

Morbidity Pattern and Immediate Outcome of Preterm Neonates Admitted to the NICU of a Tertiary Care Hospital in Central India: A Prospective Cohort Study

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ABSTRACT

Introduction: Evaluating morbidity patterns and outcomes is crucial, as it provides insight into the specific health challenges faced by preterm neonates. Such data are essential for the careful tailoring of healthcare interventions and the judicious allocation of resources.

Aim: To investigate the morbidity patterns and immediate outcomes of preterm neonates admitted to the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital in central India.

Materials and Methods: The present prospective cohort study was conducted in the NICU of Indira Gandhi Government Medical College and Mayo Hospital, Nagpur, Maharashtra, Central India, from May 2022 to April 2024. A total of 198 inborn preterm neonates admitted during the study period were included. Detailed antenatal histories, maternal risk factors, and natal histories were recorded. Gestational age was assessed using the New Ballard Score, and indications for NICU admission were documented. The collected data were entered

into a Microsoft Excel worksheet, and results were presented as frequencies and percentages.

Results: Of the 198 preterm neonates enrolled, 78 (39.40%) were classified as moderate preterm. The most prevalent maternal risk factor associated with preterm birth was anaemia, affecting 136 mothers (68.69%). The most common clinical presentation at admission was respiratory distress, observed in 176 neonates (88.89%), followed by seizures in 24 (12.12%). The most frequent morbidity was early-onset sepsis, present in 151 neonates (76.26%), followed by neonatal hyperbilirubinaemia in 123 (62.12%). Of the total 198 preterm neonates admitted, 167 (84.34%) survived and were discharged, while 31 died, resulting in a mortality rate of 15.66%.

Conclusion: Early-onset sepsis was the most common morbidity observed among preterm neonates, followed by neonatal hyperbilirubinaemia. Morbidities such as respiratory distress syndrome, intraventricular haemorrhage, and necrotising enterocolitis showed significant associations with higher mortality rates.

Keywords: Anaemia, Gestational diabetes mellitus, Intraventricular haemorrhage, Neonatal intensive care unit, Perinatal asphyxia, Pregnancy induced hypertension, Sepsis

INTRODUCTION

Preterm birth is defined as a live birth occurring before 37 completed weeks (or 259 days) of gestation [1]. Neonatal mortality is becoming increasingly significant not only because its proportion among under-five deaths has risen, but also because the interventions required to address neonatal mortality differ from those needed for older children and are closely linked to maternal health strategies [2].

In developing countries, the major causes of neonatal mortality include sepsis, prematurity, and birth asphyxia, whereas in developed nations, prematurity and congenital malformations predominate [3]. In India, the leading causes of neonatal deaths are preterm birth, neonatal infections, birth asphyxia, and congenital anomalies [4].

Regular evaluation of neonatal outcomes is essential, as they vary across regions and over time. Outcomes of preterm infants provide crucial information to parents, clinicians, and policymakers, supporting clinical decision-making, healthcare planning, resource allocation, and improvements in quality of care [5]. Preterm neonates are at increased risk of morbidities such as neurocognitive and motor impairments, malnutrition, chronic diseases, and early mortality [6].

Studying morbidity patterns and outcomes among preterm neonates is vital for understanding prevalent health challenges, identifying risk

factors, and guiding improvements in neonatal care protocols and NICU infrastructure. Such efforts ultimately enhance healthcare delivery and improve neonatal survival and quality of life.

However, limited data are available on the risk factors for preterm birth and associated outcomes in central India [7]. Therefore, the present study was undertaken to assess morbidity patterns and immediate outcomes of preterm neonates admitted to a tertiary care NICU in this region.

MATERIALS AND METHODS

The present prospective cohort study was conducted in the NICU of Indira Gandhi Government Medical College and Mayo Hospital, Nagpur, Maharashtra, Central India, from May 2022 to April 2024. All inborn preterm neonates admitted during the study period were enrolled after obtaining written informed parental consent. Approval was obtained from the Institutional Ethics Committee before study initiation (Reference No. 1346-47/2023).

Inclusion criteria: All inborn preterm neonates (<37 weeks of gestation) admitted to the NICU were included.

Exclusion criteria: Neonates with major congenital anomalies and those whose parents did not provide consent were excluded.

Sample size calculation: The required sample size was calculated as 198 preterm neonates based on a previous study by Paudel L et al., [8].

p=Anticipated proportion of neonates who were discharged: 75.3%,
d=Absolute precision=6%, α =Level of Significance=5%, $Z_{1-\alpha/2}$ =value of normal deviate at 5% level of significance=1.96

The formula used is:

$$n = \frac{Z^2_{1-\alpha/2} p [1-p]}{d^2}$$

Study Procedure

A total of 198 inborn preterm neonates admitted to the NICU during the study period were enrolled after obtaining parental consent. Mothers of the enrolled neonates were interviewed, and antenatal care discharge cards were reviewed to obtain maternal details. A comprehensive antenatal and natal history was recorded, including mode of delivery, birth weight, sex of the neonate, whether the baby cried at birth, and the need for resuscitation.

Gestational age was assessed using the New Ballard Score, and neonates were categorised as extremely preterm, very preterm, or moderate-to-late preterm. Indications for NICU admission, such as tachypnoea, lethargy, poor feeding, convulsions, hypothermia, abdominal distension, and vomiting, were documented. A thorough general and systemic examination was conducted, and clinical diagnosis were established. Laboratory investigations were performed to confirm diagnosis.

Neonates were closely monitored for complications during their NICU stay and managed according to established treatment protocols. All morbidities encountered during hospitalisation were recorded, and immediate outcomes (discharge or death) were documented.

STATISTICAL ANALYSIS

Data were entered into a Microsoft Excel worksheet. Continuous variables were expressed as mean±Standard Deviation (SD), while categorical variables were presented as frequencies and percentages. A p-value of <0.05 was considered statistically significant. Statistical analysis was performed using JAMovi software version 2.4.14.

RESULTS

A total of 198 inborn preterm neonates admitted during the study period were included. [Table/Fig-1] presents the demographic characteristics of the preterm neonates. Of the 198 neonates, 92 (46.46%) were male and 106 (53.54%) were female. Seventy-eight neonates (39.40%) belonged to the moderate preterm category. Ninety-two neonates (46.46%) were classified as very low birth weight. The majority, 170 neonates (85.85%), were Appropriate for Gestational Age (AGA).

The most common maternal risk factor for preterm birth was anaemia, affecting 136 mothers (68.69%), followed by Pregnancy-Induced Hypertension (PIH) in 73 (36.87%). Other risk factors included Preterm Premature Rupture of Membranes (PPROM) in 53 (26.77%), severe oligohydramnios in 38 (19.19%), and multiple pregnancies in 27 (13.64%) [Table/Fig-2].

[Table/Fig-3] illustrates the clinical presentations at admission. Respiratory distress was the most common manifestation, observed in 176 neonates (88.89%), followed by seizures in 24 (12.12%) and lethargy in 23 (11.62%).

Neonatal demographic characteristics	Frequency	Percentage (%)
Gender		
Male	92	46.46
Female	106	53.54
Mode of delivery		
Normal vaginal delivery	78	39.40
Lower segment caesarean section	120	60.60
Gestational age		
Extreme preterm (<28 weeks)	5	2.53
Very preterm (28 to <32 weeks)	59	29.80
Moderate preterm (32 to <34 weeks)	78	39.40
Late preterm (34 to <37weeks)	56	28.28
Birth weight		
<1000 grams	28	14.14
1000-1499 grams	92	46.46
1500-2499 grams	78	39.40
AGA/SGA/LGA		
Appropriate for gestational age	170	85.85
Small for gestational age	28	14.15
Large for gestational age	0	0

[Table/Fig-1]: Neonatal demographic characteristics (N=198).

Maternal risk factors	Frequency	Percentage (%)
Anaemia	136	68.69%
Pregnancy Induced Hypertension (PIH)	73	36.87%
PPROM	53	26.77%
Severe oligohydramnios	38	19.19%
Multiple pregnancy	27	13.64%
Maternal febrile illness	25	12.63%
Maternal chronic systemic disease	24	12.12%
Antepartum haemorrhage	23	11.62%
Chorioamnionitis	14	7.07%
Elderly primigravida	13	6.57%
Gestational diabetes mellitus	9	4.55%

[Table/Fig-2]: Maternal risk factors for preterm birth.

Clinical presentation	Frequency	Percentage (%)
Respiratory distress	176	88.89%
Seizure	24	12.12%
Lethargy	23	11.62%
Feeding intolerance	19	9.60%
Vomiting	7	3.54%
Abdominal distension	7	3.54%
Bleeding manifestations (petechiae, purpura, ecchymosis etc.)	5	2.53%

[Table/Fig-3]: Clinical presentation of preterm neonates on admission (N=198).

The most frequent morbidity was early-onset sepsis, present in 151 neonates (76.26%), followed by neonatal hyperbilirubinaemia in 123 (62.12%), Respiratory Distress Syndrome (RDS) in 84 (42.42%), and Intraventricular Haemorrhage (IVH) in 79 (39.90%) [Table/Fig-4].

[Table/Fig-5] elucidates the outcomes of preterm neonates. Among the total of 198 admitted inborn preterm neonates, 167 (84.34%) survived and were subsequently discharged, while 31 succumbed. The observed mortality rate was 15.66%.

Morbidity	Frequency	Percentage (%)
Early onset sepsis	151	76.26%
Neonatal hyperbilirubinaemia	123	62.12%
Respiratory distress syndrome	84	42.42%
Intraventricular haemorrhage	79	39.90%
Hypoglycaemia	62	31.31%
Hypothermia	59	29.80%
Apnoea of prematurity	54	27.27%
Hypocalcaemia	40	20.20%
Bronchopulmonary dysplasia	28	14.14%
Perinatal asphyxia	22	11.11%
Transient tachypnoea of newborn	21	10.61%
Late onset sepsis	20	10.10%
Congenital heart disease	16	8.08%
Retinopathy of prematurity	15	7.58%
Meconium aspiration syndrome	11	5.56%
Necrotising enterocolitis	7	3.54%

[Table/Fig-4]: Morbidity pattern of preterm neonates (N=198).

Outcome	Frequency	Percentage
Discharge	167	84.34%
Death	31	15.66%

[Table/Fig-5]: Outcome of preterm neonates (N=198).

[Table/Fig-6] summarises morbidities along with associated mortality. Preterm neonates with RDS had a 7.92 fold higher risk of mortality compared with those without RDS (Adjusted Odds Ratio [AOR] 7.92; 95% Confidence Interval (CI): 2.42-25.92). Similarly, neonates with IVH exhibited a 9.35-fold increased risk of mortality (AOR 9.35; 95% CI: 2.80, 31.12).

Morbidity	N	Deaths	OR	CI	p-value
Respiratory distress syndrome	84	27	7.92	(2.42, 25.92)	<0.001
Early-onset sepsis	151	27	1.26	(0.34, 4.66)	0.722
Intraventricular haemorrhage	79	27	9.35	(2.80, 31.12)	<0.001
Necrotising enterocolitis	7	5	10.28	(1.08, 97.09)	0.042
Congenital heart disease	16	4	2.66	(0.57, 12.43)	0.213
Hypoxic ischaemic encephalopathy	22	2	0.56	(0.09, 3.32)	0.531

[Table/Fig-6]: Association of morbidity with mortality in preterm neonates.

DISCUSSION

The present prospective cohort study was conducted in the NICU of a tertiary care center in Central India over a two-year period to assess morbidity patterns and immediate outcomes among preterm neonates. A total of 198 inborn preterm neonates were included.

In the present study, 92 neonates (46.46%) were male and 106 (53.54%) were female, with a male-to-female ratio of 0.87:1. Similar findings were reported by Gupta A et al., who observed 46 (45.54%) males and 55 (54.45%) females (male-to-female ratio: 0.84:1) [9]. In contrast, Hassan N et al., reported male predominance, with 99 males (74.5%) and 34 females (25.5%), yielding a ratio of 2.9:1 [10]. Kunle-Oluwu OE et al., also noted slight male predominance, with 71 males (51.45%) and 67 females (48.55%) [11].

Regarding mode of delivery, 78 neonates (39.40%) were delivered via Normal Vaginal Delivery (NVD), while 120 (60.60%) were delivered by Lower Segment Caesarean Section (LSCS). Sharma Y et al., reported higher NVD rates (61.90%) and lower LSCS rates (38.09%) [12]. Conversely, Raha BK et al., documented that 20.1% were delivered by NVD and 79.9% by LSCS [13].

The present study reported that, out of the 198 inborn preterm neonates enrolled, 5 (2.5%) were extremely preterm (<28 weeks), 59 (29.79%) were very preterm (28 to <32 weeks), 78 (39.40%) were moderately preterm (32 to <34 weeks), and 56 (28.28%) were late preterm. In the study by Kunle-Oluwu OE et al., 9 (6.5%) neonates were extremely preterm, 46 (33.3%) were very preterm, and 74 (56.5%) were moderate to late preterm [11].

In the present study, regarding birth weight, 28 (14.14) weighed less than 1,000 g, 92 (46.46%) weighed between 1,000 and 1,499 g, and 78 (39.40%) weighed between 1,500 and 2,499 g. Pai MS et al., reported 10.4% of neonates with birth weight <1 kg, 25.9% between 1.0 and <1.5 kg, and 33.6% between 1.5 and <2.5 kg [14]. Similarly, Ochoga MO et al., observed that 13.7% of preterm neonates weighed <1 kg, 42.1% weighed 1.0-1.5 kg, and 44.2% weighed 1.5-2.5 kg [15].

In the present study, 170 neonates (85.85%) were AGA in results in [Table/Fig-1], while 28 (14.15%) were SGA in results [Table/Fig-1]. No neonates were Large for Gestational Age (LGA). Pai MS et al., similarly reported 81.2% SGA, 16.83% AGA, and 2% LGA neonates [14].

Anaemia was the most common maternal risk factor for preterm delivery (68.69%), followed by PIH (36.87%), PPROM (26.77%), severe oligohydramnios (19.19%), multiple pregnancies (13.64%), maternal febrile illness (12.63%), chronic systemic disease (12.12%), antepartum haemorrhage (11.62%), chorioamnionitis (7.07%), elderly primigravida status (6.57%), and gestational diabetes mellitus (4.55%). Kuppusamy N et al., also identified anaemia as the predominant risk factor, followed by PPROM (24.63%), PIH (18.23%), multiple pregnancy (9.36%), antepartum haemorrhage (4.60%), and gestational diabetes mellitus (1.48%) [16]. Paudel L et al., similarly reported early-onset sepsis (40.9%) as the most common morbidity, followed by neonatal hyperbilirubinaemia (28%) [8].

In the present study, 167 preterm neonates (84.34%) survived and were discharged, while 31 (15.66%) died due to various complications. Paudel L et al., reported 75.3% discharges, 8.6% mortality, and 16.1% Discharge Against Medical Advice (DAMA) [8]. Ochoga MO et al., observed 63.2% discharges, 28.4% mortality, and 8.4% DAMA cases [15].

Genie YD et al., reported that among neonates with sepsis, 55.72% survived and 44.28% died; among those with neonatal hyperbilirubinaemia, 56.41% were discharged and 43.49% died; among neonates with respiratory distress syndrome, 45.52% survived and 54.48% died; among those with hypoglycaemia, 42.86% were discharged and 57.14% died; among neonates with hypothermia, 59.82% survived and 40.18% died; and all neonates with birth asphyxia died [17].

In the present study, morbidities such as respiratory distress syndrome, intraventricular haemorrhage, and necrotising enterocolitis were associated with higher mortality rates.

Limitation(s)

The present study was a single-centre study conducted in a tertiary healthcare facility; therefore, the findings may not be generalisable

to the wider population. Additionally, management strategies were not discussed.

CONCLUSION(S)

Morbidities including respiratory distress syndrome, intraventricular haemorrhage, and necrotising enterocolitis were significantly associated with mortality among preterm neonates. Preterm infants constitute a substantial proportion of NICU admissions. Early identification of maternal risk factors for prematurity enables timely monitoring and targeted interventions to prevent adverse outcomes. Given the increased vulnerability of preterm neonates to multiple complications, understanding morbidity patterns is essential for implementing preventive strategies and ensuring prompt management, ultimately improving neonatal outcomes.

REFERENCES

- [1] Ohuma EO, Moller AB, Bradley E, Chakwera S, Hussain-Alkhateeb L, Lewin A, et al. National, regional, and global estimates of preterm birth in 2020, with trends from 2010: A systematic analysis. *Lancet* (London, England) [Internet]. 2023;402(10409):1261-71. Available from: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(23\)00878-4/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)00878-4/fulltext).
- [2] Elmi Farah A, Abbas AH, Tahir Ahmed A. Trends of admission and predictors of neonatal mortality: A hospital based retrospective cohort study in Somali region of Ethiopia. *PLoS One*. 2018;13(9):e0203314.
- [3] Newborn Death and illness-WHO. Available from: <https://www.who.int/news-room/fact-sheets/detail/newborn-mortality>. Accessed on: 10 October 2020.
- [4] Neonatal health/UNICEF. Available from: <https://www.unicef.org/india/what-we-do/newborn-and-child-health>. Accessed on: 10 October 2020.
- [5] Hailemeskel HS, Dagnaw FT, Demis S, Birhane BM, Azanaw MM, Chanie ES, et al. Neonatal outcomes of preterm neonates and its predictors in Ethiopian public hospitals: Multicenter prospective follow-up study. *Heliyon*. 2023;9(8):e18534. Doi: 10.1016/j.heliyon.2023.e18534.
- [6] Yadav DP, Kumar V, Shah SK, Shah K. Preterm neonates admitted to the neonatal intensive care unit of a tertiary care hospital: A descriptive cross-sectional study. *JNMA J Nepal Med Assoc* [Internet]. 2024;62(276):516-20. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11455647/>.
- [7] Devi TC, Singh HS. Prevalence and risk factors associated with preterm birth in India: Systematic review and meta-analysis. *J Public Hlth Dev*. 2021;19(2):188-205.
- [8] Paudel L, Kalakheti B, Sharma K. Prevalence and outcome of preterm neonates admitted to neonatal unit of a tertiary care center in western Nepal. *J Lumbini Med Coll*. 2018;6(2):87-91. Doi: 10.22502/jlmc.v6i2.218.
- [9] Gupta A, Shetty D, Madhava KK. Prevalence and consequences of preterm admissions at the neonatal intensive care unit of tertiary care centre in south India: A retrospective study. *International Journal of Current Advanced Research*. 2017;6(5):3728-30. Doi: 10.24327/ijcar.2017.3730.0357.
- [10] Hassan N, Mukhopadhyaya S, Mohan S. Morbidity and mortality profile of preterm neonates admitted in neonatal intensive care unit of a tertiary care centre in Western Uttar Pradesh, India. *Int J Contemp Pediatr*. 2019;6(5):1859-62. Available from: <https://doi.org/10.18203/2349-3291.ijcp20193154>.
- [11] Kunle-Olowu OE, Peterside O, Adeyemi OO. Prevalence and outcome of preterm admissions at the neonatal unit of a tertiary health centre in southern Nigeria. *Open Journal of Pediatrics* [Internet]. 2014;4:67-75. Available from: https://www.scirp.org/html/9-1330299_43766.htm.
- [12] Sharma Y, Pathak OK, Poudel B, Sharma A, Sapkota RP, Devkota K. Preterm neonates admitted in the neonatal intensive care unit at a tertiary care centre: A descriptive cross-sectional study. *J Nepal Med Assoc*. 2023;61(260):320-24. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10089009/>.
- [13] Raha BK, Uddin MT, Nurunnabi M. Outcome of preterm admissions at the neonatal unit of a tertiary care military hospital of Bangladesh. *Journal of Bangladesh College of Physicians and Surgeons*. 2022;40(1):39-44.
- [14] Pai MS, Lewis LE, Yashoda S, Priyadarshini S, Margaret B. Mortality and morbidity among preterm neonates in neonatal intensive care unit. *Online J Health Allied Scs*. 2018;17(3):2.
- [15] Ochoga MO, Michael A, Abah RO, Dabit O, Ikuren I, Ebonyi A. Risk factors and outcome of preterm admissions in a special care baby unit of a tertiary hospital in North Central Nigeria. *Open Journal of Pediatrics*. 2018;8(2):117-25.
- [16] Kuppusamy N, Balasubramanian M, Krithiga M. Magnitude of preterm admissions in neonatal intensive care unit of rural medical college hospital. *Int J Sci Stud*. 2016;4(1):286-89.
- [17] Genie YD, Kebede BF, Silesh Zerihun M, Tilahun Beyene D. Morbidity and mortality patterns of preterm low birthweight neonates admitted to referral hospitals in the Amhara region of Ethiopia: Retrospective follow-up study. *BMJ Open*. 2022;12(7):e054574.

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