Available online on 15.08.2026 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

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Research Article

Assessment of Prescribing Pattern and Clinical Outcomes among Women with Risk Factor for Preeclampsia

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Article Info:

Article History:

Received 04 June 2026
Reviewed 16 July 2026
Accepted 02 August 2026
Published 15 August 2026

Cite this article as:

Parashar S, Gupta S, Verma V, Goel A, Sharma V, Sharma R, Kaushik R, Verma KK, Assessment of Prescribing Pattern and Clinical Outcomes among Women with Risk Factor for Preeclampsia, Journal of Drug Delivery and Therapeutics. 2026; 16(8):120-130 *DOI:* https://doi.org/10.22270/jddt.v16i8.7940

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Abstract

Objective(s): Preeclampsia is a pregnancy-specific hypertensive disorder marked by new-onset hypertension and proteinuria after 20 weeks of gestation, and remains a leading cause of maternal and perinatal morbidity and mortality in developing countries. This study was undertaken to assess the clinical profile, drug prescribing pattern, and maternal-fetal outcomes among women with risk factors for preeclampsia attending a tertiary care teaching hospital. **Design:** A prospective observational study. **Intervention(s):** Case records of pregnant women with moderate-to-high risk factors for preeclampsia, attending the antenatal clinic of the Department of Obstetrics and Gynaecology, MMIMSR, Mullana, were reviewed over a six-month period. Demographic data, obstetric history, clinical findings, laboratory parameters, and prescribed antihypertensive and supportive medication were recorded on structured case record forms after obtaining informed consent. **Main outcome measure(s):** Drug prescribing pattern assessed using WHO prescribing indicators, and maternal-foetal outcomes. **Results:** Of 100 antenatal records screened, 60 women met the risk criteria for preeclampsia. Most patients were 20-30 years of age, and 55% were stratified as high risk and 38.3% as moderate risk on the basis of clinical and laboratory parameters. Labetalol (75%) was the most frequently prescribed antihypertensive, followed by low-dose aspirin/Ecosprin (40%) and magnesium sulphate (15%) for seizure prophylaxis. Supportive therapy included calcium (98.3%), iron (95%), folic acid (16.6%), L-arginine (31.6%), and protein powder (31.6%). About one-third of the women received additional treatment for concomitant illnesses such as diabetes mellitus, hypertension, and thyroid disorders. **Conclusion:** The drug therapy prescribed to women at risk of preeclampsia at this centre was broadly consistent with WHO and ACOG recommendations, with labetalol as the antihypertensive of choice and low-dose aspirin used for prophylaxis. Standardised treatment protocols, early risk stratification, and continued monitoring are needed to further improve maternal and fetal outcomes.

Keywords: Preeclampsia, Drug Utilization Pattern, Antihypertensive Therapy, Maternal and Fetal Outcomes, Magnesium Sulfate, Biomarkers, Observational Study.

1. INTRODUCTION

Inappropriate and irrational use of medicines is a widespread problem across healthcare systems in developing countries. Irrational prescribing adds to the economic burden on patients and increases the risk of adverse drug reactions and drug resistance.[1] Prescription pattern (drug utilization) studies are the best available tool to examine how medicines are prescribed, dispensed and used in a population, and they help in understanding rational drug use, drug quality and patient compliance with treatment guidelines.[2] The World Health Organization (WHO) promotes drug utilization research as a means of improving prescribing practices and rational drug use in healthcare facilities, and defines it broadly as the marketing, distribution, prescription and use of medicines in society, along with their medical, social and economic consequences.[1]

Drug utilization research is chiefly concerned with the prescribing, dispensing, administration and consumption of medicines, and with the outcomes-beneficial or adverse-that follow.[11,12,13] The field dates back to the early 1960s[71] and is broadly divided into prospective, concurrent and retrospective studies; prospective designs, of the type used here, allow the most comprehensive assessment of prescribing behaviour, while concurrent studies run alongside dispensing and retrospective studies review data after the fact.[73] Beyond describing what is prescribed, such studies help measure the effect of regulatory and pricing interventions, evaluate the efficacy and safety of treatment, and flag over-use, under-dosing or misuse of medicines,[73] making them a routine part of quality assurance in clinical care. Findings from drug utilization research increasingly feed into the wider fields of pharmacoepidemiology, pharmacovigilance, pharmaco-economics and pharmacogenetics.[20]

1.1 Preeclampsia: Burden and Epidemiology

Preeclampsia is a pregnancy-specific hypertensive disorder, defined by new-onset hypertension with proteinuria (or other evidence of end-organ dysfunction) after 20 weeks of gestation. It ranks among the leading causes of maternal morbidity and mortality worldwide, with an estimated global incidence of 3-10%.[26] WHO data for 2003-2009 attributed 14% of maternal deaths to hypertensive disorders, second only to haemorrhage (27.1%),[27] and in low- and middle-income countries preeclampsia accounts for 10-15% of maternal deaths, with hypertensive disorders responsible for roughly one in ten maternal deaths across Asia and Africa. In India, preeclampsia affects an estimated 8-10% of pregnant women.[6] Risk is markedly higher in women with a prior history of preeclampsia (2-5 fold) and in nulliparous women (occurring in 3-7% of nulliparous versus 1-3% of multiparous pregnancies); high altitude has also been associated with a higher incidence, possibly through placental hypoxia and reduced uterine arterial blood flow.[28]

1.2 Etiology

No single cause of preeclampsia has been identified; proposed contributors include placental abnormalities, genetic predisposition, abnormal blood vessel development, immunological factors, and oxidative stress.[7]

1.3 Clinical Manifestations and Risk Stratification

Common clinical features include headache, oedema, excessive weight gain, blurred vision, upper abdominal pain, and elevated blood pressure. On the basis of blood pressure and proteinuria, patients are commonly stratified into mild, moderate and severe risk categories, which in turn guide the decision to initiate low-dose aspirin prophylaxis (Table 1).

Table 1: Clinical risk stratification for preeclampsia (ACOG guidelines, 2018){{9}}

Risk category	Contributing factors	Recommended action
Severe	Prior preeclampsia with adverse outcome; multifetal pregnancy; chronic hypertension; renal disease; autoimmune disease	Low-dose aspirin recommended on presence of any one factor
Moderate	Nulliparity; obesity (BMI >30); family history of preeclampsia; adverse socio-demographic factors; maternal age ≥35 years	Low-dose aspirin recommended on presence of more than one factor
Mild	Previous uncomplicated full-term delivery	Low-dose aspirin not indicated

1.4 Pathophysiology

The pathophysiology of preeclampsia is not fully understood, but abnormal placentation and multifactorial vascular endothelial dysfunction are considered central to disease onset and progression (Figure 1).

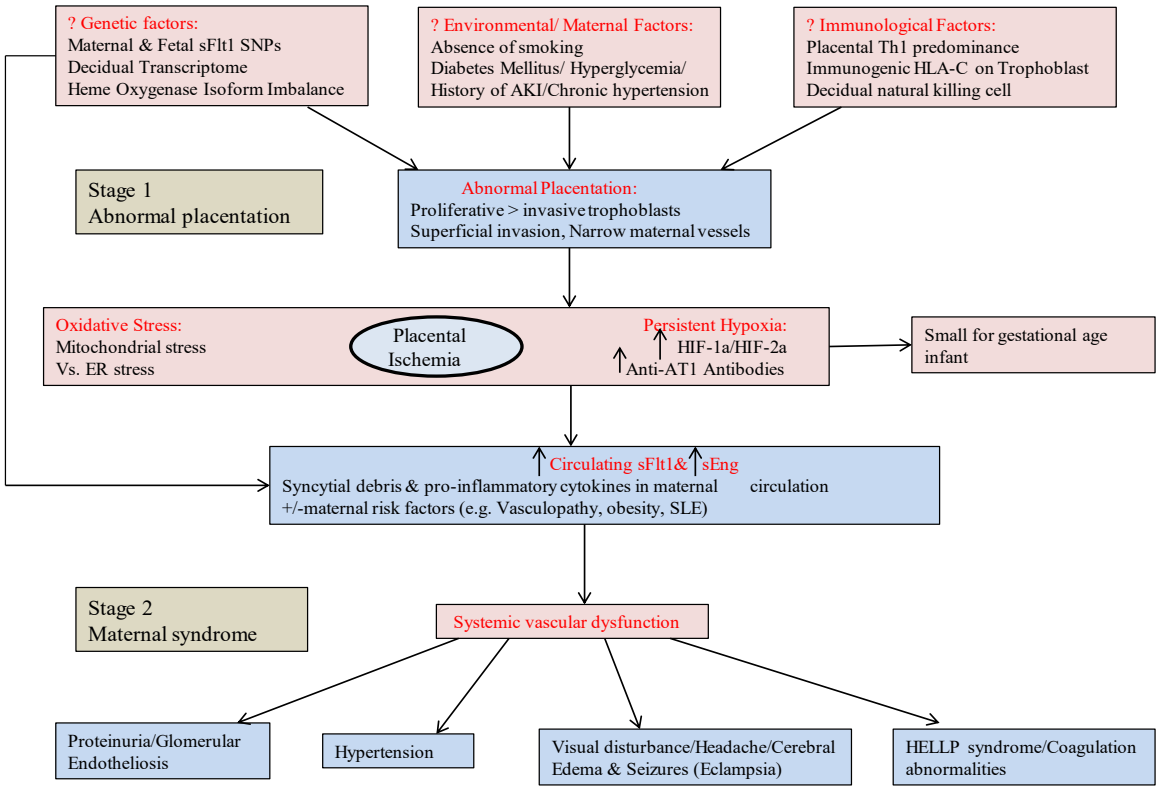

Figure 1: Pathophysiology of preeclampsia

1.5 Diagnosis

Preeclampsia is diagnosed in women with new-onset hypertension after 20 weeks of gestation together with one or more of the following: proteinuria, thrombocytopenia, hepatic dysfunction, renal impairment (excluding proteinuria), pulmonary oedema, headache, or visual disturbance. Confirmatory work-up typically includes blood tests for hepatic, renal and platelet function; 24-hour urinary protein estimation or the protein-creatinine ratio; and fetal ultrasound or biophysical profile scoring, usually performed after 28 weeks of gestation, to assess fetal wellbeing.[37]

1.6 Biomarkers

A range of biological markers has been investigated to aid the early identification of preeclampsia, spanning angiogenic, immunologic, metabolic and endocrine pathways (Table 2).

Table 2: Biomarker categories relevant to preeclampsia. VEGF: vascular endothelial growth factor; PlGF: placental growth factor; sFlt-1: soluble fms-like tyrosine kinase-1; sEng: soluble endoglin; PP-13: placental protein-13; PAPP-A: pregnancy-associated plasma protein-A.

Category	Representative biomarkers
Maturation (angiogenic) biomarkers	Pro-angiogenic: VEGF, PlGF; Anti-angiogenic: sFlt-1, sEng
Angiotensin biomarkers	Agonistic autoantibodies to the angiotensin II type 1 receptor (AT1-AA)
Immunologic biomarkers	PP-13, PAPP-A
Metabolic biomarker	Visfatin
Endocrine biomarkers	Activin A, Inhibin A

Angiogenic markers (sFlt-1 and sEng)

Normal placental vascular development depends on the pro-angiogenic factors VEGF and PlGF, which support trophoblast growth and implantation.[39] PlGF concentrations normally rise across the first 30 weeks of gestation but are reduced in preeclampsia,[38] while free VEGF is present at concentrations too low to measure reliably by standard ELISA.[41] sFlt-1, an anti-angiogenic peptide that binds and neutralises PlGF and VEGF, begins rising before the clinical onset of preeclampsia and correlates with disease severity;[42,43] levels are further elevated in nulliparous women.[44,45] sEng, a soluble form of the TGF-β1/β2 receptor, impairs nitric-oxide-mediated vasodilation and endothelial proliferation; its levels rise in the second trimester in women who go on to develop preeclampsia and fall after delivery.[46,47] Together, sFlt-1 and sEng are thought to drive the systemic endothelial dysfunction underlying the hypertension and proteinuria of preeclampsia (Figure 2).

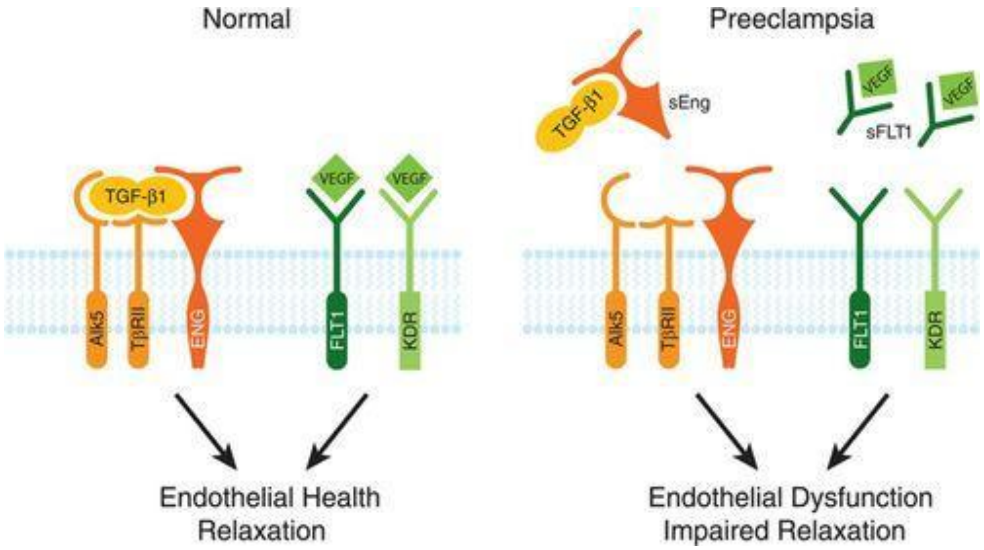

Figure 2: Effect of sEng and sFlt-1 on endothelial function

Angiotensin-related markers

The renin-angiotensin system regulates blood pressure, fluid-electrolyte balance and cardiac output.[49] While normal pregnancy is associated with resistance to the vasoconstrictive effects of angiotensin II, this resistance is lost in preeclampsia.[50] Two mechanisms have been proposed for the resulting rise in blood pressure, oedema and proteinuria: formation of angiotensin-bradykinin B2 receptor heterodimers, and generation of agonistic autoantibodies against the angiotensin II type 1 receptor (AT1-AA).[51,52] AT1-AA levels are raised in preeclampsia and can remain elevated post-partum in women with a prior history of the disease,[53] and have also been detected in fetal cord blood, where they are used to assess intrauterine growth restriction.[54]

Immunologic markers: PP-13 and PAPP-A

Placental protein-13 (PP-13), a dimeric protein abundant in placental tissue, is involved in implantation and maternal vascular remodelling.[55] First-trimester PP-13 concentrations (11-13 weeks) are reduced in women who subsequently develop preeclampsia or intrauterine growth restriction,[56] and low levels early in pregnancy have been proposed as a marker for early-onset (though not severe) disease.[57] Combining maternal serum PP-13 with uterine artery Doppler improves prediction of severe preeclampsia.[55] PAPP-A, a glycosylated protein synthesised by trophoblasts, is similarly reduced in the first trimester in preeclampsia and other pregnancy complications,[58,59,60] though it is regarded as a stronger marker of intrauterine growth restriction than of preeclampsia specifically; combining PAPP-A with uterine artery Doppler is again recommended to improve prediction.[61]

Metabolic marker: visfatin

Visfatin, a nicotinamide phosphoribosyltransferase expressed in adipose tissue, participates in nicotinamide biosynthesis and glucose homeostasis; abnormal circulating levels have been linked to insulin resistance, obesity, fetal growth restriction and gestational diabetes.[62] Reported changes in maternal visfatin levels in preeclampsia are inconsistent-both increases and decreases have been described-so its value as a diagnostic marker remains unresolved and requires confirmation in larger studies.[63,64]

Endocrine markers: activin A and inhibin A

Activin A and inhibin A are glycoproteins of the transforming growth factor-β family, released by the fetoplacental unit; activin A participates in several organ-level processes while inhibin A suppresses FSH synthesis.[65,66] Both rise through the third trimester of normal pregnancy, with levels roughly ten-fold higher in severe preeclampsia, and placental hypoxia is thought to drive activin A release from placental and endothelial cells.[67] Second-trimester serum and amniotic-fluid inhibin A correlates with disease severity,[68] and urinary activin A and inhibin A are also raised in preeclampsia,[66] though inhibin A has shown limited predictive value when measured in the first trimester.[69,70]

1.7 Complications of Preeclampsia

Maternal complications include placental abruption, disseminated intravascular coagulopathy, HELLP syndrome (haemolysis, elevated liver enzymes, low platelets), oedema, renal impairment, hepatic rupture, jaundice, intracerebral haemorrhage, and eclampsia/seizures. Fetal complications include intrauterine growth restriction, preterm birth, and fetal death, while affected neonates are at increased risk of hypoxia, brain injury, and perinatal death.

Given this burden, and the central role of antihypertensive and prophylactic drug therapy in limiting maternal and fetal complications, an assessment of prescribing patterns and clinical outcomes among women at risk of preeclampsia was undertaken at a tertiary care teaching hospital, with the objective of characterising drug utilization against WHO prescribing indicators and documenting the associated maternal-fetal outcomes.

2. MATERIALS AND METHODS

A prospective observational study was conducted in the Department of Obstetrics and Gynaecology, Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR), Mullana, Haryana, India, over a six-month period from October 2019 to March 2020. Case records of women attending the antenatal outpatient clinic were screened, and those diagnosed with, or carrying risk factors for, preeclampsia were reviewed in detail. Women aged 18-45 years with moderate-to-high risk factors for preeclampsia, including those with IVF pregnancies, were included; outpatient prescriptions were also captured. Women managed outside the Department of Obstetrics and Gynaecology, those in active labour, and those showing evidence of non-compliance were excluded.

A total of 100 antenatal records were screened, of which 60 women met the risk criteria for preeclampsia and were followed for six months. For each patient, demographic details, obstetric and medical history, clinical findings, laboratory results, and the number, frequency and duration of prescribed medicines were recorded on a structured case record form after obtaining written informed consent. All pregnant women attending the clinic were managed by a team of obstetricians, with laboratory investigations (blood pressure measurement, sonography, Doppler studies) and prescribed medicines explained to each patient. The study was approved by the Institutional Ethics Committee of Maharishi Markandeshwar (Deemed to be University) and conducted in accordance with the principles of the Declaration of Helsinki.

2.1 Study Design and Plan of Work

Table 3: Study plan of work

Phase	Duration (months)	Activity	Milestone
I	1	Literature review, protocol and questionnaire design, informed consent and case record form preparation	Literature survey completed
II	5	Patient screening and recruitment as per inclusion/exclusion criteria; observation of women at risk of preeclampsia, conducted per the Declaration of Helsinki	Assessment of prescribing pattern and maternal-fetal outcomes
III	1	Compilation of raw data and statistical analysis	Interpretation of patient outcome measures

2.2 Inclusion and Exclusion Criteria

Inclusion criteria: women aged 18-45 years with moderate-to-high risk of developing preeclampsia, including IVF pregnancies; outpatient prescriptions were included.

Exclusion criteria: patients not managed under the Department of Obstetrics and Gynaecology, women in labour, and patients with evidence of non-compliance.

Drug utilization was analysed using WHO prescribing indicators. Data were compiled and analysed using appropriate statistical software, and results were evaluated against patient demographics, prescribing patterns, and maternal-fetal clinical outcomes.

3. RESULTS

Of the 100 antenatal records screened, 60 women (60%) met the risk criteria for preeclampsia and were included in the final analysis. Risk of preeclampsia was concentrated in the younger age groups: 20-25 years (50%), 26-30 years (23.3%), 31-35 years (18.3%), and 36-40 years (8.3%) (Table 4).

Table 4: Age-wise distribution of patients

S. No.	Age group (years)	No. of patients	Percentage (%)
1	20-25	30	50.0
2	26-30	14	23.3
3	31-35	11	18.3
4	36-40	5	8.3
Total		60	100

On the basis of laboratory findings, past medical history, family history and concomitant illness, 55% of women were classified as high risk and 38.3% as moderate risk for preeclampsia, with the remaining 6.6% at mild risk (Table 5).

Table 5: Risk-category distribution of patients

S. No.	Risk category	No. of patients	Percentage (%)
1	Mild risk	4	6.6
2	Moderate risk	23	38.3
3	High risk	33	55.0

Blood pressure at presentation was mild (140/90-159/99 mmHg) in 51.6% of women, moderate (160/100-179/109 mmHg) in 33.3%, and severe (>180/100 mmHg) in 13.3% (Table 6).

Table 6: Blood pressure distribution among patients

S. No.	Level	Blood pressure range	No. of patients	Percentage (%)
1	Mild	140/90-159/99 mmHg	31	51.6
2	Moderate	160/100-179/109 mmHg	20	33.3
3	Severe	>180/100 mmHg	9	13.3
Total			60	100

Concomitant illness was present in 33.3% of women during the study period, most commonly diabetes mellitus (10%), hypertension (10%), thyroid disorders (6.6%), amenorrhea (5%) and seizure disorder (1.6%) (Table 7).

Table 7: Concomitant illnesses among study patients

S. No.	Concomitant illness	No. of patients	Percentage (%)
1	Diabetes mellitus	6	10.0
2	Hypertension	6	10.0
3	Thyroid disorder	4	6.6
4	Seizure disorder	1	1.6
5	Amenorrhea	3	5.0

Antihypertensive and prophylactic therapy prescribed for preeclampsia risk is summarised in Table 8. Labetalol was the most frequently prescribed antihypertensive (75%), followed by amlodipine/Amlong (6.6%) and telmisartan/Telma (6.6%). Low-dose aspirin (Ecosprin) was prescribed to 40% of high-risk women, and magnesium sulphate to 15% for prevention of eclamptic seizures. Supportive therapy was prescribed widely: calcium (98.3%), iron (95%), L-arginine sachets (31.6%), protein powder (31.6%) and folic acid (16.6%).

Table 8: Antihypertensive and supportive drug therapy prescribed for preeclampsia risk

S. No.	Drug	No. of patients	Percentage (%)
1	Labetalol	45	75.0
2	Amlodipine (Amlong)	4	6.6
3	Magnesium sulphate	9	15.0
4	Aspirin (Ecosprin)	24	40.0
5	Folic acid	10	16.6
6	Iron	57	95.0
7	Calcium	59	98.3
8	L-arginine sachets	19	31.6
9	Protein powder	19	31.6
10	Telmisartan (Telma)	4	6.6

Among women receiving treatment for concomitant illness, metformin (15%), levothyroxine (11.6%), insulin (3.3%) and methimazole (10%) were prescribed for diabetes mellitus and thyroid disorders. For maintenance of pregnancy, additional supportive drugs prescribed included Folvite (20%), domperidone/Perinorm (16.6%), vitamin K (5%), calcium citrate (3.3%) and thiamine (1.6%) (Table 9).

Table 9: Drug treatment for concomitant illness and gestational support

S. No.	Drug	No. of patients	Percentage (%)
1	Metformin	9	15.0
2	Vitamin K	3	5.0
3	Folvite	12	20.0
4	Levothyroxine	7	11.6
5	Insulin	2	3.3
6	Methimazole	6	10.0
7	Calcium citrate	2	3.3
8	Thiamine	1	1.6
9	Domperidone (Perinorm)	10	16.6

Overall, drug therapy in this cohort was individualised according to each patient's clinical risk profile, blood pressure severity, and concomitant illness, with treatment decisions aimed at safeguarding both maternal and fetal wellbeing.

4. DISCUSSION

Hypertensive disorders remain a major cause of maternal and perinatal mortality worldwide, and preeclampsia in particular is difficult to predict until its more advanced stages, by which point risk to both mother and fetus has already risen substantially. The diagnostic threshold used in this and most other settings-systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg, confirmed on two occasions at least four hours apart after 20 weeks of gestation-reflects this need for early, reliable identification. In developing countries, preeclampsia also contributes to longer-term cardiovascular risk: affected women face a higher lifetime risk of chronic hypertension and stroke, and children born of preeclamptic pregnancies appear to carry an increased risk of cardiovascular and metabolic disease in adulthood.

The predominance of labetalol in this cohort (75%) is consistent with its position as a first-line antihypertensive in pregnancy in both national and international guidelines, reflecting its favourable safety profile relative to other agents. The use of low-dose aspirin in 40% of women aligns with current practice of initiating prophylaxis before 16 weeks of gestation in those at moderate-to-high risk, and the use of magnesium sulphate in 15% of women is consistent with its established role in seizure prophylaxis for severe disease. The near-universal use of calcium and iron supplementation, and the frequent use of folic acid and L-arginine, reflect routine antenatal supportive care rather than preeclampsia-specific therapy, but remain relevant to overall maternal and fetal outcomes.

Although the pathophysiology of preeclampsia is not fully understood, multifactorial vascular endothelial dysfunction is considered central to disease onset, and this is broadly consistent with the biomarker literature reviewed above (notably the angiogenic imbalance involving sFlt-1, sEng, VEGF and PlGF). While biomarker testing was outside the scope of the present prescribing-pattern assessment, its growing evidence base suggests a role for future studies at this centre in combining clinical risk stratification with biochemical screening.

Taken together, these findings reinforce the value of systematic prescription-pattern assessment in pregnancy: it identifies whether prescribing is concordant with evidence-based guidelines, highlights areas where dosing, drug choice or monitoring could be standardised, and ultimately supports efforts to reduce the financial and clinical burden of inappropriate prescribing on both patient and health system.

5. CONCLUSION

Drug therapy prescribed to women at risk of preeclampsia at this centre was broadly consistent with WHO and ACOG recommendations for patient safety and effective maternal-fetal outcomes. Labetalol was the antihypertensive of choice (75%), with low-dose aspirin (Ecosprin 75-150 mg) used as prophylaxis in high-risk women. Supportive therapy, principally folic acid,

calcium, iron and protein powder, was prescribed alongside antihypertensive treatment according to each patient's individual risk profile, and additional agents (metformin, levothyroxine, insulin, methimazole, and vitamin supplementation) were used where concomitant illness was present. Magnesium sulphate was prescribed both for seizure prophylaxis and to support fetal development and reduce the risk of intrauterine growth restriction.

These prescribing patterns are intended to reduce maternal and fetal morbidity and mortality associated with preeclampsia. A limitation of this study was incomplete follow-up of maternal-fetal outcomes owing to disruption during the COVID-19 pandemic; longer-term follow-up studies are needed to confirm the clinical outcomes associated with these prescribing patterns.

Acknowledgement: The authors thank all the contributors.

Conflict of Interest: The authors declare that they have no conflict of interest.

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