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DETECTION OF PLACENTAL DISORDER RISK: A LITERATURE REVIEW

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ABSTRACT
Placental disorders including preeclampsia, fetal growth restriction (FGR), placenta previa, placental abruption, and placenta accreta spectrum (PAS) are major contributors to maternal and perinatal morbidity and mortality. Early risk detection is crucial for facilitating timely referrals, continuous surveillance, and preventive interventions. This review aims to synthesize recent evidence (2020–2026) regarding the clinical methods and diagnostic tools used to detect the risk of various placental disorders.Methods: A comprehensive literature review was conducted in accordance with the PRISMA 2020 guidelines. Systematic searches were performed across PubMed, ScienceDirect, Scopus, and Google Scholar for studies published between 2020 and 2026. Studies were rigorously screened by title, abstract, and full-text to ensure they met predetermined eligibility criteria. Eight systematic reviews and meta-analyses were included in the final analysis. The findings were categorized into three primary themes: (1) the diagnostic accuracy of ultrasound and MRI for PAS, including the optimal timing of ultrasound screening; (2) the clinical utility of the sFlt-1/PlGF biomarker ratio in detecting FGR; and (3) the incidence rates and identifiable risk factors of vasa previa. Current evidence suggests that ultrasound provides strong diagnostic accuracy for PAS in at-risk women, performing comparably to MRI, while first-trimester scans offer earlier detection albeit with lower specificity. Additionally, the sFlt-1/PlGF ratio serves as a valuable adjunctive tool for FGR detection, and the majority of vasa previa cases present with identifiable risk factors that can be detected during routine prenatal scans.

Keywords: fetal growth restriction; placenta; placenta accreta spectrum; prenatal screening; risk detection; vasa previa

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INTRODUCTION

The placenta is the interface between mother and fetus, responsible for gas exchange, nutrient transfer, hormone production, and immune modulation. Abnormal placental development or function underlies several of the most serious obstetric complications. Hypertensive disorders of pregnancy, of which preeclampsia is the most important, affect millions of pregnancies globally, and their burden has remained substantial across regions (Wang et al., 2021). Adolescent pregnancy has also been associated with a notable prevalence of preeclampsia and eclampsia (Macedo et al., 2020). Beyond the pregnancy itself, hypertensive disorders of pregnancy are linked to later cardiovascular disease, which extends the importance of early identification into long-term women's health (Melchiorre et al., 2020).

The pathophysiology of preeclampsia is increasingly understood as a placenta-centered process. Defective transformation of the spiral arteries, syncytiotrophoblast stress, and an imbalance of circulating angiogenic factors converge to produce maternal endothelial dysfunction (Jung et al., 2022; Rana et al., 2022; Redman et al., 2022; Staff et al., 2022). Similar placental insufficiency mechanisms contribute to fetal growth restriction (Lees et al., 2020; Melamed et al., 2021). In contrast, placenta accreta spectrum (PAS) arises from abnormal trophoblast invasion, most often at the site of a uterine scar, and has risen in incidence alongside cesarean delivery rates (Jauniaux et al., 2020).

Because many of these conditions are asymptomatic until late or severe stages, risk detection is a cornerstone of antenatal care. Early identification supports low-dose aspirin prophylaxis for women at high risk of preeclampsia (Hoffman et al., 2020; Rolnik et al., 2022), planned delivery in a facility with multidisciplinary capability for suspected PAS (Palacios-Jaraquemada et al., 2022), and intensified surveillance for suspected FGR. Over the past five years, several consensus statements, guidelines, and primary studies have refined how risk is detected, including multivariable first-trimester screening (Chaemsaithong et al., 2022; Wright et al., 2020), angiogenic biomarker testing (Stepan et al., 2023; Thadhani et al., 2022), standardized ultrasound and MRI criteria for PAS (Jha et al., 2020; Shainker et al., 2021), and machine-learning applications (Bertini et al., 2022; Davidson & Boland, 2021). Complementary developments include guidance on uterine artery Doppler (Bhide et al., 2021), maternal serum metabolite markers for FGR (Sovio et al., 2020), a comprehensive review of the preeclampsia syndrome (Dimitriadis et al., 2023), standardized pathology reporting for PAS (Hecht et al., 2020), and reviews of MRI for PAS (Kapoor et al., 2021). However, the evidence is dispersed across conditions and modalities, and it is not always clear which approaches are feasible in primary care and midwifery settings. This review therefore aims to synthesize recent systematic reviews and meta-analyses on the detection of placental disorder risk, to inform clinicians, midwives, and health policymakers.

METHOD

Study design and reporting guideline

This study is a literature review conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021).

Information sources and search strategy

Literature published from January 2020 to the date of the search (2026) was searched in PubMed, ScienceDirect, Scopus, and Google Scholar. Search terms combined Medical Subject Headings and free-text keywords using Boolean operators, for example: ("placenta" OR "placental disorder" OR "placental dysfunction" OR "preeclampsia" OR "fetal growth restriction" OR "placenta previa" OR "placental abruption" OR "placenta accreta") AND ("risk detection" OR "screening" OR "prediction" OR "early detection" OR "biomarker" OR "ultrasound" OR "Doppler") AND ("pregnancy" OR "antenatal"). Reference lists of key articles were hand-searched to identify additional records.

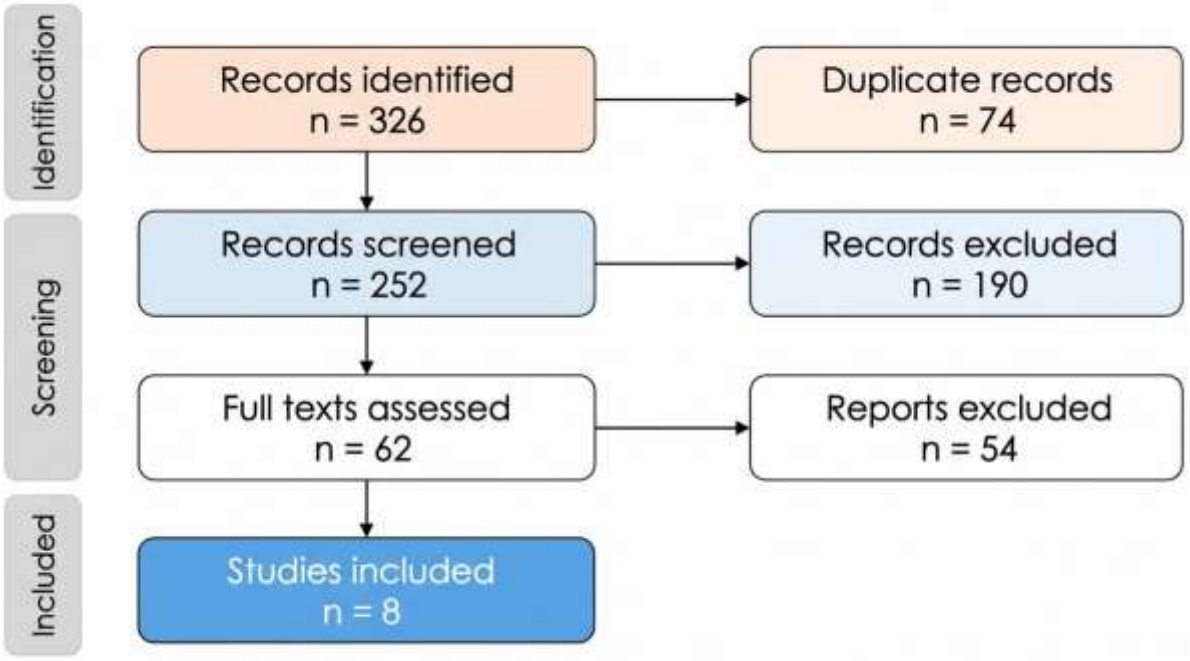
Eligibility criteria

Inclusion criteria: (a) published between 2020 and 2026; (b) full text available in English; (c) addresses detection, screening, or prediction of risk of at least one placental disorder in pregnant women; (d) systematic reviews and meta-analyses.

Exclusion criteria: (a) animal or in-vitro studies without a clinical risk-detection component; (b) articles that did not focus on placental disorders or on risk detection; (c) conference abstracts, editorials without substantive synthesis, and duplicates; (d) full text not accessible.

Study selection (PRISMA flow diagram)

Records were exported to a reference manager and duplicates were removed. Two reviewers independently screened titles and abstracts, then assessed full texts. Disagreements were resolved by discussion with a third reviewer. The selection process is shown in Figure 1.



PRISMA 2020 flow diagram · identification, screening, included
Figure 1. PRISMA 2020 flow diagram of study selection

Data extraction and quality appraisal
For each included article, the following data were extracted: first author and year, study design, population, placental condition(s), detection method, and main findings. The methodological quality of each included systematic review was appraised with the AMSTAR 2 tool. Findings were synthesized narratively and grouped thematically because of heterogeneity in populations, definitions, and outcome measures.

RESULT

Study selection results
The database search identified 326 records. After removal of 74 duplicates, 252 records were screened by title and abstract, and 190 were excluded. Sixty-two full-text articles were assessed for eligibility, and 54 were excluded. Eight articles met the inclusion criteria (Figure 1).

Characteristics of included studies
All eight included studies were systematic reviews with meta-analysis, published between 2020 and 2024. Four addressed the diagnostic accuracy of imaging for placenta accreta spectrum (PAS), one addressed the sFlt-1/PlGF ratio for fetal growth restriction (FGR), and three addressed vasa previa. Table 1 summarizes the included studies.

Table 1.
Characteristics of the eight included studies

Author (year)	Condition	Evidence base	Main finding
De Oliveira Carniello et al. (2022)	PAS	Meta-analysis, 17 studies, 1,301 women	Ultrasound sensitivity 0.833 and specificity 0.834; ultrasound and MRI had similar accuracy
Hong et al. (2022)	PAS	Meta-analysis, 18 studies, 861 pregnancies	Sensitivity 0.90 (ultrasound) vs 0.89 (MRI), no significant difference; routine MRI not recommended
Maged et al. (2023)	PAS	Meta-analysis, 54 studies, 5,307 women	2D ultrasound sensitivity 0.8703 and specificity 0.8634 in women with low-lying placenta or previa
Hessami et al. (2024)	PAS	Meta-analysis, 37 studies, 5,764 pregnancies	First trimester: sensitivity 86%, specificity 63%; second/third trimester: 88% and 92%
Chen et al. (2022)	FGR	Meta-analysis, 8 studies, 339 cases, 5,111 controls	sFlt-1/PlGF ratio >33: sensitivity 0.63, specificity 0.84, AUC 0.8354
Pavalagantharajah et al. (2020)	Vasa previa	Meta-analysis, 21 studies	0.46 cases per 1,000 deliveries; low-lying placenta (61.5%) and velamentous cord insertion (52.2%) common
Zhang et al. (2023)	Vasa previa	Meta-analysis, 24 studies	Pooled incidence 0.79 per 1,000 pregnancies (about 1 in 1,271)
Matsuzaki et al. (2022)	Type II vasa previa	Systematic review, 20 studies	Type II = 21.3% of vasa previa; outcomes similar to type I; evidence insufficient for firm conclusions

Thematic synthesis

Theme 1: Diagnostic accuracy of ultrasound and MRI for placenta accreta spectrum

Recent meta-analyses indicate that ultrasound and MRI perform comparably for PAS. De Oliveira Carniello et al. (2022) pooled 17 studies including 1,301 women and found similar accuracy for the two modalities. Hong et al. (2022) reported pooled sensitivity of 0.90 for ultrasound and 0.89 for MRI across 18 studies (861 pregnancies) and advised against routine MRI because of its cost. Maged et al. (2023) pooled 54 studies (5,307 women) and reported ultrasound sensitivity of 0.87 and specificity of 0.86 in women with a low-lying placenta or placenta previa, and they recommended combining all sonographic markers with clinical features. Timing also matters: Hessami et al. (2024) found sensitivity of 86% and specificity of 63% for first-trimester ultrasound, compared with 88% and 92% in the second and third trimesters, which suggests that early scanning could support earlier referral but yields more false positives.

Theme 2: The sFlt-1/PlGF ratio for fetal growth restriction

A meta-analysis of eight studies (339 cases of FGR and 5,111 controls) found that an sFlt-1/PlGF ratio above 33 predicted FGR with a pooled sensitivity of 0.63 and specificity of 0.84 (Chen et al., 2022). This is moderate accuracy, which supports using the ratio as an adjunct to ultrasound rather than as a stand-alone test.

Theme 3: Incidence and risk factors of vasa previa

Vasa previa is a placenta-related condition for which risk-based detection is feasible. Pavalagantharajah et al. (2020) pooled 21 studies and reported a prevalence of 0.46 per 1,000 deliveries, with low-lying placenta (61.5%) and velamentous cord insertion (52.2%) among the most frequent risk factors. Zhang et al. (2023) pooled 24 studies and estimated an incidence of 0.79 per 1,000 pregnancies (about 1 in 1,271). In a review of 20 studies, type II vasa previa accounted for 21.3% of vasa previa cases and had characteristics and outcomes similar to type I, although the authors considered the evidence insufficient for firm conclusions (Matsuzaki et al., 2022).

DISCUSSION

This review of eight systematic reviews shows that risk detection is condition-specific. For PAS, ultrasound is the primary tool and performs similarly to MRI across meta-analyses (De Oliveira Carniello et al., 2022; Hong et al., 2022; Maged et al., 2023), and first-trimester scanning offers

earlier detection at the cost of lower specificity (Hessami et al., 2024). For FGR, the sFlt-1/PlGF ratio shows moderate accuracy and is best used alongside ultrasound (Chen et al., 2022), which is consistent with the angiogenic imbalance described in mechanistic reviews (Rana et al., 2022; Staff et al., 2022). For preeclampsia, which was not covered by the included reviews, multivariable first-trimester screening remains the best-evidenced strategy (Chaemsaithong et al., 2022; Wright et al., 2020), although it requires trained sonographers, quality-assured measurements, and access to biomarker assays.

For PAS, the main challenge is not a lack of tools but the consistency of their application, and ultrasound remains a low-cost, widely available option in resource-limited settings (Maged et al., 2023). Standardized ultrasound markers and MRI protocols exist (Jha et al., 2020; Shainker et al., 2021), yet detection remains imperfect in posterior or non-previa presentations (Tinari et al., 2021). Because cesarean rates continue to shape PAS incidence (Jauniaux et al., 2020), prevention of unnecessary primary cesarean delivery and systematic ultrasound review of the scar and placental location in women with prior uterine surgery are practical priorities. The vasa previa evidence follows the same logic. Because most affected pregnancies have risk factors that can be identified before birth (Pavalagantharajah et al., 2020), the placental location and cord insertion seen on routine mid-pregnancy scans offer a practical entry point, and the authors called for revisiting risk-based or universal screening strategies.

Implications for midwifery and primary care

In Indonesia and other middle-income settings, midwives are often the first contact for pregnant women. Feasible actions include structured risk-factor assessment at the first antenatal visit, accurate blood pressure measurement and urine protein assessment at every visit, symptom education, and timely referral for Doppler, biomarker testing, or specialist ultrasound. Aspirin prophylaxis recommendations, while evidence-based (ACOG, 2020; Hoffman et al., 2020), depend on correct identification of high-risk women, which makes training and clear referral pathways essential. The ISSHP and FIGO-aligned documents also emphasize adaptation to local resources (Magee et al., 2022; Melamed et al., 2021).

Long-term perspective

Hypertensive disorders of pregnancy are risk markers for later cardiovascular disease (Melchiorre et al., 2020). Detecting placental dysfunction therefore creates an opportunity not only for better pregnancy outcomes but also for postpartum follow-up and lifelong prevention.

Strengths and limitations

Strengths include the use of PRISMA 2020, a recent time window, and the inclusion of meta-analyses across three placental conditions. Limitations include the restriction to English-language publications, the small number of included reviews (eight), uneven coverage across conditions (one review on FGR and none on preeclampsia or placental abruption), heterogeneity of definitions and outcomes in the underlying studies, and limited evidence from low- and middle-income settings.

CONCLUSION

Recent meta-analyses indicate that risk detection of placental disorders is feasible and clinically meaningful. Ultrasound has good diagnostic accuracy for PAS in at-risk women and performs comparably to MRI, first-trimester scanning offers earlier detection at the cost of specificity, the sFlt-1/PlGF ratio is a moderate adjunct for FGR, and most vasa previa cases have risk factors that can be identified on routine scans. Future work should focus on pragmatic screening pathways suited to primary care and midwifery settings, training for health workers, and prospective studies in Indonesian and other low- and middle-income populations.

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