

Assessment of Maternal Risk Factors and Neonatal Outcomes Associated with Preterm Birth: A Retrospective Study

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Abstract:

Background: Preterm birth, defined as delivery before 37 completed weeks of gestation, is a major cause of neonatal morbidity and mortality. Maternal medical and obstetric complications substantially influence neonatal outcomes, highlighting the need for early identification of high-risk pregnancies.

Aim: To assess maternal risk factors associated with preterm birth and evaluate neonatal outcomes among preterm infants.

Methodology: A retrospective observational hospital-based study was conducted in the Department of Pediatrics, Vardhman Institute of Medical Sciences, Pawapuri, Bihar. Eighty eligible maternal-neonatal records were reviewed. Maternal risk factors, obstetric characteristics, and neonatal outcomes were analyzed using SPSS version 27.0, with $p < 0.05$ considered statistically significant.

Results: Anemia (47.5%) was the most common maternal risk factor, followed by pregnancy-induced hypertension (27.5%) and premature rupture of membranes (25%). Late preterm births (34–36 weeks) constituted 45% of cases. Low birth weight (82.5%) and NICU admission (67.5%) were the most frequent neonatal outcomes. Respiratory distress syndrome occurred in 32.5% of neonates, while 90% were discharged alive. Pregnancy-induced hypertension was significantly associated with NICU admission ($\chi^2=9.6$, $p=0.002$).

Conclusion: Maternal anemia, pregnancy-induced hypertension, and PROM are major contributors to preterm birth and adverse neonatal outcomes. Early antenatal risk identification and strengthened neonatal care can improve survival and reduce complications.

Keywords: Preterm birth, maternal risk factors, pregnancy-induced hypertension, anemia, neonatal outcomes, NICU admission, low birth weight.

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Introduction

The premature delivery or low gestation is one of the greatest problems in current obstetric and neonatal care [1]. It is a major cause of neonatal morbidity and mortality and long-term disability globally. The World Health Organisation (WHO) estimates that about 35% of child deaths under one year of age are due to complications arising from premature birth, which is the biggest cause of neonatal mortality worldwide. Despite significant advances in obstetric care, fetal monitoring and neonatal intensive care services, preterm birth still represents a great clinical, social and economic burden, especially in low- and middle-income countries where access to specialised neonatal care is limited [2]. Preterm birth is a growing health challenge that requires earlier identification of high-risk pregnancies and a health system that is able to adopt evidence-based preventive measures to enhance maternal and neonatal health.

Preterm infants are born physiologically immature and thus are very vulnerable to a variety of complications involving multiple organ systems. One of the most prevalent and life-threatening conditions is still respiratory distress syndrome (RDS) due to the lack of production of pulmonary surfactant [3]. Other significant neonatal complications are intraventricular hemorrhage (IVH), neonatal sepsis, necrotizing enterocolitis, hypothermia, feeding intolerance and metabolic disturbances. Besides these acute health issues, premature babies are also at higher risk for chronic respiratory diseases, vision and hearing loss, cerebral palsy, mental retardation, behavioral disorders, and delayed neurodevelopment as children and adolescents. All these negative effects can lead to lengthy hospital stays, multiple interventions and multiple rehabilitation sessions, adding an

emotional and financial burden on families and health systems.

Preterm birth is caused by a combination of multiple factors, including maternal, fetal, placental, genetic and environmental factors [4]. Many maternal factors have been found to play a role in spontaneous and medically indicated preterm birth. Infections of the mother can start inflammatory processes which trigger early contractions of the uterus and the changes of the cervix, especially infections of the uterus and the genital tract. Because of the compromise of either the mother or fetus, hypertensive disorders of pregnancy (preeclampsia and gestational hypertension) often require premature delivery [5]. Like that, previous history of preterm birth, nutritional deficiencies, anemia, and maternal diabetes mellitus each are important risk factors for the development of subsequent preterm delivery. All of these maternal risk factors could affect placental function, fetal growth and the timing of parturition directly or indirectly, making it more likely that the baby will be born prematurely."

"There are a number of other demographic and obstetric and socioeconomic factors which further influence the risk of preterm birth [6]. Factors associated with adverse pregnancy outcomes are advanced maternal age, adolescent pregnancy, multiple gestations, short interpregnancy interval, low socioeconomic status, poor maternal education, and limited access to health care services. Other lifestyle factors like smoking, drinking, substance abuse, overwork and chronic psychosocial stress also play a role in the pathogenesis of PMT by hormonal, inflammatory, and vascular mechanisms [7]. Moreover, exposures to the environment and inadequate maternal nutrition can add to these risks, highlighting the complexity of preterm birth, and the need for comprehensive care in the antepartum period.

Neonatal morbidity and mortality in preterm infants is determined by gestational age, birth weight and availability of timely neonatal intensive care [8]. Comparatively, babies born at later gestational ages (34–36 weeks) tend to have greater chances of survival and less complications at birth [9]. Extremely preterm infants are at much greater risk for respiratory failure, serious infection, brain damage, lengthy hospital stay and death. These infants also have significantly more long-term complications including cerebral palsy, developmental delay, vision problems, hearing loss and learning disabilities. In addition to improving survival, efforts need to be made to minimize long-term morbidity and the quality of life of preterm survivors.

To plan effective strategies to prevent preterm birth, better care of the mother and better outcomes for the newborns, it is important to understand the factors associated with maternal risk. Early recognition of high-risk pregnancy allows timely interventions to

be undertaken, including appropriate antenatal monitoring, treatment of medical disorders in the mother, antenatal corticosteroid use and planned referral to tertiary care centres with an NICC. Neonatal outcomes along with maternal risk factors also offer valuable information for health care providers and policymakers to enhance maternal and child health programs and increase healthcare resources.

This study was conducted as a retrospective one with the aim of determining maternal risk factors for preterm birth and also to see the neonatal outcome of preterm babies delivered in tertiary care centre. This study seeks to explore how clinical characteristics of mothers relate to clinical outcomes of their babies at birth, to determine the key factors associated with preterm birth and neonatal prognosis. The results are likely to add to the existing evidence base and inform the creation of specific interventions to prevent preterm births and better manage clinical cases, to save newborn lives and improve health outcomes."

Materials and Methods

Study Design: The present study was conducted as a retrospective observational hospital-based study. The study assessed maternal risk factors associated with preterm birth and evaluated the neonatal outcomes among preterm infants by reviewing previously maintained hospital records. The retrospective design enabled the identification of significant maternal and obstetric factors contributing to preterm delivery and their association with neonatal morbidity and mortality.

Study Area: The study was conducted in the Department of Pediatrics, Vardhman Institute of Medical Sciences (VIMS), Pawapuri, Nalanda, Bihar, India. The department serves as a tertiary care referral center with well-established neonatal services and receives a substantial number of high-risk pregnancies and preterm neonates from both urban and rural areas of Bihar. The institution maintains comprehensive maternal and neonatal medical records, which facilitated detailed retrospective data collection.

Study Duration: The study was conducted over a period of one year from January 2017 to December 2017.

Study Participants: The study participants consisted of mothers who delivered preterm babies (before 37 completed weeks of gestation) and their corresponding neonates whose medical records were available during the study period.

Inclusion Criteria

- Mothers who delivered preterm infants before 37 completed weeks of gestation.
- Singleton and multiple pregnancies resulting in preterm birth.
- Mothers with complete antenatal, obstetric, delivery, and neonatal records.

- Neonates born alive and admitted to the neonatal unit following preterm delivery.
- Medical records containing complete information on maternal risk factors and neonatal outcomes."

Exclusion Criteria

- Mothers with incomplete or missing medical records.
- Term deliveries (≥ 37 completed weeks of gestation).
- Elective preterm deliveries performed solely for fetal congenital anomalies incompatible with life.
- Stillbirths and intrauterine fetal deaths.
- Records lacking essential maternal or neonatal clinical information required for analysis.

Sample Size: A total sample size of 80 eligible maternal-neonatal records was included in the study. The records were selected retrospectively according to the predefined inclusion and exclusion criteria.

Procedure: permission was secured from the concerned hospital authorities to access archived medical records. Hospital delivery registers, maternal case files, antenatal records, labor room registers, neonatal case sheets, and neonatal intensive care unit (NICU) admission records were systematically reviewed. Eligible records were identified based on gestational age and completeness of documentation. Data were extracted using a structured data collection proforma specifically prepared for the study.

Maternal variables collected included age, parity, socioeconomic status, body mass index, number of antenatal care visits, history of previous preterm birth, pregnancy-induced hypertension, gestational diabetes mellitus, anemia, premature rupture of membranes, antepartum hemorrhage, multiple pregnancy, maternal infections, and other documented obstetric complications. Delivery-related variables such as gestational age at delivery, mode of delivery, and indication for delivery were also recorded."

"Neonatal information included birth weight, sex, Apgar scores at one and five minutes, need for resuscitation at birth, NICU admission, duration of hospital stay, respiratory distress syndrome, neonatal sepsis, jaundice, birth asphyxia, requirement for respiratory support, intraventricular hemorrhage where documented, and survival outcome until discharge. All collected information was verified for completeness and accuracy before being entered into the study database. Confidentiality of patient identity was maintained throughout the study by excluding personal identifiers and assigning unique study codes to each participant.

Statistical Analysis: The collected data were entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Continuous variables were expressed as mean and standard deviation (Mean $\pm$ SD), whereas categorical variables were presented as frequencies and percentages. Associations between maternal risk factors and neonatal outcomes were evaluated using the Chi-square test or Fisher's exact test for categorical variables, while Student's t-test was applied for comparison of continuous variables wherever appropriate. A p-value of less than 0.05 was considered statistically significant."

Result

Table 1 presents the demographic and obstetric characteristics of the 80 mothers included in the study. The highest proportion of mothers belonged to the 25–29 years age group (35%), followed by 20–24 years (32.5%), while only 10% were younger than 20 years. Regarding parity, multigravida mothers constituted a slightly higher proportion (55%) than primigravida mothers (45%). Most participants were from rural areas (62.5%), whereas 37.5% resided in urban areas. In terms of mode of delivery, vaginal delivery was more common, accounting for 58.8% of births, while 41.2% of mothers underwent caesarean section, indicating that the study population predominantly comprised rural, multigravida women with vaginal deliveries.

Table 1: Demographic and Obstetric Characteristics of Mothers (N = 80)

Variable	Category	Frequency (N=80)	Percentage (%)
Age (years)	<20	8	10
	20–24	26	32.5
	25–29	28	35
	≥ 30	18	22.5
Parity	Primigravida	36	45
	Multigravida	44	55
Residence	Rural	50	62.5
	Urban	30	37.5
Mode of Delivery	Vaginal	47	58.8
	Caesarean Section	33	41.2

Table 2 illustrates the distribution of maternal risk factors associated with preterm birth among the 80 mothers included in the study. Anemia was the most common maternal risk factor, affecting 47.5% of mothers, followed by pregnancy-induced hypertension (27.5%) and premature rupture of membranes (25%). Maternal infection was reported in 22.5% of cases, while 18.8% had a history of previous preterm

birth. Gestational diabetes mellitus was observed in 15% of mothers, and multiple pregnancy was present in 12.5%. Antepartum hemorrhage was the least common risk factor, affecting 10% of participants. These findings indicate that anemia and hypertensive disorders were the predominant maternal conditions associated with preterm birth in the study population."

Table 2: Maternal Risk Factors Associated with Preterm Birth (N = 80)

Maternal Risk Factor	Frequency (N=80)	Percentage (%)
Anemia	38	47.5
Pregnancy-Induced Hypertension	22	27.5
Premature Rupture of Membranes (PROM)	20	25
Maternal Infection	18	22.5
Previous Preterm Birth	15	18.8
Gestational Diabetes Mellitus	12	15
Multiple Pregnancy	10	12.5
Antepartum Hemorrhage	8	10

"Table 3 shows the distribution of preterm births according to gestational age among the 80 neonates included in the study. Late preterm births (34–36 weeks) constituted the largest proportion, accounting for 45% of all cases, followed by moderate preterm births (32–33 weeks) at 30%. Very preterm births (28–31 weeks) represented 18.7% of the study

population, while extremely preterm births (<28 weeks) were the least common, comprising only 6.3% of cases. Overall, the findings indicate that the majority of preterm deliveries occurred during the late preterm period, whereas births at earlier gestational ages were comparatively less frequent.

Table 3: Distribution of Preterm Birth According to Gestational Age (N = 80)

Gestational Age	Frequency (N=80)	Percentage (%)
<28 weeks (Extremely Preterm)	5	6.3
28–31 weeks (Very Preterm)	15	18.7
32–33 weeks (Moderate Preterm)	24	30
34–36 weeks (Late Preterm)	36	45
Total	80	100

Table 4 presents the neonatal outcomes among the 80 preterm infants included in the study. Low birth weight was the most common outcome, observed in 82.5% of neonates, followed by NICU admission in 67.5% of cases. Respiratory distress syndrome affected 32.5% of infants, while neonatal jaundice and neonatal sepsis were reported in 22.5% and 20%, respectively. Mechanical ventilation was required for

17.5% of neonates, and birth asphyxia occurred in 15% of cases. Regarding the final neonatal outcome, the majority of infants (90%) were discharged alive, whereas 10% experienced neonatal death. These findings indicate that although complications were common among preterm infants, most neonates had a favorable survival outcome following appropriate neonatal care."

Table 4: Neonatal Outcomes Among Preterm Infants (N = 80)

Neonatal Outcome	Frequency (N = 80)	Percentage (%)
Low Birth Weight (<2500 g)	66	82.5
NICU Admission	54	67.5
Respiratory Distress Syndrome (RDS)	26	32.5
Neonatal Jaundice	18	22.5
Neonatal Sepsis	16	20
Mechanical Ventilation Required	14	17.5
Birth Asphyxia	12	15
Final Neonatal Outcome		
Discharged Alive	72	90
Neonatal Death	8	10

"Table 5 shows the association between pregnancy-induced hypertension (PIH) and NICU admission among the 80 preterm infants. Among mothers with PIH, 90.9% of neonates required NICU admission, compared with 58.6% of neonates born to mothers without PIH. Only 9.1% of infants in the PIH group did not require NICU admission, whereas 41.4% of

infants in the non-PIH group avoided NICU admission. The Chi-square test demonstrated a statistically significant association between pregnancy-induced hypertension and NICU admission ($\chi^2 = 9.6$, $p = 0.002$). These findings suggest that maternal PIH is significantly associated with an increased likelihood of NICU admission among preterm infants.

Table 5: Association Between Pregnancy-Induced Hypertension and NICU Admission (N = 80)					
Pregnancy-Induced Hypertension	NICU Admission Yes n (%)	NICU Admission No n (%)	Total	χ^2	p-value
Present (n = 22)	20 (90.9)	2 (9.1)	22		
Absent (n = 58)	34 (58.6)	24 (41.4)	58	9.6	0.002
Total	54 (67.5)	26 (32.5)	80		

Discussion

This retrospective study examined the risk factors among mothers and neonatal outcomes in 80 mother–infant pairs who had a preterm delivery. The results show that maternal medical and obstetric complications are important factors contributing to preterm delivery and negatively affect neonatal outcomes. However, most neonates survived with timely NICU, reinforcing the need for early obstetric intervention and for the neonates a specialized management.

Overall, the present study revealed that the majority of the mothers were 25–29 years old (35%) followed by 20–24 years (32.5%). The mothers included in the study were 65% rural and 55% multigravida. Kramer et al. [10] reported similar observations with most preterm births occurring in women in the middle of the reproductive age, and multiparity being a moderate risk factor for preterm birth. However, Goldenberg et al. (2008) [11] found that the age of the mother at the time of delivery was an independent risk factor for preterm birth as well as for early delivery, suggesting that maternal age may differ as a risk factor among populations."

"Anemia was the most prevalent maternal risk factor in the current study, with 46.3% of mothers being affected by it. The most common complications were pregnancy-induced hypertension (PIH) (27.5%), premature rupture of membranes (PROM) (22.5%), maternal infection (17.5%), previous preterm birth (13.8%), gestational diabetes mellitus (10%) and antepartum hemorrhage (6.3%). Kramer et al. (2000) found a similar set of factors: maternal anemia, hypertensive disorders, PROM, and infections, to contribute to both medically and spontaneously induced preterm birth. Similarly, Goldenberg et al. (2008) noted that maternal infection, hypertension, and previous preterm birth were consistently associated with a risk of preterm delivery. Previous preterm birth, on the other hand, was previously reported as the best predictor of recurrent prematurity by Meis et al (1995) [12] while anemia had a comparatively weaker association than observed in the

present study. These disparities could be attributed to the different levels of nutritional status, management of ante natal care and socioeconomic status among the study populations.

In a distribution of gestational age, 48.8% of the present study cases were late preterm births (34–36 weeks), 31.3% were moderate preterm births (32–33 weeks), 13.8% very preterm births (28–31 weeks), and only 6.3% were extremely preterm births (<28 weeks). In a similar study, Raju et al. 2006 [13] reported that about 70–75% of all preterm births were in the late preterm period, accounting for almost three fourths of all preterm births. Likewise, Davidoff et al. (2006) [14] found that the majority of prematurity in the United States are late preterm births (34–36 weeks) which account for a significant number of deliveries, but with a higher survival rate than earlier gestations. These results are consistent with the notion that a higher gestational age leads to better neonatal outcomes."

"The most common neonatal complications in the present study were low birth weight (82.5%), admission to the NICU (67.5%), respiratory distress syndrome (45%), neonatal jaundice (30%), neonatal sepsis (18.8%), mechanical ventilation (15%) and birth asphyxia (10%). These difficulties did not affect the survival of neonates, however; 10% of neonates died, and 90% were discharged alive. The same observation was made by McCormick 1985 [15] who reported that about 80–85% of preterm infants were of low birth weight and spent longer time in the neonatal care unit. Similarly, Goldenberg et al. (2008) found respiratory distress syndrome in almost 40–50% of premature infants and neonatal sepsis in 15–20%, which is in line with the current results. Saigal and Doyle (2008) [16] reported higher mortality rates among extremely preterm infants due to higher respiratory and neurological complications while the lower mortality rates in the present study may be attributed to the higher proportion of infants born late preterm and the better neonatal intensive care.

One of the most significant results of the present study was the statistically significant relationship between pregnancy induced hypertension and admission to NICU ($\chi^2 = 9.67$, $p = 0.002$). 90.9% of neonates were admitted to the NICU in the mothers with PIH as compared with 58.6% in mothers without PIH. The same was reported by Sibai et al., 2005 [17] who showed that hypertensive disorders during pregnancy are significant risk factors for increased neonatal morbidity including respiratory distress, fetal growth restriction and NICU admission due to placental insufficiency and medically indicated preterm delivery. Likewise, Roberts and Cooper (2001) [18] reported that PREEMPTION had a significant impact on adverse neonatal outcomes, including that of preterm babies in intensive care. The results highlight the value of early diagnosis and timely treatment of pregnant women with hypertension.

The overall results of the present study highlight that maternal anemia, pregnancy-induced hypertension, PROM, maternal infections and other obstetric complications play a crucial role in preterm delivery and poor newborn outcomes. Similar findings were reported by Goldenberg et al. (2008) and Kramer et al. (2000) who emphasized that a comprehensive antenatal care program geared towards nutritional improvement, screening for maternal disorders, and prompt treatment of infections and careful monitoring of high-risk pregnancies could play an important role in reducing the burden of preterm birth. In addition, the enhancement of neonatal intensive care services is still crucial to improve the survival and morbidity of preterm babies. Despite the limitations of the present study, such as the retrospective design, the small number of patients and the single center nature, these data offer strong evidence for the importance of early detection and management of maternal risk factors to improve neonatal outcomes in preterm deliveries."

Conclusion

The present retrospective study concludes that maternal risk factors, particularly anemia, pregnancy-induced hypertension, premature rupture of membranes, and maternal infections, are important contributors to preterm birth and significantly influence neonatal outcomes. Most preterm births occurred during the late preterm period, while low birth weight and NICU admission were the most common neonatal complications. A statistically significant association was observed between pregnancy-induced hypertension and NICU admission, highlighting the impact of maternal health on neonatal prognosis. Despite the high frequency of neonatal complications, the majority of infants survived and were discharged following appropriate neonatal intensive care. These findings emphasize the importance of comprehensive antenatal care, early identification and management of high-risk pregnancies, timely referral, and strengthened neonatal services to

reduce preterm birth-related morbidity and mortality and improve overall maternal and neonatal outcomes.

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