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Prevalence and associated factors of atrial fibrillation among patients with chronic rheumatic heart disease attending public referral hospitals in Bahir Dar city, Northwest Ethiopia, 2023

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BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF INTERNAL MEDICINE

**PREVALENCE AND ASSOCIATED FACTORS OF ATRIAL
FIBRILLATION AMONG PATIENTS WITH CHRONIC
RHEUMATIC HEART DISEASE ATTENDING PUBLIC
REFERRAL HOSPITALS IN BAHIR DAR CITY, NORTHWEST
ETHIOPIA,2023**

BY: ADANECH MENGIE (INTERNAL MEDICINE RESIDENT)

FEBRUARY,2024

BAHIR DAR, ETHIOPIA

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A RESEARCH THESIS SUBMITTED TO DEPARTMENT OF INTERNAL
MEDICINE, SCHOOL OF MEDICINE, COLLEGE OF MEDICINE AND
HEALTH SCIENCE, BAHIR DAR UNIVERSITY, IN THE PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR SPECIALTY IN INTERNAL
MEDICINE

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February, 2024

Bahir Dar, Ethiopia

DECLARATION

This is to certify that the research thesis entitled “prevalence and associated factors of atrial fibrillation among patients with Chronic Rheumatic heart disease attending public referral hospitals in Bahir Dar, Northwest Ethiopia, 2023” submitted to Department of internal medicine, School of medicine, College of medicine and health science, Bahir Dar University, in the partial fulfillment of the requirements for specialty in internal medicine is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

Adanech Mengie (internal medicine resident)

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APPROVAL OF THESIS FOR DEFENSE

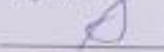
I hereby certify that I have supervised, read, and evaluated this research thesis titled "prevalence and associated factors of atrial fibrillation among patients with Chronic Rheumatic heart disease attending public referral hospitals in Bahir Dar, Northwest Ethiopia, 2023" By Adanech Mengie (internal medicine resident) prepared under my guidance. I recommend this thesis can be submitted as the final thesis draft for different purposes.

Advisor's name

Signature

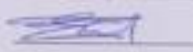
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ABSTRACT

Background: Atrial fibrillation is supra ventricular arrhythmia with uncoordinated atrial activation and, consequently, ineffective atrial contraction. Atrial fibrillation is one of the complications of rheumatic heart disease, with substantial morbidity and mortality. It is a growing public health problem, with enormous human, economic, and social burdens. Studies regarding the prevalence and factors associated with atrial fibrillation among chronic rheumatic heart disease in Ethiopia are scarce. Therefore, this study will assess the prevalence and factors associated with atrial fibrillation in patients with chronic rheumatic heart disease.

Objective: To determine the prevalence and factors associated with atrial fibrillation among patients with chronic rheumatic heart disease attending public referral Hospitals in Bahir Dar city, North West Ethiopia, 2023.

Methods and Materials: A hospital based cross sectional study was conducted from October/2023- November/2023. Data were collected with chart review by using the pre-developed data collection checklist. A total of 410 participants were included. A systematic random sampling method was used. Data were entered to Epi data version 4.6 and then exported to SPSS 26 version software for analysis. Binary logistic regression model was used to identify variables significantly associated with outcome variable. Variables with a 95% CI and p-value ≤ 0.25 during bi-variable logistic regression were entered in to multivariable analysis. In the final multivariable regression model, factors will be considered significantly associated if p value is less than 0.05. Data were presented in word and tables.

Results: In this study, 410 charts were reviewed. Prevalence of atrial fibrillation was 43% with 95% CI of 38% up to 48%. Being males (AOR = 3.81, 95% CI 2.00-7.26), age (> 30 years) (AOR = 7.26, 95% CI 3.93-13.41), Patients who had heart failure (AOR = 4.65, 95% CI 2.39-9.04), mitral valve stenosis (AOR = 6.36, 95% CI 2.92-13.87) and left atrial diameter enlargement (AOR = 3.41, 95% CI 1.64-7.09) were more likely to develop atrial fibrillation.

Conclusions and recommendations: Prevalence of atrial fibrillation was 43%. Sex, age, heart failure, mitral valve stenosis and left atrial diameter enlargement were associated with atrial fibrillation. The health care professionals better to give special attention and clinical care as accordingly for patients with associated factors of atrial fibrillation

Keywords: Associated factors, Atrial fibrillation, Prevalence, Rheumatic heart disease

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ACRONYMS

AF.....	Atrial Fibrillation
AR	Aortic Regurgitation
AS	Aortic Stenosis
BMI.....	Body Mass Index
CHF	Congestive Heart Failure
CRHD	Chronic Rheumatic Heart Disease
ECG	Electrocardiography
ECHO	Echocardiography
eGFR	Estimated Glomerular Filtration Rate
ICU.....	Intensive Care Unit
LMICs	Low and Middle Income Countries
LVEF.....	Left Ventricular Ejection Fraction
MR	Mitral Regurgitation
MS	Mitral Stenosis
MVA	Mitral Valve Area
NYHA	New York Heart Association
OACs	Oral Anticoagulants
OPD	Outpatient Department
PH	Pulmonary Hypertension
SSA	Sub Saharan Africa
TGSH	Tibebe Ghion Specialized Hospital
TR	Tricuspid Regurgitation
WHF	World Heart Federation
WHO	World Heart Organization

1. INTRODUCTION

1.1. Background

An arrhythmia is a problem with the rate or rhythm of the heartbeat. In arrhythmia, the heart can beat too fast, too slowly, or with an irregular rhythm. Normally, the heart beats at a rate of 60 to 100 beats/min(1). When a heart beats too fast, the condition is called tachycardia. When a heart beats too slowly, the condition is called bradycardia (2). Any rhythm that is not normal sinus rhythm with normal atrioventricular (AV) conduction is arrhythmia. The rhythm of the heart is set by a small region of cardiac muscle cells in the right atrium called the sinoatrial (SA) node that acts as a spontaneous pacemaker (3).

Atrial fibrillation (AF) is a supraventricular arrhythmia with uncoordinated atrial activation and, consequently, ineffective atrial contraction. Electrocardiography characteristics include: 1) irregular atrial activity, 2) absence of distinct P waves, and 3) irregular R-R intervals (4). Based on the duration of AF episodes, four types are distinguished: paroxysmal, persistent, long standing persistent and permanent AF(5). Paroxysmal AF - AF that terminates spontaneously or with intervention within 7 days of onset. Persistent AF - continuous AF that is sustained for >7 days. Long standing persistent AF - continuous AF that persisted for >12 month. Permanent AF - when the patient and clinician make a joint decision to stop further attempts to restore and/or maintain sinus rhythm (6).

Atrial fibrillation is the most common sustained cardiac arrhythmia, occurring in 1–2% of the general population(7). Atrial fibrillation is a growing public health problem, with enormous human, economic, and social burdens. Risk factors for developing atrial fibrillation include age, underlying cardiac disease, heart failure, hypertension, diabetes mellitus, obesity, smoking, alcohol consumption, thyrotoxicosis, chronic obstructive pulmonary disease and chronic kidney disease (4, 5). AF is associated with a substantial risk of all-cause mortality, cardiovascular mortality and sudden cardiac death, stroke, systemic thromboembolism, heart failure, and acute coronary syndrome (4). Patients with AF can be symptomatic or asymptomatic. Symptomatic patients may present with palpitation, dyspnea, fatigue, heart failure and hemodynamic instability(8).

Treatment is guided by the patient's symptom, duration of AF, risk of stroke and underlying heart disease. There are 3 general treatment strategies for AF, including (1) restoration of sinus rhythm (2) control of ventricular rate, and (3) prevention of stroke. Treatment may include medications to control rate or restore rhythm, surgical procedures and oral anti-coagulants to prevent stroke (4, 5, 9-11).

Rheumatic heart disease (RHD) is the major cause of atrial fibrillation in developing countries(12). RHD results from recurrent episodes of acute rheumatic fever, an autoimmune response to untreated group A streptococcal pharyngitis that causes inflammation and fibrosis of the heart valves. Severe valvular damage leads to altered hemodynamics, chamber remodeling, subsequently heart failure, pulmonary hypertension, atrial fibrillation, thromboembolism, infective endocarditis, and eventually premature death (13). RHD accounts for 275,000 deaths every year, 95% of these occurring in LMICs with limited facilities to treat advanced disease requiring valve surgery. Much of these morbidity and mortality can be prevented by existing therapies(14, 15). Thus, estimation of the burden of atrial fibrillation and its associated factor in patients with RHD is important for its prevention and control to reduce morbidity and mortality (15).

1.2. Statement of the Problem

From a clinical standpoint, atrial fibrillation represents a highly heterogeneous group of diseases, with a great variety of symptoms and range of severity, which makes the estimate of AF particularly challenging. In 2010, the global number of individuals suffering from AF was computed to be approximately 33.5 million, with increasing incidence and prevalence trends since the nineties(16). A total of 3.046 million new cases of atrial fibrillation worldwide were registered in the database during 2017(13). The estimated incidence rate for 2017 (403/millions inhabitants) was 31% higher than the corresponding incidence in 1997. These estimations are expected to further increase in future and are projected to reach 12.1 million people in the USA by 2050 and 17.9 million people in Europe by 2060 (14). The global prevalence of AF in RHD was 32.8% with substantial heterogeneity, ranging from 4.3% to 79.9% in individual studies(13, 15, 17, 18). In Sub-Saharan Africa for instance, Rheumatic heart disease is one of the leading causes of AF, reported in 20%–35% of cases in most series (13, 16, 19). In Ethiopia, according to a study conducted on semi-rural Ethiopian community of relatively younger participants, the prevalence of AF was 4.3% (20). Estimates of the incidence and prevalence of AF vary based on the characteristics of population studied and how AF is ascertained. Variations in the age and severity of illness in the population studied, diligence with which medical records are sought, duration of follow-up, and frequency of Electrocardiograms affect the reported prevalence of AF(13).

According to previous studies the incidence and prevalence of AF is increasing. The reasons and factors underlying such increases have yet to be elucidated, and included population ageing, improved survival, greater ability to treat chronic cardiac and noncardiac diseases, and improved ability to suspect and diagnose AF, among others (4, 16). The prevalence of AF increases with age, cardiovascular risk factors and co-morbidities such as hypertension, diabetes, congestive heart failure, coronary artery disease and valvular heart disease (21).

Atrial fibrillation has been the subject of intense investigation both regarding a better understanding of its mechanism and improvement of its management. However, despite the advances made, AF remains a challenge for the clinician and it is uncertain whether these theoretical advances have resulted in a significant improvement in the way the vast majority of patients is managed in general practice. Several reasons may account for such a situation. One of

them is still incomplete knowledge of the complex mechanism of this common arrhythmia. Another is the heterogeneous clinical presentation of the arrhythmia (22).

According to review of previous studies done on the prevalence of atrial fibrillation, some of studies were based on single center, hospital-based registry having selection biases that may influence the estimation of the burden of atrial fibrillation (17). In other studies that were done in resource limited countries like Sub Saharan Africa, the prevalence of atrial fibrillation were assessed based on Electrocardiography done at registry where cases of paroxysmal atrial fibrillation may be missed and it may underestimate the burden of atrial fibrillation in those resource limited setup (13). In addition to this, most of studies conducted on prevalence and associated factors of atrial fibrillation in chronic rheumatic heart disease didn't asses factors associated with AF such as hypertension and diabetes mellitus. Researches on atrial fibrillation are limited in Ethiopia except some studies done on magnitude and risk factor distribution among stroke patients and in rural communities (12, 20, 23). This study will estimate the prevalence of AF and factors associated with AF in chronic rheumatic heart disease.

1.3. Significance of Study

By showing the magnitude and associated factors of atrial fibrillation in patients with rheumatic heart disease, and mainly those with rheumatic mitral stenosis, this study may highlight the need for guidelines on the timing of clinical and Electrocardiographic screening of atrial fibrillation in this population.

Furthermore, because the duration of atrial fibrillation reduces the chances of sustained cardioversion success, a predictive tool to identify patients at high risk of developing atrial fibrillation might help in early detection and treatment.

Since there were no study done on the prevalence and associated factors of atrial fibrillation in Chronic rheumatic heart disease in our setting, the result of this study will give insight about the burden of atrial fibrillation and directs how screening and follow up of atrial fibrillation in this group of patients is important. It will also advocate senior experts to develop local guidelines regarding the timing of screening for atrial fibrillation. The finding of this research will provide relevant information to the hospital, health bureau, and policy makers on magnitude and determinant factors of atrial fibrillation in chronic rheumatic heart disease and will be used as a baseline data for other researchers interested in the area.

2. LITERATURE REVIEW

2.1 Prevalence of Atrial Fibrillation

According to global burden of disease study 2017, compared to 1990 the global prevalence of atrial fibrillation in 2017 increased from about 19.14 million to 37.57 million ,an increase of around 18.43 million cases (14). In a Meta-Analysis of the Incidence, Prevalence, and Correlates of Atrial fibrillation among rheumatic heart disease which includes eighty three studies, the global prevalence of atrial fibrillation in rheumatic heart disease was 32.8% with substantial heterogeneity, ranging from 4.3% to 79.9% in individual studies (13, 15, 17, 18, 24).

An international literature review which was conducted in France, the prevalence of atrial fibrillation is estimated to be between 600,000 and 1 million people. The incidence is estimated at between 110,000 and 230,000 new cases per year. In 2008, 412,000 hospitalized patients had a diagnosis of atrial fibrillation; this figure increased by 26% in the 3-year period between 2005 and 2008 (25). In another study in Spain which evaluated 8343 individuals, the overall prevalence of atrial fibrillation was 4.4% (26). In a study that asses the prevalence of atrial fibrillation in Portuguese population aged 40 and over, two hundred and sixty-one cases of atrial fibrillation were identified, representing a prevalence of 2.5% (27). The prevalence of atrial fibrillation among cardiac patients in China was 7.9% (28).

According to studies done in sub Saharan Africa, the prevalence of atrial fibrillation in patients with rheumatic heart disease were in the range of 9.5% to 59% (29-32). In Ethiopia, a study done at St. Paul's Hospital Millennium Medical College showed that the prevalence of AF was 43.5% among adults with cardiovascular diseases (33). Another study conducted at Tikur Anbessa specialized hospital showed that the prevalence of AF was 46.8% (12). In another study that was conducted in Gondar College of Medical Sciences Teaching Hospital on the socio-demographic and clinical profile of patients with Rheumatic heart disease, the commonest arrhythmia was atrial fibrillation, observed in 22.8% of the cases (23). According to a study on the prevalence and risk factors for atrial fibrillation and its anticoagulant requirement in adults aged ≥ 40 in Jimma Town, the prevalence of atrial fibrillation among study participants was found to be 4.3%(20).

2.2 Factors associated with Atrial Fibrillation

According to previous studies, factors that are shown to be associated with atrial fibrillation in patients with chronic rheumatic heart disease include sociodemographic factors such as Age and Sex, Behavioral factors, Clinical related variables and Echocardiographic parameters such as type of heart valve disease affected, left atrial diameter, left ventricle ejection fraction and pulmonary artery hypertension(12, 13, 15, 17, 18, 34-38).

2.2.1. Socio demographic Variables

According to studies done on the prevalence and correlates of atrial fibrillation in chronic Rheumatic heart disease in Nepal, India and Turkey, atrial fibrillation was significantly associated with increased age. It was 2.2% in age group of less than 20 years to 41% in the age group of more than 51 years age group (13, 15, 17, 18). In another study done in Iran that assesses factors associated with atrial fibrillation in rheumatic mitral stenosis, being old age was independently associated with atrial fibrillation (36).

Regarding sex, contradicting findings have been reported. In a study that was done in China, male sex was significantly associated with atrial fibrillation(39). In different studies that was done in Turkey, Iran and sub Saharan Africa, there was no significant association of atrial fibrillation with sex (12, 13, 18). However, one study that was done at Nepal showed that females were more likely to develop atrial fibrillation as compared to males (17).

2.2.2. Behavioral Variables

According to Randomized Evaluation of Long-Term Anticoagulation Therapy (RE-LY) AF registry which enrolled patients who presented to an emergency department with AF, 17.0% of AF patients had a history of alcohol consumption(40). Reported alcohol intake was highest in Western Europe and North America (34).

2.2.3. Clinical Factors

In a Prospective Registry of 15,400 Emergency Department Patients in 46 Countries which analyzed Variations in Cause and Management of Atrial fibrillation, hypertension was associated with atrial fibrillation(31, 34). In a study that was done in India, diabetes mellitus was associated with atrial fibrillation(34). However, in other study conducted at Saint Paul's Hospital Millennium Medical college in Ethiopia, diabetes mellitus were not associated with atrial fibrillation and hypertension was found to be associated with a lesser risk of atrial fibrillation as compared to patients who do not have hypertension(33). In a study conducted on the prevalence

and factors associated with atrial fibrillation among patients with rheumatic heart disease, those patients with chronic kidney disease had high risk of developing atrial fibrillation as compared to patients with no chronic kidney disease(17).

Among patients with chronic rheumatic heart disease, the presence of heart failure was significantly associated with atrial fibrillation (15). Similarly in another study that assesses the predictors of atrial fibrillation in rheumatic mitral stenosis based on clinical and Echocardiographic study, presence of heart failure was significantly associated with atrial fibrillation with most of patients who had atrial fibrillation were in New York Heart Association functional class III or IV (38). In a study done in Australia, those patients who undergo cardiac valvular surgery for rheumatic heart disease had higher risk of developing atrial fibrillation as compared to patients who did not undergo valvular surgery(37, 41-43).

2.2.4. Echocardiographic Variables

According to a study done in Iran that assesses factors associated with atrial fibrillation in rheumatic mitral stenosis, presence of pulmonary artery hypertension and reduced left ventricular ejection fraction were independently associated with atrial fibrillation (36). In another study on factors associated with atrial fibrillation in rheumatic mitral stenosis, patients with atrial fibrillation had pulmonary artery hypertension, enlarged left atrium diameter, mitral valve stenosis and reduced left ventricular ejection fraction (44, 45). However, other studies found no relationship between these features and atrial fibrillation (46).

According to research done on factors associated with development of atrial fibrillation in Chronic rheumatic heart disease, patients with valvular disease had significant association with Atrial fibrillation as compared to those with no valvular disease. In this studies, those patients with mitral valve stenosis had higher risk of developing atrial fibrillation as compared to those with no mitral valve stenosis (35, 47, 48).

In another research conducted on prevalence, risk determinants and consequences of atrial fibrillation in rheumatic heart disease, presence of mitral valve stenosis and tricuspid valve regurgitation were significantly associated with atrial fibrillation. However, presence of Mitral valve regurgitation, aortic valve stenosis and aortic valve regurgitation had no significant association with atrial fibrillation (15). In a study done on the prevalence and predictors of atrial fibrillation and its embolic complication in patients with rheumatic heart disease at Tikur Anbessa Specialized Hospital, the presence of Tricuspid valve Regurgitation and Mitral valve

Stenosis were significantly associated with atrial fibrillation but there was no significant association with the presence of Mitral Regurgitation. The association of atrial fibrillation with left atrial diameter enlargement was also statistically significant ([12](#)).

3. CONCEPTUAL FRAMEWORK

The conceptual framework described socio demographic factors, clinical factors, echocardiography related factors and the outcome variable. It was self-constructed through review of different literatures

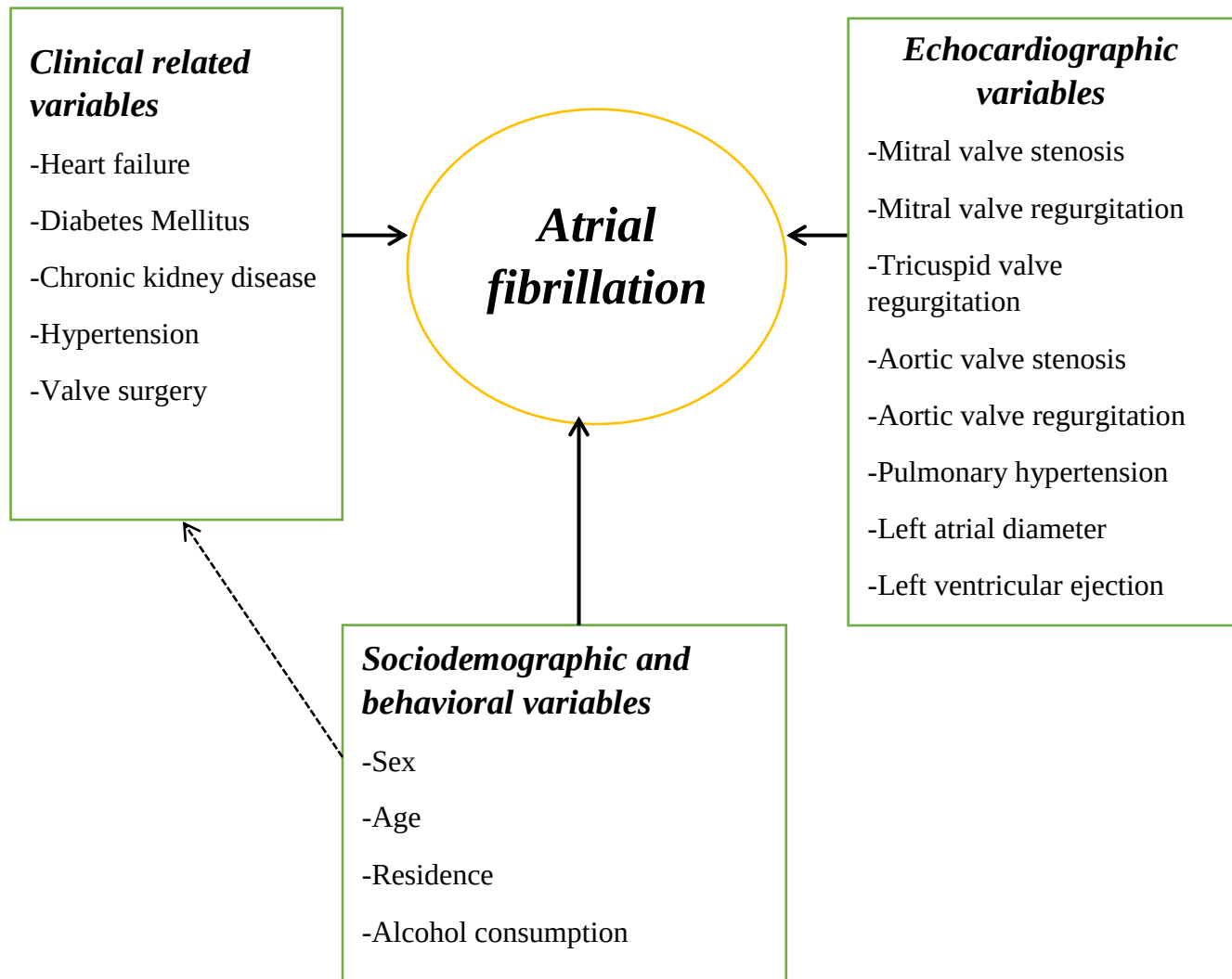


Figure 1: conceptual frame work on prevalence and factors associated with atrial fibrillation in CRHD attending public referral Hospitals in Bahir Dar city (12, 13, 15)

4. OBJECTIVE

4.2. General Objective

To assess the prevalence and associated factors of atrial fibrillation among patients with chronic rheumatic heart disease attending public referral Hospitals in Bahir Dar city Amhara, Ethiopia, 2023

4.2. Specific Objectives

1. To determine the prevalence of atrial fibrillation among patients with chronic rheumatic heart disease attending public referral Hospitals in Bahir Dar city, Amhara, Ethiopia, 2023
2. To identify factors associated with atrial fibrillation among patients with chronic rheumatic heart disease attending public referral Hospitals in Bahir Dar city, Amhara, Ethiopia, 2023

5. METHODS AND MATERIALS

5.2. Study Design

A hospital based cross sectional study was conducted based on patient record cards through the years 2021-2023

5.3. Study Area and Period

The study was conducted at public referral Hospitals in Bahir Dar city. Bahir Dar is the capital city of Amhara region in northern Ethiopia; it is located at the exit of Abay from Lake Tana at an altitude of 1,820 meters (5,970 ft.) above sea level. The city is located approximately 578 km north-northwest of Addis Ababa, and a total population of 649,429 was estimated in 2012. Tibebe Ghion Specialized Hospital started service in 2011. Felege Hiwot Comprehensive and Referral Hospital (FHCSH) started to give service since 1955. The hospitals provide internal medicine, pediatrics, ophthalmology, general surgery, obstetrics and gynecology, ENT, dermatology, dentistry, psychiatry and orthopedics services. Department of Internal medicine has inpatient and outpatient units. There are around 1014 health professionals working in TGSH, among these there are four senior cardiologists and 58 internal medicine residents. There were a total of 1,400 chronic rheumatic heart disease patients, 700 patients in TGSH and 700 patients in FHCSH through the years 2021-2023 who had regular follow up at cardiac clinic. The study was conducted at cardiac referral clinic in Bahir Dar public referral Hospitals from October/2023 – November/2023 by reviewing patient cards who had follow up from August/2021- July/2023.

5.4. Population

5.4.1. Source Population

All chronic rheumatic heart disease patients attending cardiac clinic at public referral Hospitals in Bahir Dar

5.4.2. Study Population

Patients who had follow up for CRHD at cardiac clinic in Bahir Dar public referral Hospitals from August/2021- July/2023

5.4.3. Study unit

Each selected CRHD patients

5.5. Eligibility Criteria

5.5.1. Inclusion Criteria

We included patients with clinical and Echocardiographic evidence of CRHD

Patients who had Electrocardiography

5.5.2. Exclusion Criteria

Patients who do not had complete chart documentation and Electrocardiography

5.6. Sampling

5.6.1. Sample size determination

The sample size was determined by using the following assumptions; the proportion of AF was 46.8 % (from the study done in Ethiopia, Tikur Anbessa Specialized hospital)

$$n = \frac{Z_{\alpha/2}^2 p(1-p)}{d^2}$$

Where n= sample size

$Z_{\alpha/2}$ =standard normal distribution corresponding 95% significance=1.96

P = estimated proportion of AF in CRHD patient = 46.8% in a study done at Tikur

Anbessa Specialized Hospital

d = desired precision =5%

$$n = (1.96)^2 (0.468) (0.532) / (0.05)^2$$

$$n = 382$$

10% non - response rate = 38

Sample size = 420

5.6.2. Sampling technique

First proportional allocation was made for two hospitals then participants were selected using systematic random sampling techniques, from those Kth determined by N/n . The k value will be selected based on the sample from the total population. Then study participants will be selected every Kth interval after the first number will be randomly selected.

5.7. Study Variable

5.7.1. Dependent variable

Atrial Fibrillation

5.7.2. Independent variables

Sociodemographic and Behavioral Variables: Sex, Age, Residence, Alcohol consumption

Clinical Factors: -Heart failure, Diabetes Mellitus, Chronic kidney disease, Hypertension, Valve surgery

Echocardiography Variables: Mitral valve stenosis, Mitral valve regurgitation, Tricuspid valve regurgitation, Aortic valve stenosis, Aortic valve regurgitation, pulmonary hypertension, left atrial diameter, left ventricular ejection fraction

5.8. Definition of Terms and Operational Definitions

RHD: diagnosed by cardiologist doing the echocardiography based on 2012 WHF criteria

Atrial fibrillation: physician diagnosis with ECG evidence of atrial fibrillation

Heart failure (HF): a complex clinical syndrome that results from structural or functional impairment of ventricular filling or ejection of blood, which in turn leads to the cardinal clinical symptoms of dyspnea and fatigue and signs of HF, namely edema and rales. Based on severity of symptoms of heart failure, there are four categories of NYHA functional class. Class I - no limitation of physical activity, Class II - slight limitation of physical activity, class III - marked limitation of physical activity, class IV- if symptoms of HF occur at rest.

Oral anticoagulants: drugs that reduce the risk of formation of blood clots.

Pulmonary hypertension (PH): suggested Echocardiographically when the tricuspid regurgitant jet Velocity is $\geq 2.8 \text{ m.s}^{-1}$; the pulmonary systolic arterial pressure exceeds 35 mmHg

Left ventricular ejection fraction (LVEF): is a measurement, expressed as a percentage, of how much blood the left ventricle pumps out with each heart beat. It is classified as reduced EF when EF <40%, mildly reduced when EF between 41 to 49% and preserved EF when >50%. But for data extraction purpose, we classified into reduced LVEF when EF <50% and preserved LVEF when EF >50%. Left atrial (LA) diameter: represents the anterior posterior dimension of the left atrium measured using Echocardiography. normal LA diameter ranges between 20 to 40 mm.

Type of heart valve disease: represents either stenotic or regurgitant lesion of heart valves. There are four types of heart valves - mitral, aortic, pulmonic and tricuspid valve (MS, MR, TR, AR, AS).

Severity of heart valve disease: describes the degree of stenosis or regurgitant lesion of affected heart valve and it is graded as mild, moderate or severe by Echocardiography.

Mitral Stenosis (MS): type of heart valve disease and the severity of MS is assessed by Echocardiographically based on mitral valve area (MVA) measurement, mild MS - > 1.5 cm², moderate – 1 to 1.5 cm² and severe - < 1 cm²

Hypertension (HTN): On antihypertensive medications or previously diagnosed with HTN or SBP and /or DBP is $\geq 140/90$ mmHg from two measurements.

Diabetes Mellitus (DM): previously diagnosed DM patients on oral glucose lowering agents or on Insulin, or FBS ≥ 126 mg/dl and/or HbA1c $\geq 6.5\%$ on two measurements or RBS ≥ 200 mg/dl with poly symptom.

Chronic Kidney Disease (CKD): A physician diagnosis of CKD based on KDIGO criteria.

Alcohol consumption: on average ≥ 2 drinks/day for males and ≥ 1 drinks for females.

5.9. Data Collection Tool and Procedure

Pre-developed data collection format was used to collect data from the medical record. Data extraction checklist was prepared through reviewing a variety of literatures. The data were collected by medical professionals (two nurses who work there and three Internal medicine residents). Data collectors gathered Socio demographic and behavioral factors, Clinical factors, and Electrocardiography and Echocardiographic findings of the patient.

5.10. Data Quality Assurance

Training was given on how to collect the data for Internal medicine residents and nurses for one day. Data collection was supervised by the principal investigator. Pre- testing of the checklist

was conducted on 5% of the sample size (21 charts) in Tikur Anbessa specialized hospital. Based on the pre-test, the checklist was revised and edited with necessary modification.

5.11. Data management and Analysis

The principal investigator checked the collected data and any incomplete documents was cleaned, checked for quality prior to data entry and analyzed manually by using SPSS software version 26. The descriptive analysis was done by simple frequencies and proportions, and the results were presented by words and tables. Multicollinearity was checked between each independent variable. Binary logistic regression was used to assess the association between dependent and independent variables. All explanatory variables with $p\text{-value} \leq 0.25$ from bi-variable logistic regression model was fitted in to the multivariable logistic regression model to control the possible effect of confounders. The Hosmer and Lemeshaw test was used to test the model goodness of fit. Adjusted odds ratio (AOR) with 95% CI and $p\text{-value}$ less than 0.05 was used to determine variables significantly associated the outcome variable. Variables having $p\text{-value}$ less than 0.05 during multivariable regression was declared as significantly associated variables.

5.12. Ethical Considerations

Ethical clearance was obtained from Bahir Dar University Ethics Review Committee. A support letter was sent to public referral Hospitals in Bahir Dar. Names were not used in collecting the data from the medical files. Confidentiality was maintained by keeping the data collection forms locked in a secure cabinet and the electronic data file was kept securely in a password protected computer. Data obtained in the course of study was only handle by the research team.

6. RESULTS

6.1. Sociodemographic and behavioral characteristics

In this study, 410 charts of chronic rheumatic heart disease patients were reviewed, which was 97.62% from estimated sample size. Of those, 286(69.76%) were females and the rest 124 (30.24%) were males. The median age of the patients was 28 years and the range was 15 - 58 years. Majority of patients, 255(62.20%) were rural residents and the rest 155 (37.80%) were urban residents.

Table-1 Sociodemographic characteristics of Prevalence and associated factors of Atrial fibrillation among patients with Rheumatic heart disease attending public referral hospitals in Bahir Dar City, northwest Ethiopia, 2023(n=410)

Variables	Categories	Frequency	Percent
Sex	Female	286	69.76
	Male	124	30.24
Age	≤ 30	206	50.24
	> 30	204	49.76
Residence	Urban	155	37.80
	Rural	255	62.20
Alcohol consumption	No	399	97.30
	Yes	11	2.70

6.2. Clinical related characteristics

Among 410 chronic rheumatic heart disease patients, majority had heart failure 286(69.80%). Patients who had heart failure, near to half of them 132(46.10%) were under the category of New York heart association class IV. From all rheumatic heart disease patients, no one had diabetes mellitus. Majority of the patients had no hypertension, chronic kidney disease and history of valvular surgery.

Table 2 Clinical related characteristics of Prevalence and associated factors of atrial fibrillation among patients with Rheumatic heart disease attending public referral hospitals in Bahir Dar City, northwest Ethiopia, 2023(n=410)

Variables	Categories	Frequency	Percent
Heart failure	No	124	30.20
	Yes	286	69.80
If Heart failure Yes, its NYHA Class	NYHA class I	20	7.00
	NYHA class II	46	16.10
	NYHA class III	88	30.80
	NYHA class IV	132	46.10
Diabetes mellitus	No	410	100
	Yes	0	0
Chronic kidney disease	No	404	98.54
	Yes	6	1.46
Hypertension	No	398	97.07
	Yes	12	2.93
History of valvular surgery	No	383	93.41
	Yes	27	6.59

Abbreviation: NYHA, New York Heart Association

6.3. Echocardiographic characteristics

This study showed more than half of the patients had mitral stenosis, 294(71.70%). Among these patients, majority 229(77.9%) had severe mitral stenosis. Of 410 patients 324 (79.02%) had mitral regurgitation, among these more than half 168 (51.85%) had mild mitral regurgitation. This study showed that most patients had pulmonary hypertension 296(72.20%). Majority of patient's had enlarged left atrial diameter 294 (71.70%) and most patients left ventricular ejection fraction were normal, 373 (90.98%).

Table 3 Echocardiographic characteristics of Prevalence and associated factors of atrial fibrillation among patients with Rheumatic heart disease attending public referral hospitals in Bahir Dar City, northwest Ethiopia, 2023(n=410)

Variables	Categories	Frequency	Percent
Mitral stenosis	No	116	28.30
	Yes	294	71.70
If Mitral stenosis	Mild	46	15.60

Yes, its Grade	Moderate	19	6.50
	Severe	229	77.90
Mitral regurgitation	No	86	20.98
	Yes	324	79.02
If Mitral regurgitation yes, its Grade	Mild	168	51.85
	Moderate	90	27.78
	Severe	66	20.37
Tricuspid valve regurgitation	No	149	36.34
	Yes	261	63.66
If Tricuspid regurgitation yes, its Grade	Mild	98	37.55
	Moderate	85	32.57
	Severe	78	29.89
Aortic valve stenosis	No	365	89.02
	Yes	45	10.98
If Aortic stenosis yes, its Grade	Mild	19	42.22
	Moderate	12	26.67
	Severe	14	31.11
Aortic valve regurgitation	No	319	77.80
	Yes	91	22.20
If Aortic regurgitation yes, its Grade	Mild	64	70.33
	Moderate	17	18.68
	Severe	10	10.99
Pulmonary hypertension	No	114	27.80
	Yes	296	72.20
Left atrial diameter	Normal (< 40mm)	116	28.30
	Enlarged ($\geq$ 40mm)	294	71.70
Left ventricular ejection	Reduced (< 50%)	37	9.02
	Normal ($\geq$ 50%)	373	90.98

6.4. Prevalence of Atrial Fibrillation

The prevalence of atrial fibrillation in this study was 43% with 95% CI of 38% up to 48%.

6.5. Factors associated with Atrial Fibrillation

Sixteen possible variables believed to be associated with atrial fibrillation entered in bi-variable binary logistic regression model. Those were sex, age, residence, alcohol, heart failure, chronic kidney diseases, hypertension, history of valvular surgery, mitral valve stenosis, mitral valve

regurgitation, tricuspid valve regurgitation, aortic valve stenosis, aortic valve regurgitation, pulmonary hypertension, left atrial diameter and left ventricular ejection.

On bi-variable logistic regression analysis, nine variables were associated with atrial fibrillation. All these variables were entered into multi-variable binary logistic regression model. On the final multi-variable logistic regression model, five variables became significant (p-values less than 0.05) which were sex, age, heart failure, mitral stenosis and left atrial diameter.

In this study, 109(38.11%) female and 67(54.03%) male patients had atrial fibrillation during the study period. Being males were 3.81 times more likely to develop atrial fibrillation as compared to being female (AOR = 3.81, 95% CI 2.00-7.26). Patients with age > 30 years were 7.26 times more likely to develop atrial fibrillation as compared to patients ≤ 30 years old (AOR = 7.26, 95% CI 3.93-13.41). Patients who had heart failure were 4.65 times more likely to develop atrial fibrillation as compared to patients who had not heart failure (AOR = 4.65, 95% CI 2.39-9.04). Patients who had mitral valve stenosis were 6.36 times more likely to develop atrial fibrillation than patients who had not mitral valve stenosis (AOR = 6.36, 95% CI 2.92-13.87). Patients who had left atrial diameter enlargement 3.41 times more likely to develop atrial fibrillation as compared to patients who had normal left atrial diameter (AOR = 3.41, 95% CI 1.64-7.09).

Table 4 Bi-variable and Multi-variable Binary logistic regression of Prevalence and associated factors of atrial fibrillation among patients with Rheumatic heart disease attending public referral hospitals in Bahir Dar City, northwest Ethiopia, 2023 (n=410)

Variables	Category	AF		COR(95% CI)	AOR(95% CI)	P-value
		Yes	No			
Sex	Female	109	177	1	1	
	Male	67	57	1.91(1.24-2.92)	3.81(2.00-7.26)	<0.001*
Age category	≤ 30	53	153	1	1	
	> 30	123	81	4.38(2.88-6.67)	7.26(3.93-13.41)	<0.001*
Heart failure	No	17	107	1	1	
	Yes	159	127	7.88(4.49-13.83)	4.65(2.39-9.04)	<0.001*
History of valvular surgery	No	159	224	1	1	
	Yes	17	10	2.39(4.49-13.83)	3.04(0.99-9.37)	0.052
Mitral valve	No	11	105	1	1	

stenosis	Yes	165	129	12.21(6.29-23.68)	6.36(2.92-13.87)	<0.001*
Mitral valve regurgitation	No	42	44	1	1	
	Yes	134	190	0.74(0.46-1.19)	1.42(0.77-2.63)	0.254
Pulmonary hypertension	No	11	103	1	1	
	Yes	165	131	3.06(1.95-4.79)	0.84(0.44-1.63)	0.620
Left atrial diameter	Normal	17	99	1	1	
	Enlarged	159	135	6.86(3.91-12.05)	3.41(1.64-7.09)	<0.001*
Left ventricular ejection	Reduced	26	11	1	1	
	Normal	150	223	0.28(0.14-0.59)	0.79(0.32-1.96)	0.619

*** = indicate that the variable is significant at significant level of 0.05.**

7. DISCUSSIONS

This study finding showed that the prevalence of atrial fibrillation among chronic rheumatic heart disease patients was 43% with 95% CI of 38% up to 48%. The result showed that near to half of patients with chronic rheumatic heart disease exposed for atrial fibrillation. This finding was similar with study conducted in Ethiopia at St. Paul's Hospital Millennium Medical College that showed that the prevalence of atrial fibrillation was 43.5%(33). The similarity might be due to both studies used similar study design and diagnosis approach of atrial fibrillation.

The current finding was higher than study conducted at Gondar College of Medical Sciences Teaching Hospital and in Jimma zone that showed the prevalence of atrial fibrillation were 22.8% and 4.3% respectively(20, 23). The discrepancy might be due to small sample size used in a study done in Gondar College of medicine Teaching Hospital and the study conducted in Jimma was Community based in which majority of participants did not have underlying cardiac condition which might contribute to low prevalence of atrial fibrillation.

The current finding was less than study conducted in Ethiopia at Tikur Anbessa specialized hospital, which showed that the prevalence of atrial fibrillation was 46.8% (12). The discrepancy might be due to that patients in Tikur Anbessa hospital were from a major referral center of the country, which would likely attract more severe cases.

This study finding was less than studies conducted at Sub Saharan Africa, which showed the prevalence of atrial fibrillation was up to the range of 59% (29-32). The discrepancy might be due to patient selection criteria and diagnostic method of atrial fibrillation, they used Holter ECG monitor that may increase detection of atrial fibrillation. The current finding was much higher than studies conducted at Spain (4.40%) (26), Portugal (2.50%) and China (7.90%) (27, 28). The difference might be due to different Sociodemographic conditions and different clinical setting to manage patients.

This study showed that being male was more likely to develop atrial fibrillation as compared to being female. This finding was similar with a study conducted in China(39). The finding of this study is also supported scientifically that males are more likely to develop atrial fibrillation as compared to females(1). The present study showed that increased age was significantly associated with atrial fibrillation, in which patients >30 years old were more likely to develop atrial fibrillation as compared to patients $\leq$ 30 years. This finding was similar with studies conducted in Nepal and Turkey in which patients in the age group of 30 to 60 years was found to

be more likely to develop atrial fibrillation as compared to patients less than 30 years old (17, 49). When the age of patient increases, they will be exposed to more comorbidity, which precipitate the occurrence of atrial fibrillation among chronic rheumatic heart disease. The atrial myocardium undergoes electrical and structural remodeling with age, both of which may play an important role in the initiation or perpetuation of atrial arrhythmias.

The present study showed that patients who had heart failure were more likely to develop atrial fibrillation as compared to patients who had no heart failure. The finding was similar with studies conducted in India and Australia (37, 41-43). The similarities might be due to the reason that heart failure can increase the risk for development of atrial fibrillation through elevation of cardiac filling pressure, increased interstitial fibrosis, dysregulation of intracellular calcium, autonomic and neuroendocrine dysfunction which promotes structural remodeling and atrial fibrosis, thus altering atrial conduction properties and promoting atrial fibrillation.

This study showed that patients who had mitral valve stenosis were more likely to develop atrial fibrillation than patients who had not mitral valve stenosis. This finding was similar with study conducted in India(38, 50). Mitral valve disease causes left atrial dilatation, which is a common substrate for atrial fibrillation. Patients who had left atrial diameter enlargement were more likely to develop atrial fibrillation as compared to patients who had normal left atrial diameter. This result was consistent with studies conducted in other countries (44, 45, 51). The finding of this study is also consistent with American Heart Association guideline(52). If there is left atrial enlargement, more blood accumulates at the atrium, this makes the atrium fibrillated. As a result, the patient with left atrial diameter enlargement will develop atrial fibrillation. Left atrial enlargement with a consequent decrease in left atrium function represents maladaptive structural and functional remodeling that in turn promotes electrical remodeling and a milieu conducive for incident atrial fibrillation.

8. LIMITATION OF THE STUDY

Since the data was gathered from a secondary source, certain important variables such as patient behavioral variables, which could be associated with atrial fibrillation, were missed.

9. CONCLUSION

This study showed that the prevalence of atrial fibrillation in this study was 43% with 95% CI of 38% up to 48%. Sex, age, heart failure, mitral valve stenosis and left atrial diameter enlargement were associated with atrial fibrillation among patients with chronic rheumatic heart disease.

10. RECOMMENDATION

For health care providers/professionals

The health care professionals better to give special attention and clinical care as accordingly for patients with associated factors of atrial fibrillation such as advanced age, heart failure, mitral valve stenosis and left atrial diameter enlargement.

Screening of high-risk patients is also important

For health organizations and concerned bodies

Higher health-care organizations better to give a greater emphasis on the preparation of guideline regarding the prevention of atrial fibrillation through avoiding of the exposing factors and providing necessary resources for all health-care facilities, as they need.

For researchers

The future researchers undertake studies on primary data that able to including different variables (different behavioral variables) that missed in this study.

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12. ANNEX: REQUEST FORM FOR ETHICAL CLEARANCE

Date.....

To BDU/CMHS Ethics Committee

Subject: To get ethical clearance for my research

I am Dr. Adanech Mengie, a second-year medical resident in Bahir Dar university college of medicine and health sciences, I would like to apply to your office to have ethical clearance to conduct research on the prevalence and factors associated with atrial fibrillation among patients with CRHD attending public referral Hospitals in Bahir Dar city; as partial fulfillment for the requirement of specialty program in internal medicine. Data will be extracted using a prepared questionnaire; confidentiality of records will be kept. The results of this research will show the prevalence and associated factors of atrial fibrillation among patients with CRHD attending public referral Hospitals in Bahir Dar city.

With regards

Dr. Adanech Mengie (Year II Medical Resident)

13. DATA COLLECTION CHECK LIST

The following is a check list for data collection for the research on prevalence and associated factors of atrial fibrillation among patients with CRHD attending at public referral Hospitals of Bahir Dar city. It has 4 parts: part one for socio-demographic characteristics; part two for clinical history and behavioral factors; part three for echocardiographic profile of patients and part four outcome variable

Identification related information

Data collector's Name: _____ Signature: _____ Date _____

Supervisor's Name: _____ Signature: _____

Checklist Code No: _____ Hospital Name: _____

Part-I: sociodemographic variables

Table 1: Sociodemographic variables for prevalence and factors associated with atrial fibrillation among patients with CRHD attending at public referral Hospitals of Bahir Dar city, Amhara, Ethiopia, 2023

Sno	Variable(questions)	Answers	Codes	Skipping	Remarks
101	Sex of the patient?	Male	0		
		Female	1		
102	Age of the patient?	_____			Put in years
103	Residence?	Urban	0		
		Rural	1		

Part two: Clinical History and Behavioral Factors

Table 2: Clinical History and Behavioral variables for prevalence and factors associated with atrial fibrillation among patients with CRHD attending at public referral Hospitals of Bahir Dar city, Amhara, Ethiopia, 2023

Sno	Variable(questions)	Answers	Codes	Skipping	Remarks
104	Heart Failure	No	0		
		Yes	1		
105	If Heart failure yes, NYHA class?	NYHA class I	0		
		NYHA class II	1		
		NYHA class III	2		

		NYHA class IV	3		
106	Diabetes mellitus?	No	0		
		Yes	1		
107	Chronic kidney disease?	No	0		
		Yes	1		
108	Hypertension?	No	0		
		Yes	1		
109	History of valvular surgery?	No	0		
		Yes	1		
110	Alcohol consumption	No	0		
		Yes	1		

Part three : Echocardiographic profile

Table 3: Echocardiographic profile of patients for prevalence and factors associated with atrial fibrillation among patients with CRHD attending at public referral Hospitals of Bahir Dar city, Amhara, Ethiopia, 2023

Sno	Variable(questions)	Answers	Codes	Skipping	Remarks
111	MS?	No	0	If Q111 no go to Q113	
		Yes	1		
112	If MS yes, it is?	Mild	0		
		Moderate	1		
		Severe	2		
113	MR?	No	0	If Q113 no go to Q115	
		Yes	1		
114	If MR yes, it is	Mild	0		
		Moderate	1		
		Severe	2		
115	TR?	No	0	If Q115 no go to Q117	
		Yes	1		
116	If TR yes, it is?	mild	0		
		Moderate	1		
		Severe	2		
117	AS?	No	0	If Q117 no go to Q119	
		Yes	1		
118	If AS yes, it is?	Mild	0		
		Moderate	1		
		Severe	2		
119	AR?	No	0	If Q119 no	

		Yes	1	go to Q121	
120	If AR yes, it is?	Mild	0		
		Moderate	1		
		Severe	2		
121	Pulmonary HTN?	No	0		
		Yes	1		
122	Left atrial diameter		Write in mm		
123	Left ventricular ejection		Write in percent		

Part-IV: Outcome Variable

Table 4: Outcome variable information for prevalence and factors associated with AF among patients with CRHD attending at public referral Hospitals of Bahir Dar city, Amhara, Ethiopia, 2023

Sno	Outcome variable	Category	Code	Remark
124	Atrial fibrillation (AF)	No	0	
		Yes	1	