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# Can miscarriage be predicted in pregnant women who present to the emergency department in the first trimester?

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## Abstract

**Objective** To evaluate the relationship between physician-assessed vaginal bleeding and subsequent miscarriage in first-trimester pregnancies, and to identify independent clinical predictors that could form a simple risk estimation model.

**Materials and methods** This prospective cohort study included pregnant women in their first trimester who presented to the emergency department, with or without vaginal bleeding, between January 2023 and January 2024. All participants underwent standardized clinical and ultrasonographic evaluation by the same physician. Patients were categorized into two groups: those with active vaginal bleeding (defined as bleeding similar to menses) and those without bleeding. Binary logistic regression was used to identify predictors of miscarriage.

**Results** Of the 451 participants, 260 (57.6%) presented with vaginal bleeding and 191 (42.4%) without bleeding. Miscarriage occurred in 69 (26.5%) of the bleeding group and 11 (5.8%) of the non-bleeding group ( $p < 0.01$ ). Gestational age at presentation, vaginal bleeding, and history of vaginal delivery were identified as independent predictors of miscarriage. The regression model— $0.296$  (vaginal delivery) +  $0.998$  (bleeding) –  $0.433$  (gestational age)—showed good fit (Nagelkerke  $R^2 = 0.231$ ,  $p = 0.01$ ).

**Conclusion** Active vaginal bleeding, early gestational age, and prior vaginal delivery are significantly associated with miscarriage. These parameters may serve as preliminary, easily obtainable predictors for early identification of high-risk pregnancies, though external validation in larger, multi-center studies is warranted.

**Keywords** Miscarriage, Vaginal bleeding, Pregnancy loss, First trimester, Prediction model

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## Introduction

Miscarriage, defined as spontaneous pregnancy loss before 20 weeks of gestation, remains the most common complication of early Pregnancy. It affects approximately 10–20% of clinically recognized pregnancies, and the risk increases with maternal age and certain medical or reproductive factors. Vaginal bleeding is one of the most frequent early warning signs, occurring in nearly one in four first-trimester pregnancies [1–3]. Several previous studies have attempted to identify predictors of miscarriage using clinical, biochemical, or ultrasonographic variable [4].

Some of these studies examined the relationship between the amount of vaginal bleeding during pregnancy or the presence of subchorionic hemorrhage (SCH) and first-trimester miscarriage and reported increased risk of late pregnancy loss, especially for heavy vaginal bleeding [4–9]. However, most of these studies were conducted retrospectively. The presence and amount of vaginal bleeding were generally determined according to the patient's subjective statement, and patients may tend to overestimate any bleeding during pregnancy. The primary aim of this prospective study is to evaluate the effect of vaginal bleeding amount based on the objective evaluation of the physician on ongoing pregnancy. Secondly, we studied possible risk factors that could be used for a prediction model for pregnancy loss.

**Table 1** Comparison of demographic characteristics

	Miscarriage Group (n=69)	Ongoing Pregnancy Group (n=191)	p-value
	Mean±SD; Median (Min-Max)	Mean±SD; Median (Min-Max)	
Age (years) *	28.7±6.5	28.2±5.6	0.503
Gravidity <sup>β</sup>	2 (1-8)	3 (1-9)	0.426
Parity <sup>β</sup>	1 (0-5)	1 (0-5)	0.754
Height (cm)*	158.1±5	159.2±5.2	0.111
Weight (kg) <sup>β</sup>	69 (64-74)	70 (35-76)	0.218
Body mass index (kg/m <sup>2</sup> ) *	27.7±1.7	27.4±2.1	0.225
Vaginal delivery <sup>β</sup>	0 (0-5)	0 (0-5)	<b>0.026</b>
Cesarean delivery <sup>β</sup>	0 (0-3)	0 (0-4)	0.134
Abortion <sup>β</sup>	0 (0-4)	0 (0-6)	0.356
Gestational age (week) <sup>β</sup>	6 (5-12)	8 (5-13)	<b>&lt;0.01</b>
Subchorionic Hematoma <sup>α</sup>	7 (2.7%)	11 (4.5%)	0.209
• Yes	(23.8%)	(69%)	
• No			
Active Vaginal Bleeding <sup>α</sup>	45 (17.3%)	85(32.6%)	<b>&lt;0.01</b>
• Yes	24 (9.2%)	41%	
• No			

Mean Mean, SD Standard Deviation, Min Minimum, Max Maximum, kg kilogram, m<sup>2</sup> Meter square, cm Centimeter

\*Student t test, <sup>β</sup>Mann Whitney U test, <sup>α</sup>Chi-Square test

A p-value < 0.05 was considered statistically significant

## Materials and methods

This prospective cohort study was conducted at Bursa Yüksek İhtisas Training and Research Hospital between January 2023 and January 2024 (Ethics approval no: 2011-KAEK-25 2021/11–01). Pregnant women in the first trimester who presented to the emergency department, with or without vaginal bleeding, were prospectively evaluated. Patients were divided into two groups: those presenting with active vaginal bleeding (defined as similar to menstrual bleeding) and those without any vaginal bleeding symptoms. Vaginal bleeding at presentation was evaluated by the same experienced clinician (S.S.) using an objective description to minimize inter-observer variability. Pregnancies of unknown location, uterine anomalies, and assisted reproductive pregnancies were excluded.

Eligible participants were followed up in outpatient clinics. Those who presented with vaginal bleeding and subsequently had a miscarriage were included in the miscarriage group, whereas those whose pregnancies continued until the 20th week or later were included in the ongoing pregnancy group.

## Statistical analysis

Statistical analysis was carried out using SPSS 22.0 (SPSS Inc., Chicago, IL, USA). Data were expressed as mean ± SD, median (min–max), and percentages. Normality was evaluated using Kolmogorov–Smirnov and Shapiro–Wilk tests. Mann–Whitney U and Student's t-tests were used for numerical variables as appropriate, and the Chi-square test for categorical data. Binary logistic regression analysis was used to predict the risk of miscarriage. A p-value < 0.05 was considered statistically significant.

## Results

A total of 451 pregnant women in the first trimester were prospectively evaluated, including 260 (57.6%) with vaginal bleeding and 191 (42.4%) without bleeding at presentation. During follow-up, 80 patients (17.7%) experienced miscarriage before 20 weeks of gestation. The miscarriage rate was significantly higher in the vaginal bleeding group (69/260, 26.5%) than in the non-bleeding group (11/191, 5.8%; *p* < 0.01).

Demographic and obstetric characteristics (age, BMI, gravida, parity, number of abortions, and presence of subchorionic hematoma) did not differ significantly between the two groups. However, gestational age at presentation, presence of vaginal bleeding, and history of vaginal delivery were significantly associated with miscarriage (Table 1).

Patients who miscarried presented at a significantly earlier gestational age (median 6 weeks, range 5–12) than those with ongoing pregnancies (median 8 weeks, range

5–13;  $p < 0.01$ ). Similarly, a higher proportion of women with active bleeding miscarried compared with those without bleeding (45/260 vs. 11/191;  $p < 0.01$ ) (Table 2).

Binary logistic regression analysis identified three independent predictors of miscarriage:

- Vaginal delivery number (B = 0.296, OR = 1.35,  $p = 0.03$ ).
- Presence of vaginal bleeding (B = 0.998, OR = 2.71,  $p < 0.01$ ).
- Gestational age (B = -0.433, OR = 0.64,  $p < 0.01$ ).

The regression model demonstrated good fit (Hosmer–Lemeshow  $p > 0.05$ ; Nagelkerke  $R^2 = 0.231$ ) and correctly classified 79.4% of cases. This model indicates that lower gestational age and the presence of vaginal bleeding substantially increase the likelihood of miscarriage, whereas higher gestational age has a protective effect.

## Discussion

Vaginal bleeding in the first trimester is one of the most common causes of emergency department visits in obstetric practice. However, predicting which pregnancy will progress normally and which will end in miscarriage remains a clinical challenge. In the present prospective study, we found that active vaginal bleeding, lower gestational age at presentation, and a history of prior vaginal delivery were independently associated with miscarriage. These findings indicate that simple clinical parameters, easily assessed at admission, may help identify women at higher risk of early pregnancy loss.

Previous studies showed an increased risk of miscarriage in very young or advanced-age pregnancies [10–12]. In our study, the average age of the miscarriage group and the group whose pregnancy continued was similar.

There are conflicting studies regarding the relationship between vaginal bleeding in the first trimester of pregnancy and miscarriage. Some studies state that there is no relationship, while some indicate that the risk of miscarriage increases in case of excessive bleeding. Unlike many earlier investigations relying on patient self-reporting, our study used a physician-assessed objective description (“similar to menses”), which likely reduced recall bias and improved the reproducibility of our findings [13–15].

Previous studies have shown mixed results regarding the impact of gestational age at presentation. Some authors found no relationship between gestational week and miscarriage risk, while others, such as Naert et al. [13] and Banos Cándenas et al. [16] reported that miscarriages were most frequent between the sixth and eighth weeks of gestation. Our findings corroborate these data, showing that women who miscarried presented at significantly earlier gestational ages than those whose pregnancies continued.

**Table 2** Binary logistic regression for predicting the miscarriage risk of patients applying to the emergency department with complaint of bleeding in the first trimester of pregnancy

	B	Wald	OR	P
Vaginal delivery	0.296	4.651	1.348	<b>0.03</b>
Gestational age (week)	-0.433	24.644	0.642	<b>0.01</b>
Active vaginal bleeding	0.998	10.181	0.680	<b>&lt;0.01</b>

Vaginal delivery number, gestational age and active vaginal bleeding variables were used with the Binary Logistic Regression Analysis Enter method to analyze the factors that play a role in predicting the early miscarriage. The Hosmer and Lemeshow test was  $p > 0.05$  and the models fit well with the data. The model with the best performance according to the results determined as: Miscarriage:  $0.296(\text{number of vaginal delivery}) + 0.998(\text{active vaginal bleeding}) - 0.433(\text{gestational age})$ ,  $R^2: 0.231$ ,  $p: 0.01$

CI Confidence interval, OR Odds ratio. Wald: test statistic value

A  $p$ -value  $< 0.05$  was considered statistically significant

The relationship between previous obstetric history and miscarriage risk also remains controversial. Several studies have proposed that recurrent miscarriage or multiple abortions are strong predictors of future loss [17, 18]. In particular, several studies have found that previous miscarriage is a vital risk factor for spontaneous abortion, while others similar to our study indicate no association [19].

The underlying etiology of SCH remains unclear, and the clinical significance of SCH in early pregnancy is controversial. A meta-analysis in 2011 showed that SCH was associated with an increased risk of spontaneous abortion [20]. Additionally, we did not find any relation between prior parity, gravidity, prior cesarean section, and miscarriage.

The strength of our study lies in its prospective design, homogeneous patient population, and standardized clinical evaluation performed by a single experienced clinician. These methodological strengths enhance the internal validity of our findings. However, several limitations should be acknowledged. The study was conducted in a single tertiary center, which may limit generalizability. Bleeding severity was assessed clinically rather than quantitatively, and biochemical markers such as  $\beta$ -hCG or progesterone were not included. Additionally, our proposed predictive model requires external validation in larger, multicenter studies before it can be implemented in routine practice.

In summary, our study provides evidence that early gestational age, active vaginal bleeding, and a history of vaginal delivery are significant and independent predictors of miscarriage among women presenting to the emergency department in the first trimester. Incorporating these easily obtainable variables into clinical evaluation may aid in counseling patients and stratifying risk, especially in resource-limited settings.

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### Authors' contributions

Sönmez S. conceived the study, Keskin Ö. refined the methodology, and Karaçin S.S. performed the statistical analysis and drafted the manuscript. All authors reviewed and approved the final version.

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### Data availability

All data generated or analyzed during this study are included in this published article. Additional data are available from the corresponding author upon reasonable request.

### Declarations

#### Ethics approval and consent to participate

The study was approved by the Ethics Committee of Bursa Yüksek İhtisas Training and Research Hospital (Approval number: 2011-KAEK-25 2021/11 – 01). All participants provided informed consent prior to inclusion.

#### Consent for publication

Not applicable. The manuscript does not contain any individual person's data in any form.

#### Competing interests

The authors declare no competing interests.

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### References

1. Lidegaard Ø, Mikkelsen AP, Egerup P, Kolte AM, Rasmussen SC, Nielsen HS (2020) Pregnancy loss: A 40-year nationwide assessment. *Acta Obstet Gynecol Scand* 99:1492–1496. <https://doi.org/10.1111/aogs.13860>
2. Fernlund A, Jokubkiene L, Sladkevicius P, Valentin L (2020) Predictors of complete miscarriage after expectant management or Misoprostol treatment of non-viable early pregnancy in women with vaginal bleeding. *Arch Gynecol Obstet* 302:1279–1296. <https://doi.org/10.1007/s00404-020-05672-6>
3. Dimitriadis E, Menkhorst E, Saito S, Kutteh WH, Brosens JJ (2020) Recurrent pregnancy loss. *Nat Reviews Disease Primers* 6:98. <https://doi.org/10.1038/s41572-020-00228-z>
4. DeVilbiss EA, Mumford SL, Sjaarda LA, Connell MT, Plowden TC, Andriessen VC et al (2020) Prediction of pregnancy loss by early first trimester ultrasound characteristics. *Am J Obstet Gynecol*. 223:242.e1–242.e22. <https://doi.org/10.1016/j.ajog.2020.02.025>
5. Nandekar S, Jungari M, Dewan D, Nakade M (2020) Observational study of patients presenting with bleeding in first trimester. *Indian J Forensic Med Toxicol*;14
6. Bhatu JJ, Prajapati DS (2020) A study of feto-maternal outcome in bleeding per vaginum in first trimester of pregnancy. *Int J Reprod Contracept Obstet Gynecol* 9:1191
7. Moon A, Shabbir S (2021) Pregnancy outcome in women presenting with per vaginal bleeding in first trimester of pregnancy. *Int J Reprod Contracept Obstet Gynecol* 10:439
8. Kodirovna RD (2024) Subchorionic hematoma's influence on the outcome of pregnancies. *образование наука и инновационные идеи в мире*. 40:190–6
9. Weiss JL, Malone FD, Vidaver J, Ball RH, Nyberg DA, Comstock CH et al (2004) Threatened abortion: a risk factor for poor pregnancy outcome, a population-based screening study. *Am J Obstet Gynecol* 190:745–750
10. Frederiksen LE, Ernst A, Brix N, Braskhøj Lauridsen LL, Roos L, Ramlau-Hansen CH, et al (2018) Risk of adverse pregnancy outcomes at advanced maternal age. *Obstetrics & Gynecology*. 131. <https://doi.org/10.1097/AOG.0000000000002504>
11. Frick AP (2021) Advanced maternal age and adverse pregnancy outcomes. *Best Pract Res Clin Obstet Gynecol* 70:92–100. <https://doi.org/https://doi.org/https://doi.org/10.1016/j.bpobgyn.2020.07.005>
12. Magnus MC, Wilcox AJ, Morken N-H, Weinberg CR, Hvr aberg SE Role of maternal age and pregnancy history in risk of miscarriage: prospective register based study. *BMJ* 2019;364. <https://doi.org/10.1136/bmj.l869>
13. Naert MN, Khadraoui H, Muniz Rodriguez A, Fox NS (2022) Stratified risk of pregnancy loss for women with a viable Singleton pregnancy in the first trimester. *J Maternal-Fetal Neonatal Med* 35:4491–4495. <https://doi.org/10.1080/14767058.2020.1852212>
14. Barron MLEE, Rosenberger KD. 15. Bleeding and Pregnancy Loss. Guidelines for Nurse Practitioners in Ambulatory Obstetric Settings n.d. 215. <https://connect.springerpub.com/content/book/978-0-8261-4854-4>
15. Günay T, Yardımcı OD (2022) How does subchorionic hematoma in the first trimester affect pregnancy outcomes? *Archives Med Science: AMS* 18:639–646. <https://doi.org/10.5114/aoms/113645>
16. Baños Cándenas L, Abehsera Davó D, Castaño Frías L, González Mesa E (2023) Retrospective study of first trimester metrorrhagia: pregnancy Follow-Up and relationship with the appearance of gestational complications. *Medicina* 59:1370
17. Jia D, Sun F, Han S, Lu L, Sun Y, Song Q (2024) Adverse outcomes in subsequent pregnancies in women with history of recurrent spontaneous abortion: A meta-analysis. *J Obstet Gynecol Res* 50:281–297. <https://doi.org/10.1111/jog.15848>
18. Ali N, Elbarazi I, Ghazal-Aswad S, Al-Maskari F, Al-Rifai H, Oulhaj R (2020) Impact of recurrent miscarriage on maternal outcomes in subsequent pregnancy: the mutaba'ah study. *Int J Women's Health* 12:1171–1179. <https://doi.org/10.2147/IJWH.S264229>
19. Gracia CR, Sammel MD, Chittams J, Hummel AC, Shaunik A, Barnhart KT (2005) Risk factors for spontaneous abortion in early symptomatic first-trimester pregnancies. *Obstet Gynecol* 106:993–999. <https://doi.org/10.1097/01.aog.0000183604.09922.e0>
20. Tuuli MG, Norman SM, Odibo AO, Macones GA, Cahill AG (2011) Perinatal outcomes in women with subchorionic hematoma: A systematic review and Meta-Analysis. *Obstet Gynecol*;117 <https://doi.org/10.1097/AOG.0b013e31821568de>

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