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Pre-eclampsia in Indian Pregnancy: Regional Disparities, Diagnostic Advances, and Community Solutions

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Abstract

Preeclampsia, a hypertensive disorder arising after 20 weeks of gestation, continues to pose a significant threat to maternal and perinatal health, particularly in India where prevalence ranges from 5% to 10%. This study synthesizes recent (2020 to 2025) evidence on the epidemiology, biological mechanisms, sociocultural determinants, and health system responses to preeclampsia in India, with global comparisons. A structured review of peer reviewed literature, national surveys, and policy documents reveals persistent gaps in antenatal care coverage, early detection, and facility level risk screening, particularly in rural and socioeconomically disadvantaged populations. While innovations such as first trimester risk assessment using PlGF and uterine Doppler, telemedicine, and community health worker training show promise, systemic improvements including adoption of standardized screening protocols and perinatal audit mechanisms are essential. Culturally tailored education, infrastructure investment, and conditional health financing are recommended to address disparities and improve outcomes.

1. Introduction

Pre-eclampsia, defined by hypertension (140/90 mm Hg) and proteinuria (0.3 g/24 h) or end-organ signs after 20 weeks' gestation, complicates 2–8% of pregnancies worldwide and accounts for up to 46 000 maternal deaths and 500 000 fetal losses annually [(1)]. In high-income countries, standardized screening and management have driven rates to 3–5/1 000 births; low- and middle-income nations average 25/1 000 births, reflecting stark inequities.

In India, hypertensive disorders of pregnancy (HDP) affect approximately 11% of pregnant women aged 15–49, per NFHS-5 (2019–21). Yet facility-based incidence of pre-eclampsia ranges from 5% to 10%, and eclampsia persists in 0.5–1.8% of deliveries—variations driven by under-reporting, definitional inconsistencies, and urban–rural disparities[(9)(10)(11)]. Northern and rural states (e.g., Bihar, Madhya Pradesh) report stillbirth and pre-eclampsia rates 3–4 times those in Kerala and Tamil Nadu, where tertiary centers ensure 24/7 obstetric coverage and blood-bank support[(4)].

Global Context and Definitions:

Pre-eclampsia pathophysiology centers on defective trophoblastic invasion of spiral arteries, triggering placental ischemia, systemic endothelial dysfunction, and multi-organ involvement (renal, hepatic, neurologic). Early-onset pre-eclampsia (34 weeks) carries greater perinatal risk, with perinatal death rates of 25.6% in India cohorts versus 36.9% in Tanzania[3]. Histopathologically, preeclamptic placentas show infarcts, atherosis, and syncytial knots, while immunohistochemistry reveals dysregulated angiogenic factors (sFlt-1, PlGF).

Indian Demographics and Statistics:

NFHS-5 data highlight that while 94% of pregnancies are registered early, only 59% of women attend 4 ANC visits; 14.3% receive suboptimal ANC content despite 4 visits, and WHO's
8-visit model reaches 10% of mothers. Hypertension prevalence increases with maternal age, obesity (BMI > 23), diabetes, and low education—predictors identified via NFHS-5 probit regression analyses[11].

Cultural and Social Context:

Sociocultural barriers—stigma around intimate health examinations, beliefs linking ultrasound to fetal harm, and loss of virginity fears—delay antenatal uptake, especially among adolescents and unmarried women. Traditional birth attendants remain primary caregivers in remote areas, compounding risks of undiagnosed pre-eclampsia. Indigenous language IEC materials and involvement of male community leaders have shown promise in enhancing ANC attendance.

Problem Statement and Research Objectives:

Despite India's Newborn Action Plan target of 10 pre-eclampsia stillbirths per 1 000 births by 2030, progress is uneven. This review aims to:

1. Quantify pre-eclampsia incidence and regional variations.
2. Examine biological, sociocultural, and health-system determinants.
3. Contrast Indian practice with global benchmarks.
4. Recommend culturally appropriate, feasible interventions for stakeholders.

Scope and Limitations:

Focusing on publications from 2020–July 2025, this review integrates peer-reviewed case series, RCTs, and government data. Limitations include reliance on facility-based studies in tertiary centers and under-representation of community-level data.

2. Methodology

Research Design and Approach:

A qualitative systematic review synthesizing clinical, epidemiological, and policy literature on pre-eclampsia, emphasizing the Indian context.

Database Search Strategy:

Keywords: "preeclampsia India prevalence," "pre-eclampsia management India," "ISSHP preeclampsia guidelines," "PMSMA high-risk pregnancy," and "NFHS-5 hypertension pregnancy." Databases: PubMed, Scopus, Web of Science, NFHS-5 reports, HMIS, WHO, MoHFW.

Inclusion/Exclusion Criteria:

- Inclusion: 2020–2025 peer-reviewed clinical studies, RCTs (aspirin, calcium), government guidelines (NHM, PMSMA, NPCDCS), professional guidelines (ISSHP, ACOG), NFHS-5/SRS data.
- Exclusion: pre-2020 studies, animal models, non-peer-reviewed news articles.

Data Extraction and Synthesis:

Two reviewers independently screened titles/abstracts and extracted data on incidence, risk factors, diagnostic modalities, management protocols, outcomes, and contextual factors (region, socioeconomic status, health-system capacity). Discrepancies resolved by consensus.

Data Analysis Framework:

Thematic categorization into:

1. Biological/technical factors and evidence.
2. Sociocultural challenges.
3. Current system response and gaps.
4. Innovative solutions and best practices.

Timeline and Scope:

Search conducted June–July 2025; inclusion cutoff June 30, 2025. Focus on India, supplemented by global comparative data.

3. Discussion

3.1 Biological/Technical Factors and Evidence

- **Pathogenesis and Classification:** High-risk profiles include early onset (□34 weeks), severe features (BP 160/110 mm Hg), and lab markers (thrombocytopenia, liver enzyme elevation). ISSHP's revised classification eliminates edema and focuses on organ dysfunction[8].
- **Diagnostics:** First-trimester screening combining maternal factors, MAP, PlGF, and uterine artery Doppler identifies candidates for prophylactic aspirin (150 mg nightly) with □62% reduction in preterm pre-eclampsia [12][8].

- **Laboratory and Imaging:** Regular BP monitoring (K5 Korotkoff), proteinuria assessment by ACR, and transperineal ultrasound for fetal growth restriction; Doppler velocimetry referral if umbilical artery PI 95th percentile.
- **Management Algorithms:** Chronic hypertension versus gestational hypertension versus pre-eclampsia:
    - Chronic hypertension: baseline evaluation (CBC, LFT, RFT, uric acid, renal ultrasound); continue methyldopa or labetalol[13].
    - Gestational hypertension: target BP 140–150/85–100 mm Hg, deliver at 39–40 weeks if stable[14].
    - Preeclampsia: magnesium sulfate for seizure prophylaxis; delivery at 37 weeks or earlier if severe features; corticosteroids for fetal lung maturity if 34 weeks[14].

3.2 Sociocultural Challenges Specific to India

- **Stigma and Beliefs:** Reluctance for abdominal/vaginal exams, misconceptions about ultrasound harming fetus, virginity concerns among unmarried adolescents.
- **Regional Disparities:** Northern/rural states: limited obstetric teams, scarce blood banks, lower ANC quality; Southern states: robust tertiary care, standardized protocols.
- **Socioeconomic Barriers:** Out-of-pocket ultrasound costs (INR 1 500–2 500) and MRIs (INR 10 000–15 000) exclude low-income women, leading to reliance on clinical diagnosis and delayed referral.
- **Traditional Practices:** Home deliveries with untrained birth attendants; herbal or faith-based remedies delaying medical care.

3.3 Current Health-System Response and Gaps

- **Data and Surveillance:** SRS undercounts stillbirths and HDP by □60% due to verbal-autopsy limitations; NFHS-5 data more accurate for hypertension prevalence but lacks pre-eclampsia subcategorization [15][11].
- **Guidelines and Protocols:** NHM implements PMSMA (monthly high-risk antenatal screening), JSSK (free diagnostics), and LaQshya (labour room QI); however, adherence to ISSHP and ACOG recommendations is inconsistent across states[7][16].
- **Human Resources and Training:** Shortage of obstetricians (0.2 vs 1.5/10 000 pop., rural vs urban); limited CME on HDP; inadequate simulation-based training in primary centers[17].
- **Referral Pathways:** Multi-level delays—recognition (low awareness), transport (poor roads), facility readiness (lack of HDU/HDU-ICU), leading to high intrapartum stillbirths (20% in district hospitals) [18].
- **Community Engagement:** Fragmented IEC/BCC efforts; ANC messaging often generic, not HDP-specific; variable ASHA and ANM uptake of high-risk checklists.

3.4 Innovative Solutions and Best Practices

- **First-Trimester Risk Screening:** Integrate free PlGF kits and uterine Doppler at FRUs to stratify aspirin prophylaxis[8].
- **Diagnostic Algorithms at PHCs:** Standardize transperineal ultrasound at 28 weeks to detect FGR; tele-ultrasound linking PHC to tertiary radiology[4].
- **Capacity Building:**
  - CME modules on HDP for ASHAs, ANMs, MBBS doctors.
  - Simulation-based training in fetal monitoring (CTG interpretation) and neonatal resuscitation.
- **Telemedicine and Digital Health:**
  - Safe Delivery App integration for remote monitoring of BP and proteinuria.
  - Virtual perinatal mortality meetings across districts.
- **Community Outreach:**
  - Culturally tailored IEC in local languages (Hindi, Bengali, Telugu, Kannada) on danger signs and fetal-movement counting.
  - Involve male champions and elder women for stigma reduction.
- **Policy and Financing:**
  - Incorporate pre-eclampsia as independent NHM indicator with performance-based conditional grants.
  - PPPs to subsidize rural access to ultrasound and Doppler.
- **Research and Surveillance:**
  - Establish a national HDP registry under MoHFW capturing incidence, management, outcomes.
  - Prospective cohort studies on air pollution's effect on preeclampsia.

4. Conclusion

India's pre-eclampsia burden—affecting 5–10% of pregnancies and contributing to 20% of maternal deaths—remains above global targets despite declines in maternal mortality. Biological drivers include placental malperfusion, hypertensive disorders, and immunologic factors; perinatal risks include FGR, preterm birth, and stillbirth. Under-reporting in routine systems (SRS) underestimates incidence; NFHS-5 indicates 11% hypertension prevalence but lacks detailed HDP data.

Implications for Stakeholders:

- **Healthcare Professionals:**
  - Implement ISSHP-aligned classification; screen high-risk women first trimester for aspirin prophylaxis.
  - Integrate standardized BP measurement (K5), proteinuria testing (ACR), and transperineal ultrasound in routine ANC.
  - Participate in simulation-based training and virtual morbidity-mortality reviews.
- **Policymakers:**
  - Mandate facility-level HDP audits under HMIS; link conditional NHM funds to pre-eclampsia reduction metrics.
  - Invest in rural imaging infrastructure and tele-obstetrics networks; subsidize essential HDP diagnostics.
- **Researchers:**
  - Leverage registry data to study pathogenesis, evaluate telemedicine efficacy, and examine environmental modifiers.
  - Conduct RCTs comparing aspirin dosages (75 vs 150 mg) and timing across Indian subpopulations.
- **Community Health Workers:**
  - Promote fetal-movement awareness, birth preparedness, and stigma reduction via local-language IEC.
  - Ensure high-risk women receive PMSMA screening and follow-up.

Future Research Directions:

1. Molecular profiling of pre-eclampsia cohorts for novel biomarkers.
2. Prospective evaluation of integrated tele-ultrasound and remote BP monitoring in PHCs.
3. Impact assessments of performance-based financing on HDP outcomes.

Policy Recommendations:

1. **Data Systems:** Harmonize HDP definitions; integrate pre-eclampsia indicators and audits into HMIS; establish national registry.
2. **Service Delivery:** Scale up 24/7 emergency obstetric and Doppler services at CHCs; implement tele-medicine for remote interpretation.
3. **Human Resources:** Deploy obstetricians and midwives to rural areas; mandate simulation-based HDP training.
4. **Community Engagement:** Develop culturally sensitive, gender-transformative IEC in multiple languages; engage male/community leaders.

5. **Financing:** Allocate dedicated NHM funds for HDP diagnostics; partner with private sector to subsidize equipment and supplies.

Bridging global best practices with India's diverse realities through multisectoral collaboration, targeted investments, and culturally attuned interventions can accelerate declines in pre-eclampsia and improve maternal–newborn health, advancing India toward its SDG and ENAP commitments by 2030.

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