

A Study on Echocardiography Findings in Pre-Eclampsia Women and their Maternal and Fetal Outcome

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Abstract: ***Background:** Pre-eclampsia is a multisystem hypertensive disorder of pregnancy associated with maternal cardiovascular maladaptation, end-organ dysfunction and poor perinatal outcome. Echocardiography is a safe non-invasive method for detecting subclinical cardiac changes. **Aim:** To study echocardiographic findings in pre-eclamptic women and correlate them with maternal and fetal outcomes. **Methods:** This hospital-based prospective observational study was conducted in the Department of Obstetrics and Gynaecology, PBM Hospital, Bikaner, from August 2025 to April 2026. A total of 160 pregnant women were included, with 80 pre-eclamptic women as the study group and 80 normotensive pregnant women as controls. Clinical details, blood pressure, proteinuria, hematological and biochemical investigations and echocardiography findings were recorded. Maternal and fetal outcomes were compared between groups and according to normal or abnormal echocardiography findings. **Results:** Mean systolic and diastolic blood pressure were significantly higher in the study group. Any echocardiography abnormality was seen in 65.0% of pre-eclamptic women compared with 2.5% controls. Diastolic dysfunction was the most common abnormality, followed by left ventricular hypertrophy, left atrial enlargement and systolic dysfunction. Maternal complications were significantly higher among women with abnormal echocardiography findings. Fetal outcomes were also poorer in pre-eclampsia, with higher low birth weight, NICU admission, respiratory distress syndrome, stillbirth and neonatal death. **Conclusion:** Echocardiography is useful for early detection of cardiac involvement in pre-eclampsia and may help identify high-risk women requiring closer maternal and fetal surveillance.*

Keywords: Pre-eclampsia, Echocardiography, Diastolic dysfunction, Maternal outcomes, Fetal outcomes

1. Introduction

Pre-eclampsia is a pregnancy-specific multisystem disorder characterized by new-onset hypertension after 20 weeks of gestation with proteinuria and/or evidence of maternal organ dysfunction. It remains one of the important causes of maternal and perinatal morbidity and mortality. The basic pathology begins with abnormal placentation, impaired spiral artery remodeling, endothelial dysfunction, vasoconstriction and increased systemic vascular resistance. These changes affect the kidneys, liver, brain, coagulation system, placenta and cardiovascular system. Therefore, pre-eclampsia should not be considered only as a blood pressure disorder, but also as a condition of abnormal maternal cardiovascular adaptation to pregnancy. [1, 2]

During normal pregnancy, plasma volume and cardiac output increase while systemic vascular resistance decreases. In pre-eclampsia, this adaptation is disturbed. Increased afterload, endothelial leak, reduced oncotic pressure and altered preload can produce left ventricular remodeling, diastolic dysfunction, pulmonary edema and heart failure in severe cases. Many women may remain clinically asymptomatic until complications occur. Echocardiography gives a simple, non-invasive and repeatable assessment of systolic function, diastolic function, chamber size, left ventricular hypertrophy,

filling pressure and pulmonary pressure. Previous studies have reported that pre-eclampsia is associated with diastolic dysfunction, increased left ventricular mass and adverse maternal outcomes. [3-6]

Early identification of cardiac dysfunction is important because it may guide fluid management, antihypertensive therapy, delivery planning, intensive monitoring and postpartum follow-up. It may also explain poor fetal outcome through impaired maternal hemodynamics and uteroplacental perfusion. Hence, the present study was undertaken to evaluate echocardiographic findings in pre-eclamptic women and their association with maternal and fetal outcome.

Aim and Objectives

The present study aims to evaluate echocardiographic changes in pregnant women with pre-eclampsia, with special emphasis on identifying left ventricular systolic and diastolic dysfunction by echocardiography. It also aims to compare normal and abnormal echocardiographic findings in pre-eclamptic women and assess their association with maternal and fetal outcomes.

2. Material and Methods

This hospital-based prospective observational study was conducted in the Department of Obstetrics and Gynaecology, PBM Hospital, Bikaner, from August 2025 to April 2026. The study population included pregnant women admitted or attending the outpatient department after 20 weeks of gestation. A total of 160 women were included: 80 women with pre-eclampsia as the study group and 80 normotensive pregnant women as the control group. Convenient sampling was used.

Women aged 18 years or above, willing to participate, with gestational age more than 20 weeks and having pre-eclampsia were included in the study group. Pre-eclampsia was considered in women with blood pressure $\geq 140/90$ mmHg along with proteinuria and/or end-organ involvement. Women who refused consent, had infectious disease, coagulation disorders, coronary heart disease or other major medical disorders were excluded. The control group included pregnant women without pre-eclampsia.

After written informed consent, all participants were interviewed using a pretested semi-structured proforma. Sociodemographic details, obstetric history, gestational age and clinical examination findings were recorded. Blood pressure was measured and urine protein was assessed by dipstick method. Baseline investigations including complete blood count, liver function test and renal function test were performed. Echocardiography screening was done in all cases and controls. Echocardiographic parameters included left ventricular ejection fraction, E/A ratio, left atrial size, left ventricular hypertrophy and pericardial effusion. Women with echocardiography changes were followed as per protocol and followed until delivery. Maternal outcomes, mode of delivery and neonatal outcomes were recorded. Data were entered and analyzed systematically. Categorical variables were expressed as number and percentage, while quantitative variables were expressed as mean and standard deviation. Appropriate statistical tests were applied and $p < 0.05$ was considered statistically significant.

3. Results

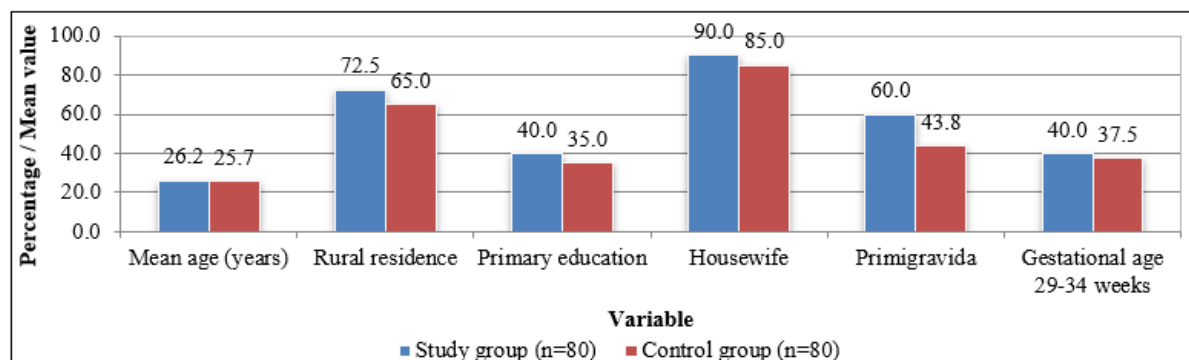
Both groups were comparable for baseline demographic features. Most women were aged 25-30 years, and mean age was 26.18 years in the study group and 25.71 years in controls. Most participants belonged to rural areas and were housewives. There was no statistically significant difference between the two groups with respect to age, residence, education, occupation, socioeconomic status, parity or gestational age.

Blood pressure parameters were significantly higher in the study group. Mean systolic blood pressure was 165.4 ± 12.6 mmHg compared with 118.5 ± 8.2 mmHg in controls, and mean diastolic blood pressure was 105.8 ± 9.4 mmHg compared with 76.3 ± 6.5 mmHg. Proteinuria was moderate to severe in most pre-eclamptic women, with +2 proteinuria in 47.5% and +3 proteinuria in 27.5%. Laboratory abnormalities were also more frequent in the study group, including thrombocytopenia, elevated liver enzymes and renal dysfunction.

Echocardiography abnormalities were significantly more common in pre-eclamptic women. Any abnormality was seen in 52 cases (65.0%) of the study group compared with only 2 cases (2.5%) of controls. Diastolic dysfunction was the commonest abnormality, present in 50.0% of the study group. Left ventricular hypertrophy was present in 27.5%, left atrial enlargement in 35.0%, mild pericardial effusion in 10.0% and systolic dysfunction in 12.5% of pre-eclamptic women. Maternal complications were observed more often in women with abnormal echocardiography findings. In the study group, thrombocytopenia was the most common complication, followed by deranged liver function, deranged renal function, eclampsia and abruptio placentae. Cesarean section was significantly higher in pre-eclamptic women. Fetal outcomes were poorer in the study group, with higher low birth weight, NICU admission, respiratory distress syndrome, stillbirth and neonatal death. Among pre-eclamptic women, abnormal echocardiography was associated with significantly higher low birth weight, NICU admission and respiratory distress syndrome.

Table 1: Baseline demographic and obstetric profile

Variable	Study group (n=80)	Control group (n=80)	p value
Mean age (years)	26.18 $\pm$ 4.45	25.71 $\pm$ 4.44	0.91
Rural residence	58 (72.5%)	52 (65.0%)	0.31
Primary education	32 (40.0%)	28 (35.0%)	0.908
Housewife	72 (90.0%)	68 (85.0%)	0.34
Primigravida	48 (60.0%)	35 (43.75%)	0.089
Gestational age 29-34 weeks	32 (40.0%)	30 (37.5%)	0.906



Graph 1: Baseline demographic and obstetric profile

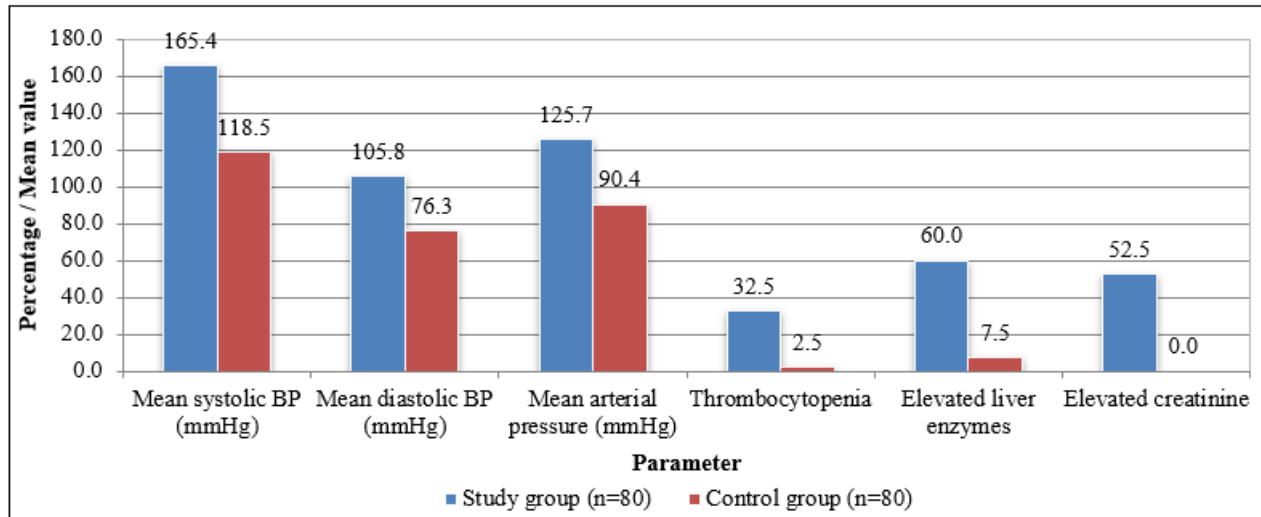
Volume 15 Issue 7, July 2026

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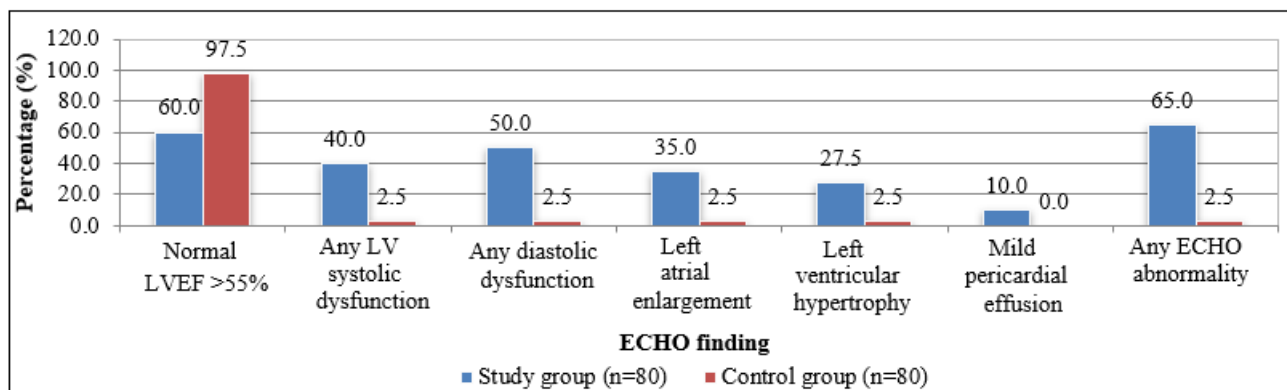
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Table 2: Clinical and laboratory profile

Parameter	Study group (n=80)	Control group (n=80)	p value
Mean systolic BP (mmHg)	165.4 +/- 12.6	118.5 +/- 8.2	<0.001
Mean diastolic BP (mmHg)	105.8 +/- 9.4	76.3 +/- 6.5	<0.001
Mean arterial pressure (mmHg)	125.7 +/- 10.2	90.4 +/- 7.1	<0.001
Thrombocytopenia	26 (32.5%)	2 (2.5%)	0.0001
Elevated liver enzymes	48 (60.0%)	6 (7.5%)	<0.001
Elevated creatinine	42 (52.5%)	0 (0%)	<0.001

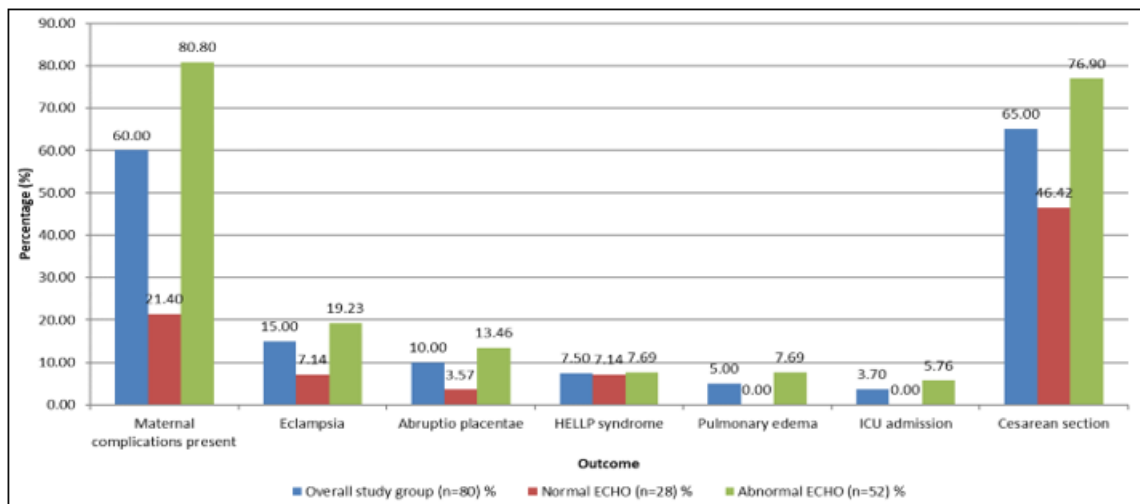
**Graph 2:** Clinical and laboratory profile**Table 3:** Summary of echocardiography findings

ECHO finding	Study group (n=80)	Control group (n=80)	p value
Normal LVEF >55%	48 (60.0%)	78 (97.5%)	0.0001
Any LV systolic dysfunction	32 (40.0%)	2 (2.5%)	0.0001
Any diastolic dysfunction	40 (50.0%)	2 (2.5%)	<0.001
Left atrial enlargement	28 (35.0%)	2 (2.5%)	0.0001
Left ventricular hypertrophy	22 (27.5%)	2 (2.5%)	0.0001
Mild pericardial effusion	8 (10.0%)	0 (0%)	0.0037
Any ECHO abnormality	52 (65.0%)	2 (2.5%)	<0.0001

**Graph 3:** Summary of Echocardiography Findings**Table 4:** Maternal outcome in pre-eclampsia and according to ECHO findings

Outcome	Overall study group (n=80)	Normal ECHO (n=28)	Abnormal ECHO (n=52)
Maternal complications present	48 (60.0%)*	6 (21.4%)	42 (80.8%)
Eclampsia	12 (15.0%)	2 (7.14%)	10 (19.23%)
Abruptio placentae	8 (10.0%)	1 (3.57%)	7 (13.46%)
HELLP syndrome	6 (7.5%)	2 (7.14%)	4 (7.69%)
Pulmonary edema	4 (5.0%)	0 (0%)	4 (7.69%)
ICU admission	3 (3.7%)	0 (0%)	3 (5.76%)
Cesarean section	52 (65.0%)	13 (46.42%)	40 (76.9%)

*Maternal complications are summarized from the study-group complication table and ECHO-based outcome comparison.



Graph 4: Mental Outcome in Pre- eclampsia and according to ECHO findings

4. Discussion

The present study showed that pre-eclampsia was associated with significant maternal cardiovascular changes on echocardiography and poorer maternal and fetal outcomes. Both the study and control groups were comparable in baseline demographic and obstetric profile. The mean age was 26.18 ± 4.45 years in the pre-eclampsia group and 25.71 ± 4.44 years in controls. Rural residence, education, occupation, parity and gestational age were also not significantly different between the two groups. This comparability is important because it suggests that the differences observed in echocardiographic findings and outcomes were mainly related to pre-eclampsia rather than demographic variation. Similar baseline comparability was reported by Muthyala et al., who evaluated Doppler echocardiographic evidence of maternal cardiac diastolic dysfunction in pre-eclamptic and normotensive pregnant women and emphasized that cardiovascular changes in pre-eclampsia are mainly due to disease-related hemodynamic stress.

In the present study, blood pressure parameters were significantly higher among pre-eclamptic women. Mean systolic blood pressure was 165.4 ± 12.6 mmHg in the study group compared with 118.5 ± 8.2 mmHg in controls, while mean diastolic blood pressure was 105.8 ± 9.4 mmHg compared with 76.3 ± 6.5 mmHg. Mean arterial pressure was also significantly raised in the study group. These findings are consistent with the basic pathophysiology of pre-eclampsia, where abnormal placentation, endothelial dysfunction, vasoconstriction and increased systemic vascular resistance increase cardiac afterload. Increased afterload places additional stress on the left ventricle and may lead to ventricular remodeling and functional impairment. Muthyala et al. also described pre-eclampsia as a condition that may lead to heart failure in late pregnancy and early puerperium, with diastolic dysfunction being an important underlying mechanism.

Laboratory abnormalities were also more frequent among pre-eclamptic women in the present study. Thrombocytopenia was present in 32.5%, elevated liver enzymes in 60.0% and elevated creatinine in 52.5% of the study group, whereas these abnormalities were very low or

absent in controls. These findings indicate systemic endothelial injury and multiorgan involvement, which are important features of severe pre-eclampsia. Hepatic dysfunction, renal impairment and thrombocytopenia reflect the severity of maternal disease. In the present study, these abnormalities were clinically important because women with abnormal echocardiography also had more maternal complications. This suggests that cardiac involvement may occur as part of a broader severe systemic disease process.

The most important finding of the present study was the high frequency of echocardiographic abnormalities among pre-eclamptic women. Any ECHO abnormality was present in 65.0% of women with pre-eclampsia compared with only 2.5% of controls. Diastolic dysfunction was the most common abnormality, seen in 50.0% of pre-eclamptic women. Left atrial enlargement was present in 35.0%, left ventricular hypertrophy in 27.5%, mild pericardial effusion in 10.0% and systolic dysfunction in 40.0%. These findings show that pre-eclampsia is strongly associated with structural and functional cardiac changes. The predominance of diastolic dysfunction suggests that impaired ventricular relaxation is an early and common form of cardiac involvement in pre-eclampsia. This finding is comparable with Muthyala et al., who reported that maternal cardiac diastolic dysfunction was significantly associated with pre-eclampsia. Zhu et al. also reported that impaired diastolic function was associated with a higher occurrence of pre-eclampsia and suggested that risk grading using diastolic function may improve maternal outcome prediction.

Left ventricular hypertrophy in 27.5% of pre-eclamptic women in the present study can be explained by sustained hypertension and increased systemic vascular resistance, which increase myocardial workload and lead to ventricular remodeling. Left atrial enlargement, seen in 35.0% of women, may reflect increased left ventricular filling pressure secondary to diastolic dysfunction. Mild pericardial effusion in 10.0% may be related to endothelial leak, fluid imbalance and hypoalbuminemia commonly seen in severe pre-eclampsia. Systolic dysfunction was also noted in a significant proportion, as normal LVEF $>55\%$ was present in only 60.0% of pre-eclamptic women compared with 97.5% of controls. This indicates that some women had more advanced cardiac involvement beyond isolated diastolic dysfunction.

Maternal outcomes were clearly poorer among women with abnormal echocardiography findings. Overall maternal complications were present in 60.0% of pre-eclamptic women, but complications were much higher in women with abnormal ECHO compared with normal ECHO findings (80.8% vs 21.4%). Eclampsia was more frequent in women with abnormal ECHO findings (19.23% vs 7.14%), and abruptio placentae was also higher (13.46% vs 3.57%). Pulmonary edema and ICU admission occurred only among women with abnormal ECHO findings. These findings suggest that echocardiographic abnormalities are not incidental findings but markers of severe disease and poor maternal reserve. Pulmonary edema in such women may be explained by increased afterload, diastolic dysfunction, endothelial leak and inappropriate fluid shifts.

Cesarean section was also more common among women with abnormal ECHO findings, occurring in 76.9% compared with 46.42% in women with normal ECHO. This may be due to greater disease severity, uncontrolled hypertension, maternal complications or fetal compromise requiring early delivery. Similar outcome-based evaluation has been reported in studies on severe pre-eclampsia, where normal and abnormal echocardiography findings were compared with maternal and perinatal outcomes. This supports the practical value of echocardiography in identifying women who may require closer monitoring, intensive care preparedness and timely delivery planning.

Fetal outcomes were also poorer in the pre-eclampsia group. Higher rates of low birth weight, NICU admission, respiratory distress syndrome, stillbirth and neonatal death were observed among pre-eclamptic women. Among them, abnormal echocardiography was associated with significantly higher low birth weight, NICU admission and respiratory distress syndrome. These findings suggest that maternal cardiovascular dysfunction may contribute to impaired uteroplacental perfusion. Increased vascular resistance, endothelial dysfunction and reduced placental blood flow may lead to fetal growth restriction, prematurity, fetal distress and neonatal morbidity.

Overall, the present study is consistent with previous studies showing that pre-eclampsia is associated with significant maternal cardiovascular dysfunction, particularly diastolic dysfunction, left ventricular hypertrophy and chamber enlargement. The study further demonstrates that abnormal echocardiography findings are associated with higher maternal complications, increased cesarean section and poorer neonatal outcomes. Therefore, echocardiography should be considered a useful, safe and non-invasive tool for risk stratification in pre-eclamptic women, especially those with severe hypertension, deranged renal or liver function, thrombocytopenia, symptoms of cardiac involvement or anticipated fluid management difficulty. Early detection of cardiac dysfunction may help in better monitoring, careful fluid management, timely delivery planning, ICU preparedness and postpartum cardiovascular follow-up.

5. Conclusion

The present study concluded that echocardiographic abnormalities are common among women with pre-eclampsia

and are strongly associated with adverse maternal outcomes. Diastolic dysfunction was the most frequent abnormality, followed by left atrial enlargement, left ventricular hypertrophy, systolic dysfunction and mild pericardial effusion. Maternal complications were substantially higher among women with abnormal ECHO findings compared to those with normal ECHO findings. Eclampsia, abruptio placentae, pulmonary edema, ICU admission and cesarean section were more frequent in the abnormal ECHO group, while pulmonary edema and ICU admission occurred only among women with abnormal echocardiography findings.

Therefore, echocardiography is a useful, safe and non-invasive investigation for detecting subclinical cardiac involvement in pre-eclampsia. It may help clinicians identify high-risk women, plan careful fluid and antihypertensive management, decide timely delivery, arrange intensive monitoring when required and improve maternal as well as fetal outcomes. Echocardiographic evaluation should be considered especially in women with severe pre-eclampsia, clinical deterioration or evidence of end-organ involvement.

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