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Research Article

Assessment of Cardiac Function in Pregnant Females of a Tertiary Care Hospital of East Uttar Pradesh: A Cross-sectional Study

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A B S T R A C T

Introduction: Cardiovascular dysfunction, including heart failure (HF), is a significant contributor to maternal mortality and is a leading non-obstetric cause of death during pregnancy. The rates of cardiovascular disease (CVD) mortality have been increasing over the years, surpassing other pregnancy-related causes of death.

Objectives: The study was conducted to assess the cardiac function in pregnant females during their third trimester and determine the prevalence of cardiac disease among pregnant women.

Methods: The study was conducted among 260 pregnant women in their third trimester who were selected as per the predefined inclusion and exclusion criteria. A thorough physical examination was done and presenting complaints such as chest pain, breathlessness, palpitations, syncope, easy fatiguability, swelling of legs, orthopnoea, and paroxysmal nocturnal dyspnoea along with few biochemical markers were documented. Data collected during the study period, which spanned from July 1, 2021, to June 30, 2022, were subjected to appropriate statistical analysis.

Results: The study had predominantly lower socioeconomic housewives (63.1% multigravida and 36.9% primigravida). Cardiac symptoms were present in 4.6% of the subjects. About 5.8% had chronic cardiac conditions, among whom, congenital heart issues were seen in 26.7%, while 73.3% had acquired heart disease. Atrial septal defect was the most common congenital condition, and rheumatic heart disease, particularly mitral stenosis and regurgitation, prevailed in acquired cases.

Conclusion: The study demonstrated a 5.8% prevalence of cardiac disease in pregnant women during their third trimester, with acquired heart disease, particularly rheumatic heart disease, being more common than congenital heart disease.

Keywords: Cardiac Dysfunction, Pregnant Women, Echocardiogram

Introduction

Cardiovascular dysfunction, including heart failure (HF), is one of the leading non-obstetric causes of maternal mortality,[1-4] with reported rates of cardiovascular disease (CVD) mortality during pregnancy increasing from 7.2 to 17.2 per 100,000 live births between 1987 and 2015, more than doubling in incidence.[5] These concerning trends are particularly pronounced among marginalised groups, such as people of colour, who face maternal health inequities and a higher risk of severe complications.[6] To address these challenges, the field of cardio-obstetrics has emerged, integrating the expertise of interdisciplinary professionals from cardiology and obstetrics to monitor cardiac function and health throughout the preconception, prenatal, and postpartum periods. Pregnancy induces significant anatomical and haemodynamic changes that place physiological stress on the cardiovascular system. This stress can exacerbate pre-existing cardiovascular dysfunction, such as hypertension, or lead to the development of new conditions like cardiomyopathy. Such conditions increase the risk of HF, which is associated with poor outcomes and high mortality rates. Pregnancy induces adaptations in the cardiovascular system to fulfil the increased metabolic demands of both the mother and the developing foetus. By approximately 32 weeks of gestation, plasma volume and cardiac output (CO) typically rise by 40%-50% above baseline levels. It is worth noting that 75% of this increase takes place by the end of the first trimester.[4] The elevation in CO primarily occurs through an initial augmentation in stroke volume during the first half of pregnancy, followed by a gradual rise in heart rate. Additionally, there is an enlargement in atrial and ventricular diameters, while overall ventricular function is generally maintained during pregnancy. However, pregnant women with pre-existing heart disease may experience suboptimal adaptation of the left ventricle (LV) and right ventricle (RV) to the physiological demands of pregnancy. Maternal cardiac dysfunction not only contributes to maternal mortality but also impairs uteroplacental flow and leads to suboptimal foetal outcomes.[7] Research on cardiovascular dysfunction and HF prevalence has predominantly focused on older populations, leaving limited understanding of these conditions among pregnant women. Existing studies have primarily concentrated on pregnant women with pre-existing cardiovascular conditions, such as cardiomyopathy. It is therefore crucial to identify clinical predictors for adverse cardiovascular and obstetric outcomes in pregnant women, as maternal mortality has been on the rise over the past two decades. Factors contributing to this increase include advanced age, obesity, diabetes, hypertension, and underlying congenital heart disease.[8] Pregnancy represents a potentially high-risk period for women with pre-existing cardiovascular disease due to the significant haemodynamic changes that occur. Echocardiography remains the preferred and commonly accessible imaging modality for diagnosing and monitoring cardiovascular disease in pregnant women due to its wide availability and lack of radiation exposure.[9] It enables the identification, risk stratification, and continuous monitoring of cardiovascular alterations throughout pregnancy. Individuals identified as being at risk should receive individual counselling and comprehensive follow-up care from a multidisciplinary team. However, there have been relatively few studies investigating the consequences of pregnancy on the cardiovascular system.[10,11]

Given these facts, we have planned an echocardiographic assessment of cardiac function during pregnancy, aiming to gather valuable information in this under-researched area.

Aim: To assess the cardiac function in pregnant females of a tertiary care hospital in East Uttar Pradesh

Material and Methods

This study was conducted at Nehru Hospital Medical College, Gorakhpur, specifically in the Outpatient and Emergency Departments of Obstetrics and Gynaecology. The objective of the study was to observe and analyse the prevalence of cardiac disease among pregnant women in their third trimester. Cross-sectional study design was utilised in the study. The researchers had obtained the necessary approval from the Institute's Ethics Committee, ensuring that ethical guidelines are followed. The study population included all pregnant women who were in their third trimester of pregnancy. These women served as the study units, and data were collected from them through various assessments and examinations. In order to determine the appropriate sample size, the prevalence of cardiac disease in pregnancy, estimated to be between 2% and 4%, was taken into consideration. Using the formula for sample size calculation, N = 4pq/L^2, where p represents the prevalence of cardiac disease (4%), q represents the complementary percentage (96%), and L represents the allowed error (2.5% in the present study), the sample size was determined to be 245.7. For convenience, a total of 260 participants were included in the study. Certain exclusion criteria were established to ensure the validity and relevance of the data. Patients who were in labour, critically ill pregnant women, those who did not provide consent, patients with known cardiovascular disease, and non-pregnant women seeking pre-conception counselling were excluded from the study. Data collected during the study period, which spanned from July 1, 2021, to June 30, 2022, were subjected to appropriate statistical analysis. The findings of the study will contribute to the understanding of the prevalence of cardiac disease among pregnant women in their third trimester, and the results will be valuable for future research and clinical practice in the field of obstetrics and gynaecology.

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Methodology

Data collection for this study involved pregnant women who attended the Department of Obstetrics and Gynaecology at BRD Medical College and provided their consent. The participants were selected based on the predefined inclusion and exclusion criteria. A detailed history was obtained from each participant, including their age, background (rural/ urban/ urban slums), education, occupation, socioeconomic class, gravid status and parity, gestational age, and history of hypertension, heart failure, cardiovascular disease, rheumatic fever, thyroid diseases, diabetes, and chronic obstructive pulmonary disease (COPD). Information regarding personal history of smoking and alcohol abuse, as well as family history of coronary artery disease, hypertension, and cardiomyopathy, was also recorded. Additionally, details of any previous treatment with beta-blockers, diuretics, and nonsteroidal anti-inflammatory drugs (NSAIDs) were noted. Presenting complaints such as chest pain, breathlessness, palpitations, syncope, easy fatiguability, swelling of legs, orthopnoea, and paroxysmal nocturnal dyspnoea were documented. A thorough physical examination was conducted, including an assessment of pulse rate (PR), blood pressure (BP), respiratory rate (RR), oxygen saturation (SPO_2), presence of pallor, icterus, cyanosis, lymphadenopathy, clubbing, and pedal oedema. The cardiovascular examination involved evaluating jugular venous pressure (JVP), apex beat, heart sounds, and murmurs. The New York Heart Association (NYHA) classification was determined for each participant. Laboratory investigations were performed, including the measurement of haemoglobin (Hb) levels and brain natriuretic peptide (BNP) levels. Echocardiography was carried out using a Vivid E95 echo machine to assess cardiac function and structure.

The collected data were coded and recorded in a Microsoft Excel spreadsheet. Statistical analysis was conducted using the OpenEpi online software. Descriptive statistics were used to summarise the data and present means, standard deviations, medians, interquartile ranges, frequencies, and percentages. Graphical representations such as histograms, box-and-whisker plots, column charts, bar charts, and pie charts were utilised as appropriate. For comparing continuous variables between groups, independent sample t-tests were employed if the data followed a normal distribution. In cases where the data did not meet the assumptions of normality, non-parametric tests such as the Wilcoxon test were used. Categorical data comparisons were performed using the chi-squared test or Fisher's exact test if the expected frequency was less than 5 for more than 25% of the cells. Linear correlation between continuous variables was assessed using Pearson's correlation for normally distributed data, while Spearman's correlation was utilised for non-normally distributed data. Statistical significance was determined at a p value threshold of less than 0.05.

Results

The study comprised a total of 260 participants, with a mean age of 26.77 years (± 3.58). The age range varied from 20 to 40 years. The occupational status of the majority of participants (96.9%) was housewives, indicating a predominance of individuals belonging to a lower socioeconomic group (Table 1). Among the participants, 63.1% were multigravida, while 36.9% were primigravida. The mean gestational age at the time of the study was 34.55 weeks (± 2.14), with a minimum of 28 weeks and a maximum of 40 weeks. In terms of dietary habits, a significant proportion of the participants (93.1%) followed a vegetarian diet. Furthermore, none of the participants had a family history of heart disease. Approximately 5% of the study population had pre-existing chronic conditions, including diabetes, gestational diabetes mellitus, hypertension, hypothyroidism, asthma, or pulmonary tuberculosis. Among the participants, 95.4% did not report any specific cardiac complaints, while 4.6% presented with symptoms such as pedal oedema, chest pain, breathlessness, or palpitations.

Table 1. Distribution of study participants according to their sociodemographic profile and associated chronic diseases (N = 260)

S. No.	Sociodemographic Details		n	%
1.	Age (years)	20-25	97	37.3
		26-30	138	53.1
		31-35	17	6.5
		> 35	08	3.1
2.	Occupation	Housewife	252	96.9
		Teacher	07	2.7
		Shopkeeper	01	0.4

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3.	Socioeconomic background	High	00	0.0
		Middle	12	4.6
		Low	248	95.4
4.	Gravidity	Primigravida	96	36.9
		Multigravida	164	63.1
5.	POG (weeks)	**Mean** = 34.55 ± 2.14		
6.	Dietary history	Non-vegetarian	18	6.9
		Vegetarian	242	93.1
7.	Chronic diseases	Diabetes mellitus	02	0.8
		Gestational diabetes	03	1.2
		Hypertension	01	0.4
		Hypothyroidism	09	3.5
		Asthma	01	0.4
		Pulmonary tuberculosis	01	0.4

POG: Period of Gestation

Table 2.Distribution of Study Participants according to their Signs and Symptoms of Cardiac Dysfunction (N = 260)

S. No.	Variables		n	%
1.	Presenting complaints	Pedal oedema[$]	0	0.0
		Chest pain	2	0.8
		Cough	3	1.2
		Breathlessness	7	2.7
		Palpitations	2	0.8
2.	Systolic BP (mmHg)	**Mean** = 111.04 ± 7.56		
3.	Diastolic BP (mmHg)	**Mean** = 74.23 ± 8.64		
4.	Respiratory rate (BPM)	**Mean** = 17.12 ± 2.06		
5.	Chest examination	B/L clear	255	98.1
		B/L crepts	05	1.9
6.	General examination	Cyanosis (present)	00	0.0
		Clubbing (present)	00	0.0
		Oedema (present)	05	1.9
7.	Pulse rate (BPM)	**Mean** = 94.68 ± 6.79		
8.	Rhythm	Regular	258	99.2
		Irregular	02	0.8
9.	Jugular Venous Pressure (JVP)	Raised	02	0.8
		Not raised	258	99.2
10.	Cardiovascular auscultation	Normal	252	96.9
		Abnormal	08	3.1

$: Pathological pedal oedema; B/L: Bilateral, BP: Blood pressure, BPM: Beats per minute

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Table 3.Distribution of Participants according to their Findings of Echocardiogram Results (N = 260)

Variables		n	%
Impression	Normal	245	94.2
	Abnormal	15	5.8
Abnormal participants (15 (5.8%))			
Type of abnormality	2 (a) Acquired heart disease	11	73.3
	2 (b) Congenital heart disease	04	26.7
Acquired heart disease (11 (73.3%))			
Type of acquired heart disease	2 (a.1) Dilated cardiomyopathy	01	9.1
	2 (a.2) Rheumatic heart disease	10	90.9
Rheumatic heart disease (10 (90.9%))			
Rheumatic heart disease findings	MR	04	40.0
	MS	04	40.0
	MR + MS	02	20.0
Congenital heart disease (4 (26.7%))			
Type of congenital heart disease	Atrial septal defect	02	50.0
	Pulmonary stenosis	01	25.0
	Tricuspid regurgitation	01	25.0

MR: Mitral Regurgitation, MS: Mitral Stenosis

Various clinical parameters were recorded during the study. The mean pulse rate was determined to be 94.68 beats per minute (± 6.79), with 0.8% of participants showing an irregular pulse (Table 2). The mean systolic blood pressure was 111.04 mmHg (± 7.56), ranging from 90 to 110 mmHg. The average respiratory rate was 17.12 breaths per minute (± 2.06), with a minimum rate of 16 breaths per minute. Bilateral chest crepitations were observed in 1.9% of the participants. No participants exhibited signs of cyanosis, and clubbing, but raised jugular venous pressure was seen in 2 (0.8%) subjects. Oedema was present in 1.9% of participants, while 0.8% showed elevated jugular venous pressure. Abnormal auscultation findings were identified in 3.1% of the participants. Among the 260 participants, 5.8% (n = 15) were found to have cardiac disease, either congenital or acquired (Table 3). Out of these, 26.7% (n = 4) had congenital heart disease, while 73.3% (n = 11) had acquired heart disease. Acquired heart disease was more prevalent than congenital heart disease. The most common congenital heart disease observed was atrial septal defect (ASD) in 50% of cases (n = 2), followed by tricuspid regurgitation (25%, n = 1) and pulmonary stenosis (25%, n = 1). Among acquired heart diseases, the majority of participants had rheumatic heart disease (90.9%, n = 10), followed by dilated cardiomyopathy. Within the rheumatic heart disease group, 40% (n = 4) had mitral stenosis, 40% had mitral regurgitation (n = 4), and 20% (n = 2) had a combination of mitral stenosis and mitral regurgitation.

Discussion

The study conducted on a sample of 260 participants revealed a cardiac disease prevalence rate of 5.7%. A comparative analysis with similar studies conducted by Birhanu et al.[12] in Ethiopia and Gomathi and Thendral[13] in Tamil Nadu, India, demonstrated higher prevalence rates of cardiac disease in their respective study populations. Our findings indicated that acquired heart disease was more common (73.3%) than congenital heart disease (26.7%); a trend consistent with the results of the studies conducted by Birhanu et al.[12] and Gomathi and Thendral[13]. This pattern is commonly observed in developing countries, which bear a greater burden of rheumatic heart disease compared to developed nations. Among congenital heart diseases, atrial septal defect (ASD) was the most frequently observed anomaly. This finding misaligns with the study conducted by Gomathi and Thendral, which identified mitral valve prolapse as the most common congenital heart disease followed by ASD.[13]

Regarding acquired heart diseases, rheumatic heart disease accounted for the highest prevalence (3.8%) in our study. Similar results were observed in the study by Gomathi and Thendral[13] in Tamil Nadu, where the prevalence of rheumatic heart disease was 4%. Another study by Otto et al.[14] reported a prevalence of 2.3% among pregnant

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women in Keren. The study conducted by Nascimento et al.[15] in Brazil demonstrated a prevalence of 3.2% for rheumatic heart disease in their study population. These studies conducted in developing countries consistently indicate a higher prevalence of rheumatic heart disease compared to congenital heart disease. In our study, among cases of rheumatic heart disease, mitral stenosis (MS) and mitral regurgitation (MR) were equally prevalent, followed by the combined lesion of mitral stenosis and mitral regurgitation. The study by Gomathi and Thendral[13] showed a higher prevalence of mitral stenosis compared to mitral regurgitation, while the study by Birhanu et al.[12] demonstrated a higher prevalence of mitral regurgitation than mitral stenosis. The mean age of the participants in our study was 26.77 ± 3.58 years, with a range of 20 to 40 years, which falls within the age group susceptible to rheumatic heart disease. The study conducted by Birhanu et al.[12] included participants with a mean age of 25.8 years and a range of 23 to 30 years. Furthermore, the majority of participants in our study belonged to a lower socioeconomic group, which aligns with the findings of the study conducted by Birhanu et al.[12] Rheumatic heart disease is known to be associated with poverty. In summary, our study identified a cardiac disease prevalence rate of 5.7% among the study participants. Acquired heart disease, particularly rheumatic heart disease, was more prevalent than congenital heart disease. These findings are consistent with studies conducted in developing countries, highlighting the burden of rheumatic heart disease. The results contribute to a better understanding of cardiac health among pregnant women and provide valuable insights for future research and clinical practices.

Conclusion

The findings of our study support the implementation of routine maternal screening echocardiography, even in the absence of known heart disease, as it can aid in identifying cardiac conditions and reducing related mortality. Introducing cardiac assessment as part of the antenatal protocol can enable early identification of women at high risk for cardiovascular complications.

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Conflict of Interest: None

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