DOI: 10.7860/IJNMR/2026/79966.2476

Original Article

Paediatrics Section

Clinical Profile and Outcome of Neonates Admitted to the Neonatal Intensive Care Unit: A Prospective Observational Study from a Tertiary Care Hospital, Raipur, Chhattisgarh, India

ANAND BHATTAR[1], ASHOK BHATTAR[2], ARUN RATHOD[3], RAJESH KUMAR SHUKLA[4], KETAN KUMAR KHOT[5], ABHINAV TIWARI[6]

ABSTRACT

Introduction: Neonatal morbidity and mortality are major public health challenges in India, particularly in resource-limited regions. Understanding the clinical profile and outcomes of neonates admitted to tertiary-care Neonatal Intensive Care Unit (NICU) is essential for improving neonatal survival and guiding region-specific health strategies.

Aim: To evaluate the clinical profile, morbidity pattern, management practices, and outcomes of neonates admitted to a tertiary-care NICU in central India and to assess factors associated with mortality.

Materials and Methods: This prospective observational study was conducted from October 2018 to March 2019 in the NICU of a tertiary-care hospital in Raipur, Chhattisgarh, India. Both inborn and outborn neonates with gestational age ≥28 weeks and birth weight ≥800 g admitted during the study period were included. Of 953 admitted neonates, 939 fulfilled the inclusion criteria. Data regarding demographic characteristics, clinical diagnoses, interventions, and outcomes were collected using a structured proforma. Continuous variables were expressed as mean±standard deviation, and categorical variables as n (%). Associations with mortality were analysed using Chi-square test or Fisher's exact test, wherever appropriate. A p-value <0.05 was considered statistically significant.

Results: Among 939 neonates, 606 (64.5%) were male and 494 (52.6%) were admitted within 48 hours of life. Preterm neonates constituted 318 (33.9%), and 436 (46.4%) had low birth weight (<2.5 kg). The most common morbidities were hyperbilirubinaemia 518 (55.2%), neonatal sepsis 372 (39.6%), Respiratory Distress Syndrome (RDS) 179 (19.1%), and birth asphyxia 183 (19.5%). The overall mortality was 15 (1.6%). Neonatal sepsis accounted for 8/15 (53.3%) deaths, followed by birth asphyxia 4/15 (26.7%). No statistically significant association with mortality was observed for the studied demographic and perinatal variables on bivariate analysis.

Conclusion: Hyperbilirubinaemia and neonatal sepsis were the most frequent causes of NICU admission, while infections and birth asphyxia were the leading causes of mortality. Strengthening antenatal care, infection control practices, early referral systems, and parental counseling may further improve neonatal outcomes in tertiary-care settings.

Keywords: Birth weight, Hyperbilirubinaemia, Mortality, Neonatal sepsis, Newborn, Prematurity

INTRODUCTION

Neonatal mortality remains a major global public health concern and accounts for nearly half of all deaths among children under five years of age worldwide. Despite substantial advances in maternal and child healthcare, an estimated 2.3 million neonatal deaths occur annually, with the highest burden in low- and middle-income countries. South Asia, including India, contributes significantly to this burden due to socio-economic disparities, limited healthcare access, and variations in quality of neonatal care services [1,2].

India has achieved considerable progress in reducing infant and under-five mortality over the past two decades; however, the decline in neonatal mortality has been relatively slower [3]. According to recent national reports, prematurity, neonatal sepsis, RDS, and birth asphyxia remain the leading causes of neonatal morbidity and mortality in the country [4]. Low birth weight and infections further increase vulnerability, particularly in resource-limited settings where antenatal care, institutional delivery services, and neonatal intensive care facilities may be suboptimal [5,6].

Tertiary care NICUs play a crucial role in improving neonatal survival by providing advanced respiratory support, infection management, thermal care, and nutritional support for critically-ill neonates. Several hospital-based studies from different regions of India have documented varying patterns of neonatal morbidity and mortality, reflecting regional differences in healthcare infrastructure, referral patterns, socio-economic factors, and infection control practices [7-9]. Understanding these regional variations is essential for developing targeted strategies to improve neonatal outcomes.

Data from central India, particularly Chhattisgarh, remain limited despite a substantial burden of neonatal admissions, especially referrals from rural and semiurban areas. Most existing studies primarily focus on mortality patterns or selected neonatal conditions, with relatively less emphasis on comprehensive clinical profiles, management practices, and outcomes such as discharge status or Leaving Against Medical Advice (LAMA) [7,10]. Such information is important for identifying gaps in neonatal healthcare delivery and optimising NICU resource utilisation.

Although the present dataset was collected during 2018-2019, region-specific NICU data from central India remain scarce. These findings therefore will provide valuable baseline information that may

help in benchmarking current neonatal trends, guiding healthcare planning, and identifying areas requiring intervention. Continuous evaluation of NICU admissions and outcomes is essential for improving neonatal survival and achieving national and global child health targets.

Therefore, the present study was undertaken to evaluate the clinical profile, morbidity patterns, management practices, and outcomes of neonates admitted to a tertiary care NICU in central India.

MATERIALS AND METHODS

This prospective observational study was conducted over a six-month period from October 2018 to March 2019 in the NICU of Balgopal Children Hospital, Raipur, Chhattisgarh, India. The NICU is a 50-bedded tertiary care referral centre catering predominantly to neonates referred from rural and semiurban areas of central India. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of Balgopal Children Hospital, Raipur (IEC Approval No: 1491/2018). Written informed consent was obtained from parents or legal guardians prior to enrolment. Confidentiality of patient information was strictly maintained throughout the study.

Inclusion criteria: Neonates with a gestational age of ≥28 weeks and birth weight ≥800 grams were included in the study.

Exclusion criteria: Neonates with gestational age <28 weeks, birth weight <800 grams, or incomplete medical records were excluded from the study.

Sample size: The study population included all neonates aged 0-28 days admitted to the NICU during the study period. Of the 953 neonates admitted during the study period, 939 neonates fulfilled the inclusion criteria and were enrolled.

Data collection: Data were collected using a predesigned, semistructured proforma that included demographic details, gestational age, birth weight, mode and place of delivery, indications for admission, clinical diagnosis, management, and outcomes. Primary outcome was in-hospital mortality. Secondary outcomes included discharge status, referral, and LAMA. For outcome association analysis, only neonates with complete data for the relevant variables were included; therefore, denominators differed across analytical tables.

Definitions and diagnostic criteria: Gestational age was determined based on last menstrual period, antenatal ultrasonography findings, or New Ballard scoring where necessary. Low birth weight was defined as birth weight <2.5 kg in accordance with World Health Organisation (WHO) criteria [6]. Neonatal sepsis was diagnosed based on clinical features (poor feeding, lethargy, temperature instability, respiratory distress) supported by laboratory investigations including complete blood count, C-Reactive Protein, blood culture, and, where indicated, cerebrospinal fluid analysis. Diagnosis was made in accordance with standard neonatal sepsis guidelines [8,11]. Birth asphyxia was defined as failure to initiate or sustain breathing at birth and was staged using the Sarnat and Sarnat classification for Hypoxic-Ischemic Encephalopathy (HIE) [12]. RDS was diagnosed based on clinical signs such as tachypnoea, chest retractions, grunting, and characteristic radiological findings. Hyperbilirubinaemia was diagnosed based on serum bilirubin levels plotted against postnatal age using standard treatment guidelines for initiation of phototherapy or exchange transfusion [5].

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 16.0. Continuous variables were summarised as mean±standard deviation. Categorical variables were expressed as frequency and percentage. Associations between selected demographic and perinatal variables and mortality were assessed using Chi-square test or Fisher's exact test, wherever appropriate. Odds Ratios (OR) with 95% Confidence Intervals (CI) were calculated. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 939 neonates were included in the study, of whom 606 (64.5%) were male and 333 (35.5%) were female, resulting in a male-to-female ratio of 1.8:1. The majority of neonates, 494 (52.6%), were admitted within the first 48 hours of life. Admissions between 2-7 days accounted for 307 (32.7%), while 138 (14.7%) neonates were admitted after seven days of life. Preterm neonates constituted 318 (33.9%) of admissions, while 436 (46.4%) had a birth weight below 2.5 kg [Table/Fig-1].

Characteristic	n (%)
Gender	
Male	606 (64.5)
Female	333 (35.5)
Age at admission	
0-48 hours	494 (52.6)
2-7 days	307 (32.7)
>7 days	138 (14.7)
Gestational age	
Preterm (<37 weeks)	318 (33.9)
Term (≥37 weeks)	621 (66.1)
Birth weight	
<2.5 kg	436 (46.4)
≥2.5 kg	503 (55.6)
Place of delivery	
Hospital	814 (86.7)
Home	16 (1.7)
Not documented/Referral	109 (11.6)
Mode of delivery	
Vaginal	383 (40.8)
LSCS	447 (47.6)
Not documented	109 (11.6)

[Table/Fig-1]: Demographic and perinatal characteristics of neonates.

The most common morbidities observed were hyperbilirubinaemia in 518 (55.2%) neonates, neonatal sepsis in 372 (39.6%), respiratory distress syndrome in 179 (19.1%), and birth asphyxia in 183 (19.5%). Congenital anomalies were identified in 76 (8.1%) neonates. The overall mortality rate was 1.6% (15 neonates). Neonatal sepsis accounted for 8 (53.3%) deaths, followed by birth asphyxia in 4 (26.7%), prematurity with respiratory distress syndrome in 2 (13.3%), and congenital anomalies in 1 (6.7%) neonate [Table/Fig-2].

Antibiotic therapy was administered to 650 (69.2%) neonates, oxygen therapy to 532 (56.6%), and phototherapy to 511 (54.4%) [Table/Fig-3].

Regarding outcomes, 830 (88.4%) neonates were discharged successfully, 88 (9.4%) Left Against Medical Advice (LAMA), 6 (0.6%) were referred to other centers and 15 (1.6%) died [Table/Fig-4].

Condition	Total cases N=939	Deaths N=15
Hyperbilirubinaemia	518 (55.2)	0
Neonatal sepsis	372 (39.6)	8 (53.3)
Birth asphyxia	183 (19.5)	4 (26.7)
Respiratory distress syndrome	179 (19.1)	2 (13.3)
Congenital anomalies	76 (8.1)	1 (6.7)

[Table/Fig-2]: Morbidity pattern with associated mortality.

Intervention	n (%)
Antibiotic therapy	650 (69.2)
Oxygen therapy	532 (56.6)
Phototherapy	511 (54.4)
Mechanical ventilation	185 (19.7)
Parenteral nutrition	151 (16.1)
Blood transfusion	116 (12.3)

[Table/Fig-3]: Interventions provided in NICU.
Multiple interventions were provided to individual neonates

Outcome	n (%)
Discharged	830 (88.4)
Left Against Medical Advice (LAMA)	88 (9.4)
Referred	6 (0.6)
Death	15 (1.6)

[Table/Fig-4]: Outcome of NICU admission.

Bivariate analysis did not demonstrate a statistically significant association between mortality and gender, gestational age, birth weight, mode of delivery, or duration of hospital stay [Table/Fig-5].

318 (33.9%), and low birth weight was observed in 436 (45.7%) neonates, reaffirming the persistent burden of prematurity and foetal growth restriction in India [5,11]. Extremely preterm neonates (<28 weeks gestation) and those with birth weight <800 g were excluded from the study because of their extremely high mortality risk and different management protocols, which could introduce bias in outcome comparison. Similar findings have been reported in NICU-based studies from central and northern India [6,13]. Several NICU-based studies from different regions of India have reported varying patterns of neonatal morbidity and mortality.

The most common morbidity observed was hyperbilirubinaemia (518; 55.2%), followed by neonatal sepsis (372; 39.6%), birth asphyxia (183; 19.5%), and RDS (179; 19.1%). Although neonatal jaundice is generally manageable with phototherapy, its high prevalence reflects improved monitoring and early diagnosis. However, the persistently high burden of neonatal sepsis indicates ongoing infection prevention challenges. Similar high sepsis prevalence has been reported in tertiary NICUs across India [8,13-15]. RDS and birth asphyxia remain major contributors to neonatal morbidity, highlighting the importance of antenatal corticosteroid administration, skilled intrapartum monitoring, and neonatal resuscitation services [4,12].

The overall mortality rate in this study was 15 (1.6%), which was lower than rates reported in several Indian tertiary NICU studies, typically ranging from 5-10% [1,6,15]. This relatively low mortality may reflect improved tertiary care infrastructure, availability of respiratory support, and timely referral. Neonatal sepsis was the leading cause of death (8; 53.3%), followed by birth asphyxia (4; 26.7%) and prematurity-related complications (2; 13.3%). These findings are consistent with national data indicating infections and perinatal complications as leading causes of neonatal mortality [4,12].

Characteristic	Category	Total patients	Mortality N (%)	OR (95% CI)	Chi-square	p-value
Gender	Male	544	8 (1.5)	0.625 (0.221-1.766)	0.812	0.375
	Female	286	7 (2.3)	Reference		
Gestational age	Full term	548	9 (1.6)	1.148 (0.328-4.014)	0.238	0.829
	Preterm	282	6 (2.1)	Reference		
Mode of delivery	LSCS	447	5 (1.1)	Reference	2.49	0.072
	Vaginal	383	10 (2.5)	2.72 (0.914-8.133)		
Birth weight	≥2.5 kg	394	5 (1.3)	Reference	1.18	0.321
	<2.5 kg	436	10 (2.2)	1.90 (0.532-6.850)		
Delivery place	Home	16	0	-	0.295	0.999
	Hospital	814	15 (1.8)	Reference		
Hospital stay	<3 days	299	8 (2.6)	2.26 (0.787-6.509)	1.9	0.129
	≥3 days	531	7 (1.3)	Reference		

[Table/Fig-5]: Bivariate analysis of selected factors associated with mortality among neonates with complete data.
Analysis was restricted to neonates with complete data available for the respective variables; therefore, denominators differed from the total study population (N=939) due to missing data

DISCUSSION

The present prospective observational study evaluated the clinical profile and outcomes of 939 neonates (0-28 days of life) admitted to a tertiary care NICU in central India. The study provides region-specific baseline data from Chhattisgarh, where published NICU-based evidence remains limited. A male predominance (606; 64.5%) was observed, consistent with several Indian NICU-based studies reporting higher admission rates among male neonates [6,13]. This trend may reflect both biological vulnerability and sociocultural healthcare-seeking behaviour. More than half of admissions (494; 52.6%) occurred within the first 48 hours of life, consistent with global evidence that the early neonatal period carries the highest risk of morbidity and mortality [2,14]. Preterm neonates constituted

Although higher mortality proportions were observed among preterm neonates, low birth weight infants, vaginal deliveries, and female neonates, these associations were not statistically significant on bivariate analysis (p-value>0.05). This may be attributed to the relatively small number of mortality events (n=15), limiting statistical power. Neonatal outcomes are influenced by multiple interrelated factors including gestational age, infection severity, birth complications, and access to timely care. Larger multicentric studies may better clarify factors associated with neonatal mortality in this region [7,16].

A notable finding was the proportion of neonates LAMA (88; 9.4%). Similar trends have been reported from resource-limited settings and are often attributed to financial constraints, prolonged hospitalisation,

limited parental awareness, and referral-related stress [9,10]. Addressing these issues requires enhanced parental counselling, financial assistance programs, and improved communication between healthcare providers and caregivers. The findings highlight the continuing burden of preventable neonatal conditions such as sepsis, prematurity, and birth asphyxia. Strengthening antenatal services, infection control practices in NICUs, and early referral systems remain essential to reduce neonatal morbidity and mortality. Systematic infection prevention strategies in NICUs have been shown to significantly reduce neonatal infections and improve outcomes [17].

Although the dataset was collected during 2018-2019, the lack of comprehensive regional NICU data from central India makes these findings valuable as baseline evidence for healthcare planning and benchmarking future trends.

Limitation(s)

The present study had several limitations. It was conducted at a single tertiary care centre, which may limit the generalisability of findings. The dataset was collected during 2018-2019 and therefore may not fully reflect current trends. Long-term neurodevelopmental follow-up of neonates was not performed. The relatively small number of mortality events limited the statistical power to detect significant associations with mortality. Additionally, referral bias may exist because the hospital functions as a tertiary care referral centre. Importantly, 88 neonates (9.4%) LAMA and their final outcomes could not be ascertained. This may have resulted in underestimation of mortality and overestimation of favourable outcomes such as discharge.

CONCLUSION(S)

This study highlighted the burden of neonatal morbidity and mortality in a tertiary care NICU in central India, with hyperbilirubinaemia, neonatal sepsis, and prematurity being the most common conditions. Despite a relatively low mortality rate, infections and birth asphyxia remain leading causes of neonatal death. Strengthening antenatal care, early referral, infection control measures, and parental counselling are essential to further improve neonatal outcomes. Future multicentric studies with larger sample sizes and long-term follow-up are recommended to identify modifiable risk factors and evaluate targeted interventions.

Author contributions: AB: Conceptualisation, study design, supervision, and critical revision of the manuscript. AsB: Data collection and patient enrolment. AR: Statistical analysis and manuscript drafting. RKS: Clinical management, manuscript review, and supervision. KKK: Clinical evaluation, data interpretation, and patient management. AT: Data compilation, literature review, manuscript preparation, and correspondence.

All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

REFERENCES

[1] UNICEF. Levels and trends in child mortality 2018. United Nations Inter-Agency Group for Child Mortality Estimation; 2018.
[2] Lawn JE, Blencowe H, Waiswa P, Amouzou A, Mathers C, Hogan D, et al. Stillbirths: Rates, risk factors, and acceleration towards 2030. Lancet. 2016;387(10018):587-603.
[3] Wahl B, Nama N, Pandey RR, Garg T, Mishra AM, Srivastava S, et al. Neonatal, infant, and child mortality in India: Progress and future directions. Indian Journal of Pediatrics. 2023;90(Suppl 1):01-09.
[4] Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, et al. Global, regional, and national causes of child mortality. Lancet. 2015;385(9966):430-40.
[5] Blencowe H, Krasevec J, de Onis M, Black RE, Stevens GA, An X, et al. National, regional, and worldwide estimates of low birth weight in 2015. Lancet Glob Health. 2019;7(7):e849-e860.
[6] Malik S, Gohiya P, Khan IA. Morbidity profile and mortality of neonates admitted in NICU of a central India teaching institute. J Clin Neonatol. 2016;5(3):168-73.
[7] Meshram RM, Gedam RA, Garg S, Kadu KS, Chakraborty MR, Kumar SB. Predictors of mortality in extramural very low birth weight neonates. Int J Contemp Pediatr. 2021;8(1):107-12.
[8] Verma P, Berwal PK, Nagaraj N, Swami S, Jivaji P, Narayan S. Neonatal sepsis: Epidemiology and antimicrobial susceptibility. Int J Contemp Pediatr. 2015;2(3):176-80.
[9] Rakholia R, Rawat V, Bano M, Singh G. Neonatal morbidity and mortality of sick newborns admitted in a teaching hospital of Uttarakhand. CHRISMED Journal of Health and Research. 2014 Oct 1;1(4):228-34.
[10] Ministry of Health and Family Welfare (India). National Family Health Survey (NFHS-5) 2019-21: India Fact Sheet. Mumbai: International Institute for Population Sciences; 2021. Available from: NFHS-5 India Fact Sheet. https://dhsprogram.com/pubs/pdf/FR375/FR375.pdf
[11] Ministry of Health and Family Welfare (India). India Newborn Action Plan (INAP). New Delhi: MoHFW; 2014. Available from: India Newborn Action Plan. https://nhm.gov.in/images/pdf/programmes/inap-final.pdf
[12] Lee AC, Kozuki N, Blencowe H, Vos T, Bahalim A, Darmstadt GL, et al. Intrapartum-related neonatal encephalopathy incidence and impairment at regional and global levels for 2010 with trends from 1990. Pediatr Res. 2013 Dec;74 Suppl 1(Suppl 1):50-72. Doi: 10.1038/pr.2013.206.
[13] Rohit M, Bhavesh M, PatelJaiminkumar, Punitha KM. Study of the morbidity and the mortality pattern in the neonatal intensive care unit at a tertiary care teaching hospital in Gandhinagar District, Gujarat, India. Journal of Research in Medical and Dental Science. 2015;3(3):208-12.
[14] Sankar MJ, Natarajan CK, Das RR, Agarwal R, Chandrasekaran A, Paul VK. When do newborns die? Timing of neonatal deaths in developing countries. J Perinatol. 2016;36(S1):S1-S11.
[15] Pachakawade ND, Deshmukh RR, Rudrakar AR. Clinical profile and outcome of neonates admitted to neonatal intensive care unit of a tertiary care hospital. J Population Therapeutics and Clinical Pharmacology. 2025;33(1):882-91.
[16] Singh S, Agrawal R, Agarwal G, Das A, Sahu R. Predictors of neonatal mortality: A retrospective cross-sectional study from the special newborn care unit of a tertiary care hospital. Cureus. 2023;15(4):e37143. Doi: 10.7759/cureus.37143
[17] Nyantakyi E, Baenziger J, Dramowski A, Wolfensberger A, Albers B. Investigating the implementation of infection prevention and control practices in neonatal care across country income levels: A systematic review. Antimicrob Resist Infect Control. 2025;14(1):8. Doi: 10.1186/s13756-025-01516-7.

PARTICULARS OF CONTRIBUTORS:
1. Neonatal Intensivist, Department of Neonatology, Balgopal Children Hospital, Raipur, Chhattisgarh, India.
2. Pediatrician, Department of Paediatrics, Balgopal Children Hospital, Raipur, Chhattisgarh, India.
3. Pediatrician, Department of Paediatrics, Balgopal Children Hospital, Raipur, Chhattisgarh, India.
4. Pediatrician, Department of Paediatrics, Balgopal Children Hospital, Raipur, Chhattisgarh, India.
5. Pediatrician, Department of Paediatrics, Balgopal Children Hospital, Raipur, Chhattisgarh, India.
6. PDCC Fellow Neonatology, Department of Neonatology, AIIMS Raipur, Chhattisgarh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Abhinav Tiwari,
Flat No 607, Maruti Homes, Mohaba Bazar, Raipur, Raipur, Chhattisgarh, India.
E-mail: abhinavt21@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 17, 2025
- Manual Googling: Apr 09, 2026
- iThenticate Software: Apr 15, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Apr 16, 2025**
Date of Peer Review: **Jul 21, 2025**
Date of Acceptance: **Apr 16, 2026**
Date of Publishing: **Jun 30, 2026**