Obstetrics and Gynaecology Section

# Spectrum, Prevalence and Fetomaternal Outcome of Cardiac Diseases in Pregnancy: A Single Center Tertiary Care Experience

AAMIR RASHID[1], SIAMA WANI[2], SHAHEERA AJAZ[3], IQBAL DAR[4], AABIDA AHMED[5], IQBAL WANI[6], IMRAN HAFEEZ[7], HILAL RATHER[8]

## ABSTRACT

**Introduction:** Cardiovascular Disorders (CVD) are significant cause of fetomaternal morbidity and mortality. Prevalence of CVD in pregnancy is less than 1% (varies from 0.3-3.5%).

**Aim:** To study spectrum, prevalence and fetomaternal outcome of cardiac diseases in pregnancy at a tertiary care center.

**Materials and Methods:** A retrospective study was conducted in which data of all antenatal patients visiting the hospital over a period of 27 months from March 2017 to June 2019 were analysed for cardiac diseases by clinical history, examination, Electocardiograpy and echocardiography. Type, Severity of heart disease was noted as per New York Heart Association (NYHA) criteria. Maternal outcome recorded in terms of Maternal death, Congestive Cardiac failure requiring ICU Care, Pregnancy Induced Hypertension, Antepartum Haemorrhage, Postpartum Haemorrhage, Deep vein Thrombosis, Anaemia and termination of pregnancy. Fetal outcome was recorded in terms Live Birth, Pre Term, Low Birth Weight, Intrauterine Death, Neonatal Death, Acute Fetal distress and Abortion.

**Results:** A total of 9298 pregnant females were screened. A total of 73 had cardiac disease, with a based prevalence of 7.85/1000. About 22 (30.13%) patients were diagnosed first time during pregnancy. Mean age was 27.46±4.4 years. Thirty two (45%) were primigravida. About 58(80%) were in either NYHA Class I or II. Rheumatic Heart Disease (RHD) was the most common {36 (46.5%)} cardiac disorder. Maternal mortality occurred in 3 (4.1%) patients. Cardiac failure occurred in 10 (13.6%) patients. Fetal outcome included abortion in 1 (1.36%), acute fetal distress in 5 (6.84%), Intrauterine death in 2 (2.73%), Low birth weight in 8 (10.9%), preterm delivery in 4 (5.4%) patients and neonatal mortality in 1 (1.36%). Medical Termination of Pregnancy (MTP) was done in 6 (8.2%) patients. Predictors of combined maternal & fetal morbidity and mortality were advanced NYHA Class (III & IV) (p=0.0001, OR 5.98 95% CI 1.2940 to 27.3424), severe left sided obstructive lesions (p=0.0001, OR 14.0 95% CI 3.8430 to 51.0019) and left ventricular dysfunction (p=0.0018, OR 18.27 95% CI 2.0982 to 159.2223).

**Conclusion:** RHD was the most common cardiac disorder reflecting need of secondary antibiotic prophylaxis. Patients who present with higher NYHA class, severe LV dysfunction and severe left heart obstructive disease represent high risk group.

**Keywords:** Cardiovascular disorder, Morbidity, Mortality, Rheumatic heart disease

## INTRODUCTION

The most significant non-obstetric cause of maternal death during pregnancy is cardiac disease [1]. Cardiac disease in pregnancy is an uncommon problem with a prevalence of less than 1% (varies from 0.3-3.5%) [2]. However, prevalence of cardiac disease in pregnancy has been found to be increasing due to higher age at first pregnancy and increase in prevalence of cardiovascular risk factors like hypertension, diabetes, obesity and increase in population of adult Congenital heart disease patients [3]. Acquired heart diseases are becoming more common in pregnancy as advancements in medical care have allowed more women with cardiac diseases to conceive and carry pregnancy till term [4]. Congenital heart disease are more common (75%) in developed world while RHD continues to be more common (55-80%) in developing world [3]. Pregnancy can lead to marked clinical deterioration in the women with heart disease because of associated cardio-circulatory changes [5] Maternal outcome is determined by the type of the cardiac disease, myocardial dysfunction, arrhythmias and prior cardiac events. The risk of fetomaternal morbidity and mortality depend on basic cardiac disease, left and right function, valvular function, NYHA class, presence of cyanosis

and pulmonary artery hypertension. Several scores have been developed to risk stratify patients with cardiac disease in pregnancy. These include CAPREG and ZAHARA scores [1,6,7]. Maternal complications include progressive heart failure, shock, various arrhythmias, placental abruption and maternal death. Perinatal outcome includes Preterm birth, Intrauterine growth restriction, low birth weight, congenital heart disease or fetal death. Better understanding of the risks associated with cardiac disorders in pregnancy and their optimal management is of vital importance for improving patient care [3]. Our hospital is the major cardiac referral center of the state where most high risk cardiac pregnancies are referred. The study was designed from our center so as to give better insight of the spectrum and fetomaternal outcome of cardiac disease in pregnancy and local population which in would lead to better management of this high risk group.

The study was conducted with in aim to study the spectrum, prevalence and fetomaternal outcome of cardiac diseases in pregnancy at a tertiary care center.

## MATERIALS AND METHODS

It was a single center retrospective study in which data of all antenatal patients visiting the hospital over a period of 27 months from March 2017 to June 2019 were analysed for cardiac diseases by clinical history, examination, Electocardiograpy and echocardiography.

The sample size was calculated by the following formula:

Sample size=$Z^2_{1-\alpha/2}$ p(1-p)$D^2$

Here, $Z(1-\alpha/2)$ is the standard normal variate=1.96, p=expected proportion of population based on previous studied [3], was assumed to be 0.04, considering the prevalence of cardiac disease in pregnancy to be D=absolute error which was assumed as 5%=0.05. From the above formula the sample size required to give adequate power is 1533. The finalized sample size was 9928 which was adequate for the study.

### Inclusion Criteria

All pregnant women with pre-existing and newly diagnosed cardiac disease attending the hospital during the study period.

### Exclusion Criteria

Patients who had cardiac condition secondary to medical ailments like chronic Hypertension and Type 2 Diabetes Melitus. Baseline data included age, parity, gestational age, NYHA functional class [8], comorbid conditions, prior cardiac events, any prior surgery/interventions, cyanosis and medications use. Patients were evaluated for any complication like arrhythymia, congestive cardiac failure and atrial fibrillation. Those patients who were included in the study were evaluated

for the mode of delivery, nature and severity of heart disease. Fetomaternal outcomes were noted. Maternal outcomes recorded in terms of Maternal death, Congestive Cardiac failure requiring ICU Care, Pregnancy Induced Hypertension, Antepartum Haemorrhage, Postpartum Haemorrhage, Deep vein Thrombosis, Anaemia and termination of pregnancy. Fetal outcomes recorded in terms of Birth, Pre-Term, Low Birth Weight, Intrauterine Death, Neonatal Death, Acute Fetal distress and Abortion. Severe left sided obstructive lesion was defined as Mitral stenosis with mitral valve area less than 1 cm$^2$ and aortic stenosis with mean transvalvular gradient of more than 40 mmg. LV systolic dysfunction was defined as Ejection fraction of less than 50% [3].

## STASTICAL ANALYSIS

Standard statistical procedures were used to analyse the data. Data were described as mean±standard deviation and percentages. Fischer exact test was used to calculate p-values. SPSS 20.0 (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp) and Microsoft Excel Software were used for data analysis. $p < 0.05$ was taken as statistically significant around 4% from published data.

## RESULTS

A total of 9298 pregnant females were screened and out of which 73 had cardiac disease giving a hospital based prevalence among attending patients of 7.85/1000. Out of 73 cases, 50 (68.49%) were booked and 23 (31.5%) were referred. Out of 73, 22 (30.13%) patients were diagnosed first time during pregnancy. The mean age of patients was 27.46±4.4 years. Majority was in age group 26-30 years age. A total of 50 (68.4%) pregnant ladies reported in first trimester, 20 (27.4%) in second trimester and 3 (4.2%) patients in third trimester. Thirty six (50%) patients were in NYHA Class I, 22 (30.13%) were in NYHA Class II, 9 (12%) were in NYHA Class III and 6 (8%) were in NYHA Class IV. The medication history was that 10 (13.69%) patients were on beta blockers and 4(5%) underwent Percutaneous Transvenous mitral Commissurotomy (PTMC) [Table/Fig-1].

RHD was the common {36 (46.5%)} cardiac disorder [Table/Fig-2].

Spontaneous vaginal delivery was seen in 20 (27.3%) patients while as Lower Segment Caesarean Section (LSCS) was done in 35 (47.9%) patients mainly for obstetric indications. Various Obstetrical Indications included Previous LSCS in 23 (31.5%), malpresentation in 2 (2.7%), Acute fetal distress in 5(6.8%) and Bad Obstetric history in 5 (6.8%) patients [Table/Fig-3]. Less than 3% of cases underwent LSCS after consultation with cardiologist due to impaired cardiovascular haemodynamics (mainly in those with LV dysfunction, Congestive cardiac failure, Severe Aortic stenosis and Mitral stenosis and CoA). Maternal

| Baseline characteristics | Number (Percentage) |
|---|---|
| **Age (Years)** | |
| 20-25 | 18 (25) |
| 26-30 | 24 (32) |
| 31-35 | 22 (30) |
| >35 | 9 (13) |
| **Gravida** | |
| G1 | 32 (45) |
| G2 | 29 (39) |
| G3 | 8 (11) |
| G4 | 4 (5) |
| **NYHA Class** | |
| I | 36 (50) |
| II | 22 (30) |
| III | 9 (12) |
| IV | 6 (8) |
| **Medications** | |
| Beta blockers | 10 (13.69) |
| Anticoagulants | 6 (8.2) |
| Diuretics | 9 (12.32) |
| Digoxin | 6 (8.2) |
| PTMC | 4 (5) |
| No medications | 38 (52) |

**[Table/Fig-1]:** Baseline characteristics.

| Type of cardiac lesion | Number (Percentage) |
|---|---|
| **Rheumatic Heart Disease (RHD)** | 36 (46.5) |
| Mitral Stenosis (MS) | 9 (12.32) |
| Mitral Regurgitation (MR) | 7 (9.58) |
| MS + MR + TR | 16 (21.91) |
| MS+ MR+AorticRegurgitation | 3 (4.1) |
| MS +MR + Aortic Stenosis | 1 (1.36) |
| **Congenital Heart Disease** | 13 (7.8) |
| Atrial Septal Defect | 5 (6.84) |
| Ventricular Septal Defect | 1 (1.36) |
| Patent Ductus Arteriosus | 1 (1.36) |
| Pulmonary Stenosis | 1 (1.36) |
| Coarctation of Aorta | 1 (1.36) |
| Ebstein anomaly | 2 (2.73) |
| Post ASD Surgical closure | 2 (2.73) |
| **Cardiomyopathy** | 8 (10.9) |
| **Mitral Valve prolapsed** | 5 (6.8) |
| **Rhythm Disturbance** | 4 (5.4) |
| **Pericardial Effusion** | 3 (4.1) |
| **Prosthetic Valve** | 4 (5.4) |

**[Table/Fig-2]:** Type of cardiac lesion.

mortality occurred in 3 (4.1%) patients. Maternal morbidity in terms of those progressing to heart failure and requiring ICU admission developed in 10 (13.6%) patients. Out of 10 patients 4 patients required ventilatory support for a mean duration of 18.5±3.4 hours. No active cardiac intervention was needed in these patients. Only supportive treatment was given. Cause of deaths included cardiac arrest after LSCS in one patient, (died 12 hours after LSCS) another developed heart failure after vaginal delivery (died 24 hours after delivery) and third patient of prosthetic valve disease died of prosthetic valve thrombosis. (15 days postpartum). Fetal outcome included abortion in 1(1.36%), acute fetal distress in 5(6.84%), Intrauterine death in 2(2.73%), Low birth weight in 8 (10.9%) and neonatal mortality in 1(1.36%) [Table/Fig-3].

Predictors of combined maternal & fetal morbidity and mortality were advanced NYHA Class (III & IV) (p=0.0001 OR 5.98 95% CI 1.2940 to 27.3424), severe left sided obstructive lesions (p=0.0001, OR 14.0 95% CI 3.8430 to 51.0019) and left ventricular systolic dysfunction (p=0.0018, OR 18.27 95% CI 2.0982 to 159.2223) [Table/Fig-4]. More than one maternal events were observed. Hence, total was more than 73.

## DISCUSSION

Heart disease in pregnancy has emerged as one of the leading causes of maternal mortality. The present study was aimed to analyse the type of cardiac lesion and assess the maternal and fetal outcomes in pregnant women with heart disease. Majority were in the age group 26-30 years age. Hospital based prevalence among attending patients of 7.85/1000 was noted. This may not reflect actual prevalence as ours is a referral centre. However, similar observations were made in previous regional studies [9,10]. Another interesting observation in our study was that 22 (30.13%) patients were diagnosed first time during pregnancy. The pathophysiologic changes associated with pregnancy are responsible for many women to first experienced symptoms during pregnancy who are otherwise asymptomatic and in compensated state. Mitchelson JB and Cleveland DE, reported that as many as 25% of RHD patients experience first time symptoms during pregnancy [11]. Desai DK et al., and Hameed A et al., have reported 30-40% of heart disease patients diagnosed during index pregnancy [12,13]. Hence, pregnancy is a useful time to screen for cardiac disorders also in otherwise undiagnosed patients which in turn has significant medical implications for both mother as well as fetus.

Although the overall prevalence of heart disease in pregnancy is similar in different studies, the relative contribution of the different causes of heart disease diagnosed during pregnancy varies with the study population. RHD was found to be most common cardiac disorder in pregnancy in our population contributing to

| Events | Number (Percentage) |
|---|---|
| **Obstetrical outcome** | |
| Spontaneous vaginal delivery | 20 (27.3) |
| Induced labour | 8 (10.9) |
| Instrumental delivery | 4 (5.71) |
| Lower segment caesarean section | 35 (47.9) |
| Medical termination of pregnancy | 6 (8.2) |
| **Maternal events** | |
| **Cardiac complications** | |
| Cardiac maternal death | 3 (4.1) |
| Congestive cardiac failure requiring ICU care | 10 (13.6) |
| **Obstetric complications** | |
| Pregnancy induced hypertension | 5 (6.8) |
| Antepartum haemorrhage | 1 (1.36) |
| Postpartum haemorrhage | 3 (4.1) |
| Deep vein thrombosis | 1 (1.36) |
| Anaemia | 11 (15.06) |
| Preterm labour | 7 (9.5%) |
| Oligohydramnios | 10 (13.6%) |
| Previous Lower segment caesarean section | 23 (31.5%) |
| Intrauterine growth restriction | 8 (10.9%) |
| Cholestasis | 12 (16.4%) |
| Malpresentation | 2 (2.7%) |
| Gestational diabetes melitus | 20 (27.4%) |
| Hypothyroidism | 18 (24.6%) |
| Bad obstetric history | 5 (6.8%) |
| Postdated | 0 |
| Cephalopelvic disproportion | 15 (20.5%) |
| Preterm premature rupture of membrane | 3 (4.1%) |
| Retained placenta with shock | 1 (1.3%) |
| **Perinatal outcome** | |
| Live birth | 63 (86.3) |
| Pre term | 4 (5.4) |
| Low birth weight | 8 (10.9) |
| Intrauterine death | 2 (2.73) |
| Neonatal death | 1 (1.36) |
| Acute fetal distress | 5 (6.84) |
| Abortion | 1 (1.36) |
| Medical termination of pregnancy | 6 (8.2) |

**[Table/Fig-3]:** Maternal and perinatal outcome.

nearly half of all disorders. MS was the most common among RHD. This is consistent with other studies [14,15]. This may be due to lack of preventive treatment and inadequate use of secondary antibiotic prophylaxis against the streptococcal infections in our population. ASD was the most common among the congenital disorders as usually ASD patients are asymptomatic till late adult life while as other congenital heart

disease present much more early. A comparison of various Indian and other western studies about the spectrum and outcome of maternal cardiac diseases is shown in [Table/Fig-5] [1,9,16-24].

Maternal mortality occurred in 3 (4.1%) patients. Maternal morbidity in terms of those developing Congestive Cardiac failure and requiring Intensive care unit admission was in 10 (13.6%) patients. Most of the patients develop cardiac failure during labour and post delivery which is a period of most labile haemodynamic changes and hence these patients require additional attention during labour [25]. Pre-term birth and low birth weight babies are major neonatal complications in women with heart disease in pregnancy. In our study, Intrauterine death occurred in 2(2.73%), Low birth weight in 8(10.9%), preterm delivery in 4(5.4%) patients and neonatal mortality in 1(1.36%). Possible reasons for low birth weight include decreased uterine blood supply due to valvular stenosis, arrhythmias and drugs like diuretics and betablockers. Hypoxia can lead to cervical softening which in turn increases the risk of preterm delivery. Other studies have shown preterm labour to be present in 10-20% of these pregnancies [26,27]. These neonates also have 3-5% risk of inheriting congenital heart disease compared to 1% risk in general population [28]. However, in the study, any such neonatal heart disease was not observed, reason may be that only 17% of patients had CHD while majority had acquired heart disease.

The study found that significant factors affecting maternal & Fetal morbidity and mortality were advanced NYHA Class III or more, severe left sided obstructive lesions and left ventricular systolic dysfunction (p<0.05). Sawhney H et al., reported in their study of 486 pregnant females with RHD maternal mortality of 10, out of which 8 belonged to NYHA Class III & IV [26]. Subbaiah M et al., reported higher maternal morbidity in those with NYHA Class III & IV [22]. Patients with LV dysfunction should be advised against conception, if EF is less than 40% or they are in NYHA Class III or IV. Grewal J et al., reported in one study of 36 pregnancies in 32 women with Dilated cardiomyopathy, 40% were complicated with maternal events and LV dysfunction was the main determinant of adverse maternal outcomes [29]. If EF is between 40-50%, exercise testing may help in clinical decision making. Mechanical prosthetic valves especially in mitral position are associated with higher risk of thromboembolic events [30]. One of this study patients died in post partum period because of prosthetic valve thrombosis despite being thrombolysed. Summarising LV dysfunction and advanced NYHA Class make pregnancies high risk. Such patients don't tolerate pregnancy well. Hence, these factors should be used to risk stratify pregnancies with cardiac disease as high risk.

| | Total | Yes (25) Maternal & perinatal morbidity/mortality | No (48) Maternal & perinatal morbidity/mortality | p-value Fisher's-exact test (two tailed) | Odds ratio | 95% Confidence interval |
|---|---|---|---|---|---|---|
| **Stenotic Vs non stenotic** | | | | | | |
| Stenotic | 18 | 14 (77.77%) | 4 (22.23) | 0.0001 | 14.00 | 3.8430 to 51.0019 |
| Nonstenotic | 55 | 11 (20%) | 44 (80%) | | | |
| **LV dysfunction** | | | | | | |
| Yes | 8 | 7 (87.5%) | 1 (12.5%) | 0.0018 | 18.27 | 2.0982 to 159.2223 |
| No | 65 | 18 (27.69) | 47 (72.31%) | | | |
| **NYHA Class ≥III** | | | | | | |
| Yes | 15 | 13 (86.66%) | 2 (13.33) | 0.0001 | 5.98 | 1.2940 to 27.3424 |
| No | 58 | 12 (20.68%) | 46 (79.31%) | | | |
| **Prosthetic Valve** | | | | | | |
| Yes | 4 | 3 (75%) | 1 (25%) | 0.113 | 6.4091 | 0.6304 to 65.1618 |
| No | 69 | 22 (31.88%) | 47 (68.11%) | | | |

**[Table/Fig-4]:** Factors affecting morbidity and mortality.

| Study | Number of patients | Year and place of study | Prevalence of heart disease in pregnancy | Aetiology | | Maternal mortality | Perinatal mortality |
|---|---|---|---|---|---|---|---|
| | | | | Congenital% | Acquired% | | |
| Siu SC et al., [1] | 546 | 2001, Canada (Toronto) | | 74% | 22% | 1% | 1% |
| Konar H and Chaudhuri S, [9] | 281 | 2012, India (Kolkata) | | 21% | 69% | 1.1% | 4% |
| Farhan HA and Yaseen IF, [20] | 252 | 2019, Iraq (Baghdad) | | 30.5% | 69.5% | -- | -- |
| Khursheed R et al [16] | 132 | 2014, India (J& K) | | 24.24% | 74.96% | 0.75% | 6.4% |
| Sliwa K et al., [21] | 225 | 2012, South africa (Capetown) | | 32% | 68% | 4% | 0.7% |
| Stangl V et al., [17] | 93 | 2008, Germany (Berlin) | | 81.7% | 10.8% | 1.1% | 1.1% |
| Subbaiah M etal [22] | 100 | 2013, India (New delhi) | 3.8% | 36% | 64% | 1% | 1.98% |
| Salam S et al., [23] | 90 | | 4.3% | 14% | 86% | 4.4% | 14% |
| Khan DA et al., [18] | 55 | 2017, India (Meghalaya) | 2.32% | 49.09 | 50.91 | 5.45% | 0 |
| Joshi et al., [19] | 42 | 2013, India (Uttarakhand) | | 14.3% | 85.7% | 4.8% | 13.1% |
| Kamat AV and Dama S, [24] | 35 | 2013, India (Karnataka) | | 29.7% | 70.3% | 2.8% | 2.8% |
| Our Study | 73 | 2018 India (J& K) | 0.785% | 17.8% | 82.2% | 4.1% | 1.36% (Excluding MTP & abortion) |

**[Table/Fig-5]:** Spectrum and outcome in various studies [1,9,16-24].

## Limitation(s)

It was a single centre study with relatively smaller sample size. Long term follow-up of patients was not done. All neonates born did not undergo screening echocardiography at birth.

## CONCLUSION(S)

The study found RHD to be the most common cardiac disorder which highlights the need of preventive treatment and use of secondary antibiotic prophylaxis against the streptococcal infections in our population. Patients who present with higher NYHA class, severe left heart obstructive disease are at higher risk of complications and require more dedicated and focused care.

## REFERENCES

[1] Siu SC, Sermer M, Colman JM, Alvarez AN, Mercier LA, Morton BC, et al. Prospective multicenter study of pregnancy outcomes in women with heart disease. Circulation. 2001;104(5):515-21

[2]  McFaul P, Dornan J, Lamki H, Boyle D. Pregnancy complicated by maternal heart disease. A review of 519 women. Br J Obstet Gynaecol. 1998;95:861-67.

[3]  Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, Blomstrom-Lundqvist C, Cifkova R, De Bonis M, et al. ESC guidelines on the management of cardiovascular diseases during pregnancy: The Task Force on the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC). European Heart Journal. 2018;39:3165-241.

[4]  Thompson JL, Kuklina EV, Bateman BT, Callaghan WM, James AH, Grotegut CA. Medical and obstetric outcomes among pregnant women with congenital heart disease. Obstet Gynecol. 2015;126:346-54. 10.1097/AOG.0000000000000973

[5]  Hsuth WA, Luetscher JA, Carlson EJ, Grislis G, Fraze E, Hargue MI. Changes in active and inactive renin throughout pregnancy. J Clin Endocrinol Metab 1982;54:1010-16.

[6]  Drenthen W, Pieper PG, Roos-Hesselink JW, Van Lottum WA, Voors AA, Mulder BJ  et al. Outcome of pregnancy in women with congenital heart disease: A literature review. J Am Coll Cardiol. 2007;49:2303-11.

[7]  Drenthen W, Boersma E, Balci A, Moons P, Roos-Hesselink JW, Mulder BJ, et al. Predictors of pregnancy complications in women with congenital heart disease. Eur Heart J. 2010;31:2124-32.

[8]  Boston ML. The criteria committee of the New York Heart Association. In Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels. 1994; pp. 253-256.

[9]  Konar H, Chaudhuri S. Pregnancy complicated by maternal heart disease: A review of 281 women. J Obstet Gynaecol India. 2012;62:301-06. 10.1007/s13224-012-0220-2

[10] Wasim T, Amer W, Majrooh A, Siddiq S. Foetomaternal outcome of pregnancy with cardiac disease. J Pak Med Assoc. 2008;58:175-78.

[11] Mitchelson JB, Cleveland DE. Optimal management of a pregnant patient with rheumatic heart disease. Kans J Med. 2018;11:80-82.

[12] Desai DK, Adanlawo M, Naidoo DP, Moodley J, Kleinschmidt I. Mitral Stenosis In pregnancy: A four experinec at King Edward VIII hospital, Durban south Africa. Br J Obstet Gynaecol. 2000;107:953-58.

[13] Hameed A, Karaalp IS, Tummala PP, Wani OR, Canetti M, Akhter MW, et al. The effect of valvular heart disease on maternal and fetal outcome of pregnancy. J Am College Cardiol. 2001;37(3):893-99.

[14] deSweit M. Cardiac disease. In: Lewis G, Drife J, editors. Why mothers die 1997-1999. The confidential enquiries into maternal deaths in the United Kingdom. London: RCOG Press; 2001. pp. 153-164.

[15] Devabhaktuni P, Devinenik K, Vemuri U. Pregnancy outcome in chronic rheumatic heart disease. J Obstet Gynaecol India. 2009;59:41-46.

[16] Khursheed R, Tabasum A, Zargar B. Maternal and fetal outcome in pregnancies complicated with maternal cardiac diseases: Experience at tertiary care hospital. The Internet Journal of Gynecology and Obstetrics. 2015;19(1):01-06

[17] Stangl V, Schad J, Gossing G, Borges A, Baumann G, Stangl K. Maternal heart disease and pregnancy outcome: A single centre experience. European Journal of Heart Failure. 2008;10(9):855-60.

[18] Khan DA, Sharma N, Kapoor M, Duwarah SG, Ahanthem SS. The spectrum of heart disease in pregnancy and its outcome in patients visiting a tertiary care centre of Northeastern: A prospective study. Journal of Clinical and Diagnostic Research. 2018;12(7):QC16-QC20.

[19] Joshi G, Joshi SC, Jha SK, Singh Y, Joshi A. Maternal heart disease and pregnancy outcome: Findings from a retrospective cohort in a tertiary care government hospital in Haldwani, Nainital. Nig J Cardiol. 2015;12:120-23.

[20] Farhan HA, Yaseen IF. Heart disease in pregnancy-clinical pattern and prevalence: Initial data from the first cardio-maternal unit in Iraq. BMC Res Notes 2019;12:491.

[21] Sliwa K, Libhaber E, Elliott C, Momberg Z, Osman A, Zühlke L, et al. Spectrum of cardiac disease in maternity in a low-resource cohort in South Africa. Heart (British Cardiac Society),2014;100(24):1967-74.

[22] Subbaiah M, Sharma V, Kumar S, Rajeshwari S, Kothari SS, Roy KK.et al. Heart disease in pregnancy: Cardiac and obstetric outcomes. Arch Gynecol Obstet. 2013;288(1):23-27.

[23] Salam S, Mushtaq S, Mohi-ud-Din, Gul I, Ali A. Maternal and fetal outcome in pregnancy with heart disease in tertiary care hospital in India. Int J Reprod Contracept Obstet Gynecol. 2017;6:3947-51.

[24] Kamat AV, Dama S. Clinical study of cardiac diseases during pregnancy. Int J Reprod Contracept Obstet Gynecol 2016;5:855-59.

[25] Stout KK, Otto CM. Pregnancy in women with valvular heart disease. Heart. 2007;93(5):552-58.

[26] Sawhney H, Aggarwal N, Suri V, Vasishta K, Sharma Y, Grover A. Maternal and perinatal outcome in rheumatic heart disease. Int J Gynaecology Obstet. 2003;80(1):9-14.

[27] Asghar F, Kokab H. Evaluation and outcome of pregnancy complicated by heart disease. J Pak Med Assoc. 2005;55:416-19.

[28] Gelson E, Mank J, Gatzoulis M, Abselm U. Cardiac disease in pregnancy. Obstet Gynaecol. 2007;9:83-87.

[29] Grewal J, Siu SC, Ross HJ, Mason J, Balint OH, Sermer M, et al. Pregnancy outcomes in women with dilated cardiomyopathy. J Am Coll Cardiol. 2010;55:45.

[30] Elkayam U, Bitar F. Valvular heart disease and pregnancy: Part II: Prosthetic valves. J Am Coll Cardiol. 2005;46(3):403-10.

PARTICULARS OF CONTRIBUTORS:
1.  Assistant Professor, Department of Cardiology, SKIMS, Srinagar, Jammu and Kashmir, India.
2.  Assistant Professor, Department of Obstetrics and Gynaecology, SKIMS, Srinagar, Jammu and Kashmir, India.
3.  Senior Resident, Department of Obstetrics and Gynaecology, SKIMS, Srinagar, Jammu and Kashmir, India.
4.  Senior Resident, Department of Cardiology, SKIMS, Srinagar, Jammu and Kashmir, India.
5.  Professor, Department of Obstetrics and Gynaecology, SKIMS, Srinagar, Jammu and Kashmir, India.
6.  Senior Resident, Department of Cardiology, SKIMS, Srinagar, Jammu and Kashmir, India.
7.  Associate Professor, Department of Cardiology, SKIMS, Srinagar, Jammu and Kashmir, India.
8.  Professor, Department of Cardiology, SKIMS, Srinagar, Jammu and Kashmir, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Shaheera Ajaz,
House no 8, LD Colony Goripora Rawalpora, Srinagar, Jammu and Kashmir, India.
E-mail: shaheeraajaz900@gmail.com

AUTHOR DECLARATION:
• Financial or Other Competing Interests:    None
• Was Ethics Committee Approval obtained for this study?     No
• Was informed consent obtained from the subjects involved in the study?    Yes
• For any images presented appropriate consent has been obtained from the subjects.    NA