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Rheumatic heart disease burden and determinants in cardiac patients: A follow up care concern in Ethiopia

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ABSTRACT

Rheumatic heart disease (RHD) is a neglected tropical disease and remains one of the leading causes of cardiovascular-related deaths in Ethiopia. This study aims to assess the burden of RHD and identify its determinants in the country. A hospital-based cross-sectional study was employed from January 5 to April 15, 2023, among cardiac patients attending Jimma Medical Center. Socio-demographic data were collected using a structured interviewer-administered questionnaire and echocardiographic patterns were taken by senior cardiologists. Data were entered into Epidata Version 4.6 and exported to SPSS version 25.0 for analysis. Bivariable and multivariable logistic regressions were performed. A p value < 0.05 was considered statistically significant. Accordingly, the most frequent morbidities were RHD ($n = 95$, 27.9%), hypertensive heart disease ($n = 92$, 27.1%), ischemic heart disease ($n = 54$, 15.9%), and dilated cardiomyopathies ($n = 54$, 15.9%). Further, female sex [AOR = 3.06: 95% CI 1.73–5.47], using wood (biomass fuel) for cooking [AOR = 1.94: 95% CI 1.10–3.42], history of malnutrition with follow-up at a health facility [AOR = 3.90: 95% CI 2.22–6.86], dental caries [AOR = 2.09: 95% CI 1.12–3.87], and living in crowded households [AOR = 2.02: 95% CI 1.15–3.52] were identified as the determinants of RHD. This finding suggests that focusing on female healthcare, reducing biomass fuel exposure, improving nutritional status, providing regular dental care, and improving living conditions could help reduce the impacts of the disease. Moreover, conducting further research regularly will also benefit the community at large.

1. Background

Cardiovascular disease (CVD) refers to all illnesses that affect the heart and circulatory system of the body, including the blood vessels and the heart's valves [1]. According to estimates from the World Health Organization, 17.9 million deaths worldwide in 2016 were attributable to CVD. The majority of CVD mortality occurs in low- and middle-income nations [2]. Ethiopia is a nation undergoing an epidemiologic transition, with non-communicable diseases, including CVD, becoming the leading causes of disease and mortality. However, novel approaches for reducing the risks have been rarely developed and put into practice [3,4].

Rheumatic heart disease develops as a result of an immunological reaction initiated in the innate immune components of the pharyngeal epithelium, which gradually results in valvular damage. This can lead to a number of long-term structural and hemodynamic consequences, including heart failure, atrial fibrillation, and stroke [5,6].

Various studies in Africa have found that RHD is the most common cause of morbidity in adolescents and young adults, accounting for up to 34% of hospital admissions related to cardiovascular morbidity [7]. In Africa, individuals with severe RHD often succumb to their condition without undergoing necessary heart surgery. The majority of these patients face limited access to surgical interventions due to the continent having only 1% of the global supply of cardiothoracic surgeons [8].

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According to the Global Burden of Disease Study, the rate of disability-adjusted life years related to RHD was 10.67 million in 2019, with low- and middle-income nations accounting for the majority of the burden [9]. Similarly, RHD results in significant financial losses for nations due to the early deaths of young adults and working-age individuals, with an estimated cost of 2.2 trillion dollars annually [10]. Even though Group A Streptococcus bacteria (GAS) is among the top ten causes of death worldwide, the scientific community does not pay much attention to the disease. Sub-Saharan Africa has continued to be the hotspot for RHD [11]. A visible indicator of this is the Drakensberg Declaration, which has provided momentum for several studies demonstrating that the burden of RHD is significantly higher than previously thought in 2005. This is evidenced by the rate of 30 per 1000 among Mozambican schoolchildren, which clearly proves the severity of the disease [12].

Based on echocardiographic research from six major referral hospitals in Ethiopia, RHD accounts for up to 40.5 % of cases [13]. A study from Dabat Health Center in Amhara Region disclosed that the overall mortality rate in patients with RHD was 125.3 per 1000 person and the mean age at death was 22 years [14].

Even though RHD is a well-known complication of Acute Rheumatic Fever (ARF), not all ARF patients develop it. A number of risk factors can render individuals more susceptible to acquiring RHD [15]. Literature highlights various factors associated with the risk of developing rheumatic heart disease. Genetic, socio-economic, nutritional, environmental, health facility-related factors, and hygiene-related factors all play a crucial role in influencing the likelihood of developing this condition [16–19]. A study conducted in Bangladesh reported that being a woman, urban resident, living in a brick-built house, having more than two siblings, and not brushing teeth after meals were identified as risk factors for RHD [20]. In contrast, a cross-sectional study in Tanzania indicated that overcrowding, age, and malnutrition are not risk factors for developing RHD [21]. Similarly, a study in Assam, India, found that a low monthly income is associated with an increased risk of RHD [22]. However, a study from Uganda did not demonstrate that low income is an associated factor for having RHD [23].

Except for a few fragmented studies on the prevalence of RHD in Ethiopia, there have been no comprehensive studies conducted on the risk factors for RHD in the country so far.

Therefore, this study was carried out to describe the burden of RHD and its determinants among patients who started follow-up at Jimma Medical Center (JMC) cardiac follow-up clinic. The study aimed to address the World Heart Federation (WHF) non-communicable disease action plan, which was developed for the World Health Assembly in 2013. This plan calls for a 25 % reduction in premature mortality from RHD by the year 2025, also known as the "25 by 25" target.

2. Methods

2.1. Study design, period, and setting

An institution-based cross-sectional study was conducted at JMC from January 5 to April 15, 2023. The center serves 15 million outpatients and 16,000 inpatients each year, with various departments operating 24 h a day. One of its departments, internal medicine, comprises a separate cardiac unit, which contains 122 beds and admits an average of 102 patients per month for various complaints [24]. It provides various medical services, including echocardiography, electrocardiogram, CT scan, MRI, and basic laboratory tests. The cardiac clinic is one of the many chronic follow-up clinics at the hospital, occurring twice weekly.

Two adult cardiologists used a Toshiba Aplio™ ultrasound system (TUS-A500, Shimoiishigami, Japan) to diagnose various CVDs in accordance with the standards of the American Society of Echocardiography [25]. In contrast, other cardiac diseases were diagnosed through echocardiography following their specific diagnostic protocols.

Echocardiographic parameters assessed include left ventricular ejection fraction, left ventricular dimensions, aortic root diameter, left atrial diameter, and tricuspid annular plane systolic excursion. Additionally, fractional shortening was measured to estimate left ventricular function, and left atrial size was assessed to determine pressure overload. Blood flow patterns across the affected valves were also analyzed to evaluate the severity of valve dysfunction.

2.2. Study population and eligibility

All cardiac patients attending follow-up at JMC cardiac clinic were the source population, and the study population were all selected adult cardiac patients attending follow-up at JMC cardiac clinic who fulfilled the inclusion criteria. Patients with a clinical diagnosis of any cardiovascular disease who were taking follow-up during the study period were included in the study. Patients aged 15 and above were treated as adults. However, individuals with comorbidities such as severe liver or kidney disease, uncontrolled diabetes, or active cancer were excluded from the study. Additionally, participants with serious medical conditions, those unable to provide informed consent were also excluded.

2.3. Operational definitions

Rheumatic heart disease was diagnosed based on the echocardiographic imaging criteria of WHF. The criteria include pathological (seen in two views, jet length, velocity, pan-systolic/pan-diastolic jet in at least one envelope) and morphological features (thickening, restricted leaflet motion, prolapse, coaptation defect, excessive leaflet tip motion) for valve regurgitation, and a gradient increase of ≥ 4 mmHg in mitral stenosis. The physiology of heart valves and the severity of the dysfunction were quantified [26].

History of malnutrition and follow-up at a health facility refers to patients who have been admitted to the hospital at least once in the past due to a diagnosis of malnutrition, with approval provided orally.

The presence of dental caries is the number of teeth that have fallen out or been lost by the patient due to dental caries (tooth decay), as reported by the patient and verified through clinical examination or patient history.

2.4. Sample size determination and sampling procedure

The sample size was determined using Epi Info STAT CALC Version 7.2.4.0 by considering the following assumptions: prevalence of rheumatic heart disease taken from a previous study (40.5 %) done in Tikure Anbesa Hospital [13], 95 % confidence level, 5 % margin of error, and population size of cardiac patients of 2345. Finally, a sample size of 352 was obtained by considering a 10 % nonresponse rate. Lists of all cardiac patients are taken from the hospital registration log book. Hereby, the study participants were selected by a simple random sampling technique using a computer-generated method until the required sample size was achieved (Fig. 1).

2.5. Data collection tools and procedures

Data were collected by four trained BSc nurses who were employed at the cardiac clinic. The data collectors were trained for two days prior to the data collection regarding the purpose of the study, interviews, measurement techniques, and ethical issues. An interviewer-administered structured questionnaire was used to assess socio-demographic variables and hygiene-related factors, whereas echocardiographic findings were done by adult cardiologists from the cardiac clinic. The questionnaire was initially prepared in English, translated to Amharic and Afan Oromo, and retranslated back to the English language for consistency. On each data collection day, all the collected data were reviewed by the principal investigator for completeness, accuracy, and clarity. A pre-test was conducted on 5 % of the patients at a different

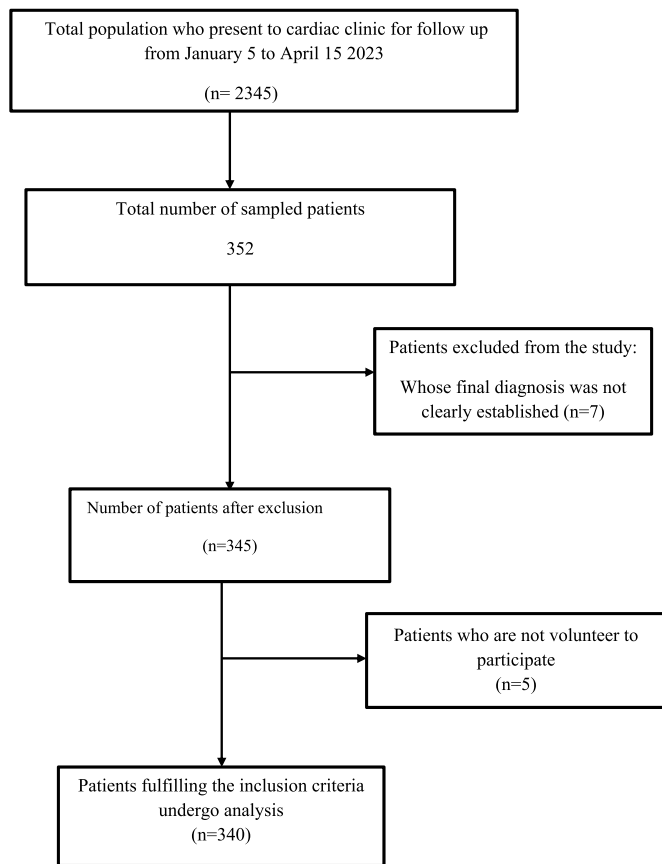


Fig. 1. A flow chart showing the recruitment of study participants.

facility with a similar setup.

Weight and height were measured using a combined height and weight scale (made in India; manufactured date: March 2017). The participant’s weight was calculated to the nearest 0.1 kg without shoes or heavy clothing, while their height was calculated to the nearest 0.1 cm while they were standing straight, their arms at their sides, and their gaze straight ahead. Body mass index (BMI) was computed by dividing the weight by the square of height.

2.6. Data process and analysis

Data were entered into EpiData Version 4.6 statistical software and exported to Statistical Package for the Social Sciences (SPSS) version 25. Data cleaning was performed before the actual data analysis. Descriptive statistics for frequencies, mean, and standard deviation were performed to summarize the dependent and independent variables. Bivariable and multivariable logistic regressions were performed to determine the association between dependent and independent variables. Binary logistic regression analysis was used to determine the crude relationship between rheumatic heart disease and independent variables that was expressed in the confidence interval, odds ratio, and p-value. Variables with a p-value of ≤ 0.25 were selected as candidates for multiple logistic regression analysis using a backward stepwise approach. This method aimed to assess the impact of each independent variable on the dependent variable, reporting the results in terms of adjusted odds ratios, confidence intervals, odds ratios, and p-values.

Model fitness was tested with the Hosmer-Lemeshow test and multicollinearity of the variables was checked via tolerance test and variance inflation factor. Statistical significance was set at p-value of < 0.05 .

3. Result

3.1. Socio-demographic characteristics of the participants

A total of 340 participants were enrolled in the study, making a 97 % response rate. Of those enrolled, 156 (45.9 %) were males, while 184 (54.1 %) of them were females. The mean ages of participants were 42.07 ± 15.79 years, with a minimum of 15 and a maximum of 78 years. Concerning educational status, 160 (47.1 %) of respondents cannot read and write; more than one-fourth (27.4 %) were farmers. The average monthly income of the recruited participants were 56 US\$ as shown (Table 1).

3.2. Cardiac disease distribution among patients who underwent echocardiography examinations in JMC

Out of the 340 individuals sampled with cardiovascular disorders who underwent echocardiography diagnosis, 95 (27.9 %) had RHD, 92 (27.1 %) had hypertensive heart disease (HHD), 54 (15.9 %) had dilated cardiomyopathy, 12 (3.5 %) had congenital heart disease, and 20 (5.8 %) had other types of heart diseases (Table 2).

3.3. Factors associated with rheumatic heart disease

Fourteen variables are included in the studies: place of residence, age, sex, occupation, literacy status, monthly income, BMI, distance from facilities, number of households, history of chronic illness in the family, source of energy for cooking, source of water, follow-up with malnutrition at health facilities, and presence of dental caries.

In the bivariate analysis, variables such as sex, place of residence, history of chronic illness in the family, source of water, source of energy for cooking, history of malnutrition with follow-up at a health facility, number of households living together, and presence of dental caries

Table 1

Socio-demographic characteristics of cardiac patients attending follow-up at JMC cardiac clinic from January 5 to April 15, 2023, (n = 340).

Variables	Category	Frequency	Percentage
Place of residence	Urban	167	49.1
	Rural	173	50.9
Sex	Male	156	45.9
	Female	184	54.1
Age(years)	15–24	38	11.2
	25–34	35	10.3
	35–44	60	17.6
	45–54	55	16.2
	55–64	91	26.8
	≥ 65	61	17.9
Educational status	Cannot read and write	160	47.1
	Can read and write with no formal school attendance	15	4.4
	Primary school	76	22.4
	Secondary school	60	17.6
Occupation	Above secondary	29	8.5
	Government employ	26	7.6
	Merchant	93	27.4
	Farmer	70	20.6
	Self-employ	51	15.0
	House wife	60	17.6
House hold monthly income (US\$)	≤ 35	106	31.2
	35–75	176	51.8
	> 75	58	17.0
Distance from facilities(KM)	1–5	229	67.4
	6–10	39	11.5
	11–20	25	7.4
	21–30	47	13.8
Family size	≤ 5	204	60.0
	> 5	136	40.0

* Retired, student and unemployed.

Table 2

Echocardiographic diagnostic classifications by age in cardiac patients attending follow-up at JMC cardiac clinic from January 5 to April 15, 2023 (n = 340).

Type of cardiac disease	Age of cardiac patients						Total, (No %)
	15–24	25–34	35–44	45–54	55–64	65 above	
Rheumatic heart disease	29	19	24	17	4	2	95(27.9)
Ischemic heart disease	0	0	8	11	19	16	54(15.9)
Hypertensive heart disease	0	0	27	9	47	9	92(27.1)
Dilated cardiomyopathy	15	0	0	10	10	19	54(15.9)
Congenital heart disease	0	4	4	4	0	0	12(3.5)
Hypertrophic cardiomyopathy	0	0	0	0	0	6	6(1.8)
Restrictive cardiomyopathy	0	5	2	0	0	0	7(2.1)
Other types of cardiac diseases **	0	0	0	6	7	7	20(5.8)
Total	44	24	61	57	91	63	340(100)

** Pericardial disease, degenerative valvular disease, Cor pulmonale.

before the diagnosis of disease were candidate variables for multiple logistic regression (p value ≤ 0.25). Multivariate analysis was then performed to control confounders, and five variables like sex, main family food cooking materials, history of malnutrition with follow-up at a health facility, presence of dental caries, and number of households living together showed a statistically significant association with RHD (p < 0.05) (Table 3).

Accordingly, by keeping all other variables constant, the odds of having RHD were three times higher in female patients compared to male patients (AOR = 3.06; 95 % C.I. 1.73–5.47; p value < 0.001). Cardiac patients treated with malnutrition at health facilities were nearly four times more likely to have RHD than those without malnutrition (AOR = 3.90; 95 % CI 2.22–6.86; p value < 0.001). Cardiac patients who use wood as a source of fuel for cooking had almost a two-fold risk of having RHD as compared to patients who use electricity as a source of energy (AOR = 1.94; 95 % CI 1.10–3.42; p value = 0.021). Similarly, patients who had more than five households had a twofold risk of having RHD as compared to those who had fewer than five households (AOR = 2.02; 95 % CI 1.15–3.52; p value = 0.013). Patients who have dental caries were two times more likely to have RHD than patients without dental caries (AOR = 2.09; 95 % CI 1.12–3.87; p value = 0.019).

4. Discussion

Evidence suggests that CVDs stand as the primary cause of morbidity and mortality on a global scale. The incidence of CVD cases in Ethiopia exhibited a twofold increase in 2017 compared to 1990, a trend attributed to rapid population expansion and the rising proportion of elderly

individuals within the population [27]. Nevertheless, there are a limited number of studies available to show the burden, distribution, and determinants of CVDs, including RHD, in nations with limited resources. Therefore, this study aimed to determine the burden of RHD and its determinants among cardiac patients attending a follow-up clinic.

In the present study, the overall prevalence of RHD was 27.9 %, making it the most frequently encountered etiology of cardiovascular disorders. This finding was nearly comparable to a study conducted in south Ethiopia, which reported a prevalence of 29.7 % [28]. However, studies in south India [29], and Uganda [30], reported higher rates of RHD, at 64.3 % and 55.4 % respectively. Furthermore, the magnitude of RHD in the current study is much higher than in other studies in north Ethiopia [31], the south-west region of Cameroon [32], and the Nigerian Savannah [33], where the range is between 6.7 % and 18.2 %. Factors such as genetic variations, economic status, cultural practices, access to healthcare, and public health initiatives may help explain the variations observed across these studies.

According to the present finding, female sex was significantly associated with having rheumatic heart disease. This finding is supported by several studies [27–30]. In contrast, research by Mutagaywa et al. reveals that there are no variations in the occurrence of RHD with regard to sex [34]. None of the literature we appraised was able to identify an explanation for the difference in sex-specific prevalence. There is no established explanation for the increased prevalence of RHD among women in our population. Gender disparities in healthcare access exist in many regions of Ethiopia; females face barriers to accessing healthcare services compared to males due to limited financial resources, cultural norms, and geographic challenges, which can all contribute to delayed or inadequate medical care [35]. The other possible genetic or

Table 3

Bivariable and multivariable logistic regression model of factors independently associated with rheumatic heart disease among cardiac patients attending follow-up at JMC cardiac clinic, 2023 (n = 340).

Variables	Categories	RHD		Bivariable result		Multivariable result	
		Yes (n)	No (n)	p value	COR(95%CI)	p value	AOR(95%CI)
Place of residence	Rural	42	125	0.24	1.3(0.82–2.1)	—	—
	Urban	53	120				
Sex	Female	70	114	0.001	3.22(1.91–5.41)	0.001	3.06(1.73–5.47)
	Male	25	131				
Number of house hold living together (Family size)	>5	50	88	0.001	0.031(0.19–0.51)	0.013	2.02(1.15–3.52)
	≤5	45	157				
Sources of water	Spring	21	71	0.14	1.5(0.9–2.7)	—	—
	River	13	25				
	Tap	61	144				
Source of energy for cooking	Animal waste	5	8	0.09	0.37(0.11–1.20)	0.391	0.56(0.15–2.10)
	Wood	54	82				
	Electric power	36	155				
History of chronic disease in the family	Yes	52	149	0.21	1.2(0.81–2.10)	—	—
	No	43	96				
History of malnutrition and follow-up at health facility	Yes	67	81	0.001	0.20(0.12–0.34)	0.001	3.90(2.22–6.86)
	No	28	164				
Presence of dental caries	Yes	37	45	0.001	0.35(0.20–0.59)	0.019	2.09(1.12–3.87)
	No	58	200				

biological reason could be due to the effect of estrogen on B cells, resulting in increased antibodies and autoimmune disease responses to infection, vaccines, and autoantigens that predispose females to RHD. On the contrary, androgens decrease B-cell maturation, reduce B-cell synthesis of antibodies, and suppress autoimmune disease production [33,36]. Studies also suggest that menopause effect with increased blood pressure, increased sympathetic tone, abnormal lipid metabolism, increased fat distribution, and increased deposition of collagen and elastin in the heart, which may accelerate aortic and mitral valve degeneration and calcification [37]. Additionally, pregnancy causes hyper dynamic circulation, and cardiovascular changes like increased blood volume, heart rate, and cardiac output may reveal an undiagnosed valvular lesion in an asymptomatic patient [38].

In the current study, the use of wood (biomass fuel) as a primary energy source for cooking has been significantly associated with the presence of RHD. This finding is consistent with previous studies conducted in the United Kingdom [39] and Sri Lanka [40]. This could be due to the fact that biomass fuel produces toxic smoke, which upon inhalation acts as an endogenous source of local inflammation by increasing the level of anti-endothelial cell antibodies and further increasing the number of circulatory neutrophils and monocytes [41]. Additionally, it has been reported that low-level autoantibodies are triggered by exposure to smoke. Initial exposure to biomass smoke may lead to a sensitization phase with a low level of cross-reactive antibodies. These antibodies may increase significantly upon streptococcal infection, potentially contributing to the development of RHD [42].

The other factor that shows an association with RHD is a history of malnutrition and follow-up at a health facility. This study is consistent with studies conducted in Bangladesh [19] and India [43]. In contrast, a cross-sectional study in Tanzania found that malnutrition is not a risk factor for developing RHD [21]. The possible justification for malnutrition to cause RHD might be that malnutrition can weaken the immune system, make individuals more susceptible to infections, impair the tissue repair process, and increase the severity of valve damage. Malnutrition can also lead to chronic inflammation and increased oxidative stress in the body. This inflammatory response can contribute to the progression of RHD by exacerbating damage to the heart valves and promoting a pro-inflammatory environment that further fuels the disease process [44].

In the current study, the presence of dental caries was identified as an independent risk factor for RHD. Patients who had dental caries were twice as likely to develop RHD compared to patients without dental caries. This is supported by studies conducted in New Zealand [45], Australia [46], and Turkey [47]. The possible mechanism could be that dental caries can provide a breeding ground for bacteria, including streptococcal pyogenes, within the oral cavity. When dental caries progresses and cavities deepen, it can lead to the exposure of the dental pulp, which contains blood vessels and nerves. Bacteria can reach the pulp, allowing them to enter the bloodstream [48]. Furthermore, the presence of dental caries can also contribute to a generally weakened immune response. The constant exposure to oral bacteria and the resulting chronic inflammation can disrupt the immune system's balance, potentially making the body more susceptible to infections [49].

Finally, this study justifies the association between RHD and the number of households living together. Patients who live in households with more than five members have double the risk of developing RHD compared to those in smaller households. This finding is consistent with studies conducted in Uganda [23] and Bangladesh [20]. Conversely, a separate study conducted in India did not find any association between household crowding and the presence of RHD [50]. The potential mechanism for overcrowding to cause RHD could be attributed to the close proximity of individuals in overcrowded households, which increases the likelihood of GAS bacteria transmission and increases the risk of reinfection and recurrence. In overcrowded households, access to healthcare services may be limited, leading to delayed or inadequate treatment for streptococcal infections that might result in repeated

episodes of inflammation in the heart valves. This can eventually lead to damage and the development of RHD [51].

5. Limitation of the study

The primary limitation of the study is that it only includes patients from a hospital setting, which hinders the ability to generalize the findings to the general population. Another limitation is the small number of patients with RHD, which reduce a precise statistical analysis of the disease's risk factors. Additionally, relying on patients' self-reported history to confirm past malnutrition and dental caries may introduce bias. Furthermore, the cross-sectional design of the study prevents the establishment of a cause-and-effect relationship.

6. Conclusion and recommendation

In the present study, the majority of cardiac illnesses are related to RHD. Specifically, sex, using wood (biomass fuel) for cooking, malnutrition, the presence of dental caries, and living with more than five households were identified as contributing factors to the problem. In the study population, females had a threefold greater chance of having RHD than males. To address these challenges, targeted healthcare programs specifically for women should be developed, utilizing the grassroots government structures of women's development armies in Ethiopia to raise awareness about RHD and its risk factors. Moreover, engaging with community health workers or local organizations to raise awareness about RHD and its risk factors, based on the study findings, is crucial. Such initiatives can greatly enhance public health education and preventive strategies. Further interventions to mitigate the health risks arising from overcrowding, malnutrition, indoor pollution, and dental caries should be solved through awareness creation, introducing modern cooking technologies, getting routine dental care, and maintaining good oral hygiene. Finally, conducting awareness campaigns that educate the public about RHD, its risk factors, and preventive measures, while engaging community leaders for effective outreach, will be vital in combating this pressing health issue.

CRediT authorship contribution statement

Hiwot Berhanu: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Elsah Tegene:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Morankar Sudhakar:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Tadesse Dukessa Gemechu:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Andualem Mossie:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Availability of data and materials

Data will be accessible from the corresponding author upon request.

Ethics approval and consent to participate

The study was conducted according to the Helsinki Declaration. The research methodology employed in this study was approved by the

Ethics Board of Jimma University Institute of Health on December 15, 2022; with reference number JUIH/IRB 277/2022. Prior to commencing data collection, the researchers followed the protocols outlined by the administrative department of Jimma Medical Center, which involved obtaining informed consent in writing from all participants. Participants were informed of their right to withdraw from the study at any time and that their participation was voluntary. Subsequent to the data collection phase, the information was de-identified and safely preserved in a secure storage facility, ensuring confidentiality by restricting access solely to authorized personnel.

Consent for publication

Not applicable.

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Abbreviations

AOR	Adjusted odds ratio
ARF	Acute Rheumatic Fever
BMI	Body mass index
CI	Confidence interval
COR	Crude odds ratio
CVD	Cardiovascular disease
DCMP	Dilated cardiomyopathy
GAS	Group A Streptococcus
HCMP	Hypertrophic cardiomyopathy
HHH	Hypertensive heart disease
IHD	Ischemic heart disease
JMC	Jimma Medical Center
LV	Left ventricle
SD	Standard deviation
SPSS	Statistical Package for the Social Sciences
US\$	United States dollar
WHF	World Heart Federation

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