"STUDY OF HIGH SENSITIVITY C-REACTIVE PROTEIN (hs-CRP) LEVELS IN EARLY AND LATE ONSET PRE ECLAMPSIA IN A TERTIARY CARE HOSPITAL: A ONE-YEAR CROSS-SECTIONAL STUDY".

BY

REG. NO. BJ0122002

Dissertation

Submitted to
KAHER, Belagavi, Karnataka,
In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY (M.S)
In
OBSTETRICS AND GYNAECOLOGY

JAWAHARLAL NEHRU MEDICAL COLLEGE,
BELAGAVI, KARNATAKA

SEPTEMBER/OCTOBER- 2025

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH, BELAGAVI, KARNATAKA

Endorsement

This is to certify that the dissertation entitled **"STUDY OF HIGH SENSITIVITY C-REACTIVE PROTEIN (HS-CRP) LEVELS IN EARLY AND LATE ONSET PREECLAMPSIA IN A TERTIARY CARE HOSPITAL: A ONE-YEAR CROSS-SECTIONAL STUDY".** 'is a bonafide research work done by **REG. NO. BJ0122002.**

Dr. YESHITA V PUJAR MD,
Professor and Head,
Department of Obstetrics and Gynaecology,
J. N. Medical College,
Nehru Nagar, Belagavi – 10
Dr. Yeshita. V. Pujar
Consultant OBG
KMC Reg. No. 39908
KLES Dr. Prabhakar Kore Hospital &
MRC, Belagavi - 590 010
Date: 09/04/2025
Place: Belagavi

Dr. N. S. MAHANTSHETTI MD
Principal,
J. N. Medical College,
Nehru Nagar,
Belagavi – 10
PRINCIPAL
Jawaharlal Nehru Medical College
BELAGAVI
Date:
Place: Belagavi

UNDERTAKING

I, **REG.NO.BJ0122002,** hereby declare that the information and the data mentioned in my dissertation **"Study of High Sensitivity C-Reactive Protein (hs-CRP) Levels in Early and Late Onset Preeclampsia in a Tertiary Care Hospital: A One-Year Cross-Sectional Study".** bclongs to me and is original.

I am aware of the definition of plagiarism as detailed below:

- An act or instance of using or closely imitating the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author.
- A piece of writing or other work reflecting such unauthorized use or imitation.
- The deliberate or reckless representation of another's words, thoughts or ideas as one's own without attribution in connection with submission of academic work, whether graded or otherwise.

I hereby declare that the thesis prepared by me is original one and does not involve plagiarism anywhere. In case at a later stage, it is found that I have indulged in plagiarism, then I am solely responsible for the same and the institution is at liberty to take any disciplinary action against me including cancellation of dissertation or any other penalties imposed by the University.

Date: 11/04/2025

Place: Belagavi

REG. NO. BJ0122002

PLAGIARISM ACCEPTED LETTER

JAWAHARLAL NEHRU MEDICAL COLLEGE

(A constituent unit of KLE Academy of Higher Education & Research Deemed-to-be-University)

(Recognized by National Medical Commission, New Delhi)

Accredited 'A+' Grade by NAAC (3rd Cycle) **Placed in Category 'A' by MoE (GoI)**

Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA

0831 – 2471350 0831 – 2470759 www.jnmc.edu principal@jnmc.edu

Ref No: MDC/PG/ Date: 07-04-2025

"ACCEPTANCE LETTER"

The softcopy of thesis entitled: **"STUDY OF HIGH SENSITIVITY C-REACTIVE PROTEIN (HS-CRP) LEVELS IN EARLY AND LATE ONSET PREECLAMPSIA IN A TERTIARY CARE HOSPITAL: A ONE-YEAR CROSS-SECTIONAL STUDY"** has been submitted for anti-plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of **09%** which is within the acceptable limits of **10%** as per the guidelines given by UGC.

Guide.

KAHER BELAGAVI J.N. MEDICAL COLLEGE

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
Reg. No. BJ0122002
Postgraduate Student,
2022-23 Batch,
Department of Obst. & Gynaecology
J. N. Medical College, Belagavi.

ETHICAL CLEARANCE LETTER

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A+' Grade by NAAC in (3rd Cycle) Placed in Category 'A' by MHRD (GoI)
JNMC INSTITUTIONAL ETHICS COMMITTEE
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http//www.jnmc.edu
E-Mail : dome@jnmc.edu
Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref No.MDC/JNMCIEC/ 207 **Date: 28/04/2023**

To

REG. NO. BJ0122002

PG Student in Obstetrics And Gynaecology
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"STUDY OF HIGH SENSITIVITY C-REACTIVE PROTEIN (HS-CRP) LEVELS IN EARLY AND LATE ONSET PRE ECLAMPSIA IN A TERTIARY CARE HOSPITAL – ONE YEAR CROSS SECTIONAL STUDY",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

(Dr. Smita Sonoli)
Member Secretary
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi.

(Dr. Harsha Hegde)
Chairman,
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi

LIST OF ABBREVIATIONS

1. **hs-CRP** - high sensitivity C-reactive protein
2. **CRP** - C-Reactive Protein
3. **GDM** - Gestational Diabetes Mellitus
4. **IUGR** - Intrauterine Growth Restriction
5. **FGR** Fetal Growth Restriction
6. **SBP**- Systolic Blood Pressure
7. **DBP**- Diastolic Blood Pressure
8. **MAP**- Mean Arterial Pressure
9. **IQR**- Inter Quartile Range
10. **PlGF**- Placental growth factor
11. **sFlt-1**- Soluble fms- like tyrosine kinase-1
12. **ROS**- Reactive Oxygen Species
13. **VEGF**- Vascular Endothelial Growth Factor
14. **PVR**- Peripheral vascular resistance
15. **AGA**- Appropriate for Gestational Age
16. **LGA**- Large for Gestational Age
17. **PIH**- Pregnancy Induced Hypertension
18. **SNPs**- Single Nucleotide Polymorphisms
19. **Lp-PLA2**- Lipoprotein- associated Phospholipase A2
20. **DIC**- Disseminated Intravascular Coagulopathy
21. **HELLP**- Hemolysis, Elevated Liver enzymes, Low Platelet count

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

ABSTRACT

Background: Pre eclampsia remains a significant cause of maternal and perinatal morbidity and mortality worldwide, with early onset preeclampsia often leading to more severe complications than late onset preeclampsia. Systemic inflammation plays a central role in the pathogenesis of preeclampsia. High-sensitivity C-reactive protein (hs-CRP), a sensitive inflammatory biomarker, has been proposed as a potential tool to assess disease severity and predict fetomaternal outcomes.

Objective: To compare hs-CRP levels between early and late onset pre eclampsia and evaluate its association with maternal and fetal outcomes.

Methods: This was a prospective cross-sectional study conducted over one year at KLE's Dr. Prabhakar Kore Hospital, Belagavi. A total of 101 antenatal women diagnosed with preeclampsia were enrolled and categorized into early onset (<34 weeks; N=42) and late-onset (≥34 weeks; N=59) groups. Maternal hs-CRP levels were measured using immunoturbidimetry. Clinical parameters, laboratory investigations, and fetal outcomes, including fetal growth restriction (FGR), umbilical artery doppler findings, mode of delivery, NICU admission, and birth weight, were compared between the groups.

Results: The mean hs-CRP level across the cohort was 7.32 ± 8.59 mg/L, exceeding the normal threshold. Although hs-CRP levels were higher in early onset pre eclampsia (median: 6.2 mg/L) than in late onset (median: 4.7 mg/L), the difference was not statistically significant ($p = 0.428$). Early onset pre eclampsia was significantly associated with severe disease ($p = 0.024$), higher systolic blood pressure ($p = 0.036$), and elevated markers of renal and hepatic dysfunction. Statistically significant associations were observed between elevated hs-CRP and fetal growth restriction ($p < 0.001$), abnormal umbilical artery doppler findings ($p < 0.0001$), and increased NICU admissions ($p < 0.05$),

particularly in the early onset pre eclampsia group. No significant association was found between hs-CRP levels and mode of delivery.

Conclusion: Although hs-CRP levels did not significantly differ between early and late onset pre eclampsia, elevated levels were associated with adverse fetal outcomes, particularly in early onset cases. hs-CRP may serve as a supportive biomarker for identifying high-risk pregnancies and guiding closer surveillance. Further longitudinal studies are warranted to validate its predictive utility and determine gestational age–specific thresholds for clinical application.

Keywords: Pree clampsia, hs-CRP, Early onset, Late onset, systemic inflammation, Fetal growth restriction, Umblical artey doppler, Fetal outcomes, Maternal outcomes.

INTRODUCTION

Hypertensive disorders of pregnancy represent a significant cause of maternal and perinatal morbidity and mortality worldwide and affect an estimated 5–10% of pregnancies [1]. Among these conditions, pre eclampsia is of particular concern because it often emerges after 20 weeks of gestation with new-onset hypertension accompanied by proteinuria or other systemic manifestations. The high prevalence of pre eclampsia, with its likelihood of potentially severe complications in both the mother and neonate, underscores the urgency to improve our knowledge of the etiology and clinical management [2]. While maternal mortality has improved in some regions with better access to obstetric care, pre eclampsia is still the main cause of adverse pregnancy outcomes, especially in low-resource settings, where often screening and timely interventions cannot be readily undertaken.

Pre eclampsia is often classified by gestational age at onset, defined as early onset if it occurs before 34 weeks and late onset if it occurs at or after 34 weeks [3]. Early onset disease is generally more severe, often associated with abnormal placentation and higher rates of intrauterine growth restriction, whereas late onset pre eclampsia may be more related to maternal cardiometabolic risk factors [4]. This subunit explains the heterogeneous nature of pre eclampsia, in which there is a need for finding consistent biomarkers that might help in differentiation of these subtypes and influence clinical decision making [5]. Early or late onset pre eclampsia remains the cause of maternal complications, like renal impairment and chronic hypertension with an increased future risk of cardiovascular diseases and bad neonatal outcome like low birth weight and prematurity [6].

The prevailing model of pre eclampsia pathogenesis centers on defective trophoblastic invasion of maternal spiral arteries, resulting in a failure of sufficient

placental perfusion and ischemia [7]. Normally, these arteries are remodeled into low-resistance vessels to support the developing fetus. In pre eclampsia, inadequate remodeling precipitates local hypoxia and oxidative stress, triggering the release of anti-angiogenic and pro-inflammatory mediators into the maternal circulation[8]. Endothelial cell dysfunction subsequently ensues, manifesting clinically as hypertension and potential end-organ effects [9]. This systemic vascular upheaval explains why pre eclampsia can affect the liver, kidneys, central nervous system, and coagulation pathways. Immune maladaptation and chronic inflammation also appear integral to the disease, creating a cycle that perpetuates endothelial damage and worsens clinical outcomes [10].

An extensive body of work has established that inflammatory processes play a pivotal role in pre eclampsia, reflected by raised levels of cytokines, chemokines, and other inflammatory biomarkers [11]. As such, research has increasingly focused on finding a sensitive index of the underlying inflammatory state that could offer prognostic information. Pre eclampsia's overlap with vascular and inflammatory conditions outside pregnancy suggests that markers used in other fields—particularly cardiovascular medicine—may be relevant. Indeed, the pathophysiology of endothelial dysfunction in atherosclerotic disease and pre eclampsia exhibits some striking parallels, paving the way for exploring shared biomarkers that might predict or indicate disease severity.

High-sensitivity C-reactive protein (hs-CRP), a refined assay for the acute-phase reactant C-reactive protein, has shown promise in this context [12]. CRP is synthesized primarily in the liver under the stimulation of pro-inflammatory cytokines such as interleukin-6, and it offers a snapshot of the body's acute inflammatory status. Traditional CRP measurements may lack the sensitivity to detect subtle rises in

inflammation, but the high-sensitivity assay can identify even minor elevations in CRP levels, which may be clinically meaningful [13]. In non-pregnant populations, hs-CRP has emerged as a reliable predictor of cardiovascular events, at times proving as valuable as lipid profiles in stratifying risk. Because pre eclampsia also involves systemic endothelial dysfunction and a heightened inflammatory milieu, hs-CRP has naturally attracted attention as a potential biomarker for this hypertensive disorder [14].

Several studies indicate that hs-CRP levels are higher in women with pre eclampsia than in normotensive pregnant women, suggesting that its elevation might precede or coincide with the onset of clinical symptoms [15]. However, the precise utility of hs-CRP—particularly its ability to differentiate between early onset and late onset pre eclampsia—remains an area of active investigation. Early identification of women at risk could prove pivotal in optimizing antenatal surveillance, guiding treatments such as low-dose aspirin, and anticipating complications that may require urgent delivery [16]. If hs-CRP consistently correlates with the severity of disease, it may also serve as a prognostic tool, informing clinicians about the likelihood of adverse maternal or neonatal outcomes [17].

The potential value of hs-CRP is amplified in low-resource regions where sophisticated tests like placental growth factor or soluble fms-like tyrosine kinase-1 may be cost-prohibitive or unavailable [18]. This raises the possibility that an economical and widely accessible biomarker could transform early detection and management of pre eclampsia in settings with limited healthcare infrastructure [19]. Even in well-resourced environments, hs-CRP could complement existing clinical assessments and laboratory evaluations, especially if used in conjunction with blood pressure monitoring, proteinuria analysis, and fetal growth assessments. Nevertheless,

it is important to interpret hs-CRP values within the broader clinical context, as confounding factors such as obesity, infections, and other inflammatory conditions may elevate CRP levels independently [20].

Despite promising data on the association between hs-CRP and pre eclampsia, key questions remain. Much of the available evidence stems from cross-sectional or case-control studies, limiting our ability to determine whether elevated hs-CRP predicts disease onset or merely reflects existing pathology [21]. Further research is warranted to validate hs-CRP as a robust and early indicator of pre eclampsia, to clarify its role in distinguishing early-onset from late-onset disease, and to define appropriate cutoff levels that can guide clinical decisions [22]. Large-scale prospective studies could elucidate the biomarker's trajectory throughout gestation, identify thresholds for intervention, and explore how maternal characteristics—such as age, metabolic health, and genetic predisposition—might influence hs-CRP levels [23].

If the inflammatory underpinnings of pre eclampsia can indeed be captured by hs-CRP, this biomarker might also help identify therapeutic targets. Anti-inflammatory interventions, such as specific cytokine inhibitors or other immune-modulating treatments, could be explored, particularly for women who exhibit marked hs-CRP elevations [24]. Personalized medicine is increasingly shaping obstetric practice, and biomarkers that predict disease could lead to individualized plans, from the timing of delivery to the use of preventive strategies. Ultimately, reducing the global burden of pre eclampsia necessitates interventions that are both cost-effective and broadly accessible. Hence, a deeper understanding of how hs-CRP correlates with disease onset and progression might not only refine diagnostic precision but also support risk stratification efforts in a variety of clinical settings [25].

In this context, the present inquiry aims to explore the significance of hs-CRP in early-onset versus late-onset pre eclampsia. By comparing hs-CRP levels in these groups and correlating them with maternal and fetal outcomes, we hope to determine whether this biomarker can offer meaningful prognostic insights. If hs-CRP proves to be a reliable indicator of disease severity and clinical trajectory, it could be integrated into current antenatal care protocols, offering a practical and economical tool for risk assessment. Such a development would be especially valuable for regions where resource constraints preclude the use of more complex tests. Overall, hs-CRP stands at the intersection of inflammation and vascular dysfunction, uniquely positioned to illuminate the pathophysiology of pre eclampsia and, perhaps, to facilitate more targeted strategies for intervention and prevention.

Need for the study

Pre eclampsia is a significant hypertensive disorder of pregnancy, affecting approximately 8% of all gestations and contributing to substantial maternal and perinatal morbidity and mortality worldwide. It is characterized by the onset of hypertension and proteinuria after 20 weeks of gestation in previously normotensive women. Despite advances in obstetric care, pre eclampsia remains a leading cause of maternal and fetal complications, including preterm birth, fetal growth restriction, and maternal organ dysfunction.[27]

The pathophysiology of pre eclampsia involves poor placentation, leading to hypoxia, oxidative stress, and a systemic inflammatory response. This inflammatory response is marked by the release of biomarkers such as high-sensitivity C-reactive protein (hs-CRP), which is a sensitive indicator of inflammation and tissue damage.

Elevated hs-CRP levels have been associated with various inflammatory conditions, including cardiovascular diseases, and recent studies suggest a potential role in pre eclampsia. However, the relationship between hs-CRP levels and the severity of pre eclampsia, particularly in differentiating early-onset (before 34 weeks) and late-onset (after 34 weeks) pre eclampsia, remains poorly understood.[28]

Early-onset pre eclampsia is often associated with more severe maternal and fetal outcomes due to its link with placental insufficiency, while late-onset pre eclampsia is generally milder but still poses significant risks. Current diagnostic and prognostic tools for pre eclampsia rely on clinical symptoms and standard biomarkers, which may not always provide early or accurate predictions of disease severity or outcomes. hs-CRP, being a cost-effective and widely available biomarker, could serve as a valuable tool for early detection and risk stratification in pre eclampsia, especially in low-resource settings where advanced diagnostic tools like placental growth factor (PlGF) and soluble fms-like tyrosine kinase-1 (sFlt-1) are not readily accessible.[28]

Despite the potential of hs-CRP as a prognostic marker, there is a lack of comprehensive studies comparing hs-CRP levels in early and late-onset pre eclampsia and their correlation with fetomaternal outcomes. This gap in knowledge limits the ability to utilize hs-CRP effectively in clinical practice for risk assessment and management of pre eclampsia. Therefore, this study aims to investigate the levels of hs-CRP in early and late-onset pre eclampsia and evaluate its association with maternal and fetal outcomes. By doing so, the study seeks to determine whether hs-CRP can serve as a reliable prognostic marker for pre eclampsia, enabling early intervention and improved management strategies to reduce adverse outcomes.[28]

This study addresses a critical gap in the understanding of the role of hs-CRP in pre eclampsia, particularly in differentiating early and late-onset cases. By establishing a correlation between hs-CRP levels and fetomaternal outcomes, the study aims to provide evidence for the use of hs-CRP as a prognostic tool in clinical practice. This could lead to earlier detection of severe pre eclampsia, timely interventions, and improved maternal and neonatal outcomes, especially in resource-limited settings where access to advanced diagnostic tools is limited. Additionally, the findings could contribute to the development of standardized guidelines for the use of hs-CRP in the management of pre eclampsia, ultimately reducing the global burden of this condition.[29]

AIMS AND OBJECTIVES

Primary Objective:

- To study and compare maternal hs-CRP levels in early and late onset pre eclampsia.

Secondary Objective:

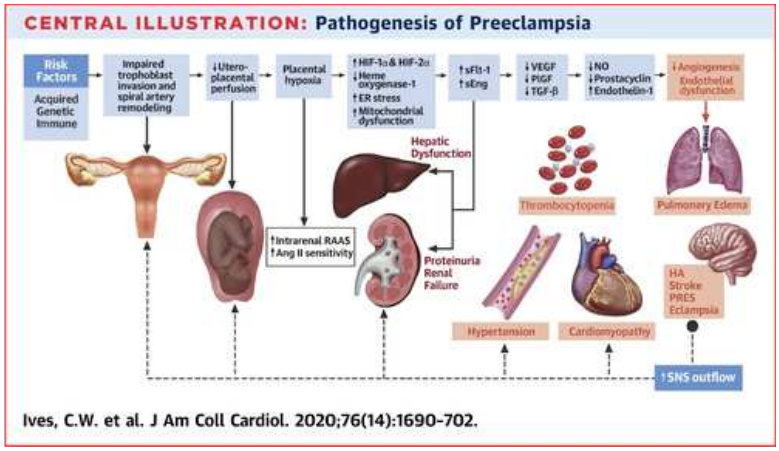
- To study the fetomaternal outcome in patients with raised hs-CRP levels.

REVIEW OF LITERATURE

High-Sensitivity C-Reactive Protein (hs-CRP):

High-sensitivity C-reactive protein (hs-CRP) is a refined version of the conventional C-reactive protein (CRP) test, which is used to measure low levels of CRP in the blood. CRP is an acute-phase protein synthesized by the liver in response to inflammation, and hs-CRP has greater sensitivity, enabling it to detect even minimal increases in CRP levels. This makes hs-CRP a valuable biomarker for assessing low-grade chronic inflammation, which is often linked to various cardiovascular and inflammatory conditions, including pre eclampsia. Elevated hs-CRP levels have been shown to correlate with the severity of pre eclampsia, and the biomarker holds potential for use in early detection, monitoring disease progression, and predicting long-term maternal and fetal outcomes. Additionally, hs-CRP may assist in distinguishing between early-onset and late-onset pre eclampsia, offering crucial insights into the pathophysiological mechanisms at play and helping guide appropriate clinical management.[30]

Pathophysiology of Pre eclampsia: Placental and Systemic Mechanisms:

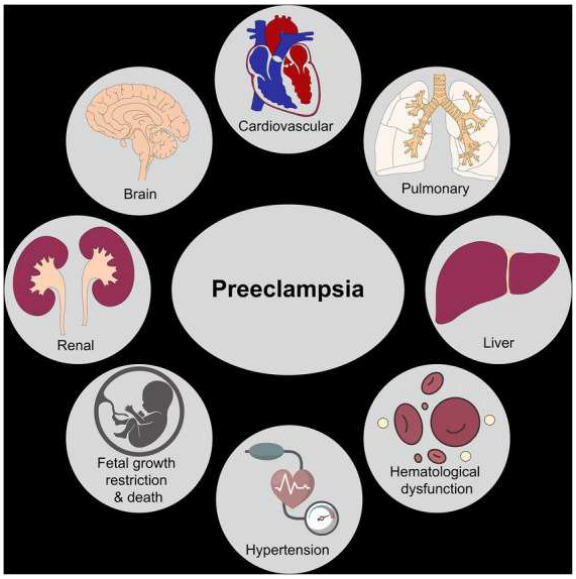


1. Abnormal Placentation:[31]

- **Normal Placentation:** In a healthy pregnancy, trophoblasts (placental cells) invade the maternal uterine spiral arteries, remodeling them into wide, low-resistance vessels. This ensures adequate blood flow to the placenta, supporting fetal growth and development.
- **Abnormal Placentation in Pre eclampsia:** In pre eclampsia, trophoblast invasion is shallow and incomplete. As a result, the spiral arteries remain narrow and resistant, leading to **placental hypoxia** (reduced oxygen supply) and **ischemia** (reduced blood flow). This inadequate placental development is the primary insult that initiates the disease process.

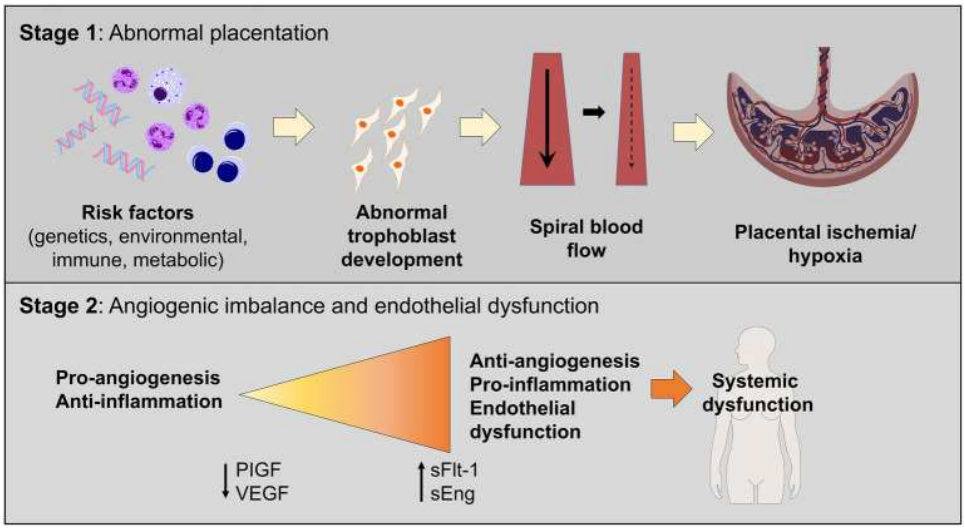
2. Placental Ischemia and Oxidative Stress:

- **Hypoxia:** Poor placental perfusion due to inadequate spiral artery remodeling results in placental hypoxia. The placenta becomes deprived of oxygen and nutrients, impairing its function.
- **Oxidative Stress:** Hypoxia triggers the release of reactive oxygen species (ROS) and inflammatory cytokines. These substances cause oxidative stress, leading to cellular damage and further exacerbating placental dysfunction. Oxidative stress also contributes to endothelial damage, which plays a central role in the systemic manifestations of pre eclampsia.[32]



3. Release of Placental Factors:[31][32]

- The ischemic placenta releases **anti-angiogenic factors** (e.g., soluble fms-like tyrosine kinase-1 [sFlt-1]) and **pro-inflammatory cytokines** into the maternal circulation. These factors disrupt the maternal endothelium, leading to systemic inflammation and vascular dysfunction.
- **Anti-angiogenic Factors:** sFlt-1 binds to vascular endothelial growth factor (VEGF) and placental growth factor (PlGF), inhibiting their protective effects on blood vessels. This results in endothelial damage and increased vascular permeability.
- **Pro-inflammatory Cytokines:** These cytokines amplify the systemic inflammatory response, further contributing to endothelial dysfunction and the clinical features of pre eclampsia.



4. Systemic Inflammation and Endothelial Dysfunction:

- **Inflammatory Response:** The release of placental factors triggers a systemic inflammatory response, characterized by elevated levels of **C-reactive protein (CRP)** and other inflammatory markers. This inflammation contributes to the widespread endothelial damage seen in pre eclampsia.[32]
- **Endothelial Dysfunction:** Endothelial cells become damaged, leading to:
    - **Increased vascular permeability:** This causes edema (swelling) and proteinuria (protein in the urine).
    - **Vasoconstriction:** Narrowing of blood vessels leads to hypertension (high blood pressure).
    - **Activation of the coagulation cascade:** This increases the risk of thrombosis (blood clots) and further compromises blood flow to organs.

5. Clinical Manifestations of Pre eclampsia:

- **Maternal Symptoms:**
    - **Hypertension:** Due to vasoconstriction and endothelial dysfunction.
    - **Proteinuria:** Caused by glomerular endothelial damage in the kidneys.
    - **Organ Dysfunction:** Affects the liver (e.g., elevated liver enzymes), kidneys (e.g., acute kidney injury), and brain (e.g., headaches, visual disturbances, seizures in severe cases).
- **Fetal Complications:**
    - **Fetal Growth Restriction (FGR):** Due to reduced placental blood flow and nutrient supply.
    - **Preterm Birth:** Often necessitated by the need to deliver the baby to protect the mother's health.
    - **Placental Abruption:** Premature separation of the placenta from the uterine wall, which can be life-threatening for both mother and baby.[33]

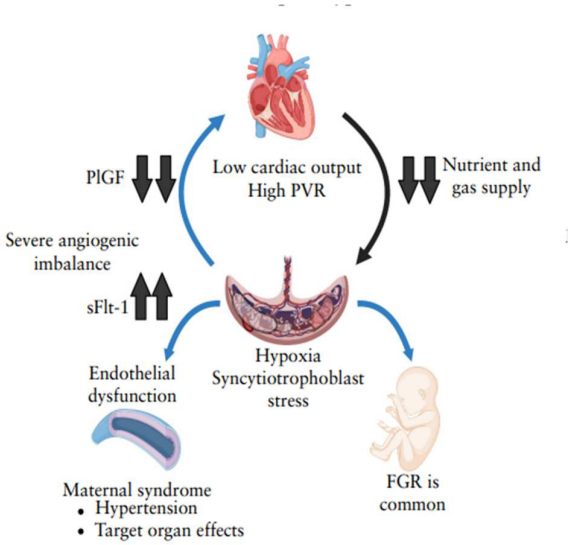
Pathophysiology of Early Onset Pre eclampsia:

1. Abnormal Placentation- Inadequate trophoblast invasion and poor remodeling of maternal spiral arteries result in high-resistance, low-capacitance vessels, restricting blood flow to the placenta. This impaired placental perfusion leads to syncytiotrophoblast stress, a hallmark of early onset Pre eclampsia.

2. Angiogenic Imbalance- Hypoxic and ischemic placenta overproduces soluble fms-like tyrosine kinase-1 (sFlt-1) and underproduces placental growth factor (PlGF). The high sFlt-1/low PlGF state creates an anti-angiogenic environment, leading to maternal endothelial dysfunction.

3. Maternal Cardiovascular Response- The maternal cardiovascular system in Early onset Pre eclampsia shows low cardiac output and high peripheral vascular resistance (PVR), reflecting poor adaptation to pregnancy demands.

4. Clinical Presentation- Early Onset Pre eclampsia usually presents before 34 weeks period of gestation. It is often associated with fetal growth restriction (FGR) due to placental insufficiency.



Pathogenesis of Late onset Pre eclampsia-

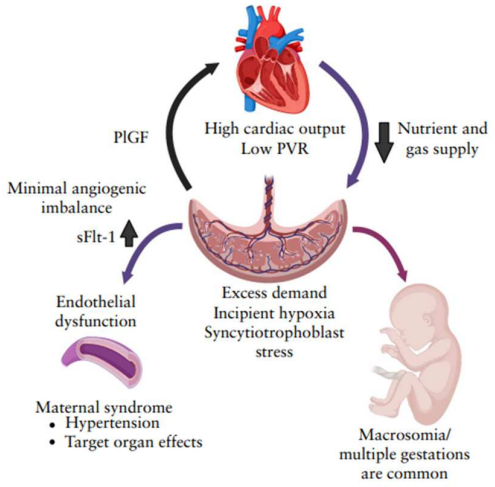
1.Hemodynamic Characteristics- Late onset Pre eclampsia is not primarily caused by defective placentation, unlike early onset. Instead, it's linked to the mother's inadequate cardiovascular adaptation to the physiological demands of pregnancy. The maternal cardiovascular system fails to compensate for increasing volume demands. This leads to relative placental underperfusion and syncytiotrophoblast stress, despite the absence of early placental abnormalities. Hemodynamic Characteristics as High cardiac output and low peripheral vascular resistance (PVR) characterize this type**.**

Despite this, maternal adaptations are insufficient to meet the growing needs of the fetus and placenta.

2. Angiogenic Profile: Often shows minimal or mild imbalance in angiogenic markers: sFlt-1 (antiangiogenic) may be only slightly elevated. PlGF (pro-angiogenic) levels are typically preserved or mildly reduced. The sFlt-1/PlGF ratio may remain normal or mildly disturbed.

3. Fetal Impact: Often presents with appropriate or large-for-gestational-age (AGA/LGA) fetuses. Less frequently associated with fetal growth restriction (FGR) compared to Early onset pre eclampsia

4. Clinical Presentation- Late Onset Pre eclampsia usually presents after 34 weeks period of gestation.



In essence, Late onset Pre eclampsia is a syndrome of maternal cardiovascular maladaptation to the demands of pregnancy, distinct from the placenta-driven, Early onset pre eclampsia. Recognizing this distinction has major implications for screening, prevention, and long-term maternal cardiovascular health monitoring.

Literature review:

National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy et al. (2000): This pivotal report provides essential guidelines for the classification, diagnosis, and management of hypertensive disorders in pregnancy. It identifies four distinct categories: chronic hypertension, pre eclampsia/eclampsia, chronic hypertension with superimposed pre eclampsia, and gestational hypertension. The working group highlights that pre eclampsia affects approximately 5-8% of pregnancies, contributing significantly to maternal and neonatal complications. It is noted that up to 20% of women with severe pre eclampsia may require intensive care, illustrating the serious risks involved. Eclampsia, though less common, occurs in 1-2% of women who do not receive preventive treatment, emphasizing the importance of early detection and timely intervention. The guidelines recommend regular blood pressure monitoring, indicating that a reading of 140/90 mmHg or higher, measured on two separate occasions, necessitates further evaluation. Severe pre eclampsia is defined by blood pressure exceeding 160/110 mmHg, along with significant proteinuria or other organ dysfunction. Magnesium sulfate is identified as the primary treatment for preventing eclamptic seizures, with studies showing a reduction in seizure recurrence by nearly 50% when used. The report's national recommendations aim to minimize adverse outcomes associated with hypertensive disorders in pregnancy.

Seiner et al. (2001): Seiner and colleagues emphasize the diversity of hypertensive disorders that manifest later in pregnancy, stressing that these conditions vary in origin, progression, and prognosis. In their study involving over 400 patients with elevated blood pressure after 34 weeks, they found that 60% had gestational

hypertension without proteinuria, while 40% exhibited characteristics of pre eclampsia. The study underscores the importance of the timing of hypertension onset, with women experiencing hypertension at or after 37 weeks typically having better maternal and neonatal outcomes compared to those whose hypertension develops earlier. Additionally, they discuss the clinical differences between early and late-onset hypertensive disorders, noting that late-onset pre eclampsia tends to have fewer placental complications and milder neonatal effects. Seiner et al. advocate for continuous maternal blood pressure monitoring and fetal assessments to identify any changes that may require intervention. For cases with milder hypertension, delayed delivery until 37 or 38 weeks is recommended, as it reduces the likelihood of neonatal intensive care admissions by approximately 25%. Their work emphasizes the importance of distinguishing between different hypertensive subtypes in late pregnancy to tailor management strategies that optimize maternal and fetal health.

Miller et al. (2003): Miller's work delves into the clinical impact of hypertension during pregnancy, particularly the burden of pre eclampsia. Affecting 5-7% of pregnancies worldwide, pre eclampsia is linked to severe complications, including placental abruption, acute kidney injury, and coagulopathies. Diagnosis is typically confirmed by sustained hypertension (≥140/90 mmHg) and significant proteinuria (≥300 mg in a 24-hour urine collection). Miller emphasizes the importance of regular antenatal visits for blood pressure and proteinuria monitoring, suggesting that early detection and intervention can reduce adverse outcomes by up to 30%. The management approach depends on the severity of the condition: mild cases may be managed with antihypertensive therapy and observation, while severe cases with blood pressure readings of 160/110 mmHg or higher require immediate hospitalization. Magnesium sulfate is the recommended treatment to prevent seizures,

with studies showing a 50% reduction in seizure risk. In preterm cases, corticosteroids are beneficial in reducing respiratory complications by approximately 50%. Miller advocates for a systematic, stepwise approach to pre eclampsia, recommending individualized management strategies based on the disease's severity and gestational age.

Ustun et al. (2005): In their study, Ustun and colleagues investigate the role of fibrinogen and C-reactive protein (CRP) as potential markers for the severity of pre eclampsia. The research involved 72 pregnant participants, equally divided between women diagnosed with pre eclampsia and normotensive controls. The study revealed that fibrinogen levels were significantly higher in the pre eclampsia group (around 450 mg/dL) compared to the healthy control group (approximately 320 mg/dL). Similarly, CRP levels were markedly elevated in the pre eclampsia group, with an average of 12 mg/L compared to 5 mg/L in normotensive pregnancies. Notably, CRP levels were even higher in severe pre eclampsia, reaching approximately 15 mg/L. The authors found a strong correlation between elevated CRP levels and the clinical severity of pre eclampsia, suggesting that CRP could serve as a predictive biomarker for worsening maternal status. They propose that elevated CRP, particularly levels exceeding 10 mg/L, may increase the likelihood of progression from mild to severe pre eclampsia by more than twofold. These findings underscore the potential of CRP as a diagnostic tool and its association with inflammation and coagulation in the pathophysiology of pre eclampsia, suggesting that targeted therapies focusing on inflammation and coagulation might improve management for at-risk individuals.

Jauniaux et al. (2006): Jauniaux and colleagues focus on the relationship between oxidative stress, placental dysfunction, and pre eclampsia. They examine the

potential evolutionary predisposition to placental disorders like pre eclampsia and fetal growth restriction. According to the authors, inadequate invasion of the uterine spiral arteries by trophoblasts can lead to poor placental blood flow, contributing to oxidative stress and inflammation, which are key components of pre eclampsia. The study acknowledges that pre eclampsia affects 2-10% of pregnancies, with varying incidence influenced by factors such as nutrition, environment, and genetics. Their findings highlight a significant increase in oxidative stress markers, such as lipid peroxides, in placental tissues from preeclamptic pregnancies. Despite some studies suggesting that antioxidant supplementation might reduce the risk of pre eclampsia by 10-15%, the results remain inconsistent. Jauniaux et al. advocate for a multifactorial approach to understanding pre eclampsia, considering genetic markers, inflammation, and nutrition, with an emphasis on the importance of placental physiology to improve prevention strategies and minimize complications.

Hamad et al. (2010): Hamad's doctoral research examines cardiovascular changes and the role of biomarkers in pre eclampsia. The study, which included 120 pregnant participants—80 diagnosed with pre eclampsia and 40 normotensive controls—assessed cardiac function, peripheral vascular resistance, and biomarkers such as C-reactive protein (CRP) and adhesion molecules. The findings indicated that in severe pre eclampsia, cardiac output was lower (4.8 L/min) compared to normotensive pregnancies (5.7 L/min), and peripheral vascular resistance was nearly 25% higher. CRP levels were found to be elevated in the pre eclampsia group, with a significant correlation ($r = 0.65$) between CRP levels and increased vascular resistance. Hamad suggests that systemic inflammation contributes to the cardiovascular dysfunction observed in pre eclampsia, particularly by altering maternal hemodynamics. The research supports the use of biomarker profiles,

including CRP, to identify women at risk for severe pre eclampsia, enabling early intervention. By connecting inflammatory biomarkers with cardiovascular changes, the study highlights the importance of a comprehensive risk assessment approach that integrates both inflammatory markers and hemodynamic measurements to improve maternal and fetal outcomes in pre eclampsia.

Cetin et al. (2011): Cetin and co-authors reviewed expert discussions from the Pregenes..ys consensus meeting, focusing on identifying reliable biomarkers for predicting pre eclampsia risk. The study emphasized that no single marker has been proven sufficiently sensitive or specific on its own. Among those discussed, high levels of sFlt-1 showed a 60–80% sensitivity for pre eclampsia prediction, while low PlGF concentrations also indicated increased risk. CRP was identified as a useful adjunct marker, with one study suggesting a 2.2-fold increase in pre eclampsia risk when CRP exceeded 10 mg/L. The consensus favored combining multiple markers—such as the sFlt-1/PlGF ratio along with CRP—alongside clinical evaluations to enhance detection rates, potentially exceeding 90%. However, the panel called for large-scale validation trials and standardized protocols to confirm real-world utility. The conclusion suggested that a combined biomarker approach holds significant promise for personalized care and prevention for women at risk of pre eclampsia.

Bishara et al. (2012): Bishara explored the use of biomarkers in diagnosing early- and late-onset neonatal sepsis, drawing parallels to maternal hypertensive conditions like pre eclampsia. CRP levels and other pro-inflammatory markers were found to increase similarly in both neonatal sepsis and maternal inflammation. Tracking CRP over time improved diagnostic accuracy by approximately 25%, and combining CRP with procalcitonin (PCT) enhanced detection rates to 85% in early

neonatal sepsis. Although direct transfer of maternal markers to the fetus was not quantified, the chapter noted that maternal hypertensive conditions could influence neonatal infection risks. Bishara recommended routine CRP testing in high-risk infants, advocating for its potential application in maternal care as well.

Chaiworapongsa et al. (2013): Chaiworapongsa and colleagues studied gene expression profiles in early-onset versus late-onset pre eclampsia to identify molecular differences between the two. They found that early-onset pre eclampsia had a higher intensity of gene expression changes, particularly in genes involved in inflammation and angiogenesis, compared to late-onset cases. Both types of pre eclampsia exhibited altered expression of vascular regulators like VEGFA and FLT1, but these changes were more pronounced in early-onset cases. The study also revealed higher CRP-related gene expression in early-onset pre eclampsia, underscoring the importance of inflammatory pathways. Their findings support the notion that early- and late-onset pre eclampsia may stem from distinct biological mechanisms and suggest the potential for personalized care and biomarker-based diagnostics.

Rasmussen et al. (2015): Rasmussen and co-authors reviewed the role of angiogenic biomarkers, specifically sFlt-1 and PlGF, in maternal and fetal health. They highlighted that abnormalities in these markers strongly correlate with the development of pre eclampsia. The sFlt-1/PlGF ratio, for example, was found to have a 90% positive predictive value for pre eclampsia in symptomatic patients. They also discussed how dysregulated angiogenesis could lead to placental insufficiency, contributing to maternal complications and impaired fetal growth. Their review emphasized the need to combine angiogenic biomarkers with clinical evaluations like blood pressure and proteinuria for improved risk assessment. Rasmussen et al.

proposed that measuring sFlt-1 and PlGF could enhance clinical decision-making and guide delivery timing.

Veerbeek et al. (2015): Veerbeek and colleagues investigated long-term cardiovascular risks in women with a history of pre eclampsia. They found that women who had early-onset pre eclampsia were more likely to develop conditions like hypertension, dyslipidemia, and obesity later in life. In particular, early-onset pre eclampsia survivors had a 2.5-fold increased risk of hypertension compared to other groups. However, engaging in healthier behaviors post-pregnancy, such as exercise and a balanced diet, led to a 15% reduction in newly diagnosed hypertension. Veerbeek et al. emphasized the importance of ongoing cardiovascular screening for women with a history of pre eclampsia, particularly those with early-onset disease, to mitigate future cardiovascular risks.

Verma et al. (2016): Verma's study explored the utility of measuring maternal serum high-sensitivity C-reactive protein (hsCRP) during the early second trimester (14–20 weeks) to predict pre eclampsia. It found that women with hsCRP levels above 8 mg/L were 2.8 times more likely to develop pre eclampsia than those with lower levels. The study suggested that hsCRP testing, with a positive predictive value of 70%, could serve as a feasible and cost-effective screening tool in resource-limited settings, especially when combined with blood pressure monitoring. Verma recommended incorporating hsCRP measurement into prenatal care to identify women at risk for severe pre eclampsia, allowing for closer monitoring and timely interventions.

Alma et al. (2017): This meta-analysis highlights biomarkers (e.g., CRP, NT-proBNP) in pre eclampsia and diastolic heart failure, emphasizing vascular inflammation and endothelial stress. These findings suggest pre eclampsia may predict future cardiovascular issues, advocating for careful monitoring and possible anti-inflammatory interventions.

Chen et al. (2018): This study examines hsCRP as a predictive marker for pregnancy-induced hypertension (PIH), showing that elevated hsCRP levels can predict PIH with a high sensitivity and specificity. The authors suggest that monitoring hsCRP could enable early interventions for PIH.

Güngör et al. (2018): This genetic study identifies SNPs in Lp-PLA2 that increase susceptibility to pre eclampsia and related cardiovascular risks. Women carrying these SNPs showed elevated inflammatory markers, proposing genetic screening and CRP monitoring as early intervention tools.

Fox et al. (2019): A review focused on pre eclampsia's cardiovascular impacts, particularly on offspring. The study also identifies biomarkers and prevention strategies (e.g., low-dose aspirin) and emphasizes postpartum evaluations to manage long-term cardiovascular risks in mothers.

Jääskeläinen et al. (2019): This study examines how obesity affects angiogenic and inflammatory markers in pre eclampsia, revealing that obesity exacerbates vascular dysfunction. The authors recommend weight-loss strategies before pregnancy to mitigate severe pre eclampsia outcomes.

Mishra et al. (2019): This study assesses hsCRP as a prognostic marker for pre eclampsia, suggesting that hsCRP levels can indicate the severity of the condition and guide clinical management. The authors stress the importance of a comprehensive approach beyond hsCRP.

Sunjaya and Sunjaya (2019): This review emphasizes early diagnostic techniques for pre eclampsia, combining biomarkers like CRP with clinical assessments and imaging. Personalized care and early screening are recommended to reduce the incidence of severe forms of the disorder.

Shen-y et al. (2020): This study links elevated CRP with severe pre eclampsia, finding that CRP levels above 10 mg/L predict serious complications such as abruptio placentae. The authors advocate for CRP measurements in high-risk pregnancies for better management.

Gencheva et al. (2021): This study evaluates hsCRP levels in normotensive pregnancies, gestational hypertension, and pre eclampsia. Elevated hsCRP correlates with increased risk of complications and preterm birth, supporting its use as a screening tool for hypertensive disorders.

Glaser et al. (2021): A review of neonatal sepsis management highlights the role of maternal conditions like pre eclampsia in increasing neonatal infection risks. It underscores the importance of early sepsis detection and timely antibiotic treatment for improving neonatal outcomes.

MATERIALS AND METHODS

Source of Data:

The present study was conducted among antenatal women diagnosed with Pre eclampsia, admitted in labour room for delivery at KLE's Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi associated to KAHER's Jawaharlal Nehru Medical College, Belagavi for a period of one year

Study Design: This was a prospective cross sectional study conducted at KAHER'S Dr Prabhakar Kore Hospital and Medical Research Centre, Nehru Nagar Belagavi

Study Period: One year.

Sampling Technique: Convenient sampling.

TABLE- OPERATIONAL DEFINITIONS	
Pre eclampsia	Pre eclampsia is defined as new onset of gestational hypertension, defined as systolic BP >140 mm hg or diastolic BP >90 mm hg or both, measured two times atleast 4 hour apart and accompanied by either proteinuria or other signs of end organ dysfunction such as below along with the new onset of --Thrombocytopenia which is platelet count less than < 100000 / microliter. Impaired liver function, not explained by another diagnosis, is characterized by significantly elevated levels of liver enzymes in the blood (more than double the upper limit of normal) or by severe and persistent pain in the upper right quadrant or epigastric region that does not respond to medication. -Renal insufficiency (serum creatinine concentration more than 1.1 mg/dl or a doubling of concentration in the absence of other renal disease.) -Neurological complications -Visual disturbances -Uteroplacental dysfunction such as fetal growth restriction, abnormal umblical artery doppler wave form analysis or still births after 20 weeks of gestation in a previously normotensive woman.
Early onset Pre eclampsia	Pre eclampsia that occurs before 34 weeks of gestation and is often associated with more severe outcomes.
Late Onset Pre eclampsia:	Pre eclampsia occurs at or after 34 weeks of gestation and is generally less severe than early onset pre eclampsia
Non Severe Pre eclampsia	Non severe pre eclampsia is a pregnancy-related condition characterized by Blood pressure ≥140/90 mmHg but <160/110 mmHg measured on two occasions at least 4 hours apart, occurs after 20 weeks of gestation in a previously normotensive woman with proteinuria of ≥300 mg/24-hour urine collection, or Protein/creatinine ratio ≥0.3, or ≥1+ on urine dipstick (if quantitative methods not available) and no

	features of severe pre eclampsia.
Severe Pre eclampsia	A diagnosis of severe pre eclampsia is made when a woman with pre eclampsia has any of the following features: 1.Systolic BP ≥160 mmHg or diastolic BP ≥110 mmHg on two occasions at least 4 hours apart while on bed rest. 2. Urinary proteinuria ≥2+ on urine dipstick 3. Thrombocytopenia: Platelet count <100,000/microliter. 4. Impaired liver function: Elevated liver enzymes (twice the normal concentration), with or without severe persistent right upper quadrant or epigastric pain. 5. Progressive renal insufficiency: Serum creatinine >1.1 mg/dL or doubling of serum creatinine in absence of other renal disease. 6. Pulmonary edema. 7. New-onset cerebral or visual disturbances: such as headaches, blurred vision, or neurological complications such as seizures (if seizures occur, it's classified as eclampsia). 8. Uteroplacental dysfunction such as fetal growth restriction, abnormal umblical artery doppler wave form analysis or still births

Inclusion Criteria:

1. All antenatal women diagnosed with Pre eclampsia, admitted in labor room for delivery
2. Singleton live pregnancy

Exclusion Criteria:

1. Antenatal women diagnosed with Pre eclampsia with history of fever or recent infections or who have received antibiotic treatment or steroids within 7 days.
2. Antenatal women diagnosed with Pre eclampsia presenting with PROM, PPROM or clinical chorioamnionitis.
3. Antenatal women diagnosed with Pre eclampsia with chronic inflammatory disorders like arthritis, inflammatory bowel disorders, SLE etc.
4. Antenatal women diagnosed with Pre eclampsia with co-existing medical disorders (Chronic hypertension, Diabetes mellitus, hepatic disorders, renal disorders).
5. Antenatal women diagnosed with Pre eclampsia with raised total leukocyte counts >11000/microliter.
6. Women diagnosed with Pre eclampsia not willing to participate in the study.

Written Informed consent was obtained from all the study patients who met the inclusion criteria and were provided with a detailed explanation of the purpose of the study.

Sample Size calculation:

The minimum required sample size for this study was calculated to ensure statistically significant and reliable results. The calculation was based on the following parameters:

1. **Prevalence of Pre eclampsia:**

   According to previous studies, the prevalence of pre eclampsia in pregnant women is approximately 5-8%. For this study, a prevalence of 6% was assumed.

2. **Confidence Level**:

   A **95% confidence level** was chosen to ensure the reliability of the results.

3. **Margin of Error (Precision):**

   A 5% margin of error was considered acceptable for this study.

4. **Design Effect:**

   A design effect of 1.0 was used, assuming a simple random sampling method.

5. **Expected Mean and Standard Deviation of hs-CRP:**

   Based on previous studies (e.g., Mishra et al., 2019), the expected mean hs-CRP level in pre eclampsia was assumed to be 6.2 mg/L, with a standard deviation of 2.5 mg/L.

6. **Power of the Study:**

   The study was designed with **80% power** to detect significant differences in hs-CRP levels between early-onset and late-onset pre eclampsia.

Using the **G*Power software**, the required sample size was calculated as follows:

- **Effect Size (d):** 0.382 (based on expected mean and standard deviation).

- **Alpha Error (α):** 0.05 (two-tailed).
- **Power (1-β):** 0.80.
- **Sample Size:** 96 participants.

To account for a **5% non-participation rate or loss to follow-up**, an additional **5 participants** were added, resulting in a **final sample size of 101 participants**.

Methodology

All antenatal women admitted in labor room for delivery at KLE's Dr Prabhakar kore hospital and medical research center associated to KAHER's Jawaharlal Nehru Medical College, Belagavi with pre eclampsia diagnosed within a week period or reports showing or features suggestive of Pre eclampsia or after admission all antenatal women with blood pressure of 140/90 mm of hg beyond 20 weeks of period of gestation were screened. A detailed information on demographics and patient history, gestational details and examination findings were noted. Prior to the procedure, the healthcare provider followed aseptic techniques. This included wearing sterile gloves and disinfecting the specific area e.g. venipuncture site from antecubital vein, totally 10 ml of venous blood sample was drawn from ante cubital vein at the time of admission and sent for estimation of Haemoglobin, Total leukocyte count, Platelet count, Blood urea, Serum creatinine, Serum bilirubin, SGOT, SGPT, Lactose dehydrogenase, Uric acid along with Urine routine and microscopy for urinary proteinuria. Once the patient is diagnosed with pre eclampsia based on clinical and biochemical parameters, considering inclusion and exclusion criteria, willing to participate in the study by signing the informed consent were included in the study.

After enrollement into the study, 1.5 ml of the blood sample was sent for hs-CRP analysis. The sample will be centrifuged and hs-CRP levels were measured by immunoturbidimetry method.

Other parameters such as Obstetric sonography, Fetal growth and umbilical artery doppler studies were noted. Patient was categorized into two groups - Early onset pre eclampsia (Early onset) and Late onset pre eclampsia (Late onset) according to their definitions.

Patients were managed as per departmental protocol and regular monitoring was done aimed at ensuring maternal and fetal wellbeing.

In all patients with Pre eclampsia, Labor was induced or augmented depending on the clinical assessment. Caesarean section was performed for either maternal or fetal indication. Post delivery of the child (Live born or Still Born), birth weight, NICU admissions were recorded.

Data Collection

- Age
- Gravidity status
- Period of gestation
- BMI
- Blood Pressure with Mean Arterial Pressure at admission
- hs-CRP Levels
- Hematological and Biochemical Parameters
- Maternal Complications - Organ dysfunction (e.g., liver dysfunction, acute kidney injury, neurological symptoms).
- Fetal Growth Restriction and Umblical artery doppler changes.
- Mode of delivery

- Fetal outcomes such as
    - Birth weight.
    - Neonatal intensive care unit (NICU) admission.
    - Perinatal mortality (intrauterine fetal demise or early neonatal death).

Ethical Considerations

- Institutional Ethical Clearence was obtained prior to initiation of the study. The details of the study were explained to the patients and an informed consent was obtained from all patients

Data handling

- The collected data were entered in Microsoft excel.

Statistical Analysis

The database was created using Microsoft Excel, and graphs were generated for data visualization. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 23 for Windows. All numerical values were entered into Microsoft Excel, and statistical tests were conducted using SPSS.

- **Continuous data** were summarized as median ± IQR.
- **Discrete (categorical) data** were presented as numbers and percentages.

Statistical Tests:

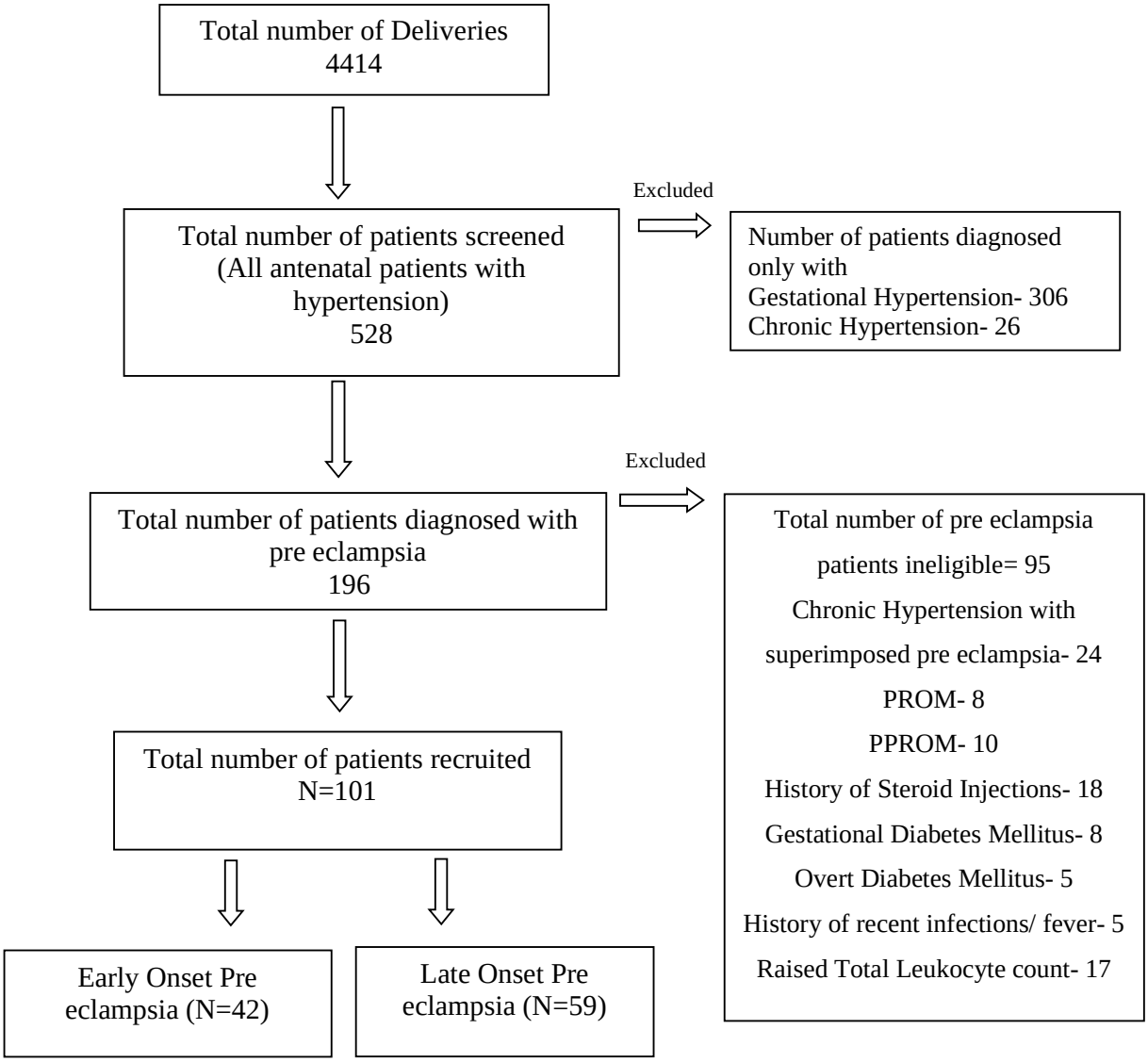
Statistical analysis was performed using **SPSS version 20.0**. The data collected were analyzed to evaluate various variables, including hs-CRP levels, maternal outcomes (e.g., hypertension, proteinuria, organ dysfunction), and fetal outcomes (e.g., live births, still births, low birth weight, intrauterine growth restriction, Umblical artery doppler changes). Continuous variables such as age, gestational age, and hs-CRP levels were expressed as **Median ± IQR**, while categorical variables like **parity** and **mode of delivery** were summarized as **frequencies and percentages**. Effect modifiers such as age, gestational age and hs-CRP levels were stratified for further analysis.[35]

The **chi-square test** was used to analyze categorical variables, while normally distributed continuous data were assessed using the **independent sample t-test** for comparing medians between two groups (e.g., early onset vs. late onset pre eclampsia) and **Karl Pearson correlation** for evaluating relationships between variables. For non-normally distributed continuous data, the **Mann-Whitney U test** was employed to compare medians. A **two-tailed p-value < 0.05** was considered statistically significant.[36]

The characteristics of participants with raised hs-CRP levels were compared and discussed to identify significant associations and trends.

RESULTS

STROBE DIAGRAM



RESULTS

TABLE 1: AGE WISE DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

Age Groups (years)	Early onset (N=42)		Late onset (N=59)		Pre eclampsia (N=101)		Chi-square (p-value)
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
≤20	4	9.5%	3	5.1%	7	6.9%	5.232 (0.264)
>20 to 25	12	28.6%	29	49.1%	41	40.6%	
>25 to 30	17	40.5%	15	25.4%	32	31.7%	
>30 to 35	5	11.9%	6	10.2%	11	10.9%	
>35	4	9.5%	6	10.2%	10	9.9%	

Table 1 presents the age wise distribution of early onset and late onset pre eclampsia cases, along with frequencies and percentages. Early onset pre eclampsia is more prevalent in women aged 26–30 years whereas late onset pre eclampsia is more common in women aged 21–25 years. The remaining age groups show relatively lower-case frequencies in both categories. The chi-square test result ($\chi^2 = 5.232$, $p = 0.264$) indicates no statistically significant difference ($p > 0.05$) in the age distribution between early and late onset cases. This indicates that age does not significantly influence the onset type of pre eclampsia in the studied population. This suggests that age is not a determining factor for the type of onset in this dataset.

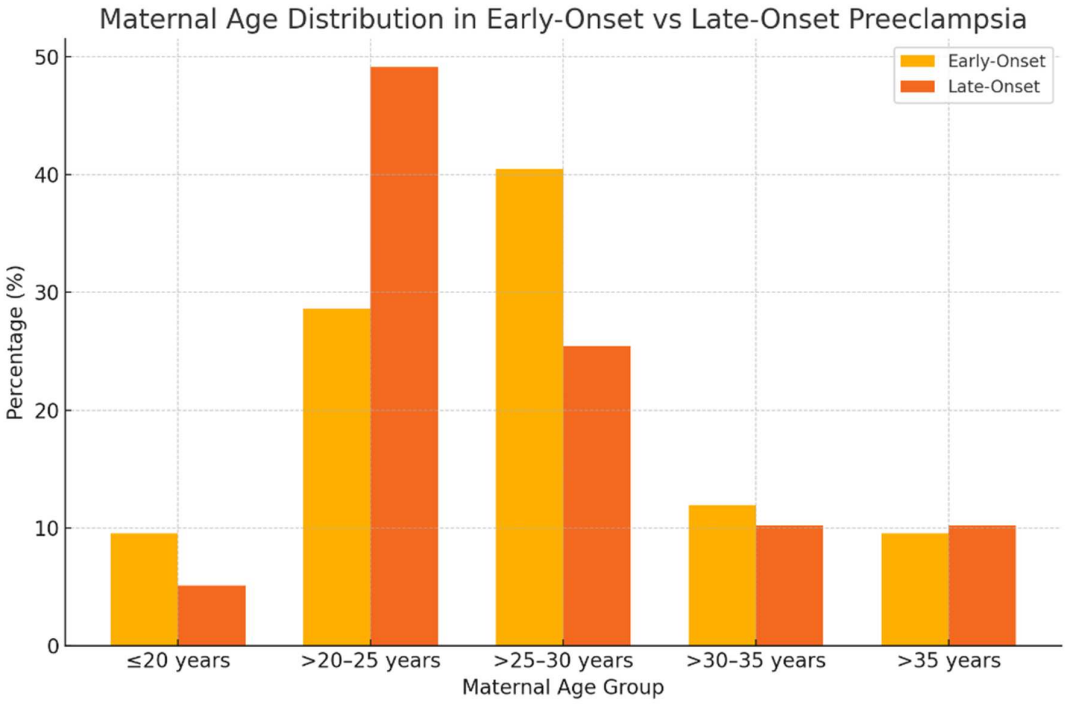


FIGURE 1: AGE WISE DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

TABLE 2: PRE PREGNANCY BMI DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

BMI	Early onset (N=42)		Late onset (N=59)		Pre eclampsia (N=101)		Chi-square (p-value)
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
≤18.5 (Under weight)	0	0	0	0%	0	0%	1.519 (0.218)
>18.5 to 24.99 (Normal)	26	61.9%	28	47.45%	54	53.46%	
25 to 29.9 (Over weight)	16	38.1%	31	52.5%	47	46.53%	
>30 (Obese)	0	0	0	0%	0	(0%)	

Table no. 2 presents the pre pregnancy BMI distribution of early onset and late onset pre eclampsia cases. Normal BMI was more common in early onset, while overweight status was more common in late onset. The chi-square test yielded a value of χ^2 = 1.519 with a p-value = 0.218, indicating no statistically significant difference in the distribution of pre-pregnancy BMI between early and late-onset pre eclampsia cases ($p > 0.05$). Pre-pregnancy BMI does not show a significant association with the timing of pre eclampsia onset (Early vs. Late) in this study population. Despite these trends, the variation is not statistically significant, meaning the observed differences could be due to chance.

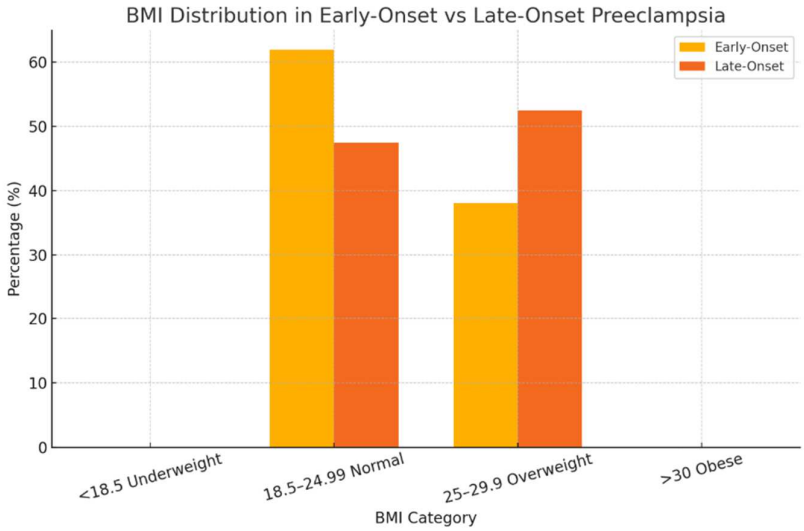


FIGURE 2: PRE PREGNANCY BMI DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

TABLE 3: GRAVIDITY DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

Gravidity	Early onset (N=42)		Late onset(N=59)		Pre eclampsia (N=101)		Chi-square (p-value)
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Primigravida	25	59.5%	30	50.8%	55	54.45%	0.745 (0.388)
Multigravida	17	40.5%	29	49.2%	46	45.55%	

Table 3 presents the gravidity distribution in early onset and late onset pre eclampsia cases, along with frequencies and percentages. A higher proportion of primigravida is noted in early onset cases. In late onset pre eclampsia, the distribution between primigravida and multigravida is more balanced. The Chi-square value is 0.745 with a p-value of 0.388, which is greater than 0.05. There is no significant difference in gravidity distribution (primigravida vs. multigravida) between early and late onset pre eclampsia cases. Although a slightly higher percentage of primigravida had early onset pre eclampsia (59.5%) compared to late onset (50.8%), this difference is not statistically meaningful.

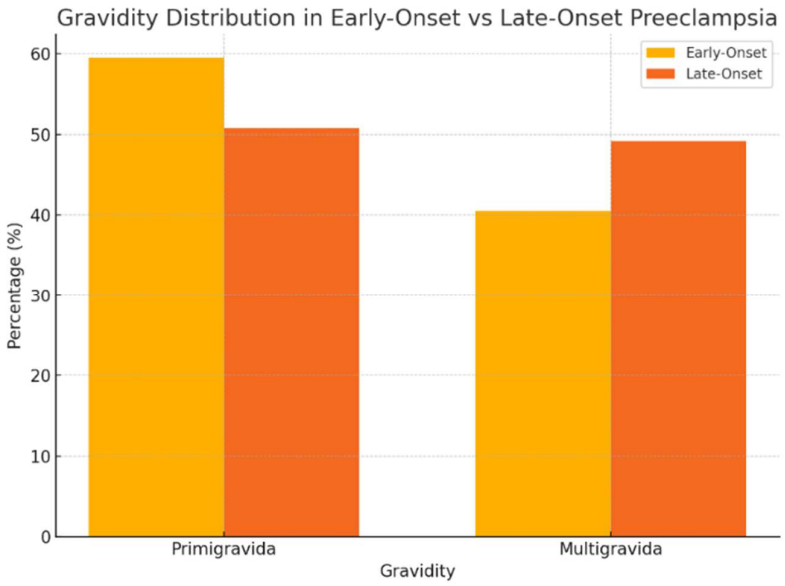


FIGURE 3: GRAVIDITY DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

TABLE 4: MEAN PERIOD OF GESTATION DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

	Early onset (N=42)		Late onset (N=59)	
	20 – 28 weeks	28 – 34 weeks	34- 37 weeks	Above 37 weeks
Frequency	4	38	32	27
Percentage	9.5%	90.5%	54.2%	45.8%
Mean gestational age	30 weeks 4 days		37 weeks 5 days	

Table no. 4 presents the mean period of gestation distribution of subjects in of early-onset and late-onset pre eclampsia cases. The Mean period of gestation in Early onset pre eclampsia is about 30 weeks 4 days where as in late-onset pre eclampsia is 37 weeks 5 days.

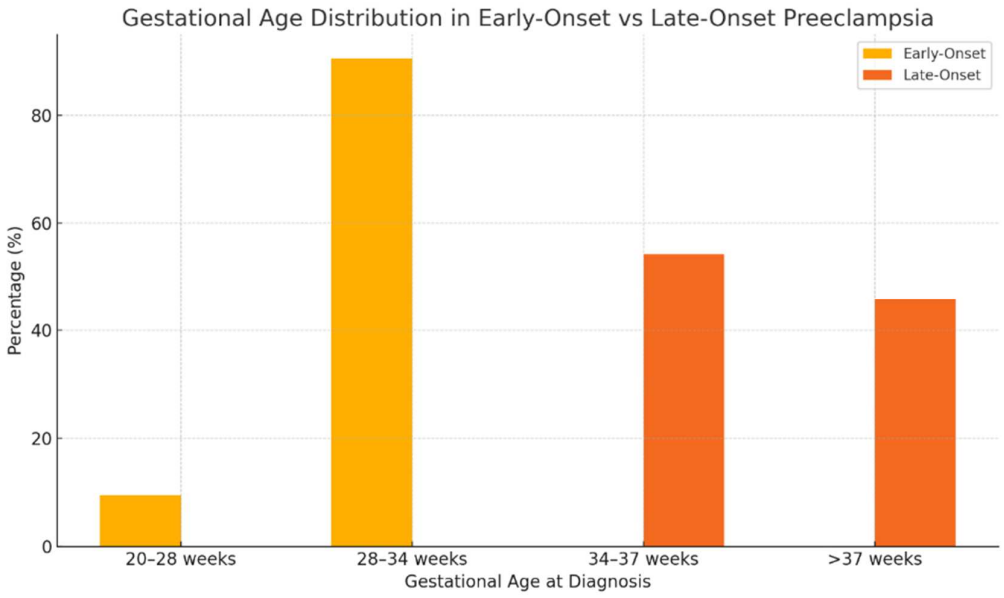


FIGURE 4: MEAN PERIOD OF GESTATION DISTRIBUTION OF SUBJECTS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

TABLE 5: NON-SEVERE AND SEVERE PRE ECLAMPSIA IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

	Early onset (N=42)		Late onset (N=59)		Pre eclampsia (N=101)		Chi square (p value)
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Non severe	7	16.6%	22	37.3%	29	28.7%	5.097 (0.024)
Severe	35	83.4%	37	62.71%	72	71.3%	

Table 5- The analysis revealed a statistically significant association between the onset time of Pre eclampsia and its severity ($p < 0.05$). Early-onset pre eclampsia was more likely to be severe (83.4%) compared to late-onset (62.71%). Conversely, non-severe cases were more common in late onset pre eclampsia (37.3%) than in early onset cases (16.6%).

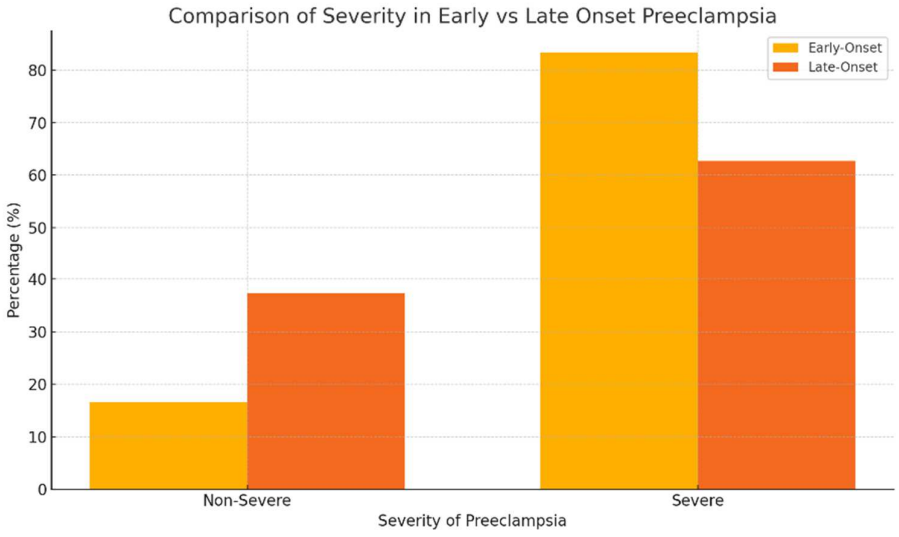


FIGURE 5: NON-SEVERE AND SEVERE PRE ECLAMPSIA IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA

TABLE 6: COMPARISON OF BLOOD PRESSURE MEASUREMENTS AT ADMISSION IN EARLY AND LATE ONSET PRE ECLAMPSIA

	Early onset (N=42)			Late onset (N=59)			p value
	Median ± IQR	Min	Max.	Median ± IQR	Min.	Max.	
SBP	164.0 ± 8.0	148	178	160 ± 14.0	146	174	0.036*
DBP	112.0 ± 8.0	90	124	110 ± 18.0	92	128	0.089
MAP	129.0 ± 10.0	110	138	128 ± 16.0	112	272	0.055

P value is obtained by Independent sample Mann Whitney U test

Table 6- **Systolic blood pressure(SBP)-** The median SBP was significantly higher in the early onset group (164.0 mmHg ± 8.0 IQR) compared to the late onset group (160.0 mmHg ± 14.0 IQR). The difference was statistically significant (p = 0.036), indicating that patients with early onset pre eclampsia tend to present with higher systolic pressures. This may reflect more severe cardiovascular involvement in early onset cases. **Diastolic Blood Pressure (DBP)-** No significant difference was found (p = 0.089), although early onset shows slightly higher median DBP. **Mean Arterial Pressure (MAP)-** Early onset cases had a marginally higher median MAP (129.0 mmHg ± 10.0 IQR) compared to late onset (128.0 mmHg ± 16.0 IQR). The p-value of 0.055 indicates a borderline non-significant trend, suggesting a potential but inconclusive association.

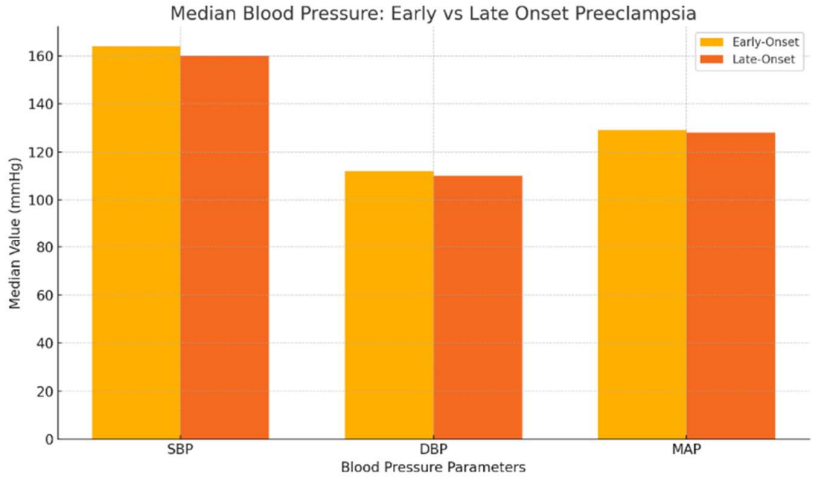


FIGURE 6: COMPARISON OF BLOOD PRESSURE MEASUREMENTS AT ADMISSION IN EARLY AND LATE ONSET PRE ECLAMPSIA

TABLE 7: hs-CRP LEVELS IN PRE ECLAMPSIA CASES

hs-CRP (mg/L)	Pre eclampsia (N=101)
Mean ± SD	7.32 ± 8.59
Median ± IQR	5.8 ± 6.2

Table 7- Normal range of hs-CRP levels are 0.5 – 5 mg/L, The mean hs-CRP in the pre eclampsia cohort was 7.39 mg/L and the median was 5.8 mg/L, both are above the normal cut-off of 5 mg/L. The interquartile range (IQR) of 6.72 indicates that a substantial proportion of patients had elevated hs-CRP, consistent with a pro-inflammatory state. With a standard deviation of 8.59, there is high variability in hs-CRP levels, suggesting a spectrum of inflammatory response among patients.

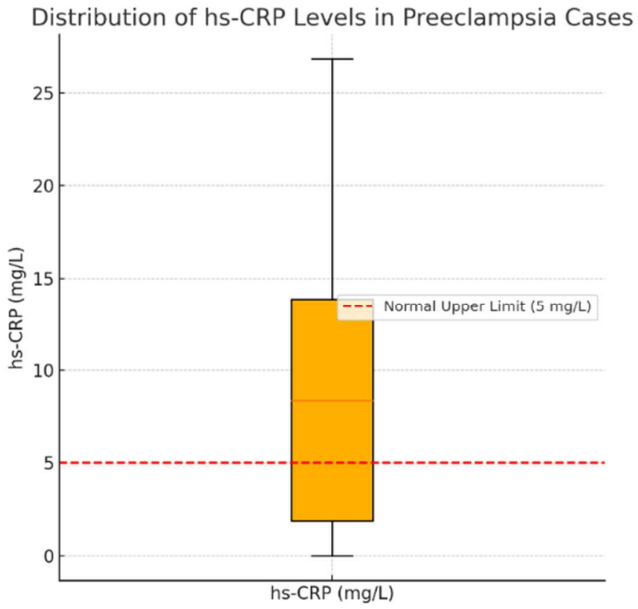


FIGURE 7: hs-CRP LEVELS IN PRE ECLAMPSIA CASES

TABLE 8: COMPARISON OF hs-CRP LEVELS IN NON SEVERE AND SEVERE PRE ECLAMPSIA IN PRE ECLAMPSIA SUBJECTS

	Pre eclampsia (N=101)	
	Non severe (N=29)	Severe (N=72)
Median hs-CRP (mg/L)	4.3	6.2
IQR	± 10.5	± 6.5
p value	0.741	

The p-value based on the Mann-Whitney U test is 0.741.

Table 8- The median hs-CRP was slightly higher in the severe group (6.2 mg/L) compared to the non-severe group (4.3 mg/L). However, the difference was not statistically significant (p = 0.741), indicating that hs-CRP alone does not significantly differentiate between severity levels of pre eclampsia when all cases are considered together. The wide IQR in the non-severe group also reflects variability in hs-CRP values among these patients.

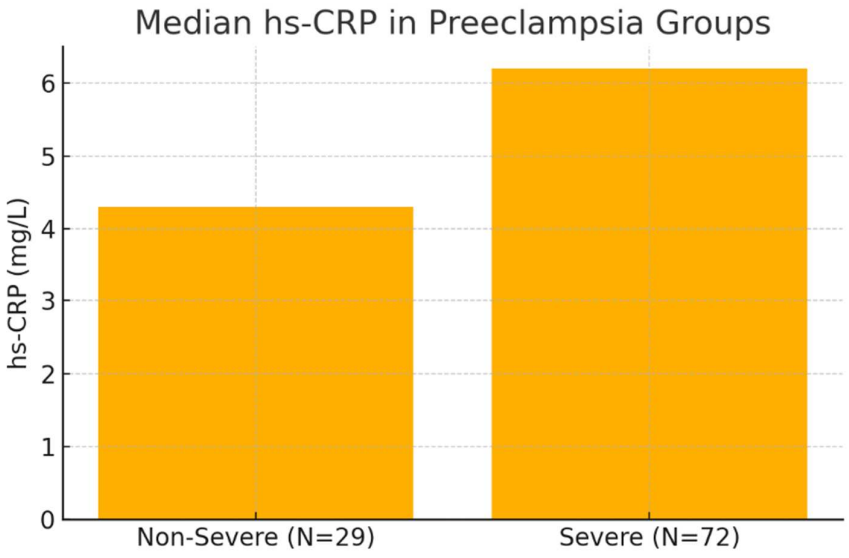


FIGURE 8: COMPARISON OF hs-CRP LEVELS IN NON SEVERE AND SEVERE PRE ECLAMPSIA IN PRE ECLAMPSIA SUBJECTS

TABLE 9: COMPARISON OF hs-CRP LEVELS IN EARLY AND LATE ONSET PRE ECLAMPSIA

	Early onset (N=42)			Late onset (N=59)		
	Median ± IQR	Min.	Max.	Median ± IQR	Min.	Max.
hs- CRP (mg/L)	6.20 ± 8.8	0.10	60.40	4.70 ± 5.10	1.00	45.70
p value	0.428					

p value is obtained by Independent sample Mann Whitney U test

Table 9 presents the median hs-CRP values among the subjects in early onset and late onset pre eclampsia cases**.** Median hs-CRP levels were higher in early onset pre eclampsia (6.20 mg/L) than in late onset cases (4.70 mg/L), indicating a trend toward a more pronounced inflammatory and early response in early-onset disease. However, the p-value (0.428) indicates that this difference is not statistically significant. The wide IQR and maximum values in both groups suggest substantial variability in individual inflammatory responses, likely influenced by additional clinical or demographic factors.

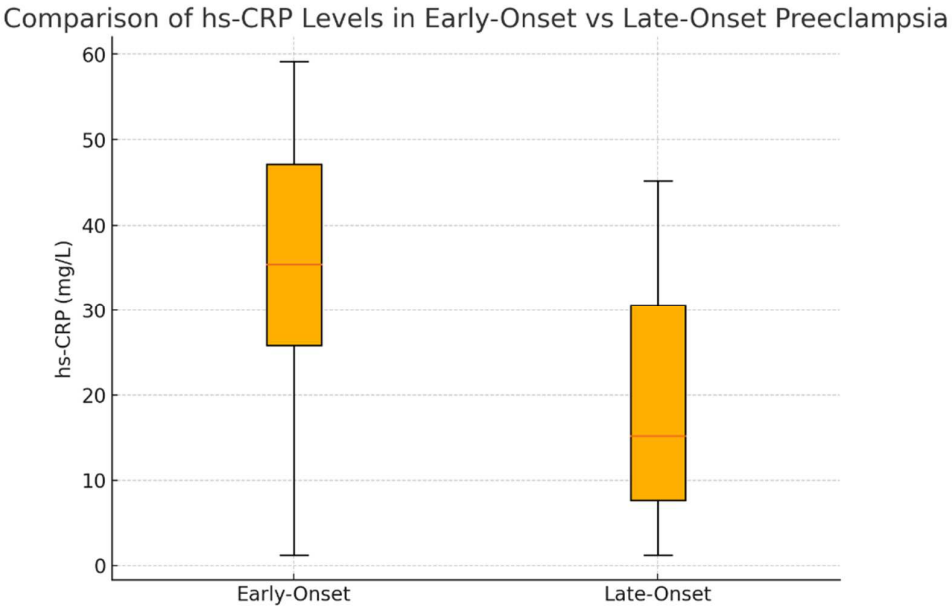


FIGURE 9: COMPARISON OF hs-CRP LEVELS IN EARLY AND LATE ONSET PRE ECLAMPSIA

TABLE 10: COMPARISON OF hs- CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA ACROSS DIFFERENT AGE GROUPS

Age Groups (years)	Early onset (N=42)		Late onset (N=59)		p value
	hs-CRP (mg/L)		hs-CRP (mg/L)		
	Median	IQR	Median	IQR	
≤ 20	9.05	30.25	7.70	3.4	-
>20- 25	9.75	8.35	4.50	4.6	0.378
>25- 30	5.80	7.5	3.90	5	0.968
>30- 35	2.40	0.9	8.45	6.4	-
>35	5.6	6.85	4.90	7.1	-

P value is obtained by Mann Whitney U test

Table 10 presents the median hscrp values of subjects based on age distribution in of early onset and late onset pre eclampsia cases. hs-CRP levels vary across age groups in both early and late onset pre eclampsia. The median hs-CRP is generally higher in early onset cases for most age groups. This supports the notion that early onset cases may be associated with a stronger inflammatory response. No age group showed a statistically significant difference in hs-CRP levels based on the p-values available. Data for other age groups lacks p-values, likely due to small sample sizes.

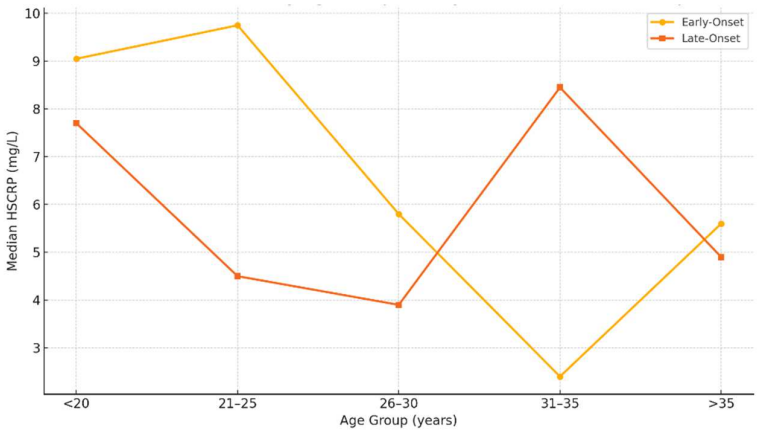


FIGURE 10: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA ACROSS DIFFERENT AGE GROUPS

TABLE 11: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA WITH PRE PREGNANCY BMI

BMI	Early onset (N=42)		Late onset (N=59)		p value
	hs-CRP (mg/L)		hs-CRP (mg/L)		
	Median	IQR	Median	IQR	
≤18.5 (Under weight)	-	-	-	-	-
>18.5 to 24.99 (Normal)	5.10	8.80	4.6	4.456	0.53
25 TO 29.9 (Over weight)	8.80	8.70	4.7	5.20	0.242
>30 (Obese)	-	-	-	-	-

p value is obtained by Mann Whitney U test

Table no 11- In Normal weight, Median hs-CRP is slightly higher in early onset (5.1 vs. 4.6), but p value is 0.530 which is not statistically significant. In Overweight, Median hs-CRP is notably higher in early onset (8.8 vs. 4.7), suggesting increased inflammation. However, p value of 0.242 is also not statistically significant. Underweight and Obese, no subjects are available for these categories in either group.

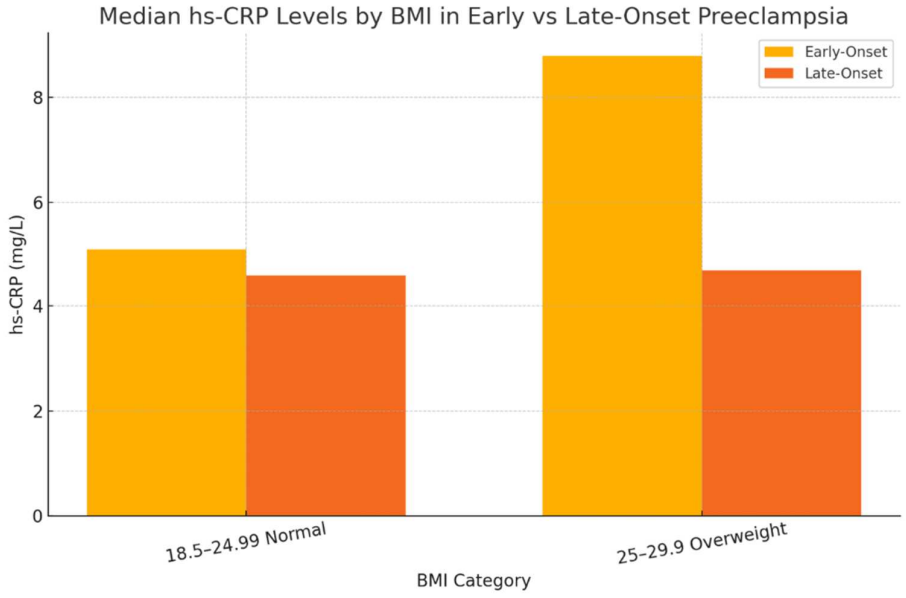


FIGURE 11: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA WITH PRE PREGNANCY BMI

TABLE 12: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA BASED ON GRAVIDITY

Gravidity	Early onset (N=42)		Late onset (N=59)		p value
	hs-CRP (mg/L)		hs-CRP (mg/L)		
	Median	IQR	Median	IQR	
Primigravida (N=55)	8.5	8	4.15	5.2	0.293
Multigravida (N=46)	5.4	8.8	4.70	5.9	0.981

P value is obtained by Mann Whitney U test

Table 12 presents that among Primigravida with early onset pre eclampsia show higher median hs-CRP levels compared to late onset, suggesting a more pronounced inflammatory response. However, the difference is not statistically significant, indicating it could be due to chance. Among multigravida, hs-CRP levels are similar between early and late onset cases, and the difference is clearly not significant.

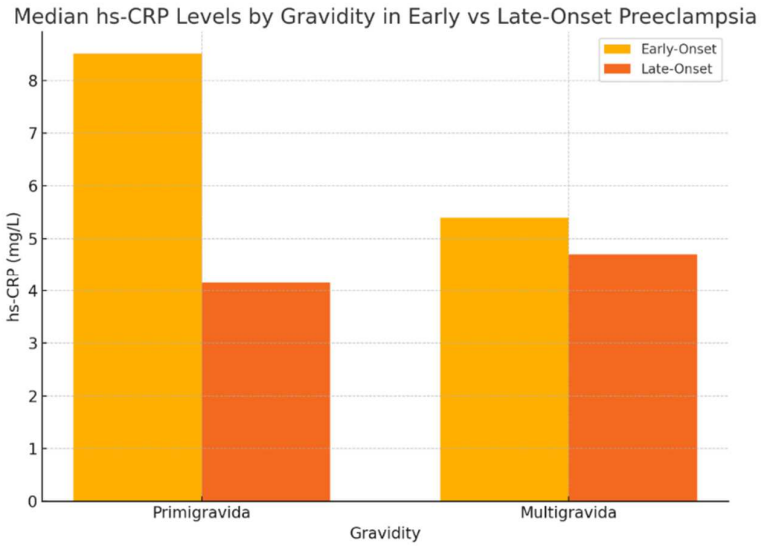


FIGURE 12: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA BASED ON GRAVIDITY

TABLE 13: MEAN PERIOD OF GESTATION hs-CRP VALUES DISTRIBUTION IN EARLY ONSET AND LATE ONSET ECLAMPSIA

Period of gestation	Early onset (N=42)		Late onset (N=59)	
	20 – 28 weeks (N=4)	28 – 34 weeks (N=38)	34- 37 weeks (N=32)	Above 37 weeks (N=27)
	Median	Median	Median	Median
hs-CRP (mg/L)	1.3	9.2	4.8	3.8
p value	-	0.4472	0.952	0.098

P value is obtained by Mann Whitney U test

Table 13- hs-CRP levels show variation across gestational age groups, with the highest median observed between 28–34 weeks. None of the p-values indicate statistical significance, though a trend indicating a possible difference, but it does not meet the conventional threshold ($p < 0.05$) in the >37 weeks group with p value 0.098. These findings suggest that while inflammation may fluctuate with gestational age, this dataset does not demonstrate significant differences between early and late onset pre eclampsia at various gestational stages.

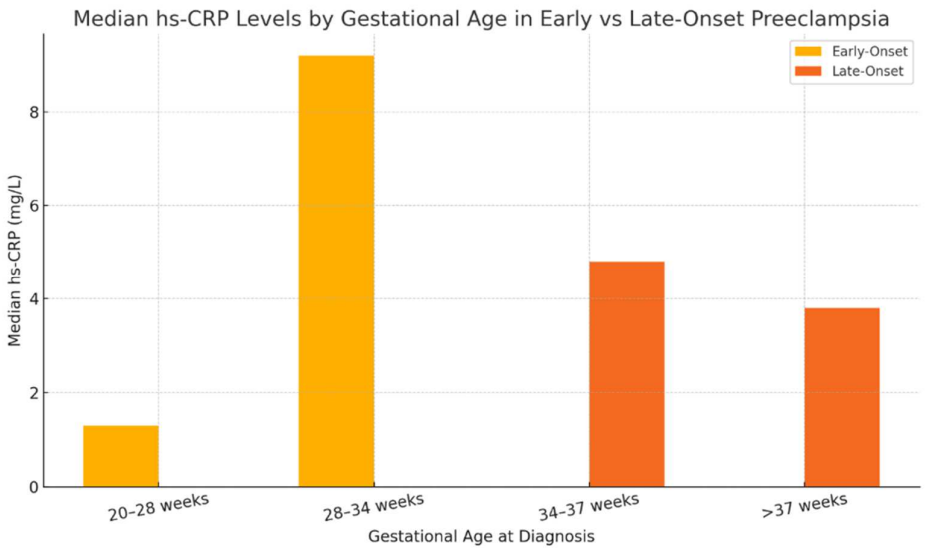


FIGURE 13: MEAN PERIOD OF GESTATION hs-CRP VALUES DISTRIBUTION IN EARLY ONSET AND LATE ONSET ECLAMPSIA

TABLE 14: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA IN NON-SEVERE AND SEVERE PRE ECLAMPSIA

Severity of pre eclampsia	Early onset (N=42)		Late onset (N=59)		p value
	hs-CRP (mg/L)		hs-CRP (mg/L)		
	Median	IQR	Median	IQR	
Non severe (N=29)	2.4(7)	4.9	4.8(22)	4.7	0.307
Severe (N=72)	8.3(35)	8.6	4.5(37)	7.2	0.417

P value is obtained by Mann Whitney U test

Table 14- In Non severe pre eclampsia, higher hs-CRP in late-onset (4.8) compared to early-onset (2.4), but the difference is not statistically significant (p = 0.307). In severe pre eclampsia, higher hs-CRP in early-onset (8.3) vs. late-onset (4.5), indicating stronger inflammation. Trends suggest early onset severe pre eclampsia may involve higher inflammation. Late onset non severe cases might also show elevated hs-CRP. However, the difference is also not statistically significant (p = 0.417).

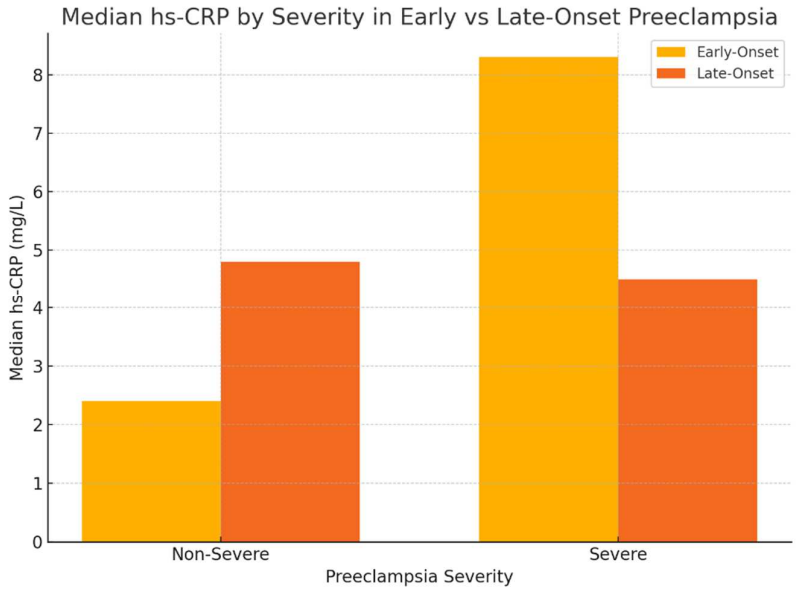


FIGURE 14: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET AND LATE ONSET PRE ECLAMPSIA IN NON-SEVERE AND SEVERE PRE ECLAMPSIA

TABLE 15: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET PRE ECLAMPSIA IN NON-SEVERE AND SEVERE PRE ECLAMPSIA

	Early onset (N=42)		p value
	hs-CRP (mg/L)		
	Non severe (N=7)	Severe (N=35)	
Median	2.4	8.3	0.120
IQR	4.9	8.6	

P value is obtained by Mann Whitney U test

Table 15- The median hs-CRP is significantly higher in Severe early onset pre eclampsia (8.3 mg/L) compared to Non severe (2.4 mg/L). This suggests a possible association between elevated systemic inflammation (indicated by hs-CRP) and severity of early onset pre eclampsia. The IQR values are relatively wide in both groups, showing variability in hs-CRP levels, especially in the severe group, which could reflect diverse inflammatory responses among patients. hs-CRP could be a useful biomarker to support clinical suspicion of severity in early onset cases. This p-value > 0.05 suggests that the difference in hs-CRP levels between the two groups is not statistically significant at the conventional 5% level. Although the median hs-CRP is notably higher in the severe group (8.3 vs 2.4 mg/L), the variation and small size of the non severe group (N=7) likely limit statistical power

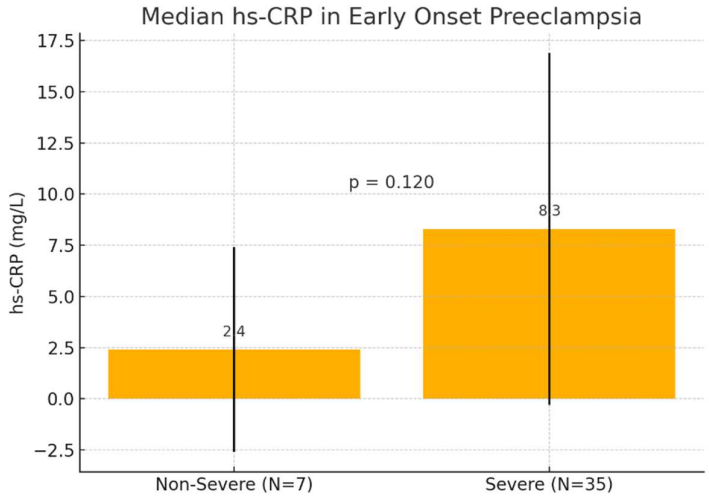


FIGURE 15: COMPARISON OF hs-CRP LEVELS IN EARLY ONSET PRE ECLAMPSIA IN NON-SEVERE AND SEVERE PRE ECLAMPSIA

TABLE- 16: COMPARISON OF hs-CRP LEVELS IN LATE ONSET PRE ECLAMPSIA WITH NON-SEVERE AND SEVERE PRE ECLAMPSIA

	Late onset (N=59)		p value
	hs-CRP (mg/L)		
	Non severe (N=22)	Severe (N=37)	
Median	4.8	4.5	0.536
IQR	4.7	7.2	

Table no 16- Median hs-CRP levels are slightly higher in the Non severe group (4.8 mg/L) compared to the Severe group (4.5 mg/L). However, the difference is not statistically significant (p = 0.536), suggesting no strong association between hs-CRP levels and severity of Late Onset pre eclampsia in this dataset. Systemic inflammation as measured by hs-CRP may not differ significantly between non-severe and severe presentations in late onset cases. The IQR is wider in the Severe group, indicating greater variability in hs-CRP values among these patients.

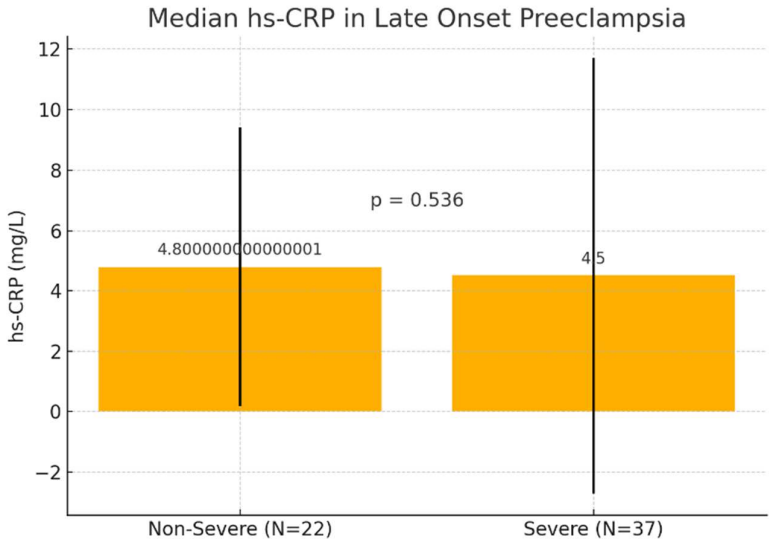


FIGURE 16: COMPARISON OF hs-CRP LEVELS IN LATE ONSET PRE ECLAMPSIA WITH NON-SEVERE AND SEVERE PRE ECLAMPSIA

TABLE 17: COMPARISON OF LABORATORY PARAMETERS IN EARLY AND LATE ONSET PRE ECLAMPSIA

	Early onset (N=42)			Late onset (N=59)			p value
	Median ± IQR	Min.	Max.	Median ± IQR	Min.	Max.	
Haemoglobin (gm/dl)	11.40±2.0	9.20	14.40	11.50± 1.7	7.30	13.70	0.850
Total leukocyte count (cells/µL)	8900 ± 2200	6900	10000	9700 ± 1000	6700.00	10400.00	0.380
Platelet count (cells/µL)	197500 ± 243000	67000	350000	237000 ± 51000	58000.00	340000.00	0.402
Blood urea (mg/dl)	18.25±7.9	9.20	30.90	13.60±6.6	5.50	27.80	<0.05*
Serum creatinine (mg/dl)	0.61±0.1	0.41	0.92	0.53±0.1	0.38	0.98	0.002*
Total bilirubin (mg/dl)	0.37±0.4	0.05	1.80	0.42±0.4	0.15	1.99	0.236
SGOT (U/L)	24.0±11.0	10.00	300.00	24.0±18	11.00	316.00	0.704
SGPT (U/L)	18.0±24.0	8.00	262.00	12.0±9.0	6.00	424.00	0.009*
LDH (U/L)	361.0±149	199.00	1695.00	342±172	176.00	2872.00	0.028*
Uric acid (mg/dl)	5.60±1.2	3.40	7.60	5.20±1.3	3.00	8.20	0.025*
hs-CRP (mg/L)	6.20± 8.8	0.10	60.40	4.70±5.10	1.00	45.70	0.428

*<0.05 p value is obtained by Independent Sample Mann Whitney U test

Comparative Analysis:

1. **Hemoglobin**: No significant difference (p-value = 0.850) was observed between early onset (11.40) and late onset (11.50), indicating similar anemia levels in both groups.
2. **Total Leukocyte Count**: No significant difference (p-value = 0.380) in leukocyte counts, suggesting similar inflammatory responses in both groups.
3. **Platelet Count**: No significant difference (p-value = 0.402), indicating similar thrombocytopenia trends in both groups.
4. **Blood Urea**: Significant difference (p-value = <0.05) with higher levels in early onset (18.25), suggesting more severe renal dysfunction in early onset pre eclampsia.
5. **Serum Creatinine**: Significant difference (p-value = 0.002) with higher levels in early onset (0.61), reflecting worse renal impairment in early onset cases.
6. **Total Bilirubin**: No significant difference (p-value = 0.236), suggesting similar liver function in both groups.
7. **SGOT**: No significant difference (p-value = 0.704), indicating no major liver damage or peripheral pathology in either group.
8. **SGPT**: Significant difference (p-value = 0.009) with higher levels in early onset (18.0), indicating more primarily liver involvement in early onset pre eclampsia.
9. **LDH**: Significant difference (p-value = 0.028) with higher levels in EOP (361.0), suggesting greater tissue damage and hemolysis in early onset cases.
10. **Uric Acid**: Significant difference (p-value = 0.025) with higher levels in EOP (5.60), indicating more severe vascular and renal complications in early onset pre eclampsia.
11. **hs-CRP**: No significant difference (p value – 0.428) between early and late onset pre eclampsia.

TABLE-18: DISTRIBUTION OF SUBJECTS ACCORDING TO MATERNAL COMPLICATIONS

	Early onset (N=42)		Late onset (N=59)		Chi-square (p-value)
	hs-CRP < 5 mg/L (N=17)	hs-CRP > 5 mg/L (N=25)	hs-CRP < 5 mg/L (N=32)	hs-CRP > 5 mg/L(N=27)	
Disseminated Intravascular Coagulopathy (DIC)	1 (2.4 %)	0 (0 %)	0 (0 %)	0 (0 %)	3.871 (0.230)
Abruptio placentae	1 (2.4 %)	1 (2.4 %)	0 (0%)	0 (0 %)	
HELLP syndrome	0 (0 %)	5 (11.6 %)	5 (8.5 %)	3 (5.1 %)	
No complications	15 (36 %)	19 (45.2 %)	27 (45.8 %)	24 (40.6 %)	

Table 18- Most patients across all groups had no complications. HELLP syndrome was the most frequently observed complication in both early and late-onset cases with hs-CRP > 5 mg/L. DIC and abruptio placentae occurred only in early-onset cases and only in a few individuals. The overall association between hs-CRP levels and complications was no statistically significant (p = 0.230).

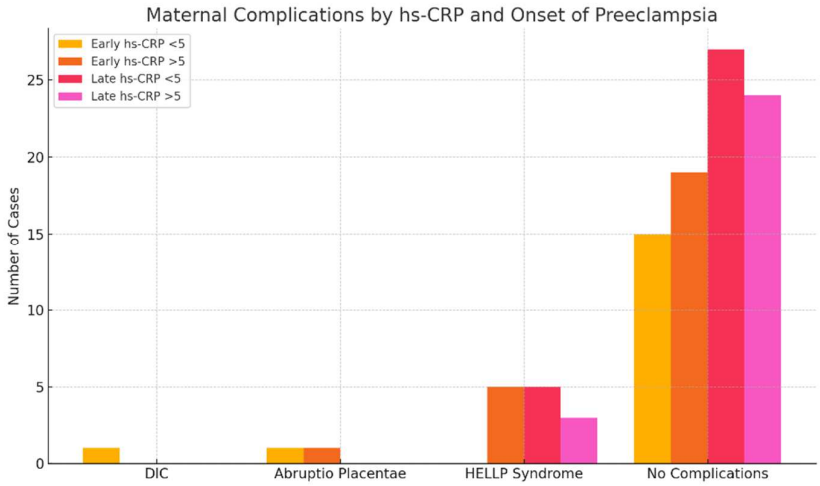


FIGURE 17: DISTRIBUTION OF SUBJECTS ACCORDING TO MATERNAL COMPLICATIONS

TABLE 19- DISTRIBUTION OF SUBJECTS ACCORDING TO MODE OF DELIVERY

Mode of delivery	Early onset (N= 42)		Late onset (N=59)		p value
	hs-CRP < 5 mg/L (N=17)	hs-CRP > 5 mg/L (N=25)	hs-CRP < 5 mg/L(N=32)	hs-CRP > 5 mg/L(N=27)	
Vaginal delivery	4 (9.5 %)	5 (11.9 %)	2 (3.4 %)	2 (3.4 %)	0.185
Instrumental delivery	0 (0%)	0 (0%)	1 (1.7 %)	1 (1. %)	0.687
Caesarean delivery	13 (30.9 %)	20 (47.7 %)	29 (49.4 %)	24 (40.4 %)	0.459

Table 19- The mode of delivery was analyzed in relation to hs-CRP levels (<5 mg/L vs. >5 mg/L) among women with early onset and late onset pre eclampsia. Across all groups, cesarean delivery was the predominant mode, particularly in late onset pre eclampsia. Cesarean section was the most frequent mode of delivery in both early and late onset pre eclampsia, with no significant difference based on hs-CRP levels. Statistical analysis revealed no significant association between hs-CRP levels and the mode of delivery in either early or late onset pre eclampsia as p values are >0.05. These findings suggest that elevated hs-CRP levels were not significantly associated with the choice or necessity of delivery mode. However, the overall high rate of cesarean sections, especially in late-onset cases, may reflect clinical decisions based on obstetric complications or fetal distress, rather than inflammatory marker levels alone.

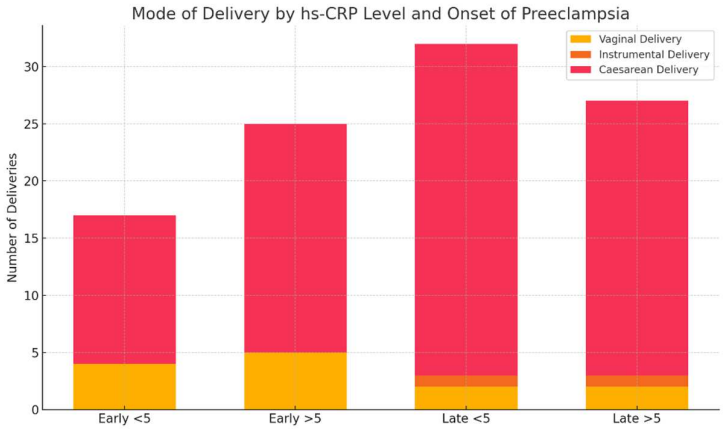


FIGURE 18- DISTRIBUTION OF SUBJECTS ACCORDING TO MODE OF DELIVERY

TABLE-20: DISTRIBUTION OF SUBJECTS ACCORDING TO FETAL GROWTH RESTRICTION

	Early onset (N=42)		Late onset (N=59)		Chi-square (p-value)
	hs-CRP < 5 mg/L (N=17)	hs-CRP 5 mg/L (N=25)	hs-CRP < 5 mg/L(N=32)	hs-CRP > 5 mg/L (N=27)	
No fetal growth restriction	7 (16.6 %)	8 (19 %)	24 (40.7 %)	21 (35.6 %)	17.13 (<0.05) *
Fetal growth restriction	10 (23.8 %)	17 (40.6 %)	8 (13.5 %)	6 (10.2%)	

Table no. 20- This table examines the relationship between hs-CRP levels and the presence or absence of Fetal Growth Restriction (FGR) in early and late onset pre eclampsia. FGR is significantly more common in early onset pre eclampsia, especially with higher hs-CRP levels. Late onset cases show much lower FGR prevalence, regardless of hs-CRP level. A Chi-square value of 17.13 with a p-value < 0.05 indicates a highly statistically significant association. The findings support the use of hs-CRP as a potential marker for predicting FGR, particularly in early-onset cases.

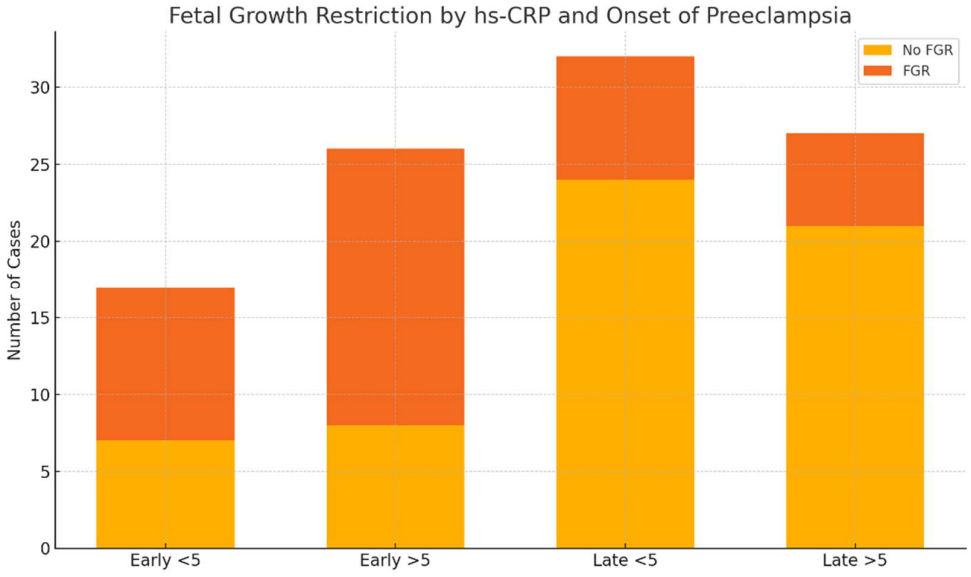


FIGURE 19: DISTRIBUTION OF SUBJECTS ACCORDING TO FETAL GROWTH RESTRICTION

TABLE 21: DISTRIBUTION OF SUBJECTS ACCORDING TO THE UMBLICAL ARTERY DOPPLER

Umblical artery doppler	Early onset (N=42)		Late onset (N=59)		Chi-square (p-value)
	hs-CRP < 5 mg/L (N=17)	hs-CRP > 5 mg/L (N=25)	hs-CRP < 5 mg/L (N=32)	hs-CRP > 5 mg/L (N=27)	
Normal	3 (7.1 %)	7 (16.7 %)	26 (44.1)	24 (40.7)	39.62 (< 0.0001)
Increased	7 (16.7 %)	11 (26.1 %)	4 (6.7)	2 (3.4)	
Absent	7 (16.7 %)	7 (16.7 %)	2 (3.4)	1 (1.7)	

Table no 21- There is a highly significant association between hs-CRP levels and Umbilical Artery Doppler findings across both early and late onset pre eclampsia groups ($\chi^2 = 39.62$, $p < 0.0001$). In early onset pre eclampsia, elevated hs-CRP levels (>5 mg/L) are associated with a higher prevalence of abnormal doppler patterns (increased or absent end-diastolic flow). Conversely, in late onset cases, the majority of participants—regardless of hs-CRP level, had normal Doppler values, suggesting less vascular compromise.

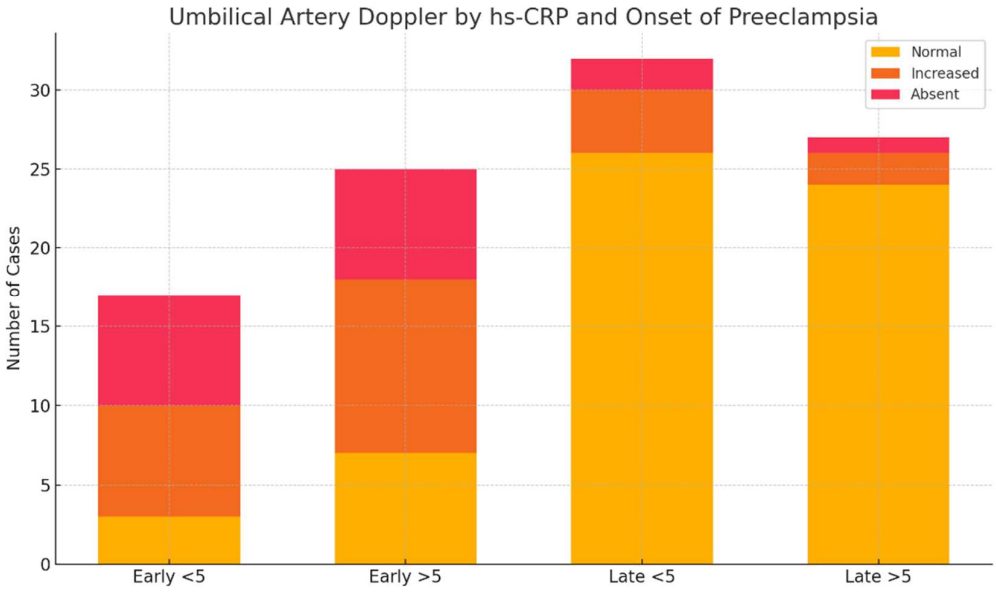


FIGURE 20: DISTRIBUTION OF SUBJECTS ACCORDING TO THE UMBLICAL ARTERY DOPPLER VALUES

TABLE 22: DISTRIBUTION OF SUBJECTS ACCORDING TO THE FETAL OUTCOMES

	Early onset (N=42)		Late onset (N=59)		Chi-square (p-value)
	hs-CRP < 5 mg/L (N=17)	hs-CRP > 5 mg/L (N=25)	hs-CRP < 5 mg/L (N=32)	hs-CRP > 5 mg/L(N=27)	
Live births	15 (35.7 %)	22 (52.4 %)	32 (54.2%)	27 (45.8%)	7.390 (0.011) *
Fresh still births	2 (4.7 %)	3 (7.1 %)	0 (0)	0 (0)	

Table no 22: This table assesses the association between hs-CRP levels and perinatal outcomes (live birth vs. fresh stillbirth) in early and late onset pre eclampsia. Fresh stillbirths occurred only in early onset pre eclampsia, particularly in both hs-CRP groups. No stillbirths occurred in late onset pre eclampsia, regardless of hs-CRP level. The Chi-square value is 7.390 with a p-value = 0.011, indicating a statistically significant association. This suggests that early onset pre eclampsia carries a higher risk of adverse perinatal outcomes, such as stillbirth, independent of hs-CRP level. But this cannot be compared as in early onset pre eclampsia fetus delivered are extremely preterm, very pre term where the chances of survival is very less when compared to late onset pre eclampsia as the period of gestation varies in both groups.

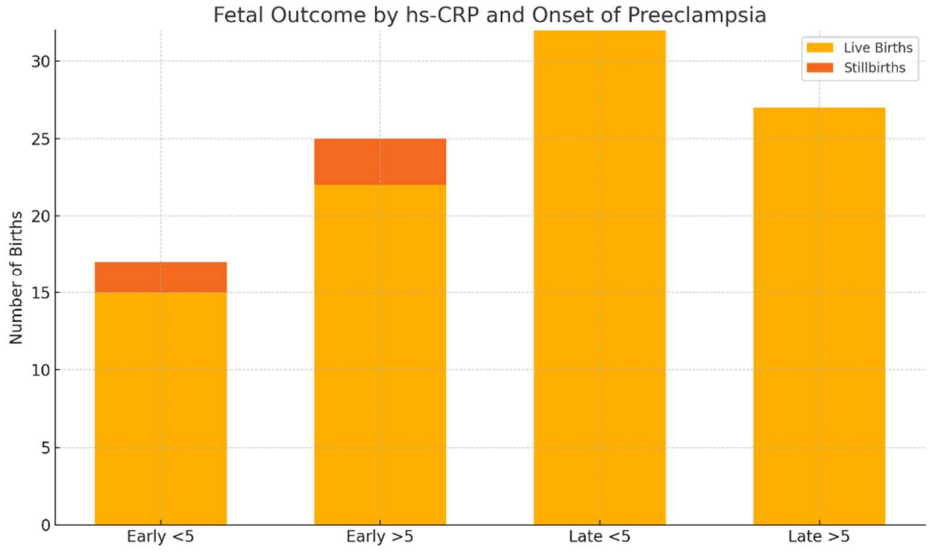


FIGURE 21: DISTRIBUTION OF SUBJECTS ACCORDING TO THE FETAL OUTCOMES

TABLE 23: DISTRIBUTION OF SUBJECTS ACCORDING TO THE BIRTH WEIGHT

Birth Weight	Early onset (N=42)		Late onset (N=59)		Chi-square (p-value)
	hs-CRP < 5 mg/L (N=17)	hs-CRP > 5 mg/L (N=25)	hs-CRP < 5 mg/L (N=32)	hs-CRP > 5 mg/L(N=27)	
≤ 1 kg	8 (19 %)	6 (14.4 %)	0 (0 %)	0 (0 %)	72.109 (<0.05) *
>1-1.5 kg	3 (7.1 %)	9 (21.4 %)	1 (1.7 %)	0 (0 %)	
>1.5- 2 kg	4 (9.5 %)	6 (14.4 %)	2 (3.4 %)	2 (3.4)	
>2-2.5 kg	2 (4.7 %)	4 (9.5 %)	8 (13.7 %)	10 (16.9)	
>2.5- 3 kg	0 (0 %)	0 (0 %)	16 (27.2 %)	10 (16.9)	
>3 kg	0 (0%)	0 (0 %)	5 (8.4 %)	5 (8.4)	

Table 23- This table examines the distribution of birth weights in early and late onset pre eclampsia cases, stratified by hs-CRP levels (<5 mg/L and >5 mg/L). Low birth weight (<1.5 kg) is significantly more common in early-onset pre eclampsia, especially in cases with low hs-CRP (<5 mg/L). Higher birth weights (≥2.5 kg) were observed only in late onset pre eclampsia, across both hs-CRP categories as the period of gestation is more, henceforth the birth weight. None of the early onset cases had babies weighing 2.5 kg or more, showing a strong association with growth restriction and prematurity. There is a highly significant association between birth weight and the type/onset of pre eclampsia, as well as hs-CRP levels ($p < 0.05$). But birth weight cannot be compared between early and late onset pre eclampsia groups as Birth weight depends on the period of gestation and both the groups are differing in period of gestation. Early onset pre eclampsia is associated with extremely pre term births due to difference in period of gestation in both the groups.

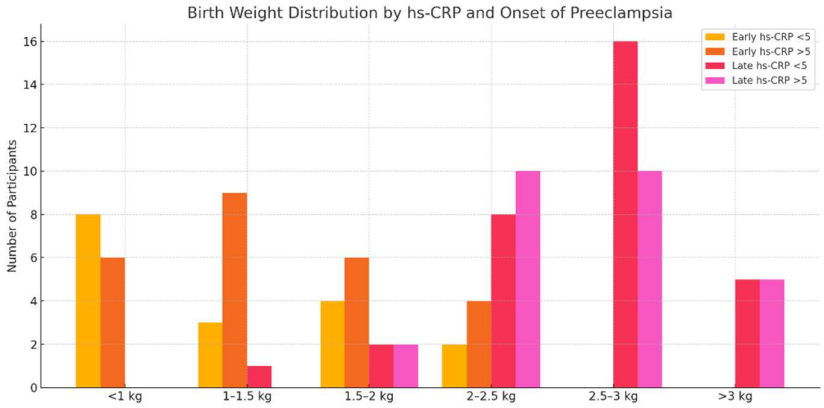


FIGURE 22: DISTRIBUTION OF SUBJECTS ACCORDING TO THE BIRTH WEIGHT

TABLE 24: DISTRIBUTION OF SUBJECT ACCORDING TO NICU ADMISSIONS

NICU Admissions	Early Onset (N=37)		Late onset (N=59)		Chi-square (p-value)
	hs-CRP < 5 mg/L (N=16)	hs-CRP > 5 mg/L (N=21)	hs-CRP < 5 mg/L (N=32)	hs-CRP > 5 mg/L (N=27)	
Yes	13 (35.2%)	18 (48.6 %)	5 (8.2 %)	4 (6.5 %)	44.02 (<0.05)
No	3 (8.1 %)	3 (8.1%)	27 (45.4 %)	23 (39.9 %)	

Table no. 24- In **early onset pre eclampsia**, NICU admissions were **very high** in both hs-CRP < 5 and > 5 groups. In contrast, in **late onset pre eclampsia**, NICU admissions were **low**, regardless of hs-CRP. The **difference in NICU admission rates** across onset and inflammation level groups was found to be **statistically significant** using the **Fisher's Exact Test** (**p < 0.05**). But this cannot be compared as the period of gestation between two groups vary and henceforth the birth weight also varies where early onset pre eclampsia is associated with extremely pre term and term birth weight babies which require NICU admission

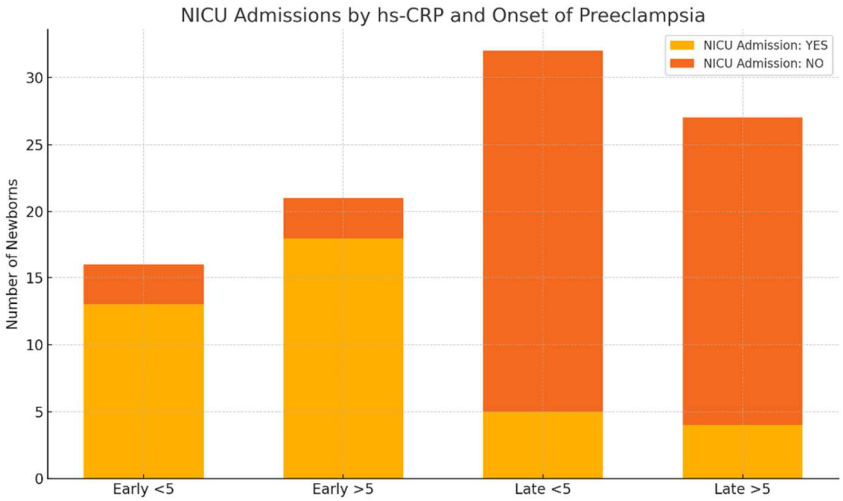


FIGURE 23: DISTRIBUTION OF SUBJECTS ACCORDING TO NICU ADMISSIONS

This study investigated the association between maternal high-sensitivity C-reactive protein (hs-CRP) levels and various clinical, obstetric and perinatal outcomes in early onset and late onset pre eclampsia. The key findings are as follows:

1. Demographic Characteristics- No statistically significant differences were observed in maternal age, pre-pregnancy BMI, or gravidity between early and late onset pre eclampsia groups. These factors did not appear to influence the timing of disease onset.

2. Severity of Pre eclampsia- Early onset pre eclampsia was significantly more likely to be severe ($p = 0.024$), with higher rates of complications and adverse outcomes compared to late onset cases.

3. Blood Pressure and Laboratory Parameters- Systolic blood pressure (SBP) was significantly higher in early onset cases ($p = 0.036$). Laboratory markers such as blood urea, serum creatinine, SGPT, LDH, and uric acid were also significantly elevated in early onset pre eclampsia, indicating more severe organ involvement.

4. hs-CRP Levels- While the median hs-CRP level was higher in early onset pre eclampsia (6.20 mg/L) compared to late onset (4.70 mg/L), the difference was not statistically significant ($p = 0.428$). A wide interquartile range suggests heterogeneity in inflammatory responses.

5. Association of hs-CRP with Clinical Variables- hs-CRP levels did not significantly differ by age, BMI, or gravidity within early vs. late onset groups. Similarly, hs-CRP levels were not significantly associated with the severity of pre eclampsia when analyzed across the full cohort.

6. Fetal Growth Restriction (FGR)- A strong and statistically significant association was found between hs-CRP levels and FGR ($p < 0.001$), particularly in early onset pre eclampsia. This suggests a role for systemic inflammation in fetal growth compromise.

7. Umbilical Artery Doppler Findings- Abnormal Doppler findings (e.g., absent or increased end-diastolic flow) were significantly more common in early onset cases with elevated hs-CRP levels ($p < 0.0001$), indicating placental vascular dysfunction associated with inflammation.

8. Neonatal Outcomes- NICU admissions, low birth weight (<1.5 kg), and stillbirths were significantly more common in early-onset preeclampsia and were more frequent among women with elevated hs-CRP. However, gestational age may confound these associations.

9. Mode of Delivery- Cesarean delivery was the most common mode across all groups. No significant association was found between hs-CRP levels and mode of delivery ($p > 0.05$), suggesting delivery decisions were more likely based on clinical complications, fetal outcomes rather than inflammatory status alone.

DISCUSSION

Pre eclampsia remains a significant obstetric challenge with profound implications for both maternal and fetal health. The present study provides valuable insights into the inflammatory differences between early and late onset pre eclampsia, particularly in terms of maternal age, BMI, obstetric scores, gestational age, severity of pre eclampsia, biochemical and inflammatory markers with a particular focus on high-sensitivity C-reactive protein (hs-CRP) as a potential biomarker for disease severity and outcome prediction. The results align with previous research while also highlighting some unique trends that warrant further investigation.[40].

High-Sensitivity C-Reactive Protein (hs-CRP) and Pre eclampsia

Elevated hs-CRP levels across the pre eclampsia cohort reaffirm the role of systemic inflammation in the pathogenesis of this disorder. In this study, the mean hs-CRP was 7.32 ± 8.59 mg/L, and the median was 5.8 mg/L—both exceeding the normal threshold of 5 mg/L. These findings are consistent with previous research by Ustun et al. (2005) and Verma et al. (2016), which demonstrated a strong association between elevated CRP levels and pre eclampsia, particularly in severe and early onset cases.

While early onset pre eclampsia showed a trend toward higher median hs-CRP values (6.2 mg/L) compared to late onset (4.7 mg/L), the difference was not statistically significant ($p = 0.428$). This aligns with findings from Chaiworapongsa et al. (2013) and Mishra et al. (2019), who reported higher inflammatory gene expression and serum markers in early onset pre eclampsia but also noted variability based on individual patient responses and gestational timing.

Maternal Age

The present study observed variations in hs-CRP levels across different maternal age groups in both early onset and late onset pre eclampsia cases. Although median hs-CRP levels tended to be higher in early onset cases across most age categories, these differences were not statistically significant. For instance, in the 21–25 year age group, early onset cases had a median hs-CRP of 9.75 mg/L, notably higher than the 4.5 mg/L observed in late onset cases within the same group ($p = 0.378$). Similar trends were noted in the 25–30 year age group, though again, without statistical significance ($p = 0.968$).

These findings suggest a possible age-related variation in the increase inflammatory response, particularly in younger women with early onset disease. However, the absence of statistically significant differences may be attributed to small subgroup sizes, limiting the power to detect true associations.

The literature remains inconclusive regarding age specific inflammatory patterns in pre eclampsia. While maternal age is a known risk factor for hypertensive disorders of pregnancy, Chaiworapongsa et al. (2013) did not establish a direct link between age and elevated CRP expression. Similarly, Gencheva et al. (2021) found no clear correlation between maternal age and hs-CRP in preeclamptic pregnancies, although elevated hs-CRP was independently associated with adverse outcomes regardless of age. The current study aligns with these findings indicating that maternal age may not be a strong independent predictor of inflammatory burden as measured by hs-CRP.

Pre-pregnancy BMI

Pre-pregnancy Body Mass Index (BMI) showed a more noticeable association with hs-CRP levels. In overweight individuals (BMI 25–29.9), early onset pre eclampsia cases had notably higher median hs-CRP levels (8.8 mg/L) compared to late onset cases (4.7 mg/L), though this difference was not statistically significant ($p = 0.242$). In those with normal BMI (18.5–24.99), hs-CRP levels were slightly higher in early onset cases (5.1 mg/L vs. 4.6 mg/L, $p = 0.530$).

These observations are consistent with existing literature that associates higher BMI with elevated systemic inflammation, reflected by increased hs-CRP levels. Obesity and overweight status are well-established risk factors for both pre eclampsia and chronic low-grade inflammation. Jääskeläinen et al. (2019) demonstrated that obese women had significantly elevated inflammatory and angiogenic markers during pregnancy, which may exacerbate endothelial dysfunction and worsen maternal outcomes. Additionally, Verma et al. (2016) suggested that overweight women are more likely to have hs-CRP levels >8 mg/L, increasing the risk of pre eclampsia by nearly threefold.

However, in this study, the absence of obese participants (BMI >30) limited further stratified analysis and may have influenced the strength of associations observed.

Blood pressure measurements in early and late onset pre eclampsia

In this study, systolic blood pressure (SBP) was found to be significantly higher in the early onset pre eclampsia group compared to the late onset group (median SBP: 164 mmHg vs. 160 mmHg, $p = 0.036$). Although the differences in diastolic blood pressure (DBP) and mean arterial pressure (MAP) were not

statistically significant ($p = 0.089$ and $p = 0.055$, respectively), both parameters were slightly elevated in early onset cases. This indicates a more severe hypertensive profile in early onset pre eclampsia, which is known to be associated with poorer maternal and fetal outcomes. The more elevated SBP and narrower interquartile ranges in early onset cases suggest a more homogenous but severe disease course. These results are consistent with prior studies by von Dadelszen et al. and Sibai et al., which reported higher blood pressure values and greater cardiovascular strain in early onset pre eclampsia due to abnormal placentation and heightened vascular resistance. These findings highlight the importance of early recognition and intensive management of hypertensive parameters in early onset cases to reduce maternal and perinatal complications.[39]

Gravidity status

In the current study, a higher proportion of early onset pre eclampsia cases were observed among primigravida (59.5%) compared to multigravida (40.5%), while the late-onset group showed a more balanced distribution (50.8% primigravida vs. 49.2% multigravida). However, the association between parity and type of onset was not statistically significant ($p = 0.388$).

These findings align with the well-documented observation that primigravidity is a major risk factor for pre eclampsia, particularly early onset disease. First pregnancies are often characterized by a naive maternal immune response to the feto-placental unit, which may contribute to abnormal placentation and a heightened inflammatory response. This theory is supported by studies such as Miller et al. (2003) and Seiner et al. (2001), which identified higher pre eclampsia rates in first-

time mothers, attributing this to incomplete immunologic adaptation and less efficient spiral artery remodeling.

In the context of this study, hs-CRP levels were higher in primigravida with early onset pre eclampsia (median: 8.5 mg/L) compared to late onset primigravida (median: 4.15 mg/L), though this difference was not statistically significant ($p = 0.293$). This trend is suggestive of a stronger inflammatory phenotype in first-time mothers who develop early-onset disease. Among multigravida, hs-CRP levels were comparable between early and late-onset groups ($p = 0.981$), indicating a less pronounced variation in inflammatory response.

The trend toward higher hs-CRP in primigravida supports earlier findings by Hamad et al. (2010) and Cetin et al. (2011), who associated elevated inflammatory markers with first-time pregnancies complicated by pre eclampsia. This suggests that primigravida women may experience a heightened systemic inflammatory reaction, which could contribute to earlier and more severe disease manifestations. The immunologic basis for the increased risk of pre eclampsia in primigravidas stems from limited prior exposure to paternal antigens, which may lead to inadequate tolerance development. This immunologic maladaptation impairs trophoblastic invasion and contributes to the poor spiral artery remodeling observed in early onset pre eclampsia. In contrast, multigravida with the same partner may benefit from immunologic priming, allowing for better placental development and reduced risk. However, the parity-pre eclampsia relationship is not absolute. Multigravida may also develop pre eclampsia, particularly in cases with a new partner (altered antigenic exposure), Pre-existing comorbidities (e.g., diabetes, obesity, chronic hypertension) and history of prior pre eclampsia, which increases recurrence risk.

In combination with elevated hs-CRP levels and other risk factors (e.g., BMI, blood pressure), it can help identify high-risk pregnancies that may benefit from enhanced surveillance and early intervention. In particular, primigravida women with elevated hs-CRP and early gestational symptoms should be closely monitored for signs of severe disease progression.

Mean Period of gestation

In the present study, early onset pre eclampsia was associated with mean gestational age of 30 weeks 4 days and late onset cases at 37 weeks 5 days. Correspondingly, hs-CRP levels were higher in early onset cases (median: 6.2 mg/L) versus late-onset (median: 4.7 mg/L), though this difference was not statistically significant ($p = 0.428$).

When analyzed across gestational age groups, the highest hs-CRP levels were observed between 28–34 weeks (median: 9.2 mg/L), particularly in early onset cases. This period coincides with peak placental stress and systemic inflammation, consistent with the pathophysiology of placental ischemia and oxidative stress, as described in studies by Jauniaux et al. (2006) and Cetin et al. (2011). However, no statistically significant association was found between hs-CRP and gestational age subgroup ($p > 0.05$), likely due to small sample sizes in the earliest and latest gestational windows.

These findings support the role of inflammation in preterm pre eclampsia, where elevated hs-CRP may reflect greater placental dysfunction and systemic response. While hs-CRP may not directly correlate with gestational age in all cases, it appears to be more elevated in earlier onset disease, suggesting its potential value in identifying high-risk, preterm pregnancies

Severity of pre eclmapsia

Although the overall comparison of hs-CRP levels between non severe and severe pre eclampsia was not statistically significant (p = 0.741), subgroup analysis revealed that severe early onset pre eclampsia was associated with notably higher median hs-CRP levels (8.3 mg/L) than non severe cases (2.4 mg/L). This supports the idea that early onset disease reflects a more pronounced inflammatory process, corroborating Hamad et al. (2010) and Gencheva et al. (2021) who noted a link between inflammatory biomarkers, vascular resistance, and disease severity.

Late onset pre eclampsia, in contrast, showed no meaningful difference in hs-CRP levels between severe and non severe subgroups (p = 0.536), suggesting that systemic inflammation may play a less pivotal role in its pathogenesis.

Biochemical Markers

The study found significant differences in biochemical markers between early- and late onset pre eclampsia. Early onset cases had higher levels of blood urea, serum creatinine, SGPT, LDH, and uric acid, indicating more severe renal and hepatic dysfunction. These findings are consistent with Sibai et al. (2005) and Lisonkova et al. (2014), who reported that early onset pre eclampsia is associated with more profound systemic vascular and organ damage. The higher hs-CRP levels in early onset pre eclampsia, although not statistically significant, suggest a more pronounced inflammatory response, which aligns with the hypothesis that early onset pre eclampsia is driven by placental dysfunction and systemic inflammation.[43]

Maternal Complications

An analysis of maternal complications in relation to hs-CRP levels revealed a trend of elevated inflammatory markers in early onset pre eclampsia. HELLP syndrome was more frequently associated with hs-CRP >5 mg/dL in early onset cases (median 12.20 mg/L), compared to lower levels in late onset cases with the same complication (median 3.55 mg/L). Out of 16 subjects having maternal complications, HELLP Syndrome was the most common complication (13 subjects) noted with either partial HELLP or complete HELLP syndrome. Although the association between hs-CRP levels and complications such as DIC and abruptio placentae was not statistically significant (Chi-square P = 0.230), the observed trend supports prior studies suggesting a stronger inflammatory milieu in early onset disease. A study by Belo et al. (2005) demonstrated significantly higher CRP levels in early onset pre eclampsia with severe features, linking systemic inflammation to endothelial dysfunction and disease progression. Similarly, Kristensen et al. (2009) reported elevated CRP in pre eclamptic women with HELLP syndrome, highlighting its potential role in predicting maternal morbidity. While our data did not reach statistical significance, likely due to small sample size, the pattern of increased hs-CRP in early onset cases with complications suggests its utility as a supplementary marker for disease severity.

Mode of delivery

Across all subgroups, caesarean section was the most common mode of delivery, followed by vaginal delivery, while instrumental delivery was rare. These results suggest that elevated hs-CRP levels were not independently associated with the type of delivery in either early or late-onset preeclampsia. This may reflect the fact that obstetric decision-making is primarily driven by fetal distress, gestational

age, severity of preeclampsia, and maternal complications, rather than inflammatory marker levels alone. Although caesarean section was the predominant mode of delivery across both early and late onset preeclampsia cases, vaginal deliveries were proportionally more common in early onset preeclampsia. However, it likely reflects specific clinical decisions driven by maternal indications and fetal viability. Many early onset cases involved extremely low birth weight fetuses and pre-viable or peri-viable gestations, where the termination of pregnancy was prioritized for maternal benefit rather than fetal survival, particularly in cases of rapidly progressing disease or multi-organ involvement. These decisions align with established management guidelines, where expectant management is not pursued beyond the point of maternal risk. In such scenarios, vaginal delivery may be preferred due to lower maternal morbidity, especially when fetal survival is unlikely. This context explains why vaginal delivery was more frequent in early-onset cases despite higher disease severity.

Several studies have indirectly explored the relationship between inflammation and delivery outcomes. Miller et al. (2003) and Seiner et al. (2001) emphasized that severe forms of preeclampsia are more likely to necessitate caesarean delivery, largely due to complications such as placental abruption, non-reassuring fetal status, or poor Bishop scores, especially in early onset cases. However, they did not identify hs-CRP as a determinant for mode of delivery. Ustun et al. (2005) and Verma et al. (2016) demonstrated that elevated CRP levels correlate with disease severity and adverse fetal outcomes, which may indirectly contribute to a higher rate of caesarean sections. In the present study, although a higher proportion of caesarean deliveries was noted in those with elevated hs-CRP, particularly in late onset cases the difference was not statistically significant, likely due to limited subgroup sizes.

Furthermore, Chaiworapongsa et al. (2013) reported that early onset preeclampsia is often accompanied by greater inflammatory and angiogenic disturbances, resulting in poor placental perfusion and fetal compromise. These underlying pathologies may necessitate emergency caesarean delivery irrespective of hs-CRP levels. Thus, hs-CRP may be more reflective of disease state than a direct influencer of delivery method.

FGR and Umbilical Artery Doppler

This study demonstrated a significant association between elevated hs-CRP levels (>5 mg/L) and both fetal growth restriction (FGR) and abnormal umbilical artery doppler findings, particularly in early onset pre eclampsia. Among early onset cases with elevated hs-CRP, the incidence of FGR was markedly higher (64%), and Doppler abnormalities such as increased or absent end-diastolic flow were more frequent, indicating severe placental insufficiency. Both associations were statistically significant ($p < 0.05$ and $p < 0.0001$, respectively).

These findings support the hypothesis that placental vascular dysfunction pathology in early onset leads to systemic inflammation, reflected by elevated hs-CRP, resulting in impaired fetal growth and abnormal fetal blood flow. This is consistent with the literature, where hs-CRP has been linked to pro-inflammatory and antiangiogenic activity that disrupts placental perfusion, as noted by Rasmussen et al. (2015) and Chaiworapongsa et al. (2013).

In contrast, late onset pre eclampsia showed fewer cases of FGR and mostly normal Doppler studies, even when hs-CRP was elevated—highlighting its distinct pathophysiological origin, likely driven more by maternal cardiovascular maladaptation than placental dysfunction.

Overall, combining hs-CRP with umblical artery doppler assessment may enhance early identification of fetuses at risk for growth restriction and adverse outcomes in preeclamptic pregnancies.

Fetal Outcomes

In the present study, live births were significantly more frequent in late onset pre eclampsia, whereas stillbirths occurred exclusively in early onset cases, particularly those with elevated hs-CRP levels. This finding reflects the well-documented disparity in perinatal outcomes between early and late onset pre eclampsia and underscores the impact of both gestational age at delivery and placental insufficiency on fetal viability. These cases were largely associated with deliveries before 28–30 weeks, a gestational window during which fetal survival is critically dependent on both fetal maturity and NICU availability. This aligns with prior studies, including Miller et al. (2003) and Fox et al. (2019), which report a markedly higher risk of stillbirth in pregnancies complicated by early onset pre eclampsia due to severe placental dysfunction, abruptio placentae, and intrauterine hypoxia.

The elevated inflammatory profile in these early onset cases, evidenced by higher median hs-CRP levels, may reflect systemic endothelial activation and placental vascular compromise, both of which are central to the pathophysiology of pre eclampsia. Although the association between hs-CRP and stillbirth was not statistically analyzed independently due to small sample size, the clustering of stillbirths in the high hs-CRP, early onset subgroup suggests a potential contributory role.

In contrast, all late onset pre eclampsia cases in this study resulted in live births, regardless of hs-CRP level. These pregnancies were typically delivered at term or near-term, allowing sufficient fetal maturation to support survival without severe

compromise. This supports findings by Seiner et al. (2001) and Veerbeek et al. (2015), who noted that late onset pre eclampsia is more often linked to maternal vascular intolerance of pregnancy, with less placental involvement and better perinatal outcomes.

Birth Weight

Significant differences in birth weight distribution were also noted in relation to hs-CRP. Extremely low birth weight infants (≤1.5 kg) were almost exclusively observed in early onset cases, particularly those with hs-CRP >5 mg/L. Conversely, infants weighing ≥2.5 kg were only seen in late onset preeclampsia, regardless of hs-CRP status. These trends suggest that elevated inflammation in early gestation may be a contributing factor to placental insufficiency, ultimately resulting in growth restriction and preterm birth. However, as noted in the literature Jauniaux et al., (2006), birth weight must be interpreted in the context of gestational age, since early-onset preeclampsia inherently limits fetal growth due to shorter gestation duration.

NICU Admissions

The difference in NICU admission rates across hs-CRP levels and onset types was statistically significant ($p < 0.05$), indicating that inflammatory burden may play a role in fetal compromise necessitating intensive care. These findings are consistent with previous studies. Gencheva et al. (2021) and Chen et al. (2018) reported that elevated hs-CRP in pregnant women correlated with a higher incidence of neonatal complications such as low Apgar scores, respiratory distress syndrome and infections, all of which contribute to NICU admission.

Elevated hs-CRP levels in pre eclamptic pregnancies reflect systemic maternal inflammation and placental dysfunction, which can impair fetal oxygenation and

growth. In early-onset preeclampsia, where placental insufficiency is more severe, this can lead to premature delivery and low birth weight, both of which are independent risk factors for NICU admission. While hs-CRP is not a direct determinant of neonatal condition, it likely acts as a proxy marker for the intrauterine environment, particularly in terms of inflammation and hypoxia.

Moreover, elevated hs-CRP is often associated with fetal growth restriction (FGR) and abnormal umbilical artery Doppler findings, as shown in this study. These fetal complications further necessitate early delivery and intensive postnatal support, strengthening the observed link between hs-CRP and NICU care.

In late-onset preeclampsia, NICU admission rates were low (6.5–8.2%) across both hs-CRP subgroups. This supports the understanding that late-onset disease is generally less severe, more maternal in origin, and occurs at more advanced gestational ages, allowing for better fetal outcomes and reduced need for NICU support.

These findings underscore the potential utility of hs-CRP as part of a multimodal biomarker panel—especially in identifying women at risk of severe early onset pre eclampsia and poor perinatal outcomes.

STRENGTHS

1. This study offers a detailed comparison of early and late onset pre eclampsia, covering a wide range of factors including maternal age, gravidity, gestational age, biochemical markers, and maternal and fetal outcomes. This holistic approach provides a clearer understanding of the differences between the two subtypes and its distinct mechanisms pathophysiology.
2. By incorporating high-sensitivity C-reactive protein (hs-CRP) into the analysis, the study provides valuable insight into the inflammatory component of pre eclampsia. The exploration of hs-CRP in relation to disease severity, maternal characteristics, and fetal outcomes adds a meaningful contribution to current literature.
3. This study provides additional insights into the role of laboratory markers, such as hsCRP, blood urea, serum creatinine, SGPT, LDH, and uric acid, in differentiating between early and late onset pre eclampsia. Although some differences were not statistically significant, the findings suggest potential avenues for future research.
4. The study highlights the importance of early detection and management of pre eclampsia, particularly in younger women and those with risk factors such as primigravida status and elevated hsCRP levels. These insights can inform clinical practice and improve maternal and neonatal outcomes.

LIMITATIONS

1. The overall sample size was less and certain subgroups—such as non-severe early-onset pre eclampsia and specific age/BMI categories—had limited representation. This may have reduced the statistical power to detect significant differences in hs-CRP levels and clinical outcomes within these subpopulations.

2. The study design was observational and cross-sectional, with hs-CRP measured at a single time point. This precludes the ability to assess temporal changes in inflammatory status or track hs-CRP trends throughout the course of the disease.

3. The absence of a matched normotensive pregnant control group limits the ability to compare hs-CRP levels directly with healthy pregnancies, which could have strengthened conclusions regarding baseline inflammation in pre eclampsia.

4. hs-CRP is influenced by many factors such as Sub clinical inflammation, smoking. stress and dietary habbits leading to abnormal values in the absence of the diease.

CONCLUSION

High-sensitivity C-reactive protein (hs-CRP) has emerged as a valuable biomarker reflecting systemic inflammation in preeclampsia, particularly in early-onset and severe forms of the disease. This study reinforces the importance of hs-CRP in elucidating the inflammatory pathophysiology of preeclampsia and its broader impact on maternal and fetal health.

Elevated hs-CRP levels were more commonly observed in early onset preeclampsia, which was associated with a more severe clinical course—including significantly higher blood pressure, renal and hepatic dysfunction, HELLP syndrome, fetal growth restriction (FGR), abnormal umbilical artery doppler patterns and increased NICU admissions. In contrast, late onset preeclampsia was associated with lower hs-CRP levels and relatively more favorable outcomes, supporting the hypothesis of distinct pathophysiological mechanisms—placental and inflammatory in early onset versus maternal metabolic in late onset disease.

Statistically significant associations between elevated hs-CRP and adverse perinatal outcomes—particularly FGR and abnormal doppler flow—underscore the potential utility of hs-CRP as a supportive marker for risk stratification and disease monitoring.

From a clinical perspective, these findings support the integration of hs-CRP into antenatal risk assessment models, particularly for younger women, primigravida and those with early onset disease. While hs-CRP should not replace standard diagnostic tools, its combined use with angiogenic markers (such as the sFlt-1/PlGF ratio) and doppler velocimetry may improve early identification of high-risk pregnancies, thereby enhancing surveillance and informing the timing of intervention.

Further large-scale, longitudinal studies are needed to validate hs-CRP as a predictive biomarker in diverse populations and to establish gestational age–specific thresholds. Research should also explore the underlying inflammatory mechanisms in pre eclampsia and assess whether targeted anti-inflammatory interventions can improve outcomes. Serial hs-CRP monitoring may offer insights into disease progression and aid in early risk stratification

SUMMARY

A Prospective cross sectional study was conducted at KAHER'S Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi to study and compare maternal hs-CRP levels in early and late onset pre eclampsia and fetomaternal outcomes in patients with raised hs-CRP levels. A total of 528 patients were screened with hypertension, out of which 101 patients were included in the study after diagnosing with pre eclampsia considering the inclusion and exclusion criteria. Patient was categorized into two groups - Early onset pre eclampsia (Early onset) and Late onset pre eclampsia (Late onset) according to their definitions. Different parameters such as Maternal age, BMI, Gravida status, Mean gestational age, Severity of pre eclampsia, biochemical and inflammatory markers with a particular focus on high-sensitivity C-reactive protein (hs-CRP) were studied among early nd lte onset pre eclampsia patients. This study findings were as follows-

- The Mean hs-CRP in pre eclampsia patients was 7.32 ± 8.59 mg/L and the median was 5.8 mg/L—both exceeding the normal threshold of 5 mg/L.
- Early onset pre eclampsia showed a trend toward higher median hs-CRP values (6.2 mg/L) compared to late onset (4.7 mg/L), but the difference was not statistically significant (p = 0.428).
- Median hs-CRP levels were higher in early onset pre-eclampsia across most age groups, though not statistically significant. In the 21–25 age group, hs-CRP was 9.75 mg/L vs. 4.5 mg/L (p = 0.378), and in the 25–30 group, 5.8 mg/L vs. 3.9 mg/L (p = 0.968).
- Among overweight individuals (BMI 25–29.9), median hs-CRP was higher in early onset (8.8 mg/L) than late onset pre-eclampsia (4.7 mg/L; p = 0.242). In

those with normal BMI (18.5–24.99), hs-CRP was slightly higher in early onset (5.1 mg/L vs. 4.6 mg/L; p = 0.530), though neither difference was statistically significant.

- Median SBP was significantly higher in early onset pre eclampsia (164 mmHg) compared to late onset (160 mmHg, p = 0.036). DBP (112 vs. 110 mmHg, p = 0.089) and MAP (129 vs. 128 mmHg, p = 0.055) were also higher in early onset, though not statistically significant.
- Primigravida were more frequent in early onset pre-eclampsia (59.5%) than late onset (50.8%), while multigravida accounted for 40.5% and 49.2% respectively (p = 0.388), showing no statistically significant association between gravidity and onset. In primigravida, median hs-CRP was higher in early onset pre-eclampsia (8.5 mg/L) compared to late onset (4.15 mg/L; p = 0.293), suggesting a trend toward greater inflammation. Among multigravida, hs-CRP levels were similar between groups (p = 0.981).
- Early onset pre eclampsia was associated with a mean gestational age of 30 weeks 4 days and late onset with 37 weeks 5 days. Median hs-CRP was higher in early onset (6.2 mg/L) vs. late onset (4.7 mg/L; p = 0.428). The highest hs-CRP levels were seen between 28–34 weeks (median: 9.2 mg/L), though no significant association was found across gestational age subgroups ($p > 0.05$).
- Overall, hs-CRP levels were higher in severe pre-eclampsia (median: 6.2 mg/L) than non-severe (4.3 mg/L), but the difference was not significant (p = 0.741). In early onset cases, severe pre-eclampsia showed higher hs-CRP (8.3 mg/L) vs. non-severe (2.4 mg/L; p = 0.120), suggesting greater inflammation. In late onset cases, hs-CRP levels were similar between severe (4.5 mg/L) and non-severe (4.8 mg/L; p = 0.536).

- Early onset pre eclampsia showed significantly higher levels of blood urea (18.25 vs. 13.60 mg/dL; $p < 0.05$), serum creatinine (0.61 vs. 0.53 mg/dL; $p = 0.002$), SGPT (18.0 vs. 12.0 U/L; $p = 0.009$), LDH (361 vs. 342 U/L; $p = 0.028$), and uric acid (5.6 vs. 5.2 mg/dL; $p = 0.025$) compared to late onset cases, indicating more severe renal and hepatic dysfunction. Median hs-CRP was also higher in early onset (6.2 vs. 4.7 mg/L; $p = 0.428$), suggesting a stronger inflammatory response, though not statistically significant.
- Maternal complications were more frequently associated with elevated hs-CRP levels in early onset pre-eclampsia. HELLP syndrome was the most common complication (13/16 cases), with higher hs-CRP in early onset cases (median: 12.2 mg/L) compared to late onset (median: 3.55 mg/L). Although the overall association between hs-CRP and complications like DIC or abruption was not statistically significant ($p = 0.230$), the trend suggests a stronger inflammatory response in early onset disease, supporting its role as a potential marker of severity.
- Caesarean section was the most common mode of delivery in both early and late onset pre-eclampsia, with no significant association between hs-CRP levels and delivery type ($p > 0.05$). Vaginal delivery was proportionally more common in early onset cases, likely due to clinical decisions prioritizing maternal safety in cases of pre-viable or severely compromised fetuses. These findings suggest that mode of delivery was influenced more by gestational age, fetal viability, and disease severity than by inflammatory status.
- Elevated hs-CRP levels (>5 mg/L) were significantly associated with fetal growth restriction (FGR) ($p < 0.05$) and abnormal umbilical artery doppler findings ($p < 0.0001$), especially in early onset pre eclampsia. In this group, FGR incidence

reached 64%, and Doppler abnormalities (increased or absent end-diastolic flow) were more frequent, indicating severe placental insufficiency. In contrast, late onset pre-eclampsia showed fewer cases of FGR and predominantly normal Doppler findings, even with elevated hs-CRP levels—suggesting a different pathophysiology primarily driven by maternal cardiovascular maladaptation rather than placental insufficiency.

- Live births were significantly more common in late onset pre-eclampsia, while all stillbirths occurred in early onset cases, particularly among those with hs-CRP >5 mg/L. These stillbirths were associated with deliveries before 28–30 weeks, highlighting the role of prematurity and placental insufficiency. No stillbirths were reported in late onset cases, regardless of hs-CRP levels, reflecting better fetal maturity and outcomes. The clustering of stillbirths in early onset with elevated hs-CRP suggests a potential link between systemic inflammation, placental dysfunction, and poor perinatal outcome.
- Significant differences in birth weight were observed with respect to hs-CRP levels. Infants with birth weight ≤1.5 kg were predominantly seen in early onset pre-eclampsia with hs-CRP >5 mg/L, while those ≥2.5 kg were exclusively seen in late onset cases, irrespective of hs-CRP levels—reflecting the impact of gestational age and placental insufficiency in early onset disease. But these cannot be compared as the period of gestation varies resulting in extremely low birth and very low birth weight babies.
- NICU admission rates were significantly higher in early onset pre-eclampsia, particularly among cases with hs-CRP >5 mg/L ($p < 0.05$), indicating a possible link between systemic inflammation and neonatal compromise. In contrast, NICU admissions were low in late onset cases (6.5–8.2%) across hs-CRP levels.

Elevated hs-CRP was also associated with FGR and abnormal Doppler findings, reinforcing its role as a marker of intrauterine inflammation and placental insufficiency, which contribute to preterm birth and NICU need.

This study found that hs-CRP levels were elevated in preeclampsia, especially in early-onset and severe cases. Although not statistically significant, higher hs-CRP was associated with worse maternal and fetal outcomes. Significant correlations were observed with fetal growth restriction, abnormal doppler findings, and increased NICU admissions. Early-onset cases showed greater inflammatory and organ dysfunction. hs-CRP may serve as a supportive biomarker for risk stratification in preeclamptic pregnancies. These findings support the role of hs-CRP as a potential marker for disease severity and placental insufficiency.

BIBLIOGRAPHY

1. American College of Obstetricians and Gynecologists. Hypertension in pregnancy. ACOG Practice Bulletin No. 203. 2019.
2. Magee LA, Pels A, Helewa M, Rey E, von Dadelszen P. Diagnosis, evaluation, and management of the hypertensive disorders of pregnancy. Pregnancy Hypertens. 2014;4(2):105–45.
3. Brown MA, Magee LA, Kenny LC, Karumanchi SA, McCarthy FP, Saito S, et al. The hypertensive disorders of pregnancy: ISSHP classification, diagnosis & management recommendations for international practice. Pregnancy Hypertens. 2018;13:291–310.
4. Sibai BM. Eclampsia. Obstet Gynecol. 2022;140(2):253–70.
5. Ghulmiyyah L, Sibai B. Maternal mortality from pre eclampsia/eclampsia. Semin Perinatol. 2012;36(1):56–9.
6. World Health Organization. WHO recommendations for prevention and treatment of Pre eclampsia and eclampsia. WHO Press; 2011.
7. Auger N, Fraser WD, Paradis G. Later life cardiovascular disease in women with hypertension during pregnancy. BJOG. 2011;118(9):1032–9.
8. Mendez-Figueroa H, Lam DV, Anderson BL. High-risk pregnancies in advanced maternal age: pathways to adverse perinatal outcomes. J Perinat Med. 2013;41(6):635–41.
9. Tranquilli AL, Dekker G, Magee L, Roberts J, Sibai BM, Steyn W, et al. The classification, diagnosis, and management of the hypertensive disorders of pregnancy. Pregnancy Hypertens. 2014;4(2):97–104.
10. Redman CWG, Staff AC. Pre eclampsia, biomarkers, syncytiotrophoblast stress, and placental capacity. Am J Obstet Gynecol. 2015;213(4 Suppl):S9–11.

11. Wu P, Haththotuwa R, Kwok CS, Babu A, Cocco N, Prathapan S, et al. Pre eclampsia and future cardiovascular health. Circ Cardiovasc Qual Outcomes. 2017;10(2):e003497.
12. Raymond D, Peterson E. A critical review of early-onset and late-onset pre eclampsia. Obstet Gynecol Surv. 2011;66(8):497–506.
13. Staff AC, Bengtson MH, Sollid CPE. Pre eclampsia and uteroplacental acute atherosis: immune and inflammatory factors. Curr Hypertens Rep. 2022;24:115–29.
14. Myatt L. Placental adaptive responses and fetal programming. J Physiol. 2016;594(8):2167–75.
15. Burton GJ, Jauniaux E. Pathophysiology of placental-derived fetal growth restriction. Am J Obstet Gynecol. 2018;218(2 Suppl):S745–61.
16. Levine RJ, Lam C, Qian C, Yu KF, Maynard SE, Sachs BP, et al. Soluble endoglin and other circulating antiangiogenic factors in pre eclampsia. N Engl J Med. 2006;355(10):992–1005.
17. Rana S, Powe CE, Salahuddin S, Verlohren S, Perschel FH, Levine RJ, et al. Angiogenic factors and the risk of adverse outcomes in women with suspected pre eclampsia. Circulation. 2012;125(7):911–9.
18. August P, Sibai B. Pre eclampsia: clinical features and diagnosis. UpToDate; 2017.
19. Ganguly E, McDermott JC, Troughton K. Inflammation, infection, and pre eclampsia. Discov Med. 2020;29(156):159–69.
20. Szarka A, Rigo J Jr, Lázár L, Bereczki C, Molvarec A. Circulating cytokines, chemokines and adhesion molecules in normal pregnancy and pre eclampsia determined by multiplex suspension array. BMC Immunol. 2010;11:59.

21. Pepys MB, Hirschfield GM. C-reactive protein: a critical update. J Clin Invest. 2003;111(12):1805–12.
22. Ridker PM. From C-reactive protein to interleukin-6 to interleukin-1: moving upstream to identify novel targets for atheroprotection. Circ Res. 2016;118(1):145–56.
23. Pitiphat W, Joshipura KJ, Williams PL, Douglass CW. C-reactive protein associated with periodontitis and preterm birth. J Dent Res. 2005;84(11):1042–7.
24. Sacks GP, Seyani L, Lavery S, Trew G. Maternal C-reactive protein levels are raised at 4 weeks gestation. Hum Reprod. 2004;19(4):1025–30.
25. Roberts WL, Sedrick R, Moulton L, Spencer A, Rifai N. Evaluation of four automated high-sensitivity C-reactive protein methods: implications for clinical and epidemiological applications. Clin Chem. 2000;46(4):461–8.
26. National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy. Report of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy. Am J Obstet Gynecol. 2000;183(1):S1–S22.
27. Seiner DB, Samuels P, Kniss DA. The spectrum of hypertension in late pregnancy. In: Seiner DB, Samuels P, Kniss DA, editors. The S. physiologic basis of gynaecology and obstetrics. Philadelphia: Lippincott Williams & Wilkins; 2001. p. 551.
28. Miller DA. Hypertension in pregnancy. In: Decherney AH, Goodwin TN, Lauder N, editors. Current diagnosis and treatment: Obstetrics and gynaecology. 10th ed. New York: McGraw-Hill; 2003. p. 318.

29. Ustun Y, Ustun YE, Kamaci M. Association of fibrinogen and C-reactive protein with severity of pre eclampsia. Eur J Obstet Gynecol Reprod Biol. 2005;121(2):154–8.
30. Jauniaux E, Postan L, Burton GJ. Placental-related diseases of pregnancy: Involvement of oxidative stress and implications in human evolution. Hum Reprod Update. 2006;12(6):747–55.
31. Hamad RR. Cardiovascular function and biomarkers in women with pre eclampsia [Doctoral dissertation]. Institutionen för kvinnors och barns hälsa/Department of Women's and Children's Health; 2010.
32. Cetin I, Huppertz B, Burton G, Cuckle H, Gonen R, Lapaire O, et al. Pregenesys Pre eclampsia markers consensus meeting: What do we require from markers, risk assessment and model systems to tailor preventive strategies? Placenta. 2011;32(Suppl):S4–S16.
33. Bishara N. The use of biomarkers for detection of early- and late-onset neonatal sepsis. In: Hematology, Immunology and Infectious Disease: Neonatology Questions and Controversies. 2012. p. 303–15.
34. Chaiworapongsa T, Romero R, Whitten A, Tarca AL, Bhatti G, Draghici S, et al. Differences and similarities in the transcriptional profile of peripheral whole blood in early and late-onset pre eclampsia: Insights into the molecular basis of the phenotype of pre eclampsia. J Perinat Med. 2013;41(5):485–504.
35. Rasmussen LG, Lykke JA, Staff AC. Angiogenic biomarkers in pregnancy: Defining maternal and fetal health. Acta Obstet Gynecol Scand. 2015;94(8):820–32.
36. Veerbeek JH, Hermes W, Breimer AY, Van Rijn BB, Koenen SV, Mol BW, et al. Cardiovascular disease risk factors after early-onset pre eclampsia, late-onset pre

eclampsia, and pregnancy-induced hypertension. Hypertension. 2015;65(3):600–6.

37. Verma A. Evaluation of the diagnostic value of the early second-trimester maternal serum high sensitivity C-reactive protein level for prediction of Pre eclampsia–A prospective study [Master's thesis]. Rajiv Gandhi University of Health Sciences, India; 2016.
38. Alma LJ, Bokslag A, Maas AH, Franx A, Paulus WJ, de Groot CJ. Shared biomarkers between female diastolic heart failure and Pre eclampsia: A systematic review and meta-analysis. ESC Heart Fail. 2017;4(2):88–98.
39. Chen H, Zhang J, Qin F, Chen X, Jiang Y. Evaluation of the predictive value of high sensitivity C-reactive protein in pregnancy induced hypertension syndrome. Exp Ther Med. 2018;16(2):619–22.
40. Güngör ZB, Tüten A, Ekmekçi H, Ekmekçi ÖB, Kucur M, Öncül M, et al. Possible effects of lipoprotein-associated phospholipase A2 single-nucleotide polymorphisms on cardiovascular risk in patients with pre eclampsia. J Matern Fetal Neonatal Med. 2018;31(23):3119–27.
41. Fox R, Kitt J, Leeson P, Aye CY, Lewandowski AJ. Pre eclampsia: Risk factors, diagnosis, management, and the cardiovascular impact on the offspring. J Clin Med. 2019;8(10):1625.
42. Jääskeläinen T, Heinonen S, Hämäläinen E, Pulkki K, Romppanen J, Laivuori H, et al. Impact of obesity on angiogenic and inflammatory markers in the Finnish Genetics of Pre eclampsia Consortium (FINNPEC) cohort. Int J Obes. 2019;43(5):1070–81.
43. Mishra N, Pradhan K, Sahoo CD, Rohilla M, Meena M. Can hsCRP be the sole investigation for predicting the severity and outcome in women with pre

eclampsia presenting late in pregnancy? Trop J Obstet Gynaecol. 2019;36(1):54–60.

44. Sunjaya AF, Sunjaya AP. Evaluation of serum biomarkers and other diagnostic modalities for early diagnosis of pre eclampsia. J Fam Reprod Health. 2019;13(2):56–[end page].
45. Shen-y SS, Mishra SP, Shafiulla SA. Association of maternal C-reactive protein in severe pre eclampsia. J Evol Med Dent Sci. 2020;9(28):2002–6.
46. Gencheva DG, Nikolaev FP, Uvhikova EH, Mihaylov RD, Pencheva BG, Inaniva KI. High sensitivity CRP levels in women with gestational hypertension, pre eclampsia and in normotensive pregnant women and its correlations. Folia Med (Plovdiv). 2021.
47. Glaser MA, Hughes LM, Jnah A, Newberry D. Neonatal sepsis: A review of pathophysiology and current management strategies. Adv Neonatal Care. 2021;21(1):49–60.
48. Coggins SA, Glaser K. Updates in late-onset sepsis: Risk assessment, therapy, and outcomes. NeoReviews. 2022;23(11):738–55.
49. Joshi K, Acharya N, Acharya [Initial], et al. Maternal serum high sensitive C-reactive protein (hsCRP) as a prognostic marker of fetomaternal outcome in hypertensive disorders of pregnancy: A novel study. Cureus. 2022;14(4):e24327.
50. Nóbrega L, Katz L, Lippo L, Amorim MM. Association of sFlt-1 and C-reactive protein with outcomes in severe pre eclampsia: A cohort study. Medicine. 2022;101(11):e29059.
51. Sarma AA, Aggarwal NR, Briller JE, Davis M, Economy KE, Hameed AB, et al. The utilization and interpretation of cardiac biomarkers during pregnancy: JACC: Advances Expert Panel. JACC Adv. 2022;1(3):100064.

52. Al Bakoush FB, Azab AE, Yahya RA. Neonatal sepsis: Insight into incidence, classification, risk factors, causative organisms, pathophysiology, prognosis, clinical manifestations, complications, systemic examination, and treatment. South Asian Res J Appl Med Sci. 2023;5(6):136–57.
53. Møller HI, Persson G, Klok FB, Vojdeman FJ, Lebech M, Hviid TVF. Investigations of leukocyte and inflammatory markers in pregnancies complicated by pre eclampsia. J....

ANNEXURE I:

INFORMED CONSENT FORM

"STUDY OF HIGH SENSITIVITY C- REACTIVE PROTEIN (HS-CRP) LEVELS IN EARLY AND LATE ONSET PRE ECLAMPSIA IN A TERTIARY CARE HOSPITAL- ONE YEAR CROSS SECTIONAL STUDY."

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

Introduction: Preeclampsia is a common hypertensive disorder of pregnancy characterized by hypertension that occurs after 20 weeks of gestation in a woman with previously normal blood pressure accompanied by proteinuria.

C- reactive protein (CRP) is an inflammatory bio marker, a sensitive index of tissue inflammation and damage. C-reactive protein is a serum glycoprotein produced by the liver during acute inflammation. The circulating CRP value reflect the ongoing inflammation and tissue damage much more accurately than do the laboratory parameters of acute phase response.

Preeclampsia often lead to adverse obstetric and neonatal outcomes and thus there is a need for early detection and effective management.

Explanation of procedure: Venous blood sample will be taken from antenatal women diagnosed with preeclampsia beyond 20 weeks of gestation and sent for investigation along with other biochemical parameters.

The sample will be centrifuged and hsCRP level will be measured by immunoturbidimetry method.

Demographic characteristics, patient examination findings along with lab parameters will be collected from the records and will be noted in the proforma. Other parameters such as mode of delivery and fetomaternal outcome will be noted in the proforma.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will not get any benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the **principal investigator**

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**STUDY OF HIGH SENSITIVITY C- REACTIVE PROTEIN (HS-CRP) LEVELS IN EARLY AND LATE ONSET PRE ECLAMPSIA IN A TERTIARY CARE HOSPITAL- ONE YEAR CROSS SECTIONAL STUDY**". My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE II:

SCREENING FORM

Participant information

IP number :

Screening number :

Date of screening (dd/mm/yyyy):

First name :

Last name :

Husband name :

Age (years) :

Address :

Phone number :

1) Diagnosis-

☐ Gestational Hypertension

☐ Chronic Hypertension

☐ Pre Eclampsia

1) Complaints of PV Leak or features of chorioamnionitis

☐ PPROM ☐ PROM ☐ NO

2) History of acute infections and fever

☐ YES ☐ NO

3) Known case of chronic inflammatory disease YES ☐ NO ☐

4) Known case of any medical conditions such as YES NO

Chronic Hypertension with Super imposed Pre Eclampsia	☐	☐
Overt Diabetes Mellitus	☐	☐
Gestationa Diabetes mellitus,	☐	☐
Heart disease	☐	☐
Renal disorder.	☐	☐

5) History of treatment with antibiotics or steroids in the last one week (like Injections)

☐ YES ☐

The women is eligible to consent only if answers to above 4 questions is NO

1) Eligible
2) Not Eligible

Did the women give consent for the study?

1) Yes
2) No

Was the women enrolled in the study

1) Yes
2) No

ENROLLMENT NUMBER :

ANNEXURE III:

DATA COLLECTION INSTRUMENTATION

Enrollement number :

Date of Admission :

Date of Delivery :

Date of Discharge :

Present pregnancy

a) Last Menstrual Period (LMP) :

b) Estimated Delivery Date (EDD) :

c) Corrected Estimated Delivery Date (If present):

d) Period of Gestation :

Obstetric History

Married life(Years) :

Obstetric Score :

Gravida : Para : Living :

Abortion : Death : Ectopic :

Past history

H/o of Gestational hypertension/ Pre eclampsia in past pregnancy

YES ☐ NO ☐

H/o of chronic hypertension

YES ☐ NO ☐

H/o any medical disorders

YES ☐ NO ☐

Clinical Characteristics at admission

Age (years)	
Gestational age at blood sampling(weeks)	
Height (in centimeters)	
Weight (in kilograms)	
BMI	
Pallor	
Icterus	
Pedal Edema	
Systolic blood pressure	
Diastolic blood pressure	
Pulse Rate	

Systemic Examination

Per abdomen: Uterine size in weeks

Presentation

Fetal heart rate

Clinically EFW

Primary Diagnosis

Investigations

Hs CRP (mg/dl)	
Haemoglobin (gm/dl)	
Total leukocyte count (/$mm^{3)}$	
Platelet count (x 10^5/ml)	
Serum Urea (mg/dl)	
Serum Creatinine (mg/dl)	
Total Bilirubin (mg/dl)	
Direct Bilirubin (mg/dl)	
Indirect Bilirubin (mg/dl)	
Serum AST/ SGOT (U/L)	
Serum ALT/ SGPT (U/L)	
Alkaline phosphatase (U/L)	
Serum total proteins (gm/dl)	
Serum Albumin (gm/dl)	
Serum Globulin (gm/dl)	
LDH (U/L)	
Sodium (mEq/L)	
Potassium (mEq/L)	
Bicarbonates (mEq/L)	
Chlorides (mEq/L)	
Uric acid (mg/dl)	
Prothrombin time (sec)	
International normalized ratio (INR)	
Urine Albumin	

Maternal complications

Abruptio placentae	
Acute liver injury	
Acute kidney injury	
Disseminated Intravascular Coagulopathy	
HELLP syndrome	
Neurological symptoms including eclampsia	
Other complications	

Fetal related parameters- Ultrasound findings

Detailed Growth Scan at weeks	
Biparietal Diameter (BPD)	
Head Circumference (HC)	
Abdominal Circumference (AC)	
Femur Length (FL)	
Estimated fetal weight (EFW)	
Amniotic Fluid Index (AFI)	
Umblical artery doppler studies	
Fetal growth restriction	

Post delivery fetal outcome

Gestational age at delivery	
Birth weight	
Liquor	
NICU admission- Reason	
Intra uterine fetal demise	
Early neonatal mortality	
APGAR score At 1 MIN At 5 min	

Mode of Delivery

Vaginal delivery (Spontaneous/ Induced)	
Instrumental delivery (Ventouse/ Forceps)	
Caesarean delivery (Indication of Caesarean delivery)	

ENROLLEMENT NO.	AGE	OBSTETRIC SCORE	PERIOD OF GESTATION	PRE ECCLAMPSIA	SEVERITY OF PRE ECCLAMPSIA	BMI	SBP	DBP	MAP	HAEMOGLOBIN	TLC	PLATELET COUNT	URINE ALBUMIN	UREA	CREATININE	SERUM BILIRUBIN	SGOT	SGPT	LDH	URIC ACID	MATERNAL COMPLICATIONS	FETAL GROWTH RESTRICTION	UMBLICAL ARTERY DOPPLER	MODE OF DELIVERY	INDICATION FOR LSCS	FETAL OUTCOME	BIRTH WEIGHT	NICU ADMISSION
1	36	G3P2L1D1	28	EARLY ONSET	NON SEVERE	24.8	158	98	118	13.4	9800	268000	1+	16.1	0.54	0.48	24	12	283	6.2	NIL	EARLY ONSET FGR	INCREASED	LSCS	PRE ECLAMPSIA WITH REDF	LIVE	820	YES- RESP DISTRESS ELBW
2	27	PRIMIGRAVIDA	28 WEEKS 1 DAY	EARLY ONSET	SEVERE	27.8	164	100	121	14.4	9800	303000	2+	18.1	0.6	0.23	17	48	381	7.2	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PE WITH AEDF	LIVE	967	YES- ELBW WITH RESP DISTRESS
3	24	PRIMIGRAVIDA	40 WEEKS	LATE ONSET	SEVERE	24.3	166	112	130	11.5	9800	176000	1+	16.1	0.5	0.25	14	14	342	5.6	NIL	NO	NORMAL	LSCS	THICK MSL	LIVE	2800	YES- FETAL DISTRESS
4	23	PRIMIGRAVIDA	35 WEEKS 4 DAYS	LATE ONSET	SEVERE	26.6	162	110	127	8.2	8800	186000	3+	27.6	0.89	0.73	26	16	261	8.2	HELLP SYNDROME	NO	NORMAL	LSCS	SEVERE PE WITH HELLP	LIVE	2100	NO
5	19	PRIMIGRAVIDA	33 WEEKS	EARLY ONSET	SEVERE	28.6	164	108	127	12.9	7600	67000	2+	23.5	0.6	0.64	300	262	626	5.8	HELLP SYNDROME	EARLY ONSET FGR	INCREASED	LSCS	SEVERE PE WITH HELLP	LIVE	1200	YES- VLBW WITH RESP DISTRESS
6	25	PRIMIGRAVIDA	35 WEEKS 1 DAY	LATE ONSET	SEVERE	28.6	170	110	130	13	8900	311000	1+	22	0.63	0.29	36	23	348	4.7	NIL	LATE ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PE WITH AEDF	LIVE	1750	YES- LBW WITH RESP DISTRESS
7	26	G3P2L2	34 WEEKS 2 DAYS	LATE ONSET	SEVERE	23.4	164	112	129	10.5	9800	206000	4+	15.8	0.67	0.51	38	16	519	5.2	NIL	LATE ONSET FGR	NORMAL	LSCS	PREVIOUS 2 LSCS WITH SEVERE PE	LIVE	1680	YES- LBW WITH RESP DISTRESS
8	29	G3P2L2	37 WEEKS 4 DAYS	LATE ONSET	NON SEVERE	23.6	152	94	113	9.9	9400	229000	2+	10	0.46	0.23	13	12	196	3.5	NIL	NO	NORMAL	LSCS	PREVIOUS LSCS WITH PRE ECCLAMPSIA	LIVE	3400	NO
9	21	G2A1	36 WEEKS 5 DAYS	LATE ONSET	NON SEVERE	26.6	148	92	111	10.6	8500	233000	1+	12.1	0.49	0.36	21	12	302	4.8	NIL	LATE ONSET FGR	INCREASED	VAGINAL DELIVERY	NA	LIVE	2200	NO
10	25	PRIMIGRAVIDA	37 WEEKS 5 DAYS	LATE ONSET	SEVERE	28.8	160	110	127	11.8	9900	184000	1+	9	0.58	0.75	19	12	346	4	NIL	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	3100	NO
11	20	PRIMIGRAVIDA	37 WEEKS 5 DAYS	LATE ONSET	SEVERE	24.3	162	112	129	11.8	9100	73000	1+	12.2	0.66	0.15	23	9	347	5.6	HELLP SYNDROME	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA WITH HELLP	LIVE	3400	NO
12	24	PRIMIGRAVIDA	36 WEEKS 5 DAYS	LATE ONSET	SEVERE	27.8	166	110	129	12.3	8600	200000	1+	17.6	0.57	0.25	25	7	220	5.2	NIL	LATE ONSET FGR	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	2200	NO
13	21	PRIMIGRAVIDA	33 WEEKS 4 DAYS	EARLY ONSET	SEVERE	24.2	168	114	132	12.5	7400	298000	2+	12.2	0.6	0.54	54	27	387	5.7	ABRUPTIO PLACENTAE	EARLY ONSET FGR	INCREASED	LSCS	ABRUPTIO PLACENTAE	LIVE	1500	YES- LBW WITH RESP DISTRESS
14	22	PRIMIGRAVIDA	34 WEEKS 3 DAYS	LATE ONSET	SEVERE	27.8	162	112	129	10.9	9400	194000	2+	15	0.62	0.23	36	10	345	4.8	NIL	LATE ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PRE ECCLAMPSIA WITH AEDF	LIVE	1120	YES- VLBW WITH RESP DISTRESS
15	32	G4P2L2A1	36 WEEKS 6 DAYS	LATE ONSET	SEVERE	25	166	110	129	11.5	7900	193000	1+	10	0.47	0.34	23	13	733	5.1	NIL	NO	NORMAL	LSCS	PREVIOUS 2 LSCS WITH SEVERE PE	LIVE	2300	NO
16	38	G2P1L1	31 WEEKS 2 DAYS	EARLY ONSET	NON SEVERE	24	148	92	111	13.5	8900	194000	2+	13.4	0.62	0.57	38	33	316	5.8	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	PREVIOUS LSCS WITYH AEDF	LIVE	1000	YES- LBW WITH RESP DISTRESS
17	24	G2P2L2	38 WEEKS	LATE ONSET	SEVERE	24.5	160	108	125	7.3	6700	108000	2+	18.8	0.81	1.21	107	17	2872	7.5	NIL	NO	INCREASED	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	2000	NO
18	25	G2P1L1	32 WEEKS	EARLY ONSET	SEVERE	23.4	162	116	131	10.4	7210	212000	2+	20	0.68	0.42	22	40	350	5.6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA WITH IMMINENT SIGNS	LIVE	2100	NO
19	35	PRIMIGRAVIDA	29 WEEKS 5 DAYS	EARLY ONSET	SEVERE	23.6	166	118	134	10.4	9800	212000	2+	16	0.58	0.68	14	18	354	5.6	NIL	NO	NORMAL	VAGINAL DELIVERY	NA	LIVE	1800	YES- RESP DISTRESS WITH LBW
20	37	G4P2L2D2A1	35 WEEKS 1 DAY	LATE ONSET	SEVERE	25	162	112	129	13.7	8700	200000	2+	22.5	0.82	1.99	316	424	561	5.7	HELLP SYNDROME	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH HELLP	LIVE	1800	YES-LBW
21	28	PRIMIGRAVIDA	34 WEEKS 4 DAYS	LATE ONSET	SEVERE	23.2	166	108	125	10.6	9800	220000	1+	20	0.48	0.78	22	87	256	5.6	NIL	LATE ONSET FGR	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2000	YES- LBW
22	30	G2P1L1	31 WEEKS 2 DAYS	EARLY ONSET	SEVERE	24.3	168	118	135	10.8	9800	230000	2+	16.5	0.58	0.42	14	18	357	6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	1900	NO
23	27	PRIMIGRAVIDA	30 WEEKS	EARLY ONSET	SEVERE	27.4	160	124	136	10.8	9800	230000	2+	16	0.42	0.88	20	40	450	6.6	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	1200	YES- RESP DISTRESS WITH VLBW
24	29	G2P1L0	32 WEEKS 6 DAYS	EARLY ONSET	SEVERE	24.2	170	110	130	13.4	9800	74000	2+	10.4	0.57	0.59	29	18	503	5.6	DESSIMINATED INTRAVASCULAR COAGULOPATHY	EARLY ONSET FGR	INCREASED	LSCS	SEVERE PRE ECCLAMPSIA WITH HELLP SYNDROME	LIVE	1600	YES- LBW WITH RESP DISTRESS
25	30	G2P1L1	30 WEEKS 5 DAYS	EARLY ONSET	SEVERE	24.3	168	110	129	12	8800	171000	4+	22.4	0.66	0.22	17	10	302	6.7	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PE WITH AEDF	LIVE	1050	YES- VLBW WITH RESP DISTRESS
26	22	PRIMIGRAVIDA	36 WEEKS	LATE ONSET	SEVERE	25.6	170	116	134	11.2	9800	340000	2+	16.48	0.52	0.64	42	48	350	5.6	NIL	LATE ONSET FGR	INCREASED	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2200	NO
27	25	G2P1L1	32 WEEKS 2 DAYS	EARLY ONSET	SEVERE	24	168	108	128	12.8	7800	350000	2+	25	0.62	0.13	33	10	416	6.2	NIL	NO	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PRE ECLAMPSIA WITH AEDF	LIVE	1600	YES- LBW
28	35	G2P1L1	34 WEEKS 3 DAYS	LATE ONSET	SEVERE	27.7	166	124	138	10.8	9200	310000	1+	16.42	0.58	0.64	32	48	416	6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2400	NO
29	23	PRIMIGRAVIDA	35 WEEKS	LATE ONSET	SEVERE	23.4	168	120	136	12.4	9700	210000	2+	17	0.56	0.66	14	18	450	6.5	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2500	NO
30	22	PRIMIGRAVIDA	35 WEEKS	LATE ONSET	SEVERE	23.6	164	112	129	13.2	9800	210000	1+	16	0.52	0.68	14	12	350	5.6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2600	NO
31	30	G2P1L1	38 WEEKS	LATE ONSET	NON SEVERE	25	148	94	112	12	9800	198000	2+	16.8	0.58	0.42	42	24	456	6.5	NIL	NO	NORMAL	LSCS	PREVIOUS LSCS WITH PRE ECLAMPSIA	LIVE	2700	NO
32	26	PRIMIGRAVIDA	27 WEEKS	EARLY ONSET	SEVERE	23.2	164	108	127	12.2	7600	178000	1+	20.9	0.56	0.27	23	16	235	5.6	NIL	NO	ABSENT END DIASTOTIC FLOW	VAGINAL DELIVERY	NA	FRESH STILL BIRTH	615	NA
33	29	G2P1L¨	35 WEEKS 6 DAYS	LATE ONSET	SEVERE	24.3	160	112	128	12.3	8800	58000	1+	11.5	0.39	0.62	14	9	240	5.6	HELLP SYNDROME	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA WITH HELLP	LIVE	3000	NO
34	32	G3A2	33 WEEKS 4 DAYS	EARLY ONSET	SEVERE	24.8	164	114	131	9.2	8900	327000	2+	11.3	0.57	0.36	21	12	337	5	NIL	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	2300	NO
35	24	G3P2L2	30 WEEKS 3 DAYS	EARLY ONSET	SEVERE	24.2	164	110	128	10.1	9800	243000	1+	25.5	0.52	0.19	24	15	221	3.4	NIL	EARLY ONSET FGR	NORMAL	LSCS	SEVERE PE WITH EARLY ONSET FGR WITH PREVIOUS LSCS	LIVE	1200	YES- LBW WITH RESP DISTRESS
36	27	PRIMIGRAVIDA	33 WEEKS 6 DAYS	EARLY ONSET	SEVERE	24.3	178	114	135	11.5	9000	193000	2+	21.1	0.79	0.22	10	21	267	7.6	NIL	NO	INCREASED	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	1460	YES- LBW WITH RESP DISTRESS
37	24	G3P1L1A1	35 WEEKS 3 DAYS	LATE ONSET	NON SEVERE	25	148	92	111	11.2	9600	205000	1+	13	0.4	0.23	15	6	256	4.8	NIL	NO	NORMAL	LSCS	PREVIOUS LSCS WITH PRE ECCLAMPSIA	LIVE	2500	NO
38	23	PRIMIGRAVIDA	37 WEEKS 4 DAYS	LATE ONSET	NON SEVERE	24	154	96	115	10.4	8600	232000	1+	14.8	0.83	0.91	21	12	273	6.9	NIL	NO	NORMAL	LSCS	FAILED INDUCTION	LIVE	2500	NO

ENROLLEMENT NO.	AGE	OBSTETRIC SCORE	PERIOD OF GESTATION	PRE ECCLAMPSIA	SEVERITY OF PRE ECCLAMPSIA	BMI	SBP	DBP	MAP	HAEMOGLOBIN	TLC	PLATELET COUNT	URINE ALBUMIN	UREA	CREATININE	SERUM BILIRUBIN	SGOT	SGPT	LDH	URIC ACID	MATERNAL COMPLICATIONS	FETAL GROWTH RESTRICTION	UMBLICAL ARTERY DOPPLER	MODE OF DELIVERY	INDICATION FOR LSCS	FETAL OUTCOME	BIRTH WEIGHT	NICU ADMISSION
39	36	PRIMIGRAVIDA	33 WEEKS 4 DAYS	EARLY ONSET	SEVERE	23.7	170	118	135	10.7	9800	116000	1+	13.6	0.61	0.61	35	18	1695	6.9	HELLP SYNDROME	LATE ONSET FGR	NORMAL	LSCS	PRE ECLAMPSIA WITH HELLP	LIVE	1300	YES- RESP DISTRESS WITH VLBW
40	34	PRIMIGRAVIDA	37 WEEKS 5 DAYS	LATE ONSET	SEVERE	26.2	160	110	127	11.1	9100	237000	1+	10.7	0.46	0.24	24	12	235	3.8	NIL	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	2800	NO
41	30	G3P1L1A1	35 WEEKS 2 DAYS	LATE ONSET	SEVERE	23.6	160	112	128	10.1	7600	306000	1+	11	0.41	0.81	19	9	327	5.4	NIL	NO	NORMAL	LSCS	NON REASSURING NST	LIVE	2380	NO
42	20	PRIMIGRAVIDA	36 WEEKS 4 DAYS	LATE ONSET	NON SEVERE	26.6	148	94	112	11.5	9900	277000	1+	10	0.49	0.46	23	9	273	3.2	NIL	LATE ONSET FGR	NORMAL	VAGINAL DELIVERY	NA	LIVE	2200	NO
43	28	G2A1	38 WEEKS	LATE ONSET	NON SEVERE	23.2	154	98	117	12.7	8800	226000	2+	13.3	0.53	0.26	17	12	246	5	NIL	NO	NORMAL	LSCS	PRE ECCLAMPSIA	LIVE	3400	NO
44	28	PRIMIGRAVIDA	38 WEEKS	LATE ONSET	SEVERE	24.3	168	120	136	9.8	9200	218000	2+	14.3	0.49	0.34	22	11	218	5.1	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2800	NO
45	22	G2P1L1	36 WEEKS 2 DAYS	LATE ONSET	SEVERE	28.8	166	118	134	12.7	9500	251000	1+	10.2	0.49	0.71	39	14	176	5.1	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2670	NO
46	26	PRIMIGRAVIDA	28 WEEKS 5 DAYS	EARLY ONSET	NON SEVERE	24.2	152	98	116	10.2	9800	231000	3+	22.8	0.59	0.15	76	64	471	5.3	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	REVERSAL EDF	LIVE	680	ELBW WITH RESP DISTRESS
47	22	PRIMIGRAVIDA	36 WEEKS 3 DAYS	LATE ONSET	SEVERE	24.3	172	114	133	11.9	7100	295000	1+	7.8	0.44	0.29	23	12	353	5.6	NIL	NO	NORMAL	LSCS	SEVERE PREECLAMPSIA WITH DECREASED FETAL MOVEMENTS	LIVE	2600	NO
48	26	PRIMIGRAVIDA	37 WEEKS	LATE ONSET	SEVERE	25	168	110	129	12.2	8600	220000	2+	12.6	0.54	0.16	31	19	352	6.6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	3900	NO
49	21	PRIMIGRAVIDA	36 WEEKS 3 DAYS	LATE ONSET	NON SEVERE	26.6	148	96	113	12.7	9400	152000	1+	5.5	0.38	0.61	12	17	216	4.6	NIL	LATE ONSET FGR	NORMAL	VAGINAL DELIVERY	NA	LIVE	2600	NO
50	27	PRIMIGRAVIDA	26 WEEKS 2 DAYS	EARLY ONSET	SEVERE	23.7	164	112	129	10	8900	175000	2+	30.9	0.77	0.64	41	28	405	7.6	NIL	NO	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PRE ECLAMPSIA WITH FAILED INDUCTION	FRESH STILL BIRTH	630	
51	36	G4P3L3	34 WEEKS 4 DAYS	LATE ONSET	SEVERE	23.4	160	114	129	13.3	8600	198000	1+	10.4	0.51	0.37	55	30	269	5.2	NIL	LATE ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE ECCLAMPSIA WITH IMMINENT SIGNS	LIVE	1600	LBW WITH RESP DISTRESS
52	24	PRIMIGRAVIDA	39 WEEKS 1 DAY	LATE ONSET	SEVERE	27.8	162	114	130	11	9800	280000	1+	10	0.54	0.6	24	14	201	6.6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECCLAMPSIA	LIVE	3100	NO
53	24	PRIMIGRAVIDA	35 WEEKS 3 DAYS	LATE ONSET	NON SEVERE	25	156	94	115	12.4	8400	248000	1+	13.6	0.61	0.19	26	10	462	4.8	NIL	NO	NORMAL	LSCS	PRE ECCLAMPSIA	LIVE	2600	NO
54	28	PRIMIGRAVIDA	36 WEEKS 6 DAYS	LATE ONSET	NON SEVERE	23.2	148	92	111	8.5	8800	137000	1+	13.7	0.52	0.26	26	11	308	5.6	NIL	NO	NORMAL	LSCS	PRE ECCLAMPSIA	LIVE	2700	NO
55	26	PRIMIGRAVIDA	33 WEEKS	EARLY ONSET	SEVERE	25.5	168	118	135	9.9	10000	203000	1+	24.3	0.66	0.05	24	10	313	6.4	NIL	EARLY ONSET FGR	INCREASED	LSCS	SEVERE PRE ECLAMPSIA WITH EOFGR	LIVE	930	YES- RESP DISTRESS WITH ELBW
56	26	PRIMIGRAVIDA	28 WEEKS 3 DAYS	EARLY ONSET	SEVERE	24.8	168	120	136	9.9	7200	131000	2+	11.8	0.71	0.34	23	11	435	6.2	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PRE ECLAMPSIA WITH AEDF	LIVE	740	YES- RESP DISTRESS WITH ELBW
57	23	G2P1L1	24 WEEKS 5 DAYS	EARLY ONSET	SEVERE	24.2	166	124	138	11.3	9600	278000	1+	22.9	0.92	0.7	22	13	252	6.8	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	VAGINAL DELIVERY	NA	FRESH STILL BIRTH	600	NO
58	22	PRIMIGRAVIDA	30 WEEKS 1 DAY	EARLY ONSET	SEVERE	24.3	160	116	131	10.4	9800	192000	1+	21.5	0.64	0.12	16	98	323	5.5	NIL	EARLY ONSET FGR	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	1600	YES- VLBW WITH RESPIRATORY DISTRESS
59	30	PRIMIGRAVIDA	28 WEEKS 6 DAYS	EARLY ONSET	SEVERE	28.5	160	104	123	11.4	7600	130000	2+	17.3	0.6	0.76	46	30	529	4.2	PARTIAL HELLP SYNDROME	EARLY ONSET FGR	INCREASED	VAGINAL DELIVERY	NA	FRESH STILL BIRTH	875	
60	24	PRIMIGRAVIDA	32 WEEKS	EARLY ONSET	SEVERE	27.6	170	114	133	12.4	8900	222000	1+	9.2	0.61	0.37	23	8	365	4.3	NIL	NO	INCREASED	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2200	YES- LBW
61	24	G3P1L1A1	37 WEEKS 2 DAYS	LATE ONSET	NON SEVERE	23.7	150	94	112	9.6	9600	211000	2+	11.8	0.41	0.5	15	8	226	4.5	NIL	NO	NORMAL	LSCS	PREVIOUS LSCS WITH PRE ECLAMPSIA	LIVE	3100	NO
62	22	G2A1	38 WEEKS 3 DAYS	LATE ONSET	SEVERE	23.4	168	112	131	11.5	9700	228000	1+	13.8	0.46	0.25	11	10	342	3.9	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2700	NO
63	20	PRIMIGRAVIDA	32 WEEKS 3 DAYS	EARLY ONSET	SEVERE	26.6	158	112	127	11.6	8700	77000	2+	27.8	0.52	1.8	125	90	693	4.8	PARTIAL HELLP SYNDROME	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	SEVERE PRE ECLAMPSIA WITH HELLP	LIVE	1130	YES- VLBW WITH RESP DISTRESS
64	29	G2A1	35 WEEKS 3 DAYS	LATE ONSET	SEVERE	25	170	124	139	10.1	8900	199000	2+	10.2	0.55	0.87	19	10	352	6.2	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2600	NO
65	29	G3P2L1D1	37 WEEKS 5 DAYS	LATE ONSET	NON SEVERE	26.6	150	90	110	11.4	7600	270000	2+	10	0.6	0.6	18	10	244	3	NIL	NO	NORMAL	LSCS	NON PROGRESSION OF LABOUR	LIVE	2500	NO
66	49	PRIMIGRAVIDA	38 WEEKS 4 DAYS	LATE ONSET	NON SEVERE	24.3	148	94	111	10.8	9900	203000	2+	18.7	0.59	0.52	192	186	527	6.3	HELLP SYNDROME	NO	NORMAL	VENTOUSE DELIVERY	NA	LIVE	3100	NO
67	24	PRIMIGRAVIDA	39 WEEKS 6 DAYS	LATE ONSET	NON SEVERE	23.7	152	98	116	10.5	9700	130000	1+	10.4	0.47	0.22	18	9	241	5	NIL	NO	NORMAL	VAGINAL DELIVERY	NA	LIVE	2600	NO
68	23	G3A2	36 WEEKS 1 DAYS	LATE ONSET	SEVERE	24.2	164	120	135	10.5	9300	180000	1+	10.4	0.47	0.22	18	9	241	5	NIL	NO	NORMAL	LSCS	SEVERE PE WITH IMMINENT SIGNS	LIVE	2500	NO
69	26	G2P1L0	31 WEEKS 5 DAYS	EARLY ONSET	SEVERE	24.3	162	118	133	10.1	8300	278000	1+	10.4	0.65	0.43	23	12	259	5.6	NIL	NO	INCREASED	LSCS	SEVERE PRE ECLAMPSIA	LIVE	1300	YES- VLBW WITH RESP DISTRESS
70	22	PRIMIGRAVIDA	34 WEEKS 2 DAYS	LATE ONSET	NON SEVERE	26.7	148	94	112	11.2	10400	110000	1+	12.9	0.53	0.44	66	14	454	6.6	NIL	NO	NORMAL	LSCS	PRE ECCLAMPSIA	LIVE	2400	NO
71	28	PRIMIGRAVIDA	35 WEEKS	LATE ONSET	SEVERE	28.4	164	112	129	11.9	9400	243000	1+	9.9	0.57	0.29	32	26	387	4.2	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2200	NO
72	29	PRIMIGRAVIDA	28 WEEKS 5 DAYS	EARLY ONSET	NON SEVERE	23.7	156	96	116	11	7600	308000	1+	16.6	0.48	0.34	24	16	334	5.2	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	VAGINAL DELIVERY	NA	LIVE	820	YES- ELBW WITH RESP DISTRESS
73	38	G2P1L1	38 WEEKS 2 DAYS	LATE ONSET	SEVERE	23.4	168	112	131	12.4	9800	214000	2+	16.42	0.68	0.72	24	42	350	6	NIL	NO	NORMAL	LSCS	PREVIOUS LSCS WITH SEVERE PE WITH IMMINENT SIGNS	LIVE	2900	NO
74	35	G2P1L1	37 WEEKS 2 DAYS	LATE ONSET	SEVERE	23.6	158	118	131	11.9	8900	229000	1+	10	0.5	0.21	17	10	334	3	NIL	LATE ONSET FGR	NORMAL	LSCS	PREVIOUS LSCS WITH SEVERE PE WITH IMMINENT SIGNS	LIVE	2100	NO
75	27	PRIMIGRAVIDA	29 WEEKS 6 DAYS	EARLY ONSET	SEVERE	25.8	164	108	127	10	9500	201000	1+	17.9	0.41	0.27	34	17	438	4.4	NIL	EARLY ONSET FGR	INCREASED	LSCS	SEVERE PE IMMIMENT SIGNS	LIVE	890	YES- RESP DISTRESS WITH ELBW
76	32	G2P1L1	34 WEEKS 6 DAYS	LATE ONSET	SEVERE	23.2	168	120	136	11.9	7300	176000	1+	18.6	0.58	0.22	27	16	343	6	HELLP SYNDROME	NO	NORMAL	LSCS	PRE ECLAMPSIA WITH HELLP	LIVE	2500	NO

ENROLLEMENT NO.	AGE	OBSTETRIC SCORE	PERIOD OF GESTATION	PRE ECCLAMPSIA	SEVERITY OF PRE ECCLAMPSIA	BMI	SBP	DBP	MAP	HAEMOGLOBIN	TLC	PLATELET COUNT	URINE ALBUMIN	UREA	CREATININE	SERUM BILIRUBIN	SGOT	SGPT	LDH	URIC ACID	MATERNAL COMPLICATIONS	FETAL GROWTH RESTRICTION	UMBLICAL ARTERY DOPPLER	MODE OF DELIVERY	INDICATION FOR LSCS	FETAL OUTCOME	BIRTH WEIGHT	NICU ADMISSION
77	31	G2P1L1	33 WEEKS 5 DAYS	EARLY ONSET	NON SEVERE	26.7	150	90	110	12.3	9200	165000	1+	13.5	0.66	0.2	10	24	199	6.9	NIL	NO	INCREASED	LSCS	FETAL DISTRESS	LIVE	2100	NO
78	20	PRIMIGRAVIDA	36 WEEKS	LATE ONSET	NON SEVERE	24.8	154	108	123	12.1	7800	278000	2+	17.7	0.63	0.63	27	10	418	3.8	NIL	NO	NORMAL	VENTOUSE DELIVERY	NA	LIVE	2400	NO
79	32	G4P1L1A2	32 WEEKS 2 DAYS	EARLY ONSET	SEVERE	24.2	166	108	127	10.6	7600	189000	1+	18.6	0.56	0.45	24	12	354	5.6	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2100	NO
80	33	G2P1L1	32 WEEKS	EARLY ONSET	NON SEVERE	24.3	150	108	122	12.7	8800	145000	1+	16.6	0.48	0.34	24	16	334	5.2	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	VAGINAL DELIVERY	NA	LIVE	980	YES- ELBW WITH RESP DISTRESS
81	33	G2P2L1	34 WEEKS 6 DAYS	LATE ONSET	SEVERE	25	168	112	131	11.9	7300	98000	1+	18.6	0.58	0.22	27	15	605	6	HELLP SYNDROME	NO	NORMAL	LSCS	PRE ECCLAMPSIA WITH HELLP	LIVE	2500	NO
82	24	G3P1L1A1	33 WEEKS	EARLY ONSET	SEVERE	28.8	164	112	129	12	8900	126000	1+	18.4	0.64	0.33	25	36	485	6.5	NIL	EARLY ONSET FGR	INCREASED	VAGINAL DELIVERY	SEVERE PRE ECLAMPSIA	LIVE	1800	YES- RESP DISTRESS
83	26	PRIMIGRAVIDA	37 WEEKS 2 DAYS	LATE ONSET	SEVERE	27.7	162	112	129	13.3	9800	70000	2+	24.5	0.98	0.34	26	40	605	6.5	HELLP SYNDROME	LATE ONSET FGR	INCREASED	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2100	YES- RESP DISTRESS LBW
84	19	PRIMIGRAVIDA	32 WEEKS 4 DAYS	EARLY ONSET	SEVERE	24.5	168	112	131	12	7800	145000	2+	18.4	0.46	0.46	28	46	486	6.4	NIL	NORMAL	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2000	YES- LBW
85	21	PRIMIGRAVIDA	32 WEEKS 3 DAYS	EARLY ONSET	SEVERE	25.3	150	98	115	12	9900	178000	2+	20.2	0.64	0.58	30	68	577	6.8	ABRUPTIO PLACENTAE	EARLY ONSET FGR	INCREASED	LSCS	ABRUPTIO PLACENTAE	LIVE	1300	YES- RESP WITH VLBW
86	20	PRIMIGRAVIDA	33 WEEKS 5 DAYS	EARLY ONSET	NON SEVERE	26.7	152	98	116	10.8	6900	243000	1+	18.4	0.71	0.34	23	11	435	6.2	NIL	EARLY ONSET FGR	ABSENT END DIASTOTIC FLOW	LSCS	VAGINAL DELIVERY	LIVE	1500	YES- VLBW
87	38	G3P2L1D1	35 WEEKS 5 DAYS	LATE ONSET	SEVERE	26.6	162	112	129	12.7	9500	251000	1+	10.2	0.49	0.71	39	14	176	5.1	NIL	NORMAL	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2400	NO
88	26	G2P1L1	37 WEEKS 5 DAYS	LATE ONSET	SEVERE	23.3	160	108	128	13.7	8700	200000	2+	22.5	0.82	1.99	45	89	255	5.7	NIL	NORMAL	NORMAL	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	2800	NO
89	23	PRIMIGRAVIDA	36 WEEKS 2 DAYS	LATE ONSET	NON SEVERE	25.5	158	92	114	12.7	8800	226000	2+	13.3	0.53	0.26	17	12	246	5	NIL	LATE ONSET FGR	INCREASED	LSCS	FAILED INDUCTION	LIVE	2200	YES- LBW
90	49	PRIMIGRAVIDA	38 WEEKS 2 DAYS	LATE ONSET	NON SEVERE	27.9	150	98	115	11.1	9100	237000	1+	10.7	0.46	0.24	24	12	235	3.8	NIL	LATE ONSET FGR	INCREASED	LSCS	PRE ECLAMPSIA	LIVE	2100	NO
91	25	G3P1L1A1	38 WEKS 2 DAYS	LATE ONSET	NON SEVERE	26.8	148	90	109	11.3	9600	278000	1+	22.9	0.92	0.7	22	13	252	6.8	NIL	NORMAL	NORMAL	LSCS	PREVIOUS LSCS WITH PRE ECLAMPSIA	LIVE	2600	NO
92	24	PRIMIGRAVIDA	32 WEEKS 4 DAYS	EARLY ONSET	SEVERE	24.3	162	116	131	12.2	7600	178000	1+	20.9	0.56	0.27	23	16	235	5.6	NIL	EARLY ONSET FGR	INCREASED	LSCS	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	1500	YES- LBW
93	26	G3P1L1A1	33 WEEKS 4 DAYS	EARLY ONSET	SEVERE	28.7	166	108	127	12.4	8400	248000	1+	13.6	0.61	0.19	26	10	462	4.8	NIL	NORMAL	INCREASED	LSCS	PREVIOUS LSCS WITH SEVERE PRE ECLAMPSIA	LIVE	1800	NO
94	38	G3P1L1A1	32 WEEKS 6 DAYS	EARLY ONSET	SEVERE	26.5	168	112	131	11.3	9800	224000	1+	22.9	0.86	0.31	22	18	299	5.6	NIL	EARLY ONSET FGR	INCREASED	VAGINAL DELIVERY	SEVERE PRE ECLAMPSIA WITH IMMINENT SIGNS	LIVE	1800	YES- LBW
95	24	G2P1L1	38 WEEKS 5 DAYS	LATE ONSET	NON SEVERE	27.4	158	94	115	12	9800	198000	2+	16.8	0.58	0.42	42	24	456	6.5	NIL	NORMAL	NORMAL	LSCS	PREVEOUS LSCS WITH PRE ECLAMPSIA	LIVE	2800	NO
96	21	PRIMIGRAVIDA	39 WEEKS	LATE ONSET	NON SEVERE	29.4	156	90	112	11.6	8700	77000	1+	27.8	0.52	1.8	125	90	693	4.8	NIL	NORMAL	NORMAL	LSCS	FAILED INDUCTION	LIVE	2900	NO
97	22	PRIMIGRAVIDA	30 WEEKS 1 DAY	EARLY ONSET	SEVERE	24.3	160	116	131	10.4	9800	192000	1+	21.5	0.64	0.12	16	98	323	5.5	PARTIAL HELLP	EARLY ONSET FGR	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	1600	YES- VLBW WITH RESPIRATORY DISTRESS
98	30	PRIMIGRAVIDA	28 WEEKS 6 DAYS	EARLY ONSET	SEVERE	28.5	160	104	123	11.4	7600	130000	2+	17.3	0.6	0.76	46	30	529	4.2	NIL	EARLY ONSET FGR	INCREASED	VAGINAL DELIVERY	NA	FRESH STILL BIRTH	875	
99	24	PRIMIGRAVIDA	32 WEEKS	EARLY ONSET	SEVERE	27.6	170	114	133	12.4	8900	222000	1+	9.2	0.61	0.37	23	8	365	4.3	NIL	NO	INCREASED	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2200	YES- LBW
100	24	G3P1L1A1	37 WEEKS 2 DAYS	LATE ONSET	NON SEVERE	23.7	150	94	112	9.6	9600	211000	2+	11.8	0.41	0.5	15	8	226	4.5	NIL	NO	NORMAL	LSCS	PREVEOUS LSCS WITH PRE ECLAMPSIA	LIVE	3100	NO
101	22	G2A1	38 WEEKS 3 DAYS	LATE ONSET	SEVERE	23.4	168	112	131	11.5	9700	228000	1+	13.8	0.46	0.25	11	10	342	3.9	NIL	NO	NORMAL	LSCS	SEVERE PRE ECLAMPSIA	LIVE	2700	NO