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**Original Research Article**

# Gamut of congenital heart diseases in a tertiary center in South India: an ode to echocardiography

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## ABSTRACT

**Background:** Echocardiography has supplanted clinical acumen in diagnosis of congenital heart diseases (CHDs). Prevalence rates of CHDs across various regions of the world are subject to change over the course of time, with increasing use of this diagnostic modality. Objective: To assess the prevalence and types of CHDs.
**Methods:** The study was conducted at a tertiary care center in South Karnataka, India. Transthoracic echocardiographic records of all patients suspected to have congenital heart disease, over a period of 60 months were analyzed. Categorization of data into acyanotic and cyanotic congenital heart disease, and further, into different types was done after an exhaustive search. Specific variables such as age, frequency and gender distribution of all kinds of CHDs were computed.
**Results:** Of a total 112,372 pediatric patients who attended our center, 1451 reports of subjects suspected to have CHDs were analyzed. The prevalence was found to be 6.22 per 1000 subjects. Of the 700 subjects (48.24%) with CHD, 664 (94.85%) were diagnosed to have Acyanotic Congenital Heart Disease and 36 (5.14%) were diagnosed to have Cyanotic Congenital Heart Disease. Among the Acyanotic CHD, Atrial Septal Defect (ASD) was found to be the most common (40.21%) seconded by Ventricular Septal Defect (VSD) (21.53%). Among the 36 subjects diagnosed to have Cyanotic CHD, it was found that Tetralogy of Fallot (TOF) was the most commonest lesion (61.11%).
**Conclusions:** Increased utilization of Echocardiography as a diagnostic modality significantly helps to better appreciate ever varying prevalence rates and types of CHDs in different parts of India. Frequent longitudinal studies in this regard help in enhanced allocation of available resources and updating of available databases.

**Keywords:** Acyanotic, Congenital heart disease, Cyanotic, Echocardiography

## INTRODUCTION

Congenital heart disease (CHD) is defined as any structural defect of the heart or the intrathoracic great vessels, that may be responsible for an immediate, or gradual functional consequence.[1] CHDs are one of the notable causes of infant mortality. In approximately 90% of the CHD cases, there may be no identifiable cause. More commonly, asymptomatic subjects may be identified during routine examinations.[2] The overall incidence and prevalence of CHD has been found to vary worldwide, and these differences may be attributable to diversity in genetics, environmental and cultural factors. In Asia, the estimated prevalence of congenital heart diseases has been noted to be 9.3/1000 live births with relatively higher prevalence observed among subjects with pulmonary outflow obstructions, as compared with those with left ventricular outflow tract obstructions. This

has been found to be higher in comparison to prevalence rates noted across both Europe and North America (8.2/1000 live births and 6.9/100 live births respectively).[3] Congenital heart disease has been classified as per Merck Manual of diagnosis broadly into Acyanotic and Cyanotic CHD. Atrial Septal Defect (ASD), Ventricular Septal Defect (VSD), Tetralogy of Fallot (TOF), Patent Ductus Arteriosus (PDA), Pulmonary Stenosis (PS), Aortic Stenosis (AS), Coarctation of Aorta (COA) and Atrioventricular Septal Defect (AVSD) totally constitute 85% of all CHDs.[4]

The remainder of 15% of CHDs is accounted for by rare and complex defects such as Truncus Arteriosus (TA), Tricuspid Atresia (TA), Total Anomalous Pulmonary Venous Connection (TAPVC), Hypoplastic Left Heart Syndrome (HLHS), Double Outlet Right Ventricle (DORV), Single Ventricle (SV), Ebstein Anomaly (EA) and Dextrocardia. Over the last two decades, echocardiography has proved to be the most important diagnostic modality in identification of CHDs, sometimes even supplanting clinical acumen. It stands to reason then, that with the increasing utilization of echocardiography, our understanding and knowledge of prevalence rates and types of CHDs are subject to change, more so in the developing world, empowering the need for further studies in this regard.

## METHODS

The study was conducted at K. S. Hegde Hospital, a tertiary care center in Mangalore, Karnataka. In this retrospective analysis, transthoracic echocardiographic records of all patients suspected to have congenital heart disease, over a period of 60 months (January 2011-January 2016) were analyzed. All in-patient and out-patient data of subjects suspected to have CHD were extensively reviewed. This also included records of live births in the center. The diagnosis of CHD was done as defined by Mitchell et al that is, any gross structural aberration of the heart or intrathoracic great vessels that is actually or potentially of functional consequence, but discounting the systemic great arteries and veins.[1] Records of subjects who presented with signs and symptoms such as shortness of breath, feeding difficulties and excessive forehead sweats, bluish discoloration of lips and tongue, recurrent respiratory tract infections, failure to thrive and syncopal episodes were studied.

Furthermore, the records of subjects who were found to present with clubbing, cyanosis, pedal edema and abdominal distension, effortless tachypnea, abnormal blood pressure for age, heart murmur and who were subject to chest X-rays, electrocardiogram (ECG) and echocardiography were reviewed. CHDs associated with syndromes and acquired heart disease constituted the exclusion criteria. Echocardiography was performed by a cardiologist and as per standards laid down by the American Society of Echocardiography, using M-mode, two-dimensional and color Doppler, pulse and continuous wave echocardiogram.[5] Categorization of data into acyanotic and cyanotic congenital heart disease, and furthermore, into different types was done after an exhaustive search. Specific variables such as age, frequency and gender distribution of all kinds of CHDs were computed.

**Table 1: Spectrum of acyanotic congenital heart disease.**

| CHD Type | ≤ 1 month | 1 month-1 year | 1-5 years | 5-12 years | > 12years | Total |
|---|---|---|---|---|---|---|
| ASD | 103 | 62 | 43 | 48 | 11 | 267 (40.21%) |
| VSD | 10 | 30 | 50 | 38 | 15 | 143 (21.53%) |
| PDA | 27 | 27 | 22 | 15 | 05 | 96 (14.45%) |
| ECD | 06 | 01 | 03 | 01 | 01 | 12 (1.81%) |
| ASD+VSD | 08 | 08 | 04 | 03 | - | 23 (3.46%) |
| ASD+PDA | 08 | 02 | 02 | 01 | - | 13 (1.96%) |
| ASD+VSD+PDA | 03 | 02 | 01 | - | - | 06 (0.9%) |
| An. IAS | 01 | 04 | - | 01 | 01 | 07 (1.05%) |
| Bicuspid AV | - | - | 02 | 04 | 02 | 08 (1.20%) |
| PAPVC | - | 02 | - | 03 | - | 05 (0.75%) |
| COA | - | - | - | 02 | - | 02 (0.30%) |
| Cardiomyopathy | - | 02 | 01 | 01 | - | 04 (0.60%) |
| VSD+PS | - | 01 | - | 01 | 01 | 03 (0.45%) |
| VSD+AR | - | - | - | - | 01 | 01 (0.15%) |
| Dextrocardia | - | 02 | - | 04 | 02 | 08 (1.20%) |
| AS | - | - | 01 | 04 | 01 | 06 (0.9%) |
| PS | - | 03 | 06 | 05 | 01 | 15 (2.26%) |
| MR | - | 03 | - | - | - | 03 (0.45%) |
| MVP | 02 | 01 | - | 20 | 19 | 42 (6.33%) |

ASD-Atrial Septal Defect, VSD-Ventricular Septal Defect, PDA-Patent Ductus Arteriosus, ECD-Endocardial cushion defect, An. IAS-Aneurysmal interatrial septum, AV-atrioventricular valve, PAPVC-Partial anomalous pulmonary venous return, COA-Coarctation of aorta, PS-Pulmonary stenosis, AR-Aortic regurgitation, AS- Aortic stenosis, MR-Mitral regurgitation, MVP-Mitral valve prolapse

**Table 2: Spectrum of cyanotic congenital heart diseases.**

| CHD Type | ≤ 1 month | 1 month-1 year | 1-5 years | 5-12 years | >12 years | Total |
|---|---|---|---|---|---|---|
| TOF | 03 | 09 | 06 | 03 | 01 | 22 (61.11%) |
| TGA | - | - | - | - | 01 | 01 (2.78%) |
| TAPVC | - | 01 | - | 01 | 01 | 03 (8.34%) |
| TA | - | - | - | 01 | - | 01 (2.78%) |
| SV | 01 | - | - | - | - | 01 (2.78%) |
| HLHS | 01 | - | - | - | - | 01 (2.78%) |
| EA | 01 | - | 01 | - | 01 | 03 (8.34%) |
| DORV | - | 01 | - | 01 | - | 02 (5.56%) |
| Dextrocardia with TOF | 01 | - | - | - | - | 01 (2.78%) |
| Dextrocardia with DORV | - | - | - | 01 | - | 01 (2.78%) |

TOF-Tetralogy of Fallot, TGA-Transposition of Great arteries, TAPVC-Total anomalous pulmonary venous return,TA-Tricuspid atresia, SV-Single ventricle, HLHS- Hypoplastic left heart syndrome, EA-Ebstein anomaly, DORV-Double outlet right ventricle.

## RESULTS

A total of 112,372 pediatric patients attended our center during the study period. Among these,1451 reports of subjects suspected to have CHDs were analyzed. Of these, 673 were purported to be normal, whereas 78 reports were reported as Patent Foramen Ovale, and hence considered insignificant.

Of the remaining 700 subjects (48.24%), 664 (94.85%) were diagnosed to have Acyanotic Congenital Heart Disease and 36 (5.14%) were diagnosed to have Cyanotic Congenital Heart Disease. Of the 664 Acyanotic CHDs, 332 (50%) were male subjects and 332 (50%) were female subjects, reflecting an equal gender predilection. Of the 36 Cyanotic CHDs, 21 (58.33%) were male and 15 (41.67%) were female. Among the 664 subjects diagnosed to have Acyanotic CHD, Atrial Septal Defect (ASD) was found to be the most common (n=267, 40.21%) seconded by Ventricular Septal Defect (VSD) (n=143, 21.53%) and followed closely by Patent Ductus Arteriosus (PDA) (n=96, 14.45%). It was also observed that 8 subjects were diagnosed to have Dextrocardia, of which 3 were found to have an associated VSD and 3 had a concomitant situs inversus.

The various Acyanotic CHDs observed and their age distribution is as depicted in Table 1. Among the 36 subjects diagnosed to have Cyanotic CHD, it was found that Tetralogy of Fallot (TOF) represented the commonest lesion (n=22, 61.11%), followed by equal distribution of Ebstein anomaly (EA) and Total Anomalous Pulmonary Venous Connection (TAPVC) (n=3, 8.34%). An interesting observation was the occurrence of dextrocardia with 2 different cyanotic lesions, namely Double Outlet Right Ventricle (DORV) and TOF. The various Cyanotic CHDs observed and their age distribution is as depicted in Table 2. The gender-wise distribution of acyanotic and cyanotic CHDs are as depicted in Table 3 and Table 4 respectively.

**Table 3: Gender-wise distribution of acyanotic congenital heart diseases.**

| Congenital heart disease | Male | Female |
|---|---|---|
| ASD | 115 (43.07%) | 152 (56.93%) |
| VSD | 95 (66.43%) | 48 (33.57%) |
| PDA | 41 (42.7%) | 55 (57.3%) |
| ECD | 05 (41.67%) | 07 (58.33%) |
| ASD+VSD | 12 (52.17%) | 11 (47.83%) |
| ASD+PDA | 05 (38.47%) | 08 (61.53%) |
| ASD+VSD+PDA | 04 (66.67%) | 02 (33.33%) |
| An. IAS | 03 (42.86%) | 04 (57.14%) |
| Bicuspid AV | 04 (50%) | 04 (50%) |
| PAPVC | 05 (100%) | - |
| COA | 02 (100%) | - |
| Cardiomyomathy | 01 (25%) | 03 (75%) |
| VSD+PS | 01 (33.33%) | 02 (66.67%) |
| VSD+AR | 01 (100%) | - |
| Dextrocardia | 05 (62.5%) | 03 (37.5%) |
| AS | 04 (66.67%) | 02 (33.33%) |
| PS | 09 (60%) | 06 (40%) |
| MR | - | 03 (100%) |
| MVP | 20 (47.61%) | 22 (52.39%) |

**Table 4: Gender-wise distribution of cyanotic congenital heart diseases.**

| CHD | Male | Female |
|---|---|---|
| TOF | 13 (59.09%) | 09 (40.91%) |
| TGA | - | 01 (100%) |
| TAPVC | 02 (66.67%) | 01 (33.33%) |
| TA | 01 (100%) | - |
| SV | 01 (100%) | - |
| HLHS | - | 01 (100%) |
| EA | 01 (33.33%) | 02 (66.67%) |
| DORV | 02 (100%) | - |
| Dextrocardia with TOF | - | 01 (100%) |
| Dextrocardia with DORV | 01 (100%) | - |

## DISCUSSION

Congenital Heart Diseases account for significant morbidity and mortality. Diagnostic modalities such as Echocardiography have provided increased insight into the ever-growing prevalence of CHDs, especially in the developing world. The prevalence rates noted across the western world currently, both in Europe and North America are 8.2/1000 live births and 6.9/100 live births respectively.[3]

This differs from earlier reports describing prevalence as being 5.51 in Europe and 6.6 in North America, highlighting the obvious importance of echocardiography in improving surveillance.[6,7] The different prevalence rates in various geographical zones are as shown in Table 5.[8-14]

**Table 5: Prevalence rates of CHDs in different geographical zones.**

| Country Frequency | Year | Frequency |
|---|---|---|
| UK | 1981 | 5.51 |
| USA | 1990 | 6.6 |
| Hong-Kong | 1991 | 6.35 |
| Norway | 1994 | 10.6 |
| Pakistan | 1997 | 4 |
| Saudi Arabia | 2001 | 10.7 |
| South Africa | 1979 | 3.9 |
| Spain | 2005 | 8.96 |
| Iran | 2007 | 8.6 |

**Table 6: Prevalence of CHDs in various regions across India.**

| Regions study population) | Period | Prevalence rates (per 1000) |
|---|---|---|
| Punjab | 1962 | 31 |
| South India | 1968 | 25.6 |
| J and K | 1979 | 9.7 |
| Shimla | 1995 | 2.25 |
| New Delhi | 2001 | 4.2 |
| J and K | 2014 | 1.12 |
| Mysore | 2006 | 6.6-13.06 |
| Present study | 2016 | 6.22 |

The average prevalence of CHDs in various regions of India has been purported to be 14.7 per thousand live births.[15] The relative prevalence in specific zones and trends over the last five decades is as depicted in Table 6.[3,16-21]

It is worthwhile noting that attempts have been made to estimate the prevalence of CHDs in various population groups over the past decades, which has been supported with echocardiographic evidence. Our study encompassed all children up to the age of 18 years, which included live born subjects and those referred from outlying centers.

Our hospital based study delivered a prevalence rate of 6.22 per 1000, which is comparable to prevalence rates noted elsewhere, although it must be reiterated that only one study, by Khalil et al identifies the prevalence among live births to be 3.9 per thousand.[21,22]

**Table 7: Profile of CHD in India.**

| Author | Year | Profile of selected CHD in India (expressed as percentage) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ASD | VSD | PDA | ECD | PS | TOF | TGA | TA | COA |
| Shrestha et al | 1980 | 23 | 30 | 11 | - | - | 04 | - | - | - |
| Kinare et al | 1981 | | 04 | 09 | - | - | 12 | 12 | - | 08 |
| Vashishtha et al | 1993 | 11 | 41 | 04 | - | - | 14 | - | - | - |
| Thakur et al | 1995 | 38 | 32 | - | - | - | - | - | - | - |
| Gowda et al | 2006 | 11.4 | 26.3 | 10.9 | - | - | 6.4 | 0.4 | - | - |
| Kapoor | 2008 | 18.9 | 21.3 | 14.6 | - | 03 | 4.6 | 1.1 | - | - |
| Misra et al | 2009 | 6.7 | 28.3 | 8.7 | 3.5 | 9.5 | 6.8 | 3.4 | 1.2 | 4.2 |
| Haleja | 2014 | 26 | 58 | 10 | 2 | 2 | 52 | 18 | 04 | - |
| Jatav et al | 2014 | 18.1 | 28.4 | 10.3 | - | 6.8 | 6.0 | 4.3 | - | 1.7 |
| Wanni et al | 2014 | 22.9 | 31.4 | 23.9 | 4.1 | 7.3 | 48 | 27 | 02 | 0.1 |
| Present study | 2016 | 40.2 | 21.5 | 14.4 | 1.8 | 2.2 | 61.1 | 2.7 | 2.7 | 0.3 |

The present study observed that among acyanotic CHDs, ASD (40.21%) was the commonest lesion, followed by VSD (21.53%) and PDA (14.45%). This finding did not corroborate with any of the previous literature cited (Table 7), all of which favored greater involvement of VSD in their studies, except for Thakur et al who observed greater prevalence of ASD.[3,15,19,21,23-28]

Also of relevance is the observation of interesting findings such as PAPVC (0.75%) and aneurysmal IAS that has not been noted previously, even among recent

cited literature such as those of Gowda et al and Wanni et al.[3,21] Among the cyanotic lesions, the most common lesion was TOF (61.11%). It was also observed that frequency of ASD was much higher compared to previous studies, whereas the frequencies of VSD and PDA favored comparably with the same. The prevalence of TOF in particular, was manifold in comparison with other reports and may be attributable to the fact that our hospital is a reputed tertiary referral center. The profile of CHDs in various Indian literatures is as depicted in Table 7.

It is worthwhile noting that 31.78% of acyanotic CHDs and 30.56% of cyanotic CHDs were diagnosed beyond the age of 5 years, which still raises questions with regard to accessibility of health services such as echocardiography in our populace. Previously, sharing of infrastructure with adult cardiology units and utilization of their resources where feasible has been mooted, as in a country like India, pediatric cardiology units remain a luxury. Optimal utilization of said infrastructure is also inclusive of creation and updating of databases catering to congenital heart diseases.

With advent of newer technology, understanding of various CHDs as well as their prevalence is subject to change. This study stresses on the requirement of longitudinal surveillance at frequent intervals, with focus on identification of prevalence of various CHDs in our population, which would definitely go a long way in optimal resource allocation and utilization, in a country where such resources are at a premium.

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## REFERENCES

1. Mitchell SC, Korones SB, Berendes HW. Congenital heart disease in 56,109 births.Incidence and natural history. Circulation. 1971;43(3):323-32.
2. Kuehl KS, Loffredo CA, Ferencz C. Failure to diagnose congenital heart disease in infancy. Pediatrics. 1999;103(4 Pt 1):743-7.
3. Ashraf M, Jan M, Rasool S, Shahzad N, Wanni K, Ahmed K. Prevalence and spectrum of congenital heart diseases in children. Heart India. 2014;2(3):76.
4. Overview of Congenital Cardiovascular Anomalies [Internet]. Merck Manuals Professional Edition. [cited 2016 Aug 28]. Available from: http://www.merckmanuals.com/professional/pediatrics/congenital-cardiovascular-anomalies/overview-of-congenital-cardiovascular-anomalies
5. Lai WW, Geva T, Shirali GS, Frommelt PC, Humes RA, Brook MM, et al. Guidelines and standards for performance of a pediatric echocardiogram: a report from the task force of the pediatric Council of the American Society of Echocardiography. J Am Soc Echocardiogr. 2006;19(12):1413-30.
6. Dickinson DF, Arnold R, Wilkinson JL. Congenital heart disease among 160 480 liveborn children in Liverpool 1960 to 1969. Implications for surgical treatment. Br Heart J. 1981;46(1):55-62.
7. Fixler DE, Pastor P, Chamberlin M, Sigman E, Eifler CW. Trends in congenital heart disease in Dallas County births. 1971-1984. Circulation. 1990;81(1):137-42.
8. Sung RY, So LY, Ng HK, Ho JK, Fok TF. Echocardiography as a tool for determining the incidence of congenital heart disease in newborn babies: a pilot study in Hong Kong. Int J Cardiol. 1991;30(1):43-7.
9. Meberg A, Otterstad J, Frøland G, Søarland S, Nitter-Hauge S. Increasing incidence of ventricular septal defects caused by improved detection rate. Acta Pædiatrica. 1994;83(6):653-7.
10. Hassan I, Haleem AA, Bhutta ZA. Profile and risk factors for congenital heart disease. JPMA. 1997;47(3):78-81.
11. Alabdulgader AA. Congenital heart disease in 740 subjects: epidemiological aspects. Ann Trop Paediatr. 2001;21(2):111-8.
12. McLaren MJ, Lachman AS, Barlow JB. Prevalence of congenital heart disease in black schoolchildren of Soweto, Johannesburg. Br Heart J. 1979;41(5):554-8.
13. MartínezOlorón P, Romero Ibarra C, Alzina de Aguilar V. Incidence of congenital heart disease in navarra (1989-1998). Rev Esp Cardiol. 2005;58(12):1428-34.
14. Nikyar B, Sedehi M, Mirfazeli A, Qorbani M, Golalipour M-J. Prevalence and Pattern of Congenital Heart Disease among Neonates in Gorgan, Northern Iran (2007-2008). Iran J Pediatr. 2011;21(3):307-12.
15. Hajela S. Profile of Congenital Heart Disease in childhood. Int J Med Res Rev [Internet]. 2014 Jun 30 [cited 2016 Aug 30];2(03). Available from: http://medresearch.in/index.php/IJMRR/article/view/105
16. Manchanda SS, Sachdev KK. Morbidity and mortality in children in Northern India (Punjab): Based on an analysis of 10,990 admissions. Indian J Pediatr. 1962;29:333-50.
17. Gupta S, Puri RK, Indira OC, Datta SP. Morbidity in children under fourteen in south India. Indian Pediatr. 1968;5(11):485-97.
18. Verma KC, Chhabra P, Magotra ML. A clinical study on prevalence of heart diseases among children in Jammu & surrounding area. Indian Pediatr. 1979;16(7):597-606.
19. Thakur JS, Negi PC, Ahluwalia SK, Sharma R, Bhardwaj R. Congenital heart disease among school children in Shimla hills. Indian Heart J. 1995;47(3):232-5.

20. Chadha SL, Singh N, Shukla DK. Epidemiological study of congenital heart disease. Indian J Pediatr. 2001;68(6):507-10.
21. Smitha R, Karat SC, Narayanappa D, Krishnamurthy B, Prasanth SN, Ramachandra NB. Prevalence of congenital heart diseases in Mysore. Indian J Hum Genet. 2006;12(1):11-6.
22. Khalil A, Aggarwal R, Thirupuram S, Arora R. Incidence of congenital heart disease among hospital live births in India. Indian Pediatr. 1994;31(5):519-27.
23. Shrestha NK, Padmavati S. Congenital heart disease in Delhi school children. Indian J Med Res. 1980;72:403-7.
24. Kinare SG, Sharma S. Congenital heart disease in first year of life (an autopsy study of 270 cases). Indian J Pediatr. 1981;48(395):745-51.
25. Vashishtha VM, Kalra A, Kalra K, Jain VK. Prevalence of congenital heart disease in school children. Indian Pediatr. 1993;30(11):1337-40.
26. Kapoor R, Gupta S. Prevalence of congenital heart disease, Kanpur, India. Indian Pediatr. 2008;45(4):309-11.
27. Misra M, Mittal M, Verma AM, Rai R, Chandra G, Singh DP, et al. Prevalence and pattern of congenital heart disease in school children of eastern Uttar Pradesh. ResearchGate. 2009;61(1):58-60.
28. Jatav R, Kumbhare M, Srinivas M, Rao D, Kumar P, Reddy P, et al. Prevalence and pattern of congenital heart diseases in Karimnagar, Andhra Pradesh, India: diagnosed clinically and by trans-thoracic-two-dimensional echocardiography. Int J Res Med Sci. 2014;2(1):186.

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