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Immediate Neonatal Outcomes in Early Neonatal Period in all the Newborns Born at a Tertiary Care Center, Tumkur-A Prospective Observational Study

Dr Pinninti keerthana -Post Graduate, Department of Pediatrics, Sri Siddhartha medical college and hospital, Tumkur-572107

Dr Subraveti Sai ravi kiran-Post Graduate, Department of Pediatrics, Sri Siddhartha medical college and hospital, Tumkur-572107

Dr Aishwarya Basavaraj Hiremath- Post Graduate, Department of Pediatrics, Sri Siddhartha medical college and hospital, Tumkur-572107

Dr Ananda kumar T S- Professor and HOD, Department of Pediatrics,Sri Siddhartha medical college, Tumkur-572107

Corresponding Author: Dr Pinninti keerthana*

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KEYWORDS

Early neonatal period, neonatal morbidity, prematurity, maternal risk factors, birth asphyxia, neonatal mortality.

ABSTRACT:

Background: The early neonatal period is a critical phase associated with a high risk of morbidity and mortality. Immediate neonatal outcomes are influenced by maternal, obstetric, and perinatal factors. Understanding these outcomes in a tertiary care setting is essential for improving neonatal survival and quality of care.

Objectives: To assess immediate neonatal outcomes during the early neonatal period and to evaluate their association with maternal and perinatal risk factors.

Methods: This prospective observational study was conducted among 220 neonates delivered at a tertiary care centre in Tumkur. Maternal demographic details, obstetric risk factors, booking status, mode of delivery, and neonatal parameters were recorded. Neonates were followed during the early neonatal period for the development of complications such as respiratory distress, neonatal jaundice, sepsis, hypoglycemia, congenital pneumonia, birth asphyxia, and mortality. Data were analysed using appropriate descriptive statistics.

Results: Among 220 neonates, the majority had favourable outcomes. The most common neonatal morbidities observed were neonatal jaundice (32.3%), transient tachypnea of the newborn (TTN) (12.27%), hypoglycemia (8.2%), and sepsis (7.7%).Congenital pneumonia (3.18%), birth asphyxia (2.27%) and Respiratory distress syndrome (1.82%) were also observed in a smaller proportion of cases. Most mothers were booked cases (79.5%). The overall neonatal mortality rate was low (0.45%). Prematurity and maternal risk factors such as hypertensive disorders, diabetes, and PROM were associated with increased neonatal morbidity.

Conclusion: Although most neonates had satisfactory early outcomes, preventable morbidities were observed, particularly among high-risk pregnancies. Strengthening antenatal care, early risk identification, and timely neonatal interventions are crucial to further reduce neonatal morbidity and sustain low mortality rates.

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INTRODUCTION

The neonatal period, defined as the first 28 days of life, is the most vulnerable phase in the life of a child and contributes significantly to under-five mortality worldwide (1). The early neonatal period (first 7 days of life) is particularly critical, as the majority of neonatal deaths occur during this time due to preventable or manageable causes such as prematurity, birth asphyxia, infections, and metabolic disturbances (1).

Globally, despite substantial improvements in child survival, neonatal mortality remains a major public health challenge. Recent global estimates indicate that approximately 2.3 million neonatal deaths occur annually, with the highest burden in low- and middle-income countries (2). India continues to contribute a significant proportion of global neonatal deaths, although there has been a steady decline due to strengthened maternal and child health programs and increased institutional deliveries (3).

Immediate neonatal outcomes are influenced by multiple maternal, obstetric, and neonatal factors. Maternal conditions such as pregnancy-induced hypertension (PIH), gestational diabetes mellitus (GDM), anemia, hypothyroidism, premature rupture of membranes (PROM), and maternal infections have been shown to significantly affect neonatal morbidity and mortality (4–6). These risk factors may predispose neonates to complications including respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), neonatal sepsis, hypoglycemia, neonatal jaundice, meconium aspiration syndrome (MAS), and hypoxic-ischemic encephalopathy (HIE) (7–9).

Prematurity is one of the most important determinants of adverse early neonatal outcomes. Preterm neonates are at increased risk of respiratory complications, feeding difficulties, hypoglycemia, infections, and the need for intensive care admission when compared to term neonates (10). In addition, perinatal factors such as mode of delivery, adequacy of antenatal care, and intrapartum complications also play a crucial role in determining early neonatal outcomes (11).

Understanding the spectrum of immediate neonatal outcomes and their association with maternal and perinatal risk factors in a tertiary care setting is essential for early identification of high-risk neonates and strengthening neonatal care services. Local epidemiological data are particularly important for planning targeted interventions and optimizing neonatal healthcare resources.

Hence, the present prospective observational study was undertaken to assess the immediate neonatal outcomes in the early neonatal period among all newborns delivered at a tertiary care center in Tumkur and to evaluate their association with maternal and perinatal risk factors.

MATERIALS AND METHODS

Study Design and Setting

This prospective, hospital-based comparative study was conducted in the Department of Paediatrics at a tertiary care centre in Tumkur over a period of 24 months. The study was initiated after obtaining approval from the Institutional Ethics Committee. All live-born neonates delivered at the tertiary care centre during the study period were screened for eligibility based on predefined inclusion and exclusion criteria.

Study Population

All newborn babies born at the tertiary care centre during the study period were considered for inclusion.

Inclusion Criteria:

- All live-born neonates delivered at the tertiary care centre, Tumkur.

Exclusion Criteria:

- Neonates with major congenital anomalies.

Sample Size Calculation

The sample size was calculated based on the primary outcome variable, neonatal mortality, using the standard formula for prevalence studies:

$$n = \frac{Z^2 \times P \times (1 - P)}{D^2}$$

Where:

- n = required sample size

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- Z = standard normal deviate at 95% confidence level (1.96)
- P = estimated prevalence of neonatal mortality
- D = absolute precision

The estimated prevalence of neonatal mortality was taken as 2.12% (P = 0.0212). With an absolute precision of 2% (D = 0.02), the minimum required sample size was calculated to be 199 neonates. After accounting for a 10% potential dropout rate, the final sample size was rounded to 220 neonates.

Ethical Considerations

Detailed information regarding the objectives and procedures of the study was explained to the parents or legal guardians of eligible neonates. Written informed consent was obtained prior to enrolment. Confidentiality of patient information was strictly maintained throughout the study. No additional investigations or interventions were carried out exclusively for research purposes, and no extra financial burden was imposed on participants.

Data Collection

A pre-structured and pre-validated proforma was used to collect and document relevant maternal, perinatal, and neonatal data. Maternal and neonatal variables included birth order, gestational age, sex of the newborn, mode of delivery, requirement of initial resuscitation, and any difficulty in initiation of breastfeeding. Data were obtained from hospital records and verified with mothers whenever feasible to ensure accuracy.

Follow-Up and Outcome Assessment

All enrolled neonates were followed up for the first seven postnatal days to assess immediate neonatal outcomes. The outcomes monitored included hypoglycemia, hypothermia, neonatal jaundice, transient tachypnea of the newborn, respiratory distress syndrome, birth asphyxia, meconium aspiration syndrome, neonatal sepsis, and neonatal mortality.

Neonates discharged before completion of seven days were advised to attend the well-baby clinic on the seventh day for follow-up evaluation. For those unable to return, telephonic follow-up was conducted to obtain information regarding the neonate's health status and any complications.

Investigations

Laboratory investigations such as Complete Blood Count (CBC), C-reactive protein (CRP), and Random Blood Sugar (RBS) were performed only when clinically indicated as part of routine neonatal care. These investigations were not conducted solely for research purposes and were carried out according to standard hospital protocols.

Statistical Analysis

All collected data were entered into Microsoft Excel and analysed using Epi Info software (version 7.2.5). Continuous variables were summarised as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. The association between categorical variables was assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant. Additional appropriate statistical tests were applied based on the distribution and nature of the variables to compare neonatal outcomes between relevant groups.

RESULTS AND OBSERVATIONS;

Table 1. Distribution of "Maternal Age"

Maternal age	Frequency (n)	Percentage (%)
<20 years	67	30.45
20-35 years	140	63.64
>35 years	13	5.91
Total	220	100.00

Table 2. Distribution of Parity and Booking Status (n = 220)

Variable	Category	Frequency (n)	Percentage (%)
Parity	Multi	121	55.0

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	Primi	**99**	**45.0**
	Total	**220**	**100.0**
Booking Status	**Booked**	**175**	**79.5**
	Unbooked	**45**	**20.5**
	Total	**220**	**100.0**

Table 3. Distribution of Maternal Risk Factors (n = 220)

Variable	Category	Frequency (n)	Percentage (%)
Pregnancy-Induced Hypertension	Yes	27	12.30
	No	193	87.70
	Total	**220**	**100.0**
Gestational Diabetes Mellitus	Yes	19	8.60
	No	201	91.40
	Total	**220**	**100.0**
Anemia	Yes	71	32.30
	No	149	67.70
	Total	**220**	**100.0**
Hypothyroidism	Yes	27	12.27
	No	193	87.73
	Total	**220**	**100.0**
Premature Rupture of Membranes	Yes	29	13.20
	No	191	86.80
	Total	**220**	**100.0**
Maternal Fever	Yes	10	4.50
	No	210	95.50
	Total	**220**	**100.0**

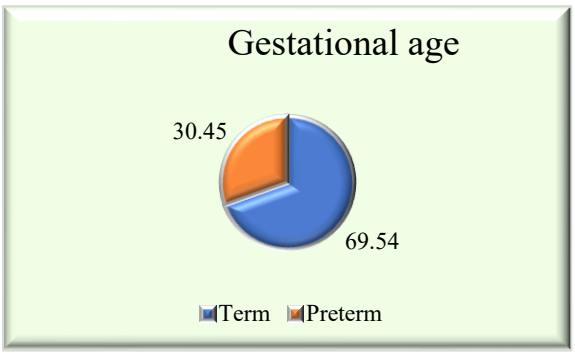

Figure 1. Distribution of gestational age

Table 4. Distribution of the Mode of Delivery

Mode of delivery	Frequency (n)	Percentage (%)
Lower segment caesarean section	174	79.09
Vaginal delivery	40	18.18
Instrumental	6	2.70
Total	220	100.0

Table 5. Distribution of Neonatal Morbidities (n = 220)

Variable	Category	Frequency (n)	Percentage (%)
Respiratory Distress Syndrome (RDS)	Yes	4	1.82
	No	216	98.18
	Total	**220**	**100.0**
Neonatal	Yes	17	7.70

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Sepsis			
	No	203	92.30
	Total	**220**	**100.0**
Transient Tachypnea of the Newborn (TTN)	Yes	27	12.27
	No	193	87.73
	Total	**220**	**100.0**
Meconium Aspiration Syndrome (MAS)	Yes	5	2.27
	No	215	97.73
	Total	**220**	**100.0**
Neonatal Jaundice (NNJ)	Yes	71	32.30
	No	149	67.70
	Total	**220**	**100.0**
Hypoglycemia	Yes	18	8.20
	No	202	91.80
	Total	**220**	**100.0**

Table 6. Distribution of Additional Neonatal Outcomes (n = 220)

Variable	Sub-category	Frequency (n)	Percentage (%)
Congenital Pneumonia	Yes	7	3.18
	No	213	96.82
	Total	**220**	**100.0**
Birth Asphyxia	HIE	3	1.36
	No HIE	2	0.93
	No	215	97.73
	Total	**220**	**100.0**
Mortality	Yes	1	0.45
	No	219	99.55
	Total	**220**	**100.0**

Table 7. Association Between Gestational Age and Perinatal/Neonatal Outcomes (n = 220)

Variable	Category	Preterm n = 67 (%)	Term n = 153 (%)	P-value
Mode of Delivery	LSCS	57 (85.07)	117 (76.47)	0.625
	Vaginal Delivery	8 (11.94)	32 (20.91)	
	Instrumental	2 (2.98)	4 (2.61)	
Respiratory Distress Syndrome	Yes	4 (5.97)	0 (0.00)	<0.001
	No	63 (94.03)	153 (100.00)	
Sepsis	Yes	5 (7.46)	12 (7.84)	1.000
	No	62 (92.54)	141 (92.16)	

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Transient Tachypnea of the Newborn	Yes	0 (0.00)	27 (17.65)	0.586
	No	67 (100.00)	126 (82.35)	
Meconium Aspiration Syndrome	Yes	4 (5.97)	1 (0.65)	0.024
	No	63 (94.02)	152 (99.35)	
Neonatal Jaundice	Yes	36 (53.73)	35 (22.88)	0.002
	No	31 (46.27)	118 (77.12)	
Hypoglycemia	Yes	14 (20.90)	4 (2.62)	<0.001
	No	53 (79.10)	149 (97.38)	
Congenital Pneumonia	Yes	4 (5.97)	3 (1.96)	0.119
	No	63 (94.03)	150 (98.04)	
Hypoxic Ischemic Encephalopathy (HIE)	Yes	2 (2.99)	1 (0.65)	0.176
	No	65 (97.01)	152 (99.35)	
Disposition	Discharged to Mother's Side	33 (49.25)	130 (84.97)	<0.001
	Admitted to ICU	34 (50.75)	23 (15.03)	

Table 8. Association of Maternal Risk Factors with Neonatal Outcomes (n = 220)

Neonatal Outcome	Maternal Age (<20 / 20–35 / >35) n (%)	P	PIH (Yes / No) n (%)	P	Anemia (Yes / No) n (%)	P	Hypothyroidism (Yes / No) n (%)	P	PROM (Yes / No) n (%)	P	Maternal Fever (Yes / No) n (%)	P	GDM* (Yes / No) n (%)	P
RDS (n=4)	1 / 2 / 1	0.340	1 / 3	0.701	1 / 3	0.570	0 / 4	0.607	3 / 1	0.426	1 / 3	0.514	1 / 3	1.000
Sepsis (n=17)	5 / 11 / 1	0.977	0 / 17	0.237	6 / 11	0.791	0 / 17	0.606	6 / 11	0.014	3 / 14	0.033	0 / 17	0.373
TTN (n=27)	8 / 10 / 2	0.536	12 / 15	<0.001	17 / 10	0.038	0 / 27	1.000	0 / 27	1.000	0 / 27	1.000	5 / 22	0.061

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MAS (n=5)	1 / 3 / 1	0.218	0 / 5	1.000	3 / 2	0.596	0 / 5	1.000	1 / 4	0.434	0 / 5	1.000	0 / 5	1.000
NNJ (n=71)	20 / 48 / 3	0.519	9 / 62	1.000	22 / 49	0.878	3 / 68	0.556	12 / 59	0.289	5 / 66	0.298	6 / 65	1.000
Hypoglycemia (n=18)	6 / 11 / 1	0.582	1 / 17	0.705	8 / 10	0.294	0 / 18	0.607	3 / 15	0.714	0 / 18	1.000	6 / 12	0.002
Congenital Pneumonia (n=7)	2 / 4 / 1	0.401	1 / 6	0.421	4 / 3	0.238	0 / 7	0.606	3 / 4	0.068	2 / 5	0.041	1 / 6	0.514
Birth Asphyxia (n=3)	1 / 2 / 0	0.781	0 / 3	1.000	2 / 1	0.566	0 / 3	1.000	1 / 2	0.531	1 / 2	0.173	0 / 3	1.000
ICU Admission (n=57)	20 / 35 / 2	0.452	2 / 55	0.018	20 / 37	0.624	0 / 57	0.023	10 / 47	0.262	6 / 51	0.021	4 / 53	0.787

DISCUSSION

The present study evaluated immediate neonatal outcomes in the early neonatal period and their association with maternal and perinatal risk factors in a tertiary care setting. The findings demonstrate that although the majority of neonates had favorable outcomes, a proportion developed complications such as respiratory distress, neonatal jaundice, sepsis, hypoglycemia, congenital pneumonia, birth asphyxia, and hypoxic-ischemic encephalopathy (HIE). The overall mortality rate observed in this study was very low, indicating effective perinatal and neonatal care services.

Neonatal morbidity remains a major contributor to under-five mortality globally, particularly in low- and middle-income countries (1). The World Health Organization estimates that a significant proportion of neonatal deaths occur within the first week of life, primarily due to prematurity, birth asphyxia, and infections (1). The low mortality rate observed in the present study may be attributed to improved antenatal care coverage, institutional deliveries, early identification of high-risk pregnancies, and timely neonatal interventions.

Prematurity is widely recognized as one of the strongest predictors of adverse neonatal outcomes (2). Preterm neonates are at increased risk of respiratory distress syndrome (RDS), hypoglycemia, sepsis, feeding intolerance, and need for NICU admission (3). In our study, respiratory complications were among the common early neonatal morbidities, which is consistent with previous reports highlighting respiratory distress as a leading cause of NICU admissions (4). The association between prematurity and respiratory morbidity has been well documented due to surfactant deficiency and structural lung immaturity (3,4).

Maternal conditions such as pregnancy-induced hypertension (PIH), gestational diabetes mellitus (GDM), anemia, and premature rupture of membranes (PROM) significantly influence neonatal outcomes (5,6). Hypertensive disorders are associated with intrauterine growth restriction, preterm birth, and perinatal asphyxia (5). Similarly, maternal diabetes increases the risk of neonatal hypoglycemia, respiratory distress, and macrosomia (6). PROM predisposes neonates to early-onset sepsis and congenital pneumonia due to ascending infections (7). The occurrence of congenital pneumonia and neonatal sepsis

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in the present study aligns with these established risk factors.

Birth asphyxia and HIE remain important causes of neonatal morbidity and long-term neurological impairment (8). Although only a small percentage of neonates in the present study developed HIE, its presence underscores the importance of effective intrapartum monitoring and timely obstetric intervention. Studies have shown that improved labour surveillance and neonatal resuscitation significantly reduce asphyxia-related morbidity and mortality (9).

Neonatal jaundice and hypoglycemia were also observed among early complications. Physiological immaturity of hepatic enzyme systems and increased red cell turnover predispose neonates to hyperbilirubinemia, particularly in preterm infants (3). Early detection and management are crucial to prevent complications such as kernicterus. Similarly, hypoglycemia is more common in preterm infants, infants of diabetic mothers, and low birth weight neonates (6).

The very low mortality rate observed in this study reflects advancements in neonatal intensive care, adherence to standard treatment protocols, and improved referral systems. Institutional delivery and adequate booking status are known to significantly improve neonatal survival by enabling early risk identification and management (10). The high proportion of booked cases in the present study may have contributed to favourable outcomes.

Overall, the findings of this study are comparable with national and global trends, which show declining neonatal mortality but persistent neonatal morbidity due to preventable causes (1,10). Strengthening antenatal care, early detection of high-risk pregnancies, skilled birth attendance, and timely neonatal resuscitation remain key strategies for further improving neonatal outcomes.

CONCLUSION

Most neonates in the present study had favourable early outcomes; however, complications such as respiratory distress, sepsis, jaundice, hypoglycemia, congenital pneumonia, and birth asphyxia were observed, particularly among preterm infants and those with maternal risk factors.

The very low mortality rate reflects effective antenatal care, institutional deliveries, and quality neonatal services. Strengthening early risk identification and timely perinatal interventions remains essential to reduce neonatal morbidity further further and improve outcomes.

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