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Prevalence of Congenital heart Diseases in children- An analysis of 197 patients in a tertiary care Hospital of Kerala

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ABSTRACT: Background: Congenital heart disease (CHD) is one of the commonest causes of infant mortality rate in developing countries. Early detection, referral and treatment of infants and children with CHD contribute to the reduction in the infant mortality rate. There are differences in the prevalence and distribution in different parts of India. A study was conducted in a tertiary care Hospital to know the prevalence of CHD in this state. **Aim of the Study:** To study the prevalence, age and gender distribution and clinical spectrum of congenital heart disease (CHD) among pediatric patients attending outpatient department (OPD) of a tertiary care hospital in Kerala. **Materials:** A prospective cross sectional study was carried over 36 months on children aged from newborn to 12 years and 179 children with CHD were screened, included and analyzed. Infants/ children aged 0 to 12 years with symptoms of CHD, or suspicious of CHDs were included. After initial clinical examination and pulse oxymetry diagnoses were confirmed by detailed 2-D Echocardiography and color Doppler studies. Two dimensional and color Doppler echocardiography were done with Neonatal (12MHz) and Pediatric (8MHz) sector transducer. ASD with less than 4.0 mm diameter was not included as a CHD. If more than one lesion was observed, the defects which caused hemodynamic imbalance or which required immediate treatment were considered as the main CHD. **Results:** 1569 children were screened out of 18753 pediatric patients who attended the neonatal ICU, Pediatric medicine departments. Among

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them 179/1569 (11.40%) children were diagnosed with CHDs were selected and analyzed. The prevalence rate was 09.57/1000 live births. Male children were 115/79 (64.24%) and 64/79 were female children (35.75%). In males prevalence rate was 06.13/1000 live births and in females the prevalence was 03.41/1000 live births. The male to female ratio was 1.79:1. The mean age was 2.6±1.72 years. **Conclusions:** The prevalence of CHD at a tertiary teaching hospital was in males was 06.13/1000 live births and in females the prevalence was 03.41/1000 live births. VSD, ASD, PDA were common in the Acyanotic CHD and TOF was common in the cyanotic group. For improved estimation of prevalence of CHDs wide spectrum of community-based studies are need of the hour. Community based studies also help in identifying CHDs at the earliest and institute remedial measures. The etiology and risk factors of CHDs are diverse and remain a challenge in defining their pathogenesis.

Key Words: Congenital heart disease (CHD), Prevalence, mortality, PDA Tetrology of Fallot's and VSD.

INTRODUCTION: Congenital heart disease (CHD) is commonest of all congenital anomalies encountered among the infant and children contributing to significant morbidity and mortality and contributing to infant mortality rate. (1) The prevalence of CHD varies from 4 to 50 per 1000 live births. (3) The wide variation in the prevalence may be due to varying genetic, socioeconomic and environmental factors playing their role in different regions. (4) The prevalence rate of CHD in India varies from 0.8 to 26.4/1000 live births. (5) If prevalence rate is taken as 9/1000 live births then the estimated total infants born with CHD would be more than 2, 00,000 per year. (6) Among them $1/5^{th}$ are likely to have major CHDs requiring immediate intervention and may result in mortality in the first year of life. (7) Currently advanced cardiac care is available to only a minority of such children. The Government of Kerala has taken an initiative to help children with CHD in the name of and started a Health scheme "Hridyam" in the year 2017. CHD contributes to 10% of the total Infant mortality rate in India (8) According to a status report on CHD in India, 10% of the present infant mortality may be accounted for by CHD. (9) According to a large hospital based study from India, the incidence of congenital heart disease is 3.9/ 1000 live births. CHD are mainly divided into acyanotic and cyanotic heart diseases; prevalence of the former is more than the later. Ventricular septal defect (VSD) (30-35%) is common among the acyanotic group and Tetralogy of Fallot (TOF) (5-7%) in the cyanotic group. (10) Majority of the CHDs occurs as an isolated defect in the heart but in around 33% has associated anomalies. (11) The present study was conducted to study the prevalence, age and gender distribution and clinical spectrum of congenital heart

disease (CHD) among pediatric patients attending outpatient department (OPD) of a tertiary care hospital in Kerala.

MATERIALS: A prospective cross sectional study was conducted in the departments of Pediatrics, Neonatology and pediatric cardiology of KMCT Hospital, Malappuram, Kerala. The study was conducted between December 2018 and January 2022 after obtaining the institutional ethics committee approval. An informed consent approved by the committee was used in collecting the information. This observational study was carried over 36 months on children aged from newborn to 12 years admitted in neonatal ICU and pediatric medicine wards of KMCT medical college and Hospital, Malappuram, Kerala. 179 children with CHD were screened, included and analyzed out of 1569 subjects aged between 0 months to 12 years. Age at 0 was considered if the child was examined at the delivery room and the actual age of the child is recorded if the reporting is to the department of pediatrics. An ethical committee approval was obtained before commencing the study. An ethical committee approved consent form and data collecting Performa was used to undertake the study. **Inclusion criteria:** 1. Infants/ children aged 0 to 12 years with symptoms of CHD, or suspicious of CHDs were included. 2. Children with all types of CHDs were included. 3. Children of both genders were included. **Exclusion criteria:** 1. Infants/children born with other major anomalies were excluded. 2. Children with retroviral positive status were excluded. Children After registering the patients for the study, detailed history was taken to observe the clinical presentation. A thorough clinical examination and pulse oxymetry was used initially to assess the children. Diagnoses were confirmed by detailed 2-D Echocardiography and color Doppler studies. Appropriate radiological studies like X-ray chest, ECG, complete blood picture, Blood and serum investigations were also carried out. The relevant data was filled up in the Performa already prepared for this purpose. Datasheet was prepared and analyzed by using SPSS system version 21. Two dimensional and color Doppler echocardiography were done with Neonatal (12MHz) and Pediatric (8MHz) sector transducer. American society of Echocardiography (ASE) guidelines and recommendations were used to report the Echocardiography examinations. (12) The CHDs were classified as per the Q20 to Q28 of tenth revision of International Classification of Diseases (ICD) (13) and International Pediatric and Congenital Cardiac Code (IPCCC), (14). ASD with less than 4.0 mm diameter was not included as a CHD. If more than one lesion was observed, the defects which caused hemodynamic imbalance or which required immediate treatment were considered as the main CHD.

Sample size formula:

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$$n=\frac{Z^2 p\,(1-p)}{E^2}$$

n-sample size
z- Z value for significance level of 1.96
p- Expected prevalence or proportion
E-allowable error
Statistical analysis: Statistical analysis was done using standard statistical methods like, mean, standard deviation, percentages and chi square test for significance (with p value significant at <0.05) were used.

RESULTS:

During 36 months of the study period 1569 children were screened out of 18,753 pediatric patients attended the departments of neonatal ICU, Pediatric medicine departments for CHDs based on their clinical presentation of heart disease. Among them 179/1569 (11.40%) children were diagnosed with CHDs were selected and analyzed. The prevalence rate was 09.57/1000 live births. Male children were 115/79 (64.24%) and 64/79 were female children (35.75%). In males prevalence rate was 06.13/1000 live births and in females the prevalence was 03.41/1000 live births. The male to female ratio was 1.79:1. The mean age was 2.6±1.72 years. The youngest child was aged 7 months and the eldest one was aged 11.6 years. There were 52/179 (29.05%) infants (<01 year) who were diagnosed with CHD, 63/179 (35.19%) were aged between 01 to 04 years, 39/179 (21.78%) were aged 05 to 08 years, 25/179 (13.96%) were aged between 09 to 12 years (Table 1).

Age interval	Male	Female	Total	Percentage
< 1 year	36	16	52	29.05
1 to 4 years	41	22	63	35.19
5 to 8 years	24	15	39	21.78
9 to 12 years	17	08	25	13.96

Table 1: Showing the Age and Gender distribution of children (n-179).

The incidence of Ventricular Septal Defect (VSD) was found in 38/179 subjects (21.22%). Atrial septal defect (ASD) was found in 31/179 (17.31%), Patent Ductus arteriosus in 25/179 (13.96%), Atrioventricular septal defect in 23/179 (12.84%), Coarctation of Aorta in 17/179 (09.49%), Bicuspid Aortic valve in 05/179 (02.79%) subjects, Tetrology of Fallot's in 09/179 (05.02%), dextro-transposition of great arteries in 05/479 (02.79%), Tricuspid atresia in 05/179 (02.79%), Total anomalous pulmonary venous connection (TAPVC) in 06/179 (03.35%), Double outlet Right Ventricle (DORV) in 07/179 (03.91%), Truncus arteriosus in 04/179 (03.91%) and Pulmonary atresia in 04/179 was noted (02.23%), (Table 2).

Type of CHD	Total	Male-115	Female-64	Percentage
VSD	38	24	14	21.22
ASD	31	22	09	17.31
PDA	25	17	08	13.96
AVSD	23	14	09	12.84
COA	17	09	08	09.49
Bicuspid Aortic valve	05	03	02	02.79
TOF	09	05	04	05.02
d-TGA	05	03	02	02.79
Tricuspid atresia	05	04	01	02.79
TAPVC	06	04	02	03.35
DORV	07	05	02	03.91
Truncus arteriosus	04	02	02	02.23
Pulmonary atresia	04	03	01	01.67

Table 2: Showing the different CHD diagnosed in the study (n-179),
(ASD-(Atrial septal defect, VSD-Ventricular septal defect, PDA- Patent ductus arteriosus, AVSD-Atrioventricular septal defect, COA- Coarctation of Aorta, TOF- Tetrology of Fallot, d-TGA-dextro- transposition of great arteries, TAPVC- Total anomalous pulmonary venous connection, DORV- Double outlet right ventricle.)

Among the 179 subjects in this study 40/179 (22.34%) children had cyanotic congenital heart diseases and 139/179 (77.65%) children had Acyanotic congenital heart diseases (Table 3 and 4). Among the cyanotic CHDs the commonest were Tetrology of Fallot's (TOF) in 09/179 (05.02%), dextro-transposition of great arteries (DORV) in 07/479 (03.91%), Total anomalous pulmonary venous connection (TAPVC) in 06/179 (03.35%), dextro-transposition of great arteries in 05/179 (02.79%), Tricuspid atresia in 05/179 (02.79%), Truncus arteriosus in 04/179 (02.23%) and Pulmonary atresia in 04/179 (02.23%) children (Table 3). 16/40 (40%) infants were diagnosed before 12 months in this study. 16/40 (40%) were diagnosed between first year and third year of age. 07/179 (17.5%) children were diagnosed in the age group of 5 to 8 years. 01/179 (02.5%) children were diagnosed between 9 and 12 years in this study (Table 3). By the end of first year 40% of the children were diagnosed, by the end of four years 80% of the children were diagnosed and by the end of 08 years 97.5% of the children were diagnosed. (Table 3)

Diagnosis	Number	<1 yr	1-4 yr	5-8 yr	9-12 yr
TOF	09	04	04	01	00
DORV	07	03	03	01	00
TAPVC	06	02	02	01	01

d-TGA	05	02	02	01	00
Tricuspid Atresia	05	02	02	01	00
Truncus arteriosus	04	02	01	01	00
Pulmonary atresia	04	01	02	01	00
Total	40	16	16	07	01
Percentage	100	40	40	17.5	02.5

Table 3: showing the different cyanotic Heart diseases in the study (n-179).
(TOF- Tetrology of Fallot, d-TGA- dextro- transposition of great arteries, TAPVC- Total anomalous pulmonary venous connection, DORV- Double outlet right ventricle).

Among the 139/179 Acyanotic CHDs diagnosed in this study the Ventricular Septal Defect (VSD) was found in 38/179 subjects (21.22%). Atrial septal defect (ASD) was found in 31/179 (17.31%), Patent Ductus arteriosus in 25/179 (13.96%), Atrioventricular septal defect in 23/179 (12.84%), Coarctation of Aorta in 17/179 (09.49%), Bicuspid Aortic valve in 05/179 (02.79%) subjects, (Table 4). Among the 139 Acyanotic CHDs in this study 39/179 (21.78%) were diagnosed in the first year of the infants. 68 (37.98%) children were diagnosed between first and fourth year of their lives. 23/179 (12.84%) children were diagnosed in the age group of 5 to 8 years. 09/179 (05.02%) children were diagnosed in their ages of 09 to 12 years (Table 4).

Diagnosis (Number)	Total	<1 yr	1-4 yr	5-8 yr	9-12 yr
VSD	38	10	22	04	02
ASD	31	09	16	04	02
PDA	25	07	10	07	01
AVSD	23	05	10	05	03
COA	17	06	08	02	01
Bicuspid Aortic valve	05	02	02	01	00
Total	139	39	68	23	09

Table 4: showing the different acyanotic Heart diseases in the study (n-179) (Atrial septal defect, VSD-Ventricular septal defect, PDA- Patent ductus arteriosus, AVSD- Atrioventricular septal defect, COA- Coarctation of Aorta)

The commonest symptom with which the children presented were cough in 126/179 (70.39%), difficulty in breathing in 121/179 (67.59%), fever in 113/179 (63.12%), recurrent coughs and colds was found in 98/179 (54.74%), cyanosis in 75/179 (pain in the chest in 20/179 (25.31%), squatting in 65/179 (36.31%), pain in the chest 46/179 (25.69%), poor weight gain in 38/179 (21.22%) and fatigability in 57/179 (31.84%) of the subjects (Table 5).

Symptom	Number	Percentage
Cough	126	70.39
Difficulty in breathing	121	67.59

Fever	113	63.12
Recurrent cough and colds	98	54.74
Cyanosis	75	41.89
Squatting	65	36.31
Pain in the chest	46	25.69
Poor weight gain	38	21.22
Fatigability	57	31.84

Table 5: Showing the symptoms of clinical presentation of CHD in the study (n-179).

History and clinical examination of the mothers of the subjects was undertaken and it was observed that among the various risk factors looked for there was no statistical significance in the maternal factors of Age, Diabetes Mellitus, Hypertension, primary infertility, radiation exposure, seizure disorders and consumption of anti-seizure drugs, maternal obesity and systemic lupus erythematosus. There was statistical significance, (p value <0.05) for the maternal risk factors like consanguinity, fever & rashes during antenatal periods and non-consumption of multivitamin and folic acid supplements in this study (Table 6).

Risk Factors	Number	Pearson $\chi 2$ value and degree of freedom (df)	P value
Maternal Age			
20 to 30	144		
30 to 35	21	9.715- df=2	0.841
>35 years	14		
Maternal DM			
Present	19		
Absent	160	0.873 df=1	0.930
Maternal Hypertension			
Present	23		
Absent	156	0.623 df=1	0.674
Consanguinity			
Present	34		
Absent	145	0.11.539 df=1	0.001
Primary infertility			
Present	21		
Absent	158	0.599 df=1	0.118

Radiation exposure Present Absent	 01 178	0.662 df=1	 0.921
Fever with rash in first trimester Present Absent	 12 167	12.58 df=1	0.001
Seizures disorder and antiepileptic consumption Present Absent	 03 176	0.643 df=1	0.125
Maternal obesity Present Absent	 07 172	0886 df=1	0.647
SLE Present Absent	 02 177	03.79 df=1	0.125
Multi Vitamin and folic acid intake Present absent	 116 63	14.87 df=2	0.0001

Table 6: Showing the univariate analysis of the CHDs and maternal risk factors elicited or diagnosed in the mothers of the subjects (n-79).

The present study was compared with similar studies conducted in India and the incidences of ASD, PDA, Pulmonary stenosis, Tetrology of Fallot's and Transposition of great arteries were significantly matching with the studies by Jatav et al, Kumar BD, Abqari S et al (Table 7).

Name of the study	Type	Age and number	VSD	ASD	PDA	PS	TOF	TGA	P VALUE
Jatav et al [14]	Prospective-clinical	0-25, n-116	28.44	18.10	10.34	06.89	06.03	04.31	-
Kumar BD [15]	Cross-sectional	1 month to 12 yrs, n-50	32	16	10	-	18	06	-
Abqari S, Gupta A,	Prospective	0-18 yrs, n-400	38	14.75	09.5	05	18	02	-

Shahab T[16]									
Present study	Prospective	0-12 yrs, 179	21.22	17.31	13.96	01.67	05.02	02.79	0.001

Table 7: Showing a comparison between the present and other similar Indian studies depicting the incidences of major CHD (n-179).

DISCUSSION: In India surveillance studies are basically conducted either in the schools or based on Hospital visits of the parents of the children for treatment. Naturally the school based studies will not include the preschool children. On the other hand Hospital based studies include the children of all age's right from the neonatal period to 12 years. Another drawback of school based studies is that the school dropout children are again not included. School based studies in India report between 1 and 5 / 1000 live births which does not represent true prevalence rate (17). Chadha L, Singh N, Shukla DK et al in 2001 in their community-based study pointed out a prevalence of 4.2/1000 individuals. (18) The present study was conducted on 179 children out of 1569 children who were screened out of 18,753 pediatric patients attended the departments of neonatal ICU, Pediatric medicine departments for CHDs based on their clinical presentation of heart disease. Among them 179/1569 (11.40%) children were diagnosed with CHDs were selected and analyzed. The prevalence rate was 09.57/1000 live births. Prevalence rates reported from Hospital based studies are higher as they all are based on referral of patients from the peripheral Hospitals. In similar studies from Mysore the prevalence rate was 10.65, from Kanpur it was 26.4, from Mumbai, it was 13.28. (19, 20) The incidence of VSD in this study was 21.22% and a similar study by Hoffman JIE (21) reported an incidence of 21%. ASD was observed in 17.31% of the children in this study which was higher when compared to the study of Bernstein D (10) who reported in 10% of their subjects. Similarly the incidence of TOF was 05.02% in this study and was found to be similar to the study by Abdulla R (12) who reported 4.6%. Review of literature showed that the CHDs are detected in the first month in 50% of patients, 75% within 3 months and 100% by the end of 3 to 4 years. (21, 22) In the present study Cyanotic CHDs were diagnosed 40% by the end of first year, 80% by the end of four years, 97.5% by the end of 08 years and 100% by the end of 12 years. **(Table 3)** Anita Saxena, Anurag Mehta et al (23) reported prevalence from a study similar to the present study of CHDs as 8.07/ 1000 live births. Among them 79.9% were Acyanotic and 20.1% children were cyanotic; VSD being the commonest CHD of Acyanotic group and transposition of great arteries was most common cyanotic CHD. The prevalence of Acyanotic Heart Diseases in this study was 07.41/1000 live births and prevalence of Cyanotic Hear

Diseases was 02.31/1000 live births. In contrast from the study by Anita Saxena, Anurag Mehta et al (23) prevalence of major Acyanotic CHDs was 1.87/1000 live births and prevalence of major cyanotic CHDs was 1.63/1000 live births. The prevalence of VSDs and ASDs in this study was 03.98 and 03.24/1000 live births respectively. In contrast the prevalence of VSD and ASD from the above study (23) was 5.22 and 0.59/ 1000 live births respectively. Review of literature showed that in a study by Smitha et al, (24) VSD was 31.82% in 2000, 38.19% in 2001, 38.06% in 2002, 22.88% in 2003 and 26.37% in the year 2004 as the prevalence rate out of total CHDs in Mysore hospitals. But Jatav et al (14) found isolated ventricular septal defect in 28.44%, isolated atrial septal defect in 18.10%, patent ductus arteriosus in 10.34%, isolated congenital pulmonary stenosis in 6.03% and tetralogy of Fallot's in 6.03%. The reported range of VSD in many studies varies from 21.3-42.8%. From their study conducted, Suhail Naik, Mohd. Irshad et al concluded that to estimate prevalence rates, elaborate community based studies should be conducted on large scale; such community based studies could be conveniently concluded by collecting the data from the various screening programs. (25)

CONCLUSIONS: The prevalence of CHD at a tertiary teaching hospital was in males was 06.13/1000 live births and in females the prevalence was 03.41/1000 live births. VSD, ASD, PDA were common in the Acyanotic CHD and TOF was common in the cyanotic group. For improved estimation of prevalence of CHDs wide spectrum of community-based studies are need of the hour. Community based studies also help in identifying CHDs at the earliest and institute remedial measures. The etiology and risk factors CHDs are diverse and remains a challenge in defining its pathogenesis.

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