Indonesian Journal of Cardiology
Indonesian J Cardiol • Vol. 47 • 2026
pISSN: 2830-3105 / eISSN: 2964-7304
doi: 10.30701/ijc.1996

Original Article

Demographic Profile and Clinical Characteristics of Newly Diagnosed Mitral Stenosis Patients February–September 2024 at Brebes General Hospital, Indonesia

Dwiana Rosida[1], Jagaddhito Probokusumo[2]

Abstract

Background: Mitral Stenosis (MS) is a common valvular manifestation of Rheumatic Heart Disease (RHD) and remains prevalent in low- and middle-income countries. Data describing the demographic, clinical, and echocardiographic characteristics of newly diagnosed MS patients in low socioeconomic settings in Indonesia are limited. This study aimed to describe the demographic profile, clinical characteristics, and echocardiographic findings of newly diagnosed MS patients at Brebes General Regional Hospital.

Methods: This observational, descriptive, cross-sectional study was conducted at the cardiology outpatient clinic of Brebes General Regional Hospital in Central Java, Indonesia, from 1 February to 30 September 2024. Adult patients with a first-time diagnosis of MS confirmed by transthoracic echocardiography were included. Demographic and socioeconomic data were obtained through structured interviews, while clinical and echocardiographic data were collected from medical records.

Results: A total of 56 patients were included. Most patients were female (69.6%) and middle-aged (mean age 50 ± 16.3 years), with the majority having low socioeconomic status. Non-isolated (mixed) MS was observed in most patients. Echocardiographic evaluation showed reduced left ventricular systolic function (mean LVEF 42.8 ± 11.2%) and impaired Right Ventricular (RV) systolic function (mean TAPSE 16.6 ± 2.6 mm). The mean tricuspid regurgitation Maximum Velocity (TR Vmax) was 2.89 ± 0.61 m/s. Despite these findings, most patients presented with mild functional limitation (New York Heart Association [NYHA] class I–II).

Conclusions: Newly diagnosed MS patients at Brebes General Regional Hospital were predominantly middle-aged women with low socioeconomic status and mixed valvular involvement. Quantitative echocardiographic assessment demonstrated impaired left and RV function, underscoring the importance of early detection and comprehensive echocardiographic evaluation in low-resource settings.

Keywords: Mitral Stenosis, Rheumatic Heart Disease, Echocardiographic, Socioeconomic Status, Clinical Characteristics

[1]Emergency Department, Brebes General Hospital, Central Java, Indonesia.
[2]Cardiology Department, Brebes General Hospital, Central Java, Indonesia.

Correspondence:
Jagaddhito Probokusumo,

Cardiology Department, Brebes General Hospital, Central Java, Indonesia.

Email: jagaddhitoprobokusumo@gmail.com

Introduction

Rheumatic Heart Disease (RHD) remains a major public health problem in low- and middle-income countries and continues to contribute substantially to cardiovascular morbidity.[1] Mitral Stenosis (MS) is one of the most common valvular manifestations of RHD and may lead to complications such as heart failure, atrial fibrillation, pulmonary hypertension, and cardioembolic stroke.[2-3] Despite global reductions in Acute Rheumatic Fever (ARF), RHD-related MS remains prevalent in regions with limited access to early diagnosis and preventive healthcare.

In patients with MS, chronic pressure overload results in progressive morphological changes of the mitral valve and left atrium, leading to plasma volume expansion, pulmonary venous congestion, and subsequent pulmonary hypertension. These pathophysiological changes contribute to the gradual development of clinical symptoms and functional limitation.[4-6]

Indonesia is considered an endemic country for RHD and ranks among those with the highest disease burden worldwide. However, contemporary national data describing the demographic and clinical characteristics of patients with newly diagnosed MS remain limited. Most available studies focus on patients with advanced disease or those undergoing surgical intervention, while data at the time of initial diagnosis, particularly in low socioeconomic settings, are scarce.

Socioeconomic factors play an important role in the persistence and progression of RHD. Low income, limited access to healthcare services, suboptimal living conditions, and inadequate health literacy may contribute to delayed diagnosis and treatment. Patterns of healthcare access, including referral status (visit type), may reflect barriers to early detection and continuity of care in resource-limited settings. Understanding these factors is essential for optimizing early diagnosis and referral strategies.

Brebes Regency is one of the most densely populated districts in Central Java and is characterized by a predominantly agricultural economy.[7-8] The region has a relatively low socioeconomic profile, with many residents working as farmers or informal workers. Local health office reports have indicated an increasing burden of non-communicable diseases, including cardiovascular disease. However, data specifically describing the demographic profile, clinical presentation, socioeconomic characteristics, and hygiene-related factors of patients with MS in this region are lacking.[9-11]

Therefore, this study aimed to describe the demographic characteristics, clinical presentation, socioeconomic status, and hygiene, as well as echocardiographic findings among patients with newly diagnosed MS at Brebes General Regional Hospital. By focusing on patients at the time of first diagnosis, this study seeks to provide baseline data that may support earlier detection, appropriate referral, and improved management of MS in low-resource settings.

Methods

Study Design and Setting

This study was an observational descriptive cross-sectional study conducted at the Cardiology Outpatient Clinic of Brebes General Regional Hospital, Central Java, Indonesia. Data collection was performed from 1 February 2024 to 30 September 2024.

Study Population

The study population consisted of adult patients diagnosed with MS who attended the cardiology outpatient clinic during the study period.

Inclusion and Exclusion Criteria

a. Inclusion Criteria
   Patients were included if they met all of the following criteria:
   1. Age ≥18 years;
   2. First-time diagnosis of MS confirmed by transthoracic echocardiography at Brebes General Regional Hospital during the study period;
   3. No prior documented diagnosis of MS or previous echocardiographic examination indicating MS at Brebes General Regional Hospital or other healthcare facilities, verified through medical record review and structured patient interviews;
   4. Availability of complete echocardiographic data.

b. Exclusion Criteria
   Patients were excluded if they had:
   1. A history of previous cardiac valve surgery or percutaneous mitral valve intervention;
   2. Degenerative (calcific) MS or congenital mitral valve disease;
   3. Significant congenital heart disease;
   4. Incomplete clinical or echocardiographic data.

Definition of Newly Diagnosed Mitral Stenosis

"Newly diagnosed mitral stenosis" was defined as the first echocardiographic confirmation of MS in a patient without any prior documented diagnosis or echocardiographic evidence of MS. This status was confirmed using hospital medical records and patient self-reported medical history obtained during interviews.

Sampling Method

All consecutive eligible patients who met the inclusion criteria during the study period were included in the analysis.

Data Collection

Data were collected using two sources:

a. Structured patient interviews, which were conducted during the study period to collect demographic data, socioeconomic characteristics (occupation and monthly income in Indonesian Rupiah [IDR]), hygiene-related factors, cardiovascular risk factors, and past medical history;
b. Medical record review, which provided information on clinical presentation, functional status, and echocardiographic findings.

Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2) and classified according to the World Health Organization (WHO) Asia-Pacific criteria. Functional status was assessed using the New York Heart Association (NYHA) functional classification

Echocardiographic Assessment

Transthoracic echocardiography was performed by cardiologists at Brebes General Regional Hospital in accordance with standard protocols. The following parameters were recorded:

a. Left Ventricular Ejection Fraction (LVEF);
b. Tricuspid Annular Plane Systolic Excursion (TAPSE);
c. Right Atrial (RA) area;
d. Right Ventricular (RV) diameter;
e. Left Ventricular Internal Diameter at end-diastole (LVIDd);
f. Tricuspid Regurgitation Maximum Velocity (TR Vmax).

Mitral Stenosis Etiology and Severity

The etiology and severity of MS were assessed in accordance with the 2021 European Society of Cardiology (ESC) guidelines. MS severity was classified as mild, moderate, or severe based on mitral valve area and mean transvalvular gradient.

Definition of Isolated and Non-Isolated Mitral Stenosis

a. Isolated MS was defined as MS without concomitant moderate or severe involvement of other cardiac valves on echocardiography.
b. Non-isolated (mixed) MS was defined as MS accompanied by at least moderate mitral regurgitation and/or aortic or tricuspid valve disease, as identified by transthoracic echocardiography. Patients with non-isolated MS could have involvement of more than one additional valve.

Statistical Analysis

Data were analyzed descriptively. Continuous variables were presented as mean ± standard deviation or median (interquartile range), as appropriate. Categorical variables were expressed as frequencies and percentages.

Ethical Considerations

The Ethics Committee of Brebes General Regional Hospital approved the study protocol. Written informed consent was obtained from all participants before interviews and data collection.

Results

Demographic and Socioeconomic Characteristics

A total of 56 patients with newly diagnosed MS were included in this study. Most patients were female (69.6%), while 30.4% were male. The largest proportion of patients was in the 41–50-year age group (35.7%), followed by those aged 51–60 years (26.8%). Only one patient (1.8%) was younger than 30 years (Table 1).

Most patients presented to the cardiology outpatient clinic through self-referral (75%), while 25% were referred from other healthcare facilities. Farming was the most common occupation (32.1%), followed by housewives (30.4%). The majority of patients had a low monthly income, with 73.2% earning less than IDR 1,500,000 per month.12

Poor oral health was common, with dental caries observed in 62.5% of patients, although 76.8% reported regular tooth brushing. Based on BMI classification, most patients had normal nutritional status (66.1%), while 12.5% were underweight and 21.4% were overweight or obese.

Clinical Presentation

Dyspnea was the most frequently reported initial symptom (89.3%), followed by palpitations (80.4%) and fatigue (73.2%) (Table 2). Other symptoms were reported by 53.6% of patients. Lower limb

Table 1. Demographic and socioeconomic characteristics of newly diagnosed mitral stenosis patients.

Parameters	Subjects (n=56)	Percentage (%)
Sex		
Male	17	30.4
Female	39	69.6
Age Group (years)		
21 – 30	1	1.8
31 – 40	10	17.9
41 – 50	20	35.7
51 – 60	15	26.8
>60	10	17.9
Visit type		
Self-referred	42	75
Referred	14	25
Occupation		
Farmer	18	32.1
Housewife	17	30.4
Trader	8	14.3
Civil servant	5	8.9
Private employee	4	7.1
Laborer	4	7.1
Income (IDR/month)		
<1.500.000	41	73.2
1.500.000 – 2.500.000	11	19.6
2.500.000 – 3.500.000	3	5.4
>3.500.000	1	1.8
Hygiene		
Dental Caries	35	62.5
Regular tooth brushing	43	76.8
Body Mass Index (BMI)		
Underweight	7	12.5
Normal	37	66.1
Overweight	9	16.1
Obese Class 1	3	5.4

Table 2. Initial clinical symptoms of patients with mitral stenosis.

Symptoms	Total (n)	Percentage (%)
Palpitations	45	80.4
Lower limb edema	17	30.4
Hemoptysis	11	19.6
Fatigue	41	73.2
Dyspnea	50	89.2
Hoarseness	15	26.8
Other	30	53.6

edema was present in 30.4% of patients, hemoptysis in 19.6%, and hoarseness in 26.8%.

Risk Factors and Medical History

Hypertension was the most common cardiovascular risk factor (30.4%), followed by dyslipidemia (19.6%) and diabetes mellitus (7.1%) (Table 3). Among female patients, 48.7% were postmenopausal, and a history of smoking was reported in 25% of patients.

A previous history of rheumatic fever was present in 73.2% of patients. Other comorbidities included tuberculosis (12.5%), asthma (7.1%), and stroke (7.1%). Regarding family medical history, hypertension (33.9%) and diabetes mellitus (23.2%) were the most frequently reported conditions, followed by heart disease (16.1%) and stroke (10.7%) (Table 3).

Functional Status

Based on the NYHA functional classification, most patients were classified as NYHA class I (48%) and class II (38%). A smaller proportion of patients were classified as NYHA class III (7%) and class IV (7%) (Figure 1).

Echocardiographic Characteristics

Echocardiographic findings are summarized in Table 4. Of the 56 patients, only one patient (1.8%) had isolated (pure) MS, while the remaining patients had non-isolated (mixed) MS. Among patients with non-isolated MS, tricuspid valve involvement was the most frequent (89.3%), followed by mitral regurgitation (73.2%) and aortic valve involvement (32.1%).

Reduced LVEF (LVEF ≤50%) was observed in all patients with isolated MS and in the majority of patients with non-isolated MS, including those with mitral regurgitation (80.5%), aortic valve disease (88.9%), and tricuspid valve involvement (86%).

Impaired RV systolic function, defined as TAPSE ≤17 mm, was not observed in the isolated MS case but was common in non-isolated MS, particularly among patients with aortic valve involvement (77.8%), followed by those with tricuspid valve disease (72%) and mitral regurgitation (65.9%).

RA enlargement (RA area >17.7 cm^2) was frequently observed in non-isolated MS, especially in patients with aortic valve involvement (66.7%) and tricuspid valve disease (62%). RV dilation (RV >41 mm) was also common, occurring in approximately half of patients with aortic (50%) and tricuspid (48%) valve involvement.

Elevated TR Vmax (TR Vmax >2.8 m/s) was predominantly observed in non-isolated MS. Increased TR Vmax values were most frequently found in patients with concomitant mitral

Table 3. Risk factors and medical history of patients with mitral stenosis.

Parameters	Subject (n=56)	Percentage (%)
Risk factors		
Dyslipidemia	11	19.6
Diabetes Mellitus	4	7.1
Hypertension	17	30.4
Hemostatic dysfunction	17	30.4
Menopause	19	48.7
Smoking	14	25
Medical history		
Rheumatic fever	41	73.2
Tuberculosis	7	12.5
Stroke	4	7.1
Asthma	4	7.1
Family medical history		
Hypertension	19	33.9
Diabetes Mellitus	13	23.2
Heart disease	9	16.1
Stroke	6	10.7
Dyslipidemia	6	10.7

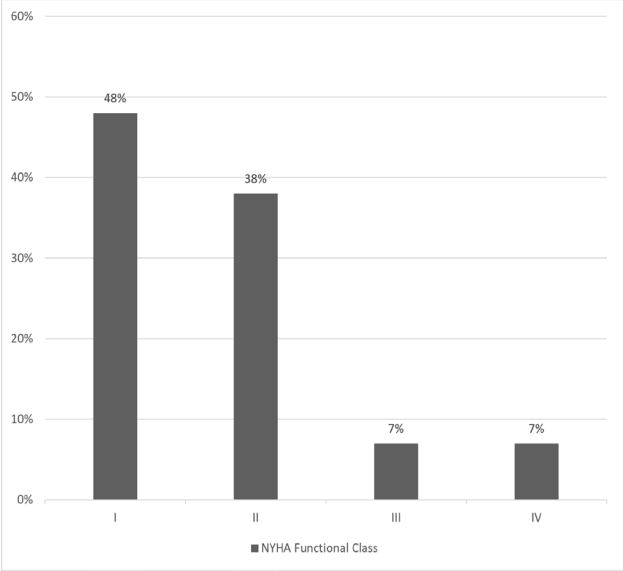

Figure 1. Distribution of NYHA functional class among patients with mitral stenosis.

Table 4. Echocardiographic characteristics according to valvular involvement in mitral stenosis (n = 56).

Parameter	Mitral Stenosis (n=56)			
	Isolated MS	Non-isolated MS		
		MR	Aorta Valve	Tricuspid Valve
	n = 1 (1.8)	n = 41 (73.2)	n = 18 (32.1)	n = 50 (89.3)
LVEF ≤ 50 (%)	1 (100)	33 (80.5)	16 (88.9)	43 (86)
TAPSE ≤17 (mm)	0 (0)	27 (65.9)	14 (77.7)	36 (72)
RA Area (cm^2)				
>17.7	0 (0)	22 (53.7)	12 (66.7)	31 (62)
11.3 – 17.7	1 (100)	18 (43.9)	6 (33.3)	16 (32)
< 11.3	0 (0)	1 (2.4)	0	3 (6)
RV (mm)				
>41	0 (0)	18 (43.9)	9 (50)	24 (48)
25-41	1 (100)	23 (56.1)	9 (50)	26 (52)
<25	0	0	0	0
TR Vmax (m/s)				
>3.4	0 (0)	10 (24.4)	3 (16.7)	11 (22)
2.8 – 3.4	0 (0)	22 (53.7)	4 (22.2)	17 (34)
< 2.8	1 (100)	9 (22)	11 (61.1)	22 (44)
LVIDd (male)				
>54.3	0 (0)	10 (83.3)	3 (50)	11 (68.8)
46.1 – 54.3	0 (0)	1 (8.3)	3 (50)	4 (25)
< 46.1	0 (0)	1 (8.3)	0	1 (6.3)
LVIDd (female)				
>48.6	0 (0)	17(58.6)	9 (75)	22 (64.7)
41.4 – 48.6	1 (100)	7 (24.1)	2 (16.7)	7 (20.6)
<41.4	0 (0)	5 (17.2)	1 (8.3)	5 (14.7)

Data presented as n (%). MS = Mitral Stenosis; MR = Mitral Regurgitation; LVEF = Left Ventricular Ejection Fraction; TAPSE = Tricuspid Annular Plane Systolic Excursion; RA = Right Atrium; RV = Right Ventricle; TR Vmax = peak tricuspid regurgitation velocity; LVIDd = Left Ventricular Internal Diameter at end-Diastole. Patients with non-isolated mitral stenosis may have involvement of more than one valve.

regurgitation, followed by those with tricuspid and aortic valve involvement. The isolated MS case demonstrated TR Vmax <2.8 m/s.

Echocardiographic parameters are summarized in Tables 5 and 6. The mean LVEF was 42.8 ± 11.2%, with a median of 42.5%, indicating reduced systolic function in most patients. The mean TAPSE was 16.6 ± 2.6 mm, with a median of 16.0 mm, suggesting impaired RV systolic function.

The mean TR Vmax was 2.89 ± 0.61 m/s, and the median value was 3.0 m/s. The mean right atrial area was 19.8 ± 5.0 cm², while the mean right ventricular diameter was 38.9 ± 7.1 mm.

The mean LVIDd was 52.6 ± 8.1 mm. When stratified by sex, male patients had a larger mean LVIDd compared with female patients (57.5 ± 7 mm vs. 50.3 ± 7.6 mm, respectively) (Table 6).

Table 5. Echocardiographic parameters of newly diagnosed mitral stenosis patients (n = 56).

Parameter	Mean ± SD	Median (IQR)
LVEF (%)	42.8 ± 11.2	42.5
TAPSE (mm)	16.6 ± 2.6	16.0
TR Vmax (m/s)	2.89 ± 0.61	3.00
RAarea (cm^2)	19.8 ± 5.0	19.0
RV diameter (mm)	38.9 ± 7.1	41.0
LVIDd (mm)	52.6 ± 8.1	53.0

LVEF = Left Ventricular Ejection Fraction; TAPSE = Tricuspid Annular Plane Systolic Excursion; RA = Right Atrium; RV = Right Ventricle; LVIDd = Left Ventricular Internal Diameter at end-Diastole.

Table 6. Left Ventricular Internal Diameter at End-Diastole (LVIDd) according to sex.

Sex	n	Mean ± SD (mm)	Median (IQR)
Male	17	57.5 ± 7	58 (52-61)
Female	39	50.3 ± 7.6	53 (45-55)

SD: Standard Deviation; IQR: Interquartile Range.

Discussion

RHD remains a major cause of MS in low- and middle-income countries. In this study, most patients with newly diagnosed MS were middle-aged, with the highest proportion aged 41–50 years. This finding is consistent with previous studies reporting that MS commonly affects individuals during their productive years in endemic regions.[13] The predominance of middle-aged patients underscores the ongoing burden of RHD-related valvular disease and its potential socioeconomic impact.

Female patients constituted the majority of the study population, a pattern consistently reported in previous studies.[14-15] Although the mechanisms underlying this sex predominance remain unclear, hormonal, immunological, and sociocultural factors have been suggested. However, this study was not designed to explore causal explanations for sex differences in MS prevalence.

Most patients presented to the cardiology outpatient clinic without referral. This finding may reflect limited access to primary healthcare services and suboptimal referral pathways, which have been reported in previous studies to contribute to delayed diagnosis and management of MS.[16] In the present study, however, most patients were classified as NYHA functional class I or II, indicating relatively preserved functional capacity at the time of diagnosis. This suggests that although referral pathways may be limited, a proportion of patients were still diagnosed before advanced functional deterioration occurred.

Low socioeconomic status was common among patients in this study, with most working as farmers or housewives and earning a low monthly income. Brebes Regency is predominantly an agricultural region, and occupational patterns observed in this study reflect regional characteristics. Information on agricultural cycles and climate-related income instability was derived from regional statistics and prior reports rather than from individual-level patient economic data.[17] Similar associations between low socioeconomic status and RHD have been reported elsewhere.[18-19] Okello et al. found that while low income was common in both case

and control groups, higher income was associated with a significantly lower risk of RHD, suggesting a complex relationship between socioeconomic status and disease burden.[20]

RHD develops as a consequence of inadequate secondary prophylaxis following ARF, an autoimmune condition triggered by Group A Streptococcus infection.[21] Chronic valvular damage may lead to complications such as heart failure, arrhythmias, pulmonary hypertension, atrial fibrillation, and infective endocarditis. Endocarditis may result from bacterial pathogens such as Streptococcus viridans and Staphylococcus aureus.[22-23] Oral bacteria can enter the bloodstream through activities such as tooth brushing or chewing in the presence of dental disease, leading to bacterial colonization of damaged valves and vegetation formation. Progressive enlargement of vegetations may impair valvular function and contribute to congestive heart failure. In this study, a high proportion of patients had dental caries despite reporting regular tooth brushing, suggesting that oral hygiene practices and access to dental care may influence oral health status.

Most patients in this study had a normal nutritional status. This finding differs from reports in adolescent RHD populations, where malnutrition has been more frequently observed.[24-26] Differences across age groups, socioeconomic contexts, and disease stages may partly explain this discrepancy.

Dyspnea and palpitations were the most common presenting symptoms, consistent with the hemodynamic consequences of MS. Although structural and functional abnormalities were evident on echocardiography, most patients were classified as NYHA functional class I or II. This may reflect early clinical presentation despite significant echocardiographic abnormalities, highlighting the value of echocardiography in detecting subclinical disease progression.

Echocardiographic analysis demonstrated reduced LVEF and impaired RV systolic function, as reflected by reduced TAPSE values. Elevated TR Vmax suggested an increased echocardiographic probability of pulmonary hypertension in a substantial proportion of patients. RA enlargement and RV dilation were also commonly observed. These findings are consistent with chronic pressure overload resulting from long-standing MS and mixed valvular disease.[28-30] Male patients had larger left ventricular internal diameters than female patients, reflecting sex-related differences in cardiac dimensions.

Echocardiography remains a cornerstone for the diagnosis and follow-up of MS. In resource-limited settings, delayed detection of ARF and limited access to primary healthcare services may result in patients presenting at secondary or tertiary care facilities. Strengthening primary prevention strategies, including early identification and treatment of Group A Streptococcus infections, may help reduce the burden of RHD. Recommendations for echocardiographic screening should consider local resource availability and feasibility at the primary care level.

Limitations

This study has several limitations. Its cross-sectional design precludes causal inference. The single-center setting and relatively small sample size may limit generalizability. Some demographic and medical history data were obtained through patient interviews, which may introduce recall bias. In addition, socioeconomic and environmental factors were inferred from regional data rather than individual-level measurements.

Conclusion

This study describes the demographic, clinical, and echocardiographic characteristics of patients with newly diagnosed MS at Brebes General Regional Hospital. Most patients were middle-aged women with low socioeconomic status and non-isolated (mixed) valvular involvement. Echocardiographic evaluation revealed reduced left ventricular ejection fraction, impaired RV systolic function, and elevated TR Vmax in a substantial proportion of patients, although most presented with mild functional limitation based on the NYHA classification.

These findings highlight the persistent burden of RHD–related MS in low-resource settings and emphasize the importance of early detection, timely referral, and comprehensive echocardiographic assessment. Strengthening primary prevention and access to appropriate cardiac evaluation may help reduce disease progression and associated morbidity.

List of Abbreviations

ARF	Acute Rheumatic Fever
BMI	Body Mass Index
ESC	European Society of Cardiology
IDR	Indonesian Rupiah
LVEF	Left Ventricular Ejection Fraction
LVIDd	Left Ventricular Internal Diameter at End-Diastole
MS	Mitral Stenosis

NYHA	New York Heart Association
RHD	Rheumatic Heart Disease
RA	Right Atrial
RV	Right Ventricle
TAPSE	Tricuspid Annular Plane Systolic Excursion
TR Vmax	Maximum Tricuspid Regurgitation Velocity
WHO	World Health Organization

Ethical Clearance

This study has obtained ethical approval from the Ethics Committee of Brebes General Regional Hospital.

Publication Approval

All authors consent to the publication of this manuscript.

Authors' Contributions

All authors contributed to the conception, drafting, and revision of the article, provided final approval for publication, agreed on the journal, and took accountability for all aspects of work.

Acknowledgments

None.

Conflict of Interest

None.

Availability of Data and Materials

Not applicable.

Funding

None.

Copyright/Permissions for Figures

Not applicable.

Generative AI and AI-Assisted Technologies in the Writing Process

Authors acknowledge that artificial intelligence (AI) tools were only used to assist in language editing and did not generate or alter the scientific content, analyses, or conclusions presented in this manuscript.

References

1. Rudiktyo E, Wind A, Doevendans P. Characteristics of patients with rheumatic heart disease in a national referral hospital in Indonesia. Med J Indones. 2022;31(3):178–85.
2. World Health Organization. Rheumatic fever and rheumatic heart disease. Geneva: World Health Organization; 2018.
3. Ghamari S, Abbasi M, Moghaddam S, Aminorroaya A, Rezaei N, et al. Rheumatic heart disease is a neglected disease relative to its burden worldwide: findings from the Global Burden of Disease 2019. J Am Heart Assoc. 2022;11(13):e025593.
4. Gunawan N, Budiarto R, Andriati A. Profile of patients with mitral stenosis in Dr Soetomo General Hospital, Surabaya, January 2015–December 2017. Juxta J Ilm Mhs Kedokt Univ Airlangga. 2021;12(1):42–4.
5. Lima N, Patel D, Sundaram N, Castro R, Huffman C, Diaz M, et al. Hospital admissions for mitral stenosis in pregnancy in the United States: a thirteen-year analysis. Am J Cardiovasc Dis. 2023;13(1):10–20.
6. Kurbaini F, Hairrudin, Wulandari P. Analisis faktor risiko kejadian atrial fibrilasi pada pasien mitral stenosis di RSD Dr Soebandi Jember. J Kesehat Univ Husada Surakarta. 2024;15(2):44–52.
7. Wikipedia. Brebes Regency. Available from: https://id.m.wikipedia.org. Accessed December 9, 2024.
8. Badan Pusat Statistik Provinsi Jawa Tengah. Upah minimum kabupaten/kota di Provinsi Jawa Tengah. 2024. Available from: https://jateng.bps.go.id. Accessed December 9, 2024.
9. Dinas Kesehatan Kabupaten Brebes. *Laporan kinerja instansi pemerintah tahun 2023*. Brebes: Dinkes Kabupaten Brebes; 2024.
10. Desita S, Lefi A, Rahman M, Oktaviono Y. Clinical characteristics and number of valve lesions in rheumatic heart disease severity. Glob Med Health Commun. 2021;9(1):36–41.
11. Nulu S, Bukhman G, Kwan G. Rheumatic heart disease: the unfinished global agenda. Cardiol Clin. 2017;35(1):165–80.
12. Rakasiwi L, Kautsar A. *Pengaruh faktor de-*

mografi dan sosial ekonomi terhadap status kesehatan individu di Indonesia. Kajian Ekon Keuang. 2021;5(2):146–57.
13. Shah S, Sharma S. Mitral stenosis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023.
14. Negi PC, Kandoria A, Asotra S, Ganju NK, Merwaha R, Sharma R, et al. Gender differences in the epidemiology of rheumatic fever/rheumatic heart disease patient population of a hill state of northern India: a 9-year prospective hospital-based registry. Indian Heart J. 2020;72(6):552–6.
15. Bowen A, Currie B, et al. Burden of acute rheumatic fever and rheumatic heart disease. In: The 2020 Australian guideline for prevention, diagnosis and management of acute rheumatic fever and rheumatic heart disease. Australia: RHD Australia; 2022. p.14.
16. Islam A, Majumder A. Rheumatic fever and rheumatic heart disease in Bangladesh: a review. Indian Heart J. 2016;68(1):88–98.
17. Marseva AD, Putri EI, Ismail A. Estimasi kerugian ekonomi petani bawang merah. J Ilm Inov. 2022;22(3):291–6.
18. Sharma N, Toor D. Impact of socio-economic factors on increased risk and progression of rheumatic heart disease in developing nations. Curr Infect Dis Rep. 2019;21(6):21.
19. Steer A, Carapetis J, Nolan T, Shann F. Systematic review of rheumatic heart disease prevalence in children in developing countries: the role of environmental factors. J Paediatr Child Health. 2002;38(3):229–234.
20. Okello E, Kakande B, Sebatta E, Kayima J, et al. Socioeconomic and environmental risk factors among rheumatic heart disease patients in Uganda. PLoS One. 2012;7(8):e43917.
21. Shi XR, Chen BY, Lin WZ, Li YL, et al. Microbiota in gut, oral cavity, and mitral valves are associated with rheumatic heart disease. Front Cell Infect Microbiol. 2021;11:643092.
22. Puspita D, Krevani CK. *Infeksi gigi sebagai penyebab bakteremia pada endokarditis infektif*. J Kedokt Gigi Unbrah. 2019;6(2):142–51.
23. Keynan Y, Rubinstein E. Pathophysiology of infective endocarditis. Curr Infect Dis Rep. 2013;15(4):342–346.
24. Sari, Maya S. *Hubungan penyakit jantung rematik dengan status gizi anak di Rumah Sakit Umum Haji Adam Malik Medan*. Medan: Universitas Sumatera Utara; 2019.
25. Zaman M. Childhood nutrition and prevention of rheumatic fever. Glob Heart. 2015;10(1):63–9.
26. Berhanu H, Tegene E, Sudhakar M, Gemechu TD, Mossie A. Rheumatic heart disease burden and determinants in cardiac patients: a follow-up care concern in Ethiopia. Int J Cardiol Cardiovasc Risk Prev. 2024;24:200352.
27. Huxley VH. Sex and the cardiovascular system: the intriguing tale of how women and men regulate cardiovascular function differently. Am J Physiol Heart Circ Physiol. 2007;31(1):17–22.
28. Ardani NI, Aditya G. Rheumatic heart disease. Bioscientia Med. 2024;8(2):4705–11.
29. Pandian N. Recommendations for the use of echocardiography in the evaluation of rheumatic heart disease: a report of the American Society of Echocardiography. J Am Soc Echocardiogr. 2022;35(1):5–8.
30. Farooq O, Jan A, Ghani U. Pulmonary hypertension as a predictor of early outcomes of mitral valve replacement in rheumatic heart disease patients. Cureus. 2021;13(12):e20070.