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## PATTERNS OF CARDIOVASCULAR DISEASES AMONG CARDIAC DISEASE SUSPECTED PATIENTS IN BAHIR DAR CITY, ETHIOPIA

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### ABSTRACT

**Background:** Rheumatic heart disease (RHD) has remained a substantial public health challenge in low and middle-income countries. We aimed to determine the prevalence and associated factors of RHD among patients who received echocardiographic examinations.

**Methods:** A total of 849 patients who underwent echocardiography examinations were included in the study. Descriptive statistics and logistic regression analysis were performed. The odds ratio with 95% confidence interval, and p-values were used to determine the presence of associations.

**Results:** A total of 849 cardiac disease suspected cases were included in the analysis, of which 406 (47.8%) had a definite cardiac disorder. RHD is responsible for 76(18.2%) of the total cardiovascular disorders. The prevalence of RHD was 76(9.0%) among the total study population. The sex and age of the patients showed associations with rheumatic heart disease. The odds of having RHD among females was nearly three times that of male counterparts (AOR= 2.9, 95%CI: 1.6-5.4). Besides, the odds of having RHD among younger than 24, and from 25 to 35 was seventeen times that of respondents older than 50 years of age (AOR=17.2, 95%CI: 7.2-41.5, & AOR=17.1, 95%CI: 7.3-40.0) respectively.

**Conclusions:** One-half of the cardiac disease suspected individuals had a definite cardiac disease, and RHD accounted for 18.2% of the total cardiac diseases. Younger age and female in gender were associated with greater likelihood of having RHD. Therefore, interventions should be tailored to the magnitude of the problem; females and younger age groups should be the focus of concern.

**Keywords:** Cardiac disease, Rheumatic heart disease, Echocardiography, Ethiopia

### INTRODUCTION

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels. Rheumatic heart disease(RHD) is one of the CVDs that result in damage to the heart muscle and valves from rheumatic fever caused by streptococcal bacteria(1). Cardiovascular diseases (CVDs) are the leading cause of death globally; evidence shows that more people die annually from CVDs than from any other cause. Nearly, 17.9 million people died from CVDs in 2016, representing 31% of all global deaths. Over three-quarters of CVD deaths take place in low- and middle-income countries (1, 2).

RHD remains an important public health challenge across the globe; it accounts for more than 15.6 million cases worldwide each year, however, low and middle-income countries are disproportionately affected (3, 4). The disease persists in all countries of WHO regions, however, the African, South-East

Asia, and Western Pacific regions are the worst affected, accounting for 84% of all prevalent cases and 80% of all estimated deaths due to RHD(5).

According to health institution level studies conducted in Africa, RHD is the main cause of heart failure and is responsible for more than 34.0% of cardiovascular disease-related hospital admissions (6, 7). RHD mostly affects the population in low and middle-income countries, particularly; where poverty is widespread. RHD commonly affects children and can result in life-long disability or death. Effective early intervention can prevent premature mortality from RHD(4, 8).

A country like Ethiopia, whose economy is very weak, and the population living standard is very low, and more than 30% of the population living below the national poverty line bears the highest potential risk of communicable diseases including RHD (9). In addition, as RHD is more common in

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young age, and Ethiopia is a country of young population with over 70 percent of the total population is below the age of 30, and about 45 percent of the population is below 15 years of age, as a consequence, the country pertains highest potential risk of RHD, and other cardiovascular diseases (10, 11). However, studies conducted on cardiovascular disease including RHD are very scarce.

Therefore, this study aimed to determine the pattern of RHD among patients suspected of heart disease and who underwent echocardiography examinations. Furthermore, our study aims to produce hypotheses for future study directions and to have some insight into the contributing factors for RHD.

## METHOD AND MATERIALS

**Study design and setting:** a cross-sectional study design was used among patients visiting cardiac clinics from October 1, 2019 to October 1, 2020. The study was conducted in two hospitals (Felege Hiwot Referral and Addinas General) hospitals. The hospitals are found in Bahir Dar City, located at 560 km distance from Addis Ababa, the capital city of Ethiopia. These hospitals are a few of the health institutions that provide cardiovascular disease examinations and interventions in the city. Patients suspected of a cardiac problem from different health institutions and nearby regions are commonly referred to these hospitals for diagnosis and intervention.

Echocardiographic examination was performed in the parasternal long axis, short axis, apical four chambers, and occasionally in the subcostal and suprasternal views using GE and Sonoscape echocardiography machines at Adinas & Felege Hiwot hospitals. Indices were analyzed and presented in the left ventricle systolic diameter (LVIDS), left ventricle diastolic diameter (LVIDD), and the ejection fraction (EF). All the echocardiographic diagnoses were based the American Society of Echocardiogram and World Heart Federation guidelines (12, 13).

**Study period:** we included patients who received echocardiographic examinations from October 1, 2019, to October 1, 2020) and the data was collected from June 15, to May 10, 2021.

### **Sample size and sampling technique**

All patients for whom echocardiography diagnostic tests were carried out in the two hospitals during the selected one-year period were included in this study. A total of 849 cardiac disease suspected patients were included in our final analysis. As eligibility criteria, our analysis considered only the first echocardiographic examination reports of each patient in the study.

### **Study variables**

Both hospitals use cardiac disease examination tools consisting of age, the gender of the patients, and the echocardiographic diagnosis.

Rheumatic heart disease, is the outcome variable of interest for this study, and age, and gender were independent factors available on the charts and used for this study.

**Other cardiac disorders:** ischemic heart disease, hypertensive heart disease, Pericardial Effusion, Dilated Cardiomyopathy (DCMP), Degenerative valvular heart diseases (DVHD), Cor-plumonale, pulmonary hypertension, etc

### **Operational definitions**

**RHD:** According to the World Heart Federation (WHF) criteria for echocardiographic diagnosis of **RHD** as defined by the presence of any evidence of mitral or aortic regurgitation seen in two planes associated with at least two of the following morphologic abnormalities of the regurgitating valve: restricted leaflet motility, focal or generalized valvular thickening, and abnormal sub-valvular thickening (13).

Ischemic heart disease: were documented by detection of regional wall motion abnormality on a different region of the heart (such as loss systolic thickening, hypokinesia, akinesia dyskinesia) and associated with LV systolic dysfunction(14).

Hypertensive heart disease: was diagnosed in the presence of any or combination of the following abnormalities: left ventricular diastolic dysfunction (e.g. altered E: A ratio), left ventricular hypertrophy, left ventricular systolic dysfunction, and dilated left atrium, a surrogate of impaired LV filling in the presence of hypertension(15).

Pericardial Effusion: This was diagnosed when there is echo-free space between the visceral and parietal pericardium(16).

Dilated Cardiomyopathy (DCMP): was diagnosed when there are dilated heart chambers with normal or decreased wall chambers as well as impaired LV systolic function(17).

Cor-plumonale: was present when there is dilated and hypertrophied right ventricle (RV), evidence of increased RV systolic pressure D-shaped LV in diastole (diastolic flattening of the LV septum) (18).

### **Data management and analysis**

The data received from the hospitals were entered into SPSS software version 26 for analysis. Data cleaning was performed to make it ready for analysis. Then after descriptive statistics such as frequency distributions, percentages for categorical variables, and median, and interquartile range for the continuous variable were performed. Logistic regression analysis between rheumatic heart disease, and demographic factors (sex and age) were performed to see the crude effect of these factors on rheumatic heart disease. The results were presented in tables, and figures for the descriptive study, and odds ratio with its 95% confidence level and p-values were used for the logistic regression analysis.

### Ethical approval

Ethical clearance was obtained from the research and the ethical review committee of Bahir Dar University. Permissions were received from Felege Hiwot Referral Hospital and Addinas General Hospital to use the echocardiography data from the cardiac unit. The data were anonymous; there are no names or any personal identifier in the data.

## RESULTS

### Demographic characteristics of patients visiting cardiac clinics in Bahir Dar city

This study analyzed a total of 849 patients suspected of having cardiac disorder for which echocardiography examinations were done. About 55% of the study participants were males, and 44% were younger than 49 years of age. The ages of the respondents were varied between 6 and 103 years, the median and interquartile range for the ages was 52, and 34.6 years respectively. This study was conducted in two hospitals, 490 (57.7%) of the cases were from Addinas hospital, and the remainings were from FelgeHiwot hospital (table 1).

**Table 1:** Demographic characteristics of patients suspected of cardiac disease in Bahir Dar city

Variable	Categories	frequency	Percent	Chi-square
Sex	Male	377	44.4	20.6
	Female	472	55.6	
Age in years	<24	113	13.3	85.6
	25-35	137	16.1	
	36-49	125	14.7	
	>49	474	55.8	
Hospital	Addinas	490	57.7	0.2
	Felege Hiwot	359	42.3	

### Cardiac diseases distribution among patients underwent echocardiography examinations in Bahir Dar city

Out of 849 individuals with health problems that underwent echocardiography diagnosis 406 (47.2%) had a definite cardiac disease. The prevalence of RHD was 76 (9.0%); it accounts for 18.2% of the total cases of

revealed that the prevalence of hypertensive heart disease (HHD) was 80(9.4%), ischemic heart disease (IHD) was 59(6.9%), degenerative valvular heart disease (DVHD) was 63(7.4%), and dilated cardiomyopathy (DCMP) was, 56(6.6%) (Table 2).

**Table 2:** Diagnostic classifications of cardiac patients using Transthoracic Echocardiography Examinations in Bahir Dar city

Cardiac diseases	Frequency	Percentage
Hypertensive Heart Disease (HHD)	Yes	80
	No	769
Rheumatic Heart Disease (RHD)	Yes	76
	NO	773
Degenerative Valvular Heart diseases (DVHD)	Yes	63
	No	786
Ischemic Heart Disease (IHD)	Yes	59
	No	790
Dilated Cardiomyopathy (DCMP)	Yes	56
	No	793
Pericardial Effusion (PE)	Yes	43
	No	806
Co-pulmonale	Yes	36
	No	813
Restrictive cardiomyopathy (RCM)	Yes	14
	No	835
Congenital heart disease (CHD)	Yes	6
	No	843
Overall Cardiac disease	Yes	406
	No	443

### *Echocardiographic diagnostic classifications by gender among cardiac patients in Bahir Dar city*

Gender distributions of cardiac diseases indicated that rheumatic heart disease was much higher among females compared to males of the total confirmed cardiac cases (61 vs. 15) p-value (<0.001), ischemic heart disease is higher for males than females (36, vs. 23) p-value (<0.008), and similarly dilated cardiomyopathy was higher for males compared to females (33 vs. 23) p-value (0.02) (table 3).

**Table 3:** Echocardiographic diagnostic classifications by gender in cardiac patients in Bahir Dar City

Disease	Male, n	Female, n	Total (%)	Chi square	P-value
HHD	42	38	80(19.7)	2.3	0.12
RHD	15	61	76(18.7)	20.6	<0.001
DVHD	30	33	63(15.5)	0.7	0.4
IHD	36	23	59(14.5)	7.1	0.008
DCMP	33	23	56(13.8)	5.1	0.02
PE	22	21	43(10.6)	0.84	0.36
Co-pulmonale	13	23	36(8.9)	1.1	0.31
RCM	6	8	14(3.5)	0.01	0.9
CHD	1	5	6(1.5)	1.9	0.2
Any cardiac disease	183	223	406(47.8%)	0.5	0.7

### *Valvular lesions among RHD patients in Bahir Dar city*

Our study showed that 58 (7.5%) and 199 (23.4%) of the study participants had mitral stenosis and regurgitations respectively. In addition, 29(3.4%) and 104(12.2%) of the study participants had aortic stenosis and regurgitations respectively. About 56(96.6%) of the total patients with mitral stenosis and 54(27.1%) of mitral regurgitations were positive for RHD. Besides, one out of four patients with aortic stenosis and one in three patients with aortic regurgitations were positive for RHD.

The findings of this study also indicated that some cardiac patients reported having more than one valvular lesion. More specifically, the distribution of RHD among cardiac patients with more than one lesion varies based on the kind of valvular lesion combined; 38(86.4%) cases with MS and MR, 7(35%) with AS and AR were positive for RHD (Table 4).

**Table 5:** The frequency distributions & percentages of Valvular lesions based on severity among patients who underwent echocardiographic examinations in Bahir Dar city

Valvular lesions	Severity			RHD (N=76)
	Mild	Moderate	Severe	
Mitral stenosis (n=58)	17(26.6%)	11(17.2%)	30(56.3%)	58(76.3%)
Mitral regurgitation (n=199)	123(61.8%)	53(26.6%)	23(11.6%)	54(71.7%)
Aortic stenosis (n=29)	15(51.7%)	10(34.5%)	4(13.7%)	8(10.5%)
Aortic regurgitation (n=104)	79(75.2%)	21(20%)	4(3.8%)	34(44.7%)

### **Regression analysis of rheumatic heart disease by sex and age among patients underwent echocardiography examinations**

This study is based on echocardiographic diagnostic tests in patients suspected of cardiac disease. Our data contain only sex and age as potential confounding factors that entered both in bivariate and multivariate regression analysis. Both the sex and age of the patients showed associations with RHD. The study revealed that females were more likely to be positive for RHD, where the odds of having a positive diagnosis for RHD among females was nearly three times that for male patients (AOR= 2.9, 95%CI: 1.6-5.4). Similarly,

the age of the respondents was showed strong associations with RHD; the odds of disease were significantly higher among the young age group than older ones. The odds of RHD among respondents whose age was 35 years or younger was seventeen times that of respondents older than 50 years of age (table 6).

**Table 6:** Regression analysis of rheumatic heart disease for sex and age among patients who underwent echocardiography examinations in Bahir Dar city

Variable	Classifications	RHD		OR (95% CI for OR)		P-value
		Yes	No	Crude	Adjusted	
Sex	Male	15	362	1.00		0.001
	Female	61	411	3.58(2.01-6.41)	2.9(1.6-5.4)	
Age in years	<24	24	89	18(7.5-43.0)	17.2(7.2-41.5)	<0.001
	25-35	31	106	19.5(8.4-45.5)	17.1(7.3-40.0)	
	36-49	14	111	8.4(3.3-21.3)	7.5(3.0-19.2)	
	>49	7	467	1.00	1.00	

### **Discussions**

Current evidence shows that CVDs are the leading causes of death globally. Low and middle-income countries are disproportionately affected by the disease, where over 80% of these deaths take place (2, 19). However, there is a limited number of studies available to show the burden, distribution, and determinant factors for CVDs including RHD in low-income countries. Therefore, this study was aimed to determine the prevalence and the associated factors of RHD among cardiac disease suspected patients.

Accordingly, 406 (47.8%) of patients who underwent echocardiographic examinations reported having a definite cardiac disease. Our finding is supported by a study conducted in Buea, South West Region of Cameroon, where 45.2% of patients who had undergone echocardiographic tests had a definite CVS (20). In the current study, nearly one in ten patients (9.0%) of the study participants that received echocardiographic tests were positive for RHD. This finding is in accordance with a study conducted by Nigerian savannah, where 9.8% of the study subjects with abnormal results had an echocardiographic diagnosis of RHD (21). However, the magnitude of RHD in the current study is much higher than other studies, where the proportion of RHD lies in the ranges of 3.1% to 6.5% (20, 22, 23). The difference may be attributed to several reasons such as

variations in socioeconomic status, gender ratio, and age composition in the study population. In addition, our study domain was patients suspected of cardiac disease and who visited cardiac treatment centers seeking interventions; this might increase the magnitude of RHD in our study population unlike similar studies conducted among apparently healthy individuals.

In this study, of the cardiac patients with mitral stenosis, 56(96.6%) were positive for RHD. This is supported by the evidence that most mitral stenosis cases among cardiac patients are caused by RHD (24). Likewise, studies conducted so far revealed that in most of the cases, cardiac patients with mitral stenosis were positive for RHD (25, 26). Our findings also showed that nearly, 30% of patients who reported having mitral regurgitations were positive for RHD. This finding is in line with similar other study findings where the RHD manifests as congestive heart failure due to valvular involvement including mitral valve regurgitations (27, 28). In this study, the prevalence of RHD was significantly higher among females compared to males, 61(80%) vs. 15(20%) respectively. Furthermore, the odds of having RHD among the female was about three times more likely as compared to their male counterparts in patients suspected of cardiac diseases. This finding is supported by several

pieces of evidence, where the female sex is at higher risk of acquiring RHD compared to males. A review study conducted on the impacts of gender on RHD, all review articles included were showed that a female predominance for RHD (29).

Similarly, a study conducted in India showed that the prevalence of RHD was more than two-fold higher in females than males (71.4% vs. 29.6%) (30). Besides, several studies across the globe indicated that the risk of RHD varies for women and men (31-33).

The age of the respondents showed a strong association with RHD; the disease was significantly higher among the young age group than older ones. The odds of RHD among respondents younger than 35 years of age was more than seventeen times that of older than 50 years of age. Evidence showed that virtually anyone at any age can get RHD; however, the risk is highest among children and young adults (34-36). Our finding is supported by the evidence from other studies that RHD is more prevalent among young age than older ones; a study conducted in Fiji Oceania among participants between the ages of 5 to 65 years, almost half of RHD cases occurred before age 40 years (37). Similarly, several studies conducted across the globe indicated that the risks of RHD inversely correlated with age, showing that as the age of study participants increases the risk of RHD decreases (8, 36, 38).

This study was conducted merely based on echocardiographic examinations done for cardiac disease suspected patients. The data was primarily collected for the purpose of diagnosis and intervention. Our study has drawbacks in terms of controlling confounding factors for RHD, because the data composed of only sex and age as confounding factors; the remaining data is all about clinical information such as sign, symptom, specific diagnosis of cardiac diseases, and intervention plan.

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## Conclusion

In this study, one in ten cardiac suspected cases were positive for RHD. Males and females with the cardiac disorder have different risk profiles for rheumatic heart disease that might have a substantial impact on the prognosis and treatment outcomes. The odds of RHD among the females is three times that of males. In addition, the odds of RHD inversely decreases with age, the young age groups were at a higher risk of getting the disease compared to older ones. In general, RHD is substantially higher in this study compared to several studies available, indicating that it is an important public health challenge to our community. Therefore, interventions should be tailor the magnitude of the problem, and should also target females and young age groups.

### *Competing interests*

The authors declare that they have no competing interests.

### *Authors' contribution*

HB and ZAA- conceptualized the study, designed the study, performed data analysis, interpreted the findings, and drafted the manuscript.

MA, YK, AG, YA...and GTW - critically reviewed the report and manuscript.

All authors read and approved the final version of the manuscript.

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