**Review Article**

**Maternal, placental, and Fetal complications of preeclampsia in low resource settings**

**ABSTRACT**

**Background:** Preeclampsia remains a leading cause of maternal and perinatal morbidity and mortality, particularly in low- and middle-income countries, where healthcare resources are limited. Understanding the spectrum of its complications is critical for early recognition and management.

**Objectives:** To review and synthesize existing literature on the maternal, fetal, and placental complications of preeclampsia, with a focus on challenges specific to low- and middle-income countries.

**Methods:** This review draws on published data from peer-reviewed studies conducted predominantly in low-resource settings, highlighting major complications and discussing limitations in available data.

**Results:** Preeclampsia contributes to a wide range of maternal complications such as eclampsia, HELLP syndrome, and organ dysfunction. Fetal outcomes include growth restriction, preterm birth, and stillbirth. Placental pathology, though underreported, plays a central role in disease progression and outcomes. Majority of complications and consequences of preeclampsia are preventable, which is why it is no longer a major concern in developed countries. However, low- and middle-income countries must adopt suitable and context-specific strategies to reduce its burden.

**Conclusion:** Preeclampsia poses significant risks to mothers and infants in low- and middle-income countries. Greater investment in early screening, community education, and health system strengthening is essential. More region-specific, recent data are needed to inform effective interventions.

**Key words**: preeclampsia, maternal and fetal complications, low resource setting

Introduction

Preeclampsia exists along a spectrum of hypertensive disorders of pregnancy (HDP), which includes gestational hypertension, preeclampsia without severe features, preeclampsia with severe features, and eclampsia [1]. It can develop any time after 20 weeks of gestation and up to 6 weeks postpartum [1]. Preeclampsia is defined as a complex, multi-pathway disease process characterized by hypertension consisting of two readings with a systolic blood pressure ≥140 mmHg and/or diastolic BP ≥90 mmHg, measured 4–6 hours apart and accompanied by proteinuria, indicated by a urine dipstick reading of ≥1+ or ≥300 mg per 24 hours, occurring after 20 weeks of gestation in a previously normotensive patient [2]. According to the Royal College of Obstetricians and Gynaecologists, severe preeclampsia is defined as blood pressure ≥170/110 mmHg, measured twice at least 6 hours apart, with or without heavy proteinuria, and may be accompanied by maternal signs of end-organ dysfunction, including renal failure, liver dysfunction, central nervous system disturbances, pulmonary edema, or right upper quadrant pain[3,2].

Globally, preeclampsia is the second-leading cause of maternal mortality, contributing to an estimated 76,000 maternal deaths annually, with 500,000 fetal and newborn lives lost each year due to its perinatal consequences [3,19].

 Moreover, preeclampsia complicates 2-8% of all pregnancies, and 10-15% of direct maternal deaths are associated with preeclampsia and eclampsia [3]. In the past three decades, the incidence of preeclampsia has increased by 11% globally and it has become the single leading cause of maternal mortality in many low-resource settings [1,20]. Over 99% of maternal deaths due to hypertensive disorders of pregnancy occur in low- and middle-income countries (LMICs), where there is also a higher incidence of progression to eclampsia. Alarmingly, nearly 50% of eclamptic seizures take place outside of hospital settings, reflecting critical gaps in timely access to care [1].

The gap in terms of access to adequate sexual and reproductive care represents a violation of human rights which affects millions of women throughout the world, particularly those living in low and middle-income countries [4]. This situation led to the death of 303,000 women in 2015 due to pregnancy-associated causes [4]. Of these women, 99% lived in low and middle-income countries, where the likelihood of death due to such causes is 30 times higher than in high-income countries [4]. The reduction in the global maternal mortality is a goal established by the United Nations in the Sustainable Development Goals [4] (SDGS), however, nowadays, the reduction rate is not enough in order to reach this goal [4]. The majority of maternal deaths occur in rural settings, and most of them could be prevented with adequate medical care before, during and after childbirth [4]. However, the lack of resources and qualified staff, as well as the difficulty in referring or transferring patients, makes it difficult to ensure the right to quality care in rural communities, where only 56% of births will receive medical care by qualified staff [4].

The aim of this article is to explore the maternal, fetal, and placental complications linked to preeclampsia, mainly in low-resource settings. It also sheds light on feasible strategies that can help reduce the burden and improve outcomes.

This review is based on recent literature sourced from PubMed, Google Scholar, BMC, PLOS, and other relevant databases. Articles were selected for inclusion based on their relevance to the topic, using keywords such as “preeclampsia,” “maternal complications,” “fetal outcomes,” “placental complications,” and “low-resource settings.” Only articles published in English were considered.

**Pathophysiology of Preeclampsia.**

Despite decades of research, preeclampsia remains incompletely understood. Numerous theories have been proposed, but its exact cause is still unsettled. It is however, widely recognized as a complex, multi-systemic disorder arising from placental dysfunction [3]. One of the most accepted frameworks is the two-stage model: the first stage involves abnormal placentation early in pregnancy, while the second stage reflects the maternal systemic response to these placental abnormalities [3]. In the first stage, inadequate trophoblast invasion and impaired remodelling of the spiral arteries result in reduced placental perfusion and chronic ischemia [5][3]. This hypoperfusion triggers oxidative stress and leads to the release of anti-angiogenic factors such as soluble fms-like tyrosine kinase-1 (sFlt-1) and a reduction in placental growth factor (PlGF) [5]. The imbalance between pro- and anti-angiogenic factors contributes to endothelial dysfunction, which is central to the clinical manifestations of the disease [5][3]. The second stage is characterized by systemic endothelial activation and inflammation, manifesting as hypertension, proteinuria, and organ dysfunction [3]. Uterine artery Doppler findings often show increased resistance, reflecting poor uteroplacental blood flow [5].

Genetic predisposition also plays a role in susceptibility, with certain variants being more common in African populations [5][3]. In addition, metabolic and cardiovascular conditions, such as obesity or pre-existing hypertension, are believed to contribute especially to late-onset preeclampsia by independently promoting endothelial dysfunction [3]. Environmental and socioeconomic factors, particularly in low-resource settings, further exacerbate the risk of preeclampsia by limiting access to prenatal care, resulting in delayed diagnosis and inadequate management. Additionally, the prevalence of nutritional deficiencies—such as low levels of calcium, magnesium, and essential vitamins—can impair endothelial function and placentation, thereby increasing susceptibility to preeclampsia [5]. When preeclampsia progresses to eclampsia, the pathophysiological process extends to the central nervous system. A key mechanism is the disruption of the blood–brain barrier, which leads to cerebral edema and increases the risk of seizures. In severe cases, it may result in intracerebral hemorrhage or white matter necrosis [5].

**Maternal and placental complications**

Hypertensive disorders of pregnancy, particularly preeclampsia and eclampsia, are among the leading causes of maternal morbidity and mortality worldwide, with the burden disproportionately affecting low-resource settings such as sub-Saharan Africa [6]. Approximately 10% of maternal deaths globally are attributed to these conditions, with some regions like Uganda reporting preeclampsia as a factor in up to 25% of maternal deaths [6].

The pathophysiology of preeclampsia often results in a cascade of life-threatening complications. Key maternal complications include progressing to Eclampsia, HELLP syndrome (Hemolysis, Elevated Liver enzymes, Low Platelet count), disseminated intravascular coagulation (DIC), acute renal failure, pulmonary edema, cerebral hemorrhage, hepatic rupture, and stroke [7,8,3]. HELLP syndrome occurs in a significant subset of preeclamptic women, with prevalence varying globally—ranging from 4.9% in Iran to 40% in India [8]. Its complications include respiratory failure, liver rupture, blood transfusion need, and coagulation abnormalities. Women presenting with epigastric pain are five times more likely to develop HELLP syndrome [8].

Pre-eclampsia-eclampsia syndrome also forms an infamous triad with obstetric hemorrhage and sepsis, together contributing significantly to maternal, fetal, and neonatal mortality, particularly in resource-constrained settings [9]. In extreme cases, the condition can lead to multiorgan involvement including kidney and liver failure, disseminated intravascular coagulation (DIC), and central nervous system complications [9]. A recent study reported neurologic dysfunction in 52.2% of women, liver dysfunction in 23.9%, hematologic abnormalities in 19.5%, and renal dysfunction in 13.2% [9].

Placental complications are intimately tied to preeclampsia due to abnormal placental implantation and perfusion, leading to placental insufficiency, abruption, and infarction. These contribute to fetal growth restriction, oligohydramnios, and intrauterine fetal demise [10,8].

In a Ugandan study, 19% of patients experienced eclampsia, 15% had placental abruption, and 2% developed coagulopathy; maternal mortality was noted in 1% [11]. Similarly, a study conducted in Nigeria shows statistics of common complications such as acute kidney injury (6.37%), stroke (3.0%), puerperal sepsis (3.98%), and aspiration pneumonia (5.26%) being documented [5].

Analysis of maternal outcomes further reveals that the immediate clinical causes of death among women with pre-eclampsia/eclampsia include renal failure, eclampsia, and multi-organ failure [12]. The risks of prolonged maternal hospital stay, neonatal intensive care unit (NICU) admission, and perinatal mortality were notably higher among this group [12]. Moreover, women with pre-eclampsia/eclampsia were also at increased risk of undergoing caesarean section and delivering preterm [12]. Furthermore, early-onset severe preeclampsia carries a graver prognosis. Studies report higher rates of neurologic (52.2%), hepatic (23.9%), hematologic (19.5%), and renal dysfunction (13.2%) in early-onset cases compared to later presentations [7]. These are compounded by higher rates of caesarean delivery, ICU admission, preterm birth, and perinatal mortality [12]. In resource-limited settings, the absence of prompt diagnosis and intervention significantly heightens these risks. Delayed diagnosis, lack of antenatal care, and socio-economic struggles amplify these risks in LMICs [7,10]. For example, women in developing countries face a seven-fold increased risk of developing preeclampsia and a three-fold higher risk of progressing to eclampsia, with a fourteen-fold higher mortality risk [7]. According to institutional data from tertiary hospitals in sub-Saharan Africa, hypertensive disorders have now surpassed hemorrhage as the leading cause of maternal mortality [1].

**Fetal and neonatal complications of preeclampsia**

Fetal complications of preeclampsia include iatrogenic prematurity, low birth weight, and NICU admission and stillbirth [7]. As a largely placental disease, pre-eclampsia is a recognized risk factor for low birth weight [10]. The initiating event in pre-eclampsia is incomplete conversion of the spiral arteries in early pregnancy, due to inadequate invasion of the vessel walls by the extra-villous trophoblast [10]. For the fetus, poorly formed materno-fetal vascular connections mean a relative lack of nutrients and hence restricted growth.[10] Moreover, preeclampsia was linked to the highest rates of extreme preterm birth, stillbirth, and low Apgar scores when compared to other hypertensive disorders such as gestational or chronic hypertension [12]. Neonatal survival depends on a wide range of factors, but birth weight is a key determinant [10].

More than half (54.5%) of the live babies were admitted to the NICU showing continued strain on neonatal health.[7] Neonatal morbidity is a costly affair in an already low-resourced setting [7]. premature babies of mothers who have experienced pre-eclampsia carry an elevated mortality risk that persists even after leaving hospital, as a discharge weight of 1500 g in urban Uganda is associated with a 20% risk of death within three months [10]. Globally, across all contexts, babies born at lower birth weights have a higher risk of perinatal death than babies who are appropriately grown for gestational age [10]. The perinatal death rate in pregnancies affected by severe pre-eclampsia or eclampsia in urban Uganda is two-fold higher than in normotensive women, with some evidence suggesting a perinatal death rate of over 20% in pregnancies complicated by preeclampsia [10].

Early neonatal deaths were caused by severe prematurity, very low birth weight, and respiratory distress syndrome [7]. The patients presented late and were very sick, giving no time for interventions such as corticosteroids for fetal lung maturation to be administered[7].Moreover, preeclampsia was linked to the highest rates of extreme preterm birth, stillbirth, and low Apgar scores when compared to other hypertensive disorders such as gestational or chronic hypertension [12].Being born abruptly prematurely, having very low birth weight in a low-resource setting, the odds weigh heavily against the tender, fragile lives of the neonates. It is worrying that nearly half of the babies were lost through stillbirths and early neonatal deaths [7].

According to WHO, approximately 2.6 million stillbirths at 28 weeks of gestation or later occurred worldwide in 2015[13].  Ninety-eight percent of these are to mothers in low- and middle-income countries where poverty and lack of resources may limit access to basic obstetric care, medications, monitoring equipment, medical staff, emergency transportation, and facility-based delivery [14], and about 22% of the babies were stillborn and had hypertensive mothers [7]. Fetal death ratios (FDR) in sub-Saharan Africa are around 10-fold higher than FDR in high-income countries (29 vs 3 per 1,000 births, respectively) [13]. Additionally, infant mortality in women with preeclampsia is 3 times higher in LMIC than in high-income countries [2]. While the global stillbirth rate has decreased by 2% annually from 2000 to 2015, most of these deaths remain preventable with improved periconceptional and pregnancy care [13]. Stillbirths are significantly associated with hypertensive disorders, maternal comorbidities, and poor access to quality care [13,14]. In a large WHO trial across seven LMICs, hypertensive disorders were the second most common cause of stillbirths, responsible for 28% of cases[13,14].These deaths were frequently linked to abruptio placentae, uteroplacental insufficiency, and placental infarction [13,14].Analysis of 465 stillbirths in Ghana identified hypertension as the cause in 11.2% of cases, following intrapartum hypoxia (22.6%) and antepartum hemorrhage (14.4%) [14].In one comparative study, the stillbirth and neonatal mortality rates were 13.1% and 6.0%, respectively, with 47% of neonates born under 2.5 kg and 12.1% exhibiting signs of intrauterine growth restriction[15].

**Discussion:**

**Prevalence and common maternal, placental, fetal complications**:

Rolnik et al. reported that preeclampsia affects 2-8% of pregnancies [16]. preeclampsia has been documented in several countries, reflecting regional and systemic healthcare disparities. According to the World Health Organization (WHO), the global prevalence of preeclampsia is estimated to be around 0.4% [5]. However, a study conducted in Nigeria found a pooled prevalence of 4.51%, significantly higher than the global average [5]. This highlights a notable disparity in disease burden between high-income and low-resource regions [5]. Other Reported prevalence includes Guadeloupe (31%), Réunion (31%), Mauritius (34%), Cameroon (37.4%), China (38%), Zimbabwe (58%), Thailand (34%), Turkey (29%), and India (26%) [16].

A study by Kumari A. et al. reported that the incidence of maternal complications in preeclamptic patients ranged between 14% and 53% [11], emphasizing the substantial risk this condition poses to maternal health. Solwayo Ngwenya identified HELLP syndrome as the most common maternal complication in preeclamptic patients, occurring in 9.1% of 118 cases [11]. Another study by Xue-Jun Gao et al. observed that eclampsia occurred in 21% of preeclamptic cases, frequently accompanied by renal failure, placental abruption, and HELLP syndrome [11]. HELLP syndrome itself is notably prevalent and linked to respiratory failure, liver rupture, and severe hematologic abnormalities [8]. Neurologic, hepatic, hematologic, and renal dysfunctions are more frequently reported in early-onset cases [15]. Other life-threatening conditions such as DIC, renal failure, stroke, and hepatic rupture [7,8,3].

Placental complications such as abruption, infarction, and insufficiency contribute significantly to poor perinatal outcomes, including fetal growth restriction, oligohydramnios, and intrauterine death [10,8] These placental abnormalities are underreported despite being central to the disease mechanism.

Fetal complications such as iatrogenic prematurity, low birth weight, respiratory distress syndrome are among the common difficulties faced by neonates born to preeclamptic/eclamptic mother [7]. Over 54.5% of live-born babies were admitted to NICU, indicating serious postnatal complications [7].

**Maternal and fetal mortality in LMICs**

The prevalence of maternal death among women complicated by preeclampsia in low-income is higher than in middle and high-income setting [15]. Despite all the research published in the last three decades on screening and prevention of preeclampsia, the condition remains one of the main causes of maternal and perinatal morbidity and mortality, both in low and high-income countries [16].

maternal mortality associated with PE and eclampsia in Nigeria is notably high, with a pooled prevalence of 6.04% [5]. This rate is significantly higher compared to high-income countries, where maternal mortality rates due to these conditions are typically below 1% [5]. In Zimbabwe, hypertensive disorders were the third leading cause of maternal deaths [16]. The higher prevalence of maternal mortality associated with Preeclampsia /Eclampsia syndrome in low-resource settings could be related to late presentation of patients, associated with lack of proper knowledge, limited access to quality antenatal care, and poor obstetric care provision in health institutions due to resource constraints [15].

WHO estimates that 22% of stillbirths are among hypertensive mothers in LMICs, with fetal death ratios in sub-Saharan Africa being 10 times higher than in high-income countries [2]. For instance, in Nigeria the fetal mortality rate in stands at 16.73%, which is also higher than global averages for high-resource settings, where the rate is generally below 10% [5]. The increased fetal mortality in Nigeria shows the severe impact of preeclampsia and eclampsia, reflecting the urgent need for improved prenatal and emergency care [5].

**Genetic and health factors contributing to preeclampsia**

Genetic factors, poor baseline health status, and lack of access to high quality antenatal care may all contribute to the severity of preeclampsia observed in sub-Saharan African women [10]. Genetic background plays a pivotal role, with certain genetic predispositions potentially exacerbating the risk of PE. Studies have identified genetic variants associated with PE risk that are more prevalent in African populations compared to others [5]. Nutritional status is another critical factor; deficiencies in essential nutrients such as calcium, magnesium, and vitamins influence endothelial function and placentation, thereby modifying preeclampsia risk [5].

**Limited Access to Prenatal Care**

One of the primary contributors to maternal morbidity and mortality in preeclampsia cases is limited access to adequate prenatal care. The majority of maternal morbidity and mortality is due to limited access of prenatal intervention [2]. In high-income countries, 98% of women report having at least one prenatal visit, compared to only 68% in LMIC, while the goal is of at least four prenatal visits. Only 61% of women in urban areas and 39% of women in rural areas meet this goal [2]. Dekker and Sibai noted that proper antenatal care and timed delivery are of utmost importance in tertiary prevention of preeclampsia [16]. A problem observed in low- income settings is that women with identifiable risk factors for developing hypertensive disorders of pregnancy cared for in inappropriate city health clinics or rural areas [16]. This disparity in prenatal care access underscores the importance of early detection and timely intervention, which could prevent many of the complications associated with preeclampsia.

**Screening and diagnostic limitations**

At present, there is not a single reliable and cost-effective screening test for preeclampsia which can be recommended for use in most developing countries [17]. Measuring blood pressure and proteinuria is challenging in low‑resource settings due to the financial cost and lack of training [3]. Significant training is needed to measure blood pressure accurately, along with the availability of well‑maintained equipment, both of which pose a challenge to the early identification of preeclampsia in community settings [3]. A detection tool that is affordable and can be easily applied is needed [3]. The challenges extend into intrapartum and neonatal care. In community settings, fetal compromise is usually assessed by asking women about reduced fetal movements or by assessment for small for gestational age fetus [3]. The lack of appropriate or well-equipped instruments serves as a significant barrier to effective healthcare delivery. By the time they seek hospitalization, they are faced with critical shortages that delay timely interventions and negatively impact prognosis.

**Challenges in implementing WHO guidelines in Sub-Saharan Africa**

A study examining the adherence to WHO screening and management guidelines for preeclampsia in six sub-Saharan African countries showed extremely low use of recommended practices and availability of magnesium sulfate for acute hospital treatment, despite it being on the essential drug list in all surveyed countries [1]. This presents a marked difference from the favorable outcomes seen by the blanket use of magnesium sulfate which has good maternal outcomes as most of the very sick patients survivedm There were no maternal death reported in similar studies in rich-resourced countries such as Kuwait and UK. [7] Magnesium sulfate a low-cost and widely recommended medication, has consistently demonstrated efficacy in preventing eclamptic seizures and altering maternal outcomes in cases of preeclampsia and eclampsia. Its ability to prevent seizures and reduce mortality is well-established, yet its use remains limited in many low-resource settings. Despite being recommended by the World Health Organization and listed as an essential drug its availability and consistent use are still lacking. There is a need for better integration of magnesium sulfate administration into the community health worker’s toolkit. Similarly, a successful example from Pakistan where CHWS workers and midwives have been trained to administer misoprostol in women with postpartum hemorrhage. This is supportive to of the recommendation that with proper training, it is feasible to incorporate even emergency medication administration in community settings where accessibility and availability are an issue [3].

**Preventable deaths in LMICs**

The WHO report states that critically most of the deaths were avoidable if they had care and access to healthcare [16].

Ukah et al. found that the ability to recognize women at highest risk of complications earlier could aid in preventing these adverse outcomes through improved management [16]. Studies also highlight the high prevalence of early-onset preeclampsia in countries such as Zimbabwe (58%) and India (26%), further emphasizing the need for improved screening and prenatal care in these regions [16].

Cost-effective interventions already exist that could save over one million babies each year [13]. So by early detection and timely intervention, such as the use of magnesium sulfate and delivery management, mortality rates can be significantly reduced. Additionally incorporating routine laboratory testing for HELLP syndrome in the diagnostic protocol for preeclampsia or eclampsia, especially among teenage mothers, those experiencing epigastric pain, and those referred from lower health facilities, could enhance timely detection and management of mothers with preeclampsia whose pregnancies are complicated by HELLP syndrome [8].By this slight addition alone, an even greater portion of the burden could be alleviated.

**Challenges in Low-resource settings**

There are many known difficulties that are faced during the treatment of preeclampsia, but due to its unknown pathology tackling it completely remained difficult and at times unattainable.This section will cover the main challenges in managing preeclampsia in low- and middle-income countries (LMICs) and they center around three overarching themes: (1) low education levels and health literacy among women, (2) an insufficient number of healthcare providers highly trained in obstetric care, and (3) inadequate health infrastructure to support critically ill patients [1]. Recognizing and addressing these root challenges holds great potential to improve outcomes in pregnancies complicated by preeclampsia [1].

These obstacles can be categorized into patient-, provider-, system-, and community-level factors each playing a different role and together amplifying the burden.

**Patient-Level Challenges**

Low education levels and limited health literacy were thought to be the root cause of most patient-level barriers [1]. Many women believe pregnancy is a safe and natural process and remain unaware of complications such as preeclampsia or its associated risks [1]. Some providers noted that even women currently being managed for preeclampsia may not fully understand their diagnosis [1]. One clinician shared, "Even those with preeclampsia, some of them don't know. Like you will be managing them and if another person asks them, they don't even understand what you're managing them for" (ID 3 HO Female) [1].

Cultural beliefs can also lead to misinterpretations of clinical symptoms. For instance, swelling (edema), a potential sign of preeclampsia, may be perceived positively [1]. A healthcare worker explained, "It takes a lot of time to teach [patients] basic things, like if you are getting swollen, edema, it may be a sign [of preeclampsia] [1]. Because traditionally in some areas, they might think that when you are getting edema it may be an indication that the fetus is a male" (ID 20 C Male) [1].

Financial barriers further compound these challenges. In low-resource settings such as rural Haiti, women frequently delay or forgo antenatal care due to the costs associated with clinic visits, diagnostics, and transport [2]. Even when care is initiated, many are unable to complete follow-up appointments [1,2]. Cultural norms, as the results of a survey in 41 LMIC showed that nearly a quarter of women said they did not go to the health facility for delivery because a male provider staffed it, such a preference for female providers, also deter women from seeking facility-based care for delivery and routine monitoring, resulting in delayed presentation and worse maternal and fetal outcomes [1,2].

**Additional patient-level barriers include:**

Conflicting cultural and religious beliefs, inadequate antenatal care (ANC) attendance, non-acceptance of medical diagnoses and, poor adherence to treatment recommendations Lack of agency to make independent healthcare decisions [1].

Studies from Ethiopia, Haiti, Zimbabwe, and Nigeria similarly highlight how patients’ limited understanding of preeclampsia symptoms, psychosocial stress attribution for hypertension, and sociocultural norms interfere with ANC attendance, early detection, and provision of appropriate care [1].

**Provider-Level Challenges**

Challenges at the provider level further hinder the management of preeclampsia. Key issues identified include: insufficient number of highly trained healthcare workers in obstetrics and emergency maternal care, limited time available for patient counselling and education, inadequate monitoring of maternal and fetal well-being during pregnancy and, gaps in provider knowledge and confidence regarding preeclampsia management [1].

Additionally, diagnostic limitations in rural and low-resource settings severely impact timely diagnosis. Ultrasonography for fetal growth assessment is often unavailable, and fetal heart monitoring relies on less accurate tools like the Pinard stethoscope [1,3,2]. Blood pressure measurements are frequently compromised by outdated and poorly calibrated equipment, and proteinuria testing using dipstick which is the recommended practice by the WHO is inconsistently performed due to lack of supplies and training [1,3,2].Moreover, most risk prediction models for preeclampsia, were developed in high-resource settings and rely heavily on laboratory parameters and frequent monitoring tools often unavailable in LMICs [16].The absence of context-specific predictive models prevents early identification of at risk women and the timely application of preventive strategies [16].

**System-Level Challenges**

Structural and systemic factors contribute substantially to the delays and inadequacies in care. These include: inadequate healthcare infrastructure, including a shortage of intensive care units and blood products, financial barriers limiting access to diagnostics and hospital care, delays in laboratory testing critical for monitoring disease progression, insufficient supplies of essential medications such as magnesium sulfate, and lack of emergency transportation systems capable of timely referrals [1].

A study across six sub-Saharan African countries revealed extremely low adherence to WHO guidelines for preeclampsia screening and management, despite magnesium sulfate being listed as an essential drug in all surveyed nations [1]. These findings highlight a troubling gap between policy and practice. Additionally, inadequate obstetric and neonatal services greatly impact outcomes for mothers and infants. Preterm deliveries, often indicated due to severe preeclampsia, result in high perinatal morbidity and mortality rates due to limited availability of surfactant therapy, inadequate antibiotic coverage, and shortages of skilled personnel for neonatal care [1,3,9]

**Community-level challenges**

Finally, challenges at the community level cannot be overlooked. Most maternal deaths occur outside of healthcare facilities, in settings where antenatal care is absent or severely limited [1,3]. In community setups, determining the cause of death is difficult, and often reliance is placed on the relatives' or caretakers' recall of the symptoms experienced by the women prior to death [1,3] .If the cause of death cannot be determined, preventing future mortality from similar cases becomes challenging and lack of data limits research and slows progress in improving maternal and fetal outcomes [1,3].Early signs of preeclampsia often go unrecognized due to lack of training among community health workers, poor access to functional diagnostic tools, and the absence of standardized screening guidelines [1,3]. Blood pressure measurement errors, unreliable proteinuria testing, and delays in referral remain common [1,3]

**Strategies for improvement and prevention**

 Preeclampsia continues to be a significant contributor to maternal and fetal morbidity and mortality, especially in low- and middle-income countries (LMICs). Preventing its onset and minimizing its complications requires a multifaceted approach that addresses both systemic barriers and individual-level risk factors. In resource-limited environments, where advanced diagnostic tools and specialist care are often inaccessible, innovative and practical strategies must be adopted. This section outlines key pillars for prevention, focusing on scalable, cost-effective interventions that can be integrated into existing healthcare systems.

**1. Community education and raising awareness**

Educating women and midlevel healthcare workers to recognize acute onset edema can reduce complications and delays in care [2]. Learning about the signs and symptoms of preeclampsia and the possibilie dangers and consequences are crucial for early detection. Awareness campaigns can help overcome cultural barriers and encourage timely care seeking, especially in rural areas.In regions with a high incidence of eclampsia cases interventions to improve community monitoring and overcome barriers to care—such as health education—may be the most effective use of resources [18]Universal antenatal care is imperative as a preventive step to educate women about the dangers of severe pre-eclampsia/eclampsia [7].Affordable and accessible antenatal care services should be available, where women are taught about the dangers of pre-eclampsia/eclampsia, ensuring early hospital presentations. This could help prevent complications and unnecessary loss of lives [7].

**2. Improving health care coverage and Quality**

Early and consistent antenatal care is essential for identifying high-risk pregnancies. Planned delivery after 36 weeks of gestation is effective in preventing maternal morbidity in women with pre-eclampsia [18]. Standardizing protocols and ensuring routine screening for blood pressure and proteinuria can enhance early diagnosis and intervention. Now to optimize care for preterm births and improve perinatal outcomes, neonatal intensive care units (NICUs) should be equipped with adequate facilities and trained staff, which are often lacking in low-resource settings [12]. For example, although preterm delivery and NICU admission rates were significantly higher in Canada compared to the current study, their perinatal mortality was much lower [12]. Furthermore, neonatal care facilities must be improved to enhance outcomes. Neonatal health should be placed on the global agenda, receiving the same attention as maternal health [7]. The adequate use of existing interventions and surveillance of related indicators have great potential to prevent stillbirths, particularly in Latin American and Caribbean countries [13], which means that applying what is already existing can make a huge difference if consistent and successfully followed.

**3. Training and empowering healthcare providers**

Many interventions have been trialed globally to improve pre-eclampsia care on a healthcare system level [6]. These interventions include: (1) the immediate availability of clinical protocols for treating pre-eclampsia within relevant clinical areas and (2) multidisciplinary team training in emergency pre-eclampsia care [6]. The effectiveness of training in obstetric emergency care has been studied across various global contexts and has emerged as a key intervention to reduce maternal and neonatal mortality. In several global settings, initiatives have standardized this type of training on a national basis [6]. Training and support for healthcare workers, strengthening health systems, and providing counselling for pregnant women are examples of investments aimed at preventing stillbirths [13].

**4. Utilizing Risk Prediction Models**

Risk prediction models have shown great successes over the past years. Ukah et al. highlighted that simple tests to predict severe early-onset preeclampsia could improve management and outcomes, especially in low-resource settings by enabling earlier referrals [16]. The fullPIERS model by von Dadelszen et al. effectively predicted adverse maternal outcomes in hypertensive pregnancies, with an AUROC (Area Under the Receiver Operating Characteristic) of 0.88, sensitivity of 76%, and specificity of 87%. It remained accurate for up to 48 hours, allowing time for interventions like corticosteroids or transfer [16]. Both internal and external validations confirmed its reliability across gestational ages [16]. Early identification of high-risk women may help prevent complications through timely care [16].

**5. Improving Access to Essential Medications**

Administration of magnesium sulfate more than halves the risk of eclampsia in women with pre-eclampsia (WHO). It is considered an essential drug by the WHO, although data on its availability and its relationship with the prevalence of eclampsia are scarce [18]. Ensuring the availability of magnesium sulphate and encouraging its use is a simple step but has promising results.

Use of magnesium sulfate to prevent eclampsia, combined with timely delivery, remains a critical strategy to reduce maternal and perinatal mortality from hypertensive disorders of pregnancy at the facility level [18]. Magnesium sulfate has been shown to significantly decrease the risk of eclampsia (by more than half) and the risk of placental abruption (more than half) when compared with placebo or no anti-convulsant (WHO) [3].

Another common medication is low dose aspirin. Its affordability and availability over the counter make it a practical and cost-effective as a preventive strategy, especially in low- and middle-income countries where other interventions may be less accessible. The Collaborative Low-dose Aspirin Study in Pregnancy (CLASP) suggested that aspirin could effectively reduce the risk of recurrent early-onset pre-eclampsia when administered before 32 weeks of gestation [16].

**6. Innovative Approaches for Rural and Remote Areas**

In recent years and due to the constant strain and difficulties faced in low and middle income countries many innovative ideas have been implemented like for instance The Healthy Pregnancy initiative which proposes a strategy to improve prenatal care by providing equipment, training, and supervision to nurses responsible for prenatal care in rural areas [4]. This case study shows that with this strategy, nursing staff can identify and refer most obstetric risks in time, thereby contributing to the reduction of maternal mortality. The "Healthy Pregnancy" project enables timely detection of key obstetric complications, facilitating the referral of pregnant women at high risk of maternal and neonatal mortality. In this regard, this project has contributed to the improvement of prenatal care in rural areas [4].

Another interesting intervention for early detection of preeclampsia is a wristband that comfortably and snugly quantifies the expansion caused by edema called “mom-edema-meter”, When measurements reach a specific threshold, women are advised to seek further medical care [2]. Applying such applicable interventions can alter the outcomes greatly, reducing the burden and saving lives.

**7. Policy and Health System Strengthening**

Sustainable prevention requires investment in maternal health systems, clear national guidelines, and collaboration between governments, NGOs, and international partners to ensure equity in care. Identifying and investigating the causes of fetal death would allow for systematic management, potentially reducing the prevalence of fetal death and the associated risk in future pregnancies [13]. Despite the alarming rates, research into stillbirth and the implementation of effective solutions has been particularly sparse in low- resource settings [14]. So, in general, encouraging research related to preeclampsia will allow each country to find the gaps in their healthcare system and this can become a first step to find shortcoming and provide good quality health care.

Moreover, addressing these issues requires improving healthcare infrastructure, enhancing access to prenatal care, and implementing more effective management protocols to reduce the impact of pre-eclampsia/eclampsia on maternal and fetal health [5]. Developing and rigorously evaluating culturally appropriate interventions for early detection, risk stratification, and management of pre-eclampsia/eclampsia is essential [5]. Such interventions can significantly improve maternal and fetal outcomes [5]. Additionally, exploring the feasibility and effectiveness of implementing national public health programs focused on pre-eclampsia/eclampsia prevention and awareness campaigns holds promise for broader population-level impact [5]. Standardizing diagnostic criteria and reporting methods across healthcare facilities is also crucial for accurate national burden assessment [5].

Providing global policymakers with insights into how to address one of the major contributors to maternal and neonatal morbidity and mortality is crucial [7]. Global efforts must involve developmental aid and debt relief for poorer countries to ensure that funds are directed toward maternal and neonatal health issues [7]. Tackling such complex issues requires global efforts from various stakeholders, including brainstorming teams, field experts, financial institutions, health organizations, governments, and international organizations [7].

It is important to move away from the current approach of either "vertical" programs—focused solely on disease-specific targets—or "horizontal" programs, which aim only to resolve health system issues. A "diagonal approach" is recommended, where both disease prevention and health system strengthening are pursued simultaneously [3].

**Conclusion**

Preeclampsia remains a significant contributor to maternal, fetal, and placental morbidity and mortality, especially in low- and middle-income countries where healthcare resources are limited. The complications associated with this condition are severe and far-reaching, yet many are preventable with timely identification, appropriate monitoring, and strategic interventions. This review highlights the urgent need for resource-appropriate strategies tailored to these settings. Moving forward, encouraging research and focusing on placental complications and early detection in community-based settings all this will be essential for reducing the burden of preeclampsia and improving outcomes for mothers and babies alike

**Limitations**

This review faced several limitations. Firstly, the available data does not comprehensively represent all low- and middle-income countries, with notable gaps in geographic and demographic coverage. Furthermore, much of the data included is not recent, with very few studies conducted within the past two years, which may limit the relevance of findings to current healthcare contexts.

A major limitation is the fragmented focus of existing literature many studies concentrate either on maternal or fetal outcomes, with minimal integrated analysis of both. Additionally, there is a significant lack of research dedicated to placental complications, which hinders a full understanding of the triad of maternal, fetal, and placental outcomes in preeclampsia. This imbalance limits the understanding of the full spectrum of preeclampsia outcomes in resource-constrained settings.

Additionally, a significant proportion of births in LMICs occur outside formal healthcare settings, such as in homes or under the care of traditional birth attendants. As a result, many cases of preeclampsia particularly those that do not escalate to severe complications go unreported, leading to underrepresentation in the data. Moreover, most documented cases reflect women who arrive late to care facilities, often already experiencing advanced or severe complications. This introduces a skew in the data, as early or mild cases are frequently missed, and the findings predominantly reflect the more critical end of the clinical spectrum.

Another concern is the variability in study designs, diagnostic criteria, and outcome definitions across the literature, making direct comparison and synthesis challenging. Many studies also lacked large sample sizes or were conducted in single-centre settings, limiting statistical power and external validity.

**References**

1. Atluri N, Beyuo TK, Oppong SA, Moyer CA, Lawrence ER. Challenges diagnosing and managing preeclampsia in a low-resource setting: A qualitative study of obstetric provider perspectives from Ghana. PLOS Glob Public Health. 2023 May 2;3(5):e0001790. doi:10. 1371/journal. pgph. 0001790.

2. Bender RM, Ryan GL. Pre-eclampsia and eclampsia: global challenges in low resource settings complete with proposed interventions in rural Haiti. Proc Obstet Gynecol. 2013;3(1):1 -6. doi:10. 17077/21 54-4751. 1205.

3. Salam RA, Das JK, Ali A, Bhaumik S, Lassi ZS. Diagnosis and management of preeclampsia in community settings in low and middle-income countries. J Fam Med Prim Care. 2015;4(4):501-6. doi:10. 4103/2249-4863. 174265

4. Crispín Milart PH, Prieto-Egido I, Díaz Molina CA, Martínez-Fernández A. Detection of high-risk pregnancies in low-resource settings: a case study in Guatemala. Reprod Health. 2019;16(1):80. doi:10. 1186/ s12978-019-0748-z.

5.Kokori E, Aderinto N, Olatunji G, Komolafe R, Babalola EA, Isarinade DT, et al. Prevalence and preeclampsia/eclampsia among pregnant women in Nigeria: a systematic review and meta-analysis. Eur J Med Res. 2024;29(1):1-11. doi:10. 1186/s40001-024-02086-x.

6.Nakimuli A, Akello J, Sekikubo M, Nakubulwa S, Adroma M, Nabuufu R, et al. Variations in emergency care for severe pre-eclampsia in Uganda: a national evaluation study. AJOG Glob Rep. 2025 Feb;5(1 ):100424. doi:10. 1016/j.xagr. 2024. 1 00424.

7.Ngwenya S. Severe preeclampsia and eclampsia: incidence, complications, and perinatal outcomes at a low-resource setting, Mpilo Central Hospital, Bulawayo, Zimbabwe. Int J Womens Health. 2017; 9:353-7. doi:10. 2147/1JWH.S131934.

8.Abdullahi FM, Tornes YF, Migisha R, Kalyebara PK, Tibaijuka L, Ngonzi J, et al. HELLP syndrome and associated factors among pregnant women with preeclampsia/eclampsia at a referral hospital in southwestern Uganda: a cross-sectional study. BMC Pregnancy Childbirth. 2024;24(1):626 doi:10. 1186/s12884-024-06835-y.

9. Gebremedhin H, Gebremichael H,Gebreyesus H, Gebregziabher H,Gebrehiwot H, Gebremariam H, et al. Clinical presentation, maternal-fetal, and neonatal outcomes of early-onset versus late onset preeclampsia-eclampsia syndrome in a teaching hospital in a low-resource setting: A retrospective cohort study. PLOS One. 2023;18(2): e0281952. doi:10. 1371/journal.pone. 0281952.

10. Nakimuli A, Starling JE, Nakubulwa S, Namagembe I, Sekikubo M,Nakabembe E, et al. Relative impact of pre-eclampsia on birth weight in a low resource setting: A prospective cohort study. Pregnancy Hypertens. 2020 Jul; 21:1-6. doi:10. 1016/ jpreghy. 2020. 04. 002.

11.Iftikhar G, Jabbar S, Huma Z, et al. Frequency of complications in patients with preeclampsia. Pak J Med Health Sci. 2020;14(3):1187-9.

12.Dassah ET, Kusi-Mensah E, Morhe ESK, Odoi AT. Maternal and perinatal outcomes among women with hypertensive disorders in pregnancy in Kumasi, Ghana. PLOS One. 2019;14(10):e0223478. doi:10. 1371/ journal.pone. 0223478.

13. de Mucio B, Sosa CG, Colomar M, Mainero L, Cruz CM, Chávez LM, et al. The burden of stillbirths in low resource settings in Latin America: Evidence from a network using an electronic surveillance system. PLOS One. 2023;18(12);:e0296002. doi:10. 1371/journal. pone. 0296002.

14.Angell JN, Abdul-Mumin AS, Gold KJ. Determining the cause of stillbirth in Kumasi, Ghana. Int J Gynaecol Obstet. 2019;147(2):173-8. doi:10. 1002/ijgo. 12930.

15.Gebrehiwet TG, Gebreyesus H,Gebremariam A, Gebremedhin A, Gebremichael H, Gebregziabher T, et al. Clinical presentation, maternal-fetal, and neonatal outcomes of early-onset versuslate-onset preeclampsia-eclampsia syndrome in a teaching hospital in a low-resource setting: A retrospective cohort study. PLOS One. 2023;18(2): e 0281 815. doi:10. 1371/ journal.pone. 0281815.

16.Ngwenya S, Jones B, Mwembe D, Nare H, Heazell A. Statistical risk prediction models for adverse maternal and neonatal outcomes in severe preeclampsia in a low-resource setting: proposal for a single-centre cross-sectional study at Mpilo Central Hospital, Bulawayo, Zimbabwe. BMC Res Notes. 2019;12(1):456. doi:10. 1186/ s13104-019-4539-y.

17. Kusuma W, Nurdiati DS, Supriyati D, et al. Alternatives of risk prediction models for preeclampsia in a low middle-income setting. Open Access Maced J Med Sci. 2022;1 O(E):1234-9. doi:10. 3889/oamjms. 2022. 9030.

18.Vousden N, Lawley E, Seed PT, Gidiri ME, Goudar S, Sandall J, et al. Incidence of eclampsia and related complications across 10 low- and middle-resource geographical regions: Secondary analysis of a PLOS Med. 2019;16(3):e1 002775. doi:10. 1371/journal.pmed. 1002775. cluster randomised controlled trial

19. Toledo-Jaldin, L., Bull, S., Contag, S., Escudero, C., Gutierrez, P., Heath, A., ... & Moore, L. G. (2019). Critical barriers for preeclampsia diagnosis and treatment in low-resource settings: An example from Bolivia. *Pregnancy hypertension*, *16*, 139-144.

20. Lakshmy, S., Ziyaulla, T., & Rose, N. (2021). The need for implementation of first trimester screening for preeclampsia and fetal growth restriction in low resource settings. *The Journal of Maternal-Fetal & Neonatal Medicine*, *34*(24), 4082-4089.