Clinical Characteristics and Valve Lesions in Rheumatic Heart Disease Among Children at Hiwot Fana Comprehensive Specialized Hospital: A Comparative Study of Newly Diagnosed and Known Cases

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Abstract

Background. Rheumatic heart disease remains a significant health burden in resource-limited settings. This study investigated the clinical characteristics and valve lesion patterns of RHD in children from Eastern Ethiopia, comparing newly diagnosed and known RHD patients. *Objective.* This study aimed to characterize the clinical features and valve lesion patterns in children with Rheumatic heart disease and provide a comparative analysis between newly diagnosed and known cases. *Methods.* A hospital-based cross-sectional study was conducted at Hiwot Fana Comprehensive Specialized Hospital from January 1 to December 31, 2021. A total of 39 children with RHD were included, with data collected from medical records, clinical assessments, and echocardiographic evaluations. Descriptive statistics and chi-square tests were used for analysis. *Results.* Among the 39 children studied, 25 were newly diagnosed and 14 were known RHD cases. The majority were female (71.8%). The median age was 10 years. Shortness of breath (53.9%) and cough (38.5%) were the most common presenting complaints. Only 14.3% of known RHD patients were adherent to secondary prophylaxis. Severe acute malnutrition and severe anemia were the most common comorbidities. Class IV heart failure was present in 89.7% of the patients. Echocardiographic findings revealed that all patients had mitral valve involvement, with mitral regurgitation (94.9%) being the most frequent. *Conclusion.* This study revealed that rheumatic diseases in children in Eastern Ethiopia present at advanced stages. Low adherence to secondary prophylaxis and high rates of severe heart failure highlights the consequences of delayed diagnosis and management. These findings underscore the urgent need for better healthcare infrastructure, enhanced prevention programs, and improved strategies to increase prophylaxis adherence to prevent disease progression and improve outcomes for affected children.

Keywords

rheumatic heart disease, clinical characteristics, valve lesions, comparative analysis, eastern Ethiopia

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Introduction

Background

Rheumatic heart disease (RHD) remains a significant public health threat, particularly for children in developing countries like Ethiopia. It is a debilitating condition primarily affecting the heart valves, particularly the mitral and aortic valves, resulting from acute rheumatic fever

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(ARF), a complication of untreated streptococcal pharyngitis.[1] The global burden of RHD is immense, with developing nations disproportionately affected due to factors like poverty, overcrowding, and limited access to healthcare.[2-9] In children, RHD can hinder growth and development, making early diagnosis and intervention crucial.[10]

Despite the substantial national burden of RHD, particularly in Ethiopia's Eastern region, there is a scarcity of studies exploring the clinical characteristics and patterns of valve lesions in children. This study aimed to address this critical knowledge gap. The lack of understanding concerning the specific clinical features and valve lesion patterns in this population hinders the development of tailored interventions, early detection, and optimal management of RHD.

Furthermore, a comparative analysis of the clinical characteristics and patterns of valve lesions in newly diagnosed and known RHD groups will help identify potential gaps in the prevention and management of the disease, whether due to delayed diagnosis or subsequent management issues. Therefore, this study aimed to comprehensively characterize the clinical features and valve lesion patterns in children with RHD and provide a comparative analysis of these conditions in newly diagnosed and known cases.

Methods and Materials

Study Area, Design, and Period

A hospital-based cross-sectional study design was used to prospectively study children admitted from January 1 to December 31, 2021, to the pediatric ward and pediatrics ICU of Hiwot Fana Comprehensive Specialized Hospital (HFCSH) who were diagnosed with RHD. HFCSH, Haramaya University's tertiary teaching hospital, is located in Harar and serves 5.8 million people, including the populations of the Harari Region, Diredawa City Administration, Somali Region, and the Eastern Hararghe Zone of Oromia Regional State. At HFCSH, the pediatric ward and ICU accommodate 30 beds (6 in PICU and 24 in the pediatric ward) with about 640 total admissions per year, among which approximately 72 had an RHD diagnosis (Health Management Information System data, 2019; unpublished).

Patient Involvement

Patients were not directly involved in the design of this study.

Population

Using a prevalence (P) of 50%, a 95% confidence level, and a 5% (0.05) margin of error (d), the sample size for our study was initially determined to be 384 participants using the OpenEpi program. During the study period, 67 children with RHD were admitted to the pediatric unit, representing 9.9% of the total 678 admissions. To enhance the representativeness of our data and maximize our sample size within the constraints of the available population, we chose to include all 67 children with RHD, ensuring that our findings more accurately reflect the actual clinical scenario, given the relatively small number of eligible patients.

After excluding 21 repeat admissions and 7 cases where adequate information could not be obtained, the study focused on 39 children with RHD admitted to the pediatric ward and pediatric ICU of HFCSH from January 1 to December 31, 2021 (Figure 1).

Data Collection Methods and Quality Control

A comprehensive review of medical records for children with rheumatic heart disease (RHD) admitted to the pediatric ward and ICU at Hiwot Fana Comprehensive Tertiary Teaching Hospital between January 1 and December 31, 2021, was conducted. The review included demographic information, clinical history, presenting symptoms, laboratory results, chest X-ray findings, and echocardiography reports.

An experienced team of pediatricians and cardiologists conducted standardized clinical assessments on each enrolled child (n=39) from January 1 to December 31, 2021. These assessments included a thorough physical examination for cardiac symptom evaluation, vital sign measurement, and collection of additional clinical data.

Pediatric cardiologists performed echocardiographic assessments adhering to standardized protocols to identify valve lesions and their characteristics during the same period (January 1-December 31, 2021). Additionally, laboratory data (complete blood count, ESR, and creatinine), chest X-ray, and ECG were obtained.

The data collection tool was developed specifically for this study to align with the objectives and variables. While the tool was not based on validated scales, it was piloted on 2 RHD patients in the Jugol Hospital pediatric ward to assess its consistency, completeness, and ease of understanding.

Two days of training were given to both the data collectors and supervisor. The principal investigator closely monitored the data collection process to ensure completeness, accuracy, and data collection consistency. During sessions, thorough checking was done before analyzing the filled questionnaires. Two separate individuals conducted double data entry. When any gap was identified, it was communicated with data collectors daily. Following data entry, the dataset was
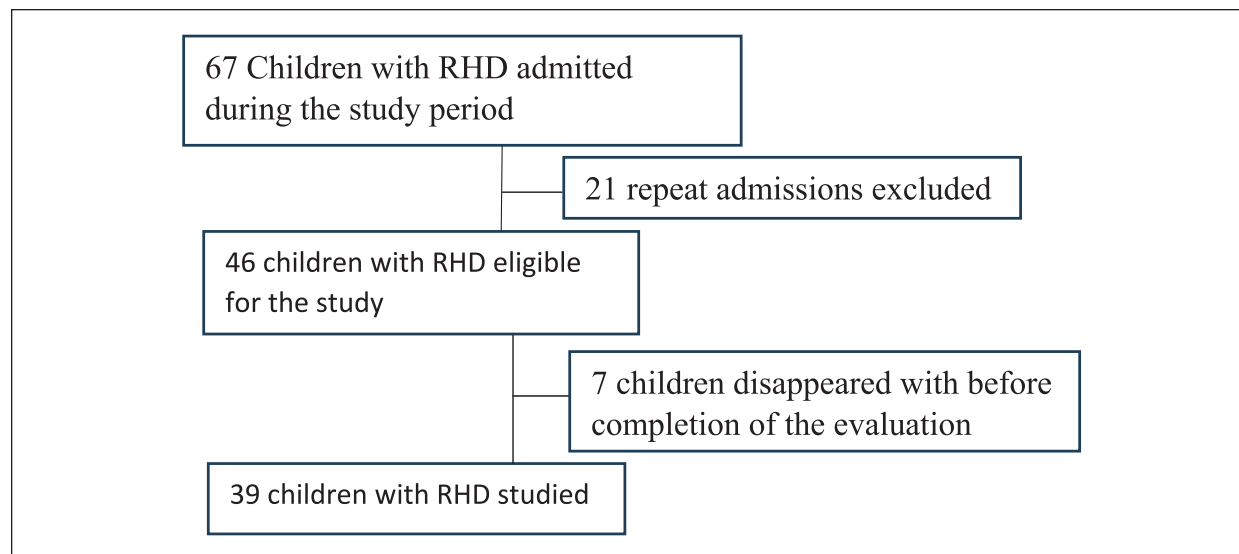
Figure 1. Patient selection procedure.

reviewed for completeness and any missing data points were addressed.

Data Processing and Analysis

After data collection, each questionnaire was checked thoroughly for completeness. The data was then coded using a standardized coding scheme and double-entered into EpiData version 3.1. Subsequently, the data was transferred to Stata version 14.2 for statistical analysis.

Descriptive statistics, including frequency, proportions, means, and standard deviation were computed. Chi-square tests were used to identify any association between RHD status and dependent variables. Due to the small sample size, Fisher's exact method was also employed.

Ethical Approval and Informed Consent

To ensure ethical conduct throughout the research process, approval was obtained from the Haramaya University College of Health and Medical Sciences Institutional Health Research Ethical Review Committee (reference number: IHRERC/245/2020). The study was conducted in strict accordance with the principles outlined in the 1964 Declaration of Helsinki.

Following the ethical approval process, written permission for data access was obtained from the hospital managers/medical directors of Hiwot Fana Comprehensive Specialized Hospital. To safeguard patient privacy, the study utilized anonymized data throughout the analysis. This approach ensured that researchers did not have access to any personally identifiable information

(PII) such as medical record numbers, phone numbers, or patient names.

Since data was collected from medical charts, consent from parents/guardian was not needed.

Result

Baseline Characteristics

During the study period, a total of 67 children with RHD were admitted. However, 21 were repeat admissions, and 7 disappeared before completing the evaluation. Therefore, 39 children with RHD were enrolled in the study (Figure 1).

Fourteen children had a known diagnosis of RHD, and 25 were newly diagnosed. The majority (71.8%, n=28) were females, while the remaining participants (28.2%, n=11) were males. Among the 25 newly diagnosed cases, 18 (72%) were female and 7 (28%) were male. Among the 14 known RHD cases, 10 (71.4%) were female and 4 (28.6%) were male (Figure 2).

The median age of the children was 10 years with an IQR of 4. In newly diagnosed RHD cases, the median age was 10 with an IQR of 5, while in known RHD cases, the median age was 10.5 with an IQR of 4. There is no statistically significant difference in the mean age between children with newly diagnosed RHD and those with known RHD, as indicated by the t-test (two-tailed P-value=.29).

Clinical Characteristics

Shortness of breath (53.9%) was the most frequent presenting complaint, followed by cough (38.5%). When
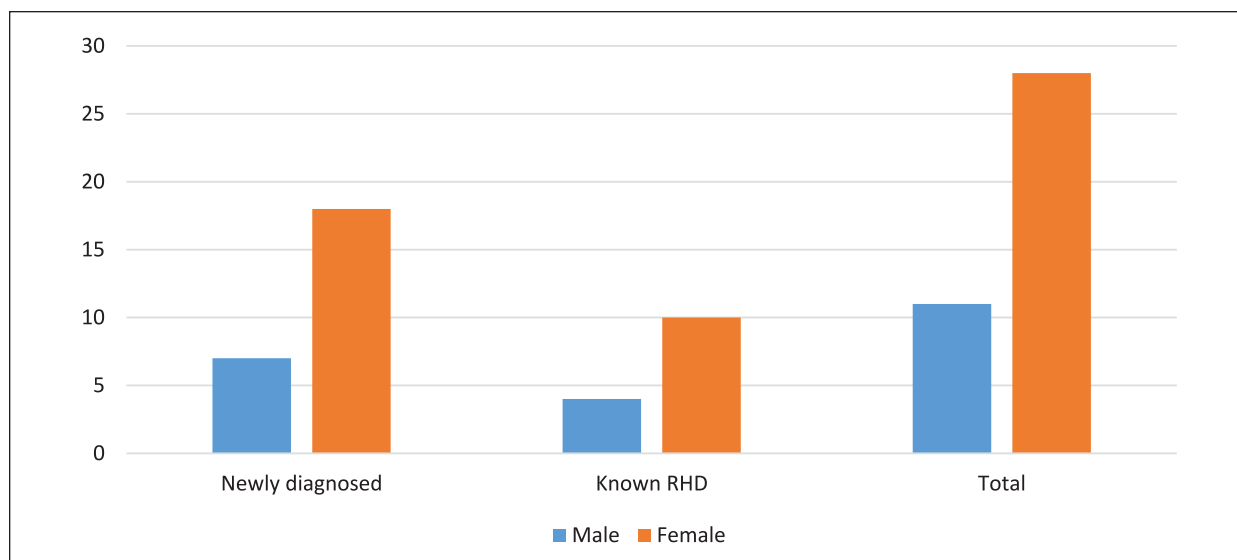
Figure 2. Sex of children admitted with diagnosis of RHD at HFCSH.

Table 1. Clinical Characteristics of Children Diagnosed With RHD at HFCSH.

	RHD status		
	New (N=25)	Known (N=14)	Total (N=39)
Clinical characteristics	Freq (%)	Freq (%)	Freq (%)
Cough	10 (40)	5 (35.71)	15 (38.46)
Shortness of breath	12 (48)	9 (64.29)	21 (53.85)
Other	3 (12)	0 (0)	3 (7.69)
Class IV HF	23 (92)	12 (85.7)	35 (89.7)
Rheumatic fever	1 (4)	3 (21.4)	4 (10.3)

comparing presenting complaints between new and known RHD patients, 12 (48%) of the newly diagnosed RHD patients presented with shortness of breath, and 10 (40%) presented with a cough. In the known RHD patient group, 9 (64.2%) presented with shortness of breath, and 5 (35.7%) presented with a cough (Table 1).

A significant proportion of patients (35 out of 39, or 89.7%) presented with Class IV Heart Failure upon admission. Among these 35 patients, 23 were newly diagnosed cases of RHD, while 12 were known RHD cases (Table 1).

Among patients admitted with class IV heart failure (HF), pneumonia was the most frequently identified trigger, affecting 20% (7 patients). Rheumatic fever was identified in 11% (4 patients), and infective endocarditis was confirmed or suspected in 14% (5 patients).

Of the 4 (10.3%) rheumatic fever cases among 39 RHD patients, 1 (4% of the group) occurred in the Newly diagnosed RHD patients, whereas 3 (21.4% of the group) occurred in the Known RHD patients (Table 1).

Among the 14 children with a known diagnosis of RHD, only 2 (14.3%) were adherent to secondary prophylaxis, while 6 (42.9%) were non-adherent, and the remaining 6 (42.9%) had never taken prophylaxis (Figure 3).

Ten (25.6%) children had at least one comorbidity. The most frequent comorbidities were severe acute malnutrition (5; 12.8%) and severe anemia (Hb < 7 g/dl; 5; 12.8%). Among the newly diagnosed group, 7 had comorbidities, with 3 cases of severe acute malnutrition and 4 cases of severe anemia. Among the 14 known RHD group, 3 had comorbidities, including 2 cases of severe acute malnutrition and 1 case of severe anemia (Figure 4).

Physical Examination and Chest X-Ray Findings

The median pulse rate was 116 beats per minute (bpm) with an IQR of 21 bpm. In the newly diagnosed RHD group, the median pulse rate was 115 bpm with an IQR
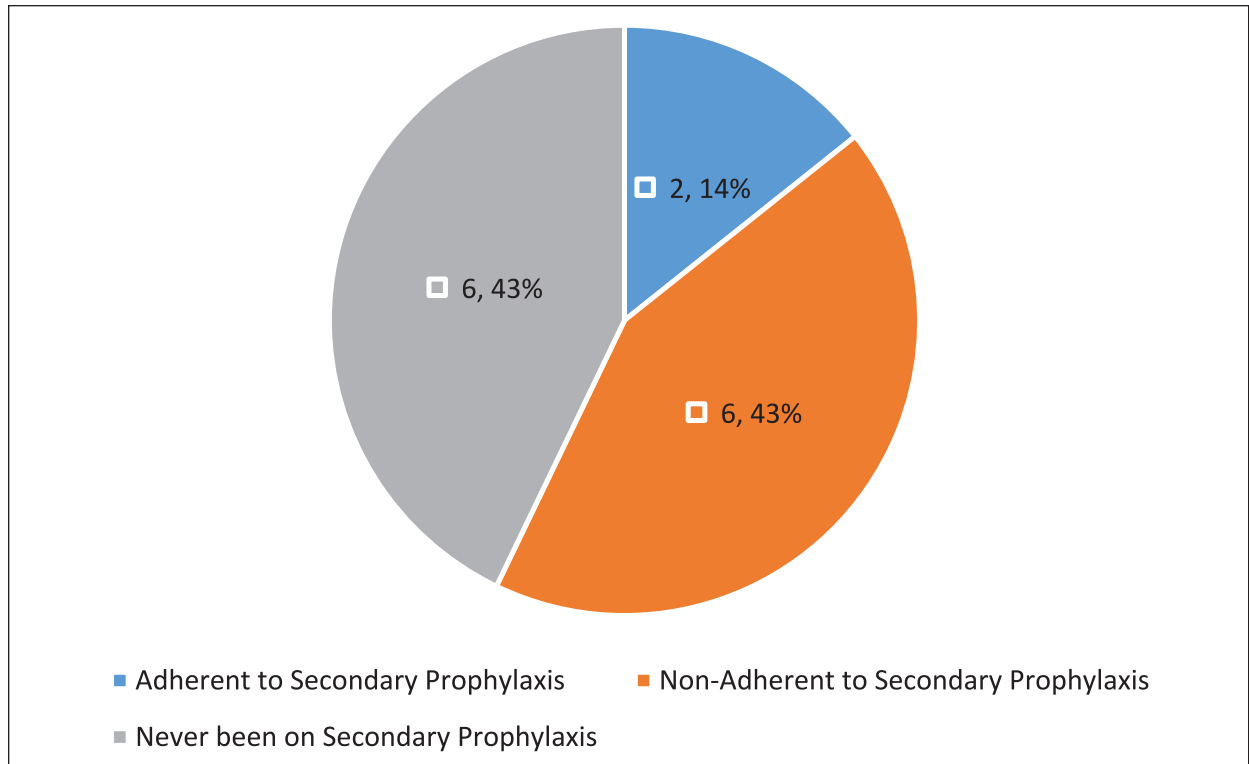
Figure 3. Adherence of known RHD patients at HFCSH to secondary prophylaxis.
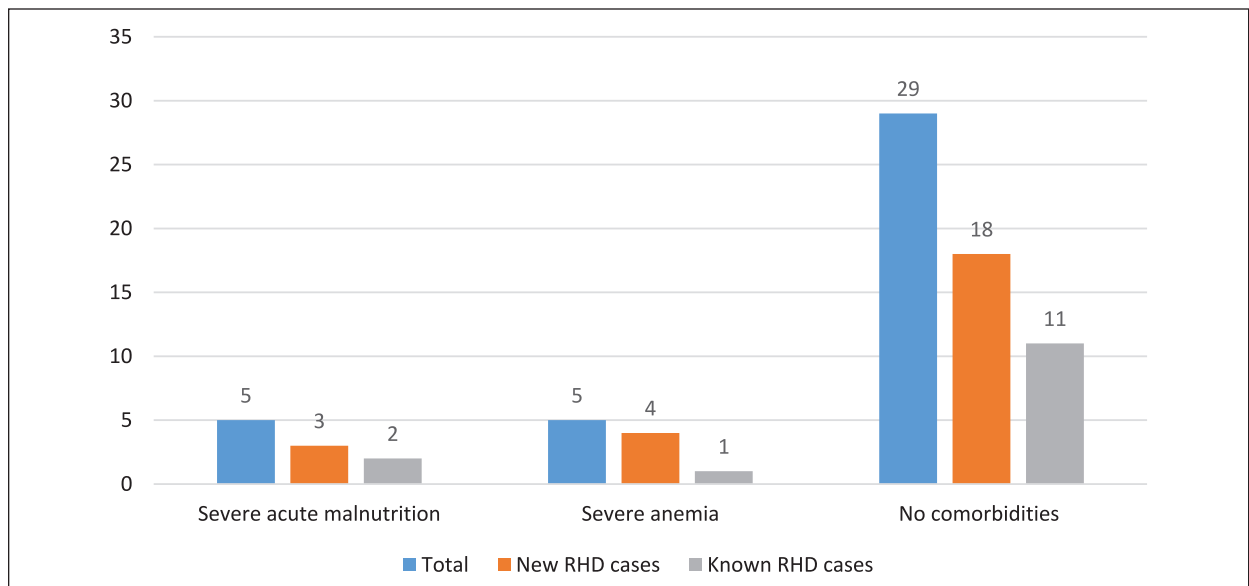
Figure 4. Comorbidities in children with RHD admitted to HFSCH.

of 24 bpm, whereas in the known RHD group, the median pulse rate was 120 bpm with an IQR of 16 bpm.

The median respiratory rate was 36 bpm with an IQR of 22 bpm. In the newly diagnosed RHD group, the median respiratory rate was 36 bpm with an IQR of

18 bpm, whereas in the known RHD group, the median respiratory rate was 36 bpm with an IQR of 24 bpm.

The median body temperature was 36.9°C with an IQR of 0.9°C. In the newly diagnosed RHD group, the median temperature was 36.9°C with an IQR of 0.4°C,

Table 2. Vital Sign and BMI Distribution of Children With RHD Admitted to HFCSH.

Vital sign and BMI	New RHD (N = 25) (Median, IQR)	Known RHD (N = 14) (Median, IQR)	Total (N = 39) (Median, IQR)
Pulse rate in beats per min	115, 24	120, 16	116, 21
Respiratory rate breath/min	36, 18	36, 24	36, 22
Temperature in °C	36.9, 0.4	37, 1.3	36.9, 0.9
Saturation in %	96, 5.5	93.5, 5	95.5, 5
BMI in kg/m^2	14, 2.7	12.9, 2.6	13.85, 2.9

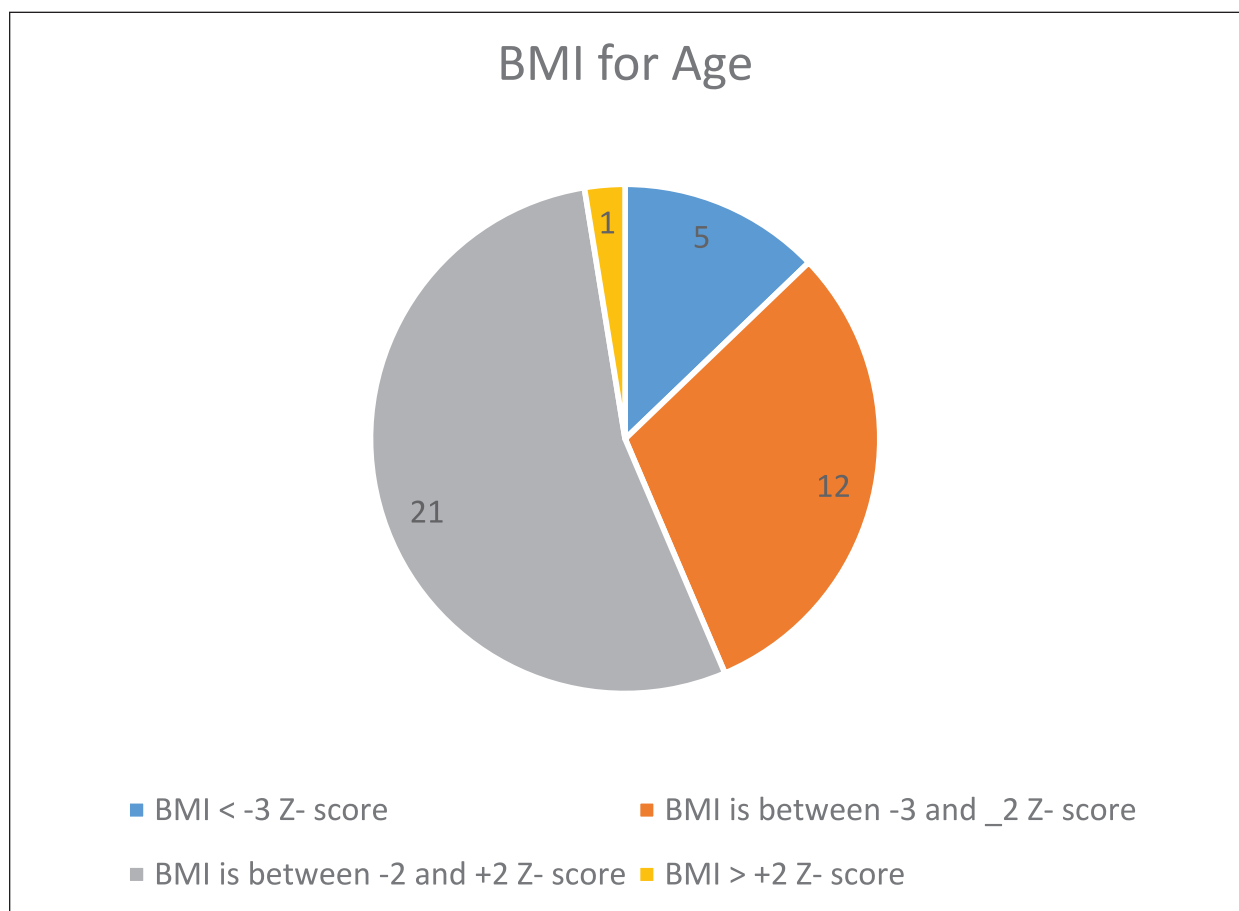**Figure 5.** BMI for age distribution of children with RHD admitted to HFCSH.

whereas in the known RHD group, the median temperature was 36.95°C with an IQR of 1.3°C.

The median oxygen saturation on room air was 95.5% with an IQR of 5%. In the newly diagnosed RHD group, the median oxygen saturation was 96% with an IQR of 5.5%, whereas in the known RHD group, the median was 93.5% with an IQR of 5%.

The median body mass index (BMI) was 13.85 kg/m² with an IQR of 2.9 kg/m². In the newly diagnosed RHD group, the median BMI was 14 kg/m² with an IQR of 2.7 kg/m², whereas in the known RHD group, the median BMI was 12.9 kg/m² with an IQR of 2.6 kg/m² (Table 2).

According to WHO Z-scores for age, 5 (12.8%) children were severely wasted (<-3 Z-score), 12 (30.8%) were moderately wasted (-3 to -2 Z-score), 21 (53.8%) had normal weight (-2 to $+2$ Z-score), and 1 (2.6%) was overweight ($>+2$ Z-score) (Figure 5).

At least one abnormal chest examination finding was present in 24 (61.5%) children. The most common findings were crepitations (41.0%), decreased or absent air entry (39.5%), dullness (39.5%), and wheezing (9.3%).

The point of maximal impulse (PMI) was displaced downward and to the left in 28 (71.8%) children, while it was in the normal position in 9 (23.1%) and on the left

Table 3. Physical Examination and Chest X-Ray Findings of Children With RHD Admitted to HFCSH.

Characteristics	Category of the findings	Frequency (%)
Chest findings		
	At least one chest finding	24 (61.54)
	Crepitation	16 (41.03)
	Decreased or absent air entry	17 (39.53)
	Dullness	17 (39.53)
	Wheezing	4 (9.30)
Point of maximum impulse		
	Normal position	9 (23.08)
	On left lower sternal	2 (5.13)
	Deviated to left and/or downward	28 (71.79)
Apical heave		
	Yes	24 (61.54)
	No	15 (38.46)
Parasternal heave		
	Yes	22 (56.41)
	No	17 (43.59)
S3 gallop		
	Yes	5 (12.82)
	No	34 (87.18)
Chest X-ray finding		
	Left atrial enlargement	31 (86.1)
	Cardiomegaly	29 (80.6)
	Pulmonary edema	9 (26.5)
	Pulmonary arterial hypertension	11 (36.7)
	Pleural effusion	8 (24.2)
	Pneumonia	7 (21.2)

lower sternal border in 2 (5.1%). Apical heave (61.5%) and parasternal heave (56.4%) were the most frequent abnormal cardiac examination findings. P2 heart sound was accentuated in 28 (77.8%) children. A third heart sound (S3 gallop) was present in 5 (12.8%) children. Almost all children (97.4%) had a significant murmur on cardiac auscultation.

Chest X-ray revealed abnormal findings in a significant proportion of participants. Left atrial enlargement was the most frequent abnormality, observed in 86.1% (31) of patients. Other findings included cardiomegaly (80.6%), pulmonary edema (26.5%), signs suggestive of pulmonary arterial hypertension (PAH; 36.7%), and pleural effusion (24.2%) (Table 3).

Laboratory Findings

The median hemoglobin (Hb) concentration was 10.3 g/dl with an IQR of 3.5 g/dl. In the newly diagnosed RHD group, the median Hb concentration was 10.2 g/dl with an IQR of 2.8, whereas in the known RHD group, the median Hb concentration was 11.35 g/dl with an IQR of 4.

The median erythrocyte sedimentation rate (ESR) was 40 mm/hour with an IQR of 40 mm/hour. In the newly diagnosed RHD group, the median ESR was 35 mm/hour with an IQR of 35 mm/hour, whereas in the known RHD group, the median ESR was 45 mm/hour with an IQR of 35 mm/hour.

The median serum creatinine level was 0.4 mg/dl with an IQR of 0.2 mg/dl. In the newly diagnosed RHD group, the median serum creatinine level was 0.4 mg/dl with an IQR of 0.1 mg/dl, whereas in the known RHD group, the median was 0.4 mg/dl with an IQR of 0.6 mg/dl.

Echocardiographic Findings in RHD Patients

Echocardiography revealed significant valvular involvement in a vast majority of patients with RHD. All 39 patients showed evidence of mitral valve involvement. The most frequent finding was mitral regurgitation (MR), present in 37 patients (94.9%). MR was found in 23 patients (92%) in the New RHD group and all 14 patients (100%) in the Known RHD group. The severity of MR varied: 3 patients (7.7%) had mild MR, 7 patients

Table 4. Pattern of Valve Lesions Among Children With RHD Admitted to HFCSH.

	RHD category		
	New (N = 25)	Known (N = 14)	Total (N = 39)
Valve lesion	Freq (%)	Freq (%)	Freq (%)
Mitral regurgitation			
No	2 (8)	0 (0)	2 (5.13)
Mild	2 (8)	1 (7.14)	3 (7.69)
Moderate	5 (20)	2 (14.28)	7 (17.95)
Severe	16 (64)	11(78.57)	27 (69.23)
Mitral stenosis (MS)			
No	12 (48)	5 (35.71)	17 (43.59)
Mild	4 (16)	5 (35.71)	9 (23.08)
Moderate	5 (20)	1 (7.14)	6 (15.38)
Severe	4 (16)	3 (21.43)	7 (17.95)
Aortic regurgitation			
No	9 (36)	4 (28.6)	13 (33.3)
Mild	9 (36)	5 (35.7)	14 (35.9)
Moderate	7 (28)	4 (28.6)	11(28.2)
Severe	0 (0)	1 (7.1)	1 (2.6)
Aortic stenosis			
No	24 (86)	14 (100)	38 (97.4)
Mild	0 (0)	0 (0)	0 (0)
Moderate	0 (0)	0 (0)	0 (0)
Severe	1 (4)	0 (0)	1 (2.6)
Pulmonic valve lesion			
No	21 (84)	11 (78.6)	32 (82.1)
Regurgitation	4 (16)	3 (21.4)	7 (17.9)
Stenosis	0 (0)	0 (0)	0 (0)

(17.9%) had moderate MR, and 27 patients (69.2%) had severe MR. Specifically, in the New RHD group, 2 patients (8%) had mild MR, 5 patients (20%) had moderate MR, and 16 patients (64%) had severe MR; whereas in the Known RHD group, 1 patient (7.14%) had mild MR, 2 patients (14.28%) had moderate MR, and 11 patients (78.57%) had severe MR. (Table 4).

Mitral stenosis (MS) was identified in a subset of patients (22 out of 39, 56.4%), with 13 patients in the New RHD group and 9 in the Known RHD group. The severity of MS also varied: 9 patients (23.1%) had mild MS, 6 patients (15.4%) had moderate MS, and 7 patients (17.9%) had severe MS. In the New RHD group, 4 patients had mild MS, 5 had moderate MS, and 4 had severe MS; whereas in the Known RHD group, 5 patients had mild MS, 1 had moderate MS, and 3 had severe MS.

Twenty patients (51.3%) had both MR and MS concurrently, while 2 patients (5.1%) had isolated MS without MR. Both cases of isolated MS were in the New RHD group (Table 4).

A substantial portion of patients (26 out of 39, or 66.7%) had aortic valve involvement. The severity of aortic regurgitation (AR) varied: fourteen patients (35.9%) had mild AR, 11 patients (28.2%) had moderate AR, and only one patient (2.6%) had severe AR. When classified into the New and Known RHD groups, in the New RHD group of 25, 9 had mild AR, 7 had moderate AR, and none had severe AR; whereas among the Known RHD group of 14, 5 had mild AR, 4 had moderate AR, and 1 had severe AR. Only one patient (2.6%) had aortic stenosis (AS), and it was severe and present in the New RHD group. This severe AS co-existed with MR.

Pulmonic valve involvement was less frequent than involvement of the mitral and aortic valves. Among 39 patients, 7 (17.9%) had pulmonic regurgitation, with 4 from the new RHD group and 3 from the known RHD group. No patients had pulmonic stenosis (Table 4).

The pressure gradient measured across the tricuspid valve averaged 27.17 mmHg, with standard deviation of 19.734 mmHg.

Table 5. Pattern of Cardiac Chamber Involvement Among Children With RHD in HFCSH.

Cardiac chamber	Findings	RHD category		
		New (N = 25)	Known (N = 14)	Total (N = 39)
		Freq (%)	Freq (%)	Freq (%)
Right atrial size	Normal	10 (40)	5 (35.7)	15 (38.5)
	Mildly dilated	5 (20)	4 (28.6)	9 (23.1)
	Moderately dilated	9 (36)	5(35.7)	14 (35.9)
	Severely dilated	1 (4)	0 (0)	1 (2.6)
Left atrial size	Normal	0 (0)	0 (0)	0 (0)
	Mildly dilated	3 (12)	0 (0)	3 (7.7)
	Moderately dilated	12 (48)	7 (50)	19 (48.7)
	Severely dilated	10 (40)	7 (50)	17 (43.6)
Right ventricular size	Normal	12 (48)	6 (42.9)	18 (46.2)
	Mildly dilated	6 (24)	1 (7.1)	7 (17.9)
	Moderately dilated	7 (28)	7 (50)	14 (35.9)
	Severely dilated	0 (0)	0 (0)	0 (0)
Left ventricular size	Normal	6 (24)	1 (7.1)	7 (17.9)
	Mildly dilated	2 (8)	1 (7.1)	3 (7.7)
	Moderately dilated	8 (32)	5 (35.7)	13 (33.3)
	Severely dilated	9 (36)	7 (50)	16 (41)

The right atrial (RA) size varied among patients. A normal RA size was observed in nearly 40% (15 patients), while mild, moderate, and severe dilation were identified in 21%, 37%, and 2.6% of patients, respectively. When analyzed by subgroup, 10 patients in the new RHD group and 5 in the known RHD group had a normal RA size. Conversely, 5 patients in the new group and 4 in the known group had mildly dilated RA, 9 in the new group and 5 in the known group had moderately dilated RA, and 1 patient in the new group had severely dilated RA.

Similarly, right ventricular (RV) size varied, with normal dimensions in almost half (47%) of patients. Mild and moderate dilation were seen in 18% and 34% of patients, respectively. Among the 25 new RHD patients, 12 had a normal RV size, 6 had mildly dilated RV, and 7 had moderately dilated RV. Among the 14 known RHD cases, 6 had a normal RV size, 1 had mildly dilated RV, and 7 had moderately dilated RV.

All 39 RHD patients had a dilated left atrium. Among these, 3 patients (7.7%), all from the new RHD group, had a mildly dilated left atrium. Nineteen patients (48.7%), including 12 from the new group and 7 from the known group, had a moderately dilated left atrium. Seventeen patients (43.6%), 10 from the new group and 7 from the known group, had a severely dilated left atrium.

Eighty-two percent (32 patients) had a dilated left ventricle, with 19 from the new RHD group and 13 from the known RHD group. In contrast, 17.9% (7 patients) had a normal left ventricle, with 6 from the new RHD group and 1 from the known RHD group. Additionally, 3 patients (7.7%), 2 from the new RHD group and 1 from the known RHD group, had a mildly dilated left ventricle. Thirteen patients (33.3%), 8 from the new RHD group and 5 from the known RHD group, had a moderately dilated left ventricle. Sixteen patients (41%), 9 from the new RHD group and 7 from the known RHD group, had a severely dilated left ventricle (Table 5).

One important finding was the presence of a thrombus in a single patient (2.56%). Notably, left ventricular function remained normal in all cases, despite the observed chamber size variations.

Association of RHD Status With Dependent Variables

We conducted Fisher's Exact Test to examine the association between RHD status and various dependent variables, including presenting symptoms, presence of ADHF, infective endocarditis, rheumatic fever, and the pattern and severity of valve lesions. A *P*-value and Cramér's *V* were calculated. The tests did not show a significant association (Tables 6 and 7).

Discussion

This study investigated the clinical characteristics and valve lesion patterns of rheumatic heart disease (RHD) in a resource-limited setting in Eastern Ethiopia. Among

Table 6. RHD Status Versus Heart Failure.

Characteristics	Findings	RHD category			Test statistics	
		New (N=25)	Known (N=14)	Total (N=39)	Fisher's exact: P-value	Cramér's V
Class IV heart failure	Yes	23	12	35	.455	0.0994
	No	2	2	4		
	Total	25	14	39		
Comorbidities	No	18	11	29	.867	0.1279
	Severe acute malnutrition	3	2	5		
	Severe anemia	4	1	5		
	Total	25	14	39		
Presenting complaint	Cough	10	5	15	.477	0.2356
	Shortness of breath	12	9	21		
	Other	3	0	3		
	Total	25	14	39		
Rheumatic fever	Yes	1	3	4	.123	−0.2756
	No	24	11	35		
	Total	25	14	39		
Infective endocarditis	No	23	11	34	.474	0.2021
	Possible	1	2	3		
	Definite	1	1	2		
	Total	25	14	39		

the 39 children evaluated, 72% were female and 28% were male, with a median age of 10 years. These demographics are consistent with studies from Timor-Leste, which reported a median age of 11 years, India, where the mean age was 9.6 years, and another study in Ethiopia, which reported a mean age of 10.8 years.[11-13] However, the proportion of female patients in our study was higher compared to Timor-Leste (48% female), India (male-to-female ratio of 1.15:1), and another study in Ethiopia (59.9% female patients).[11-13] These differences could be attributed to social and geographic variations and the small sample size.

Of the children evaluated, 64% were newly diagnosed with RHD, while 36% were known RHD patients. In Harare, Zimbabwe, a similar distribution was observed, with 63.6% of children newly diagnosed.[14] Shortness of breath was the most common presenting complaint in both groups. Only 14% of known RHD patients were adherent to secondary prophylaxis, lower than the 42.18% adherence rate reported in India.[13] Additionally, 21% of known RHD cases had a history of rheumatic fever, compared to only 4% of newly diagnosed cases, highlighting a gap in managing RHD that might be due to a lack of awareness or clear guidelines, leading to disease progression and recurrent rheumatic fever. Fisher's exact test showed no significant association between RHD status and occurrence of rheumatic fever, possibly due to the small sample size.

Severe acute malnutrition and severe anemia were common comorbidities in both RHD groups, consistent with a tertiary hospital study in Ethiopia that found malnutrition in 50.7% of patients.[12] At admission, 89.7% of patients had class IV heart failure, with comparable figures between the 2 groups. Furthermore, 62% of patients had chest examination findings suggestive of congestion, indicating congestive heart failure, again consistent with studies in Ethiopia and other low-resource settings where children with RHD often present at advanced stages.[6,9,15-17] However, the proportion of class IV heart failure in our study was significantly higher than reported in other Ethiopian studies (13.6%) and studies from Timor-Leste (78% for all heart failure classes combined) and India (36.4% for all heart failure classes combined).[11-13] This suggests delayed detection and management of RHD.

Pneumonia, rheumatic fever, and infective endocarditis were common precipitating factors for heart failure in both RHD groups, similar to findings from India and Ethiopia.[12,13] Emphasis should be placed on preventing these conditions through preventive and therapeutic

Table 7. Pattern of Valve Lesions Versus RHD Status.

Valve lesion	Findings	RHD category			Test statistics	
		New (N = 25)	Known (N = 14)	Total (N = 29)	Fisher's exact: P-value	Cramér's V
Mitral Regurgitation	No	2	0	2	.806	0.2005
	Mild	2	1	3		
	Moderate	5	2	7		
	Severe	16	11	27		
	Total	25	14	39		
Mitral stenosis	No	12	5	17	.466	0.2743
	Mild	4	5	9		
	Moderate	5	1	6		
	Severe	4	3	7		
	Total	25	14	39		
Aortic regurgitation	No	9	4	13		
	Mild	9	5	14	.696	0.2228
	Moderate	7	4	11		
	Severe	0	1	1		
	Total	25	14	39		
Aortic stenosis	No	24	14	38	.641	−0.1214
	Mild	0	0	0		
	Moderate	0	0	0		
	Severe	1	0	1		
	Total	25	14	39		
Pulmonic valve involvement	No	21	11	32	.493	0.0679
	Yes	4	3	7		
	Total	25	14	39		

approaches. Fisher's exact test found no significant differences in presenting complaints, comorbidities, occurrence of class IV heart failure, or chest findings between the 2 groups, likely due to the small sample size.

The mitral valve was the most commonly affected, with mitral regurgitation occurring in 95% of patients—92% in the newly diagnosed group and 100% in the known RHD group. Severe mitral regurgitation was present in 69% of cases. Aortic regurgitation was the second most common valve lesion, occurring in 67% of patients. Additionally, 56% had mitral stenosis, and 51% had both mitral stenosis and mitral regurgitation. The patterns and severity of valve lesions were comparable between newly diagnosed and known RHD groups, with no significant associations found using Fisher's exact test, likely due to the small sample size. The predominance of mitral and aortic regurgitation aligns with existing literature, underscoring the extensive valvular damage associated with pediatric RHD.[9,16,18] Similar findings were reported in Timor-Leste, where 98% of patients had mitral regurgitation and 67% had severe

cases, with 77% also having aortic regurgitation.[11] In India, mitral regurgitation was the most common valvular lesion, while in Addis Ababa, Ethiopia, 97.1% of patients had mitral regurgitation with 62.5% being severe.[12,13] However, the frequency of mitral stenosis in our study was higher than in Addis Ababa (31.4%) and Timor-Leste (20%).[11,13] This indicates advanced disease progression at presentation in our cohort.

Left heart chambers were more commonly affected, with all patients showing left atrium dilatation and 82% having dilated left ventricles. Moderate to severe left atrial dilatation was present in 92% of RHD patients, and 74% had moderate to severe left ventricular dilatation. Additionally, 61% of patients had right atrium dilatation, and 53% had right ventricular dilatation. These patterns and severities of chamber dilatation were similar between newly diagnosed and known RHD groups, with no significant associations found using Fisher's exact test. Our findings show a higher prevalence of chamber dilatation compared to Western and Central Africa, where left ventricular dilatation was present in

13.6% of patients and left atrial dilatation in 13.8%.[19] This further supports the notion of delayed diagnosis and advanced disease at presentation in our cohort.

Limitations

Several limitations should be considered when interpreting the findings of this study. Firstly, the relatively small sample size and single-center design may limit the generalizability of our results to other settings within Ethiopia and beyond. Furthermore, the lack of long-term follow-up data precludes a comprehensive assessment of treatment outcomes and disease progression in this population. Future studies with larger sample sizes, prospective designs, and longer follow-up periods are needed to address these limitations and provide a more robust understanding of RHD epidemiology and outcomes in Eastern Ethiopia.

This study did not perform a formal sample size calculation due to the limited number of RHD admissions during the study period. This limitation may affect the generalizability of the findings, as the sample size was determined by the available cases rather than a predetermined calculation.

The use of a non-validated data collection tool, which was pilot-tested but not formally validated, represents a limitation of this study and may impact the generalizability of the findings.

Conclusion

This study highlights the critical public health challenge posed by RHD in Eastern Ethiopia, where a significant proportion of cases present at advanced stages of the disease. The comparison between newly diagnosed and known RHD patients revealed no significant differences in presenting complaints; however, there was a trend toward more severe valve lesions and a history of rheumatic fever in the known RHD group. This, combined with a low adherence to secondary prophylaxis (14%), suggests that delayed diagnosis may contribute to disease progression. Notably, a significantly higher proportion of patients in our study exhibited advanced heart failure (class IV), higher rates of mitral stenosis, and greater chamber dilatation compared to other reports, underscoring a concerning pattern of delayed diagnosis and management.

The high prevalence of newly diagnosed RHD cases and the alarming rates of severe heart failure emphasize the urgent need for improved primary healthcare infrastructure to facilitate early detection and management of RHD. Additionally, strengthening rheumatic fever prevention programs and developing effective strategies for enhancing adherence to secondary prophylaxis are crucial steps in preventing disease progression and improving long-term outcomes for children with RHD.

Author Contributions

Manuscript conceptualization: TL, YK, SA, FA, and KM; Data management and analysis: TL, FA, and YK; investigation: TL, YK, SA, FA, and KM; methodology: TL, YK, FA, and KM; Validation: TL, YK, SA, FA, and KM; writing the original manuscript draft: TL and S A. All authors reviewed and provided inputs to the draft and approved the decision to submit for publication.

Data Sharing Statement

Any of the data used for analysis in the study is available from the corresponding author and ready to be provided up on reasonable request.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Supplemental Material

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