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Original Research Article

Risk factors and pregnancy outcomes of preterm birth at a tertiary hospital in Vietnam

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ABSTRACT

Background: Preterm birth remains a leading cause of neonatal morbidity and mortality worldwide.
Methods: A comparative cross-sectional study was conducted on 272 women (136 preterm and 136 term deliveries) at Hue University of Medicine and Pharmacy Hospital from April 2024 to May 2025. Multivariable logistic regression analysis was used to identify independent risk factors.
Results: Independent risk factors for preterm birth included adverse marital status (aOR=23.56; 95% CI: 2.87-193.55), history of preterm birth (aOR=8.77; 95% CI: 2.69-28.61), premature rupture of membranes (PROM) (aOR=2.4; 95% CI: 1.16-4.85), abnormal amniotic fluid volume (aOR=3.87; 95% CI: 1.66-9.03), anemia (aOR=2.35; 95% CI: 1.20-4.61), preeclampsia (aOR=5.99; 95% CI: 2.12-16.95) and leukocytosis ≥15×10^9/L (aOR=4.74; 95% CI: 1.86-12.11). Most cases were late preterm (76.5%). Neonatal outcomes were generally favorable, with 97.0% achieving Apgar scores of 8-10 at 5 minutes and a mortality rate of 1.5%.
Conclusions: Preterm birth is associated with multiple independent clinical and socio-demographic factors. Early identification of high-risk pregnancies may improve maternal and neonatal outcomes.

Keywords: Preterm birth, Risk factors, Pregnancy outcomes, PROM, Preeclampsia

INTRODUCTION

Preterm birth is defined as delivery occurring between 22 and before 37 completed weeks of gestation, accounting for approximately 8-12% of all births, equivalent to an estimated 13.4 million cases annually worldwide and remains a leading cause of neonatal mortality.[1,2] Preterm infants are at increased risk of respiratory distress syndrome, intraventricular hemorrhage, necrotizing enterocolitis, sepsis and neurodevelopmental disorders, with neurological sequelae affecting up to one-third of infants born before 32 weeks of gestation.[1,3]

From the maternal perspective, preterm birth not only impacts physical health but also imposes significant psychological and economic burdens. The risks of postpartum depression and anxiety are increased and the recurrence rate of preterm birth in subsequent pregnancies may reach 25-50%.[1,4] In Vietnam, the prevalence of preterm birth ranges from 8% to 10%, with multiple risk factors including previous preterm birth, multiple gestation, infections during pregnancy, preeclampsia, stress and inadequate antenatal care.[2,5,6]

Although advances in medical care have significantly improved the survival of preterm infants, long-term complications remain common. Identifying risk factors and evaluating pregnancy outcomes are essential for prevention and reduction of complications. Therefore, this study was conducted to investigate factors associated with preterm birth and to assess pregnancy outcomes among

women delivering at Hue University of Medicine and Pharmacy Hospital.

METHODS

A comparative cross-sectional study was conducted at Hue University of Medicine and Pharmacy Hospital from April 2024 to May 2025. A total of 272 women were enrolled, including 136 preterm births (22-36$^{6}/_{7}$ weeks) and 136 term births (37-41$^{6}/_{7}$ weeks).

Eligible participants had singleton live births with complete medical records and provided informed consent. Women with uncertain gestational age, fetal anomalies, or significant psychiatric disorders were excluded.

Data were collected from medical records, clinical examination and structured interviews, including demographic characteristics, obstetric history, pregnancy-related factors and maternal and neonatal outcomes.

Statistical analysis was performed using SPSS version 20.0. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean±standard deviation. Group comparisons were conducted using the Chi-square test or Fisher's exact test as appropriate. Logistic regression analysis was performed to identify independent risk factors. Multicollinearity was assessed before multivariable analysis. A $p<0.05$ was considered statistically significant.

Ethical approval was obtained from the Institutional Review Board of Hue University of Medicine and Pharmacy (No. H2024/288).

RESULTS

Baseline characteristics

The mean maternal age was comparable between the preterm and term groups (29.4±6.91 vs. 29.82±5.58 years). A higher proportion of women in the preterm group resided in rural areas and had adverse marital status.

Table 1 shows the baseline characteristics of the study participants.

Table 1: Baseline characteristics of study participants.

Variables	Preterm, (n=136)	Term, (n=136)
Age (mean±SD)	29.4±6.91	29.82±5.58
≤18	9 (6.6%)	3 (2.2%)
19-34	94 (69.1%)	103 (75.7%)
≥35	33 (24.3%)	30 (22.1%)
Rural residence	81 (59.6%)	65 (47.8%)
Adverse marital status	13 (9.6%)	1 (0.7%)

Factors associated with preterm birth

Univariate analysis showed that previous preterm birth, PROM, abnormal amniotic fluid volume, anemia, leukocytosis and preeclampsia were significantly associated with preterm birth ($p<0.05$).

Table 2 presents the univariate analysis of factors associated with preterm birth.

Table 2: Factors associated with preterm birth (univariate analysis).

Factors	OR	95% CI	P value
Adverse marital status	14.27	1.84-110.68	0.011
Previous preterm birth	5.4	1.77-16.21	0.003
PROM	2.2	1.26-3.94	0.006
Abnormal amniotic fluid	5.44	2.59-11.41	<0.001
Anemia	2.2	1.26-3.94	0.006
IUGR	5.32	1.14-24.74	0.03
Leukocytosis ≥15×10⁹/L	3.78	1.65-8.69	0.002
Preeclampsia	3.96	1.54-10.14	0.004

Multivariable logistic regression analysis identified several independent predictors of preterm birth.

Table 3 shows the multivariable logistic regression analysis.

Table 3: Multivariable logistic regression analysis of factors associated with preterm birth.

Variables	aOR	95% CI	P value
Adverse marital status	23.56	2.87-193.55	0.003
Previous preterm birth	8.77	2.69-28.61	<0.001
PROM	2.4	1.16-4.85	0.018
Abnormal amniotic fluid	3.87	1.66-9.03	0.002
Anemia	2.35	1.20-4.61	0.013
Preeclampsia	5.99	2.12-16.95	0.001
Leukocytosis ≥15×10⁹/L	4.74	1.86-12.11	0.001

Pregnancy outcomes

The characteristics of labor, mode of delivery, gestational age at birth, neonatal birth weight, Apgar scores and neonatal mortality are presented in Table 4.

Spontaneous labor accounted for 75.7% of cases, while medically indicated preterm birth represented 24.3%.

Vaginal delivery was performed in 55.1% of cases, whereas cesarean section accounted for 44.9%.

The mean gestational age at delivery was 34.59±2.31 weeks, with the majority of cases classified as late preterm (34-36 weeks and 6 days), accounting for 76.5%.

Regarding neonatal outcomes, most newborns had favorable Apgar scores, with 82.4% achieving 8-10 points at 1 minute and 97.0% at 5 minutes. The neonatal mortality rate was low (1.5%).

Table 4 presents the maternal and neonatal outcomes.

Table 4: Pregnancy outcomes.

Characteristics	N	Percentages (%)
Onset of labor		
Spontaneous	103	75.7
Indicated	33	24.3
Mode of delivery		
Vaginal delivery	75	55.1
Cesarean section	61	44.9
Gestational age at delivery (in weeks)		
Mean±SD	34.59±2.31	
22-27+6	4	2.9
28-31+6	9	6.6
32-33+6	19	14.0
34-36+6	104	76.5
Birth weight (g)		
<1000	4	2.9
1000-<1500	6	4.4
1500-<2500	64	47.1
≥2500	62	45.6
Apgar score at 1 minute		
0-3	3	2.2
4-7	21	15.4
8-10	112	82.4
Apgar score at 5 minutes		
0-3	2	1.5
4-7	2	1.5
8-10	132	97.0
Neonatal mortality		
Yes	2	1.5
No	134	98.5

DISCUSSION

Marital status was significantly associated with preterm birth in our study (p<0.05). Women who were separated, divorced, single, or widowed had a markedly higher risk of preterm birth compared with married women (OR=14.27; 95% CI: 1.84-110.68; p=0.011). This finding is consistent with the study by Shah, which reported that unmarried women had an increased risk of preterm birth (OR=1.22; 95% CI: 1.14-1.31) (Table 2).[7]

The observed association may be explained by the lack of emotional, social and financial support from a partner. Such deficiencies can contribute to increased psychological stress during pregnancy, which may adversely affect endocrine and immune responses, thereby increasing the risk of preterm birth.

A history of preterm birth was strongly associated with an increased risk of preterm delivery in the current pregnancy. In our study, the proportion of women with a previous preterm birth was significantly higher in the preterm group (14.0%) compared to the term group (2.9%) (p=0.003). Logistic regression analysis indicated that women with a history of preterm birth had a 5.4-fold higher risk of preterm delivery compared to those without such a history (95% CI: 1.77-16.21) (Table 2). These findings are consistent with previous studies. Phung Van Thuyet reported an even higher risk (OR=9.12; 95% CI: 2.41-34.4), while Leal et al found that a history of preterm birth increased the risk by 3.74 times (95% CI: 2.92-4.79).[8,9] The underlying mechanisms may include cervical insufficiency, structural uterine abnormalities, or unresolved underlying maternal conditions. Therefore, careful assessment of obstetric history is essential for early risk stratification and implementation of preventive strategies in subsequent pregnancies.

PROM is a common condition in preterm birth. In our study, PROM occurred in 32.4% of the preterm group compared to 17.6% in the term group (p=0.006), with an odds ratio of 2.2 (95% CI: 1.26-3.94) (Table 2). This finding is consistent with previous studies, in which PROM has been identified as a leading cause of preterm birth, accounting for approximately 30-40% of spontaneous preterm deliveries.[1] The underlying pathophysiology is primarily related to chorioamnionitis, which triggers the release of prostaglandins, leading to membrane weakening, early rupture and the initiation of labor. These findings highlight the importance of early detection and management of genitourinary infections to reduce the risk of PROM-related preterm birth.

Preeclampsia was also significantly associated with preterm birth in our study, increasing the risk by 3.96 times (95% CI: 1.54-10.14), which is consistent with the findings of Dahman HAB (OR=6.34; p<0.001).[10] Preeclampsia is both a serious maternal complication and a major indication for medically indicated preterm delivery. Therefore, strengthening screening strategies, along with calcium supplementation and low-dose aspirin prophylaxis in high-risk women and close blood pressure monitoring, are essential to reduce preterm birth associated with this condition.

The proportion of intrauterine growth restriction (IUGR) in the preterm group was 7.4%, significantly higher than in the term group (1.5%) (p=0.03). Regression analysis showed that IUGR increased the risk of preterm birth by 5.32 times (95% CI: 1.14-24.74). These findings reflect abnormalities in fetal development, primarily related to impaired uteroplacental perfusion and placental dysfunction, resulting in reduced oxygen and nutrient

supply to the fetus. Such abnormalities not only lead to fetal growth restriction but also activate biological pathways associated with preterm labor, including increased prostaglandin production, oxidative stress and placental inflammatory responses.[11]

Maternal anemia was also identified as an independent risk factor for preterm birth. Women with anemia had a 2.2-fold higher risk of preterm delivery (95% CI: 1.26-3.94). Similarly, Wang reported a relative risk of 1.51 (95% CI: 1.33-1.72).[12] Anemia reduces oxygen-carrying capacity, leading to chronic placental hypoxia and stimulation of cytokine release, which may induce uterine contractions. In addition, anemia increases susceptibility to infections, an important intermediate factor contributing to preterm birth. Therefore, early screening and appropriate management of iron-deficiency anemia during pregnancy are essential preventive strategies.

In our study, women with abnormal amniotic fluid volume had a 5.44-fold higher risk of preterm birth compared to those with normal amniotic fluid levels (95% CI: 2.59-11.41; p<0.05) (Table 3). This finding is consistent with the study by Dahman conducted in Yemen, which reported that abnormal amniotic fluid volume was significantly associated with an increased risk of preterm birth (OR=3.0; p=0.000).[10] Both oligohydramnios and polyhydramnios may reflect underlying maternal or fetal conditions, such as hypertension, diabetes, fetal anomalies, or placental dysfunction. Regular monitoring of amniotic fluid index can facilitate early detection of abnormalities and timely interventions to reduce the risk of preterm birth.

Women with a white blood cell count ≥15×10⁹/L had a 3.78-fold higher risk of preterm birth compared to those with lower levels (95% CI: 1.65-8.69; p=0.002) (Table 2). Elevated leukocyte counts may indicate an underlying inflammatory or infectious process. Goldenberg suggested that intra-amniotic inflammation leads to the release of cytokines such as interleukin-6 and tumor necrosis factor-alpha, as well as prostaglandins, which can trigger preterm labor.[11] These findings further support the hypothesis that inflammation plays a central role in the pathogenesis of preterm birth. Monitoring leukocyte levels, in combination with other inflammatory markers, may be useful for early risk identification and prevention in high-risk pregnancies.

Multivariable logistic regression analysis identified several independent predictors of preterm birth in our study. Among these, adverse marital status (separated/divorced/single/widowed) showed strongest association, increasing the risk of preterm birth by more than 23-fold (aOR=23.56; 95% CI: 2.87-193.55; p=0.003). These finding highlights potential impact of psychosocial stress and lack of social support on pregnancy outcomes (Table 3).

A history of preterm birth remained strong independent predictor, with adjusted OR=8.77 (95% CI: 2.6-28.61; p<0.001). This consistent with prev studies demonstrating that prior preterm delivery is one of the most significant risk factors for recurrence, likely due to persistent underlying maternal/uterine conditions (Table 3).

PROM was also independently associated with preterm birth (aOR=2.4; 95% CI: 1.16-4.85; p=0.018), supporting the well-established role of membrane rupture and intrauterine infection in triggering early labor. Similarly, abnormal amniotic fluid volume significantly increased the risk (aOR=3.87; 95% CI: 1.66-9.03; p=0.002), suggesting the contribution of placental dysfunction and maternal-fetal pathology (Table 3).

Maternal anemia was identified as independent risk factor (aOR=2.35; 95% CI: 1.20-4.61; p=0.013), possibly through mechanisms related to chronic hypoxia and increased susceptibility to infection. Preeclampsia also showed strong association (aOR=5.99; 95% CI: 2.12-16.95; p=0.001), reflecting both its pathophysiological impact on placental perfusion and its role as major indication for medically indicated preterm delivery (Table 3).

In addition, elevated white blood cell count (≥15×10⁹/l) was independently associated with preterm birth (aOR=4.74; 95% CI: 1.86-12.11; p=0.001), further supporting the role of inflammation and infection in the pathogenesis of preterm labor (Table 3).

Overall, these findings indicate that preterm birth is a multifactorial condition influenced by a combination of socio-demographic, obstetric and clinical factors. Identification of these independent predictors is essential for early risk stratification and targeted interventions to improve pregnancy outcomes.

Regarding labor characteristics and mode of delivery, our study showed that spontaneous labor accounted for 75.5% of preterm births, while medically indicated preterm deliveries comprised 24.3% (Table 4).This distribution is consistent with existing literature, in which indicated preterm births account for approximately 20-30% of cases.[1] These findings suggest that spontaneous preterm labor remains the predominant pathway, reflecting the role of physiological and local pathological triggers such as infection, premature rupture of membranes and uterine contractility disorders.

In terms of delivery mode, vaginal delivery accounted for 55.1% of cases, while cesarean section was performed in 44.9% (Table 4). This is comparable to findings from the National Hospital of Obstetrics and Gynecology, where vaginal delivery and cesarean section rates were 59.3% and 40.7%, respectively.[13] The relatively high cesarean section rate among preterm births may be attributed to planned interventions in cases of fetal distress, preeclampsia, or abnormal fetal presentation, aiming to optimize maternal and neonatal outcomes. These results highlight the importance of strengthening preventive strategies for spontaneous preterm labor, including early

detection and treatment of genitourinary infections and effective management of maternal comorbidities, while also ensuring appropriate indications for cesarean delivery.

The mean gestational age at delivery was 34.59±2.31 weeks, with late preterm births (34-36 weeks and 6 days) accounting for the majority (76.5%). Moderate preterm (32-33 weeks and 6 days), very preterm (28-31 weeks and 6 days) and extremely preterm (<28 weeks) accounted for 14.0%, 6.6% and 2.9%, respectively (Table 4). These findings are consistent with previous studies by Hong and Trung, which also reported a predominance of late preterm births.[14,15] The mean birth weight was 2325.0±587.9 g, with the largest proportion in the 1500-2500 g group (47.1%), followed by ≥2500 g (45.6%), 1000-1500 g (4.4%) and <1000 g (2.9%) (Table 4). This distribution is comparable to that reported by Hong, where the lowest proportion was observed in the <1000 g group and the highest in the 1500-2500 g group.[15]

Neonatal outcomes in our study were generally favorable. Apgar scores improved significantly at 5 minutes, with 97.0% of newborns achieving scores of 8-10, while only 1.5% had scores of 4-7 and 1.5% had scores of 0-3 (Table 4). These results are better than those reported by Linh where normal Apgar scores were observed in 61.5% of cases.[16] The neonatal mortality rate in our study was 1.3%, which is lower than that reported by Hong (4.9%) and Lang (15.6%).[17] This difference may be explained by the lower proportion of extremely preterm births in our cohort, with most cases belonging to the late preterm group, which is associated with higher gestational age and birth weight, leading to better survival outcomes.

These findings emphasize the importance of preventive strategies aimed at prolonging pregnancy as close to term as possible, particularly in women at high risk of early preterm birth. Early identification and management of risk factors, along with timely referral of threatened extremely preterm cases to tertiary centers with advanced neonatal care capabilities, are essential to reduce neonatal mortality and improve overall pregnancy outcomes.

Limitations

The study was conducted at a single center and used a cross-sectional design, limiting generalizability and causal inference.

CONCLUSION

Preterm birth is a multifactorial condition associated with several independent risk factors. Early identification and management of high-risk pregnancies are essential to improve maternal and neonatal outcomes.

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