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ORIGINAL ARTICLE

Congenital cardiac malformations in children with down syndrome: An echocardiographic based study.

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ABSTRACT… Objective: To find out the prevalence and pattern of congenital heart diseases (CHDs) in children with Down syndrome (DS). **Study Design:** Cross-sectional study. **Setting:** Department of Pediatrics, Rai Medical College Teaching Hospital, Sargodha, Pakistan. **Period:** January 2021 to December 2022. **Material & Methods:** A total of 165 children of either gender, aged 1 month to 12 years with DS diagnosed with the help of typical clinical features and confirmation by cytogenetic studies were analyzed. Children diagnosed with DS were further evaluated for cardiac assessment as per 2-D echocardiographic and Doppler examinations. The prevalence of CHDs was noted among children with DS. **Results:** In a total of 165 children with DS, 86 (52.1%) were male. The mean age was noted to be 1.8±1.2 years while 106 (64.2%) children were aged below 1 year. The existence of CHDs was found to be in 56 (33.9%). Among 56 children with CHDs, ventricular septal defect (VSD), atrial septal defect (ASD) and tetralogy of fallot (TOF) were the commonest forms of CHDs noted in 16 (28.6%), 12 (21.4%) and 9 (16.1%) children respectively. **Conclusion:** High prevalence of CHDs in children with Down syndrome was noted. The VSD and ASD were the most common forms of CHDs among children with Down syndrome.

Key words: Atrial Septal Defect, Congenital Heart Disease, Down Syndrome, Tetralogy of Fallot, Ventricular Septal Defect.

INTRODUCTION

Down syndrome (DS) is considered to be the commonest form of chromosomal anomalies affecting 1 out of 700 live-births.[1] It is established that congenital heart diseases (CHDs) have an influence on the growth and survival of the children having DS.[2] Globally, the prevalence of CHD is estimated to be around 9 for 1000 live-births.[3] Among Asian population, it might have higher rates owing to higher incidence of consanguineous marriages, diabetes mellitus and overweight/obesity.[5-7]

Among DS patients, CHD is the commonest cause of mortality and morbidity within early years of pediatric age groups.[4] The literature presents the prevalence of CHDs among children with DS to be ranging between 40-64%.[4] Geographically, the prevalence of CHDs exhibit variation in its forms and kinds.[5,6] A study from Norway shared that seasonal variations also affect DS and other birth defects in their occurrence, showing involvement of environment as an indirect causative factors, while genetic factors are irrespective of the seasonal changes.[7] Looking for the prevention and improvement in the "quality of life" of the affected children, it is useful to have awareness of the occurrence of CHD and its anatomical characteristics among children presenting DS, along with associated complications, morbidity and mortality determinants. Moreover, as the course of the DS is affected by the CHD type and repair time, so in order to have best survival rates, it is very important to initiate the treatment of cardiac abnormalities within due course of time.[8]

Data from Developed world has shown that among patients having DS, the commonest CHDs were

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"atrioventricular septal defect (AVSD)", "patent ductus arteriosus (PDA)", "atrial septal defect (ASD)", "ventricular septal defect (VSD)", and "tetralogy of fallot (TOF)" with AVSD. In Pakistan, proper investigations have not been done to assess the true incidence of CHDs among DS children. Comparing with Western population, we might have higher prevalence due to the fact that the frequency of consanguineous marriage is higher and pregnant women have limitations in accessing the prenatal care. Even though, CHD is highly prevalent among children having DS, the efforts put in for the evaluation of associated factors and causes have not been enough. Local data for the assessment of CHDs among children having DS has not been abundant therefore we aimed to find out the prevalence and pattern of CHDs in children with DS.

MATERIAL & METHODS

This cross-sectional study was done at "The Department of Pediatrics, Rai Medical College Teaching Hospital, Sargodha", Pakistan from January 2021 to December 2022. Children of either gender, aged 1 month to 12 years with DS diagnosed with the help of typical clinical features and confirmation by cytogenetic studies were analyzed. Children with dysmorphic features were excluded. Approval from "Institutional Ethical Committee" was acquired (certificate number: ERC/2021/173, dated: 3rd November 2021). Informed/written consents were obtained from parents/guardians.

The DS was diagnosed on the basis of clinical features and genetic confirmation. These children were further evaluated for cardiac assessment and underwent 2-D Echocardiographic and Doppler examinations. At the time of enrollment, gender, age, maternal age and types of CHDs (if present) were noted.

Data analysis was done with "Statistical Package for Social Sciences (SPSS)", version 26.0. Descriptive statistics like proportion, frequencies, mean and standard deviation were applied depending upon the types of variables. Chi-square test was applied for the comparison of categorical data taking p-value ≤ 0.05 as statistically significant.

RESULTS

In a total of 165 children with DS, 86 (52.1%) were male. The mean age was 1.8±1.2 years while 106 (64.2%) children were aged below 1 year. The mean maternal age was 26.2±4.8 years whereas maternal age of 124 (75.2%) cases was noted to be below 30 years. The existence of CHDs was found to be in 56 (33.9%). Table-I is describing baseline characteristics of children with DS.

Characteristics of Children		Frequency (%)
Gender	Boys	86 (52.1%)
	Girls	79 (47.9%)
Age (years)	<1	106 (64.2%)
	1-5	44 (26.7%)
	6-12	15 (9.1%)
Maternal age (years)	<30	124 (75.2%)
	≥30	41 (24.8%)
Congenital heart disease	Yes	56 (33.9%)
	No	109 (66.1%)

Table-I. Baseline characteristics of children with down syndrome (n=165)

In a total of 56 children with various types of CHDs, it was revealed that VSD, ASD and TOF were the commonest forms of CHDs noted in 16 (28.6%), 12 (21.4%) and 9 (16.1%) children respectively (Figure-1).

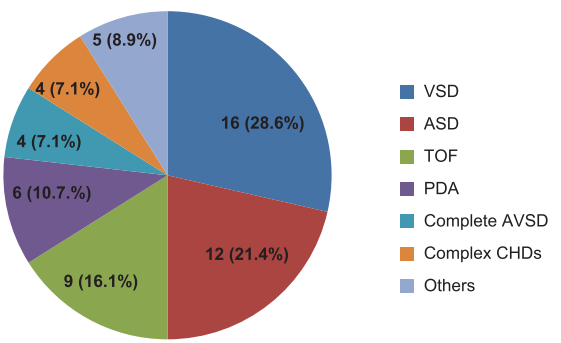

Figure-1. Distribution of types of congenital heart diseases (n=56)

Distribution of child's gender, age and maternal age did not show any significant association with the existence of CHDs (Table-II).

Characteristics of Children		Congenital Heart Diseases		
		Yes (n=56)	No (n=109)	P-Value
Gender	Boys	34 (60.7%)	52 (47.7%)	0.1132
	Girls	22 (39.3%)	57 (52.3%)	
Age (years)	<1	41 (73.2%)	65 (59.6%)	0.1710
	1-5	10 (17.9%)	34 (31.2%)	
	6-12	5 (8.9%)	10 (9.2%)	
Maternal age (years)	<30	39 (69.6%)	85 (78.0%)	0.2405
	≥30	17 (30.4%)	24 (22.0%)	

Table-II. Comparison of characteristics of the children having down syndrome with respect to existence of congenital heart diseases.

DISCUSSION

Our study is amongst the first ones that describe the frequency and patterns of cardiac abnormalities among DS patients in Pakistan. We carried out this study at the pediatric unit, but referrals from other healthcare facilities were also included, thus providing data on the frequency and pattern of CHD in DS from our region. Our study revealed that, 33.9% was the overall occurrence of CHDs among DS patients which is comparable to what was reported by Narchi et al[9] (35.2%) but lesser than the regional data shared by Al-Jarallah[10] (49%) from Afghanistan. Studies like the "California Birth Defects Monitoring Program registry", Torfs CP et al (43.9%)[11], Venugopalan P et al (60%)[12], Salih AF (53%)[13], Vida VL et al (54%)[14], Ashraf M (50%)[15], Azman BZ et al (49.3%)[16], Masaki M et al(50.5%)[17], Amark K et al (52.5%)[18] and McElhinney DB et al (65.7%)[19], which addressed large population, have all reported high burden of CHDs in children with DS. The use of different screening programs and diagnostic facilities, along with some other factors like inheritance, socioeconomic status, and variation in the environment of the various study populations might be the reason of the variation in the occurrence of CHD among DS patients.

In embryogenesis, specific molecular pathways might also get influenced by gene-environment interactions and gene-gene interactions.[14] Genetic factors, certain embryological mechanism, and cell characteristics are perhaps the determinants of the pattern of cardiac abnormalities, as have been suggested previously. There are some other elements including financial status, and different living circumstances across the world, which could also contribute in the variation of CHD prevalence among DS cases.[20] At the same time, consanguineous marriage prevails at higher rate in Pakistan, which may enhance the risk of the development of CHD among infants. A recently conducted study by Rehman Y et al showed that 57% children with DS having CHDs had growth failure. We were unable to document the growth parameters in the present study but it is very important to identify and treat children with DS having CHDs so that growth indicators of the affected children can be improved.[21]

In Pakistan, the available data is inadequate, and therefore do not depict the true burden of CHDs, which in comparison with other countries might be higher. The true incidence of CHD among children with DS needs further evaluation with large sample size.

CONCLUSION

High prevalence of CHDs in children with Down syndrome was noted. The VSD and ASD were the most common forms of CHDs among children with Down syndrome

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2	Sadaf Liaqat	Data collection, Final approval.	
3	Sohaib Riaz	Literature Review, Methodology.	
4	Veena Kumari	Proof Reading.	
5	Khurram Shahnawaz	Literature review, Methodology.	
6	Farhan Zahoor	Literature review, References.	
7	Fazal ur Rehman	Drafting, References.