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Original Research Article

Unraveling the enigma of preterm birth: maternal factors, interventions, and neonatal implications

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ABSTRACT

Background: Preterm birth is a substantial global health issue with significant consequences to the newborn, family and society. Preterm deliveries affects nearly 15 million births worldwide.
Methods: A retrospective cross-sectional study, conducted in a tertiary healthcare center on 100 preterm births. The data used, was of a period of 6 months in 2023.
Results: The incidence of preterm was found to be 100 out of 791 live births (12.4%). Among which majority, (64%), fell into the moderate to late preterm range and with 40% falling within the 21-25 age group .While 41% had less than four antenatal care visits. Among the identified risk factors in the preterm births, high blood pressure and anemia were prevalent medical disorders, affecting 20 and 36 of cases, respectively. In obstetrical factors, 24 were attributed to multiple gestations. Lower socioeconomic status was a significant contributing factor, affecting 55 of the studied population. NICU admission ranged from short stays of 1-3 days (34%) to more extended durations, with 18% requiring care for 10-21 days and tocolytics were employed in 27 cases, with a notable 66.60% instances demonstrating effectiveness in preventing preterm birth.
Conclusions: In this study, we found high incidence of preterm birth (12.4%). Various socio-demographic, obstetric and neonatal risk factors were associated with preterm birth. Risk factor anticipation and timely interventions will help in the reduction of preterm births and associated mortalities.

Keywords: Clinical interventions, Neonatal outcomes, Perinatal morbidity, Preterm birth, Preterm birth prevention

INTRODUCTION

Preterm birth is a substantial global health issue with significant consequences to the newborn, family and society. Preterm deliveries affects nearly 15 million births worldwide.[1]

Preterm birth (PTB) is defined as any live birth occurring before 37 completed weeks of gestation; this can be subdivided into:[2] 1) Extremely preterm- birth that occurs before 28 weeks of gestation; 2) Very preterm birth: birth that occurs between 28 weeks and 31 weeks, 6 days of gestation and 3) Moderate to late preterm birth: birth that occurs between 32 weeks and 36 weeks, 6 days of gestation.[2]

Across countries, the rate of preterm birth ranges from 4-16% of babies born in 2020.[3] Premature or preterm births claim lakhs of lives every year in India, which records the maximum number of such deaths in the world. An estimated 134 lakh babies were born prematurely in 2020 worldwide, of which 30 lakh or 22 per cent were from

India.[4] An estimated 13.4 million babies were born preterm in 2020 (before 37 completed weeks of gestation).[3] Preterm birth complications are the leading cause of death among children under 5 years of age, responsible for approximately 900 000 deaths in 2019.[3] Three-quarters of these deaths could be prevented with current, cost-effective interventions.[3]

Several factors have been identified as risks for preterm birth. Socio-demographic factors such as ethnicity, older age of mothers and smoking have been reported as risk factors for preterm birth. Low education levels of mothers have also been documented as risk factors for preterm birth by many studies. Primi-parity has been linked as an obstetric risk factor for preterm birth. Further, poor access to antenatal care services during pregnancy leads to poor pregnancy outcomes like preterm births.[5]

Babies born preterm have a higher risk of dying as reported from a multi-country study conducted in low- and middle-income countries (LMICs). The greater risk of dying has been mostly associated with neonatal infections. In comparison to term infants, they are more prone to short and long-term neurocognitive and motor impairments together with increased risk of malnutrition, chronic diseases and early deaths.[6]

METHODS

A retrospective cross-sectional study by collecting data from medical records of 100 preterm deliveries occurring over 6 months of the year 2023 in a tertiary health care center in western India. This study was conducted at Dr MK shah medical college and research Centre, Ahmedabad Gujarat from 1st July 2023 to 31st December 2023.

Inclusion criteria

All preterm live births who were admitted in NICU in our institute were included.

Exclusion criteria

Exclusion criteria were fetuses with congenital anomalies, intrauterine deaths (IUD), and births occurring at less than 28 weeks of gestation, as well as neonates not admitted to our institute's NICU of the mothers who delivered at our facility.

Various demographic risk factors (age, parity, booking status, ANC visits and BMI), medical risk factors (HTN, anemia, thyroid disorders, addiction) and obstetrical risk factors (previous History preterm birth, multiple gestation, infection, PROM etc.) of past and present pregnancy were noted.

Diagnostic modalities such as history, clinical examination and ultrasonography (cervical length is measured, if <2.5mm then it was considered as incompetent cervix) are used in the study. Treatment modalities used in the prevention (tocolytics, progesterone, cervical encerclage etc.) were noted. Neonatal outcome such as APGAR score, birth weight, sex, days and indication of NICU admission were also recorded. Microsoft Excel was used as statistical tool.

RESULTS

Among 791 deliveries 100 patients had preterm deliveries at our institute showing a rate of 12.4% of preterm deliveries in study period (Table 1). The distribution of preterm births in the study cohort (n=100) revealed that, 29% as very preterm (between 28 weeks and 31 weeks, 6 days), and the majority, constituting 71%, fell into the moderate to late preterm category (32 weeks to 36 weeks, 6 days) (Table 1). In the perinatal and neonatal mortality cases (n=7, comprising 2 stillbirths and 5 neonatal deaths), 6 neonates exhibited a birth weight below 1500gms and were delivered at a gestational age between 28-32 weeks (very preterm). Consequently, it can be observed that moderate to late preterm neonates demonstrate a more favorable survival rate (Table 1).

Table 1: Number of patients (according to age at preterm birth).

Gestational age at preterm: (n=100)	Number of patients (%)
Very preterm: Between (28 weeks and 0 days and 31 weeks and 6 days of gestation)	29
Moderate to late preterm: (Between 32 weeks and 0 days and 36 weeks and 6 days of gestation	71

In the studied cohort of 100 preterm deliveries, maternal age distribution revealed 40% in the 21-25 age group, with 34% in the 26-30 age range. Primigravida constituted 56%, and 65% received booked antenatal care. Additionally, 59% had less than four ANC visits, and 32% had a BMI below 18.5 kg/m².There was an elevation in the incidence of preterm births within the age group of 21-25 (40%), which aligns with this being a key reproductive age bracket (Table 2).

Among the identified risk factors in the preterm births (n=100), prevalent medical disorders included high blood pressure (20), thyroid disorders (11), and anemia (36). Obstetrical factors contributing to preterm births comprised multiple gestations (24) and infections (20). Lower socioeconomic status was noted in 55 of the studied population. Cervical and uterine/placental anatomical factors accounted for 10 and 4, respectively, while 12 experienced premature rupture of membranes (PROM) (Table 3).

The rise in the number of patients from lower socioeconomic status could be attributed to the fact that the

tertiary care center offers antepartum, intrapartum, and postpartum care without any cost, making it more accessible to individuals from economically disadvantaged backgrounds (Table 3). Several patients exhibited a combination of multiple risk factors concurrently. For instance, Mrs. XYZ (IPID060923/0012), a 21-year-old woman in her third pregnancy, presented with symptoms of preterm labor, accompanied by severe anemia, pregnancy-induced hypertension (PIH), and vaginal infection. She hails from a socioeconomically disadvantaged background (Table 3).

Table 2: Maternal variables leading to preterm birth.

Maternal variables (n=100)		Number of patients (%)
Age (years)	<20	8
	21-25	40
	26-30	34
	31-35	10
	>35	8
Parity	Primigravida	56
	2nd -4th gravida	40
	Grandmultipara>/=5	4
Booked/ unbooked	Booked	65
	Unbooked	35
ANC visit	<4	59
	>/=4	41
BMI (kg/m^2)	<18.5	32
	18.5-24.9	36
	25.0-29.9	25
	30.0-34.9	7

Table 3: Associated risk factors leading to preterm birth.

Associated risk factors		Number of patients
Medical disorders	High blood pressure	20
	Thyroid disorders	11
	Diabetes mellitus	04
	Anemia	36
	Addiction	24
Anatomical	Uterine and placental	04
	Cervical	10
Obstetrical factors	Previous preterm birth	07
	Multiple gestations (twins, triplets, etc.)	24
	Infections and inflammatory conditions	20
	Stress and psychosocial factors	03
	Lower socioeconomic status	55
	PROM	12
	Others	03

In the fetal and neonatal outcomes (n=124), perinatal mortality was limited, with 2% still births neonatal mortality affected 5% of infants. The distribution of baby weight revealed 74% as low birth weight (2500-1500gm), 40% very low birth weight (1500-1000gm), and 10% extremely low birth weight (<1000gm). Among the infants, 56% were male, and 44% were female. NICU admission ranged from 34% for 1-3 days to 14% for more extended durations (>21 days), indicating the need for intensive care. Common diagnoses included respiratory distress syndrome (RDS) in 20 cases, septicemia in 11, and jaundice in 44 (Table 4). Similar to the convergence of multiple risk factors contributing to preterm labor, diverse indications also culminate in the admission of neonates to the Neonatal Intensive Care Unit (NICU). For example, a male neonate delivered at 31 weeks gestation with a birth weight of 1.4 kg was diagnosed with Transient Tachypnea of the Newborn (TTN), Respiratory Distress Syndrome (RDS), and septicemia. Consequently, he necessitated an extended NICU stay exceeding 21 days (Table 4). Among 100 patients 30% underwent caesarian section due to certain maternal or fetal complications (Table 4).

Table 4: Fetal and neonatal outcome in preterm birth (n=124).

Fetal and neonatal outcome		Number of patients (%)
Perinatal mortality	SD	2
	Neonatal mortality	5
APGAR score[7]	<7 after 5 minutes	37
	>7 after 5 minutes	63
Baby weight	2500-1500gm (low birth weight)	74
	1500-1000gm (very low birth weight)	40
	<1000gm (extremely low birth weight)	10
Sex	Male	56
	Female	44
NICU admission	</=3 days	34
	3-7days	41
	7-10 days	15
	10-21days	18
	>21 days	14
Diagnosis	RDS	20
	NEC	07
	TTN	06
	Septicemia	11
	Weight loss	49
	Jaundice	44
	Polycythemia	05

In antepartum management for preventing preterm birth, progesterone was used in 8 of cases and showed

effectiveness in 25% instances. Tocolytics were employed in 27 of cases, demonstrating efficacy in 66.60% instances. Antibiotics were used in 26 of cases, with 38.40% instances showing efficacy. In intrapartum management, rescue cerclage was not utilized, and antenatal corticosteroids were not specifically employed for preventing preterm birth. Magnesium sulfate for neuroprotection was used in 2 cases but was not aimed at preventing preterm birth (Table 5). Cervical cerclage was performed in 8 cases, with 6 of them conducted at external hospitals, demonstrating an efficacy rate of 50% in prevention of preterm labour (Table 5). Several patients were admitted during the active phase of 1st stage of labor, preventing the administration of preventive measures such as tocolytics or antenatal corticosteroids to mitigate the risk of preterm labor (Table 5).

Table 5: Management of preterm labour.

Management			Effective in prevention of preterm birth
Antepartum (medical and surgical)	Progesterone	8	25%
	Tocolytics	27	66.60%
	Cervical encerclage (18-24 weeks of gestation)	8	50%
	Antibiotics	26	38.40%
Intrapartum (medical and surgical)	Cervical encerclage (Rescue cerclage)	0	0%
	Antenatal corticosteroids	50	Not used to prevent preterm birth
	Magnesium sulphate for neuroprotection	2	Not used to prevent preterm birth

DISCUSSION

The study describes the incidence, risk factors and consequences associated with preterm births based on data available.[5]

The study revealed a preterm birth incidence of 12.4% among total births. In a systematic review conducted by Chawanpaiboon et al, incorporating data from 107 countries, the global preterm birth rate was reported at 10.6%.[8] Additionally, a systematic analysis by Blencowe et al, utilizing data from 184 countries, estimated preterm births at 11.1%.[6] These findings suggest that the institute's preterm rate is higher than global estimates, potentially attributed to its status as a tertiary referral center and different maternal variables of draining population maybe different .

Gurung et al shows a preterm rate of 3% (178) out of 5786 (97.0%) in multiple gestation[5] compared to our study of 24/100. Multifetal pregnancy and hydramnios are well-recognized risks for preterm birth. With these, uterine overdistention imparts greater stress on the myometrium. Similar inflammatory responses have been observed in the amnion of women with polyhydramnios and twins.[1] The higher incidence of multifetal gestation observed in our study may be attributed to the tertiary referral center setting.

Genetic mutations in components of collagen and elastic fibers or proteins required for their assembly can be risk factors for cervical insufficiency and preterm birth (Nallasamy, 2017; Volozonoka, 2020).[1] hence and increased rate of preterm deliveries due to cervical incompetency (10/100).

Ascending infection is considered to be the most common entry route where microorganisms colonize the cervix, decidua, and possibly the membranes, and then may enter the amnionic sac. Colonization with an infectious agent has been detected in 25 to 40 percent of all preterm deliveries by Goldenberg et al.[1] 20 patients out of 100 were diagnosed with infections at admission.

Study showed that the risk of preterm was higher among nulliparous mothers (56%). A study found that women who sought <4 ANC visits during pregnancy were at higher risk of preterm birth, in our study (59%) of the women had </=4 ANC visits. ANC visits should focus on improved screening of at-risk pregnant women together with the ability to treat and manage infections and provide dietary support and counseling services and further research is needed.[5]

Several studies have linked male babies to be at higher risk for preterm births.[5] (56% male sex in our study). However, a study showed no significant association between sex of the child and preterm births.[5]

The NICU admission is also seen among all preterm births according to institutes policy, the major causes of NICU admission are LBW where 74% came under the criteria of low birth weight while 10% came under the criteria of extremely low birth weight .again increasing the chance of NICU admission along with increasing days of admission, again increasing the financial and emotional burden on parents.

Among the 791 mothers enrolled during the study period, preventive medication was initiated in the antenatal period due to underlying risk factors. Our data underscores the effectiveness of various interventions, including

tocolytics, cervical encerclage, and antibiotics. These findings emphasize the importance of judicious use of these medications in patients diagnosed with the risk of preterm labor.

Several limitations need to be acknowledged in this study. Firstly, the diagnostic modalities employed were restricted to history, clinical examination, and ultrasound due to financial constraints, leading to the exclusion of biochemical markers for the diagnosis of preterm labor. Additionally, the study was conducted at a tertiary healthcare center, potentially introducing selection bias as patients with more complex cases or higher-risk factors may be overrepresented. The reliance on retrospective data collection from medical records poses inherent limitations, including the potential for incomplete or inconsistent information. Furthermore, the study duration of six months may not capture the full spectrum of seasonal variations in preterm births. Lastly, the absence of a control group hinders the establishment of causal relationships, limiting the ability to draw definitive conclusions about the effectiveness of interventions in preventing preterm births.

CONCLUSION

A notable preterm birth incidence of 12.4% was observed, with socio-demographic, obstetric, and neonatal factors identified as associated risks. Proactive identification of risk factors and timely interventions are crucial for reducing preterm births and related mortalities. Regular antenatal care (ANC) visits play a pivotal role in early detection of risk factors (such as incompetent cervix, prior preterm birth history, and multi-fetal gestation), facilitating preventive measures. Interventions like tocolytic medications and cervical cerclage can be initiated in primary health care centers until the patient is transferred to a tertiary health care facility. Opting for preterm delivery in a tertiary health care center is recommended, considering that all preterm neonates require NICU admission.

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