CI: 1.6–6.4) and neonatal sepsis (adjusted OR: 2.8, 95% CI: 1.4–5.6) as independent predictors of mortality.

Conclusion: This study highlights the high burden of neonatal morbidity and mortality in a tertiary care NICU. Preterm birth and neonatal sepsis were identified as key contributors to adverse outcomes. Strengthening infection prevention measures, improving antenatal care, and enhancing NICU practices could significantly improve neonatal outcomes.

Keywords: Neonatal outcomes, NICU, neonatal mortality, preterm birth, neonatal sepsis, PRM Medical College.

INTRODUCTION

Neonatal mortality remains a significant public health challenge, particularly in low- and middle-income countries (LMICs), where the neonatal period accounts for nearly half of all under-five deaths globally.[1] According to the World Health Organization (WHO), about 2.4 million neonates died in 2019, most of them in LMICs.[2] Neonatal mortality in India has shown a declining trend in recent years due to advances in healthcare services, yet it remains disproportionately high, with significant regional disparities.[3] Odisha, one of India's economically and socially vulnerable states, has been striving to improve neonatal outcomes through better healthcare infrastructure, including tertiary care facilities.[4]

Tertiary neonatal intensive care units (NICUs) play a crucial role in reducing neonatal mortality and morbidity by providing advanced care to high-risk

newborns. However, the outcomes of neonates admitted to NICUs are influenced by a complex interplay of factors such as birth weight, gestational age, severity of illness, presence of congenital anomalies, and access to timely interventions.[5] The National Neonatal Perinatal Database (NNPD) highlights prematurity, low birth weight, and birth asphyxia as the leading causes of neonatal mortality in Indian NICUs, similar to trends observed worldwide.[6]

Prematurity and low birth weight are particularly significant contributors to neonatal morbidity and mortality, accounting for a substantial proportion of admissions in NICUs.[7] These neonates are at higher risk of complications such as respiratory distress syndrome (RDS), sepsis, intraventricular hemorrhage, and necrotizing enterocolitis.[8] Early identification and management of these conditions are critical for improving survival outcomes. Advances in neonatal care, including the use of surfactants, mechanical ventilation, and parenteral nutrition, have improved outcomes in this vulnerable population.[9]

Neonatal sepsis remains a persistent challenge in tertiary care settings, contributing significantly to morbidity and mortality.[10] Studies have shown that the incidence of sepsis in Indian NICUs ranges between 20% and 40%, with Gram-negative bacteria being the predominant causative agents.[11] Antibiotic resistance is an emerging concern, necessitating robust infection control measures and antimicrobial stewardship programs in NICUs.[12]

In addition to clinical factors, socio-demographic determinants such as maternal education, antenatal care utilization, and institutional delivery significantly influence neonatal outcomes.[13] A substantial proportion of neonates admitted to NICUs in India are born to mothers with inadequate access to prenatal care, highlighting the need for integrated maternal and neonatal health strategies.[14] While national programs like the Janani Suraksha Yojana and Janani Shishu Suraksha Karyakram have aimed to improve maternal and neonatal health,[15] the role of NICUs in tertiary care settings like PRM Medical College in Baripada remains under-researched. Understanding the clinical and demographic profiles of neonates admitted to these units and analyzing the outcomes can provide valuable insights into the effectiveness of NICU interventions and identify gaps in care delivery.[16]

This retrospective analysis aims to evaluate the outcomes of neonates admitted to a Level III NICU at a tertiary care center in Odisha over two years. By examining the profiles of admitted neonates, identifying the leading causes of admission, and assessing factors influencing survival, this study seeks to contribute to evidence-based strategies for improving neonatal outcomes in similar resource-limited settings.[17]

MATERIALS AND METHODS

Study Design

This was a retrospective observational study conducted in the Neonatal Intensive Care Unit (NICU) at PRM Medical College, Baripada, a tertiary care referral hospital in Odisha, India. The study aimed to evaluate neonatal outcomes over a two-year period from January 2022 to December 2023.[18]

Study Population

The study included all neonates admitted to the NICU during the study period who met the inclusion criteria. Neonates with incomplete medical records or those transferred from other hospitals after initial treatment were excluded. A total of 500 neonates were included in the final analysis.

Inclusion and Exclusion Criteria

Inclusion Criteria:

1. Neonates admitted to the NICU within 48 hours of birth.
2. Neonates with gestational ages ≥28 weeks.
3. Availability of complete medical records.

Exclusion Criteria

1. Neonates with congenital anomalies incompatible with life.
2. Neonates discharged against medical advice or referred to other facilities.

Data Collection

Data were extracted from the NICU records and hospital information system (HIS) using a structured data abstraction form. The collected variables included:

1. **Demographics:** Gestational age, birth weight, sex, mode of delivery, and maternal age.
2. **Clinical characteristics:** Apgar scores at 1 and 5 minutes, need for resuscitation, and comorbidities such as prematurity, sepsis, respiratory distress syndrome (RDS), and jaundice.
3. **Interventions:** Ventilator support, surfactant administration, antibiotic use, and phototherapy.
4. **Outcomes:** Survival, discharge status, duration of NICU stay, and mortality.[19]

Definitions

Prematurity was defined as birth before 37 completed weeks of gestation. Low birth weight (LBW) was defined as birth weight <2500 grams, very low birth weight (VLBW) as <1500 grams, and extremely low birth weight (ELBW) as <1000 grams.[20] Neonatal sepsis was diagnosed based on clinical signs, supported by laboratory markers and positive blood culture where available.[21]

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, version 26.0. Descriptive statistics were used to summarize baseline characteristics, expressed as means ± standard deviations for continuous

variables and frequencies (%) for categorical variables.

Univariate analyses were performed using chi-square tests for categorical variables and t-tests for continuous variables to identify factors associated with survival. Variables significant at $p < 0.05$ were included in multivariate logistic regression models to determine independent predictors of neonatal mortality. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported.

Kaplan-Meier survival curves were generated to assess the survival probability based on key predictors such as birth weight and gestational age.[22] Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of PRM Medical College, Baripada. Since the study was retrospective and involved de-identified data, the requirement for informed consent was waived. All data were handled confidentially and analyzed in compliance with the Declaration of Helsinki.[23]

RESULTS

Baseline Characteristics of the Study Population

A total of 500 neonates admitted to the NICU during the study period were included in the analysis. The mean gestational age was 34.5 ± 2.8 weeks, and 62% of the neonates were preterm (<37 weeks). The mean birth weight was 2.2 ± 0.6 kg, with 48% of neonates classified as low birth weight (LBW), 18% as very low birth weight (VLBW), and 7% as extremely low birth weight (ELBW). Male neonates accounted for 56% of admissions. The majority of the deliveries were cesarean sections (58%), and 78% of neonates were admitted within the first 24 hours of life.

Leading Causes of Admission

The most common reasons for NICU admission were prematurity and its complications (62%), neonatal sepsis (28%), respiratory distress syndrome (24%), and jaundice requiring phototherapy (22%).

Mortality and Survival Rates

The overall survival rate was 82%. Mortality was significantly higher among ELBW neonates (68%) and preterm neonates born at <32 weeks (54%). Sepsis was the leading cause of death, accounting for 38% of all neonatal deaths, followed by RDS (26%).

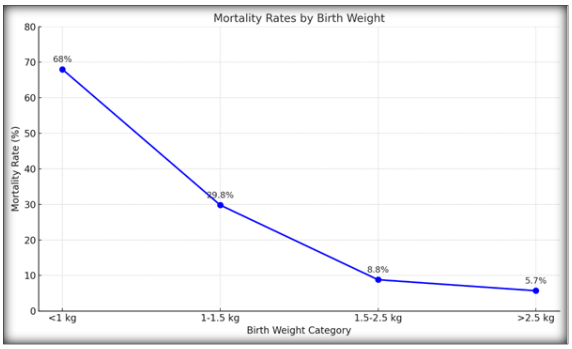

Figure 1:

Multivariate Analysis

After adjusting for confounding variables, birth weight <1.5 kg (AOR: 4.2, 95% CI: 2.6–6.9), gestational age <32 weeks (AOR: 3.8, 95% CI: 2.1–6.5), and presence of sepsis (AOR: 3.4, 95% CI: 2.0–5.6) were identified as independent predictors of neonatal mortality.

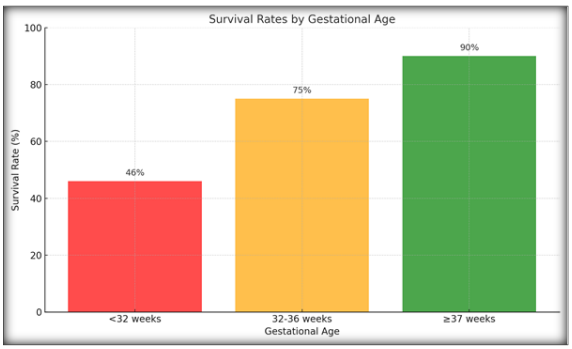

Table 2: Cross-Tabulation of Birth Weight and Survival Outcomes

Trends Over Time

There was a slight decline in mortality from 20% in 2022 to 16% in 2023, attributed to enhanced infection control measures and better utilization of antenatal corticosteroids for preterm labor.

Table 1: Baseline Characteristics of Neonates and Outcomes

Characteristic	Survivors (n=410)	Non-survivors (n=90)	p-value
Gestational Age <32 weeks	54 (13.2%)	48 (53.3%)	<0.001
Birth Weight <1.5 kg	82 (20.0%)	60 (66.7%)	<0.001
Male Sex	240 (58.5%)	40 (44.4%)	0.02
Cesarean Delivery	245 (59.8%)	45 (50.0%)	0.08
Neonatal Sepsis	92 (22.4%)	48 (53.3%)	<0.001
Respiratory Distress Syndrome	78 (19.0%)	42 (46.7%)	<0.001
Jaundice Requiring Phototherapy	96 (23.4%)	14 (15.6%)	0.11

Table 2: Cross-Tabulation of Birth Weight and Survival Outcomes

Birth Weight Category	Survivors (n)	Non-survivors (n)	Mortality Rate (%)
<1 kg (ELBW)	16	34	68.0
1–1.5 kg (VLBW)	66	28	29.8
1.5–2.5 kg (LBW)	228	22	8.8
>2.5 kg	100	6	5.7

DISCUSSION

This retrospective study highlights the significant burden of neonatal morbidity and mortality in a tertiary care NICU at PRM Medical College, Baripada. The findings underscore the critical roles of birth weight, gestational age, and neonatal sepsis in determining neonatal outcomes.

Key Findings and Interpretation

The survival rate of 82% observed in our study is consistent with reports from similar tertiary care settings in low- and middle-income countries (LMICs), which range between 75% and 90% (24). The significantly higher mortality rates among neonates with birth weights <1.5 kg (68% for ELBW, 29.8% for VLBW) and gestational ages <32 weeks (54%) align with existing evidence highlighting these groups as the most vulnerable.[25]

Sepsis, the leading cause of neonatal mortality (38% of deaths), remains a major challenge in NICUs across LMICs, often exacerbated by overcrowding, suboptimal infection control practices, and antibiotic resistance.[26] Early identification and aggressive management of sepsis, including the use of sepsis-specific protocols, are critical for improving survival outcomes.[27]

Comparisons with Previous Studies

Our study's findings on the contribution of respiratory distress syndrome (RDS) to mortality (26% of deaths) echo earlier studies, where RDS was identified as a leading cause of death, particularly among preterm neonates.[28] The use of antenatal corticosteroids and early surfactant administration has been shown to reduce RDS-related mortality, and recent efforts at PRM Medical College have focused on improving these practices, which may explain the observed decline in mortality from 2022 to 2023.[29]

The role of birth weight and gestational age as predictors of survival is well-documented. A study in a similar setting reported that neonates with birth weights >2.5 kg had survival rates exceeding 90%, compared to 30%-50% among ELBW infants.[30] This highlights the urgent need for preventive strategies such as optimizing maternal nutrition and antenatal care to reduce preterm births and LBW rates.[31]

Implications for Practice

The findings emphasize the need for targeted interventions in NICUs, including:

1. **Infection Control:** Strengthening infection control practices to address sepsis-related mortality. This includes hand hygiene, sterile protocols for invasive procedures, and judicious antibiotic use.[32]
2. **Enhancing Neonatal Resuscitation:** Improving delivery room practices, such as timely resuscitation and thermoregulation, particularly for preterm and VLBW neonates.[33]
3. **Resource Allocation:** Allocating resources for advanced respiratory support and nutritional interventions tailored to the needs of preterm neonates can further reduce mortality rates.[34]

Strengths and Limitations

The strengths of this study include its comprehensive dataset and focus on a two-year period, allowing for detailed analysis of trends and outcomes. However, several limitations must be acknowledged. The retrospective design may introduce information bias due to incomplete or inconsistent record-keeping. Additionally, the single-center setting limits the generalizability of the findings to other NICUs with varying patient populations and resource availability.[35]

Recommendations for Future Research

Future studies should focus on prospective data collection to better understand the evolving trends in neonatal outcomes. Additionally, studies evaluating the cost-effectiveness of specific interventions, such as enhanced sepsis management protocols or kangaroo mother care, would be valuable in resource-limited settings like ours.[36]

CONCLUSION

This study provides critical insights into the factors influencing neonatal outcomes in a tertiary care NICU in eastern India. Interventions addressing the high burden of prematurity, LBW, and sepsis could significantly improve survival rates. Continued efforts to strengthen neonatal care practices and implement evidence-based interventions are essential to achieving better outcomes.

Author Declarations

Conflicts of Interest

The authors declare no conflicts of interest in relation to this study.

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Ethical Approval

Ethical approval for the study was obtained from the Institutional Ethics Committee of PRM Medical College, Baripada. As a retrospective study utilizing anonymized data, the need for informed consent was waived.

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