Int. J Med. Pharm. Res.
E-ISSN: 2958-3683 | **P-ISSN**: 2958-3675
Available on: https://ijmpr.in/

International Journal of
Medical and Pharmaceutical Research

ORGINAL ARTICLE **OPEN ACCESS**

Cardiovascular Changes In Preeclampsia Patients – A Two-Dimensional Transthoracic Echocardiographic Study

Dr. Saswati Sanyal Choudhury[1], Dr. Pranab Jyoti Bhattacharyya[2], Dr. Sushmita Das[3]

[1]MD,FICOG,FIAOG,FICMCH , Professor, Department of Obstetrics and Gynaecology, Gauhati Medical College and Hospital, Guwahati, Assam
[2]MD,DM,FAPSIS,FAPSC,FCSI,FESC,FACC,FSCAI, Professor, Department of Cardiology, Gauhati Medical College and Hospital, Guwahati, Assam
[3]Department of Obstetrics and Gynaecology, Gauhati Medical College and Hospital, Guwahati, Assam

OPEN ACCESS

*Corresponding Author:

Dr. Sushmita Das
Department of Obstetrics and Gynaecology, Gauhati Medical College and Hospital, Guwahati, Assam

Received: 04-07-2025
Accepted: 23-07-2025
Available Online: 07-08-2025

A B S T R A C T

Background: Preeclampsia is a significant hypertensive disorder of pregnancy associated with increased maternal and fetal morbidity. Emerging evidence suggests that it is also linked with subclinical cardiovascular dysfunction, particularly diastolic abnormalities. This study aims to evaluate echocardiographic changes, especially diastolic function, in preeclamptic women using two-dimensional transthoracic echocardiography.

Objectives: To assess left ventricular function, focusing on diastolic and systolic parameters, in women with preeclampsia, and to correlate echocardiographic findings with gestational age and maternal age.

Methods: This hospital-based case-control study included 250 pregnant women between 20 and 36+6 weeks of gestation. Of these, 125 were diagnosed with preeclampsia and 125 were normotensive controls. Standard 2D echocardiography was used to assess parameters such as mitral inflow velocities, deceleration time, and E/e' ratio. Statistical analysis was performed using SPSS version 26.0.

Results: Early-onset preeclampsia (<34 weeks) was observed in 36% of cases. Mitral valve peak E velocity was significantly lower in cases (83.37 ± 20.19 cm/s) compared to controls (101.55 ± 6.91 cm/s, $p < 0.0001$). Deceleration time was mildly prolonged in cases (188.12 ± 37.57 ms) but not statistically significant ($p = 0.096$). The E/e' ratio was significantly lower in cases (8.23 ± 0.88 vs. 9.59 ± 1.81, $p < 0.0001$). Grade 1 diastolic dysfunction was present in 19.2% of preeclamptic women, with none in controls ($p < 0.0001$). Diastolic dysfunction was more common in the 21–30 year age group and in those with gestational age >34 weeks.

Conclusion: Preeclampsia is associated with early changes in left ventricular diastolic function, even in the absence of overt cardiac symptoms. 2D echocardiography is a valuable non-invasive tool for detecting subclinical cardiac dysfunction in these patients. Routine cardiac evaluation may aid in risk stratification and long-term cardiovascular monitoring of women with preeclampsia.

Keywords: Preeclampsia, Echocardiography, Diastolic Dysfunction, Pregnancy, Left Ventricular Function, Cardiovascular Changes.

INTRODUCTION

Preeclampsia is a multisystem hypertensive disorder that affects 2–8% of pregnancies globally and remains a leading cause of maternal and perinatal morbidity and mortality, especially in low- and middle-income countries. Characterized by new-onset hypertension and proteinuria after 20 weeks of gestation, preeclampsia is increasingly recognized as a systemic vascular disease with significant cardiovascular implications for both the mother and fetus.

The pathogenesis of preeclampsia involves abnormal placental implantation and inadequate remodeling of spiral arteries, leading to placental ischemia and the release of antiangiogenic and proinflammatory factors into the maternal circulation. This cascade results in widespread endothelial dysfunction, increased systemic vascular resistance, and altered

cardiovascular hemodynamics. These changes not only complicate the antenatal period but are also associated with long-term maternal cardiovascular risks such as chronic hypertension, ischemic heart disease, and heart failure.

During normal pregnancy, adaptive cardiovascular changes—such as increased cardiac output and decreased systemic vascular resistance—support fetal development. In contrast, preeclampsia disrupts these adaptations, leading to increased arterial stiffness, left ventricular remodeling, and subclinical myocardial dysfunction. While many of these alterations remain clinically silent, their early detection is crucial for timely intervention.

Two-dimensional transthoracic echocardiography (2D-TTE) is a non-invasive and cost-effective modality that can detect structural and functional cardiac changes in pregnancy. Previous studies have shown that preeclamptic women often exhibit diastolic dysfunction, increased left ventricular wall thickness, and altered filling patterns, even in the absence of overt symptoms. However, routine echocardiographic evaluation in preeclampsia is not yet standard practice.

This study aims to evaluate cardiovascular changes in women with preeclampsia using 2D echocardiography and correlate these findings with maternal and perinatal outcomes. By identifying early cardiac involvement, we hope to underscore the importance of echocardiographic assessment in the management and prognosis of preeclamptic pregnancies.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, time-bound case-control study conducted over a period of one year, from October 2023 to September 2024, in the Department of Obstetrics and Gynaecology at Gauhati Medical College and Hospital (GMCH), Guwahati, Assam.

Study Population

A total of 250 pregnant women between 20 and 36+6 weeks of gestation were enrolled. Among them, 125 women diagnosed with preeclampsia formed the case group, while 125 normotensive pregnant women served as the control group.

Inclusion Criteria

Cases: Pregnant women aged 18–45 years, with systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg on two occasions four hours apart, with or without proteinuria or other signs of severe preeclampsia (as per ACOG 2020 criteria).
Controls: Pregnant women of similar gestational age with normal blood pressure and no features of hypertensive disorders of pregnancy.

Exclusion Criteria

* Chronic hypertension
* Renal or connective tissue disorders
* Anemia
* Pre-existing cardiac conditions
* Gestational diabetes
* Antepartum eclampsia
* Antiphospholipid antibody syndrome

Data Collection

Demographic data, obstetric history, blood pressure readings, urine albumin levels, platelet count, liver enzymes, and fetal outcomes were recorded. All participants underwent a standardized 2D transthoracic echocardiographic examination in the Department of Cardiology, GMCH.

Echocardiographic Parameters Assessed

Systolic function: Left ventricular ejection fraction (LVEF)
Diastolic function: E/A ratio, mitral annular e′ velocity (septal and lateral), E/e′ ratio, deceleration time
Structural parameters: Interventricular septal and posterior wall thickness, chamber dimensions

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Quantitative variables were expressed as mean ± standard deviation and compared using Z-tests. Categorical variables were analyzed using Chi-square or Fisher's exact tests. A p-value <0.05 was considered statistically significant.

Ethical Considerations
The study was approved by the Institutional Ethics Committee of GMCH. Informed written consent was obtained from all participants. The study complied with the Declaration of Helsinki and Good Clinical Practice guidelines.

Certainly. Here is a detailed "Results" section for your thesis paper, written using the exact values from Tables 6, 13, 15, 19, 23, 24, and 25:

RESULTS
This study included 250 pregnant women, of whom 125 were diagnosed with preeclampsia (cases) and 125 were normotensive pregnant women (controls). Echocardiographic parameters were compared between the two groups to evaluate cardiac structural and functional changes, with a particular focus on diastolic function and its association with maternal age and gestational age.

Early-Onset Preeclampsia:

Table 1: Early onset (<34WEEKS) of Preeclampsia

Early onset of Preeclampsia	**Cases**	**Total**	**Early onset of Preeclampsia**
Yes	45	36%	Yes
No	80	64%	No

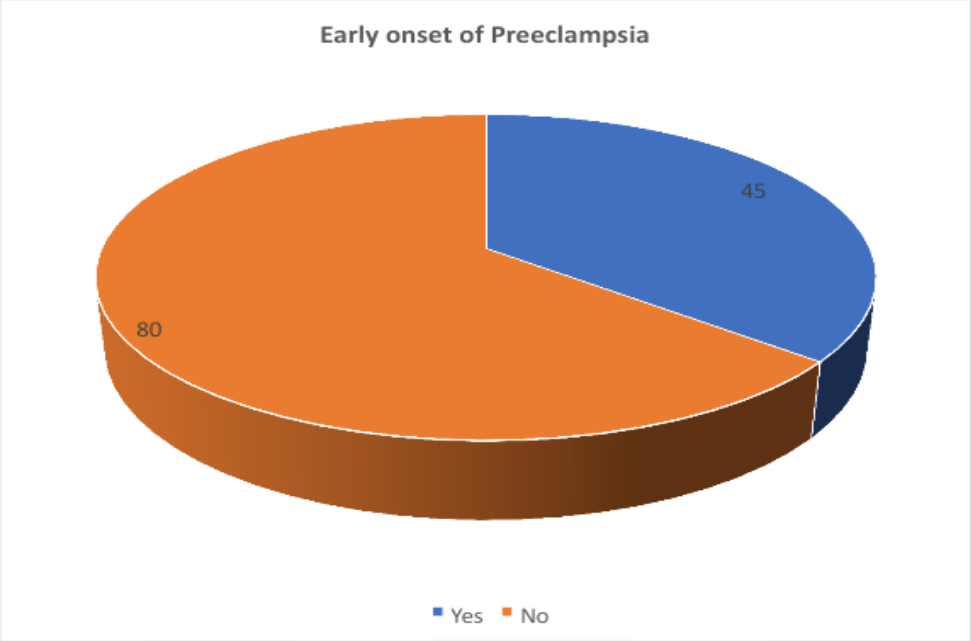

Figure 1: Early onset of Preeclampsia
Among the 125 preeclamptic cases, 45 women (36%) had early-onset disease, defined as onset before 34 weeks of gestation. The remaining 80 cases (64%) had onset after 34 weeks. This indicates that more than one-third of preeclamptic women in the study developed the condition early in gestation, which is clinically significant as early-onset preeclampsia is often associated with more severe maternal and fetal outcomes.

Mitral Valve Peak E Velocity :

Table 2: Mean MV peak E velocity (cm/s)

	Mean MV peak E velocity(cm/s)	**S.D**	**P value**
Cases	83.37	20.19	
Controls	101.55	6.91	**0.0001(significant)**

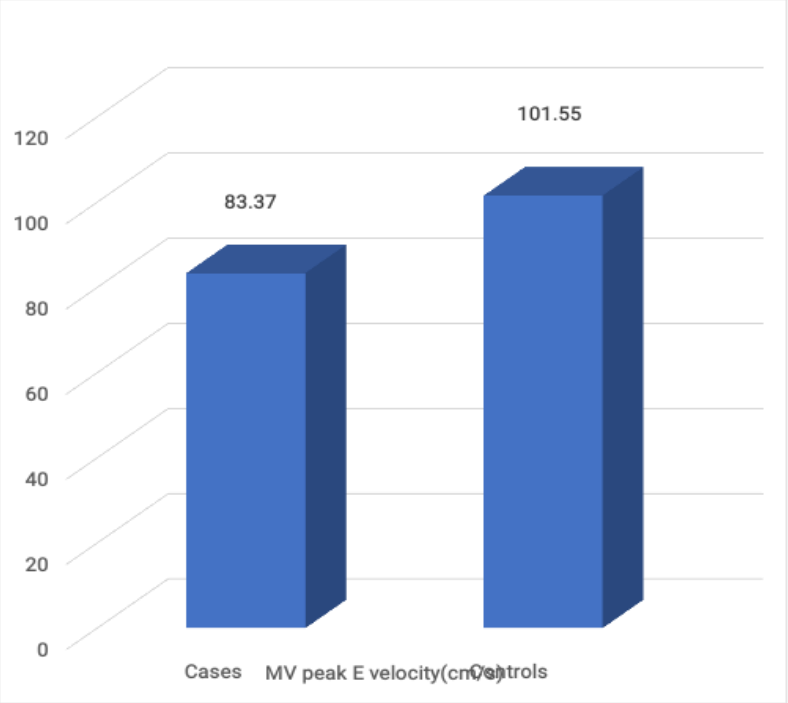

Figure 2: Mean MV peak E velocity (cm/s)

The mean MV peak E velocity was significantly lower in the preeclampsia group (83.37 ± 20.19 cm/s) compared to the control group (101.55 ± 6.91 cm/s). The difference was statistically significant ($p < 0.0001$). A lower E-wave velocity suggests impaired early diastolic left ventricular filling, indicating abnormal relaxation, which is a typical feature of diastolic dysfunction.

Deceleration Time:

Table 3: Mean MV deceleration time(minutes)

	Mean MV deceleration time(minutes)	**S.D**	**P value**
Cases	188.12	37.57	0.096(nonsignificant)
Controls	181.63	21.81	

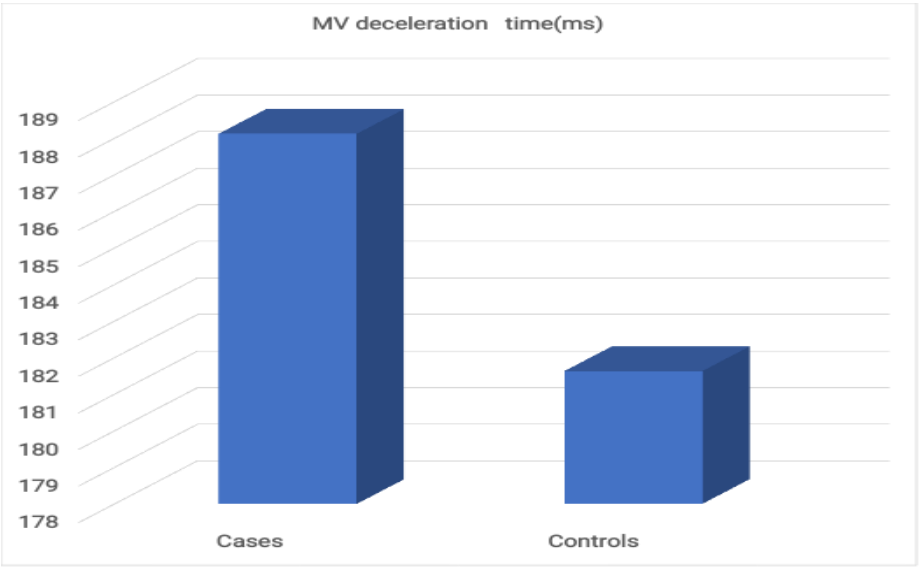

Figure 3: Mean MV deceleration time(minutes)

The mean deceleration time of the mitral inflow E wave was 188.12 ± 37.57 ms in the cases and 181.63 ± 21.81 ms in the controls. Although the deceleration time was slightly longer in the preeclampsia group, the difference was not statistically significant (p = 0.096). This mild prolongation still suggests a trend towards impaired diastolic relaxation among preeclamptic women.

E/e' Ratio – Estimation of LV Filling Pressure :

Table 4: Mean MV E/ MV medial E'

	Mean MV E/ MV medial E'	**S.D**	**P value**
Cases	8.23	0.88	
Control	9.59	1.81	**0.0001(significant)**

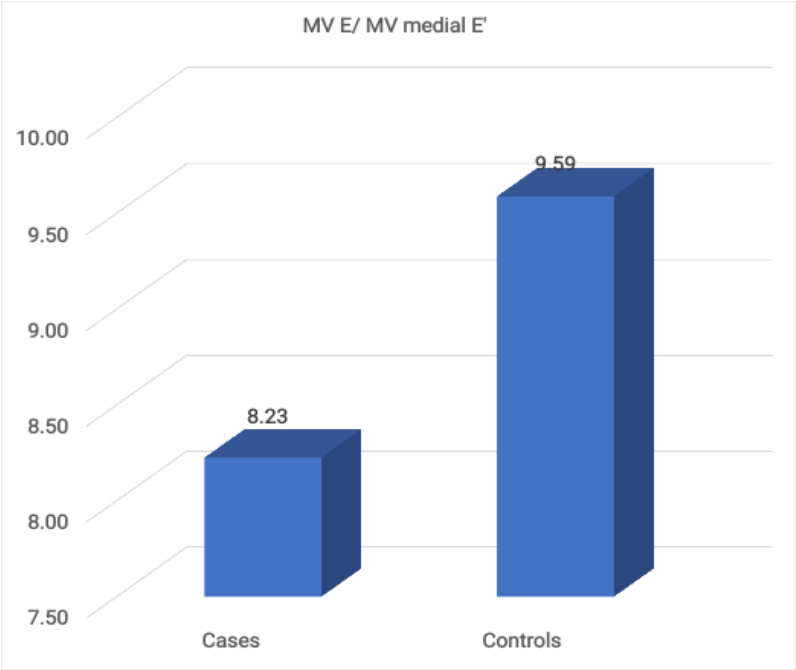

Figure 4: Mean MV E/ MV medial E'

The mean E/e' ratio, a surrogate for left ventricular filling pressure, was 8.23 ± 0.88 in preeclamptic patients and 9.59 ± 1.81 in controls. Surprisingly, the E/e' ratio was significantly lower in cases (p < 0.0001), which deviates from the commonly expected trend. This might be influenced by regional myocardial relaxation dynamics and merits further investigation.

Mitral Valve E/A Ratio Between Preeclamptic and Normotensive Pregnancies

Table 5: Mean MV E/A

	Mean MV E/A	**S.D**	**P value**
Cases	1.12	0.31	
Control	1.26	0.13	**0.0001(significant)**

The mitral valve E/A ratio, a key echocardiographic parameter for assessing left ventricular diastolic function, was significantly reduced in the preeclamptic group compared to the normotensive controls. The mean MV E/A ratio in preeclamptic patients was **1.12 ± 0.31**, while in the control group it was **1.26 ± 0.13**. This difference was statistically significant (**p = 0.0001**). The lower E/A ratio among cases suggests impaired early diastolic filling and is indicative of Grade 1 diastolic dysfunction, supporting the presence of subclinical cardiac changes in preeclampsia.

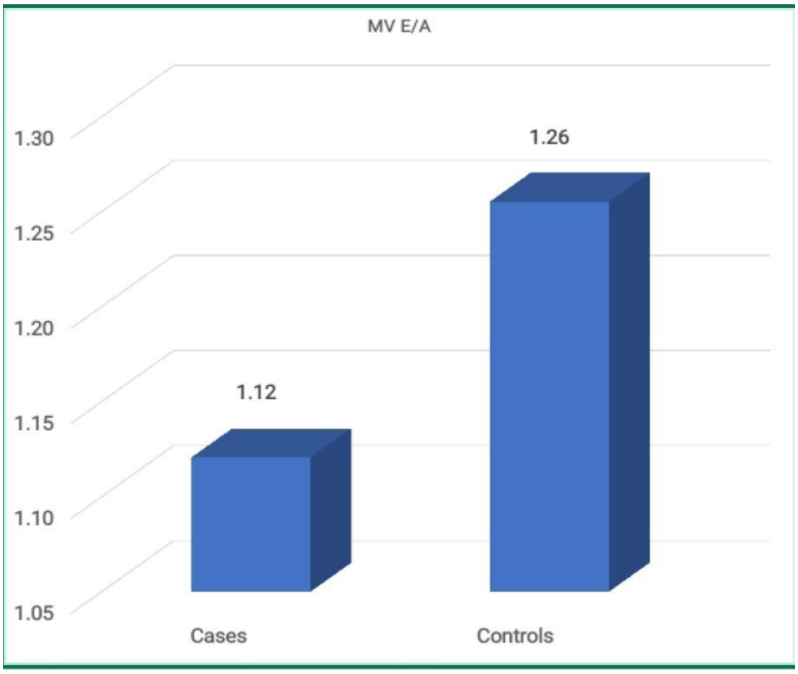

Figure 5: Mean MV E/A

Prevalence of Diastolic Dysfunction :

Table 6: Diastolic dysfunction

Diastolic dysfunction	Cases	Controls	Total
Grade 1 D/D	24(19.20%)	0	0
No D/D	101(80.80%)	125(100.00%)	125(50.00%)
Total	125(50.00%)	125(50.00%)	250(100.00%)

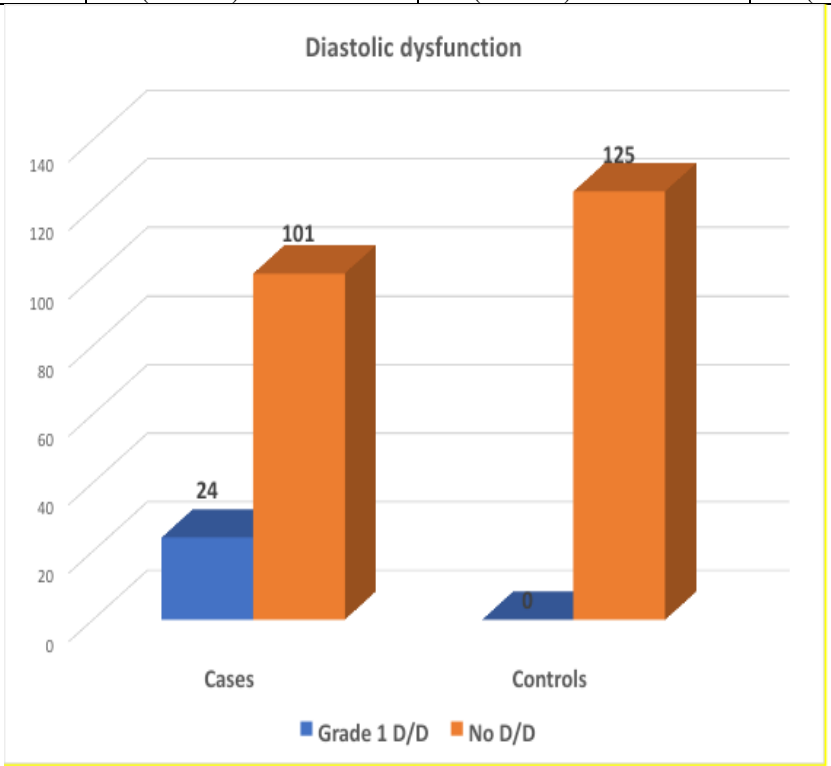

Figure 6: Diastolic dysfunction

Grade 1 diastolic dysfunction was identified in 24 out of 125 preeclamptic cases (19.2%), whereas none of the 125 controls exhibited any form of diastolic dysfunction. This difference was highly statistically significant ($p < 0.0001$), strongly indicating an association between preeclampsia and subclinical myocardial relaxation abnormalities.

Age-wise Distribution of Diastolic Dysfunction :

Table 7: Distribution of Grade 1 Diastolic dysfunction based on age among cases

Age (in years)	Grade 1 Diastolic dysfunction	Percentage
≤20	3	12.5
21-30	13	54.2
31-40	8	33.3
Total	24	100

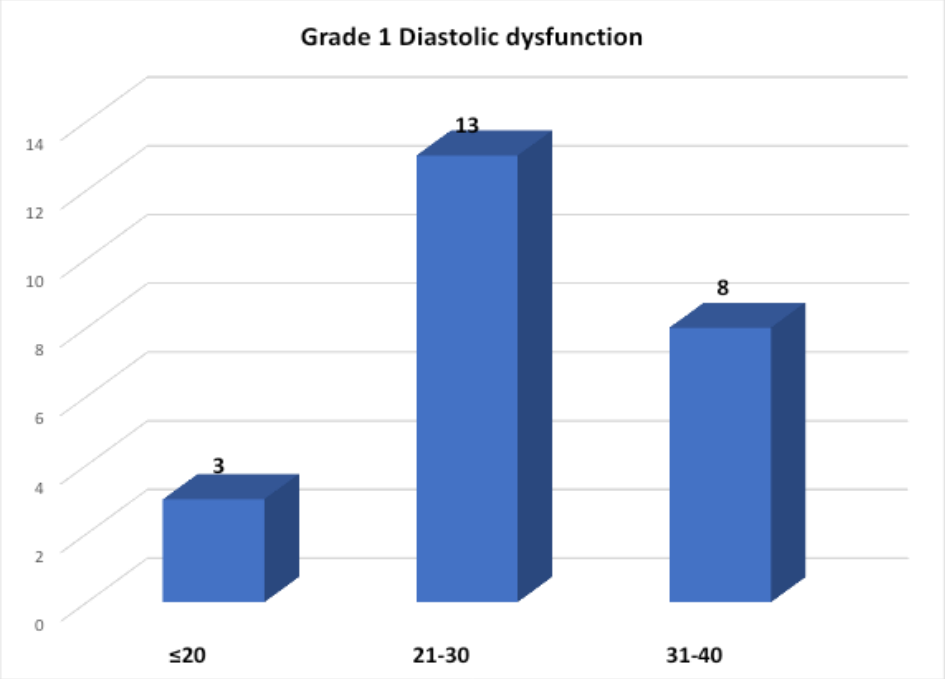

Figure 7: Distribution of Grade 1 Diastolic dysfunction based on age among cases

Among the 24 preeclamptic patients with Grade 1 diastolic dysfunction:

- **3 cases (12.5%) were aged ≤20 years,**
- **13 cases (54.2%) were between 21–30 years,**
- **8 cases (33.3%) were aged 31–40 years.**

This distribution suggests that diastolic dysfunction was most frequently observed in women aged 21–30 years, although it was also notably present in older age groups, implying that maternal age may influence the severity of cardiac involvement.

Gestational Age-wise Distribution of Diastolic Dysfunction :

Table 8: Distribution of Grade 1 Diastolic dysfunction based on gestational age among cases

Gestational age	Grade 1 Diastolic dysfunction	Percentage
≤34 weeks	3	12.5
>34 weeks	21	87.5
Total	24	100

When stratified by gestational age:

- ***3 cases (12.5%) with diastolic dysfunction had gestational age ≤34 weeks, 21 cases (87.5%) had gestational age >34 weeks.***

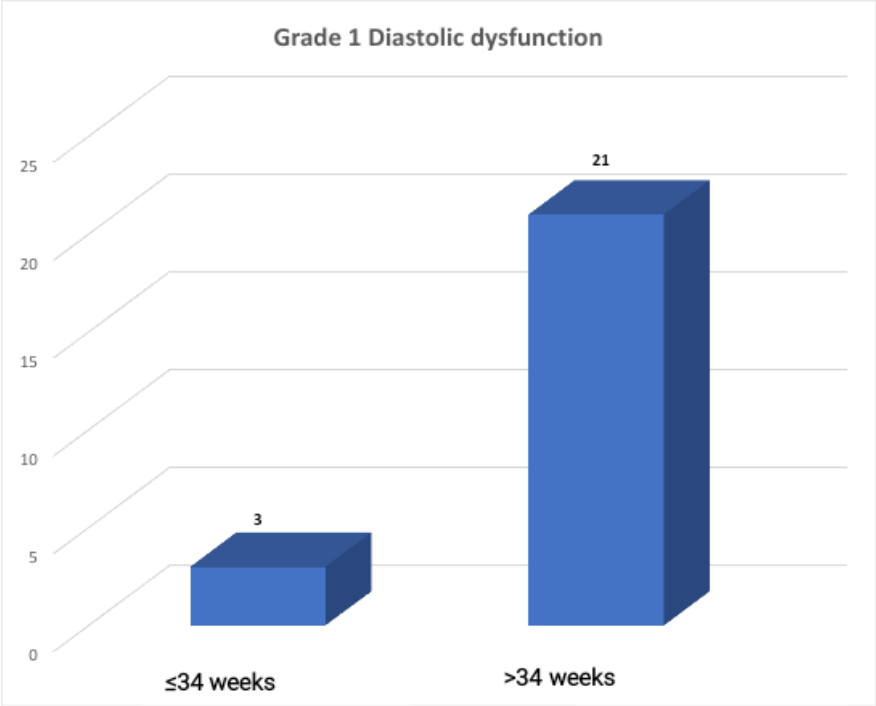

Figure 8: Distribution of Grade 1 Diastolic dysfunction based on gestational age among cases

This indicates that although early-onset preeclampsia is often associated with more severe disease, the majority of diastolic dysfunction cases in this study were detected in women with late-onset preeclampsia, suggesting that cardiac changes may evolve or persist even in those with more advanced gestation**.**

DISCUSSION

Preeclampsia is a multisystem disorder with known cardiovascular implications that often go unrecognized during the antenatal period. This study evaluated cardiovascular changes in preeclamptic women using two-dimensional transthoracic echocardiography, with a particular focus on diastolic function. The findings reinforce the growing body of literature indicating that subclinical cardiac dysfunction is a frequent and early manifestation of preeclampsia.

In our study, **early-onset preeclampsia (<34 weeks)** was observed in **36%** of cases, which aligns with previous studies that associate early-onset disease with greater maternal and fetal complications. However, an interesting observation was that **the majority of Grade 1 diastolic dysfunction cases (87.5%) were found in women with gestational age >34 weeks**, suggesting that even late-onset preeclampsia is not free from significant cardiovascular compromise. This finding contrasts with literature such as the systematic review by Valensise et al. (2016), which reported a higher prevalence of cardiac dysfunction in early-onset cases. The discrepancy may be attributable to population differences, variation in disease severity, or timing of echocardiographic evaluation.

A significant reduction in **MV peak E velocity** was noted in the preeclampsia group compared to controls (83.37 ± 20.19 cm/s vs. 101.55 ± 6.91 cm/s, $p < 0.0001$). This indicates impaired early diastolic filling, likely due to reduced myocardial compliance. The **deceleration time** was mildly prolonged in the preeclampsia group (188.12 ± 37.57 ms), though not statistically significant. Prolongation of deceleration time is consistent with abnormal relaxation, a hallmark of early diastolic dysfunction.

Interestingly, the **E/e' ratio**, which reflects left ventricular filling pressure, was lower in the preeclamptic group (8.23 ± 0.88) than in controls (9.59 ± 1.81), contrary to the expected pattern. Typically, a higher E/e' ratio correlates with increased filling pressures, as seen in previous studies by Shahul et al. and Mahendru et al. This unexpected trend may suggest altered regional myocardial mechanics or compensatory changes in mild-to-moderate preeclampsia. Further longitudinal and tissue Doppler–based assessments may clarify this anomaly.

The prevalence of **Grade 1 diastolic dysfunction** was **19.2% in preeclamptic women**, and **0% in normotensive controls**, which was statistically significant ($p < 0.0001$). This confirms that preeclampsia is associated with early myocardial relaxation abnormalities, even in the absence of clinical cardiac symptoms. This finding echoes those of Melchiorre et al., who described increased LV mass and diastolic dysfunction in preeclamptic women with normal ejection fraction, reinforcing the role of echocardiography in detecting subclinical cardiovascular impairment.

When analyzing **age-wise distribution**, women in the **21–30 years** age group represented the majority of diastolic dysfunction cases (54.2%), followed by those aged 31–40 years (33.3%). Though advanced maternal age is generally considered a risk factor for cardiovascular disease, our data indicate that younger women are not exempt from cardiac involvement in preeclampsia. This suggests that routine cardiac evaluation in all preeclamptic women may be justified, regardless of age.

Overall, the echocardiographic changes observed in this study support the hypothesis that preeclampsia induces structural and functional cardiac alterations. Left ventricular relaxation impairment, represented by altered E velocity and presence of Grade 1 diastolic dysfunction, may serve as early indicators of cardiovascular risk. These findings underscore the utility of echocardiography in antenatal risk stratification and highlight the need for postpartum cardiovascular follow-up in women with preeclampsia.

Limitations:
This study was limited to a single-center population and employed conventional 2D echocardiography. Advanced modalities such as speckle-tracking echocardiography (STE) or strain imaging were not included, which could have offered deeper insight into subclinical systolic dysfunction. Additionally, long-term follow-up to assess persistence of dysfunction postpartum was beyond the scope of this study

.

REFERENCES

1. American College of Obstetricians and Gynecologists. Gestational hypertension and preeclampsia: ACOG Practice Bulletin, Number 222. Obstet Gynecol. 2020;135(6):e237–60.
2. Williams Obstetrics. 26th ed. Cunningham FG, Leveno KJ, Bloom SL, et al. New York: McGraw-Hill Education; 2022.
3. Melchiorre K, Sutherland GR, Liberati M, Thilaganathan B. Preeclampsia is associated with persistent postpartum cardiovascular impairment. Hypertension. 2011;58(4):709–15.
4. Valensise H, Vasapollo B, Gagliardi G, Novelli GP. Early and late preeclampsia: two different maternal hemodynamic states in the latent phase of the disease. Hypertension. 2008;52(5):873–80.
5. Shahul S, Rhee J, Hacker MR, et al. Subclinical left ventricular dysfunction in preeclamptic women with preserved ejection fraction: a speckle-tracking study. Circ Cardiovasc Imaging. 2015;8(4):e003179.
6. Roberts JM, Gammill HS. Preeclampsia: recent insights. Hypertension. 2005;46(6):1243–9.
7. Driessen M, Denk B, Henrich W, et al. Right ventricular function and hemodynamics in preeclampsia: a systematic review. J Clin Hypertens. 2017;19(6):580–6.
8. Mahendru AA, Everett TR, Wilkinson IB, Lees CC. Cardiovascular function in normal pregnancies and preeclampsia: a prospective longitudinal study. Am J Obstet Gynecol. 2014;210(5):483.e1–8.
9. Kilic D, Guler T. Evaluation of cardiac structural and electrical remodeling in patients with preeclampsia. Hypertens Pregnancy. 2022;41(1):19–27.
10. Giorgione V, O'Driscoll J, Poon LC. Maternal cardiac function before and after delivery in pregnancies complicated by preeclampsia. Ultrasound Obstet Gynecol. 2022;59(3):363–70.
11. Yerlikaya-Schatten G, Karner E. Cardiovascular hemodynamics in preeclampsia: echocardiographic evaluation in third trimester. Pregnancy Hypertens. 2024;45:102034.
12. Turan O, Turan S, Berg C, et al. Computerized fetal heart rate analysis, Doppler ultrasound, and biophysical profile score in the prediction of neonatal outcomes in preeclampsia. Ultrasound Obstet Gynecol. 2019;54(1):104–11.
13. World Health Organization. Maternal mortality: Levels and trends. Geneva: WHO; 2023.
14. American Heart Association. Cardiovascular disease risk in women after preeclampsia. Circulation. 2011;123(9):e423–9.
15. Macdonald-Wallis C, Lawlor DA, Fraser A, May M, Nelson SM, Tilling K. Hypertensive disorders of pregnancy and risk of hypertension and microalbuminuria later in life: a prospective cohort study. Hypertension. 2012;59(6):1234–40.