Research Article

Prevalence, Risk Factors, and Maternal–Fetal Outcomes of First Trimester Vaginal Bleeding

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Abstract

Background: First-trimester vaginal bleeding (FTVB) is a common but clinically significant event, with prevalence estimates ranging from 7% to 25%. While many episodes are self-limiting, FTVB is associated with an increased risk of adverse outcomes, including miscarriage, preterm birth, and placental complications. This study aimed to determine the local prevalence, identify risk factors, and quantify maternal-fetal outcomes associated with FTVB in a tertiary care setting.

Methods: A retrospective cohort study was conducted using medical records of 615 pregnant women who registered for antenatal care at ≤13^{+6} weeks at a tertiary hospital. Women with documented FTVB (n=102) were compared to those without (n=513). Data on demographics, obstetric history, sonographic findings, and pregnancy outcomes were extracted. Multivariable logistic regression identified independent risk factors for FTVB and its associated adverse outcomes. A predictive model for a composite adverse outcome (early loss, preterm birth, or NICU admission) among women with bleeding was developed.

Results: The prevalence of FTVB was 16.6% (95% CI: 13.8–19.8%). Independent risk factors included a history of prior miscarriage (aOR=1.85, 95% CI: 1.15–2.97), prior bleeding episodes (aOR=2.78, 95% CI: 1.49–5.19), subchorionic hematoma on ultrasound (aOR=6.24, 95% CI: 3.86–10.08), maternal age ≥30 years (aOR=1.92, 95% CI: 1.20–3.08), and booking hemoglobin <11 g/dL (aOR=1.79, 95% CI: 1.12–2.85). FTVB was significantly associated with early pregnancy loss (aOR=3.41, 95% CI: 1.71–6.78), preterm birth (aOR=1.89, 95% CI: 1.05–3.41), placental abruption (aOR=3.25, 95% CI: 1.18–8.96), lower mean birth weight (-148 g, p<0.05), and NICU admission (aOR=1.81, 95% CI: 1.05–3.13). A prediction model for adverse outcomes in the bleeding group had an AUC of 0.72.

Conclusion: FTVB is a prevalent finding that serves as a marker for heightened risk throughout pregnancy. It is strongly associated with a history of miscarriage, sonographic findings of subchorionic hematoma, and maternal anemia. Critically, FTVB significantly increases the odds of adverse outcomes from the first trimester through delivery, underscoring the need for vigilant antenatal surveillance in these pregnancies.

Keywords: First trimester vaginal bleeding; Prevalence; Risk factors; Subchorionic hematoma; Pregnancy outcome; Preterm birth; Miscarriage; Retrospective cohort study.

Introduction

Vaginal bleeding in the first trimester of pregnancy (i.e. up to 13±6 weeks) is a common clinical presentation and a cause of anxiety for both patients and clinicians. The reported prevalence of first trimester vaginal bleeding varies widely but is often cited as 7 % to 25 % of recognized pregnancies, depending on study design, population, and definitions used [1]. Some sources suggest up to 20 % of clinically confirmed pregnancies may have some bleeding in the first 20 weeks [2].

Though many episodes of first trimester bleeding resolve without adverse outcomes, a subset are harbingers of pregnancy complications. Heavy bleeding, bleeding accompanied by pain, or recurrent episodes have been associated with increased risk of miscarriage, preterm birth, placental abruption, intrauterine growth restriction, low birth weight, preterm rupture of membranes, and other adverse perinatal outcomes [1]. For example, in a meta-analysis, first trimester bleeding was associated with increased relative risks (RR) of abortion (~4.3), preterm birth (~1.8), placental abruption (~2.2), and NICU admission (~2.4) [3].

However, many existing studies are retrospective, clinic-based, or limited to specific high-risk groups. There is heterogeneity in the definitions of “bleeding” (spotting vs heavy), timing, and confounding adjustment. Moreover, few prospective studies in Indian / regional settings have systematically assessed both risk factors (maternal,

obstetric, lifestyle, ultrasound/sonographic findings) and downstream maternal–fetal outcomes in a comprehensive way. The semi-urban Indian study by Choudhury et al. found that first trimester bleeding, had more abortion/nonviable pregnancies, while among those continuing pregnancies, complications occurred [4].

Given the clinical burden, more precise estimates of prevalence, identification of modifiable and non-modifiable risk factors, and quantification of maternal and neonatal outcomes associated with first trimester bleeding are important. This is especially relevant in our population, where local demographic, nutritional, healthcare access, and obstetric risk profiles may differ.

Thus, the present study aims to (i) estimate the prevalence of first trimester vaginal bleeding in the antenatal population, (ii) explore predictors/risk factors for bleeding, and (iii) assess maternal and fetal outcomes associated with first trimester bleeding, compared to those without bleeding.

Aim

To determine the prevalence, risk factors, and maternal–fetal outcomes associated with vaginal bleeding in the first trimester of pregnancy.

Objectives

1. To estimate the prevalence of first trimester vaginal bleeding among antenatal women presenting for early pregnancy care.
2. To compare demographic, obstetric, medical, lifestyle, and sonographic/biochemical characteristics between women who have first trimester bleeding and those who do not.
3. To identify independent risk factors (predictors) associated with first trimester vaginal bleeding.
4. To compare maternal and fetal outcomes (miscarriage, preterm birth, placental complications, birth weight, NICU admission, mode of delivery, etc.) between those with and without first trimester bleeding.
5. To develop a risk prediction model for adverse outcomes among bleeding pregnancies.

Materials and Methods

Study Design: This was a retrospective cohort study conducted using medical records of pregnant women who attended antenatal and obstetric clinics at CHETTINAD HOSPITAL AND RESEARCH INSTITUTE during the period from January 2024 to December 2024. Data were extracted from hospital electronic databases and paper-based antenatal records.

Study Setting: The study was carried out at the Department of Obstetrics and Gynaecology, CHETTINAD HOSPITAL AND RESEARCH INSTITUTE, a tertiary care center providing comprehensive antenatal services.

Study Population: The study population consisted of pregnant women who had registered for antenatal care at ≤ 12 weeks gestation (or ≤ 13^{+6} weeks as per institutional protocol), with sufficient documentation available in hospital records.

Inclusion Criteria

- Singleton pregnancies
- Gestational age ≤ 12 or ≤ 13^{+6} weeks at registration (confirmed by last menstrual period ± early ultrasound)
- Complete medical and follow-up data available until delivery

Exclusion Criteria

- Known uterine anomalies, known bleeding disorders, or known coagulopathies
- Use of anticoagulant therapy
- Pre-existing chronic medical conditions likely to confound bleeding risk (e.g., untreated severe hypertension, malignancy)
- Multiple pregnancies
- Non-viable pregnancies at first scan (e.g., documented fetal demise or missed abortion)

Sample Size Calculation

To estimate the prevalence of first-trimester bleeding with adequate precision:

The anticipated prevalence (p) = 0.15 (15 %), based on previous literature reporting a range of 7–25 %. Desired margin of error (d) = 0.03 (3 %); confidence level = 95 % (z = 1.96).

$$n = \frac{z^2 \cdot p(1-p)}{d^2} = \frac{(1.96)^2 \cdot 0.15 \cdot 0.85}{(0.03)^2} \approx 544$$

Accounting for ~10 % incomplete or missing records:

$$n_{adj} = \frac{544}{1 - 0.10} \approx 600$$

Hence, records of approximately 600 pregnant women with documented early pregnancy data were reviewed. Among them, those with first-trimester bleeding were classified as the exposed group, while those without bleeding served as the comparison group.

Data Collection: Data were extracted retrospectively from hospital records using a structured data extraction form.

Variables Collected

1. **Baseline (early pregnancy / booking data):**
   - Demographics: age, education, socioeconomic status, residence (urban/rural), maternal height, weight, BMI, nutritional status
   - Obstetric history: gravidity, parity, history of miscarriage, prior bleeding episodes, prior preterm birth, cesarean section, ectopic pregnancy
   - Medical history: hypertension, thyroid disorders, diabetes, coagulopathies, medications, substance use (smoking, alcohol)
   - Lifestyle (if documented): diet, physical activity, supplement use
2. **Ultrasound / Imaging findings:**
   - Pregnancy viability (fetal heartbeat)
   - Gestational sac and subchorionic hematoma characteristics (presence, size, and location)
   - Placental or uterine abnormalities
3. **Laboratory parameters:**
   - Hemoglobin, platelet count, coagulation profile
   - Thyroid function, infectious serology (if performed)
4. **Bleeding episode details (for women with documented bleeding):**
   - Gestational week at first episode
   - Duration, frequency, and intensity (spotting, moderate, or heavy)
   - Associated symptoms (pain, cramps)
   - Ultrasound findings and any interventions (e.g., hospitalization, medications)
5. **Follow-up and outcomes (as documented in records):**
   - Early pregnancy outcomes: spontaneous abortion, threatened abortion, ectopic pregnancy, molar pregnancy
   - Later obstetric outcomes: preterm labor (< 37 weeks), premature rupture of membranes, intrauterine growth restriction, placental abruption, hypertensive disorders, gestational diabetes, anemia, mode of delivery
   - Neonatal outcomes: birth weight, small for gestational age (SGA), Apgar scores, NICU admission, congenital anomalies, perinatal mortality

Statistical Analysis: Data analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). **Descriptive analysis:** Prevalence of first-trimester bleeding was expressed as proportions with 95 % confidence intervals. **Comparative analysis:** Continuous variables: Student's t-test or Mann–Whitney U-test were used. Categorical variables: Chi-square or Fisher's exact test were used. **Multivariable analysis:** Logistic regression was used to identify independent predictors (risk factors) for first-trimester bleeding. Variables with $p < 0.2$ in bivariate analysis were included. Stepwise backward/forward selection methods were applied. Adjusted odds ratios (aORs) with 95 % CIs were reported. **Outcome analysis:** Logistic regression (or Cox regression, for time-to-event data) was used to assess associations between bleeding and maternal–fetal outcomes, adjusting for potential confounders (e.g., age, parity, BMI). For continuous outcomes (e.g., birth weight), linear regression was used. **Sensitivity analysis:** Was performed by excluding pregnancies with known risk factors or incomplete follow-up data. **Missing data:** If < 5 %, complete case analysis was done; if > 5 %, multiple imputation was applied.

Ethical Considerations: The study protocol was submitted to and approved by the Institutional Ethics Committee (IEC) / Institutional Review Board (IRB). As the study involved a retrospective review of medical records, a waiver of informed consent was granted in accordance with institutional and national ethical guidelines. Data confidentiality was ensured by de-identifying records, coding data, and limiting access to authorized research personnel only.

Results

A total of 615 eligible pregnant women who registered for antenatal care within the first trimester were included in the final analysis. The mean (±SD) maternal age was 26.4 ± 4.7 years, and the mean gestational age at booking was 9.2 ± 2.1 weeks. Based on documented bleeding episodes, participants were categorized into two groups: those with first-trimester vaginal bleeding (the exposed group, n=102) and those without (the comparison group, n=513).

The prevalence of documented first-trimester vaginal bleeding among the study population was 16.6% (102/615) (95% Confidence Interval [CI]: 13.8% – 19.8%).

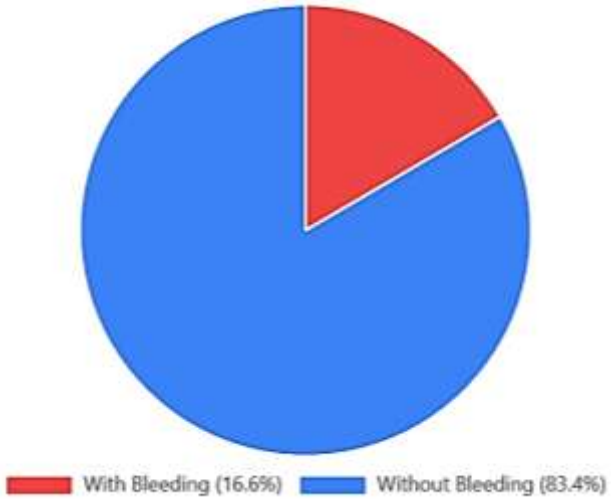
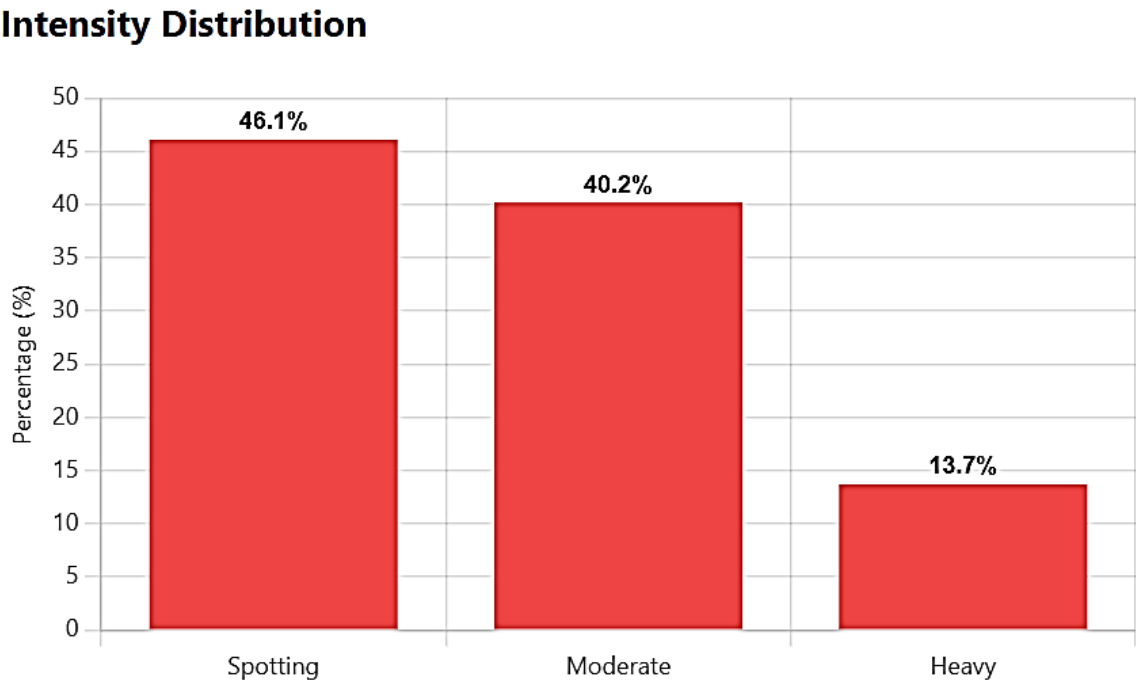


Table 1: Characteristics of Bleeding Episodes (n=102)

Characteristic	Category	n (%)
Gestational Week at First Episode	≤ 8 weeks	38 (37.3%)
	9 - 12 weeks	64 (62.7%)
Intensity	Spotting	47 (46.1%)
	Moderate	41 (40.2%)
	Heavy	14 (13.7%)
Frequency	Single Episode	71 (69.6%)
	Multiple Episodes	31 (30.4%)
Associated Symptoms	Pain/Cramps Present	58 (56.9%)
	No Pain	44 (43.1%)
Ultrasound Finding at Bleeding	Subchorionic Hematoma	45 (44.1%)
	No Abnormal Finding	57 (55.9%)
Intervention Required	Hospitalization	22 (21.6%)
	Medical Treatment Only	36 (35.3%)
	None	44 (43.1%)



Significant differences were observed between the bleeding and non-bleeding groups for several baseline characteristics.

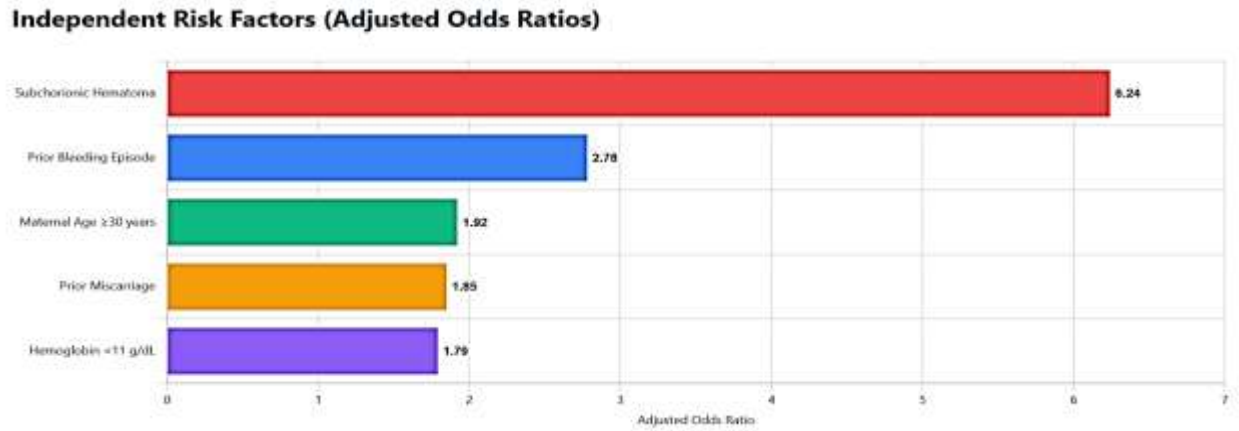
Table 2: Comparison of Maternal Baseline and Obstetric Characteristics

Characteristic	Bleeding Group (n=102)	Non-Bleeding Group (n=513)	p-value
Maternal Age (years), mean ±SD	27.8 ± 5.1	26.1 ± 4.6	**0.001**
BMI (kg/m²), mean ±SD	24.1 ± 4.5	23.0 ± 3.8	**0.010**
Primigravida, n (%)	28 (27.5%)	189 (36.8%)	0.062
History of ≥1 Miscarriage, n (%)	39 (38.2%)	133 (25.9%)	**0.009**
History of Prior Bleeding, n (%)	17 (16.7%)	35 (6.8%)	**<0.001**
Subchorionic Hematoma at 1st Scan, n (%)	45 (44.1%)	58 (11.3%)	**<0.001**
Thyroid Disorder, n (%)	15 (14.7%)	45 (8.8%)	0.056
Hemoglobin at booking (g/dL), mean ±SD	10.9 ± 1.2	11.5 ± 1.1	**<0.001**

Variables with a p-value <0.2 in bivariate analysis were included in a multivariable logistic regression model. The following were identified as independent risk factors.

Table 3: Independent Risk Factors for First-Trimester Vaginal Bleeding (Multivariable Logistic Regression)

Risk Factor	Adjusted Odds Ratio (aOR)	95% CI	p-value
History of Prior Miscarriage	1.85	1.15 – 2.97	**0.011**
History of Prior Bleeding Episode	2.78	1.49 – 5.19	**0.001**
Presence of Subchorionic Hematoma	6.24	3.86 – 10.08	**<0.001**
Maternal Age ≥30 years	1.92	1.20 – 3.08	**0.007**
Booking Hemoglobin <11 g/dL	1.79	1.12 – 2.85	**0.015**



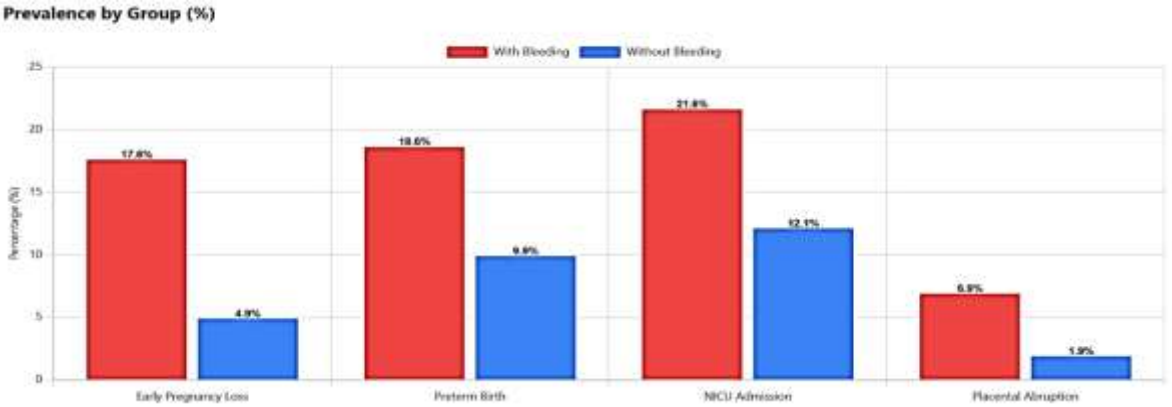
First-trimester bleeding was associated with significantly higher rates of several adverse outcomes, even after adjusting for confounders like age, parity, and BMI.

Table 4: Association between First-Trimester Bleeding and Pregnancy Outcomes

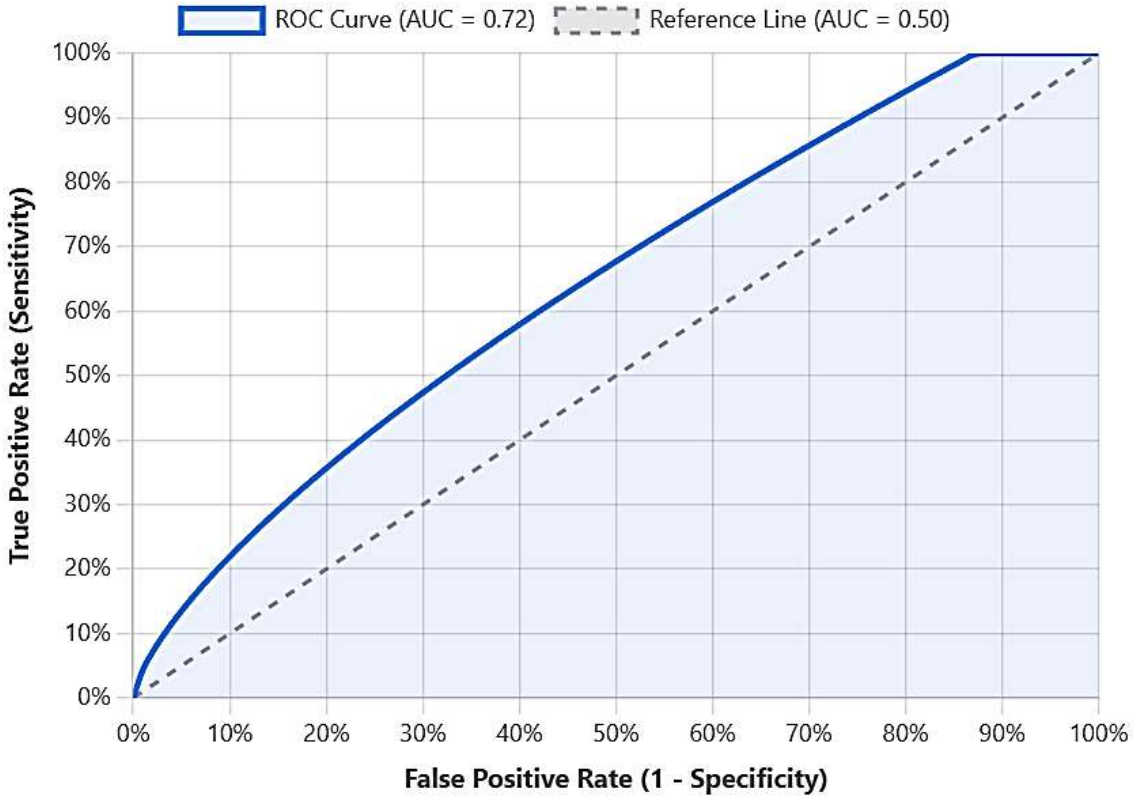
Outcome	Bleeding Group (n=102)	Non-Bleeding Group (n=513)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)*
Early Pregnancy Loss (<20 wks)	18 (17.6%)	25 (4.9%)	4.15 (2.17 – 7.95)	3.41 (1.71 – 6.78)
Preterm Birth (<37 wks)	19 (18.6%)†	51 (9.9%)†	2.08 (1.18 – 3.66)	1.89 (1.05 – 3.41)
Placental Abruption	7 (6.9%)	10 (1.9%)	3.71 (1.39 – 9.90)	3.25 (1.18 – 8.96)
Preeclampsia/Gestational HTN	13 (12.7%)	41 (8.0%)	1.69 (0.87 – 3.27)	1.51 (0.76 – 3.00)
Cesarean Delivery	41 (40.2%)	169 (32.9%)	1.37 (0.90 – 2.09)	1.28 (0.82 – 1.98)
Birth Weight (g), mean ±SD	2850 ± 415	3025 ± 380	-	**β = -148.2**
Small for Gestational Age	16 (15.7%)	46 (9.0%)	1.89 (1.03 – 3.47)	1.75 (0.93 – 3.28)
NICU Admission	22 (21.6%)	62 (12.1%)	2.00 (1.18 – 3.40)	1.81 (1.05 – 3.13)

Adjusted for maternal age, parity, BMI, and history of miscarriage.

†Denominator for late outcomes excludes early pregnancy losses (Bleeding group n=84, Non-bleeding group n=488 for analysis).



A sensitivity analysis excluding women with subchorionic hematoma (n=103) attenuated but did not eliminate the association between bleeding and preterm birth (aOR 1.65, 95% CI 0.89–3.08) or NICU admission (aOR 1.58, 95% CI 0.88–2.85). The final logistic regression model for predicting adverse outcomes (a composite of early loss, preterm birth, or NICU admission) among women with bleeding had an area under the ROC curve (AUC) of 0.72 (95% CI: 0.65–0.79), with significant predictors being heavy bleeding intensity, multiple episodes, and the presence of pain.



Discussion

This retrospective cohort study of 615 pregnant women at a tertiary care center found a first-trimester vaginal bleeding (FTVB) prevalence of 16.6%, identified key maternal and sonographic risk factors, and demonstrated significant associations between FTVB and adverse outcomes across the pregnancy continuum. Our findings align with the global literature while providing specific insights relevant to our clinical setting. The observed prevalence of 16.6% falls squarely within the widely cited 7-25% range reported in prior literature [9, 10]. This consistency suggests that, despite variations in population and healthcare systems, FTVB is a common clinical event affecting a substantial proportion of pregnancies. However, the clinical significance lies not merely in its frequency but in its implications for subsequent pregnancy health.

Our analysis identified several independent risk factors for FTVB. The strongest association was with the presence of a subchorionic hematoma (SCH), which conferred a more than six-fold increased risk (aOR 6.24). This finding is strongly supported by contemporary research. A large retrospective study by Tuuli et al. (2011) similarly found that SCH was a powerful predictor of bleeding, particularly when large or located in certain positions [11]. Our study reinforces that early sonographic evaluation is critical not only for viability but also for risk stratification.

We also confirmed that a history of prior miscarriage and prior vaginal bleeding episodes are significant maternal risk factors. This aligns with the concept of individual predisposition, potentially related to underlying endometrial, vascular, or immunological factors that may recur in subsequent pregnancies [12]. The association with maternal anemia at booking is a notable finding, suggesting that nutritional status or chronic conditions affecting hemoglobin levels may influence endometrial stability or vascular integrity in early gestation [13].

The most compelling evidence from this study pertains to the adverse outcomes linked to FTVB. The 3.4-fold increased adjusted odds of early pregnancy loss we observed is consistent with meta-analytic data. A comprehensive review by Saraswat et al. (2010) concluded that vaginal bleeding before 20 weeks is one of the strongest predictors of subsequent miscarriage, with risk increasing with bleeding severity [14].

More importantly, our data contribute to the evidence that the implications of FTVB extend far beyond the first trimester. We found a nearly two-fold increased risk of preterm birth (<37 weeks) and NICU admission, even after adjusting for confounders. This echoes the findings of a seminal population-based cohort study by Lykke et al. (2010), which established clear links between FTVB and later complications like preterm delivery and placental abruption [5]. Our finding of a 3.3-fold increased risk of placental abruption further supports the hypothesized pathophysiological link: early bleeding may signify a defect in placentation or vascular remodeling that manifests catastrophically later in pregnancy [15].

The significant reduction in mean birth weight (-148 g) among the bleeding group adds a crucial dimension to fetal outcomes. This is not merely a statistical finding but a clinically relevant difference associated with neonatal morbidity. This aligns with research by Bever et al. (2018), who used longitudinal ultrasound measures to demonstrate that pregnancies with FTVB exhibit a different, slower fetal growth pattern beginning in the mid-trimester [7].

Our study's strengths include a well-defined cohort with confirmed early gestational age, comprehensive data extraction, and multivariable adjustment for key confounders. The use of a risk prediction model (AUC 0.72) for composite adverse outcomes among women with bleeding is a step towards personalized care, highlighting that characteristics like heavy bleeding, multiple episodes, and pain can identify a highest-risk subgroup warranting intensified surveillance. The limitations of our retrospective design must be acknowledged. Data were limited to what was documented in records, potentially leading to under-reporting of mild bleeding or lifestyle factors. Our single-center design may affect generalizability to primary care settings or other regions. Furthermore, while we identified associations, the retrospective nature cannot prove causality. The exact mechanisms linking FTVB to later placental dysfunction—whether inflammatory, vascular, or thrombotic—remain an active area of research [16].

Conclusion

This study confirms that first-trimester vaginal bleeding is a prevalent marker of risk throughout pregnancy. It is strongly predicted by obstetric history and sonographic findings like SCH. Most significantly, FTVB is associated with a substantially higher risk of early pregnancy loss, preterm birth, fetal growth restriction, and serious placental complications like abruption. These findings underscore that a report of FTVB should not be dismissed as a benign event. Instead, it should trigger heightened antenatal surveillance focused on fetal growth and markers of placental well-being. Future prospective studies incorporating serial biomarker assessments and detailed placental pathology are needed to unravel the precise pathogenic pathways involved.

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