



## SCREENING OF CARDIOVASCULAR DISORDERS IN PREGNANCY BY ANTENATAL 2D ECHO CARDIOGRAPHY

Dr. Mandala Shravani<sup>1\*</sup>, Dr. Jadala Sankirth<sup>2</sup>, Dr. Kovuri Umadevi<sup>3</sup>,

Dr. Alekhya Madarapu<sup>4</sup>, Dr. Achanta Vivekanand<sup>5</sup>

<sup>1</sup>Postgraduate, Department of Obstetrics and Gynaecology, Prathima Institute of Medical Sciences Karimnagar, Telangana, India

<sup>2</sup>Postgraduate, Department of Orthopaedics, Government Medical College Nizamabad, Telangana, India

<sup>3</sup>Postgraduate Department of Pathology, Government Medical College Nizamabad, Telangana, India

<sup>4</sup>Intern, Department of Pathology, Government Medical College Nizamabad, Telangana, India

<sup>5</sup>Professor, Department of Obstetrics and Gynaecology, Prathima Institute of Medical Sciences Karimnagar, Telangana, India

**\*Corresponding author: Dr. Mandala Shravani**, Postgraduate, Department of Obstetrics and Gynaecology, Prathima Institute of Medical Sciences Karimnagar, Telangana, India

---

### ABSTRACT

**Background:** Cardiovascular diseases are the leading cause of maternal mortality and morbidity in India. Due to physiological hemodynamic changes occurring during pregnancy, patients with asymptomatic pre-existing cardiac disease become manifest during this time. Such complications can be avoided if 2D echo is used as a screening tool to detect cardiac issues early in pregnancy.

**Material and methods:** A prospective observational study was done in the Department of Obstetrics of Prathima Institute of Medical Sciences, Karimnagar over 2 years during which 120 antenatal women who were booked for checkups were selected for the study after taking consent.

**Results:** Statistically significant associations were seen in women with abnormal 2D echo scans, maternal morbidity, and neonatal morbidity, with the most number of neonates born to females with abnormal scans requiring ICU admissions.

**Conclusion:** 2D echo scan usage as a screening tool can reduce maternal mortality and morbidity due to cardiac issues by early detection and management of the same.

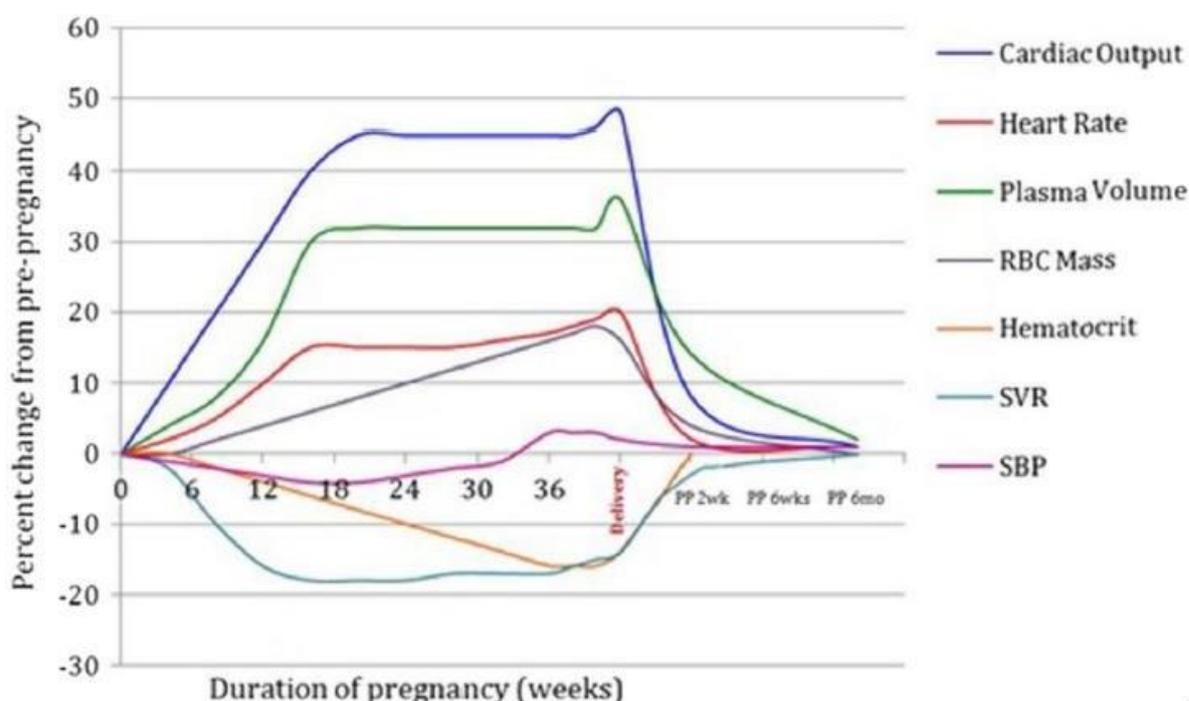
---

### INTRODUCTION

Pregnancy may cause Several reversible hemodynamic changes over a short period. Cardiovascular changes occur early in pregnancy by the sixth to eighth week of gestation. The plasma volume expands up to 40% during pregnancy under the influence of estrogen. This leads to physiologic anemia during pregnancy. The rise in cardiac output is accompanied by an increase in heart rate (which rises 10–20 beats per minute above pre-pregnancy rates). These changes can cause hemodynamic stress over the heart with a limited cardiac reserve.<sup>1,2</sup>

Heart disease affects approximately 0.2- 4% of pregnant women. Because of the increased load on the heart during pregnancy and the accompanying circulatory changes, many heart diseases including valvular diseases are frequently discovered for the first time during this period.<sup>3</sup> Obesity, pre-existing diabetes, and pre-existing hypertension are important risk factors. Beyond pregnancy, the postpartum period has a higher risk for up to a year after delivery, with around one-third of maternal fatalities happening in this time frame.<sup>2</sup>

Maternal mortality in pregnant women with heart disease is about 10%, which is 100 times higher than in women without heart disease. Additionally, risk varies based on the underlying cardiac condition, with maternal heart disease complicating up to 4% of pregnancies and up to 16% of pregnancies in women with prior cardiac disorders.<sup>1,4</sup>



In India, cardiac disease continues to be the leading but diagnosed cause of maternal mortality. Heart diseases are the most important non-obstetrical causes of maternal deaths during pregnancy, accounting for almost 10% of maternal deaths. They complicate 1-3% of all pregnancies with congenital defects in 70-80% of the cases. The most common valvular lesion in developing nations like India is mitral stenosis, which still makes up the bulk of instances of rheumatic heart disease (RHD). If either parent has congenital heart disease (CHD), the chances of the offspring developing the condition are 2-4%.<sup>6</sup>

Echocardiography is a clinically crucial technique for evaluating pregnant women, both in the setting of underlying cardiovascular illness and those without known pre-existing disease

. Furthermore, it doesn't require the use of radiation or intravenous contrast and is readily accessible.

In India, echocardiography is not routinely applied to antenatal women unless it is warranted by the positive cardiac symptoms. As a result, asymptomatic heart diseases will

always go unnoticed and the majority of antenatal women suffering from heart diseases will only get diagnosed after landing into complications, which is a major cause of maternal and fetal morbidity.

All these can be prevented by screening every mother during pregnancy by 2D-Echocardiography for the detection of cardiac abnormalities. Though the economic burden is a major hurdle, the advantage of decreasing maternal and fetal mortality by early detection of heart disease outweighs the economic burden.

This study was conducted to establish an 'evidence-based protocol' for the early diagnosis of cardiovascular disorders in pregnancy by screening with 2D-Echocardiography to reduce the negative impact on maternal and fetal outcomes.

## **METHODOLOGY**

This is a hospital based prospective observational study conducted in the Department of Obstetrics and Gynaecology, Prathima Institute of Medical Sciences, Karimnagar, Telangana, over 2 years from 1 December 2020 to 30 November 2022. All antenatal women who were booked in the outpatient of Prathima Institute of Medical Sciences were included in this study after taking consent. Antenatal women with known cardiac abnormalities and who didn't give consent were excluded from this study. Using a simple random sampling method, 120 women were selected. Patients were grouped according to the trimester of pregnancy. Most of the patients in our study were in the first trimester. Detailed history and clinical examination, Electrocardiogram, and Echocardiogram were done on all the patients. 2D echo was done using a Phillips Echo machine, and 2D, Doppler, and color flow mapping were done by standard methods.

Ethical clearance was obtained from Institutional Ethical, Prathima Institute Of Medical Sciences, Karimnagar, before conducting the study.

## **DATA ANALYSIS:**

Obtained data were entered in MS-excel 2007 and data was analyzed using IBM SPSS (Statistical Package for the Social Sciences) software trial version 22. Nominal data analysis (as presented in numbers & percentages). Continuous data were expressed as mean & standard deviation. Appropriate statistical tests were applied, (chi-square test), and  $< 0.05$  p values were considered significant.

## **RESULTS**

Of the 120 patients in the present study, the majority belonged to the 21 to 30 years age group (73.3%; N= 88) followed by the 31 to 40 years age group (19.2%; N = 23). One patient was aged above 40yrs.

The majority of the study population were housewives (53.3%; N = 64). The rest (47%) belonged to working-class women of which most of them were Engineers (12.5%; N = 15), followed by students (10.8%; N = 13). 40.8% (N = 49) of the study population belongs to upper lower socio-economic status (as per modified Kuppaswamy classification). 6.7% of the population belonged to the upper class and lower class. 49.2% (N = 59) of the study population were Para -2 and 28.3% were primigravida, the rest of the study population comprised multiparous women. 94 (78.3%) of the patients had term delivery, while 21.7% had preterm delivery

The majority of the study population had normal ECG (79.2%; N = 95). Amongst the abnormal ECG patterns left ventricular hypertrophy was most prevalent (6.7%), followed

by sinus tachycardia (2.5%), short PR interval (2.5%), RBBB (2.5%), and atrial premature complexes (2.5%). VPCs were seen in 0.8% of study subjects.

Out of the 120 patients, 91 patients had had NORMAL 2D ECHO (75.4%). 29 patients had

abnormal 2D ECHO of which, Severe LV dysfunction, EF-30% (2.5%); moderate LV dysfunction, EF - 40%, dilated LV (2.5%) and Global hypokinesia of LV,, dilated LV, EF-45%, mild LV Dysfunctions (2.5%) were most common. Peripartum cardiomyopathy was the most common heart condition (13.3%), followed by rheumatic heart disease (4.2%). The majority were asymptomatic (90.8%), and only 9.2% of them had symptoms related to the cardiac system.

LSCS was the most common mode of delivery (50.8%) in this study. 49.2% had a normal vaginal delivery.

The majority of the neonates had no complications, however, 49.2% of neonates developed complications of which, respiratory distress syndrome was most common (17.5%), followed by low birth weight 12.5%. 68.3% of the study population had babies weighing > 2.5 kg. Primi parous women had the most abnormal 2D echo scans observed than para -2. This difference was observed to be statistically significant. Among patients with abnormal 2D Echo scans, women belonging to the age group of 21- 30yrs were more prevalent, when compared to patients with normal reports. Statistical significance was observed between socioeconomic status and abnormalities in 2D echo scans. Most of the patients belonging to the lower and upper lower classes had abnormal 2D echo scans.

Among the Abnormal 2D Echo study population, the majority were having low birth weight (<2.5kgs) and the difference was found to be statistically significant when compared to the normal 2DECHO study population. Pre-term delivery was more common in patients who had abnormal 2D Echo and the difference was found to be statistically significant when compared to the normal 2DECHO study population.

LSCS was more common in patients with abnormal 2D echo scans, due to planned deliveries. Normal vaginal delivery and LSCS were equally distributed in patients with normal scans.

Neonatal complications were significantly higher in neonates born to patients with abnormal 2D echo findings than those with normal scans. The correlation between NICU admissions and abnormal 2D echo findings was statistically significant and neonates born to patients with abnormal 2D echo findings had higher NICU admission than ones with normal scans.

## DISCUSSION

Echocardiography is usually not routinely performed on pregnant women unless required. As a result, asymptomatic heart problems would always go undiagnosed. This causes a delay in the diagnosis of the majority of prenatal women with heart disease, which is a key contributor to maternal and fetal morbidity.

The morbidity and mortality rates of pregnant women with cardiac conditions are as high as >30% and 7% respectively.<sup>7</sup> This can be prevented by regular 2D-Echocardiography screenings for heart abnormalities conducted on every pregnant woman. Although it is associated with a higher financial burden, the benefit of lowering maternal and fetal mortality through early cardiac disease identification outweighs the financial burden.

Hence the present Hospital based prospective observational study was undertaken for 2 years to evaluate the prevalence of cardiac problems among antenatal mothers (n=120 irrespective of symptoms or history of cardiac diseases) by screening them with 2D-Echocardiography in the Department Of Obstetrics and Gynaecology, Prathima Institute Of Medical Sciences, Karimnagar, Telangana, India.

In the present study, the majority of the study population belongs to the 21 to 30 years age group. In all NFHS surveys, irrespective of place of residence, the fertility rate peaks at age 20- 24, after which it declines steadily, the report said which supports our study.<sup>8</sup>

According to a report<sup>9</sup> done on Married women surveyed in India showed, the mean age at first pregnancy is around 21 years. The survey also found that women in urban areas had their first child more than a year later than their rural counterparts.

In the present study, the majority study population are housewives, as the present study covers the rural area near the tertiary center where the present study is conducted. The majority of study participants belong to upper lower socio-economic status and Lower middle level according to the modified Kuppaswamy scale. Low socioeconomic status can increase the risk of adverse pregnancy outcomes, but it remains unclear whether this negative association is attributed to inadequate prenatal care.

In a study done by Kim MK et al.<sup>10</sup> higher rates of abortion, Caesarean delivery, preeclampsia, preterm delivery, and obstetrical hemorrhage are usually seen in lower socioeconomic status.

In the present study, 90% of the study population was asymptomatic only 10% had symptoms related to the cardiac system. Almost 80% study population had normal ECG and among abnormal ECG patterns left ventricular hypertrophy was more prevalent (6.7%). Up to 24.6% had abnormal 2D ECHO which includes pre-existing conditions and newly developed conditions during pregnancy. The most common 2D ECHO abnormality observed is LV dysfunction and dilated LV.

Schannwell CM et al.<sup>11</sup> who conducted a study on 46 healthy women stated that The natural volume overload in pregnancy leads to a reversible 'physiological' left ventricular hypertrophy, a short-term decrease in systolic function, and a significant change in left ventricular diastolic function, which appears to be the proper explanation LVH in ECG.

A study conducted by Beaton A, et al. showed a 17% prevalence of heart disease.<sup>12</sup>

Peripartum cardiomyopathy (PPCM) was the most common heart condition (13.3%), followed by rheumatic heart disease (4.2%) observed in the present study population. Peripartum cardiomyopathy (PPCM) is a rare, often dilated, cardiomyopathy with systolic dysfunction that presents in late pregnancy or, more commonly, the early postpartum period. PPCM was described in a workshop held by the US National Heart, Lung, and Blood Institute (NHLBI) in the 1990s as "Heart failure that develops in the final month of pregnancy or up to five months after delivery and has left ventricular systolic dysfunction (left ventricular ejection fraction (LVEF) 45% or fractional shortening 30%, or both)".<sup>13</sup> Gomathi T. et al.<sup>1</sup> observed RHD & MVP as the most common heart diseases in her study.

Since heart failure symptoms, such as leg and foot edema and some shortness of breath, might resemble those of the third trimester of pregnancy, it may be challenging to diagnose PPCM.

In the present study, 50.8% of the study population underwent LSCS and 49.2% had normal vaginal delivery. Among the Abnormal 2D Echo study population, the majority mode of delivery was LSCS followed by Normal vaginal delivery whereas in the normal population, it was almost equally distributed and the difference was not found to be statistically significant. Labor-related hemodynamic alterations are eliminated by cesarean birth. Additionally, it frequently enables more suitable invasive and non-invasive hemodynamic management.<sup>14,15</sup> Hrycyk J et al.<sup>14</sup> had similar results, where 46.6% of their cardiac disease mothers had undergone LSCS. Contrary to all these studies Zloto K et al.<sup>15</sup> managed to conduct LSCS only in 9.5% of their study population.

Among the Abnormal 2D Echo study population, the majority were having maternal & neonatal complications (low birth weight-62.1%, preterm delivery-48.3%, NICU admissions-79.3%), and the difference was found to be statistically significant when compared to the normal 2DECHO study population which is consistent with Lammers AE et al.<sup>16</sup>

There were no cases of maternal or neonatal deaths in the present study which may be due to early screening and continuous monitoring and proper management. All this (no mortality and less morbidity) was possible due to the "LEAD TIME" which is extra time added due to early diagnosis of cardiac diseases or complications during the antenatal period by routine 2D ECHO screening in the present study.

For screening instead of ECG, 2D ECHO is preferred because, Echocardiography provides information about disease etiology, leads to an accurate and non-invasive assessment of disease severity, and is a powerful means of monitoring progression. Only with echocardiography it has been demonstrated that during pregnancy congenital heart disease is the first leading abnormality followed by rheumatic heart disease.

A correct cardiac diagnosis reveals the need for noninvasive monitoring during pregnancy and childbirth, sheds light on the prognosis, and helps establish whether surgical or medicinal intervention is necessary. Following a maternal echocardiogram, the need for fetal echocardiography should be evaluated.

The risk of pregnancy should be assessed before and during pregnancy, and management of pregnancy and delivery must be planned accordingly based on the severity and type of disease and other 2DECHO parameters.

This study **concluded** that prenatal diagnosis, counseling, proper referral, routine antenatal supervision, and delivery at a facility with the necessary resources improve the pregnancy outcomes for both mother and child when there is heart disease. Thus, we emphasize the importance of monitoring cardiac patients to identify and treat heart failure early on during pregnancy, delivery, and puerperium.

There are certain limitations to this study, ie. Small sample size, Single-center study. (No comparison arm consisting of control healthy group) ; No clear-cut criteria to diagnose abnormal 2D ECHO as it gets overlapped with normal physiological changes of pregnancy.

## **FUNDING**

Nil

## **CONFLICT OF INTEREST**

None

## REFERENCES

1. Gomathi T, Thendral V. A study of screening echocardiography in asymptomatic pregnant women. *Indian J Obstet Gynecol Res* 2019;6(4):440-443.
2. Afari HA, Davis EF, Sarma AA. Echocardiography for the pregnant heart. *Curr Treat Options Cardiovasc Med* [Internet]. 2021;23(8):55. Available from: <http://dx.doi.org/10.1007/s11936-021-00930-5>
3. Lim ST. Rheumatic heart diseases in pregnancy. *Ann Acad Med Singapore* 2002; 31:340-8. Kotit S, Yacoub M. Cardiovascular adverse events in pregnancy: A global perspective. *Glob Cardiol Sci Pract* [Internet]. 2021;2021(1): e202105.
4. Montoya ME, Karnath BM, Ahmad M. Endocarditis during pregnancy. *South Med J* 2003; 96:1156-7.
5. Capeless EL, Clapp JF. Cardiovascular changes in the early phase of pregnancy. *Am J Obstet Gynecol* 1989; 161:1449-53.
6. Hameed A, Karaalp IS, Tummala PP, et al. The effect of valvular heart disease on maternal and fetal outcomes of pregnancy. *J Am Coll Cardiol*. 2001;37:893e899.
7. PTI. India's overall TFR declines but 5 states are yet to achieve a replacement level of fertility: NFHS-5 [Internet]. *Economic Times*. 2022 [cited 2022 Dec 15]. Available from: <https://economictimes.indiatimes.com/news/india/indias-overall-tfr-declinesbut-5-states-yet-to-achieve-replacement-level-of-fertility-nfhs-5/articleshow/91444600.cms?from=mdr>
8. Median age at first pregnancy among married women in India 2015-16 by age group [Internet]. *Statista*. [cited 2022 Dec 15]. Available from: <https://www.statista.com/statistics/680256/median-age-at-first-pregnancy-by-agegroups-india/>
9. Kim MK, Lee SM, Bae S-H, Kim HJ, Lim NG, Yoon S-J, et al. Socioeconomic status can affect pregnancy outcomes and complications, even with a universal healthcare system. *Int J Equity Health* [Internet]. 2018;17(1):2.
10. Schannwell CM, Zimmermann T, Schneppenheim M, Plehn G, Marx R, Strauer BE. Left ventricular hypertrophy and diastolic dysfunction in healthy pregnant women. *Cardiology* [Internet]. 2002;97(2):73–8.
11. Beaton A, Okello E, Scheel A, DeWyer A, Ssembatya R, Baraka O, et al. Impact of heart disease on maternal, fetal, and neonatal outcomes in a low-resource setting. *Heart* [Internet]. 2019;105(10):755–60.
12. Pearson GD, Veille JC, Rahimtoola S, Hsia J, Oakley CM, Hosenpud JD, et al. Peripartum cardiomyopathy: National Heart, Lung, and Blood Institute and Office of Rare Diseases (National Institutes of Health) workshop recommendations and review. *JAMA* [Internet]. 2000;283(9):1183–8.
13. Hrycyk J, Kaemmerer H, Nagdyman N, Hamann M, Schneider K, Kuschel B. Mode of delivery and pregnancy outcome in women with congenital heart disease. *PLoS One* [Internet]. 2016;11(12):e0167820.
14. Zloto K, Hochberg A, Tenenbaum-Gavish K, Berezowsky A, Barbash-Hazan S, Bardin R, et al. Fetal congenital heart disease - mode of delivery and obstetrical complications. *BMC Pregnancy Childbirth* [Internet]. 2022;22(1):578.

15. Lammers AE, Diller G-P, Lober R, Möllers M, Schmidt R, Radke RM, et al. Maternal and neonatal complications in women with congenital heart disease: a nationwide analysis. *Eur Heart J* [Internet]. 2021;42(41):4252–60.