

# Echocardiographic pattern of rheumatic heart disease among adults at St. Paul's Hospital Millennium Medical College cardiac unit, Addis Ababa, Ethiopia: a hospital-based cross-sectional study

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## Abstract

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**Background:** Rheumatic heart disease (RHD) is a major health problem in sub-Saharan Africa. It starts during childhood, has a progressive clinical course, and usually requires valve repair or replacement during adolescent or adulthood. Rheumatic heart disease (RHD) is a major cardiovascular problem among young adults in St. Paul's set-up. However, little is known about the extent of cardiac involvement and severity of valvular dysfunction among adults.

**Objectives:** The goal of this study was to evaluate the echocardiographic pattern of rheumatic valvular disease among adults at St. Paul's Hospital Millennium Medical College cardiac unit.

**Methods:** A hospital-based cross-sectional study was conducted among adults' evaluated by echocardiography over a period of 12 months (July 2019 to June 2020) at St. Paul's Hospital Millennium Medical College cardiac unit. All patients with a first diagnosis of rheumatic heart disease were included in the study. Data were collected prospectively using a structured checklist, entered, and analyzed using SPSS version 23 statistical software.

**Results:** A total of 384 patients had met the diagnostic criteria for RHD during the study period and all were included in the study. Females accounted for 73.7% with a male to female ratio of 1: 2.8. The types of valvular involvement were mitral valve in 95.6% followed by aortic valve in 61.5% of patients. Mitral regurgitation was the most common isolated valvular dysfunction in 26.8% of patients. Similarly, mitral regurgitation was the most prevalent severe valvular lesion found in 32.0% of all cases of mitral regurgitation followed by severe mitral stenosis in 22.9% of patients with mitral stenosis.

**Conclusion:** A significant proportion of adults with RHD presents with severe valve disease and multi-valvular involvement at St. Paul's Hospital Millennium Medical College cardiac unit. Efforts toward active early diagnosis and treatment of RHD and effective preventive measures at both primary and secondary healthcare facilities are required.

**Keywords:** Addis Ababa, adult, pattern, echocardiography, Ethiopia, rheumatic valve disease

## Background

Rheumatic heart disease (RHD) is a chronic complication of acute rheumatic fever, a multisystem disease resulting from an autoimmune reaction to a Group A streptococcus (GAS) pharyngitis (1). Rheumatic heart disease (RHD) continues to be a major health burden in sub-Saharan Africa (2). The clinical presentations of hospitalized patients with heart disease have been widely reported (1-3). Children and young adults are predominantly affected with an estimated mortality of more than 250,000 cases worldwide annually (4). In a hospital-based study conducted in Ethiopia, cardiovascular diseases accounted for 35% of hospital admissions (5). Of which, the major reason for hospitalization was RHD. Studies in Ethiopia also reported that RHD is associated with a significant cause of recurrent heart failure hospitalization and/or death (5-6). This shows that Ethiopia has encountered a high burden of the disease leading to hospitalization and possibly increased health expenditure.

The type of valve involved in RHD can easily be detected by echocardiography, which has become a key noninvasive test in the assessment of valve lesions caused by RHD (7). Transthoracic echocardiography with color flow Doppler can adequately assess valvular lesions and differentiate rheumatic from other causes of valve lesion (8). Mitral valve was the most affected valve followed by aortic valve. Tricuspid and pulmonic valves were rarely involved directly by RHD (9).

There are few published studies regarding the severity of valvular dysfunction in adults with RHD in Sub-Saharan Africa (3, 6, 10). A report from Cameroon showed severe valve lesion in 80.9% of patients with RHD (11). A study from Uganda also reported moderate to severe valve lesion in 72.9% of cases of RHD (12). In Ethiopia, there is limited data on the severity of valvular involvement and associated complications among adults with RHD. A study conducted among adults with RHD at Tikur Anbessa Hospital reported a magnitude of 78% and 69.6% of cases of mitral stenosis and mitral regurgitation respectively (13).

The current treatment of RHD in Ethiopia is based mainly on medical management. There is an ongoing effort to perform cardiac surgery

at the Children's Cardiac Center-Ethiopia to address this problem. However, the hospital is struggling with lack of medical supplies and is not operating with full capacity. As most valvular lesions with timely intervention holds a good prognosis for the patient, knowing the type and severity of rheumatic valvular lesions as well as associated complications has a paramount importance in planning an appropriate intervention. Therefore, this study aimed to evaluate the echocardiographic patterns of valvular involvement of RHD among adults visiting St. Paul's Hospital Millennium Medical College (SPHMMC) cardiac unit in Addis Ababa, Ethiopia.

## Methods

### Study setting

The study was conducted at SPHMMC, which is a public hospital and medical teaching college in Addis Ababa. It provides service for a catchment population of more than 5 million and receives referrals from all over the country. It has an inpatient capacity of more than 392 beds and serves an average of 200,000 emergency and outpatient clients' annually (14). The adult cardiac unit has nine cardiologists who perform echocardiography. The echocardiography unit's register was used to find reports of patients with diagnosis of RHD during the period of July 1<sup>st</sup>, 2019, to June 30, 2020.

### Study design and period

A hospital-based cross-sectional study design was conducted to characterize the echocardiographic findings of patients diagnosed with rheumatic heart disease evaluated at the adult echocardiography unit of SPHMMC from July 1<sup>st</sup>, 2019, to June 30, 2020.

### Study population

Adults with rheumatic heart disease who were seen in the hospital's echocardiographic unit from July 1, 2019 to June 30, 2020.

### Sample size determination

Sample size calculation for this study was performed using the single population proportion formula; considering the infinite size of the population, 50% for unknown prevalence of rheumatic heart disease

among adults in Ethiopia, 5% margin of error and 95% confidence interval. Thus, the calculated sample size was 384.

### Sampling method and sampling procedure

All patients with a diagnosis of RHD at the echocardiography unit of SPHMMC from July 1<sup>st</sup>, 2019, to June 30, 2020, were illegible for the study. They were recruited prospectively using a convenient sampling method until the intended sample size was reached.

Echocardiograms were performed by cardiologists using GE Vivid E9 echocardiographic machine. Patients had transthoracic 2-D, M-Mode, and Doppler studies (including continuous wave, pulsed wave, color, and Tissue Doppler). Echocardiographic studies were performed according to the American Society of Echocardiography standards (8).

The diagnosis of RHD was based on World Heart Federation (WHF) criteria, where the presence of any evidence of mitral or aortic regurgitation seen in two planes associated with a minimum of two of the following valve lesions: restricted leaflet motility, focal or generalized valvular thickening, and abnormal sub-valvular thickening (7). Data were then summarized by the distribution of valvular involvement, type of lesion (i.e., stenosis vs. regurgitation), and severity of valvular dysfunction described as mild, moderate, and severe according to the American College of Cardiology/American Heart Association (ACC/AHA) guidelines (8). The age, sex, echocardiographic findings of valve lesions, pulmonary hypertension, and ventricular functions of each patient with the diagnosis of RHD were collected using a structured check list by a trained cardiology fellow.

### Statistical analysis

Each completed checklist was entered and analyzed using SPSS version 23 statistical software. Frequencies and cross tabulations were used to summarize descriptive statistics of the data and tables and graphs were used for data presentation. Proportions of categorical variables were compared using Pearson chi-square test and significant association were considered when p-values < 0.05.

## Results

### Demographic characteristics

A total of 1585 echocardiographic studies were performed during the period from July 1, 2019 to June 30, 2020. Of which 384 (24.2%) patients who had met the diagnostic criteria for RHD were included in the study. Patients with the diagnosis of RHD were in the age range of 14-65 years with a median age of 30 (interquartile range (IQR), 23-38) years. Two hundred eighty-three (73.7%) patients were females with a male to female ratio of 1: 2.8. The most affected age group was from 21-30 years in 150 (39.1%) patients followed by 31-40 years in 100 (26.0%) patients (Figure 1).

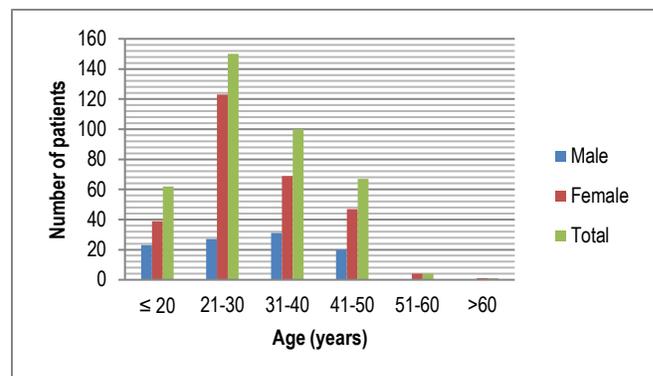


Figure 1: Age and sex distribution of patients with rheumatic heart disease among adults at St. Paul's Hospital Millennium Medical College cardiac unit, Addis Ababa, Ethiopia, 2020.

### Pattern of valve involvement

Mitral valve was the most involved valve found in 95.6% of cases, followed by aortic and tricuspid valves in 61.5% and 0.5% of them respectively. Among patients with isolated mitral valve involvement, pure mitral regurgitation (MR) was the dominant lesion found in 103 (26.8%). Another 10.4% of cases had mitral stenosis (MS) in addition to MR; thus, MR was seen in a total of 37.2% of patients with isolated rheumatic mitral valve disease with the remaining patients having pure MS (1.3%). Aortic valve was involved in 61.5% of cases making it the second most common valve to be involved; most cases had associated mitral valve involvement. Isolated involvement of aortic valve was seen in 4.4% of patients. Rheumatic tricuspid valve involvement was found in 2 patients.

Multiple valves were involved in more than half of all cases (57.0%). Among cases with multi-valvular involvement, the most common valvular lesions were a combination of MR and aortic regurgitation (AR) found in 30.2% patients, followed by a combined MR, MS, and AR in 19.3% of patients (Table 1).

**Table 1: Types of valvular lesions of rheumatic heart disease among adults at St. Paul's Hospital Millennium Medical College cardiac unit, Addis Ababa, Ethiopia, 2020.**

Valvular lesion	Overall, n (%) N = 384	Male, n (%) N = 101	Female, n (%) N = 283
MR only	103 (26.8)	15 (14.9)	88 (31.1)
MS only	5 (1.3)	-	5 (1.8)
MR +MS	40 (10.4)	12 (11.9)	28 (9.9)
AR only	11 (2.8)	4 (4.0)	7 (2.5)
AS only	3 (0.8)	2(2.0)	1 (0.3)
AR +AS	3 (0.8)	1 (1.0)	2 (0.7)
MR +AR	116 (30.2)	36 (35.6)	80 (28.3)
MR +AS	3 (0.8)	-	3 (1.1)
MS +AR	3 (0.8)	-	2 (0.7)
MR +MS +AR	74 (19.3)	23 (22.8)	51 (18.0)
MR+ AR + AS	16 (4.2)	5 (4.9)	13 (4.6)
MR +MS +AR +AS	5 (1.3)	3 (2.9)	1 (0.3)
MR +MS +AR +AS+ TS	2 (0.5)	-	2 (0.7)
TR	266 (69.3)	75 (74.3)	191 (67.5)
Pulmonary hypertension	207 (53.9)	64 (63.4)	143 (50.5)

MR: mitral regurgitation; MS: mitral stenosis; AR: aortic regurgitation; AS: aortic stenosis; TS: tricuspid stenosis; TR, tricuspid regurgitation

## Severity of valve dysfunction

The valvular lesions were grouped into mild, moderate, and severe forms. MR was the most prevalent severe valvular lesion found in 32.0% of all cases followed by tricuspid regurgitation (TR) in 29.7%, which was secondary to left sided valve disease. Among the valves directly affected by rheumatic disease, MS was the second most common severe form of valvular dysfunction observed in 22.9% of overall patients (Table 2).

**Table 2: Severity of valve lesion among adults with rheumatic heart disease at St. Paul's Hospital Millennium Medical College cardiac unit, Addis Ababa, Ethiopia, 2020.**

Type of Valve dysfunction	Severity of valve dysfunction			
	None N (%)	Mild N (%)	Moderate N (%)	Severe N (%)
MR	24 (6.3)	142 (37.0)	95 (24.7)	123 (32.0)
MS	257 (66.9)	13 (3.4)	26 (6.8)	88 (22.9)
AR	154 (40.1)	98 (25.5)	94 (24.5)	38 (9.9)
AS	351 (91.4)	14 (3.6)	8 (2.1)	11 (2.9)
TR	118 (30.7)	67 (17.4)	85 (22.1)	114 (29.7)
TS	382 (99.4)	0	1 (0.3)	1 (0.3)

MR: mitral regurgitation; MS: mitral stenosis; AR: aortic regurgitation; AS: aortic stenosis; TS: tricuspid stenosis; TR, tricuspid regurgitation

## Discussion

This hospital-based echocardiographic study showed that the predominant valve involvement was mitral valve followed by aortic valve among adults with RHD. The most common type of rheumatic valve lesion was MR, which was frequently associated with AR. Similarly, severe MR was the predominant finding followed by MS among patients with severe valvular dysfunction. Primary rheumatic tricuspid valve involvement was rare and pulmonic valve involvement was not encountered.

The pattern of valvular involvement of RHD in this study showed that mitral valve was affected predominantly followed by aortic and tricuspid valves in decreasing frequency. The prevalent involvement of the mitral valve was extensively reported in previous studies at tertiary care centers in other parts of developing countries, including Uganda (15), Nepal (16-18), India (19), Indonesia (20), and Pakistan (21), usually followed by aortic valve disease. This study also revealed that MR (isolated or combined) was the predominant valvular presentation in 95.6% of cases of RHD. This data was supported by similar findings in other studies (20, 22-24). Recent studies conducted among children in Ethiopia also reported MR as the most common rheumatic valvular lesion followed by AR (25- 26). This study also showed that the most frequent multi-valvular lesions were a combination of MR and AR followed by a combined MR, MS, and AR, which were the cases in other studies (5, 26-28).

Overall, majority of respondents in the current study were presented with severe than mild valvular dysfunction. Among the individual valve lesions, MR and AR presented with milder than severe grades of dysfunction. However, MS and aortic stenosis (AS) presented with severe degrees than mild degrees. Many community-based RHD studies among school children reported milder valve dysfunction as the most common valve lesion (5-7, 27, 29). However, consistent with several other reports (6, 10, 15, 25-26), moderate to severe valvular lesions were more frequent in case of SPHMMC cardiac unit adult RHD population. The predominant presentation of severe valve stenosis than mild stenosis implies a late presentation of the disease leading to severe symptoms requiring advanced cardiac care

service. This late presentation might be because of delayed diagnosis and/or referral, lack of regular definitive surgical intervention in the country and/ or costly overseas definitive interventions (6).

This is a hospital-based cross-sectional study, which has several limitations. First, it is a single hospital-based study and may not represent the true picture in other hospitals and/or the community. Second, patients who were referred to a tertiary care center are more likely to be symptomatic and present with more severe disease, which might overestimate the magnitude of severe valve lesions. Third, reason for referral and symptom status was not assessed for there was no documentation in the echocardiography laboratory. Finally, outcome of patients was not assessed for there was no follow-up study. Despite all these shortcomings, this study was one of the few recent reports on the pattern and severity of rheumatic valvular heart disease among adults as seen on echocardiography in Sub-Saharan Africa.

In conclusion, RHD presents with severe valve disease and frequent multiple valve involvement among adults at the cardiac unit of St. Paul's Hospital Millennium Medical College. Therefore, a strong national primary and secondary rheumatic fever and RHD preventive strategies should be implemented to combat this huge health problem. Furthermore, establishing and strengthening tertiary hospitals with expertise capable of providing definitive surgical interventions to reduce the burden of severe cases is warranted.

## Abbreviations

ACC/AHA: American College of Cardiology/American Heart Association

AR: Aortic regurgitation

AS: Aortic stenosis

GAS: Group A streptococcus

MR: Mitral regurgitation

MS: Mitral stenosis

RHD: Rheumatic heart disease

SPHMMC: Saint Paul's Hospital Millennium Medical College

SPSS: Statistical Package for Social Sciences

TR: Tricuspid regurgitation

TS: Tricuspid stenosis

WHF: World Heart Federation

## Declarations

### Ethics approval and consent to participate

The current manuscript had got ethical approval from St. Paul's Hospital Millennium Medical College (SPHMMC) IRB. Written informed consent was taken from each study participant. The study was done based on the declaration of Helsinki. Moreover, the privacy of the study participants was maintained and assured.

### Consent for publication

Not applicable.

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### Authors' contributions

Both authors contributed equally for this work.

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### Competing interests

Both authors read and approved the final manuscript. The authors declare that they have no competing interests.

### Availability of data and materials

The datasets used and/or analyzed in the current study or data collection tool are available from the corresponding author on a reasonable request.

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