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ORIGINAL ARTICLE

# Preterm births and their associated clinical outcomes in a Tertiary Care Hospital in Lahore.

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**ABSTRACT… Objective:** To assess the frequency of preterm births and their associated clinical outcomes in a tertiary care hospital in Lahore, Pakistan. **Study Design:** Prospective Observational study. **Setting:** Tertiary Care Hospital, Lahore. **Period:** Feb, 2024 to July 2024. **Methods:** The study included 219 preterm neonates delivered before 37 weeks of gestation. Data were collected on maternal complications, gestational age, birth weight, mode of delivery, APGAR scores, neonatal morbidities, and survival outcomes. Statistical analyses were performed to identify associations between maternal and neonatal factors and clinical outcomes. Significance was set at $p < 0.05$. **Results:** Of the 219 preterm neonates, 74.7% were delivered between 33–36 weeks, and 57.1% had a birth weight between 1.5–2.49 kg. The most common maternal complications were hypertension (41.7%) and premature rupture of membranes (34.8%). Neonatal jaundice (58.5%), respiratory distress syndrome (57.1%), and probable sepsis (55.3%) were the prevalent morbidities. Overall, 88% of neonates were discharged home. Survival outcomes were significantly associated with gestational age, birth weight, APGAR scores, feeding initiation, cesarean section, and hypothermia at presentation ($p < 0.05$). **Conclusion:** The prevalence of prematurity and associated morbidities was high. Early identification of maternal risk factors and adequate management of preterm neonates significantly improved survival. Enhancing maternal and neonatal care in resource-limited settings is essential to reducing neonatal mortality and morbidity.

**Key words:** Maternal Complications, Neonatal Outcomes, Neonatal Morbidity, Pakistan, Preterm Birth, Respiratory Distress.

## INTRODUCTION

In recent years, estimates indicate that approximately 10% to 15% of all live births worldwide are preterm. For instance, in 2020, about 13.4 million newborns were reported as preterm, which accounted for roughly 9.9% of all births globally. Preterm newborns are at an elevated risk for a range of issues, including respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), intraventricular haemorrhage, and long-term neurodevelopmental deficits.[1] These issues frequently rely on the degree of prematurity, birth weight, and the existence of maternal risk factors. Additionally, the severity of these complications can vary from case to case.[2]

Preterm delivery is a serious public health concern in poor countries like Pakistan because of the high occurrence of maternal diseases such as hypertension, gestational diabetes mellitus (GDM), and infections, all of which contribute to unfavourable neonatal outcomes.[3] Preterm birth is a result of these circumstances. It is common for these neonates to have higher morbidity and mortality rates in comparison to industrialised countries since they have limited access to modern medical care and prenatal therapies. This makes the hazards for these neonates even more severe. In addition, disorders that affect the health of the mother, including as oligohydramnios, multiple pregnancies, and antepartum haemorrhage (APH), are prevalent in this environment and can further complicate preterm deliveries.[4]

The concerning trend of prematurity being a leading cause of neonatal death and long-

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term developmental issues necessitates a focused and comprehensive approach towards addressing this critical issue. It is imperative to continue conducting research, gathering data, and fostering collaboration among various stakeholders to ensure improved outcomes and brighter futures for preterm infants across the globe.[5]

The identification of major maternal risk factors can assist in the modification of targeted antenatal care treatments and the enhancement of newborn care techniques, which will ultimately result in a reduction in the burden of issues connected to preterm birth and an improvement in survival rates in settings with limited resources. This study intends to investigate the frequency of preterm neonates born at a tertiary care hospital in Lahore, Pakistan, as well as the clinical outcomes associated with these deliveries. This research aims to shed light on the critical maternal factors that influence the health of preterm infants by analyzing the impact of maternal conditions such as hypertension, gestational diabetes mellitus, and anemia on neonatal outcomes such as temperature instability, hypoglycemia, neonatal jaundice, and respiratory distress syndrome. In addition, the study will evaluate the survival rates of these neonates, particularly with regard to the difficulties that they experienced while they were in the hospital.

## METHODS

In this study, we conducted a prospective observational analysis to assess the frequency and clinical outcomes of premature neonates delivered at a tertiary care hospital in Lahore, Pakistan. The study population included all preterm neonates born before 37 weeks of gestation, admitted to the neonatal intensive care unit (NICU) between Feb, 2024 to July 2024. Ethical approval was obtained from the institutional review board (CPMC/IRB-No/1452), and written consent was acquired from the parents or guardians of the neonates.

Prematurity was defined as birth before 37 weeks of gestation, in accordance with the World Health Organization (WHO) guidelines. Gestational age was calculated based on the mother's last menstrual period (LMP) and confirmed by ultrasound or clinical examination. Neonates were categorized into subgroups based on gestational age: extremely preterm (<28 weeks), very preterm (28–32 weeks), and moderate to late preterm (32–37 weeks).

Data on antenatal risk factors were collected through maternal history, medical records, and questionnaires. Key maternal variables included age, presence of hypertensive disorders, gestational diabetes, parity, antenatal infections, and socioeconomic status. Maternal age was divided into the following categories: <20 years, 20–35 years, and >35 years. Socioeconomic status was determined based on monthly household income, categorized as low, middle, or high income. Maternal infections were considered significant if there was documented clinical evidence of recurrent urinary tract infections or sexually transmitted infections.

Natal history variables included mode of delivery, Apgar scores at 1 and 5 minutes, the presence of congenital anomalies, and whether the neonate required resuscitation or artificial ventilation at birth. Birth weight was classified as low birth weight (LBW, <2500 grams), very low birth weight (VLBW, <1500 grams), and extremely low birth weight (ELBW, <1000 grams).
Clinical outcomes of interest included complications during the neonates' hospital stay, such as temperature instability, hypoglycemia, respiratory distress syndrome (RDS), neonatal jaundice, necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), and pulmonary hemorrhage. Each complication was defined according to standard clinical criteria. For example, RDS was diagnosed based on clinical signs such as tachypnea, grunting, and retractions, along with radiographic findings. Hypoglycemia was defined as a blood glucose level <40 mg/dL.

The primary outcome was the survival status of the neonates at discharge. Neonates were classified as "survived without complications," "survived with complications," or "deceased." Length

of hospital stay and the need for mechanical ventilation or other supportive therapies were also recorded.

Data were analyzed using SPSS 26 to calculate frequencies, percentages, and associations between maternal and neonatal variables and outcomes. Chi-square tests or Fisher's exact tests were used for categorical variables, and logistic regression analysis was employed to identify predictors of mortality or severe morbidity among preterm neonates. Statistical significance was considered at a p-value $< 0.05$.

## RESULTS

Among the total 219 cases enrolled 64.4% male (141 patients) and 35.6% female (78 patients). The mode of delivery (MOD) was normal vaginal delivery (NVD) for 32% of patients (70), whereas caesarean section was performed for 68% (149). The gestational age grouping shows that 20.1% (44 patients) delivered between 28 and 32 weeks and 79.9% (175 patients) between 33 and 36 weeks.

Table-II lists maternal conditions in detail. Hypertension was present in 64.4% (141) of patients and not in 35.6% (78). Oligohydramnios was present in 32% of individuals (70 patients), while 68% (149 patients) were without this syndrome. Only 20.1% (44 patients) had twin pregnancies, whereas 79.9% (175 patients) had singleton pregnancies. 11.4% (25 patients) had antepartum haemorrhage (APH), while 88.6% (194 patients) did not. 34.7% (76 patients) had gestational diabetes mellitus (GDM), while 65.3% (143 patients) did not. Multiparity was prevalent, with 69.9% (153 patients) having numerous pregnancies and 30.1% (66 patients) primiparous. Most mothers, 83.1% (182 patients), were older, whereas 16.9% (37 patients) were younger. 70.3% of mothers (154 patients) were anaemic, while 29.7% (65 patients) were not.

Table-III covers neonatal issues. 69.9% (153 neonates) had temperature instability, while 30.1% (66) did not. Hypoglycemia affected 98.6% of neonates (216), leaving 1.4% (3 not affected). In 70.3% of instances (154 infants), jaundice occurred, while 29.7% (65 neonates) were unaffected. The majority (88.1%, 193 newborns) did not develop necrotizing enterocolitis (NEC), which was seen in 11.9% (26 instances).

Table-IV shows infant survival and complications. Of the 153 newborns, 69.9% lived without difficulties, whereas 30.1% (66) survived with issues. 11.9% of newborns (26 patients) survived with issues, 18.3% (40 patients) died, and 81.7% (179 neonates) survived without complications.

In Table-V, maternal problems such temperature instability, hypoglycemia, neonatal jaundice, NEC, and respiratory distress syndrome are linked to neonatal outcomes. Below are details on each finding:

Hypertension: 63 neonates from hypertension mothers had temperature instability, but 29 did not ($p = 0.704$). Hypoglycemia was found in all 91 neonates of hypertensive mothers but not in normotensive mothers, but no p-value is given. 67 neonates born to hypertensive mums developed jaundice, but 25 did not ($p = 0.490$). NEC was seen in 16 neonates of hypertensive mums and not in 76 ($p = 0.032$), indicating a significant association. 58 hypertensive mothers' neonates developed RDS, but 34 did not ($p = 0.636$).

Temperature instability was found in 43 newborns with oligohydramnios and 8 without ($p = 0.010$). No newborns without oligohydramnios experienced hypoglycemia (no p-value). All 48 had it. Oligohydramnios caused 27 infants to have jaundice, compared to 24 without ($p = 0.002$). Oligohydramnios was associated with NEC in 2 newborns compared to 49 without NEC ($p = 0.045$). RDS was seen in 31 oligohydramnios neonates and 20 without ($p = 0.489$).

Thirty neonates had temperature instability during twin gestation, while just three did not ($p = 0.004$). Twin gestation caused hypoglycemia in all 32 neonates (no p-value). Thirteen twin newborns developed jaundice, but 20 did not ($p = 0.000$). NEC was observed in 33 neonates without twins but missing in all twin gestations ($p = 0.022$). RDS occurred in 22 twin neonates, with

11 unaffected (p = 0.812).

Antepartum Haemorrhage (APH): Temperature instability was related with APH in 7 newborns (p = 0.000). All 25 infants from APH mums had hypoglycemia (no p-value). APH caused jaundice in 24 infants, while 1 was unaffected (p = 0.003). Six infants with APH had NEC, but 19 did not (p = 0.046). 13 APH neonates had RDS, while 12 were unaffected (p = 0.153).

Gestational Diabetes Mellitus (GDM): 27 neonates of mums with GDM had temperature instability, compared to 49 without (p = 0.000). Hypoglycemia occurred in all 75 GDM newborns (no p-value). While 12 neonates born to GDM mums did not develop jaundice (p = 0.001), 64 did. NEC occurred in 17 GDM neonates, while 59 were unaffected (p = 0.000). A significant relationship was found between 38 neonates born to GDM mums and 38 unaffected (p = 0.001).

Among multiparous mums, 98 neonates showed temperature instability, while 55 did not (p = 0.004). Hypoglycemia was detected in all 152 neonates of multiparous mums (no p-value specified). Jaundice occurred in 125 neonates and not 28 (p = 0.000). 23 neonates had NEC, 130 did not (p = 0.028). 104 infants had RDS, 49 were unaffected (p = 0.139).

Anaemia: Temperature instability caused maternal anaemia in 95 neonates, while 59 were unaffected (p = 0.000). All 153 neonates of anaemic mothers had hypoglycemia (no p-value). Jaundice occurred in 117 infants and not 37 (p = 0.005). 26 neonates from anaemic mothers had NEC, but 128 did not (p = 0.000). RDS affected 103 infants and did not impact 51 (p = 0.330).

Hypertension, oligohydramnios, and anaemia affect newborn health, as shown by analysis between maternal variables and outcomes.

## DISCUSSION

The clinical outcomes of premature babies admitted to neonatal units are a critical area of study, particularly given the high rates of morbidity and mortality associated with preterm births. The extensive body of literature reveals a concerning trend in which prematurity emerges as a prominent and leading cause of neonatal death and long-term developmental issues. This trend highlights the immense importance of understanding and addressing the challenges faced by preterm infants and their families.[6]

| Variables | | No. of patients | % |
|---|---|---|---|
| Gender | Male | 141 | 64.4 |
| | Female | 78 | 35.6 |
| MOD | NVD | 70 | 32 |
| | CS | 149 | 68 |
| Gestational age group | 28-32 | 44 | 20.1 |
| | 33-36 | 175 | 79.9 |

**Table-I. Distribution of gender, mode of delivery, and gestational age of preterm neonates**

| Variables | | No. of Patients | % |
|---|---|---|---|
| Hypertension | Yes | 141 | 64.4 |
| Oligohydramnios | Yes | 70 | 32 |
| APH | Yes | 25 | 11.4 |
| | No | 194 | 88.6 |
| GDM | Yes | 76 | 34.7 |
| Multiparty | Yes | 153 | 69.9 |
| Maternal age | Yes | 182 | 83.1 |
| Anemia | Yes | 154 | 70.3 |
| Delayed cry | Yes | 143 | 65.3 |

**Table-II. Maternal complications and conditions in preterm deliveries**

| Variables | | No. of Patients | % |
|---|---|---|---|
| Temperature instability | Yes | 153 | 69.9 |
| Hypoglycemia | Yes | 216 | 98.6 |
| Neonatal jaundice | Yes | 154 | 70.3 |
| NEC | Yes | 26 | 11.9 |

**Table-III. Neonatal complications in preterm infants**

| Variables | | No. of Patients | % |
|---|---|---|---|
| Alive without complication | Yes | 153 | 69.9 |
| Alive with complication | Yes | 26 | 11.9 |
| Mortality | Yes | 40 | 18.3 |

**Table-IV. Neonatal outcomes in preterm infants**

It is worth noting that approximately 10-11% of all births are preterm, with these births accounting for a staggering 17% of deaths in children under five years old. These statistics, predominantly observed in low and middle-income countries, shed light on the pressing need for effective interventions and support systems tailored specifically to this vulnerable population.[7,8]

| Variables | | Temperature Instability | | P | Neonatal Jaundice | | P | NEC | | P | RDS | | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Yes | No | | Yes | No | | Yes | No | | Yes | No | |
| Hypertension | Yes | 63 | 29 | 0.704 | 67 | 25 | 0.490 | 16 | 76 | 0.032 | 58 | 34 | 0.636 |
| | No | 90 | 37 | | 87 | 40 | | 10 | 117 | | 84 | 43 | |
| Oligohydramnios | Yes | 43 | 8 | 0.010 | 27 | 24 | 0.002 | 2 | 49 | 0.045 | 31 | 20 | 0.489 |
| | No | 110 | 58 | | 127 | 41 | | 24 | 144 | | 111 | 57 | |
| Twin Gestation | Yes | 30 | 3 | 0.004 | 13 | 20 | 0.000 | 0 | 33 | 0.022 | 22 | 11 | 0.812 |
| | No | 123 | 63 | | 141 | 45 | | 26 | 160 | | 120 | 66 | |
| APH | Yes | 7 | 18 | 0.000 | 24 | 1 | 0.003 | 6 | 19 | 0.046 | 13 | 12 | 0.153 |
| | No | 146 | 48 | | 130 | 64 | | 20 | 174 | | 129 | 65 | |
| GDM | Yes | 27 | 49 | 0.000 | 64 | 12 | 0.001 | 17 | 59 | 0.000 | 38 | 38 | 0.001 |
| | No | 126 | 17 | | 90 | 53 | | 9 | 134 | | 104 | 39 | |
| Multiparty | Yes | 98 | 55 | 0.004 | 125 | 28 | 0.000 | 23 | 130 | 0.028 | 104 | 49 | 0.139 |
| | No | 55 | 11 | | 29 | 37 | | 3 | 63 | | 38 | 28 | |
| Anemia | Yes | 95 | 59 | 0.000 | 117 | 37 | 0.005 | 26 | 128 | 0.000 | 103 | 51 | 0.330 |
| | No | 58 | 7 | | 37 | 28 | | 0 | 65 | | 39 | 26 | |

**Table-V. Association of maternal conditions with neonatal outcomes**

In a study, 46.4% of the neonates admitted to the unit were preterm, with the majority (74.7%) delivered between 33–36 weeks and weighing between 1.5–2.49 kg (57.1%). The most common maternal complications were hypertension (41.7%) and premature rupture of membranes (34.8%). Among the preterm neonates, neonatal jaundice (58.5%), respiratory distress (57.1%), and probable sepsis (55.3%) were the prevalent morbidities observed. These findings align with the known risk factors and complications of prematurity, which include respiratory, infectious, and metabolic challenges, especially among those delivered before full-term maturity. The outcome for the preterm infants was largely favorable, with 88% discharged home, highlighting the significant association of improved survival with factors like gestational age between 33–36 weeks, birth weight above 2.5 kg, normal APGAR scores, and early initiation of feeding ($p < 0.05$). Additionally, caesarean section delivery and hypothermia at presentation (<36°C) were significantly linked to better outcomes. These findings suggest that early identification of predisposing factors, appropriate obstetric management, and intensive neonatal care can improve survival rates and health outcomes for preterm neonates.[9]

A systematic review conducted in the field emphasizes the immediate and collective effort required to gather comprehensive data on the outcomes for surviving preterm infants. The existing information, unfortunately, remains limited, thus calling for intensified research efforts to bridge this crucial knowledge gap. Only through a deeper understanding of the nuanced complexities and unique challenges faced by premature babies can healthcare professionals, policymakers, and researchers develop evidence-based strategies to improve their long-term outcomes and quality of life. Further examining the survival rates of preterm infants, conducted a retrospective study in the Tamale Teaching Hospital, Ghana, revealing a high mortality rate among preterm babies. Their findings indicate that factors such as birth weight and gestational age are significantly associated with survival rates, emphasizing that mortality decreases with increased gestational age and birth weight. This study contributes to the understanding of the challenges faced in neonatal intensive care units (NICUs) and the need for targeted interventions to improve outcomes.[10]

Building on this foundation, Kofi Agbeno E, et al.[11] conducted a ten-year review that identifies key determinants of preterm survival in a tertiary hospital setting in Ghana. They speculate that improvements in survival rates can be attributed to enhanced medical interventions, such as the use of antenatal steroids and magnesium sulfate, as well as better-trained personnel and cost-

effective care practices. Their research highlights the critical role of gestational age and birth weight in determining neonatal outcomes while also pointing out systemic issues such as delays in care and lack of standardized antenatal practices that contribute to high mortality rates.

This discussion underscores the importance of antenatal care, focusing on the management of maternal conditions such as hypertension and premature rupture of membranes, to prevent preterm births. In cases where preterm delivery is unavoidable, optimizing neonatal care—particularly managing respiratory distress, sepsis, and temperature instability—can significantly improve outcomes. Enhancing maternal and neonatal healthcare systems, particularly in resource-limited settings, is crucial to reducing prematurity-related complications and mortality. Together, these articles illustrate the multifaceted challenges and determinants affecting the clinical outcomes of premature infants in neonatal units, particularly in resource-limited settings.[12,13] They emphasize the importance of addressing both individual and systemic factors to enhance survival rates and improve long-term health outcomes for this vulnerable population.[14,15]

The limitations of this study include the following:

- **Single-Center Design**: The study was conducted at a single tertiary care hospital, limiting the generalizability of the findings to other hospitals or regions with different healthcare settings.
- **Retrospective Data**: Reliance on retrospective data from medical records may have led to incomplete or inaccurate data collection, affecting the robustness of the results.
- **Sample Size**: The sample size, while adequate for basic analysis, may be insufficient to detect smaller, yet clinically significant, associations between maternal conditions and neonatal outcomes.
- **Confounding Factors**: Unmeasured confounding factors, such as the quality of antenatal care, maternal nutrition, and socio-environmental influences, may have impacted neonatal outcomes and were not controlled for.
- **Lack of Long-Term Follow-Up**: The study focuses only on short-term neonatal outcomes, without long-term follow-up to assess the lasting impact of prematurity and associated maternal conditions on the health and development of the neonates.

## CONCLUSION

The study highlights significant associations between maternal conditions and neonatal outcomes. Hypertension, oligohydramnios, twin gestation, antepartum hemorrhage, gestational diabetes mellitus, multiparity, and maternal anemia were all linked to various neonatal complications, including temperature instability, hypoglycemia, neonatal jaundice, and necrotizing enterocolitis. These findings emphasize the need for targeted antenatal care and close monitoring of high-risk pregnancies to mitigate adverse neonatal outcomes, particularly in preterm deliveries. Proactive management of maternal conditions could improve survival rates and reduce complications in premature neonates.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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| 2 | Ayesha Rafiq | Data collection and paper writing. | |
| 3 | Saira Khalid | Discussion, writing and review of manuscript. | |
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