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Original Research Article

A PROSPECTIVE ANALYSIS OF CAUSES OF NEONATAL MORTALITY IN PRETERM PREGNANCY IN A TERTIARY HEALTH CARE CENTRE

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Abstract

Background: The study aimed to evaluate the risk factors associated with preterm labor, analyze neonatal outcomes, and identify the causes of neonatal mortality in preterm pregnancies. **Materials and Methods:** A prospective observational study was conducted at the Department of Obstetrics and Gynecology, Himalayan Institute of Medical Sciences, Dehradun, over one year. Pregnant women delivering between 28–37 weeks of gestation were included, and data on maternal risk factors, mode of delivery, neonatal outcomes, and causes of neonatal mortality were collected. Statistical analysis was performed using SPSS v22. **Result:** A total of 105 preterm deliveries were analyzed. The majority (58.10%) occurred between 34–37 weeks of gestation. PPROM (40%), UTI (32.24%), and anemia (29.52%) were the leading maternal risk factors. Most newborns (79.28%) were low birth weight (1.5–2.5 kg), and 50% required NICU admission, primarily for jaundice (28.83%) and respiratory distress syndrome (18.92%). APGAR scores ≥7 at 5 minutes were observed in 94.55% of newborns. Neonatal mortality was 7.2%, with respiratory distress syndrome (37.5%) being the leading cause. **Conclusion:** Preterm birth is a multifactorial condition significantly impacting neonatal outcomes. Effective antenatal care, early identification of risk factors, and robust NICU facilities are essential to reducing neonatal morbidity and mortality associated with preterm births.

INTRODUCTION

Preterm labor is a leading cause of neonatal mortality and morbidity. According to the World Health Organization (WHO), preterm labor is defined as labor occurring after the period of fetal viability but before the completion of 37 weeks of gestation, or before 259 days from the first day of a woman's last menstrual period.[1] Preterm labor is typically associated with changes in cervical dilation and uterine contractions, with or without membrane rupture, occurring after 28 weeks but before 37 weeks of gestation.[2] Preterm deliveries are classified into two groups: early preterm (delivery between 28 to 34 weeks) and late preterm (delivery between 34 to 37 weeks).[3] Additionally, preterm babies are categorized by birth weight: extremely low birth weight (ELBW) for babies less than 1 kg, very low birth weight (VLBW) for those between 1 to 1.5 kg, and low birth weight (LBW) for those between 1.5 to 2.5 kg.[4]

Globally, preterm birth is a significant public health issue, with a prevalence ranging from 5 to 18% across 184 countries.[5] Each year, over 15 million preterm babies are born, with 60-85% of them in South Asia and Africa.[6] Preterm births are more common in low-income countries, where the incidence is approximately 12%, compared to 9% in high-income countries.[6] The rising rate of preterm labor worldwide is due in part to advances in medical technology, such as improved prenatal scanning, increased iatrogenic preterm deliveries, and the use of assisted reproductive technologies that result in multiple gestations.[7] In the United States, the incidence of preterm births increased from 10.6% in 1990 to 12.5% in 2004.[8] India ranks among the top ten countries globally for preterm birth rates. According to data from 2010, approximately 27 million babies are born annually in India, with 3.5 million being preterm.[1] The mortality rate for babies

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born before 37 weeks is around 75%, with 40% of these deaths occurring in infants delivered before 32 weeks.[9] Preterm labor has several causes, with approximately 45-50% of cases being idiopathic, 30% resulting from preterm premature rupture of membranes (PROM), and 15-20% due to iatrogenic factors.[10] The main causes of preterm labor include unexplained spontaneous preterm labor with intact membranes, idiopathic PROM, maternal or fetal medical indications, and multiple gestations such as twins or higher-order multiples.[3] According to the American College of Obstetricians and Gynecologists (ACOG), there are warning signs of preterm labor, including changes in vaginal discharge, pressure in the lower abdomen, regular uterine contractions, uterine tightening, and backache.[11] The ACOG criteria (1997) for diagnosing preterm labor are based on uterine contractions (4 in 20 minutes or 8 in 60 minutes) with progressive cervical changes, including cervical dilation of more than 1 cm and effacement of 80% or more.[12] Several pathological processes contribute to preterm birth, including intrauterine infection, uterine ischemia, abnormal allogenic reactions, uterine overdistension, endocrine disorders, and cervical disease.[13] Due to the multifactorial nature of preterm labor, it is essential to study the various risk factors involved. These risk factors include cervical insufficiency, pregnancy-induced hypertension, malpresentation, uterine anomalies, multiple gestations, previous cesarean sections, PROM, antepartum hemorrhage, gestational diabetes mellitus, oligohydramnios, polyhydramnios, urinary tract infections, chorioamnionitis, anemia, Rh-negative pregnancies, hypothyroidism, and a history of abortion or preterm deliveries.[14] Women with short interpregnancy intervals are also at a higher risk of preterm labor because their nutrient stores may not be fully replenished.[15] Similarly, women with low body mass index (BMI) are more likely to experience spontaneous preterm birth, while obese women have a higher risk of medically indicated preterm birth due to comorbidities such as gestational diabetes mellitus (GDM), pregnancy-induced hypertension (PIH), and caesarean delivery.[16] After preterm labor, mothers are at an increased risk of developing infections and medical complications, including renal disease, cardiac conditions, and diabetes.[17] Preterm infants face various challenges due to their underdeveloped organ systems, which typically mature between 34 and 37 weeks of gestation.[4] These infants are more vulnerable to complications such as respiratory distress syndrome, hypoglycemia, hypothermia, hyperbilirubinemia, intraventricular hemorrhage, necrotizing enterocolitis, patent ductus arteriosus (PDA), retinopathy of prematurity (ROP), cerebral palsy, and sepsis. Preterm birth not only imposes a significant emotional burden on families but also places a financial strain on healthcare systems. Diagnosing preterm labor is challenging and often occurs at an advanced stage. Identifying the risk factors for preterm labor is crucial for several reasons. First, recognizing these risk factors allows for early intervention and the potential prevention of preterm birth. Second, understanding the prevalent risk factors within a population can inform targeted interventions. Lastly, identifying the risk factors for preterm labor provides insights into the underlying mechanisms responsible for preterm birth.[14]

MATERIALS AND METHODS

The study was conducted in the Department of Obstetrics and Gynecology at the Himalayan Institute of Medical Sciences (HIMS), Swami Ram Nagar, Dehradun, over a period of one year. Subjects were recruited from patients presenting in the Gynaecology and Obstetrics OPD, IPD, and Emergency Department at HIMS, Dehradun, after obtaining written informed consent. Ethical clearance was obtained from the university's ethical committee.

Inclusion Criteria

- Women who delivered in the hospital after 28 weeks but before 37 completed weeks of gestation.

Exclusion Criteria

- Patients with false labor pains.
- Patients referred with intrauterine fetal demise were excluded due to inadequate information.

Methodology: The study included pregnant women between 28 and 37 weeks of gestation diagnosed with preterm labor. According to the American College of Obstetricians and Gynecologists (ACOG) criteria, preterm labor is defined as:

Uterine contractions (8 in 60 minutes or 4 in 20 minutes) with progressive cervical changes.

Cervical dilation greater than 1 cm.

Effacement of the cervix ≥ 80%.

Detailed anthropometric and demographic data were recorded at the time of admission. Present pregnancy history, including genitourinary infections, antepartum hemorrhage, hypertensive disorders, and PROM, was collected. Past medical, surgical, and obstetric histories were also noted, particularly for preterm birth and abortions. A thorough physical, systemic, and obstetrical examination was performed. Speculum and per vaginum examinations were conducted as indicated, and the Bishop score was recorded. The risk factors related to preterm labor and neonatal outcomes were analyzed. Risk factors included a history of preterm birth, second-trimester losses, habitual abortions, uterine anomalies, and conditions like bacterial vaginosis, multiple pregnancies, antepartum hemorrhage, and more. Lifestyle factors such as low socioeconomic status, low pre-pregnancy weight, smoking, or substance abuse during pregnancy were also evaluated. All participants underwent various investigations, including hemogram, LFT, KFT, TORCH profile, urine routine, urine culture sensitivity, vaginal culture sensitivity, ultrasonography, and other necessary tests to evaluate the underlying cause of preterm labor. Gestational

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age at delivery, mode of delivery, and neonatal outcomes in terms of birth weight, APGAR score, morbidity, and mortality were recorded. Neonatal outcomes, including the need for NICU admission, respiratory morbidity, and neonatal infections, were also assessed. Babies were followed for a maximum of 7 days post-delivery.

Statistical Analysis: Data were collected and entered into MS Excel 2010. Statistical analysis was performed using SPSS version 22. Descriptive statistics were used for quantitative variables like blood pressure, pulse rate, and weight. Frequency and percentages were calculated for qualitative variables such as socioeconomic status, uterine anomalies, anemia, and sepsis. Categorical variables were presented in numbers and percentages, while continuous variables were presented as mean ± SD and median.

RESULTS

[Table 1] Distribution of Cases According to Period of Gestation

This table highlights the distribution of preterm births across different gestational age groups. A majority of the cases (61, 58.10%) were late preterm (34–37 weeks), indicating that most preterm deliveries occurred closer to term. Early preterm cases, including 28–31+6 weeks and 32–33+6 weeks, accounted for 21.90% and 20.00% of cases, respectively, suggesting a smaller but significant proportion of more premature deliveries.

Table 1: Distribution of cases according to period of gestation (week) (n=105).

Period of Gestation (weeks)	Frequency	Percentage
28–31+6 weeks	23	21.90%
32–33+6 weeks	21	20.00%
34–37 weeks	61	58.10%
Total	105	100%

[Table 2] Risk Factors Associated with Preterm Birth

This table examines the various maternal and pregnancy-related risk factors linked to preterm birth. The most common risk factor was preterm premature rupture of membranes (PPROM) at 40.00%, followed by urinary tract infections (32.24%) and anemia (29.52%). Hypertensive disorders like PIH (30.48%) and a history of threatened abortion (22.86%) were also significant contributors. Other notable factors included hypothyroidism (21.90%), gestational diabetes mellitus (19.05%), and malpresentation (12.38%). More severe conditions, such as intrauterine growth restriction (4.76%) and uterine anomalies (1.90%), were less frequent. These results underscore the multifactorial etiology of preterm births, with several patients experiencing multiple comorbidities.

Table 2: Risk factors associated with preterm birth in current pregnancy. (More than one co morbidity were present in many patients)

Risk Factors	Frequency	Percentage
PPROM	42	40.00%
UTI	34	32.24%
Anaemia	31	29.52%
H/O Threatened Abortion	24	22.86%
PIH	32	30.48%
Hypothyroidism	23	21.90%
GDM	20	19.05%
Itching P/V	12	11.43%
RH Negative	15	14.29%
IUGR	5	4.76%
Oligohydramnios	9	8.57%
Polyhydramnios	6	5.71%
AFI	5	4.76%
IHCP	9	8.57%
Intra-abdominal Surgery	5	4.76%
Hydrocephalus	1	0.95%
APH	14	13.33%
Twins	6	5.71%
Emotional Trauma	2	1.90%
Maternal Infection	2	1.90%
Uterine Anomaly	2	1.90%
Idiopathic	10	9.52%
Malpresentation	13	12.38%
Previous LSCS	27	25.71%

[Table 3] Distribution of Mode of Delivery

Among the 105 cases, 60 (57.14%) were delivered vaginally, while 45 (42.86%) required lower segment cesarean section (LSCS). This indicates that while vaginal delivery remained the predominant mode, a significant proportion of preterm births required surgical intervention, likely due to maternal or fetal complications.

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Table 3: Distribution of mode of delivery of study subjects (n=105).

Mode of Delivery	Frequency	Percentage
LSCS	45	42.86%
Vaginal	60	57.14%
Total	105	100.00%

[Table 4] Distribution of Birth Weight of Newborn Baby

The majority of newborns (88, 79.28%) had low birth weight (1500–2500 grams), with a mortality rate of 4.55% in this group. Very low birth weight (1000–1500 grams) was observed in 13 cases (11.71%), with 23.08% mortality. Only 2 newborns (1.80%) weighed less than 1 kg, and both had adverse outcomes (50% expired, 50% intrauterine death). In contrast, 7.21% of babies weighed ≥2500 grams, with no mortality reported. These findings emphasize the strong correlation between low birth weight and neonatal mortality.

Table 4: Distribution of Birth Weight (grams) of Newborn Baby (n=111)

Birth Weight (grams)	Frequency	Percentage	Baby Expired
< 1 KG	2	1.80%	1 (50%), 1 (50%) IUD
1000–1500 grams	13	11.71%	3 (23.08%)
1500–2500 grams	88	79.28%	4 (4.55%)
≥ 2500 grams	8	7.21%	0 (0%)
Total	111	100%	9 (8.1%)

[Table 5] Distribution of APGAR Scores

The APGAR scores of newborns showed an encouraging trend. At 0 minutes, 88.18% of babies scored ≥7, with a mean score of 8.14 ± 1.86, reflecting good immediate post-delivery outcomes for most newborns. By 1 minute, the percentage of babies with scores ≥7 increased to 93.64%, with a mean score of 9.05 ± 1.58. At 5 minutes, 94.55% of babies scored ≥7, with a mean score of 9.48 ± 1.33. The steady improvement in APGAR scores over time suggests effective resuscitation and postnatal care.

Table 5: Distribution of APGAR Score of Study Subjects (n=111)

APGAR Score	Frequency	Percentage	Statistics
At 0 Minute			
< 7	13	11.82%	Mean ± Stdev: 8.14 ± 1.86
≥ 7	97	88.18%	Median (IQR): 9 (8–9)
			Range: 1–9
At 1 Minute			
< 7	7	6.36%	Mean ± Stdev: 9.05 ± 1.58
≥ 7	103	93.64%	Median (IQR): 10 (9–10)
			Range: 3–10
At 5 Minutes			
< 7	6	5.45%	Mean ± Stdev: 9.48 ± 1.33
≥ 7	104	94.55%	Median (IQR): 10 (10–10)
			Range: 3–10

[Table 6] Requirement of Admission to NICU

Half of the newborns (50.00%) required NICU admission, indicating the significant burden of complications in preterm deliveries. This highlights the critical need for NICU resources in managing these vulnerable infants.

Table 6: Distribution of Requirement of Admission to NICU of Newborn (n=110)

Requirement of Admission to NICU	Frequency	Percentage
No	55	50.00%
Yes	55	50.00%
Total	110	100.00%

[Table 7] Distribution of Reasons for Admission to ICU

The leading cause of NICU admission was jaundice (28.83%), followed by sepsis (22.52%) and respiratory distress syndrome (RDS, 18.92%). Hypoglycemia, birth asphyxia, and encephalopathy each accounted for 7.21% of cases. Other conditions like NEC (4.50%) and hypothermia (3.60%) were less common but significant. These findings underline the diverse complications associated with preterm births.

Table 7: Distribution of Reason of Admission to ICU of Study Subjects

Reason of Admission to ICU	Frequency	Percentage
Jaundice	32	28.83%
Sepsis	25	22.52%
Hypoglycemia	8	7.21%
Birth Asphyxia	8	7.21%

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Respiratory Distress Syndrome (RDS)	21	18.92%
NEC	5	4.50%
Hypothermia	4	3.60%
HMD	5	4.51%
Encephalopathy	8	7.21%

[Table 8] Congenital Anomalies in Newborns

Among the newborns, 2 (1.80%) had congenital anomalies. One had hydrocephalus, and the other had fetal duodenal atresia, each accounting for 0.91% of cases. Although rare, congenital anomalies pose significant challenges in neonatal management.

Table 8: Congenital Anomaly in Newborn (n=2)

Congenital Anomaly	Frequency	Percentage
Hydrocephalus	1	0.91%
Fetal Duodenal Atresia	1	0.91%

[Table 9] Causes of Neonatal Mortality

Out of 8 neonatal deaths, the most common cause was RDS (37.5%), followed by birth asphyxia, NEC, hyaline membrane disease (HMD), sepsis, and encephalopathy, each contributing 12.5%. These results highlight the multifactorial nature of neonatal mortality, with respiratory complications being the predominant cause.

Table 9: Causes of Neonatal Mortality (n=8)

Cause	Frequency	Percentage
Birth Asphyxia	1	12.5%
NEC	1	12.5%
RDS	3	37.5%
HMD	1	12.5%
Sepsis	1	12.5%
Encephalopathy	1	12.5%
Total	8	100%

DISCUSSION

In the present study, the majority of preterm deliveries occurred between 34–37 weeks (58.10%), while 28–33+6 weeks accounted for 41.9% of cases. These findings align with studies by Assadi et al. which reported 76.35% preterm births between 32–37 weeks, and Shetty et al. in Karnataka, where 55.7% were late preterm.[9,15] However, Philip T. et al. in Kerala observed a slightly different distribution, with 53.43% of cases between 32–34 weeks and 38.03% between 34–37 weeks.[1] This variation highlights regional differences in gestational age at preterm birth. Umeigbo in Nigeria showed contrasting results, with 41.7% of preterm births occurring between 28–30 weeks, likely reflecting differences in healthcare access and population characteristics.[4]

The most common risk factor in this study was preterm premature rupture of membranes (PPROM, 40%), followed by urinary tract infections (32.24%) and pregnancy-induced hypertension (30.48%). These findings are consistent with Shetty et al., who identified hypertension (32.9%) and PPROM (18.1%) as the leading risk factors.[9] Garg S et al. also found PPROM (22%) as a common risk factor.[8] However, studies like Bangal V et al. in Maharashtra reported higher rates of antepartum hemorrhage (22.53%) and uterine overdistension (16.9%). The differences highlight variations in antenatal care and risk factor profiles across regions.[16]

This study found a higher rate of vaginal deliveries (57.14%) compared to cesarean sections (42.86%), consistent with Shetty et al. in Karnataka (55.7% vaginal).[9] However, studies like Kuzniewicz W M in California (66.4% vaginal) and Wagura et al. in Kenya (74.1% vaginal) reported even higher vaginal delivery rates. The higher cesarean rate in the current study may be attributed to the inclusion of high-risk cases, emphasizing the role of obstetric complications in determining the mode of delivery.[5]

The majority of newborns in this study (79.28%) were low birth weight (1.5–2.5 kg), with mortality rates of 4.55%. Extremely low birth weight (<1 kg) had the highest mortality (50%). These findings are similar to Umeigbo in Nigeria, where 38.8% were low birth weight and 10.15% were <1 kg. Garg S et al. observed 100% mortality in <1 kg newborns, similar to this study.[8] The strong association between birth weight and neonatal mortality aligns with findings by Das et al. in Meghalaya, which emphasized the vulnerability of extremely low-birth-weight newborns.[10]

In the present study, 94.55% of newborns had APGAR scores ≥7 at 5 minutes, indicating good outcomes for most babies. Akhter et al. in Srinagar reported similar trends, with mean APGAR scores improving significantly from 1 to 5 minutes.[17] Das et al. in Meghalaya also found that 75.25% of babies scored >8 at 5 minutes. The consistent findings across studies emphasize the importance of immediate neonatal resuscitation in improving outcomes.[10]

In this study, 50% of newborns required NICU admission, a lower percentage than reported by studies such as Akhter et al. in Srinagar (83%).[17] The lower NICU admission rate in this study may

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reflect better antenatal care and effective management of less severe cases. Garg S et al. highlighted jaundice (28.83%) and sepsis (22.52%) as common NICU admission causes, consistent with the current study's findings.[8]

Jaundice (28.83%) was the most common reason for NICU admission, followed by sepsis (22.52%) and respiratory distress syndrome (18.92%). These findings align with Garg S et al., who also found neonatal jaundice as the leading cause.[8] Das et al. in Meghalaya similarly reported jaundice as the primary reason for NICU admissions, followed by respiratory complications, indicating the universal nature of these issues in preterm newborns.[10]

This study reported 1.8% of newborns with congenital anomalies, consistent with Brown H K et al. in Canada, which reported a 4.39% prevalence of anomalies. The lower rate in the current study may reflect underreporting or differences in prenatal screening practices. The findings emphasize the need for early detection and management of congenital anomalies to improve neonatal outcomes.[18]

Respiratory distress syndrome (RDS) accounted for 37.5% of neonatal deaths, followed by birth asphyxia and sepsis (12.5% each). These findings are consistent with Assadi et al., where RDS was the leading cause of mortality (71.1%).[15] Bangal V B in Maharashtra also found RDS (40.74%) as the primary cause, emphasizing its significant contribution to neonatal mortality in preterm births. Improved respiratory support and antenatal steroids could mitigate this risk.[16]

CONCLUSION

The present study highlights that preterm birth is a multifactorial condition with significant maternal and neonatal implications. The majority of preterm deliveries occurred between 34–37 weeks of gestation, with low birth weight being a prominent risk factor for neonatal morbidity and mortality. Common maternal risk factors included PPROM, UTI, and anemia, while neonatal complications such as jaundice and respiratory distress syndrome were the leading causes of NICU admissions. Vaginal delivery was the predominant mode of delivery, and neonatal outcomes were favorable for those with adequate birth weight and APGAR scores ≥7. Early identification and management of risk factors, along with adequate NICU facilities, are crucial to improving preterm birth outcomes.

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