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Pattern, Relative Frequency and morbidity of Pediatric Heart diseases at Tibebe-Ghion Specialized Teaching Hospital, Bahir Dar, North West Ethiopia

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ABSTRACT

Background: Significant efforts has been put to curve child mortality and morbidity over years and showed a remarkable improvement. Regrettably, paediatric cardiac diseases with an alarming morbidity and mortality rate and psychosocial burden have been given less due attention in LMICs.

Objective: Describe the patterns, clinical presentations and morbidity of children with heart diseases attending Bahir Dar University Tibebe-Ghion specialized teaching hospital, North-west Ethiopia.

Methods: We conducted descriptive cross sectional study of children with echocardiography confirmed heart diseases, aged from birth to 15 years, evaluated from June 2019-February 2024.

Results: Four hundred fifteen children with heart diseases were attending our pediatric cardiac clinic during the study period. Fifty four percent were males. The median (IQR) age of children enrolled was 24 months (4 to 97). Congenital heart defects account for 67.5% of Pediatric heart diseases and acquired heart diseases for 30.6%. 76.4% of the acquired heart diseases had rheumatic heart diseases. Of all CHDs, 72.5% had acyanotic CHD and 23.6% were cyanotic. 24.6% of acyanotic CHDs were isolated ventricular septal defect followed by isolated patent ductus arteriosus (13.8%), atrioventricular septal defect (11.3%), and atrial septal defect (10.3%). TOF (36.4%) was the leading cyanotic CHD followed by d-TGA (16.7%), Tricuspid Atresia (16.7%), and DORV(12.1%). Respiratory distress (65%) and murmur (83%) were the most common presenting complaint and clinical finding respectively. 49% and 32% of children with heart disease had congestive heart failure and pulmonary hypertension respectively.

Conclusion: The proportion of congenital heart defects in the paediatric population is rising. Respiratory distress and cardiac murmur are the most common presenting complaint and clinical

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finding of children with heart diseases respectively. Significant proportion of children with heart diseases present with congestive heart failure and pulmonary hypertension.

Keywords: Pediatric heart disease; Congestive heart failure; Pulmonary hypertension

INTRODUCTION

There are little reliable data concerning the spectrum and prevalence of paediatric cardiac disease in Low and Middle Income Countries (LMIC), but enough to know that the burden is considerable with patients typically presenting with advanced disease [1]. Heart diseases in children include those present at birth (congenital heart diseases) and those acquired later in life (rheumatic heart disease, cardiomyopathies, pericardial diseases, myocarditis and others) [2].

Heart diseases in paediatric population are considered to be significant contributors to mortality and morbidity as well as frequent causes of hospital admission among children [3]. The burden of heart disease is significant in comparison with other better studied and funded diseases in LMIC [4]. Estimates for prevalence of Congenital Heart Defects (CHD) in sub-Saharan Africa from Global Burden of Disease (GBD) data are also very high, with rates up to 350 per 100,000 in Niger [5].

Congenital Heart Defects (CHD) are the most common birth defects; responsible for nearly one-third of all congenital birth defects [2]. Ventricular Septal Defect (VSD) followed by Atrial Septal Defect (ASD) was the commonest acyanotic heart lesions while Tetralogy of Fallot (TOF) was the commonest cyanotic heart lesion. Studies in LMICs have characterised the spectrum of Acquired Heart Disease (AHD) of which Rheumatic Heart Disease (RHD) was the most common followed by dilated cardiomyopathy/myocarditis [3, 6-8]. Studies showed that heart failure and pulmonary hypertension associated with CHD are more common in LMICs compared to HICs [9-11]. RHD is also the most frequent cause of heart failure in sub-Saharan Africa [12,13].

The 2030 Agenda for sustainable development outlines a transformative vision. Of the goals, SDG 3.4 aims to reduce premature mortality from non-communicable diseases including cardiovascular disorders by one third [14]. Regrettably, paediatric cardiac diseases with an alarming morbidity and mortality rate and psychosocial burden have been given less due attention [15].

Although overall child mortality has decreased by half globally, death and morbidity due to heart disease has consistently increased in LMICs over the past few decades [16]. Given the increase in CHD prevalence and the consequent increase in morbidity, sustainable treatment strategy should be planned to achieve the SDGs in Africa. Failing to build this capacity, heart diseases may become a major contributor to missing the 2030 SDG target 3.4 [17,18].

Our Search of literature showed that most studies done in our country has focused mainly on relative frequencies of paediatric heart diseases without highlighting the detailed profiles and magnitude of the disease burden in terms of morbidity [19,20]. The study is therefore aimed at determining the patterns, detailed profiles and morbidities of cardiac diseases among children attending our hospital pediatric cardiology unit.

MATERIALS AND METHODS

Setting and Participants

The study was conducted on clients who had attended the paediatric cardiology unit of Bahir Dar University Tibebe-Ghion Specialized Teaching Hospital, one of the referral centres in North-west Ethiopia, over a four years and nine months period from June 2019–February 2024. Four hundred fifteen children who had heart lesions confirmed by echocardiography were included.

Study Design

A descriptive cross sectional hospital based study was conducted on patients attending paediatric cardiology unit of Bahir Dar University Tibebe-Ghion specialized teaching hospital. The study period spanned from June 2019 to February 2024. Children, from birth to 15 years of age, with heart lesions on the basis of clinical evaluation and echocardiography over this time period were included.

Exclusion criteria: Children who/whose care givers are not willing to be included in the study.

- Children whose diagnosis is not supported by echocardiography.
- Patients with incomplete documentation of files and/or questionnaire.

Structured questionnaire that details demographic, socio-economic, clinical, and echocardiographic variables was used. Descriptive analysis was performed for age, gender, clinical diagnosis, and detailed heart disease profiles. Their caregivers were informed of the study objectives and methods to be used, and consent was taken for their agreement before filling the questionnaire. Ethical clearance was obtained from the ethics and research committee of college of medicine and health sciences of Bahir Dar University.

Operational Definition

Congenital heart defect: Defect that present at birth and may occur singly or in combination.

Acyanotic congenital heart defect: Congenital heart defects that don't normally interfere with the amount of oxygen or blood that reaches the tissues of the body.

Cyanotic congenital heart defect: Heterogeneous group of cardiac abnormalities that result in deoxygenated blood being pumped to the body without first passing through the lungs.

Acquired heart disease: Conditions affecting the heart and its associated blood vessels that develop during a person's lifetime.

Rheumatic Heart Disease (RHD): Acute and chronic heart disorders caused by rheumatic fever.

Stage A/borderline rheumatic heart disease: Abnormal echocardiographic features but do not fulfil criteria for the diagnosis of RHD.

Statistical Analysis

Recorded data were cleaned, coded and analysed with IBM SPSS Statistics for windows, version 25. The Categorical variables were analysed in the form of proportions and percentages and presented in tables. Discrete variables including age were analysed and summarized as medians (IQR).

RESULTS

Socio–Demographic Characteristics

Four hundred fifteen (415) children aged from birth to 180 months with a diagnosis of heart diseases were enrolled in to the study during the time period from June 2019- February 2024. Fifty four percent (222/415) were males. The median (IQR) age of children enrolled was 24 months (4 to 97). **Table 1** demonstrates the detailed socio-demographic characteristics.

Table 1: Socio-demographic parameter of children with heart diseases: Bahir Dar University Tibebe-Ghion specialized teaching hospital, June 2019-February 2024

Demographic parameters	Age category of children with heart diseases							
	0–28 days	1–12 months	≥ 1–2 years	≥ 2–6 years	≥ 6–12 years	≥ 12 years	Total	%
				Sex				
Male	37	57	23	40	39	26	222	53.5
Female	22	43	19	37	36	36	193	46.5
				Maternal educational status				
Not able to read and write	18	39	21	31	49	53	211	50.8
Able to read and write	27	30	14	24	16	7	118	28.4
ISCED 1=Primary education	0	3	0	1	1	0	5	1.2
ISCED 2=Lower secondary	2	3	1	4	0	0	10	2.4
ISCED 3=Upper secondary	2	3	0	5	2	0	12	2.9
ISCED 4=Post secondary non-tertiary	1	5	1	2	0	0	9	2.2
ISCED 5=Short cycle tertiary	4	10	2	4	3	0	23	5.6
ISCED 6=Bachelor's degree	5	5	3	6	4	1	24	5.8

ISCED 7=Master's degree	0	2	0	0	0	1	3	0.7
Estimated daily family income								
Absolute poverty (< $1.90/day)	17	19	7	27	21	18	109	26.3
Lower middle income ($1.90–3.20/d)	12	29	14	17	23	22	117	28.2
Upper middle income ($3.20–5.50/d)	18	28	10	15	19	10	100	24
High income (>$5.50/day)	12	24	11	18	12	12	89	21.5
Residency								
Urban	43	71	23	49	30	19	235	56.6
Rural	16	29	19	28	45	43	180	43.4
Cardiac disease in the family								
Yes	0	3	0	0	2	1	6	1.4
No	59	97	42	77	73	61	409	98.6
Suspected/confirmed genetic/syndromic disorders								
Yes	18	30	12	18	5	2	85	20.5
No	41	70	30	59	70	60	330	79.5

Relative Prevalence of Cardiac Defects and Diseases

Congenital heart defects account for 67.5% of all Pediatric heart diseases and only 30.6% exhibit acquired heart diseases. 76.4% of all children with acquired heart diseases have rheumatic heart disease. Of all the congenital heart defects, 72.5% constitute acyanotic CHDs and the remaining 23.6% were cyanotic. Twenty five percent of acyanotic CHDs had isolated ventricular septal defect followed by isolated patent ductus arteriosus, 13.8%; isolated atrioventricular septal defect atrial septal defect, 11.3%; and isolated atrial septal defect, 10.3%. TOF (36.4%) was the leading cyanotic CHD followed by d-TGA, 16.7%; tricuspid atresia, 16.7%; and DORV, 12.1%. **Table 2** illustrates the relative frequency of various pediatric heart diseases.

Table 2: The relative frequency of pediatric heart diseases: Bahir Dar University Tibebe-Ghion specialized teaching hospital, June 2019-February 2024.

Heart diseases category	Total	Heart diseases category	Total
Acyanotic congenital heart diseases	203	Double Outlet Right Ventricle (DORV)	8
ASD, isolated	21	DORV-VSD type	1
VSD, total	50	DORV-TOF type	3
PDA, isolated	28	DORV-TGA type (Taussig-Bing anomaly)	1

AVSD, isolated	23	DORV with non-committed VSD	1
Pulmonary stenosis, isolated	9	DORV-AVSD-PS hetrotaxy	2
ASD+VSD	11	Truncus arteriosus	3
ASD+PDA	9	Ebstein Anomaly (Isolated and combined)	4
ASD+PS	5	Other cyanotic CHDs (less common)	5
ASD+AVSD	7	Minor CHD+Pulmonary HTN	4
VSD+PDA	7	Pulmonary hypertension, isolated	11
VSD+RVOTO	3	Persistent pulmonary hypertension of the newborn	4
Others with two combined defects	10	Mixed lesion	7
≥ Three acyanotic CHDs	11	CHD+CRVHD	4
Coarctation of aorta	2	CHD+Pericardial disease	1
Other acyanotic CHDs	6	CHD+Myocardial disease	2
S/P surgical ASD and PDA closure	1	Acquired heart diseases	120
Cyanotic congenital heart diseases	66	Rheumatic heart disease	93
Tetralogy of fallot	24	RHD without rheumatic recurrence	17
d-TGA	11	RHD with rheumatic recurrence	54
d-TGA with intact/Restrictive VSD	3	Clinical ARF with carditis	14
d-TGA with adequate mixing	4	Subclinical ARF with carditis	7
d-TGA+VSD+LVOTO	4	Borderline/Stage A RHD	1
Tricuspid atresia	11	Pericardial disease	6
Tricuspid atresia type I	6	Cardiomyopathy	10
Tricuspid atresia type II	2	Myocarditis	5
Tricuspid atresia type III	3	Other acquired heart diseases	6
		Total	415

Presenting Complaints and Clinical Signs of Children with Heart Diseases

Respiratory distress was the most common presenting complaint (65%) followed by cough (53%), dyspnea on exertion (49%) and diaphoresis (40%). See details in **Table 3**.

Table 3: Presenting complaints of children with heart diseases: Bahir Dar University Tibebe-Ghion specialized teaching hospital, June 2019-February 2024.

Heart disease category	Presenting complaint of children with heart diseases													
	RD	Chest pain	DOE	FTT	Cough	Diaphoresis	Anorexia	Abdominal Distension	Lower limb swelling	Cyanosis	Chest Deformity	Orthopnea	PND	Palpitation
Acyanotic CHD	129	6	73	73	97	88	34	10	10	11	14	7	4	5
Cyanotic CHD	42	5	33	23	32	30	20	4	4	47	10	6	5	0
Acquired heart diseases	73	30	83	26	72	35	56	16	40	2	40	59	44	28
RHD	53	22	66	20	53	23	46	11	29	0	37	52	39	28
Myocarditis	4	1	3	2	3	2	1	1	1	1	1	0	0	0
Pericardal diseases	5	3	3	1	5	4	3	1	2	1	0	2	2	0
Cardio-myopathes	9	1	5	3	8	4	2	1	4	0	1	3	3	0
Other AHD	2	3	6	0	3	2	4	2	4	0	1	2	0	0
Isolated PHT	9	0	8	4	9	6	5	0	2	4	1	0	0	0
PPHTN	4	0	1	0	1	2	1	0	0	2	0	0	0	0
Minor CHD +severe PHT	4	0	0	3	4	3	1	0	0	1	0	0	0	0
Mixed heart lesions	7	2	7	3	5	3	5	0	3	0	1	3	3	2
Total	268	43	205	132	220	167	122	30	59	67	66	75	56	35

%	64.6	10.4	49.4	31.8	53	40.2	29.4	7.2	14.2	16	15.9	18	13.5	8.4

Note: AHD: Acquired Heart Diseases; CHD: Congenital Heart Defect; DOE: Dyspnea on Exertion; FTT: Failure to Thrive; PHT: Pulmonary Hypertension; PND: Paroxysmal Nocturnal Dyspnea; PPHTN: Persistent Pulmonary Hypertension of the Newborn; RD: Respiratory Distress; RVHD: Rheumatic Valvular Heart Disease.

Cardiac murmur (83%) was the most common clinical finding followed by hepatomegaly (41%), and dyspnea at rest (37%). See details in **Table 4**.

Table 4: Clinical signs of children with heart diseases at presentation: Bahir Dar University Tibebe-Ghion specialized teaching hospital, June 2019-January 2024.

Heart diseases category	Clinical signs of children with heart diseases at presentation															
	Murmur	Dyspnea at rest	Hepato-megaly	Distended jugular vein	Cyanosis	Muffled heart sound	Split S2	Accentuated S2	Dysrhythmia	Lower limbedema	Bulged precordium	Ascites	Facial deformity	Friction rub	Clubbing	Others
Acyanoict CHD	178	50	64	6	11	34	19	33	18	6	17	2	45	0	1	4
Cyanotic CHD	58	28	19	3	54	14	4	6	7	3	10	0	5	0	9	1
Acquired heart diseases	88	63	67	26	3	31	7	21	17	32	40	8	4	6	1	7
RVHD	85	50	48	20	1	26	7	21	14	23	37	4	1	2	0	6
Myocarditis	0	3	4	1	1	0	0	0	2	1	1	1	2	0	0	0
Pericardial diseases	0	4	4	2	1	5	0	0	0	2	1	1	1	3	1	1

Cardio-myopathies	0	4	8	2	0	0	0	0	0	2	0	1	0	0	0	0
Other AHD	3	2	3	1	0	0	0	0	1	4	1	1	0	1	0	0
Isolated PHT	5	4	8	5	4	1	3	6	0	2	1	1	3	0	0	0
PPHTN	3	2	1	0	3	0	1	2	2	0	0	0	0	0	0	0
Minor CHD+ +Severe PHT	4	2	4	0	1	0	0	4	0	0	0	0	2	0	0	0
Mixed Cardiac lesions	7	6	6	2	0	2	2	4	3	2	2	0	1	0	0	0
Total	343	155	169	42	76	82	36	76	47	45	70	11	60	6	11	12
%	83	37	41	10	18	20	9	18	11	11	17	2.5	14	1.5	2.5	3

Note: AHD: Acquired Heart Diseases; CHD: Congenital Heart Defect; PHT: Pulmonary Hypertension; PPHTN: Persistent Pulmonary Hypertension of the Newborn; RVHD: Rheumatic Valvular Heart Diseases

Epidemiology of Congestive Heart Failure and Pulmonary Hypertension

Congestive heart failure was documented in 202/415(49%) of all children with heart lesions. 57% and 34% of all children with heart failure has Ross class IV and class III heart failure respectively making a cumulative of 44% all children with heart lesions. Children with acquired heart diseases have the highest proportion of heart failure in our study (70%) (**Table 5**).

Table 5: Profile of congestive heart failure in children with heart diseases: Bahir Dar University Tibebe-Ghion specialized teaching hospital, June 2019-February 2024

Pediatric heart diseases category	ROSS congestive heart failure classification						Total heart disease	% heart failure
	ROSS–I	ROSS–II	ROSS–III	ROSS–IV	Heart failure	No heart failure		
Acyanotic CHD	0	9	34	34	77	126	203	37.9
Cyanotic CHD	0	0	7	15	22	44	66	33.3
Acquired heart diseases	3	5	23	53	84	36	120	70

Rheumatic heart diseases	2	5	16	39	62	31	93	66.7
Myocarditis	0	0	0	4	4	1	5	80
Pericardial disease	1	0	1	2	4	2	6	66.7
Cardiomyopathies	0	0	4	6	10	0	10	100
Other acquired heart diseases	0	0	2	2	4	2	6	66.7
Isolated PHT	0	0	3	3	6	5	11	54.5
PPHTN	1	0	0	1	2	2	4	50
Minor CHD +Severe PHT	0	1	0	3	4	0	4	100
Mixed cardiac lesions	0	0	1	6	7	0	7	100
Total	4	15	68	115	202	213	415	48.7
% from total heart failure	2	7.4	33.7	57	48.7	51.3		

Note: PHT: Pulmonary Hypertension; PPHTN: Persistent Pulmonary Hypertension of the Newborn

In our study, 133/415 (32%) of children with heart lesions had pulmonary hypertension of various range and type. Of all children with pulmonary hypertension, 62% had severe pulmonary hypertension (**Table 6**).

Table 6: Relative frequency and grading of pulmonary hypertension in children with heart diseases: Bahir Dar University Tibebe-Ghion teaching hospital, June 2019-January 2024

Heart disease category	Pulmonary hypertension grading					Total heart diseases	Total PHT	% PHT
	Mild	Moderate	Severe	No PHT	No grading			
Acyanotic CHD	6	22	27	141	7	203	55	27
Cyanotic CHD	0	2	7	57	0	66	9	13.6
Acquired heart diseases	8	11	25	76	0	120	44	36.7
Rheumatic heart diseases	7	11	25	50	0	93	43	46.2
Myocarditis	0	0	0	5	0	5	0	0
Pericardial diseases	0	0	0	6	0	6	0	0

Cardiomyop athies	0	0	0	10	0	10	0	0
Other AHD	1	0	0	5	0	6	1	16.7
Isolated PPHT	0	1	10	0	0	11	11	100
PPHTN	0	1	3	0	0	4	4	100
Minor CHD +Severe PHT	0	0	4	0	0	4	4	100
Mixed cardiac lesions	0	0	6	0	1	7	6	85.7
Total	14	37	82	274	8	415	133	32
% from total PHT	10.5	27.8	61.8				32	

Note: PHT: Pulmonary Hypertension; PPHTN: Persistent Pulmonary Hypertension of the Newborn. No grading doesn't mean "no PHT". AHD: Acquired Heart Diseases

DISCUSSION

Our analysis has shown a snapshot of a very important piece of information regarding the current patterns and clinical presentations of cardiac diseases in children. Among all the children with cardiac disease enrolled to the study, 67.5% had congenital cardiac defects and only 30.6% had acquired heart disease. This finding enlightens the emergence of congenital heart defects as the leading cause of pediatric heart diseases in LMICs [5].

Acyanotic congenital heart defects account for 72.5% of all congenital heart defects making the proportion of cyanotic congenital heart defects to be 23.6%. Isolated ventricular septal defect was the most common acyanotic CHD followed by isolated patent ductus arteriosus, atrioventricular septal defect and atrial septal defect respectively. Tetralogy of Fallot was the most common acyanotic CHD comprising 36.4% of all cyanotic CHDs followed by d-TGA, tricuspid atresia and DORV. Rheumatic heart disease is the most common acquired heart disease. This finding is in line with other studies elsewhere in the world.

Our study revealed respiratory distress (65%) as the most common clinical presentation and cardiac murmur (83%) as the most common clinical sign in children with heart diseases.

Congestive heart failure was found in 37.9%, 33.3% and 70 % of children with acyanotic, cyanotic and acquired heart diseases respectively. Forty four percent of all children with heart diseases had developed congestive heart failure. These findings were in line with the findings from LMICs but far higher compared to reports from High Income Countries (HICs). This is explained, in part, by the fact that children in LMICs with heart diseases have less access to medical and surgical care, sub–optimal medical care, lower family awareness on pediatric cardiac diseases, and less due attention in the national policy; all leading to delayed presentation, intervention and its consequences, congestive heart failure, pulmonary hypertension and the ultimate death.

Thirty two percent of all the studied children had pulmonary hypertension with nearly 90% of them being higher grade (moderate and severe pulmonary hypertension). Twenty seven percent, 13.6% and 36.7% of children with acyanotic, cyanotic and acquired heart diseases exhibit pulmonary hypertension respectively. This findings were consistent with reports from LMICs and far more higher than reports from HICs. This finding is substantiated by sub-optimal care, difficulty health services access and lower awareness level in the community, health care providers and beyond.

CONCLUSION

The proportion of congenital heart defects in the paediatric population is rising. Respiratory distress and cardiac murmur are the most common presenting complaint and clinical finding of children with heart diseases respectively. Significant proportion of children with heart diseases are presenting with congestive heart failure and pulmonary hypertension.

LIMITATIONS

This study is a descriptive cross sectional hospital based study. Hence, generalizability is limited as it is only descriptive and doesn't represent the whole population.

RECOMMENDATIONS

As the challenges of providing optimal care for a child with heart disease are unparalleled; reflected by the relatively high

proportion of heart failure and pulmonary hypertension, a lot more needs to be done on awareness creation, access and optimal timely management of children with heart diseases. Early diagnosis and prevention of these deadly complications requires sensitization of the community and the health work force and awareness creation to the policy makers on pediatric heart diseases.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board of Bahir Dar University College of Medicine and Health Sciences without comments (protocol number: 861/2023). We obtained verbal consent from the participants and/or caregivers.

CONSENT FOR PUBLICATION

Not Applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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