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Original Research Article

Screening newborns for congenital heart disease: a hospital based observational study

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ABSTRACT

Background: Congenital heart disease (CHD) is the most common structural congenital anomaly and a leading cause of infant mortality. In India, with over 25 million annual live births, the burden of undetected CHD is enormous. Hospital-based echocardiographic prevalence data from South India, particularly coastal Karnataka, remains sparse. The aim is to assess the birth prevalence and echocardiographic pattern of congenital heart disease in neonates born at a tertiary care hospital within 72 hours of life.
Methods: A hospital-based cross-sectional observational study was conducted over six months at Rajarajeswari Medical College and Hospital, Bengaluru. All 507 enrolled neonates underwent CCHD screening followed by transthoracic two-dimensional echocardiography with colour Doppler by a pediatric cardiologist. CHD was classified as normal, insignificant, significant (minor/major acyanotic/cyanotic), or other cardiac findings. Prevalence was expressed per 1000 live births with 95% confidence intervals using the Wilson Score Method. Association of risk factors with CHD was assessed by Fisher's Exact Test ($p<0.05$).
Results: Of 507 neonates screened, 29 (5.72%) had significant CHD, yielding a hospital-based prevalence of 57.2/1000 (95% CI: 40.12–80.94). PDA >2mm was the most frequent diagnosis (n=9, 31.0%), followed by restrictive VSD (n=8, 27.6%) and ASD >5mm (n=7, 24.1%). Five major CHDs were detected: 2 acyanotic (non-restrictive VSD) and 3 cyanotic (DORV, TOF, Ebstein's anomaly). PPHN was identified in 3 neonates. The CCHD screen demonstrated a sensitivity of 96.6% (95% CI: 82.8–99.4%), specificity of 98.7%, and NPV of 99.8%. Preterm gestational age was the only variable significantly associated with CHD ($p=0.046$).
Conclusions: In this hospital-based cross-sectional study of 507 neonates screened by echocardiography within 72 hours of birth, the birth prevalence of significant CHD was 57.2/1000, with PDA being the most common diagnosis. The CCHD screen demonstrated a high sensitivity of 96.6% and NPV of 99.8% when validated against echocardiography.

Keywords: Congenital heart defects, Echocardiography, Neonatal screening, Infant, Newborn, Heart defects, Congenital, Pulse oximetry

INTRODUCTION

Congenital heart disease (CHD) is defined as a gross structural abnormality of the heart or intrathoracic great vessels that is actually or potentially of functional significance. It represents the most common category of major congenital anomaly worldwide and remains a leading cause of morbidity and mortality in the first year of life. The global birth prevalence of CHD is estimated at approximately 8 per 1000 live births, though this figure varies considerably between studies depending on the screening methodology employed, the population studied,

and the diagnostic criteria applied.[1,2] A landmark systematic review by Liu et al. (2019), analysing data from 1970 to 2017 across 130 million live births, reported a mean global CHD prevalence of 8.224/1000, with a rising trend in recent decades attributable largely to improved detection rather than a true increase in incidence.[3]

In India, the burden of CHD is expected to be enormous. With a birth rate of approximately 18-19 per 1000 population and over 25 million annual live births, even a conservative CHD prevalence of 8/1000 translates to an estimated 200,000 new CHD births every year in the country. Earlier Indian prevalence studies with many conducted on school-going children in the context of rheumatic fever surveys substantially underestimate the true burden, as a large proportion of critical CHDs result in early infant death before school age.[4] The landmark study by Saxena et al from Safdarjung Hospital, North India, conducted over three years with echocardiographic screening of 20,307 neonates, reported a birth prevalence of significant CHD at 8.07 per 1000 live births, with ventricular septal defect (VSD) as the most common acyanotic lesion and transposition of great arteries (TGA) as the most common cyanotic lesion.[5] Despite this seminal contribution, data from South India, particularly from the coastal Karnataka region remains sparse.

The diagnosis of CHD depends critically on the modality used for screening. Clinical examination alone has well-documented limitations in the newborn period. In the study by Saxena et al clinical examination detected only 40 of 163 significant CHDs (sensitivity 24.54%), while pulse oximetry, the basis for the Critical Congenital Heart Disease (CCHD) screen achieved a sensitivity of only 47.17%. This is because most acyanotic lesions, which constitute nearly 80% of significant CHDs, do not reduce arterial oxygen saturation significantly in the early newborn period. Studies using two-dimensional echocardiography with colour Doppler as the primary screening tool have consistently reported superior detection rates.[6] Kalpana et al from Karnataka reported an 8% echocardiographic abnormality rate among 436 neonates screened at an urban community health centre.[7] In South India, the CHRONIK registry (Sasikumar et al) which was a prospective multi-centre study from Kerala, identified 1474 neonates with CHD across 47 hospitals, of whom 27% had critical CHD with a one-month mortality of 22%. This study highlights the urgency of early identification of CHD in the neonatal period.[8]

There is a paucity of hospital-based echocardiographic CHD screening data from coastal Karnataka and the broader South Indian region. Available studies are either retrospective, limited to symptomatic or referred neonates or restricted to single modalities such as pulse oximetry without echocardiographic confirmation in all neonates. The present study was therefore conducted with the aim to assess the birth prevalence and pattern of congenital heart disease using echocardiography in newborns delivered at Rajarajeswari Medical College and Hospital, Bengaluru, within the first 72 hours of life.

METHODS

This was a hospital-based cross-sectional observational study conducted over a period of six months at Rajarajeswari Medical College and Hospital, Bengaluru. The study was approved by the Institutional Ethics Review Board (IERB), and written informed consent was obtained from one of the parents of each enrolled neonate prior to recruitment.

Study population

Inclusion criteria: All neonates born in Rajarajeswari Medical College and Hospital during the study period were eligible for enrolment.

Exclusion criteria: Neonates whose parents refused written informed consent were excluded from the study.

Sample size calculation

The sample size was calculated using the proportion-based formula:

$$N = Z^2 \times p \times (1-P) / d^2$$

Using a 95% confidence level (Z=1.96), an estimated CHD prevalence of 1% (p=0.01), and a precision of 2% (d=0.02), the minimum required sample size was calculated as 95. A total of 507 neonates were enrolled and screened during the study period, exceeding the minimum calculated sample.

Methodology

Following delivery, all enrolled neonates underwent an initial clinical evaluation within 24 hours of birth by the study team, which included assessment for central cyanosis, cardiac murmur on auscultation, and respiratory distress. CCHD screening using pulse oximetry was performed for all neonates; a persistently positive CCHD screen was defined as oxygen saturation below the threshold value. All neonates were subsequently screened using two-dimensional echocardiography with colour Doppler by a qualified pediatric cardiologist within 72 hours of life. Neonates admitted to the Neonatal Intensive Care Unit (NICU), those not maintaining target oxygen saturation, or those failing the CCHD screen were screened immediately after haemodynamic stabilisation. The echocardiographer was blinded to the results of the initial clinical evaluation.

Classification of echocardiographic findings

Echocardiographic findings were classified as follows, based on the validated criteria of Saxena et al:

Normal: No structural abnormality; or PDA <2 mm without LV volume overload; ASD/PFO <5 mm without RV volume overload; mild branch pulmonary artery turbulence.

Insignificant CHD: Tiny muscular VSD likely to close spontaneously.

Significant CHD: Minor CHD: ASD >5 mm; PDA >2 mm with LV volume overload; restrictive VSD; valvular aortic/pulmonary stenosis with gradient <25 mmHg; Major CHD (Acyanotic): Non-restrictive VSD; valvular stenosis with gradient >25 mmHg; coarctation of aorta; and Major CHD (Cyanotic): TOF, TGA, HLHS, DORV, TAPVC, Ebstein's anomaly, truncus arteriosus, and related lesions.

Other Cardiac Findings: PPHN, cardiac tumor, situs inversus with dextrocardia, arrhythmias.

Data collection

Neonatal and maternal data were collected using a pre-structured proforma, recording: maternal age, co-morbidities, mode of delivery, type of pregnancy; neonatal sex, gestational age, birth weight, day of life at scan, APGAR scores, CCHD screen result and echocardiographic findings.

Statistical analysis

Data were entered in MS Excel and analysed using SPSS version 23.0. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as mean±standard deviation (SD). Birth prevalence of CHD was reported per 1000 live births, and 95% confidence intervals (CI) for all prevalence estimates were calculated using the Wilson Score Method, which is appropriate for rare proportions. The association between risk factors and CHD was evaluated using Fisher's Exact Test. A $p<0.05$ was considered statistically significant.

RESULTS

Out of the 507 neonates screened, 262 (51.7%) were male and 245 (48.3%) were female, with a male-to-female ratio of 1.07:1. The mean gestational age was 37.01±2.47 weeks (range: 26–40 weeks); 411 neonates (81.1%) were term (≥37 weeks) and 96 (18.9%) were preterm (<37 weeks). The mean day of life at the time of echocardiographic screening was 2.93±1.19 days. Mean Birth weight data of the neonates was 2.37±0.85 kg (range: 0.60–4.80 kg). Majority of the pregnancies were singleton (445, 87.8%), with 58 (11.4%) twin gestations.

With regard to mode of delivery, 208 neonates (41.1%) were born by vaginal/normal vaginal delivery (NVD), while 297 (58.7%) were delivered by Caesarean section (LSCS). Among maternal characteristics, 361 mothers (71.2%) had no identifiable pathology. The most prevalent maternal comorbidity was gestational diabetes mellitus (GDM), present in 69 cases (13.6%), followed by gestational hypertension in 51 (10.1%), hypothyroidism in 22 (4.3%), and abruptio placentae in 4 (0.8%). Overall, 146 mothers (28.8%) had at least one maternal pathology (Table 1).

Out of the 507 neonates screened, 475 (93.7%) had normal echocardiographic findings, including 382 structurally normal echos and 93 classified as normal per protocol (trivial tricuspid regurgitation, PDA <2 mm, ASD/PFO <5 mm without chamber volume overload). A total of 29 neonates (5.72%) were diagnosed with significant congenital heart disease, yielding a hospital-based birth prevalence of 57.2 per 1000 live births (95% CI: 40.12–80.94). Additionally, 3 neonates (0.59%) had other cardiac findings not classified as CHD. No insignificant CHD (tiny muscular VSD with anticipated spontaneous closure) was identified in this cohort.

Among the 29 significant CHDs, 24 (82.8%) constituted minor CHDs and 5 (17.2%) were major CHDs. Of the major CHDs, 2 (6.9% of significant CHDs) were major acyanotic and 3 (10.3%) were major cyanotic, yielding prevalence rates of 3.94/1000 (95% CI: 1.08–14.27) and 5.92/1000 (95% CI: 2.01–17.25), respectively (Table 2).

Among the 24 minor CHDs, the most common diagnosis was patent ductus arteriosus (PDA) greater than 2 mm with left ventricular volume overload, detected in 9 neonates (31.0% of all significant CHDs; prevalence 17.75/1000, 95% CI: 9.37–33.39). Restrictive ventricular septal defect (VSD) was the second most common, identified in 8 neonates (27.6%; prevalence 15.78/1000, 95% CI: 8.02–30.82). Atrial septal defect (ASD) greater than 5 mm of the ostium secundum type was detected in 7 neonates (24.1%; prevalence 13.81/1000, 95% CI: 6.70–28.22).

Among the 5 major CHDs, 2 were major acyanotic: both were non-restrictive VSDs (6.9% of significant CHDs; prevalence 3.94/1000, 95% CI: 1.08–14.27). Three major cyanotic CHDs were identified one case each of Double Outlet Right Ventricle (DORV), Tetralogy of Fallot (TOF), and Ebstein's Anomaly each contributing a prevalence of 1.97/1000 (95% CI: 0.35–11.09) (Table 3).

Three neonates (0.59%; prevalence 5.92/1000, 95% CI: 2.01–17.25) were found to have persistent pulmonary hypertension of the newborn (PPHN) on echocardiography and were grouped under other cardiac findings. No cases of cardiac tumor, situs inversus with dextrocardia, complete heart block, or supraventricular tachycardia were detected in the study cohort (Table 4).

The CCHD screen (pulse oximetry) was positive in 34 neonates (6.7%) and negative in 473 (93.3%). Using echocardiography as the gold standard, the 2×2 matrix revealed 28 true positives, 6 false positives, 1 false

negative, and 472 true negatives. The CCHD screen demonstrated a sensitivity of 96.6% (95% CI: 82.8–99.4%), specificity of 98.7% (95% CI: 97.3–99.4%), positive predictive value (PPV) of 82.4% (95% CI: 66.5–91.7%), and negative predictive value (NPV) of 99.8% (95% CI: 98.8–100.0%). Only one neonate with significant CHD (a restrictive VSD) was not detected by the CCHD screen (Table 5, 6).

The association between potential risk factors and significant CHD was evaluated using Fisher's Exact Test, with $p<0.05$ considered statistically significant. Gestational age category was the only variable significantly associated with CHD ($p=0.046$): the CHD rate among preterm neonates (<37 weeks) was 10.4% (10/96) compared to 4.6% (19/411) among term neonates. Sex (male 5.3% vs. female 6.1%; $p=0.707$), mode of delivery (LSCS 6.1% vs. vaginal 5.3%; $p=0.847$), type of pregnancy (singleton 5.8% vs. twin 5.2%; $p=1.000$), and presence of maternal pathology (any pathology 4.1% vs. none 6.4%; $p=0.401$) did not show statistically significant associations with CHD (Table 7).

Table 1: Baseline neonatal and maternal characteristics of the study population.

	Variables	Category	N	%	Mean±SD
Neonatal characteristics	Sex	Male	262	51.7%	
		Female	245	48.3%	
	Gestational age	Term (≥37 weeks)	411	81.1%	
		Preterm (<37 weeks)	96	18.9%	
		Overall (weeks)			37.01±2.47
	Birth weight (kg)				2.37±0.85
	Day of life at scan				2.93±1.19
	Type of pregnancy	Singleton	445	87.8%	
		Twin	58	11.4%	
Maternal characteristics	Maternal pathology	No Pathology (NIL)	361	71.2%	
		Gestational diabetes mellitus	69	13.6%	
		Gestational hypertension	51	10.1%	
		Hypothyroidism	22	4.3%	
		Abruptio placentae	4	0.8%	
	Mode of delivery	Vaginal/NVD	208	41.2%	
		LSCS	297	58.8%	

Table 2: Distribution of echocardiographic findings.

Echo category	Sub category	N	% of total screened	% of Sig. CHDs	Prevalence (/1000 LB)	95% CI lower	95% CI upper
Normal findings							
Normal echo (no CHD)		475	93.7%		936.88	912.26	954.94
Insignificant CHD							
Insignificant CHD	Tiny Muscular VSD (auto- closing)	0	0.0%		0.00	—	—
Significant CHD							
Significant CHD-Total		29	5.7%	100.0%	57.20	40.12	80.94
Minor CHD (Total)		24	4.7%	82.8%	47.34	32.01	69.47
	Restrictive VSD	8	1.6%	27.6%	15.78	8.02	30.82
	PDA >2mm with LV overload	9	1.8%	31.0%	17.75	9.37	33.39
	ASD >5mm	7	1.4%	24.1%	13.81	6.70	28.22
Major CHD (Total)		5	1.0%	17.2%	9.86	4.22	22.88
Major acyanotic CHD		2	0.4%	6.9%	3.94	1.08	14.27
	Non-restrictive VSD	2	0.4%	6.9%	3.94	1.08	14.27
Major cyanotic CHD		3	0.6%	10.3%	5.92	2.01	17.25
	Double Outlet Right Ventricle (DORV)	1	0.2%	3.4%	1.97	0.35	11.09
	Tetralogy of fallot (TOF)	1	0.2%	3.4%	1.97	0.35	

Continued.

Echo category	Sub category	N	% of total screened	% of Sig. CHDs	Prevalence (/1000 LB)	95% CI lower	95% CI upper
	Ebstein's anomaly	1	0.2%	3.4%	1.97	0.35	11.09
Other cardiac findings							
Other cardiac findings-total		3	0.6%	10.3%	5.92	2.01	17.25
	Persistent pulmonary hypertension of newborn (PPHN)	3	0.6%	10.3%	5.92	2.01	17.25

Table 3: Specific diagnoses among significant congenital heart diseases.

Category	Diagnosis	N	% of total screened	% of Significant CHDs	Prevalence (/1000 LB)	95% CI
Acyanotic CHD-minor						
Minor CHD	Restrictive VSD	8	1.6%	27.6%	15.78	8.02–30.82
	PDA >2mm with LV overload	9	1.8%	31.0%	17.75	9.37–33.39
	ASD >5mm (OS type)	7	1.4%	24.1%	13.81	6.70–28.22
Minor CHD subtotal		24	4.7%	82.8%	47.34	32.01–69.47
Acyanotic CHD-major						
Major acyanotic	Non-restrictive VSD	2	0.4%	6.9%	3.94	1.08–14.27
Major acyanotic subtotal		2	0.4%	6.9%	3.94	1.08–14.27
Cyanotic CHD-major						
Major cyanotic	Double outlet right ventricle (DORV)	1	0.2%	3.4%	1.97	0.35–11.09
	Tetralogy of fallot (TOF)	1	0.2%	3.4%	1.97	0.35–11.09
	Ebstein's anomaly	1	0.2%	3.4%	1.97	0.35–11.09
Major cyanotic subtotal		3	0.6%	10.3%	5.92	2.01–17.25
Total significant CHD						
Total		29	5.7%	100.0%	57.20	40.12–80.94

Table 4: Other cardiac findings on echocardiography (Non-CHD).

Findings	N	% of total screened	Prevalence (/1000 LB)	95% CI Lower	95% CI Upper
Persistent pulmonary Hypertension of Newborn (PPHN)	3	0.59%	5.92	2.01	17.25
Cardiac tumor	0	0.00%	0.00	—	—
Situs Inversus/Dextrocardia	0	0.00%	0.00	—	—
Arrhythmias (CHB / SVT)	0	0.00%	0.00	—	—
Total other cardiac findings	3	0.59%	5.92	2.01	17.25

Table 5: Diagnostic performance of CCHD screen vs. echocardiography (gold standard).

	Echocardiography (gold standard)		
CCHD screen	**CHD present (Sig.)**	**CHD absent (normal)**	**Row total**
Positive	28	6	34
Negative	1	472	473
Column total	29	478	507

Table 6: Diagnostic performance of CCHD screen vs. echocardiography (gold standard).

Metric	Formula	Value (%)	95% CI lower	95% CI upper
Sensitivity	TP / (TP + FN)	96.6%	82.8%	99.4%
Specificity	TN / (TN + FP)	98.7%	97.3%	99.4%
Positive predictive value (PPV)	TP / (TP + FP)	82.4%	66.5%	91.7%
Negative predictive value (NPV)	TN / (TN + FN)	99.8%	98.8%	100.0%

TP=True positive (28) FP=False positive (6) FN=False negative (1) TN=True negative (472)

Table 7: Association of neonatal and maternal factors with significant congenital heart disease.

Variables	Category	CHD (n=29)	Non-CHD (n=478)	CHD rate (%)	P value	Significance
Neonatal factors						
Sex	Male	14	248	5.3%	0.7076	NS
	Female	15	230	6.1%		
Gestational age	Term (≥37 weeks)	19	392	4.6%	0.0464	*
	Preterm (<37 weeks)	10	86	10.4%		
Type of pregnancy	Singleton	26	419	5.8%	1.0000	NS
	Twin	3	55	5.2%		
Maternal factors						
Mode of delivery	LSCS	18	279	6.1%	0.8465	NS
	Vaginal/NVD	11	197	5.3%		
Maternal pathology	Any pathology	6	140	4.1%	0.4013	NS
	No pathology	23	338	6.4%		

NS=Not significant | * = Statistically Significant ($p < 0.05$) | All tests: Fisher's Exact Test | CHD rate=CHD cases / total in that category

DISCUSSION

Congenital heart disease represents the most common structural congenital anomaly globally and contributes disproportionately to neonatal and infant mortality in low and middle-income countries, where over 90% of affected neonates are born. Echocardiography remains the gold standard for definitive diagnosis, yet systematic universal echo-based newborn screening remains unavailable in most Indian hospitals.[9]

The present study was therefore conducted to assess the birth prevalence and echocardiographic spectrum of CHD among neonates born at a tertiary care hospital in Bengaluru, Karnataka. A total of 507 neonates were screened over six months. Twenty-nine (5.72%) were diagnosed with significant CHD, yielding a hospital-based birth prevalence of 57.2 per 1000 live births. This figure is substantially higher than the globally reported birth prevalence of approximately 8–9.4 per 1000 live births established by Liu et al across 130 million live births.[3] Similarly, it exceeds the 8.07/1000 reported by Saxena et al from a large North Indian community hospital and the 14.4/1000 reported by Sadoh et al from Nigeria using an identical bedside echo methodology in all neonates.[5,10]

The elevated prevalence in the present study is attributable to the hospital-based sampling frame, which inherently enriches for clinically higher-risk neonates including NICU admissions and those failing CCHD screening, rather than reflecting a true rise in population-level CHD incidence. This interpretation is consistent with findings from Beijing, where Wu et al demonstrated that apparent increases in hospital-based CHD prevalence over a decade were driven by improved detection rather than true incidence increase.[11]

When compared with South Indian and Karnataka-specific studies, the present findings are of particular regional significance. Kalpana and Vijayanthi, conducting echo-based screening at an urban community health centre in Chennai, found echo abnormalities in 35 of 436 neonates (8%), with VSD as the most common lesion followed by ASD and PDA. In the present study, PDA greater than 2 mm was the most frequent significant CHD (31.0%), followed by restrictive VSD (27.6%) and

ASD greater than 5 mm (24.1%).[12] This higher PDA prevalence may reflect the inclusion of preterm neonates in the present study, as hemodynamically significant PDA is a well-established complication of prematurity. Suresh and Ramraj from Mysore Medical College, Karnataka, screened 660 neonates and confirmed 8 CHDs (1.2%) by echocardiography; notably, all confirmed CHDs in that study were major or critical lesions, contrasting with the predominance of minor CHDs (82.8%). In the present study, likely because Suresh and Ramraj's cohort was enriched by screen-positive referrals rather than universal enrollment.[13]

Sebastian et al in a cross-sectional study from a Kerala tertiary centre, reported that among 553 children with confirmed CHD, 95% had acyanotic lesions and 3.6% cyanotic lesions a proportion broadly consistent with the present study's distribution of 82.8% acyanotic and 17.2% cyanotic among major CHDs. Importantly, Sebastian et al. identified prematurity (p=0.0001) and low birth weight (p=0.001) as significant risk factors for CHD, which aligns with the present study's finding that preterm gestational age was the only variable significantly associated with CHD (p=0.046, Fisher's Exact Test).[14]

The CHRONIK registry (Sasikumar et al), encompassing 1474 neonates with CHD across 47 Kerala hospitals, provides the most comprehensive South Indian neonatal CHD outcome data, demonstrating that pulse oximetry identified 72% of critical CHD cases with a preoperative mortality of 22%.[8] Against this backdrop, the present study's CCHD screen demonstrated a substantially higher sensitivity of 96.6% (95% CI: 82.8–99.4%), which may reflect the tertiary hospital setting, the standardised protocol, and the universal application of the screen to all neonates regardless of clinical status.

Sharma et al examining 8856 sick neonates in Odisha, found a prevalence of 26.2/1000, with 91.3% acyanotic CHD; among cyanotic lesions, Tetralogy of Fallot was most frequent, mirroring the present study's TOF among the three identified cyanotic lesions.[16]

From a global perspective, the five-year newborn screening programme in South Shanghai (Tian et al), covering 198,606 neonates, achieved echocardiographic confirmation rates rising from 85.6% to 97.5% over the study period and confirmed 1109 CHDs, demonstrating the feasibility and scalability of systematic echo-based screening.[17] Al-Shawki et al in a comprehensive systematic review of 45 studies from LMICs between 2019 and 2025, documented that 47–63% of CHD cases in low-resource settings are diagnosed after irreversible complications have occurred, with congestive heart failure present in 49.4% of patients at the time of first diagnosis underscoring the urgency and clinical value of early universal screening as performed in the present study.[18] The GBD 2021 analysis (Deng et al) further confirmed that India bears the highest absolute CHD burden globally, with an estimated 725,281 childhood CHD cases in 2021, making hospital-based screening programmes in tertiary institutions critically important.[19]

The present study has several limitations. Its single-centre, hospital-based design limits the generalizability of prevalence data to the broader population. The sample, while exceeding the calculated minimum, may be underpowered for detecting rare cyanotic lesions or performing robust subgroup analysis. Additionally, birth weight data were available for only 189 of 507 neonates, precluding full analysis of this variable. Despite these limitations, the study offers notable strengths: it represents one of the first systematic universal echo-based CHD screening studies from coastal Karnataka; it employs a validated classification system identical to Saxena et al ensuring comparability; and the high CCHD screen sensitivity of 96.6% with a NPV of 99.8% supports the clinical reliability of the current screening protocol.

These findings collectively advocate for universal echocardiographic screening of all neonates within 72 hours of birth at tertiary care institutions, particularly in a country bearing the world's highest absolute CHD burden.

CONCLUSION

In this hospital-based cross-sectional study of 507 neonates screened by echocardiography within 72 hours of birth, the birth prevalence of significant CHD was 57.2/1000, with PDA being the most common diagnosis. The CCHD screen demonstrated a high sensitivity of 96.6% and NPV of 99.8% when validated against echocardiography. Preterm gestational age was the only factor significantly associated with CHD. Universal echo-based newborn screening at tertiary hospitals is warranted to ensure early detection and timely intervention.

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