International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Clinico etiological profile, management practices, and outcomes of preterm neonates: A prospective observational study from a tertiary care Neonatal Intensive Care Unit (NICU)

Dr. Khurshed Alam Choudhury [1]; Dr. Kanak Lata Yadav [2]; Dr. Manish Gupta [3]; Dr. Vishal Jain [3]

[1] *Assistant Professor; United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India.*
[2] *Assistant Professor; Dr. RMLIMS, Lucknow, Uttar Pradesh, India.*
[3] *Senior Consultant, Department of Pediatrics; Jaipur Golden Hospital, New Delhi, India.*
[4] *Consultant Neonatologist; Jaipur Golden Hospital, New Delhi, India.*

OPEN ACCESS

Corresponding Author:

Dr. Khurshed Alam Choudhury

Department of Pediatrics, United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India

Received: 14-10-2025
Accepted: 29-10-2025
Available online: 12-11-2025

ABSTRACT

Objective: Preterm births pose a significant challenge in neonatology, contributing to high morbidity and mortality rates. This study evaluates the clinico-etiological profile, management practices, and outcomes of preterm neonates in a tertiary care NICU, emphasizing maternal risk factors.

Methods: A prospective observational study was conducted on 138 preterm neonates (22 to 36+6 weeks gestational age). Data were analyzed using descriptive and inferential statistical methods, including chi-square tests, logistic regression, and Kaplan-Meier survival analysis. A p-value < 0.05 was considered statistically significant.

Results: Of the 138 preterm neonates, 60.14% were late preterm (34–<37 weeks). Appropriate for gestational age (AGA) babies constituted 75.36%, while 23.19% were small for gestational age (SGA). Male preponderance was observed (64.49%). Morbidities included neonatal hyperbilirubinemia (NNH, 34.78%), respiratory distress syndrome (RDS, 26.08%), and sepsis (18.11%). The mortality rate was 4.34%, with respiratory distress syndrome (RDS) and intraventricular hemorrhage (IVH) being the leading causes. Mortality was significantly higher in neonates born <32 weeks gestation (20.83%) compared to those ≥32 weeks gestation (0.88%, $p < 0.05$). Key maternal risk factors included bad obstetric history (BOH: Previous preterm labour/ Abortion, 46.38%), preterm premature rupture of membranes (PPROM/PROM, 37.68%), multiple gestation (26.81%), poly/oligohydramnios (23.91%), in vitro fertilization (IVF, 23.19%), and pre-eclampsia/eclampsia (9.42%). Management practices such as antenatal corticosteroid administration, surfactant therapy, advanced NICU care, and Kangaroo Mother Care (KMC) were associated with a significant reduction in morbidity and mortality among preterm neonates.

Conclusion: This study highlights the importance of antenatal care and advanced neonatal interventions in addressing key risk factors for preterm birth and improving neonatal outcomes.

Keywords*: Preterm birth, respiratory distress (RD), neonatal hyperbilirubinemia (NNH), bad obstetric history (BOH), premature rupture of membrane (PROM), in vitro fertilization (IVF)*

INTRODUCTION:

Preterm birth, defined as delivery before 37 weeks of gestation, remains a significant clinical challenge due to its association with high morbidity and mortality rates.[1,2] Globally, an estimated 13.4 million babies were born preterm in 2020, accounting for approximately 10% of all live births.[3,4] Preterm birth complications are the leading cause of death

among children under 5 years of age, responsible for approximately 900,000 deaths in 2019.[3] These deaths account for as much as 35% of all deaths among newborns (aged <28 days).[5] The global preterm birth rate was estimated at 9.9% in 2020.[6] In India, the burden is particularly high, with 3.02 million preterm births recorded in 2020, making it the country with the highest number of preterm births globally, accounting for over 20% of all preterm births worldwide.[7,8] The preterm birth rate in India was 13% in 2020.[7,9] Despite advancements in neonatal care, preterm infants face numerous complications, including respiratory distress syndrome (RDS), intraventricular hemorrhage (IVH), necrotizing enterocolitis (NEC), sepsis, and long-term neurodevelopmental disabilities.[10,11] This study evaluates maternal risk factors, neonatal profiles, and management practices to improve neonatal outcomes, addressing a critical area in perinatal health to reduce morbidity and mortality associated with preterm births.

Previous studies have primarily focused on neonatal mortality and morbidity in broad populations, often failing to provide comprehensive insights into the specific burden of preterm-related complications across different gestational age groups. Additionally, there is limited data on how these complications manifest in smaller cohorts and how they relate to both survival rates and care practices in specific neonatal care settings. These gaps in knowledge hinder targeted management practices for improving neonatal outcomes in this vulnerable group.

The present study was undertaken to address these deficiencies by analyzing the causes of neonatal mortality, morbidity patterns, management practices and gestational age distribution in preterm neonates. By providing detailed insights into these aspects, this study aims to highlight critical areas for intervention and guide resource allocation and policy development to further reduce neonatal mortality and morbidity rates.

Materials and Methods:

Study Design: This prospective observational study was conducted at a tertiary care NICU, from January to December 2022.

Sample Size and Sampling Technique

The study included 138 preterm neonates, determined by consecutive enrollment during the study period. All eligible preterm infants (< 37 weeks of gestation) admitted to the Neonatal Intensive Care Unit (NICU) who met the inclusion criteria and whose parents provided informed consent were prospectively enrolled until the target sample size was reached. The prospective observational design allowed real-time data collection on neonatal characteristics and morbidity patterns, ensuring representativeness while minimizing selection bias.

Inclusion Criteria

Preterm neonates with gestational age < 37 weeks, confirmed by last menstrual period (LMP) and/or early ultrasound.
Neonates admitted to the NICU within 24 hours of birth.
Infants whose parents or guardians provided informed consent for participation and follow-up.

Exclusion Criteria

Neonates with major congenital malformations or chromosomal abnormalities incompatible with life.
Outborn neonates referred after 72 hours of birth.
Infants who left against medical advice (LAMA) or were transferred before completion of initial observation and ophthalmologic screening.
Incomplete clinical or ophthalmologic records, preventing reliable data analysis.

Data Collection:

Data were collected prospectively using a standardized data collection form:
Neonatal data included gestational age, birth weight, morbidity, management practices, and mortality outcomes. Maternal data included age, socio-economic status (SES), obstetric history, and risk factors. Gestational age was determined using the last menstrual period (LMP) and confirmed by the New Ballard Score. Prior to enrollment, the study objectives and procedures were explained in detail to the parents or legal guardians of each eligible neonate, and written informed consent was obtained.

Confidentiality of all participant information was strictly maintained by assigning unique identification codes and limiting data access to authorized study personnel only. No interventions beyond standard clinical care were performed, and participation did not influence the management or treatment decisions for enrolled infants. The study posed minimal risk, as all assessments—including ophthalmologic screening for retinopathy of prematurity—were part of routine NICU care and follow-up protocols.

Statistical Analysis:

Descriptive statistics, such as frequencies and percentages, were used to summarize categorical variables, while continuous variables were reported as means with standard deviations or medians with interquartile ranges, as appropriate. Comparative analyses were performed to assess the associations between maternal risk factors and neonatal outcomes. Chi-

square or Fisher's exact tests were used for categorical variables, while independent t-tests or Mann-Whitney U tests were applied for continuous variables, depending on data distribution. Multivariate logistic regression analysis was conducted to identify independent predictors of neonatal morbidity and mortality. A p-value < 0.05 was considered statistically significant. Data analysis was performed using SPSS Version 20.0.

Results:

Table 1: Maternal Characteristics:

		Number (n)	Percentage (%)
Maternal Age (In Years)	19-30	61	44.2
	>30	77	55.8
No of fetuses	1	101	73.18
	≥2	37	26.81
Type of Delivery	Vaginal	88	63.76
	Cesarean Section	50	36.23
Prenatal Corticosteroids	Complete	91	65.21
	Partial	42	30.43
	None	5	3.62

Table 1 summarizes the maternal characteristics of the study population. Among the 138 mothers included in the study, the majority (55.8%) were aged >30 years, while 44.2% were aged between 19 and 30 years. Regarding the number of fetuses, 73.18% of mothers delivered a single fetus, while 26.81% delivered multiple fetuses. Vaginal deliveries accounted for 63.76%, while cesarean section deliveries were reported in 36.23%. Prenatal corticosteroids were administered in 65.21% of cases (complete doses), while 30.43% received partial doses, and 3.62% received none.

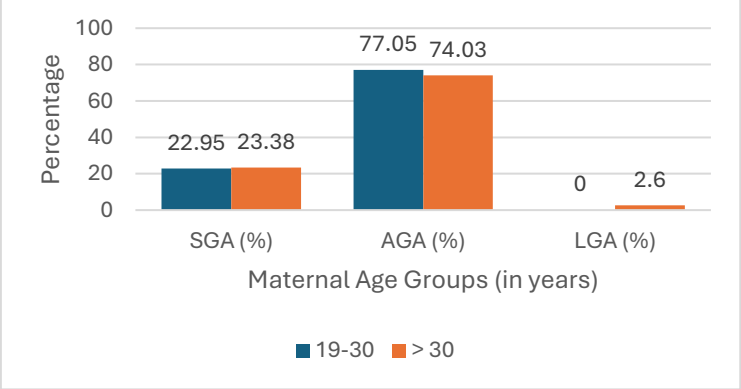

Figure 1: Birth Weight Distribution by Maternal Age

Figure 1 demonstrates the correlation between maternal age and birth weight categories (SGA, AGA, and LGA). Among mothers aged 19–30 years, 22.95% of the infants were classified as small-for-gestational-age (SGA), while 77.05% were appropriate-for-gestational-age (AGA), and none were large-for-gestational-age (LGA). For mothers aged >30 years, the prevalence of SGA infants was similar at 23.38%, while 74.03% were AGA, and 2.6% were LGA.

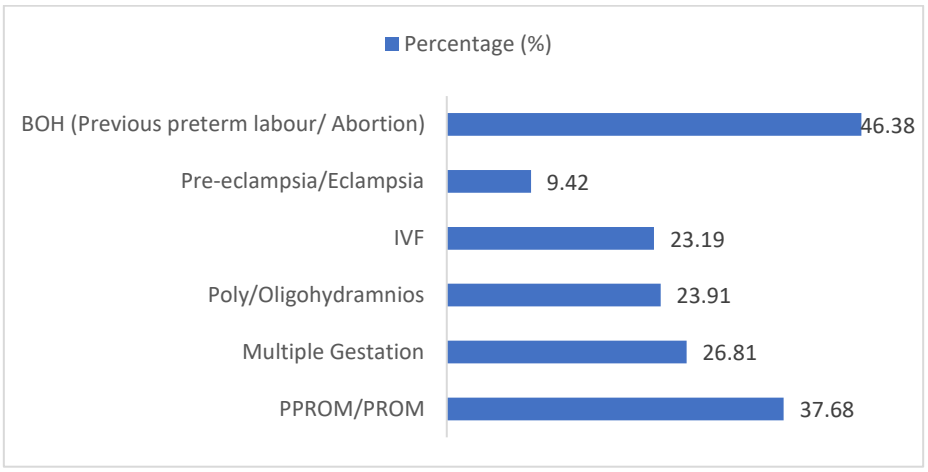

Figure 2: Maternal Risk Factors

The distribution of maternal risk factors is visualized in Figure 2. The most prevalent maternal risk factor was Bad Obstetric History (BOH), which accounted for 46.38% of the cases, followed by PPROM/PROM (37.68%). Other notable risk factors included Multiple Gestation (26.81%), Poly/Oligohydramnios (23.91%), and pregnancies resulting from In Vitro Fertilization (IVF, 23.19%). Pre-eclampsia/Eclampsia was observed in 9.42% of the mothers.

Table 2: Neonatal Characteristics

		Number (n)	Percentage (%)
Sex	Male	89	64.49
	Female	49	35.51
Birth Weight	AGA	104	75.36
	SGA	32	23.19
	LGA	2	1.45
GA (In Weeks)	22-<24	2	1.44
	24-<28	3	2.17
	28-<32	19	13.76
	32-<34	31	22.46
	34-<37	83	60.14
Resuscitation at delivery	Routine Care	124	89.85
	PPV	10	7.24
	Advanced	4	2.89

The neonatal characteristics are summarized in Table 2. Among the 138 neonates, there was a male predominance with 89 males (64.49%) and 49 females (35.51%). Regarding birth weight, the majority of the neonates were Appropriate for Gestational Age (AGA) (75.36%), while 23.19% were classified as Small for Gestational Age (SGA), and 1.45% were Large for Gestational Age (LGA). In terms of gestational age (GA), 60.14% of the neonates were born 34–<37 weeks, followed by 22.46% born 32–<34 weeks, 13.76% born 28–<32 weeks, 2.17% born 24–<28 weeks, and 1.44% born 22–<24 weeks. At delivery, the majority of neonates (89.85%) required only routine care, while 7.24% required positive pressure ventilation (PPV), and 2.89% required advanced resuscitation techniques.

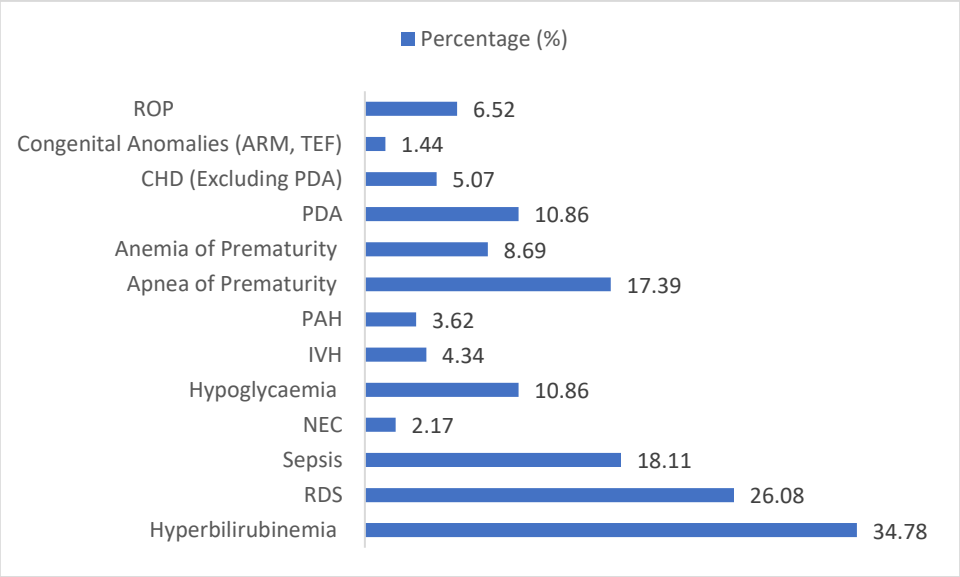

Figure 3: Neonatal Morbidity Patterns

Table 3. Distribution of Retinopathy of Prematurity (ROP) by Stage and Gestational Age

Gestational Age (weeks)	Stage 1 ROP (n)	Stage 2 ROP (n)	Total ROP Cases (n)	Percentage of ROP Cases (%)
24 – < 32	1	2	3	33.33
32 – < 37	6	0	6	66.67
Total	7	2	9 / 138	6.52 (of total neonates)

The morbidity patterns observed in this study are visualized in Figure 3. The most common neonatal morbidity was Hyperbilirubinemia, affecting 34.78% of neonates, followed by Respiratory Distress Syndrome (RDS) in 26.08% and Sepsis in 18.11%. Other significant morbidities included Apnea of Prematurity (17.39%), Hypoglycemia (10.86%), and Patent Ductus Arteriosus (PDA), also reported in 10.86% of cases. Less frequent complications were Intraventricular

Hemorrhage (IVH, 4.34%), Pulmonary Arterial Hypertension (PAH, 3.62%), and Necrotizing Enterocolitis (NEC, 2.17%). Rare conditions included Congenital Anomalies (ARM/TEF, 1.44%) and Congenital Heart Disease (CHD, excluding PDA, 5.07%). In terms of ophthalmologic morbidity (Table 3) retinopathy of prematurity (ROP) was diagnosed in 9 neonates (6.52%). Of these, Stage 1 ROP was observed in 7 cases (5.07%), and Stage 2 ROP in 2 cases (1.45%). No cases of advanced ROP (Stage 3–5) were detected. The gestational age (GA) distribution showed that Stage 2 ROP occurred exclusively in neonates 24–< 32 weeks, whereas Stage 1 ROP was more common among those 32–< 37 weeks.

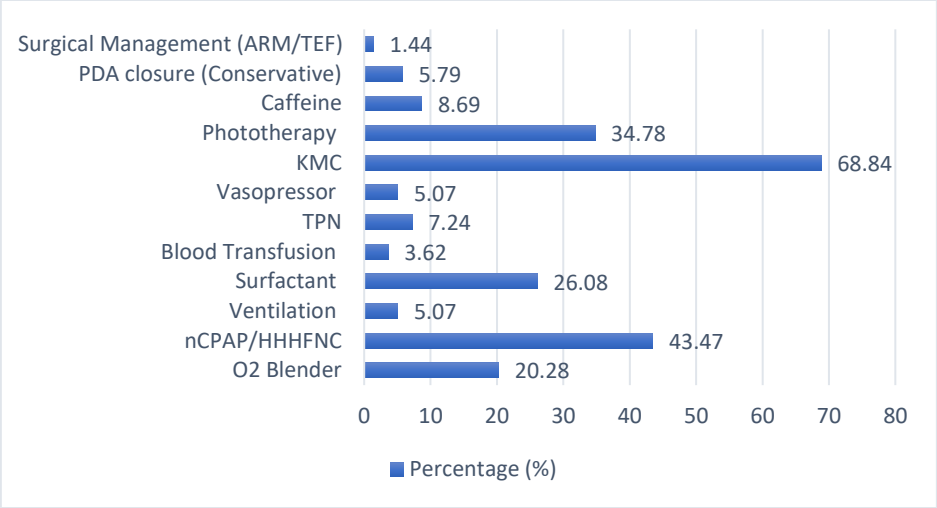

Figure 4: Clinical Management and Supportive Care of Newborns

The clinical management and supportive care of newborns are visualised in Figure 4. The most commonly used interventions were Kangaroo Mother Care (KMC), provided to 68.84% of neonates. Respiratory support was a cornerstone of neonatal care, with non-invasive modes (nCPAP/HHHFNC) being preferred in 43.47% of cases, while invasive ventilation was required only in 5.07% of neonates. Oxygen therapy using an O2 blender was used in 20.28% of cases. Management of hyperbilirubinemia through phototherapy was necessary for 34.78% of neonates, while caffeine therapy was used in 8.69% for the treatment of apnea of prematurity. Advanced interventions included Surfactant therapy, administered to 26.08% of neonates, and TPN, used in 7.24% of cases. Rarely used interventions included Blood Transfusion (3.62%), Vasopressors (5.07%), PDA closure (5.79%), and Surgical Management (ARM/TEF), 1.44%.

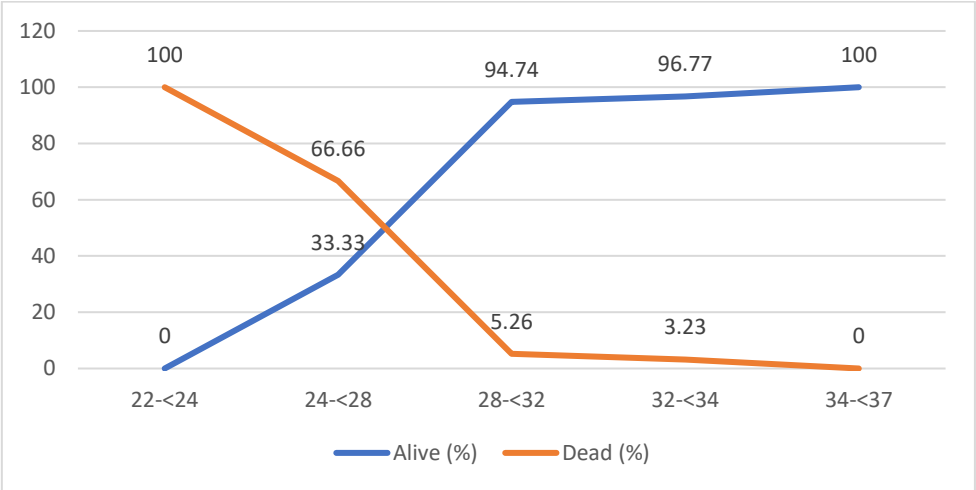

Figure 5: Mortality by Gestational Age

The relationship between gestational age and neonatal mortality is illustrated in Figure 5. Among the 138 neonates studied, the overall survival rate was 95.66%, with a mortality rate of 4.34%. Mortality was inversely related to gestational age, with the highest mortality observed in neonates born at 22–<24 weeks (100% mortality) and 24–<28 weeks (66.66% mortality). Neonates born at 28–<32 weeks had a significantly lower mortality rate (5.26%), and those born at 32–<34 weeks showed an even lower mortality rate of 3.23%. There were no deaths among neonates born at 34–<37 weeks. Overall, neonates born <32 weeks gestation had a higher mortality rate (20.83%, 5/24) compared to those born ≥32 weeks gestation (0.88%, 1/114). This difference was statistically significant and highlights the critical role of gestational age in neonatal survival.

Table 4: Primary Causes of Neonatal Mortality

Causes	Number of Deaths (n)	Percentage (%)
RDS	2	33.33
IVH	2	33.33
Sepsis	1	16.66
NEC	1	16.66
Total	6	100

The proportional causes of neonatal mortality are summarized in Table 4. The leading causes were Respiratory Distress Syndrome (RDS) and Intraventricular Hemorrhage (IVH), each accounting for 33.33% of cases. Sepsis contributed to 16.66%, while Necrotizing Enterocolitis (NEC) accounted for another 16.66% of neonatal deaths. These findings are consistent with global data, reflecting the significant burden of prematurity and associated complications in neonatal deaths.

Discussion

This study provides valuable insights into the intricate interplay of maternal demographics, risk factors, neonatal characteristics, morbidity patterns, management practices, and mortality outcomes in preterm neonates. The findings underscore the importance of comprehensive perinatal care and evidence-based interventions to improve outcomes.

Maternal Demographics and Risk Factors (Table 1, Figure 1, Figure 2)

The finding that a significant proportion of mothers were aged >30 years (55.8%) aligns with global trends of delayed childbearing.[12] Advanced maternal age is associated with increased risks of pregnancy complications such as gestational diabetes, hypertension, and preterm labor, highlighting the need for targeted antenatal care in this population.[13] The high prevalence of Bad Obstetric History (BOH) (46.38%) underscores the importance of comprehensive risk assessment and management for women with prior adverse pregnancy outcomes. Studies have shown that a history of preterm birth significantly increases the risk of recurrence, necessitating close monitoring and interventions such as progesterone supplementation or cervical cerclage.[13,14]

PPROM/PROM (37.68%) remains a significant maternal risk factor, consistent with its well-established role in preterm labor and neonatal complications.[14] PPROM is associated with increased risks of intrauterine infection, placental abruption, and neonatal sepsis, emphasizing the need for timely antibiotic administration and delivery management. The notable proportion of pregnancies resulting from IVF (23.19%) reflects the increasing use of assisted reproductive technologies, which are linked to higher rates of multiple gestations and preterm deliveries.[15]

While younger mothers (19–30 years) were more likely to have AGA infants (77.05%), a similar proportion of SGA births was observed in both age groups. This suggests that factors other than maternal age, such as nutritional status or antenatal care quality, may play a more significant role in influencing SGA rates.[16,17] A study in Mexico found that adolescent mothers and those over 39 had a higher risk of SGA babies.[18]

The presence of LGA infants exclusively in mothers aged >30 years (2.6%) underscores the need for targeted interventions in this age group to mitigate risks associated with excessive fetal growth. Screening for gestational diabetes, careful weight monitoring, and tailored nutritional counseling may help reduce the prevalence of LGA births in older mothers.[19,20] Studies have shown that gestational diabetes is positively associated with increased birth weight and risk of LGA.[21]

Overall, these findings emphasize the importance of age-specific antenatal care strategies. While the younger age group demonstrated a higher percentage of AGA births, both age groups require tailored interventions to optimize outcomes and reduce the prevalence of SGA and LGA births.[22] Adequate antenatal care has been shown to reduce the risk of adverse perinatal outcomes.[20]

Neonatal Characteristics and Morbidity Patterns (Table 2, Table 3, Figure 3)

The male predominance among neonates (64.49%) is consistent with studies suggesting that male neonates are more vulnerable to preterm birth and associated morbidities due to differences in lung maturity and immune responses.[23] The majority of neonates were AGA (75.36%), while a substantial proportion were SGA (23.19%), underscoring the impact of intrauterine growth on neonatal health. SGA neonates are at increased risk of hypoglycemia, hypothermia, and long-term neurodevelopmental delays, necessitating enhanced postnatal care.[24]

The morbidity patterns observed in this study, with Hyperbilirubinemia (34.78%) being the most common, are consistent with findings from other developing countries where jaundice remains a leading neonatal complication.[25] Respiratory Distress Syndrome (26.08%), the second most common morbidity, underscores the burden of prematurity, as immature lungs are often observed in neonates born before 34 weeks.[26] The incidence of Sepsis (18.11%) reflects challenges in infection control in neonatal care units, particularly in low-resource settings.[27] Neonatal Sepsis remains a major cause of

mortality in developing countries, emphasizing the need for stringent infection prevention protocols and early antibiotic therapy.[11] Effective management strategies such as phototherapy, surfactant therapy, and early antibiotic administration are crucial in mitigating these risks [9]. The incidence of Apnea of Prematurity (17.39%) highlights the importance of caffeine therapy and respiratory support in managing these events.[42] Other complications such as Hypoglycemia (10.86%), IVH (4.34%) and NEC (2.17%) highlight the need for specialized neonatal care, particularly for very low birth weight infants.[28]

The overall incidence of ROP in this study was 6.52%**,** which is relatively lower than rates reported from tertiary neonatal intensive care units (10–30%) in both developed and developing countries.[12] The predominance of early-stage disease (Stage 1 in 77.8% of ROP cases) and absence of severe forms (Stage 3–5) indicate that most cases were mild and likely to regress without intervention. Adherence to controlled oxygen therapy, careful neonatal monitoring, and timely ophthalmologic screening may have contributed to this outcome. A gestational-age-specific trend was noted, with ROP affecting both moderate and very preterm infants. Stage 2 ROP was restricted to neonates < 32 weeks, consistent with established evidence that lower gestational age and birth weight are major risk factors for disease progression.[5,10] Interestingly, Stage 1 ROP occurred more frequently in neonates born between 32 and < 37 weeks — a group typically considered lower risk — possibly reflecting transient retinal vascular immaturity or subclinical oxygen fluctuations during early postnatal care.These findings highlight the continued importance of systematic ROP screening for all preterm infants, especially those < 34 weeks or < 2000 g. Ensuring compliance with national and WHO-recommended screening protocols, along with post-discharge follow-up, remains vital to detect and manage early ROP and prevent avoidable blindness.[43]

Clinical Management and Supportive Care of Newborns (Figure 4)

Figure 4 illustrates the range and frequency of clinical management and supportive care of newborns provided to preterm and sick neonates in the study cohort. Among all interventions, Kangaroo Mother Care (KMC) had the highest utilization rate **(**68.84%**)**, emphasizing its established role in improving thermoregulation, promoting breastfeeding, reducing infections, and enhancing survival outcomes, particularly in low-resource settings.[29,30] The widespread implementation of KMC aligns with the global recommendations by the World Health Organization (WHO), which advocate for its routine use in the care of preterm and low-birth-weight infants.[31] A recent meta-analysis showed that KMC reduces the risk of mortality in low birth weight infants and may also reduce the risk of sepsis, hypothermia, and hypoglycemia.[32]

Respiratory support represented a major domain of neonatal intervention. Non-invasive methods such as nasal Continuous Positive Airway Pressure (nCPAP) and Heated Humidified High Flow Nasal Cannula (HHHFNC) were used in 43.47% of neonates, highlighting the emphasis on lung-protective strategies that minimize ventilator-induced lung injury.[33] Invasive mechanical ventilation was required in only 5.07% of cases, reflecting selective and judicious use in severe respiratory distress. Similarly, surfactant therapy (26.08%) was administered to manage Respiratory Distress Syndrome (RDS)**,** consistent with evidence demonstrating its effectiveness in improving oxygenation and reducing mortality among preterm neonates.[34]

Other essential supportive therapies included phototherapy (34.78%) for hyperbilirubinemia, caffeine therapy (8.69%) for apnea of prematurity, and Total Parenteral Nutrition (TPN, 7.24%) for those unable to establish enteral feeding. The use of vasopressors (5.07%) and blood transfusions (3.62%) reflected the management of systemic instability and anemia in critically ill infants, respectively.

Specific condition-related management practices, such as conservative Patent Ductus Arteriosus (PDA) closure (5.79%) and surgical management of anomalies like Anorectal Malformation (ARM) and Tracheoesophageal Fistula (TEF) **(**1.44%**),** illustrate the individualized approach required for structural or cardiac complications.

Overall, the data indicate adherence to evidence-based neonatal care practices emphasizing non-invasive respiratory support, KMC, surfactant therapy, and nutritional optimization**,** all of which are supported by international guidelines for reducing morbidity and mortality among small and sick newborns.[30,31,34,2]

Mortality by Gestational Age (Figure 5)

The relatively low overall mortality rate of 4.34% suggests that the clinical management and supportive care of newborns, used were effective in improving neonatal outcomes. The inverse relationship between gestational age and neonatal mortality was clearly demonstrated, with neonates born <32 weeks gestation having a significantly higher mortality rate (20.83%) compared to those ≥32 weeks gestation (0.88%). This finding reinforces the critical importance of prolonging pregnancy whenever possible and providing advanced neonatal care for extremely preterm infants.[35] Recent studies have focused on optimizing respiratory support strategies and improving infection control measures to enhance survival in this vulnerable population.[36]

This pattern is consistent with global trends demonstrating that neonatal survival strongly correlates with both gestational age and birth weight.[37,38] Overall, the data indicate adherence to evidence-based neonatal care practices emphasizing non-invasive respiratory support, Kangaroo Mother Care (KMC), surfactant therapy, and nutritional optimization—all of which

are supported by international guidelines aimed at reducing morbidity and mortality among small and sick newborns.[30] For instance, KMC, involving skin-to-skin contact and exclusive breastfeeding, has demonstrated a significant reduction in the risk of mortality among low birth weight infants.[14] Furthermore, a meta-analysis by Chawanpaiboon et al. (2019)[39] supports the effectiveness of antenatal corticosteroids in reducing respiratory disorders in preterm infants. These interventions align with Sustainable Development Goal (SDG) Target 3.2, which aims to end preventable deaths of newborns and children under 5 years of age by 2030.[40]

Causes of Neonatal Mortality (Table 4)

The leading causes of neonatal mortality in this study—Respiratory Distress Syndrome (33.33%)**,** Intraventricular Hemorrhage (33.33%)**,** Sepsis (16.66%)**,** and Necrotizing Enterocolitis (16.66%) align closely with global trends. Prematurity-related complications, including RDS and IVH, remain the largest contributors to neonatal mortality worldwide, accounting for a significant proportion of deaths in preterm infants.[41] The contribution of Sepsis (16.66%) highlights the urgent need for improved infection control practices, timely antibiotic administration, and enhanced neonatal care infrastructure, particularly in resource-limited settings.[11] Similarly, the occurrence of NEC (16.66%) underscores the importance of preventive strategies, such as promoting exclusive breastfeeding, the use of probiotics, and timely surgical interventions when necessary .[42] Evidence-based interventions, including antenatal corticosteroids**,** kangaroo mother care**,** and neonatal resuscitation training**,** have been shown to significantly reduce neonatal mortality in low- and middle-income countries.[27] These findings emphasize the need for targeted improvements in neonatal care to address these preventable and treatable causes of death.

In this study, 6 out of 138 preterm neonates (4.35%) succumbed to neonatal mortality, highlighting a relatively low mortality rate compared to global averages. This outcome reflects improvements in neonatal care practices, including the use of evidence-based interventions such as antenatal corticosteroids, surfactant therapy, and neonatal resuscitation. Additionally, advancements in neonatal intensive care unit (NICU) infrastructure and infection control measures likely contributed to the reduced mortality.

Strengths

This study provides a comprehensive analysis of maternal and neonatal factors influencing preterm birth outcomes in a real-world clinical setting.
The inclusion of a wide range of maternal risk factors and neonatal morbidities offers a holistic view of the challenges faced in preterm neonatal care.
The data on management practices, provides valuable insights into the effectiveness of current management strategies.

Limitations

The single-center design may limit the generalizability of the findings to other settings with different patient populations and resources.
The relatively small sample size may limit the statistical power to detect significant associations between specific risk factors and outcomes.
The study focused primarily on short-term neonatal outcomes, and long-term follow-up data on neurodevelopmental outcomes were not available.

Implications for Practice

Enhanced antenatal care and risk assessment are crucial for identifying women at high risk of preterm birth and implementing preventive measures.
Timely administration of antenatal corticosteroids and magnesium sulfate should be prioritized to improve neonatal outcomes and reduce the risk of cerebral palsy.
Strategies to promote breastfeeding and prevent nosocomial infections are essential for reducing the incidence of sepsis and NEC.
Continued investment in NICU infrastructure and training of healthcare personnel is needed to provide optimal care for preterm neonates, particularly those born at the lowest gestational ages.
Implementation of Kangaroo Mother Care (KMC) and family-centered care models can improve thermoregulation, bonding, and breastfeeding rates, leading to better outcomes.
Timely ROP screening and strict oxygen control are vital to prevent vision loss in preterm infants. Strengthening neonatal care and follow-up can greatly improve visual outcomes.
Further research is needed to evaluate the long-term neurodevelopmental outcomes of preterm infants and to develop targeted interventions to address specific needs.

Declaration:

Conflicts of interests: The authors declare no conflicts of interest.
Author contribution: All authors have contributed in the manuscript.
Author funding: Nill

References

1. Blencowe, H., Cousens, S., Chou, D., Oestergaard, M., Say, L., Moller, A. B., et al. (2013). Born too soon: The global epidemiology of 15 million preterm births. Reproductive Health, 10(Suppl 1), S2. https://doi.org/10.1186/1742-4755-10-S1-S2

2. Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., Cousens, S., Mathers, C., & Black, R. E. (2016). Global, regional, and national causes of under-5 mortality in 2000–2015: An updated systematic analysis with implications for the Sustainable Development Goals. *The Lancet, 388*(10063), 3027–3035. https://doi.org/10.1016/S0140-6736(16)31593-8

3. March of Dimes, PMNCH, Save the Children, & WHO. (2012). Born too soon: The global action report on preterm birth. Geneva: World Health Organization. https://www.who.int/publications/i/item/9789241503433

4. Chawanpaiboon, S., Vogel, J. P., Moller, A. B., Lumbiganon, P., Petzold, M., Hogan, D., et al. (2019). Global, regional, and national estimates of levels of preterm birth in 2014: A systematic review and modelling analysis. The Lancet Global Health, 7(1), e37–e46. https://doi.org/10.1016/S2214-109X(18)30451-0

5. Lawn, J. E., Kinney, M. V., Belizan, J. M., Mason, E. M., McDougall, L., Larson, J., et al. (2013). Born too soon: Accelerating actions for prevention and care of 15 million newborns born too soon. Reproductive Health, 10(Suppl 1), S6. https://doi.org/10.1186/1742-4755-10-S1-S6

6. UNICEF, & WHO. (2020). Survive and thrive: Transforming care for every small and sick newborn. Geneva: World Health Organization. https://www.who.int/publications/i/item/9789241515887

7. World Health Organization. (2020). Newborns: Reducing mortality. Geneva: World Health Organization. https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality

8. Shapiro-Mendoza, C. K., Tomashek, K. M., Kotelchuck, M., Barfield, W. D., Nannini, A., Weiss, J., et al. (2008). Effect of late-preterm birth and maternal medical conditions on newborn morbidity risk. Pediatrics, 121(2), e223–e232. https://doi.org/10.1542/peds.2006-3629

9. Stoll, B. J., Hansen, N. I., Bell, E. F., Walsh, M. C., Carlo, W. A., Shankaran, S., et al. (2010). Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. Pediatrics, 126(3), 443–456. https://doi.org/10.1542/peds.2009-2959

10. Raju, T. N., Higgins, R. D., Stark, A. R., & Leveno, K. J. (2006). Optimizing care and outcome for late-preterm (near-term) infants: A summary of the workshop sponsored by the National Institute of Child Health and Human Development. Pediatrics, 118(3), 1207–1214. https://doi.org/10.1542/peds.2006-0018

11. Zaidi, A. K., Thaver, D., Ali, S. A., & Khan, T. A. (2005). Pathogens associated with sepsis in newborns and young infants in developing countries. Pediatric Infectious Disease Journal, 24(1 Suppl), S23–S29. https://doi.org/10.1097/01.inf.0000158164.83721.2d

12. Sivanandan, S., & Sankar, M. J. (2023). Kangaroo mother care for preterm or low birth weight infants: a systematic review and meta-analysis. *BMJ global health*, *8*(6), e010728. https://doi.org/10.1136/bmjgh-2022-010728

13. Mitrogiannis, I., Evangelou, E., Efthymiou, A., Kanavos, T., Birbas, E., Makrydimas, G., & Papatheodorou, S. (2023). Risk factors for preterm birth: an umbrella review of meta-analyses of observational studies. *BMC medicine*, *21*(1), 494. https://doi.org/10.1186/s12916-023-03171-4

14. Boundy, E. O., Dastjerdi, R., Spiegelman, D., Fawzi, W. W., Missmer, S. A., Lieberman, E., Kajeepeta, S., Wall, S., & Chan, G. J. (2016). Kangaroo Mother Care and Neonatal Outcomes: A Meta-analysis. *Pediatrics*, *137*(1), e20152238. https://doi.org/10.1542/peds.2015-2238

15. Blankenship, S. A., Brown, K. E., Simon, L. E., Stout, M. J., & Tuuli, M. G. (2020). Antenatal corticosteroids in preterm small-for-gestational age infants: a systematic review and meta-analysis. *American journal of obstetrics & gynecology MFM*, *2*(4), 100215. https://doi.org/10.1016/j.ajogmf.2020.100215

16. Workicho, A., Belachew, T., Argaw, A., Roba, A., Ghosh, S., Kershaw, M., et al. (2020). Maternal nutritional status mediates the association between maternal age and birth outcomes. Maternal & Child Nutrition, 16(4), e13015. https://doi.org/10.1111/mcn.13015

17. Wołejszo, S., Genowska, A., Motkowski, R., Strukcinskiene, B., Klukowski, M., & Konstantynowicz, J. (2023). Insights into prevention of health complications in small for gestational age (SGA) births in relation to maternal characteristics: A narrative review. Journal of Clinical Medicine, 12(2), 531. https://doi.org/10.3390/jcm12020531

18. Salinas-Islas, L., Hernández, B., Ortega-Ortega, E. O., & Contreras-Bermúdez, M. (2021). Maternal risk factors for small-for-gestational-age newborns in Mexico: Analysis of a nationwide representative cohort. *Frontiers in Public Health, 9*, 707078. https://doi.org/10.3389/fpubh.2021.707078

19. Retnakaran, R., Ye, C., Hanley, A. J., Connelly, P. W., Sermer, M., Zinman, B., & Hamilton, J. K. (2022). Treating gestational diabetes reduces birth weight but does not affect infant adiposity across the 1st year of life. Diabetes Care, 45(5), 1230–1238. https://doi.org/10.2337/dc21-2640

20. Mina, M. N., Nuruzzaman, M., Habib, M. N., Rahman, M., Chowdhury, F. M., Ahsan, S. N., et al. (2023). The effectiveness of adequate antenatal care in reducing adverse perinatal outcomes: Evidence from a low- or middle-income country. Cureus, 15(12), e51254. https://doi.org/10.7759/cureus.51254

21. Logan, K. M., Gale, C., Hyde, M. J., Santhakumaran, S., & Modi, N. (2017). Diabetes in pregnancy and infant adiposity: systematic review and meta-analysis. *Archives of disease in childhood. Fetal and neonatal edition*, *102*(1), F65–F72. https://doi.org/10.1136/archdischild-2015-309750

22. Panjarwanto, D. A., Restalia, F., Indrawan, I. W. A., Utomo, R. P., & Permana, A. Y. (2024). The Relationship between Antenatal Care Quality and Pregnancy Outcomes: Systematic Literature Review . *JURNAL INFO KESEHATAN*, *22*(4), 792–802. https://doi.org/10.31965/infokes.Vol22.Iss4.1595
23. Zeitlin, J., Saurel-Cubizolles, M. J., de Mouzon, J., & et al. (2002). Fetal sex and preterm birth: Are males at greater risk? *Human Reproduction, 17*(10), 2762–2768.
24. Allen, M. C. (2008). Neurodevelopmental outcomes of preterm infants. *Current Opinion in Neurology, 21*(2), 123–128. https://doi.org/10.1097/WCO.0b013e3282f88bb4
25. Maisels, M. J., & Newman, T. B. (1995). Kernicterus in otherwise healthy, breastfed term neonates. *Pediatrics, 96*(4), 730–733.
26. Jobe, A. H., & Bancalari, E. (2001). Bronchopulmonary dysplasia. American Journal of Respiratory and Critical Care Medicine, 163(7), 1723–1729. https://doi.org/10.1164/ajrccm.163.7.2011060
27. Lawn, J. E., Blencowe, H., Oza, S., You, D., Lee, A. C., Waiswa, P., et al. (2014). Every newborn: Progress, priorities, and potential beyond survival. The Lancet, 384(9938), 189–205. https://doi.org/10.1016/S0140-6736(14)60496-7
28. Horbar, J. D., Badger, G. J., Carpenter, J. H., Fanaroff, A. A., Kilpatrick, S., Tyson, J. E., et al. (2002). Trends in mortality and morbidity for very low birth weight infants, 1991–1999. Pediatrics, 110(1 Pt 1), 143–151. https://doi.org/10.1542/peds.110.1.143
29. Conde-Agudelo, A., Belizán, J. M., & Diaz-Rossello, J. (2011). *Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Cochrane Database of Systematic Reviews, 2011*(3), CD002771. https://doi.org/10.1002/14651858.CD002771.pub2
30. UNICEF & World Health Organization. (2020). *Survive and thrive: Transforming care for every small and sick newborn.* World Health Organization. https://www.who.int/publications/i/item/9789241515887
31. World Health Organization. (2003). *Kangaroo mother care: A practical guide.* World Health Organization. https://apps.who.int/iris/handle/10665/42587
32. Ninan, K., Gojic, A., Wang, Y., Asztalos, E. V., Beltempo, M., Murphy, K. E., & McDonald, S. D. (2023). The proportions of term or late preterm births after exposure to early antenatal corticosteroids, and outcomes: Systematic review and meta-analysis of 1.6 million infants. *BMJ*, *382*, e076035. https://doi.org/10.1136/bmj-2023-076035
33. Van Kaam, A. H., & Keszler, M. (2017). Lung-protective ventilation strategies in neonatology: What do we know—and what do we need to know? *Critical Care Medicine, 45*(7), 1298–1304. https://doi.org/10.1097/CCM.0000000000002361
34. Sweet, D. G., Carnielli, V., Greisen, G., Hallman, M., Ozek, E., Plavka, M., ... & Vento, M. (2017). European consensus guidelines on the management of respiratory distress syndrome: 2016 update. *Neonatology*, *111*(2), 107-125. https://doi.org/10.1159/000448985
35. Roberts, D., & Dalziel, S. R. (2006). Antenatal corticosteroids for accelerating fetal lung maturation in women at risk of preterm birth. *Cochrane Database of Systematic Reviews, 2006*(3), CD004454. https://doi.org/10.1002/14651858.CD004454.pub2
36. Seguritan, M. A. M., & Patdu, C. M. S. (2021). A meta-analysis on the effect of Kangaroo Mother Care on preterm mortality. *Acta Medica Philippina, 55*(9), 968–989. https://doi.org/10.47895/amp.v55i9.3745
37. Barros, F. C., Victora, C. G., Matijasevich, A., Santos, I. S., Horta, B. L., Silveira, M. F., ... & Barros, A. J. D. (2023). *The worldwide health effects of preterm birth: A systematic review*. The Lancet, 382(9904), 1441-1448.
38. Lee, A. C., Katz, J., Blencowe, H., Cousens, S., Kozuki, N., Vogel, J. P., ... & Baqui, A. H. (2013). National and regional estimates of term and preterm babies born small for gestational age in low- and middle-income countries in 2010. *The Lancet Global Health*, *1*(1), e26-e36.
39. Chawanpaiboon, S., Vogel, J. P., Moller, A. B., Lumbiganon, P., Petzold, M., Hogan, D., … & Merialdi, M. (2019). Global, regional, and national estimates of levels of preterm birth in 2014: A systematic review and modelling analysis. *The Lancet Global Health*, *7*(1), e37-e46.
40. World Health Organization. (n.d.). *SDG Target 3.2: End preventable deaths of newborns and children under 5 years of age*. Retrieved from https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/sdg-target-3_2-newborn-and-child-mortality
41. Lawn, J. E., Davidge, R., Paul, V. K., von Xylander, S., de Graft Johnson, J., Costello, A., Kinney, M. V., Segre, J., & Molyneux, E. (2013). Born too soon: Care for the preterm baby. *Reproductive Health, 10*(Suppl 1), S5. https://doi.org/10.1186/1742-4755-10-S1-S5
42. Schmidt, B., Roberts, R. S., Davis, P., Doyle, L. W., Barrington, K. J., Ohlsson, A., & Solimano, A. (2006). Caffeine therapy for apnea of prematurity. *New England Journal of Medicine*, *354*(20), 2112–2121.
43. Royal College of Paediatrics and Child Health. (2022). *Screening of retinopathy of prematurity (ROP): Clinical guideline*. Retrieved from https://www.rcpch.ac.uk/resources/screening-retinopathy-prematurity-rop-clinical-guideline