



ORIGINAL ARTICLE

Cardiovascular anomalies in infants born to diabetic mothers: A study at a Tertiary Care Hospital.

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ABSTRACT... Objective: To find out the frequency of cardiovascular anomalies in infants born to diabetic mothers (IDMs). **Study Design:** Case-control study. **Setting:** Department of Pediatric Medicine and the Department of Obstetrics & Gynecology, Rai Medical College / Teaching Hospital, Sargodha. **Period:** January 2022 to December 2022. **Material & Methods:** A total of 50 term IDMs were enrolled in case group while equal number of healthy infants (n=50) were enrolled as controls. All mothers received prenatal care. Standard diagnostic criteria were followed for labeling diabetes and gestational diabetes. All infants underwent detailed physical and clinical examination. Demographic and maternal characteristics along with perinatal and maternal information were noted. All infants underwent echocardiographic evaluation. **Results:** In a total of 100 infants, 51 (51.0%) were boys and 49 (49.0%) girls. The mean birth weight, Apgar score (at 5-minutes), maternal age and gestational age were 2.84 ± 1.8 kg, 8.8 ± 0.7 , 29.5 ± 3.2 and 37.4 ± 1.8 weeks respectively. Maternal hypertension was observed among 12 (12.0%) subjects. Birth weight ($p < 0.0001$), maternal age ($p = 0.0129$) and gestational age ($p = 0.0110$) were significantly higher among cases while Apgar score was significantly lower among cases in comparison to controls ($p = 0.0028$). Cardiovascular anomalies were diagnosed in 10 (20.0%) cases in comparison to 3 (6.0%) controls and the difference was found to be statistically significant. Among IDMs, hypertrophic cardiomyopathy (HCM) was the most frequent cardiovascular anomaly, noted in 4 (8.0%) cases. **Conclusion:** The frequency of cardiovascular anomalies was significantly high among IDMs in comparison to infants born to non-diabetic mothers. IDMs should undergo cardiac examination to rule out the possibility of existing cardiovascular anomalies.

Key words: Cardiovascular Anomalies, Gestational Diabetes, Hypertension, Infants Born to Diabetic Mothers, Prenatal Care.

INTRODUCTION

Considering birth defects, congenital heart anomalies are the most frequent affecting between 8 to 12 per 1000 live births.^{1,2} Maternal diabetes has been documented as one of the reasons behind cardiovascular anomalies in the newborns but the exact etiology of this relationship is still unknown.³ During the evolution of the fetal cardiovascular system, maternal diabetes exert teratogenic effects and hence the risk of the occurrence of anomalies is increased.⁴

The prevalence of diabetes affects both developed and developing countries. It is estimated that around 60 million females belonging to

reproductive age (18 to 44 years) have diabetes.⁵ Pregestational diabetes has been found to influence relatively increased rates of adverse maternal and fetal outcomes.^{5,6} Comparing with the infants born to non-diabetic mothers, infants born to diabetic mothers (IDM) have higher occurrence rates of cardiovascular malformation. Congenital heart disease (CHD) has almost 5% occurrence rate among IDMs.⁷ Regional data highlighted patent ductus arteriosus (PDA), ventricular septal defect (VSD), atrial septal defect (ASD) and patent foramen ovalum (PFO) have been found to be the commonest types of CHDs in IDMs.⁸

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In Pakistan, not much is known about the burden of cardiovascular anomalies in IDMs so we planned this study to find out the frequency of cardiovascular anomalies in IDMs. The findings of this study might help us in adding important insights to the existing global literature.

MATERIAL & METHODS

This case-control study was done at the department of pediatric medicine and the department of obstetrics & gynecology, Rai Medical College / Teaching Hospital, Sargodha from January 2022 to December 2022. Approval from "Institutional Ethical Committee" was obtained (certificate number: ERC/2021/173, dated: 3-November 2021).

Inclusion criteria for the case group were terms IMDs and mothers who received prenatal care. Controls were term newborns of non-diabetic and healthy mothers who received prenatal care. Preterm newborns or those with intrauterine growth retardation, low Apgar score (<7 at 1-minute and at 5-minutes) were excluded. Mothers who did not receive prenatal care or those mothers who did not have GDM diagnostic tests were also excluded. Standard diagnostic criteria were followed for labeling diabetes and gestational diabetes according to "World Health Organization (WHO)". A total of 50 cases each were enrolled for both study groups.

After the selection of infants in the two groups, all infants underwent detailed physical examination. Demographic and maternal characteristics along with perinatal and maternal information were noted. All infants underwent echocardiographic evaluation. The echocardiographic examination was done by a pediatric cardiologist.

Data were analyzed employing "Statistical Package for Social Sciences (SPSS)", version 26.0. Quantitative data was highlighted in the form of means and standard deviation. Qualitative variables were represented in the form of numbers and proportions. Quantitative data were compared employing independent sample t-test whereas comparison of categorical variables was done using chi-square test. $P < 0.05$ was marked

as significant.

RESULTS

In a total of 100 infants, 51 (51.0%) were boys and 49 (49.0%) girls. The mean birth weight, Apgar score (at 5-minutes), maternal age and gestational age were 2.84 ± 1.8 kg, 8.8 ± 0.7 , 29.5 ± 3.2 and 37.4 ± 1.8 weeks respectively. Maternal hypertension was observed among 12 (12.0%) subjects. Birth weight ($p < 0.0001$), maternal age ($p = 0.0129$) and gestational age ($p = 0.0110$) were significantly higher among cases while Apgar score was significantly lower among cases in comparison to controls ($p = 0.0028$) as shown in Table-I.

Study Variables	Cases (n=50)	Controls (n=50)	P-Value
Gender	Boys	27 (54.0%)	0.5484
	Girls	23 (46.0%)	
Birth weight (kg)	3.02 ± 0.31	2.64 ± 0.28	<0.0001
Apgar score at 5-minutes	8.6 ± 0.7	9.0 ± 0.6	0.0028
Maternal age (years)	30.4 ± 3.4	28.6 ± 3.7	0.0129
Gestational age (weeks)	37.8 ± 1.3	36.8 ± 2.4	0.0110
Maternal hypertension	7 (14.0%)	5 (10.0%)	0.5383

Table-I. Characteristics of infants in both study groups (N=100)

Cardiovascular anomalies were diagnosed in 10 (20.0%) cases in comparison to 3 (6.0%) controls ($p = 0.037$) as shown in Figure-1.

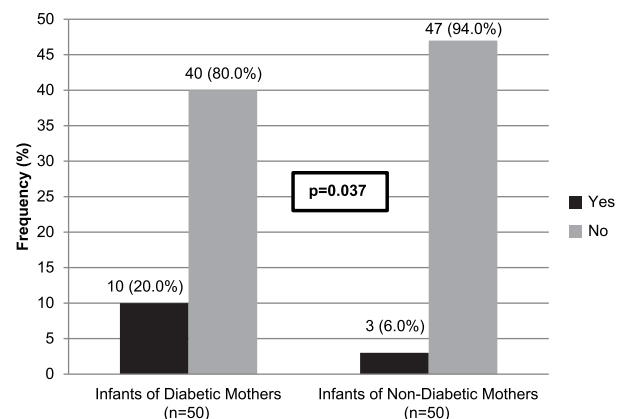


Figure-1. Comparison of frequency of cardiovascular anomalies (N=100)

Among IDMs, hypertrophic cardiomyopathy (HCM) was the most frequent cardiovascular anomaly, noted in 4 (8.0%) cases. The details about the frequency and types of cardiovascular anomalies among cases and controls (Table-II).

Cardiovascular Anomalies	Cases (n=50)	Controls (n=50)
Patent ductus arteriosus	2 (4.0%)	1 (2.0%)
Hypertrophic cardiomyopathy	4 (8.0%)	-
Ventricular septal defect	1 (2.0%)	1 (2.0%)
Atrial septal defect	1 (2.0%)	-
Patent foramen ovalue	2 (4.0%)	-
Tetralogy of fallot	-	1 (2.0%)

Table-II. Frequency comparison of various kinds of cardiovascular anomalies

DISCUSSION

The frequency of cardiovascular anomalies was significantly higher among IDMs as compared to infants of non-diabetic mothers (20.0% vs. 6.0%, $p=0.037$) in this research. According to our findings, IDMs had 3.3 higher chances of cardiovascular anomalies when compared to infants born to non-diabetes mothers. In this study, HCM was the most frequent cardiovascular anomaly noted in 8% cases. The literature highlights that IDMs have an 8.5% higher risk of congenital heart anomalies while structural abnormalities range from septal defects to duct-dependent lesions.^{9,10} Regional data has shown PDA, HCM and PFO to be the most frequent cardiovascular anomalies noted among IDMs.¹¹ Some other studies produced comparable findings to the present study that PDA, PFO, and HCM are the commonest cardiac anomalies among IDMs.^{12,13} According to the Najafian et al, PDA was the most frequently observed cardiac anomaly followed by ventricular hypertrophy, mitral valve prolapse and mitral regurgitation respectively.¹⁴ A study from Saudi Arabia mentioned that among IDMs, HCM, PFO and PDA were the most frequently observed cardiac anomalies.¹⁵

A retrospective study done by Akbariasbagh et al from Iran found overall prevalence of cardiovascular anomalies among IDMs as 30% which is higher than what was noted in this

study (20.0%).¹⁶ Dimitriu et al shared that cardiac abnormalities were noted in 23% of the IDMs, without being affected by pulmonary hypertension and HCM.¹⁷ Schafer et al mentioned in their study that the occurrence of cardiovascular anomalies among all other anomalies was 37.6%.¹⁸ The literature states no significant differences in the occurrence of cardiac malformations in infants ($p=0.29$) with any type of maternal diabetes.¹⁹ Some others have noted that the extent of diabetes mellitus either of overt diabetes (in terms of years) or gestational diabetes (in term of months) had no significant relationship with the occurrence of cardiovascular anomalies among IMDs.²⁰ The experts recommend that the risk of having infants with cardiac defects could be reduced by providing proper glycemic control to the expected mothers.²¹ But, for the prevention of cardiac anomalies in newborns, the effectiveness of glycemic control has not been properly estimated. As the assessment of glycated hemoglobin (HbA1c) was absent in our study, therefore, monitoring of diabetes control status of the mothers with diabetes was not possible. It was due to the fact that the objective of this study did not include to search for any relation between maternal serum HbA1c and newborn's congenital anomalies. Considering the findings of this study, IDMs need to undergo proper clinical examination and follow-ups.

Our findings should further be verified in the future multi-centric trials. We were unable to estimate the effect of glycemic control on the maternal and fetal outcomes among IDMs. Further prospective trials should also be planned to evaluate the impact of maternal diabetes on the health of affected infants.

CONCLUSION







The frequency of cardiovascular anomalies was significantly high among IDMs in comparison to infants born to non-diabetic mothers. IDMs should undergo cardiac examination to rule out the possibility of existing cardiovascular anomalies.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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2	Sohaib Riaz	Introduction, Proof reading.	
3	Hussain Bux Korejo	Literature review, Methodology.	
4	Khurram Shahnawaz	Proof reading.	
5	Farhan Zahoor	Literature review, Methodology.	
6	Veena Kumari	Literature review, References.	
7	Fazal ur Rehman	Drafting, References.	