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10.21761/jms.v9i02.08

ORIGINAL RESEARCH ARTICLE

Evaluation of Maternal Risk Factors in Preterm Neonates and their Clinical Outcome in a Tertiary Care Teaching Hospital

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ABSTRACT

Introduction: Preterm birth is a significant global health concern with various maternal risk factors and clinical outcomes. This study aims to understand the prevalence of preterm birth worldwide and specifically in India, as well as the complications and long-term consequences associated with it. Additionally, the economic burden and regional disparities in preterm birth outcomes are explored, along with the factors contributing to the rising prevalence of preterm birth.

Material and Methods: The objectives of this study include investigating the incidence of preterm birth, analyzing the distribution of birth weights, identifying maternal and obstetric risk factors associated with preterm birth, examining the association between mode of delivery and preterm birth, and assessing the morbidities observed in preterm neonates. The study is conducted using a specific sample size and inclusion criteria, and ethical considerations are taken into account.

Results: In this study of 55 preterm neonates, various morbidities were observed. Hyaline membrane disease affected 14 neonates (25.45%), while birth asphyxia occurred in 6 neonates (10.90%). Sepsis was a major concern, developing in 40 neonates (72.73%). Neonatal hyperbilirubinemia was seen in 26 neonates (47.3%), hypoglycemia in 17 neonates (30.9%), hypocalcemia in 33 neonates (60%), and hypothermia in 11 neonates (20%). Apnea of prematurity was predominantly seen in 9 neonates (16.36%), and shock affected 11 neonates (20%). Patent ductus arteriosus (PDA) developed predominantly in 8 neonates (14.54%) and bronchopulmonary dysplasia (BPD) in 3 neonates (5.45%). Retinopathy of prematurity occurred in 2 neonates (3.6%), as did intraventricular hemorrhage (IVH) and periventricular leukomalacia (PVL). Nutritional inadequacy was a concern in 12 neonates (21.81%).

Conclusion: This study sheds light on the prevalence of preterm birth, identifies important risk factors, and highlights the morbidities associated with prematurity in neonates. The implications of this research extend to improving preventive measures and enhancing preterm care protocols.

Keywords: Preterm birth, Neonates, Maternal risk factors, Clinical outcomes, Morbidity.

Submission: 17-10-2024; **Acceptance:** 22-11-2024; **Published:** 31-12-2024

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How to cite this article: Prasad PL, Gupta AK, Rai PL, Chandra S. Evaluation of Maternal Risk Factors in Preterm Neonates and their Clinical Outcome in a Tertiary Care Teaching Hospital. SRMS J Med Sci 2024;9(2):102-109.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Preterm birth, defined as the delivery of a baby before 37 weeks of gestation, is a significant global health concern.[1] It is associated with various complications and poses challenges for both the newborns and their families. Understanding the maternal risk factors contributing to preterm birth and their impact on clinical outcomes in preterm neonates is crucial for effective management and prevention strategies.

According to the World Health Organization (WHO), approximately 15 million preterm births occur each year, accounting for 11.1% of all births. South Asia alone contributes to 13.3% of these preterm births, with India reporting 3.5 million preterm infants annually.[2] Preterm births can be categorized into different subgroups based on gestational age, including extremely preterm (less than 28 weeks), very preterm (28–31^{6+} weeks), moderately preterm (32–33^{6+} weeks), and late preterm (34–36^{6+}weeks).[3]

Preterm birth is influenced by various maternal risk factors, including a history of preterm birth, anemia, tobacco consumption, premature rupture of membranes (PROM), high blood pressure (HBP), vaginal bleeding, urinary tract infection (UTI), inadequate prenatal care, maternal age, and multiple pregnancies.[4] These factors contribute to increased morbidity and mortality in preterm infants, leading to conditions such as respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), retinopathy of prematurity, anaemia of prematurity, sepsis, and feeding difficulties. Long-term complications, such as cerebral palsy, intellectual impairment, chronic lung disease, and sensory impairments, further burden individuals born preterm, their families, and society as a whole.

Preterm birth imposes a significant economic burden due to the costs associated with initial hospital stays, neonatal intensive care, and long-term complex health

needs resulting from disabilities.[5] Regions like South Asia and sub-Saharan Africa account for a substantial portion of preterm births and associated complications, with these areas experiencing over 80% of the 1.1 million deaths related to preterm birth complications.

Survival rates for preterm infants vary significantly depending on the location of birth. Extremely preterm babies born in low- and middle-income countries face a high risk of mortality within the first few days of life, whereas high-income settings show lower mortality rates for babies of the same gestational age.[2] Although progress has been made in the care of premature infants, the prevalence of preterm birth continues to rise. Factors such as changes in health trends, including increased maternal age, underlying health issues like diabetes and hypertension, assisted reproductive technologies leading to multiple pregnancies, and shifts in obstetric practices contribute to this upward trend.[6]

In India, preterm birth affects a significant number of infants, with 3.34 million babies born prematurely and 361,600 children under the age of five losing their lives due to preterm birth complications.[7] Additionally, 23.4% of global preterm births are reported in India. Identifying and understanding the risk factors associated with preterm birth in different geographic regions is crucial for implementing effective preventive measures and improving outcomes for preterm infants and their mothers.

Despite the impact of preterm birth in India, limited studies have explored the risk factors contributing to this issue. Furthermore, existing research is often limited to specific geographical areas. Therefore, this study aims to analyze the demographic and obstetric risk factors influencing preterm birth outcomes, assess morbidity and mortality in preterm neonates, and contribute to the development of preventive strategies.

By examining maternal risk factors and their clinical outcomes in preterm neonates admitted to the NICU, this study aims to provide valuable insights into addressing the challenges associated with preterm birth and improving the care and outcomes for these vulnerable infants.

MATERIAL AND METHODS

In this study, conducted at the Department of Pediatrics of Shri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS) in Bareilly, a tertiary care teaching hospital, we aimed to investigate certain factors and outcomes related to preterm neonates. The study spanned a duration of 18 months and employed a hospital-based, observational design.

The sample size was determined using a formula based on prevalence and working error, assuming a prevalence of 13% and a working error of 5%. The minimum number of neonates required for the study was determined to be 55, but all preterm babies admitted to the NICU were included. Ethical approval and informed consent were obtained from the institutional ethics committee and parents, respectively.

The inclusion criteria specified preterm babies with gestational age ranging from 26 weeks 0 days to 36 weeks 6 days admitted to the NICU of SRMSIMS Bareilly. Exclusion criteria included neonates with congenital malformations and parents or guardians not willing to participate.

Preterm neonates were identified based on gestational age assessment using the last menstrual period or, if uncertain, through first-trimester ultrasound data and the Ballard scoring system. Data on birth weight, APGAR scores, detailed histories, and examination findings were recorded.

Preterm neonates weighing over 1800 g and considered stable were kept with their mothers in the postnatal ward, while those with immediate or subsequent problems were admitted to the NICU for monitoring, investigation, and management following standard protocols. The mean duration of hospital stay was documented, along with morbidities such as birth asphyxia, hyaline membrane disease, hyperbilirubinemia, sepsis, necrotizing enterocolitis, intraventricular hemorrhage, and metabolic and electrolyte abnormalities. Various maternal factors, including age, booking status, father's occupation, parity, pregnancy order, previous pregnancy outcomes, medical conditions, and obstetric risk factors, were recorded as explanatory variables.

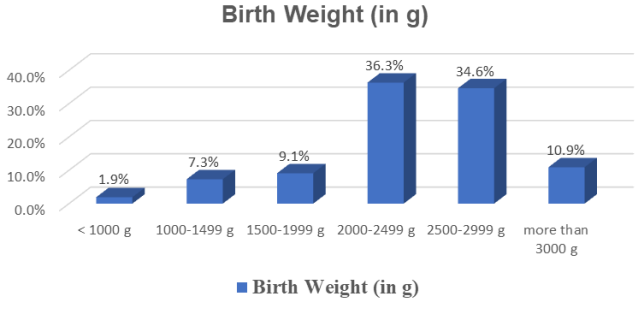
Data were collected in a pre-structured proforma, and neonatal outcomes such as discharge with or without morbidities, death, or discharge against medical advice were also noted. The study adhered to ethical guidelines, and statistical analysis was performed using SPSS software, with results reported as mean ± standard deviation for continuous variables and numbers (percentages) for categorical variables. A significance level of $p < 0.05$ was considered.

RESULTS

Only 55 preterm babies were admitted to the NICU. Late preterm babies were 42 (76.4%). There were no extremely preterm babies. Late preterm babies were 67.3%, followed by moderate preterm babies (18.2%). Graph 1 shows that weight gain between 6 to 8 kg during the period of gestation amongst mothers of preterm neonates and maternal height less than 155 cm were significant at 0.05. The number of primigravidas was more (25) than gravida-2 (23) and gravida 3 (7) mothers. Previous abortion/preterm deliveries/stillbirth/neonatal death was

present in 8 babies, of which five babies were male and three babies were female. Inadequate (Polyhydramnios/ Oligohydramnios) amniotic fluid was present in 5 babies. The majority of 47 (85.45%) mothers were anemic (Table 1). Hypertension and diabetes mellitus were present in 3 (5.45%) mothers, and rheumatic heart disease, HIV, and hypothyroidism were present in 1 (1.81%) each. Four mothers were hospitalized for different infections (Table 2).

Graph 2 shows that 34 (61.82%) babies were delivered by LSCS of which 18 babies were males and the remaining 16 babies were females. Graph 3 shows the distribution of studied patients based on MSAF. In the resuscitation done category, the analysis revealed that no females with a birth weight between 1000 to 1499 g required resuscitation, while one female with a birth weight between 1500 to 1999 g did require resuscitation (Table 3). Similarly, no males with a birth weight greater than 2000 g required resuscitation. The *p-value* of 0.269 suggests that there was no significant difference between males and females regarding the need for resuscitation at birth (Table 4).



Graph 1: Distribution of studied patients based on the weight of preterm neonates

Table 1: Distribution of studied patients based on generalized risk factors

Parameters		*No of patients (n = 55) (%)*	*Mean ± SD*
Weight gain during pregnancy	Less than 6 kg	05 (9.1%)	5.78±1.69
	6–8 kg	44 (80.0%)	7.03 ± 3.48
	More than 8 kg	06 (10.9%)	8.90± 2.39
Maternal height	Less than 155 cm	34 (61.8%)	152.10 ± 34.63
	More than 155 cm	21 (38.2%)	157.83 ± 29.78
Maternal age	Less than 16 years	0 (0.0%)	
	More than 35 years	6 (10.9%)	

Table 2: Distribution of studied patients based on obstetric risk factors

Past-obstetric history		*No. of patients (%)*
Gravida	Gravida-1	25 (45.5%)
	Gravida-2	23 (41.8%)
	Gravida-3	7 (12.7%)
Previous abortion/ preterm deliveries/ stillbirth/neonatal death	No	47 (85.5%)
	Yes	8 (14.5%)
Antenatal visits	4	55 (100.0%)
Amniotic fluid volume	Adequate	50 (90.9%)
	Inadequate (Polyhydramnios / Oligohydramnios)	5 (9.1%)
Anaemia	Yes	47 (85.5%)
	No	9 (14.5%)
Ante partal hemorrhage/placenta abruption/placenta previa	Yes	2 (3.6%)
	No	53 (96.4%)
Fibroid uterus	No	55 (100.0%)

Table 3: Distribution of studied patients based on chronic medical and surgical conditions

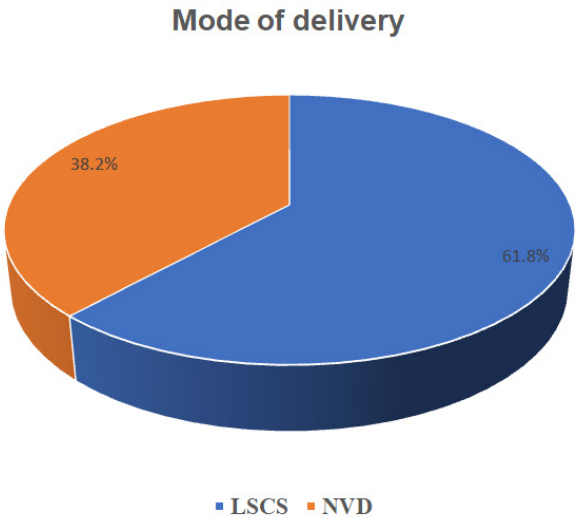
Parameters		*No of patients*	*Percentage (%)*
Hypertension		3	5.5
Diabetes mellitus		3	5.5
Rheumatic heart disease		1	1.8
HIV		1	1.8
Hypothyroidism		1	1.8
Hospitalization during pregnancy		4	7.3
Infections in mother	UTI	1	1.8
	Malaria	1	1.8
	Fever	2	3.6
	Others	0	0.0

Regarding major malformations, the study found that two males with a birth weight between 1000 to 1499 g had major malformations, while no females in this birth weight range had such malformations. In the 1500 to 1999 g birth weight range, one female had a major malformation, while no males in this category did (Table 5).

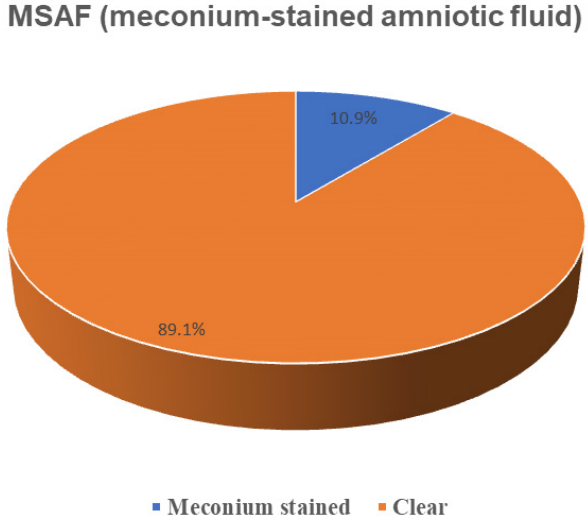
The most common morbidities related to prematurity were early onset sepsis (72.7%), hypocalcaemia (60.0%), hypoglycemia (30.9%), hyaline membrane disease (25.5%),

Table 4: Distribution of studied patients based on natal risk factors

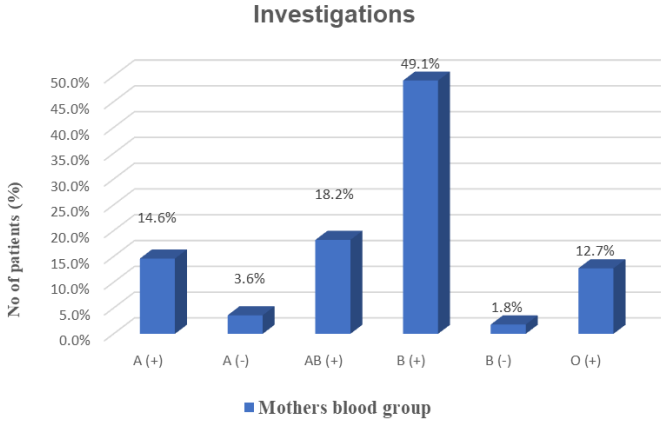
Parameters	*Options*		*Male*	*Female*	*p-value*
Mode of delivery	LSCS	1000–1499	5	3	0.005 (Sig.)
		1500–1999	6	8	
		2000–2499	7	0	
		2500–2999	0	5	
	NVD	1000–1499	3	2	0.056
		1500–1999	4	6	
		2000–2499	6	0	
Meconium-stained amniotic fluid (MSAF)	Meconium stained	1000–1499	3	0	0.289
		1500–1999	1	1	
		2000–2499	0	0	
		2500–2999	0	1	



Graph 2: Distribution of studied patients based on the mode of delivery



Graph 3: Distribution of studied patients based on MSAF



Graph 4: Distribution of studied patients based on investigations

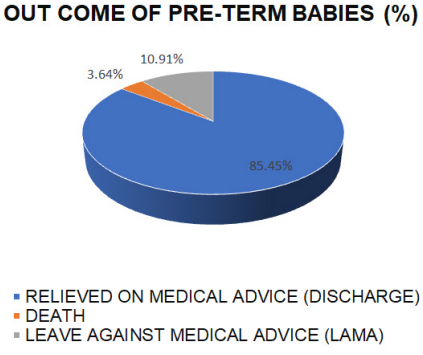
Table 5: Distribution of studied patients based on neo natal risk factors

Parameters		*Male*	*Female*	*p-value*
Resuscitation done	1000–1499	0	1	0.269
	1500–1999	3	1	
	2000–2499	1	0	
Major malformations	1000–1499	2	0	0.083
	1500–1999	0	1	

and birth asphyxia (10.9%) in descending order. Other morbidities, PDA, BPD, ROP, IVH, and PVL were also noted (Graph 4). A statistically significant association was found in morbidities (Neonatal hyperbilirubinemia, sepsis, hypoglycemia, and hypocalcemia) and prematurity in neo-nates based on sex (Table 6). About 85.45% of preterm babies were relieved on medical advice; two died and six babies were left against medical advice (Table 7).

Table 6: Distribution of studied patients based on morbidities related to prematurity in neonates

Parameters	*No of patients (n = 55)*	*Male*	*Female*
Birth asphyxia	6 (10.9%)	4 (66.6%)	2 (33.4%)
Hyaline membrane disease	14 (25.5%)	9 (64.3%)	5 (33.7%)
Intraventricular hemorrhage (IVH)	3 (5.5%)	2 (66.6%)	1 (33.4%)
Peri ventricular leukomalacia (PVL)	2 (3.6%)	2 (100.0%)	0 (0.0%)
Neo-natal hyperbilirubinemia	26 (47.3%)	15 (57.7%)	11 (42.3%)
Sepsis	40 (72.7%)	22 (55.0%)	18 (45.0%)
Retinopathy of prematurity	2 (3.6%)	1 (50.0%)	1 (50.0%)
Hypothermia	11 (20.0%)	6 (54.5%)	5 (45.5%)
Hypoglycemia	17 (30.9%)	10 (58.8%)	7 (41.2%)
Hypocalcemia	33 (60.0%)	20 (60.6%)	13 (39.4%)
Apnea of prematurity	9 (16.4%)	5 (55.5%)	4 (44.5%)
Shock	11 (20.0%)	6 (54.5%)	5 (45.5%)
Patent ductus arteriosus (PDA)	8 (14.5%)	5 (62.5%)	3 (37.5%)
Bronchopulmonary dysplasia (BPD)	3 (5.5%)	2 (66.6%)	1 (33.4%)
Nutritional inadequacy	12 (21.8%)	7 (58.3%)	5 (41.7%)



Graph 5: Distribution of studied patients based on the outcome of preterm babies

DISCUSSION

The present study aimed to investigate the incidence and risk factors associated with preterm birth, as well as the related morbidities in neonates. Prematurity is the leading cause of death in children under 5 years of age. Approximately 1 million children die each year due to complications of preterm birth.[8] Many preterm survivors face a lifetime of learning disabilities and visual and hearing problems.

In terms of the incidence of preterm birth, the present study reported a rate of 26.0% out of 1737 total deliveries. This is higher compared to the study by Gurang *et al.*[9] which reported an incidence of 93 per 1000 live births over a 14-month period. However, the study by Philip *et al.*[10] found a higher proportion of preterm births in the 32 to 34-week gestational age range, whereas the majority of preterm births in the present study were in the 34-36+6-week range. This difference could be attributed to variations in the study populations and methodologies.

Regarding birth weight, the majority of cases in the present study fell into the 2000 to 2499 g category, followed by 2500 to 2999 g. These findings align with the study by Afaya *et al.*[11]. which reported that 23.7% of newborns had low birth weight (<2500 g). However, Li *et al.*[12] reported different rates for various birth weight categories, with 48.3% classified as low birth weight.

The present study identified several maternal risk factors associated with preterm birth. Low socioeconomic status was found in 34.55% of cases, which is similar to the findings of Li *et al.*[9] who reported a low socioeconomic status in 33% of their cohort. Weight gain during pregnancy of less than 6 kg and maternal height of less than 155 cm were also found to be significant risk factors in the present study. In contrast, Li *et al.*[9] reported a lower rate of twin pregnancy (3.3%) compared to the current study.

The discussion also highlights the role of obstetric risk factors in preterm birth. Gravida 1 mothers constituted the highest proportion in the present study, followed by gravida 2 and gravida three mothers. Previous abortion, preterm deliveries, stillbirth, and neonatal death were present in a small percentage of cases. Maternal complications and underlying diseases, such as pregnancy-induced hypertension (PIH) and antepartum hemorrhage (APH), were associated with preterm birth, consistent with findings from other studies. The association between anemia in pregnancy and preterm birth varied across studies, with the present study not finding a significant association.

Mode of delivery was also examined, with 61.82% of cases delivered by cesarean section in the present study. This finding aligns with the study by Olugbenga *et al.*[13], which reported a significant association between cesarean section and preterm birth. The occurrence of meconium-stained amniotic fluid (MSAF) was also investigated, with 89.09% of cases showing clear MSAF. This finding was statistically significant, indicating a potential association between MSAF and preterm birth.

Birth asphyxia, hyaline membrane disease, hyperbilirubinemia, and sepsis were among the identified

Table 7: Distribution of studied patients based on morbidities related to prematurity in neonates

Parameters		*Male*	*Female*	*p-value*
Birth asphyxia (N = 6)	1000–1499	0 (0.0%)	1 (16.7%)	
	1500–1999	3 (50.0%)	0 (0.0%)	0.111
	2000–2499	0 (0.0%)	1 (16.7%)	
	2500–2999	1 (16.7%)	0 (0.0%)	
Hyaline membrane disease (N = 14)	1000–1499	3 (21.4%)	0 (0.0%)	
	1500–1999	0 (0.0%)	1 (7.1%)	0.279
	2500–2999	4 (28.6%)	2 (14.3%)	
	more than 3000	2 (14.3%)	2 (14.3%)	
Intraventricular haemorrhage (IVH) (N = 3)	2500–2999	2 (66.6%)	0 (0.0%)	0.083
	more than 3000	0 (0.0%)	1 (33.4%)	
Peri ventricular leukomalacia (PVL) (N = 2)	1000–1499	2 (100.0%)	0 (0.0%)	1.000
Neo-natal hyperbilirubinemia (N = 11)	1000–1499	4 (36.7%)	0 (0.0%)	
	1500–1999	2 (18.2%)	3 (27.3%)	0.045 (Sig.)
	2500–2999	0 (0.0%)	2 (18.2%)	
Sepsis (N = 11)	1500–1999	4 (36.7%)	1 (9.10%)	
	2000–2499	0 (0.0%)	4 (36.7%)	0.020 (Sig.)
	2500–2999	2 (18.2%)	0 (0.0%)	
Retinopathy of prematurity (N = 11)	1500–1999	3 (27.3%)	3 (27.3%)	0.740
	2000–2499	3 (27.3%)	2 (18.2%)	
Hypothermia (N = 11)	1500–1999	4 (36.7%)	1 (9.10%)	0.121
	2500–2999	2 (18.2%)	4 (36.7%)	
Hypoglycemia (N = 17)	1000–1499	6 (35.3%)	0 (0.0%)	
	1500–1999	4 (23.5%)	4 (23.5%)	0.012 (Sig.)
	2000–2499	0 (0.0%)	3 (17.7%)	
Hypocalcemia (N = 33)	1000–1499	6 (18.2%)	4 (12.1%)	
	1500–1999	12 (36.4%)	3 (9.1%)	0.033 (Sig.)
	2000–2499	0 (0.0%)	4 (12.1%)	
	2500–2999	2 (6.1%)	2 (6.1%)	
Apnea of prematurity (N = 9)	1500–1999	3 (33.3%)	2 (22.2%)	
	2000–2499	0 (0.0%)	2 (22.2%)	0.126
	2500–2999	2 (22.2%)	0 (0.0%)	
Shock (N = 11)	1000–1499	3 (27.3%)	0 (0.0%)	
	1500–1999	3 (27.3%)	3 (27.3%)	0.084
	2500–2999	0 (0.0%)	2 (18.2%)	
Patent ductus arteriosus (N = 8)	1000–1499	2 (25.0%)	0 (0.0%)	
	1500–1999	3 (37.5%)	2 (25.0%)	0.236
	2500–2999	0 (0.0%)	1 (12.5%)	
Bronchopulmonary dysplasia (N = 3)	1500–1999	1 (33.3%)	1 (33.4%)	0.386
	2500–2999	1 (33.3%)	0 (0.0%)	
Nutritional inadequacy (N = 12)	1000–1499	2 (16.7%)	0 (0.0%)	
	1500–1999	3 (25.0%)	2 (16.7%)	0.345
	2500–2999	2 (16.7%)	3 (25.0%)	

morbidities. The findings of the present study align with the study by Shrestha L and Shrestha P[14], which reported similar morbidities in preterm neonates.

In this study, it was observed that relief on medical advice (discharge) was 47 (85.45%) $p = 0.0001^*$ $p < 0.05$, death was 02 (3.64%), and leave against medical advice (LAMA) was 06 (10.91%) $p > 05$, respectively. Intaraphet S *et al.*[54] reported that there was no incident of stillbirth in the term group, while a higher rate of 1.7% was observed in the preterm group.

LIMITATIONS OF THE STUDY

Lack of Long-term Follow-up

The study did not track maternal and neonatal outcomes beyond the immediate postnatal period, which limits the understanding of the long-term effects of the identified risk factors.

Limited Regional Representation

While the sample size in the study may be substantial, it primarily represents a single region, which restricts the generalizability of the findings to the entire country or other regions.

Unanalyzed Risk Factors

Several potential risk factors, such as previous medical history, previous preterm births, cervical length, and BMI, were not included in the analysis. This omission limits a comprehensive understanding of the factors contributing to preterm birth.

RECOMMENDATIONS

Focus on Combating Obstetric Complications

Efforts should be intensified to address specific obstetric complications, particularly pregnancy-induced hypertension (PIH) and antepartum hemorrhage (APH). Further research should be encouraged to investigate the mechanisms through which these factors contribute to preterm birth.

Health Education and Family Planning

Emphasize health education programs that raise awareness among women of reproductive age and their communities about the risks associated with high parity (having multiple children). Promote family planning to enable women to make informed decisions about the timing and spacing of pregnancies.

Regular Screening and Treatment

Implement regular screening for urinary tract infections (UTIs) during the antenatal period and ensure prompt treatment when necessary. This proactive approach can help identify and manage UTIs, which have been linked to preterm birth.

By addressing these limitations and implementing the recommended actions, future studies can improve the understanding of preterm birth risk factors and potentially contribute to more effective strategies for prevention and management.

CONCLUSION

In conclusion, our study highlights the significant prevalence of premature births, accounting for 26.02% of the total 1,737 births examined. The study also sheds light on the challenges faced in collecting and analyzing population-based data in developing countries, where access to antenatal and perinatal care is limited, birth registration is incomplete, and information on gestational age is lacking, particularly outside of hospital settings. However, even in low-middle-income countries with scarce resources, focused care can have a significant impact on reducing neonatal morbidity and mortality, particularly in the late preterm group. By recognizing the common risk factors for preterm birth, we can increase awareness about high-risk pregnancies, improve preventive measures for these risk factors, and enhance preterm care protocols in nurseries.

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