
GLYCOSYLATED FIBRONECTIN AND sFlt-1/PLGF RATIO AS PREDICTORS OF EMERGENCY CAESAREAN DELIVERY AND INTRAPARTUM FOETAL DISTRESS IN WOMEN WITH SUSPECTED PREECLAMPSIA

Iva Paneva

University Clinic for Obstetrics and Gynecology, Faculty of Medicine, Skopje, Republic of North Macedonia, iva.paneva25@gmail.com

Milena Petrovska

Ss. Cyril and Methodius University in Skopje, Department of Microbiology and Parasitology, Faculty of Medicine, Skopje, Republic of North Macedonia, milena_petrovska@hotmail.com

Goran Kochoski

University Clinic for Obstetrics and Gynecology, Faculty of Medicine, Skopje, Republic of North Macedonia, goran_kocoski@yahoo.com

Igor Samardziski

University Clinic for Obstetrics and Gynecology, Faculty of Medicine, Skopje, Republic of North Macedonia, igidoc@yahoo.com

Strahil Panev

International Slavic University “G. R. Derzhavin, Sveti Nikole, Republic of North Macedonia, strahil.panev@msu.edu.mk

Ognen Petrovski

Institute for Clinical Pharmacology and Toxicology, Medical Faculty, Skopje, Republic of Macedonia, drpetrovski@hotmail.com

Vesna Livrinova

University Clinic for Obstetrics and Gynecology, Faculty of Medicine, Skopje, Republic of North Macedonia, livrinovav@gmail.com

Liljana Simonovska

Zan Mitrev Clinic, Skopje, Republic of Macedonia, damjanovska25@hotmail.com

Abstract: Preeclampsia (PE) and other placentally mediated disorders of pregnancy result from endothelial dysfunction and angiogenic imbalance. Circulating biomarkers such as the soluble fms-like tyrosine kinase-1/placental growth factor (sFlt-1/PlGF) ratio and glycosylated fibronectin (GlyFn) reflect placental stress and may predict adverse pregnancy outcomes. This study evaluated their ability to predict the need for emergency caesarean section and intrapartum foetal distress among women with suspected PE.

In a prospective cohort, 129 pregnant women with singleton pregnancies and clinical suspicion of PE were enrolled at the University Clinic of Gynaecology and Obstetrics, Skopje (May 2024–May 2025). sFlt-1/PlGF ratio and GlyFn levels were measured at presentation. Patients were categorized as sFlt-1/PlGF ≥ 85 or < 85 and GlyFn ≥ 350 $\mu\text{g/mL}$ or < 350 $\mu\text{g/mL}$. Outcomes included mode of delivery, emergency caesarean, intrapartum foetal distress, need for induction, birthweight, and Apgar score ≤ 7 . Logistic regression models were adjusted for gestational age at delivery.

Elevated sFlt-1/PlGF (≥ 85) and GlyFn (≥ 350 $\mu\text{g/mL}$) were both associated with earlier delivery (median ≈ 33 weeks), lower birthweight, and higher rates of caesarean for foetal distress and low Apgar scores (all $p < 0.001$). After adjustment, sFlt-1/PlGF ≥ 85 predicted 2.6-fold higher odds of caesarean for foetal distress (OR 2.62; $p = 0.039$) and nearly ninefold higher odds of Apgar ≤ 7 (OR 8.88; $p = 0.0015$). GlyFn ≥ 350 $\mu\text{g/mL}$ showed similar but weaker, nonsignificant trends.

Both biomarkers identify pregnancies with placental dysfunction; however, the sFlt-1/PlGF ratio demonstrates stronger predictive value for intrapartum foetal distress and neonatal compromise. GlyFn may complement angiogenic profiling as a rapid point-of-care triage tool, but sFlt-1/PlGF provides superior prognostic information for delivery planning and surveillance.

Keywords: delivery outcomes, sFlt-1/PlGF ratio, GlyFn, preeclampsia, intrapartum foetal distress

1. INTRODUCTION

Preeclampsia (PE) is a multisystem hypertensive disorder of pregnancy characterized by new-onset hypertension after 20 weeks' gestation together with proteinuria or other end-organ dysfunction. PE remains a leading cause of

maternal and perinatal morbidity and mortality worldwide and is etiologically linked to placental dysfunction: a maladapted placenta releases factors that drive maternal endothelial injury, inflammation and the systemic manifestations of the disease. Delivery of the placenta is currently the only definitive ‘cure’, which explains why prediction of placental failure and timely decision-making about surveillance and delivery are central to clinical management (Steeegers et al, 2010; Dimitriadis et al, 2023; Tannetta and Sargent, 2013).

Placentally mediated disorders of pregnancy — a spectrum that includes early-onset preeclampsia, foetal growth restriction (FGR), placental abruption and a large proportion of stillbirths — arise from defective placentation and impaired utero-placental perfusion that limit oxygen and nutrient transfer to the foetus and trigger maternal systemic disease. Defective spiral artery remodelling is a central pathophysiological mechanism in placentally mediated disorders of pregnancy. In healthy pregnancy, extravillous trophoblasts invade the maternal decidua and myometrium, transforming the spiral arteries into large, low-resistance vessels that ensure adequate utero-placental perfusion. In placentally mediated disorders of pregnancy, shallow trophoblast invasion and incomplete remodelling leave the arteries narrow and vasoreactive, leading to placental hypoperfusion and ischemia (Pijnenborg et al, 2006; Burton et al, 2019). The resulting oxidative stress in the syncytiotrophoblast triggers the release of anti-angiogenic factors such as soluble fms-like tyrosine kinase-1 (sFlt-1) and other inflammatory mediators into the maternal circulation, causing systemic endothelial dysfunction and multiorgan involvement, like those seen in preeclampsia (Roberts and Hubel, 2009; Redman and Sargent, 2010). This two-stage model — abnormal placentation followed by maternal endothelial response — is widely accepted as pathophysiological mechanism explaining the clinical syndrome (Redman and Sargent, 2010).

Clinically, placentally mediated disorders are challenging because many affected pregnancies are not detected until late and because the timing from compensated placental insufficiency to irreversible foetal compromise is difficult to predict — which is why interest in placental biomarkers and combined surveillance strategies (ultrasound Dopplers and serial growth measurements with biochemical markers) has grown as a means to identify foetuses at highest risk and guide timely delivery (King et al, 2022; Lawn et al, 2016).

Circulating, placenta-derived biomarkers reflect the degree of placental stress and dysfunction. Among these, dysregulated angiogenic signalling — specifically an excess of the anti-angiogenic soluble fms-like tyrosine kinase-1 (sFlt-1) and a reduction of the pro-angiogenic placental growth factor (PlGF) — is a well-established pathogenic axis in preeclampsia and other placentally mediated disorders of pregnancy (Stepan et al, 2023; Graupner and Enzensberger, 2021). The maternal **sFlt-1/PlGF ratio** has been extensively studied and implemented clinically as a rule-out and rule-in test in women with suspected preeclampsia. Large studies demonstrated excellent negative predictive value for short-term exclusion of PE and have shown that high ratios are associated with imminent delivery and adverse perinatal outcomes linked to placental insufficiency (Zeisler et al, 2016; Simon et al, 2020). Importantly, work beyond diagnostic performance for preeclampsia, has explored the sFlt-1/PlGF ratio as a **predictor of other placentally mediated disorders** (foetal growth restriction (FGR), placental abruption or intrauterine foetal death), highlighting its value in identifying placental dysfunction before clinical deterioration and determining foetal monitoring strategies, ultimately reducing foetal and maternal morbidity and mortality in these pregnancies (Benton et al, 2016; Hughes et al, 2025; Chen et al. 2022, Korzeniewski et al, 2025; Chang et al, 2017). Given the different clinical presentation of placental insufficiency (early-onset vs term PE, PE with severe foetal growth restriction vs maternal-predominant disease), a **biomarker panel** that integrates angiogenic imbalance (sFlt-1/PlGF) with markers of extracellular matrix and trophoblast glycosylation like glycosylated fibronectin (GlyFn) may improve prediction of **placentally mediated birth outcomes**.

GlyFn can be measured in maternal serum and, because some GlyFn assays are adaptable to point-of-care platforms, GlyFn has practical appeal for rapid clinical assessment (Diabetomics, 2023). According to current evidence, glycosylated fibronectin (GlyFn) has emerged as an innovative biomarker for the early prediction of preeclampsia already in the first trimester (Sokratous et al, 2023a), when the therapeutic window for intervention and improvement of outcomes is greatest. It can also be used to predict the risk of preeclampsia within the following two weeks in the second and third trimesters in women with newly diagnosed gestational hypertension (Sokratous et al, 2023b), as well as in the third trimester (between 35 and 37 weeks of gestation) to predict delivery within the subsequent three weeks due to preeclampsia (Sokratous et al, 2024). This biomarker has also demonstrated good diagnostic performance for preeclampsia in patients with suspected symptoms and signs of the disease (Nagalla et al, 2020; Paneva et al, 2025).

The aim of this study is to evaluate the predictive performance of the sFlt-1/PlGF ratio and GlyFn for **placentally mediated birth outcomes** beyond preeclampsia with the goal to provide useful patient counselling as well as guidance for planning and monitoring of labour and delivery in these patients. Outcomes of interest are mode of birth, need for emergency caesarean section, intrapartum foetal distress, need for labour induction, birthweight and Apgar score ≤ 7 .

2. MATERIAL AND METHODS

Study population

Between May 2024 and May 2025, we evaluated 129 women with singleton pregnancies who were hospitalized at the University Clinic of Gynaecology and Obstetrics in Skopje due to signs and symptoms of suspected preeclampsia (elevated blood pressure refractory to standard antihypertensive therapy, persistent headache unresponsive to analgesics, epigastric pain, oedema, visual disturbances or proteinuria).

In addition to the standard clinical and laboratory assessment mandated by the institutional protocol for women admitted with suspected preeclampsia, capillary whole blood was obtained by finger prick for measurement of glycosylated fibronectin, and venous blood was drawn for determination of the sFlt-1/PLGF ratio, after prior written informed consent was obtained from each participant. The study was conducted following approval from the Ethics Committee of the Faculty of Medicine in Skopje.

Analysis of sFlt-1, PLGF, and GlyFn

GlyFn was measured using a point-of-care device (Lumella™ PE test; DiabetOmics, Inc., Hillsboro, OR, USA) after collection of 5 µL of capillary whole blood from the fingertip. The assay employs monoclonal antibodies directed against GlyFn to quantify its concentration, and the result is displayed on the reader after only 10 minutes (Diabetomics 2023).

The levels of sFlt-1, PIGF, and the sFlt-1/PIGF ratio were measured using a fully automated electrochemiluminescence immunoassay (ECLIA) analyzer (Cobas e 411), which applies an immunoassay technique based on highly specific monoclonal antibodies against PIGF and sFlt-1 (Verlohren et al, 2010; Schenider et al, 2009).

Diagnosis and outcomes

After completion of the protocol-based clinical and laboratory evaluations, all women were divided into two groups according to the measured sFlt-1/PIGF ratio. Category 1: sFlt-1/PIGF ratio < 85 and category 2: sFlt-1/PIGF ratio ≥ 85, based on previously established cut-off values from published studies (Verlohren et al, 2014; Verlohren et al, 2012).

With respect to glycosylated fibronectin, patients were also classified into two categories: category 1: GlyFn < 350 and category 2: GlyFn ≥ 350, cut-offs that is provided by the manufacturer of the test (Diabetomics, 2023).

Outcomes of interest were mode of birth, need for emergency caesarean section, intrapartum foetal distress, need for labour induction, birthweight and Apgar score ≤ 7.

Statistical analysis

Continuous variables after testing for its distribution, are presented as median with interquartile range (IQR).

Significant differences between groups were based on P-values (< 0.05). For all continuous variables we use the Mann-Whitney test to produce the p-values, and for all categorical variables, we use Pearson's Chi-square test.

Multivariable logistic regression was used to assess the association between delivery outcomes. Adjustment was for gestational age at delivery. The adjusted odds ratios are the exponentiated regression coefficients, estimated by maximum likelihood, with two-sided Wald tests for p-values and Wald 95% CIs from the model's standard errors. Gestational week is included as a continuous covariate on the log-odds scale.

3. RESULTS

Patients with sFlt-1/PIGF ≥ 85 had a significantly earlier gestational age at inclusion (median 33.1 weeks vs 37.3 weeks, $p < 0.001$) and were predominantly diagnosed with preeclampsia (90.5% vs 17.5%, $p < 0.001$) (Table 1). These patients delivered earlier (median 33.5 weeks vs 37.6 weeks, $p < 0.001$) and had markedly lower birthweights (median 1820 g vs 3110 g, $p < 0.001$).

While the overall rate of caesarean section was high in both groups, C-section due to foetal distress was significantly more frequent in the high-ratio group (39.2% vs 21.1%, $p = 0.026$). Low Apgar scores (≤ 7) at 1 and 5 minutes were much more common among women with sFlt-1/PIGF ≥ 85 (64.9% vs 8.8% and 51.4% vs 5.3%, both $p < 0.001$), indicating compromised neonatal outcomes.

Overall, elevated sFlt-1/PIGF ratios were strongly associated with earlier delivery, lower birthweights, more frequent C-section due to foetal distress and lower Apgar scores (≤ 7), consistent with severe placental dysfunction.

Table 1. Baseline characteristics and delivery outcomes in all patients and divided into groups according to sFlt-1/PLGF ratio

	All patients	sFLT-1/PLGF ≥ 85	sFLT-1/PLGF < 85	p-value
Maternal age	30.00 (26.00–35.00)	30.00 (26.00–36.00)	30.00 (26.00–34.00)	0.433
Gest. age at inclusion	35.10 (32.05–37.80)	33.10 (31.10–35.90)	37.30 (35.30–38.40)	<0.001
Diagnosis PE, N (%)	77 (58.8%)	67 (90.5%)	10 (17.5%)	<0.001
Diagnosis GH, N (%)	54 (41.2%)	7 (9.5%)	47 (82.5%)	<0.001
Gest. age at delivery	36.10 (32.60–38.20)	33.45 (31.53–36.23)	37.60 (36.30–39.00)	<0.001
Birthweight	2400.00 (1620.00–3110.00)	1820.00 (1237.50–2390.00)	3110.00 (2750.00–3440.00)	<0.001
Spontaneous birth, N (%)	23 (17.8 %)	9 (12.2%)	14 (24.6%)	0.064
C-section, N (%)	106 (82.2%)	63 (85.1%)	43 (75.4%)	0.161
Emergency C-section, N (%)	55 (42.0%)	36 (48.6%)	19 (33.3%)	0.078
C-section for foetal distress, N (%)	41 (31.3%)	29 (39.2%)	12 (21.1%)	0.026
Induction of labour, N (%)	39 (29.8%)	21 (28.4%)	18 (31.6%)	0.691
Apgar score 1 minute ≤ 7, N (%)	53 (40.5%)	48 (64.9%)	5 (8.8%)	<0.001
Apgar score 5 minute ≤ 7, N (%)	41 (31.3%)	38 (51.4%)	3 (5.3%)	<0.001

Source: Author's research

Values are median (interquartile range) or Number N (%). PE: preeclampsia; GH: gestational hypertension; sFlt-1: soluble Fms-like tyrosine kinase; PLGF: placental growth factor

In contrast, patients with **elevated GlyFn ($\geq 350 \mu\text{g/mL}$)** also demonstrated a pattern of **earlier inclusion** (median 33.3 weeks vs 36.1 weeks, $p < 0.001$) and were overwhelmingly diagnosed with **preeclampsia** (91.3% vs 22.6%, $p < 0.001$) (Table 2). They delivered **significantly earlier** (33.6 weeks vs 37.2 weeks, $p < 0.001$) and had **lower birthweights** (1900 g vs 2985 g, $p < 0.001$).

The **rate of caesarean section** was higher in the GlyFn ≥ 350 group (88.4% vs 72.6%, $p = 0.021$), and **C-section for foetal distress** was also more frequent (39.1% vs 22.6%, $p = 0.041$). Similarly, **neonatal compromise** was reflected in markedly increased rates of **Apgar ≤ 7** at 1 min (58.0% vs 21.0%) and 5 min (47.8% vs 12.9%), both $p < 0.001$.

Table 2. Baseline characteristics and delivery outcomes in all patients and divided into groups according to GlyFn level

	All patients	GlyFn < 350	GlyFn ≥ 350	p-value
Maternal age	30.00 (26.00–35.00)	29.00 (25.00–33.00)	32.00 (26.00–36.00)	0.196
Gest. age at inclusion	35.10 (32.05–37.80)	36.10 (34.10–38.18)	33.30 (31.10–36.30)	<0.001
Diagnosis PE, N (%)	77 (58.8%)	14 (22.6%)	63 (91.3%)	<0.001
Diagnosis GH, N (%)	54 (41.2%)	48 (77.4%)	6 (8.7%)	<0.001
Gest. age at delivery	36.10 (32.60–38.20)	37.20 (35.20–38.48)	33.60 (31.60–36.75)	<0.001
Birthweight	2400.00 (1620.00–3110.00)	2985.00 (2285.00–3305.00)	1900.00 (1315.00–2685.00)	<0.001
Spontaneous birth, N (%)	23 (17.8%)	17 (27.4%)	6 (8.7%)	0.004
C-section, N (%)	106 (82.2%)	45 (72.6%)	61 (88.4%)	0.021
Emergency C-section,	55 (42.0%)	22 (35.5%)	33 (47.8%)	0.152

N (%)				
C-section for foetal distress, N (%)	41 (31.3%)	14 (22.6%)	27 (39.1%)	0.041
Induction of labour, N (%)	39 (29.8%)	21 (33.9%)	18 (26.1%)	0.330
Apgar score 1 minute \leq 7, N (%)	53 (40.5%)	13 (21.0%)	40 (58.0%)	<0.001
Apgar score 5 minute \leq 7, N (%)	41 (31.3%)	8 (12.9%)	33 (47.8%)	<0.001

Source: Author's research

Values are median (interquartile range) or Number N (%). PE: preeclampsia; GH: gestational hypertension; GlyFn: glycosylated fibronectin.

Table 3. Odds ratios for sFlt-1/PLGF \geq 85 vs < 85 across delivery outcomes

Outcome Variable	Adjusted OR (95% CI)	p-value	Interpretation
Spontaneous birth	0.78 (0.27–2.29)	0.653	No significant association
Emergency C-section	2.16 (0.93–5.03)	0.073	Trend toward higher odds
C-section for fetal distress	2.62 (1.05–6.56)	0.039	Significant increase in odds
Induction of labor	2.35 (0.91–6.04)	0.077	Trend toward higher odds
Low Apgar (\leq 7 at 1 or 5 min)	8.88 (2.31–34.12)	0.0015	Significant increase in odds

Source: Author's research

In multivariable logistic regression models adjusted for gestational age at delivery, elevated **sFlt-1/PLGF ratio (\geq 85)** was significantly associated with adverse delivery outcomes. Women with high sFlt-1/PLGF ratios had more than **2.6-fold higher odds of caesarean section for foetal distress (OR = 2.62; p = 0.039)** and almost **nine-fold higher odds of lower Apgar scores (\leq 7) at either 1 or 5 minutes (OR = 8.88; p = 0.0015)** compared with those with lower ratios. While higher ratios also showed trends toward increased odds of emergency caesarean (OR = 2.16; p = 0.073) and need for induction of labour (OR = 2.35; p = 0.077), these associations did not reach statistical significance. No significant relationship was observed between lower sFlt-1/PLGF ratios (<85) and odds of spontaneous onset of labour (p = 0.653).

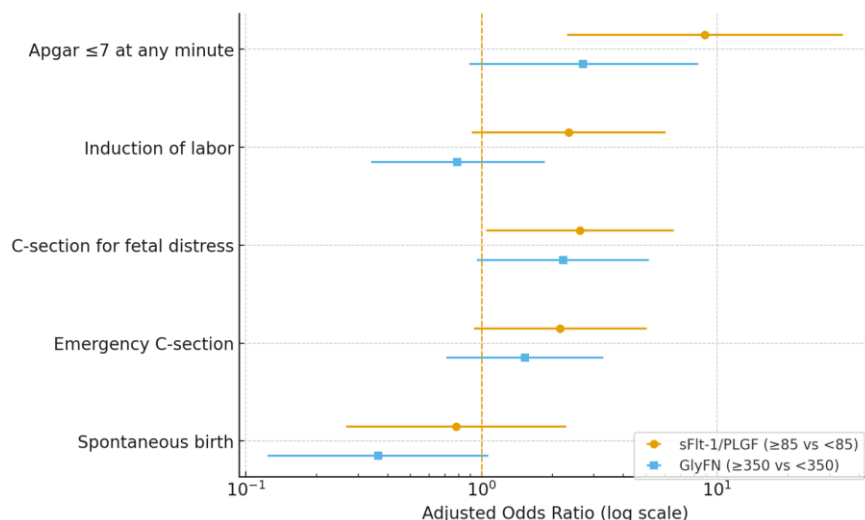
Table 4. Odds ratios for GlyFn \geq 350 vs < 350 across delivery outcomes

Outcome Variable	Adjusted OR (95% CI)	p-value	Interpretation
Spontaneous birth	0.37 (0.12–1.07)	0.066	Trend toward lower odds
Emergency C-section	1.53 (0.71–3.29)	0.28	No significant association
C-section for fetal distress	2.22 (0.96–5.12)	0.061	Trend toward higher odds
Induction of labor	0.78 (0.34–1.86)	0.596	No evidence of associations
Low Apgar (\leq 7 at 1 or 5 min)	2.70 (0.89–8.33)	0.078	Trend toward higher odds

Source: Author's research

For **glycosylated fibronectin (GlyFn)**, values \geq 350 μ g/mL were generally associated with less favourable outcomes, although most associations did not achieve statistical significance after adjustment. There was a trend toward **lower odds of spontaneous birth (OR = 0.37; p = 0.066)** with higher GlyFn levels and **higher odds of caesarean section for foetal distress (OR = 2.22; p = 0.061)** and **lower Apgar scores (OR = 2.70; p = 0.078)**. The direction of these associations suggests that elevated GlyFn concentrations may be indicative of higher delivery risk, consistent with placental dysfunction reflected by the biomarker.

Figure 1. Comparative performance of biomarkers. Side-by-side, adjusted-for-gestational-age, comparison of the two biomarkers across all five outcomes, using the ORs/CIs/p-values.



Source: Author's research

Across five GA-adjusted logistic models, GlyFn showed the strongest discrimination for spontaneous birth (adjusted OR 0.37, 95% CI 0.12–1.07; $p=0.066$), indicating lower GlyFn (<350) was associated with a higher likelihood of spontaneous delivery. The sFlt-1/PLGF showed no adjusted association. For intrapartum surgical outcomes, sFlt-1/PLGF consistently outperformed GlyFn: it exhibited larger effect sizes for predicting emergency caesarean section (OR ≈ 2.16) and intrapartum caesarean section for foetal distress (OR 2.62; 95% CI 1.05–6.56; $p=0.039$), and it was the clearest predictor for low Apgar (≤ 7) with an ≈ 9 -fold increase in odds (95% CI 2.31–34.12; $p=0.0015$). For need for induction of labour, sFlt-1/PLGF showed a positive trend (OR ≈ 2.35 ; $p=0.08$). Overall, if prioritizing a single marker by endpoint, choose GlyFn for predicting chance of spontaneous birth, and sFlt-1/PLGF for emergency caesarean section, caesarean section for intrapartum foetal distress and low Apgar; for need for induction of labour, sFlt-1/PLGF is better. (Figure 1).

4. DISCUSSION

According to our study, both an elevated sFlt-1/PIGF ratio (≥ 85) and an elevated GlyFn (≥ 350 $\mu\text{g/mL}$) identified pregnancies with clear evidence of placental dysfunction: earlier gestational age at delivery, markedly lower birthweights and higher rates of caesarean delivery for intrapartum foetal distress and low neonatal Apgar scores. After adjustment for gestational age at delivery, the sFlt-1/PIGF ratio demonstrated the stronger and more consistent associations with intrapartum events — notably a 2.6-fold increased odds of caesarean for foetal distress and an ≈ 9 -fold increased odds of low Apgar score (≤ 7) — whereas GlyFn showed directionally similar but generally attenuated associations that failed to reach conventional statistical significance in adjusted models.

These findings align with and extend contemporary literature demonstrating that angiogenic imbalance, reflected by an elevated sFlt-1/PIGF ratio, is strongly associated with imminent delivery and adverse perinatal outcomes. Several recent cohort studies have reinforced the ratio's role not only as a tool for diagnosis and short-term rule-out of preeclampsia but also as a prognostic marker for maternal and foetal complications and timing of delivery (Bonacina et al, 2022; Kosińska-Kaczyńska et al, 2024). Investigators have reported that elevated ratios are predictive of preterm delivery and adverse outcomes in pregnancies complicated by foetal growth restriction or hypertensive disorders, and that different ratio thresholds show good discrimination for specific short-term risks (delivery within 48 hours to 2 weeks, severe neonatal compromise) (Bonacina et al, 2022; Kosińska-Kaczyńska et al, 2024; Hong et al, 2024). Our results — higher frequency of caesarean for foetal-distress and substantially worse neonatal Apgar scores in the high-ratio group — are consistent with this body of evidence and support use of the sFlt-1/PIGF ratio for risk stratification in hospitalized patients with suspected placental insufficiency.

Notably, the literature shows variation in the optimal cut-off for different outcomes and populations; commonly used clinical cut-offs (38, 85, 110 and gestation-specific thresholds) each have varying sensitivity/specificity trade-offs depending on whether the clinical goal is rule-out PE, rule-in PE, prediction of imminent delivery or prediction of other adverse outcomes (Verlohren et al, 2014; Verlohren et al, 2012; Bonacina et al, 2022). That heterogeneity helps

explain why we chose the ≥ 85 cut-off (consistent with prior prognostic studies) and why our results should be interpreted in the context of the studied population and gestational age distribution.

Evidence for GlyFn is rapidly evolving. Glycosylated fibronectin has been proposed as a practical point-of-care (POC) biomarker that can detect placental dysfunction and predict imminent preeclampsia in symptomatic women (Sokratous et al, 2023; Sokratous et al, 2024; Paneva et al, 2025). Several recent evaluations — including multi-centre, prospective studies — have reported higher GlyFn in women who develop preeclampsia and associations with preterm delivery and neonatal compromise. Our findings that GlyFn ≥ 350 $\mu\text{g/mL}$ identified a subgroup with earlier deliveries, lower birthweights and more caesarean deliveries for foetal distress reinforce GlyFn's potential as a rapid triage tool in clinical settings where immediate decision support is needed (Nagalla et al, 2020; Paneva et al, 2025). However, GlyFn in our adjusted models had weaker independent predictive value for intrapartum neonatal compromise than the sFlt-1/PIGF ratio. This suggests GlyFn may be most useful either as a front-line POC triage test or as part of a multimarker model rather than as a stand-alone predictor of intrapartum events.

Two implications arise from comparing our results with recent literature. First, the sFlt-1/PIGF ratio appears particularly helpful for identifying pregnancies at high risk of acute foetal compromise that may require expedited delivery or heightened intrapartum surveillance; this supports integration of angiogenic profiling into decision pathways for hospitalized women with suspected placental insufficiency (ObG Project, 2025). Second, GlyFn's portability and rapid results make it attractive for initial triage (for example, in low-resource or emergency settings), but clinicians should be cautious about relying on GlyFn alone to predict intrapartum foetal distress or neonatal outcomes — combining GlyFn with angiogenic markers and ultrasound/Doppler surveillance is likely to provide the best predictive performance (Arnouts et al, 2025).

Strengths of our study include a prospectively collected cohort with contemporaneous measurement of both biomarkers at presentation and rigorous adjustment for gestational age at delivery in multivariable models. Limitations should be acknowledged. The single-centre design and modest sample size limit precision for some adjusted effects (notably several GlyFn associations that trended but did not reach significance). Thresholds for GlyFn and sFlt-1/PIGF vary across studies and assay platforms; this heterogeneity complicates direct numeric comparisons of cut-offs performances across cohorts. Finally, while Apgar score and mode of delivery are clinically relevant, they are imperfect proxies for long-term neurodevelopmental or perinatal morbidity and should be complemented by follow-up studies.

5. CONCLUSION

Our observations are in line with recent high-quality evidence that an elevated sFlt-1/PIGF ratio identifies pregnancies at high risk of imminent delivery and neonatal compromise and show that GlyFn show a similar trend but with weaker independent association for intrapartum foetal distress and low Apgar in adjusted models. Clinically, GlyFn may serve as an expedient POC triage marker while sFlt-1/PIGF ratio measurement adds stronger prognostic information, useful for planning surveillance, timing of delivery and intrapartum management. Future larger, multi-centre studies should evaluate integrated algorithms that combine GlyFn, sFlt-1/PIGF and ultrasound Doppler parameters, and should examine whether biomarker-guided management strategies reduce adverse intrapartum outcomes.

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