Received: 10 May 2024 | Revised: 17 July 2024 | Accepted: 13 August 2024

DOI: 10.1002/joa3.13137

ORIGINAL ARTICLE

Journal of Arrhythmia Open Access WILEY

Prevalence of atrial fibrillation based on tertiary hospital survey in Indonesia: A smartphone-based diagnosis

Yoga Yuniadi MD PhD[1] | Alice I. Supit MD[1] | Dicky A. Hanafy MD PhD[1] | Sunu B. Raharjo MD PhD[1] | Dony Y. Hermanto MD[1] | Faris Basalamah MD PhD[2] | Benny Hartono MD[3] | Reynold Agustinus MD[4] | Agung F. Chandranegara MD[5] | Chaerul Ahmad MD PhD[6] | Mohammad Iqbal MD PhD[6] | Alexander E. Tondas MD PhD[7] | Hauda El-Rasyid MD[8] | Haryadi Haryadi MD[9] | Antonia A. Lukito MD PhD[10] | Daniel Tanubudi MD[11] | Ignatius Yansen MD[11] | Erika Maharani MD[12] | Rerdin Julario MD[13] | Ardian Rizal MD[14] | Putra S. Antara MD[15] | Muzakkir Amir MD PhD[16]

Correspondence
Yoga Yuniadi, National Cardiovascular Center Harapan Kita, Jakarta and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia.
Email: yogay136@gmail.com

Funding information
Universitas Indonesia, Grant/Award Number: PENG-001/UN2.RST/PPM.00.00/2023

Abstract

Objective: Atrial fibrillation (AF) is one of the most common arrhythmic disorders worldwide. This study aims to describe the prevalence of AF in various cities in Indonesia using single-lead hand held electrocardiography linked to a smartphone-based application.

Methods: This is a cross-sectional epidemiological study conducted at tertiary hospital of major cities in Indonesia, between January 2018 and July 2019. The AliveCor Kardia™ Mobile system device was used as a screening tool for AF and confirmed its finding with clinical diagnoses made by cardiologists.

Results: A total of 9773 subjects were enrolled in this study. The prevalence of AF reported by the device and cardiologist was 3.2% and 3.5%, respectively. AF prevalences are equal in men than women. The majority of subjects (56%) are having low risk for stroke or systemic thromboembolism. Prevalence of risk factors such as heart failure, hypertension, diabetes, and history of stroke among AF patients were 50%, 22.9%, 31.9%, 13.5%, and 5.8%, respectively.

Conclusion: The prevalence of AF at referral hospitals visitors based on smartphone diagnosis in Indonesia is 3.2%.

KEYWORDS
atrial fibrillation, Indonesia, smartphone-based, tertiary hospital

For affiliations refer to page 1106.

1 | INTRODUCTION

Atrial fibrillation (AF) refers to supraventricular tachyarrhythmia characterized by disorganized and diffuse electrical activity that displaces normal sinus node function. AF is the most common etiology of arrhythmias worldwide, accounting for 33% of arrhythmia-related hospitalizations.[1] It is estimated that there are more than 5 million people with AF in the United States, which will increase twice over the next decade. AF is associated with an increased risk of thromboembolism, decreased cognitive function, and mortality.[2] In Southeast Asia, the prevalence of AF is reported to be 1.5% in Singapore, 0.4%–2.2% in Thailand, and 0.5%–0.7% in Malaysia.[3] Currently no official large data of AF from Indonesia. We aim to collect simple prevalence data of AF from tertiary hospital of major cities of Indonesia.

One third of AF were asymptomatic.[4] Silent AF is found in approximately 10% of patients with ischemic stroke. Screening for AF with an implanted loop recorder is one of the best monitoring strategies, especially in patients with recurrent transient ischemic attacks.[5,6] However, the usage of implanted loop recorded have some major setbacks due to the invasive nature of the procedure. A simpler and non-invasive method was needed to effectively screen for AF in asymptomatic patients. Currently, several portable ECG devices are available outside the hospital, ranging from one-lead to three-lead ECG devices. Portable ECG has the advantage of being easy to carry anywhere, lightweight, and relatively low costs. AliveCor™ is an FDA approved six-lead ECG recorder capable of acquiring ECG signals. This application uses a random forest machine learning algorithm to distinguish sinus rhythm from AF and other rhythm disturbances.[7–9] Hence this study was conducted by means of AliveCor™ device which then validated by cardiologist.

2 | METHODS

2.1 | Study population

This is a unique cross-sectional study to screen AF of subject who are visiting tertiary hospital in Indonesia, including patient at outpatient department, hospitalized patient, accompanying person, care givers, and hospital employees. Informed consent was obtained. This study was done in eight major cities of Indonesia between January 2018 and July 2019. Basic characteristics of patients, such as gender, age, history of heart failure, hypertension, diabetes, stroke, coronary artery disease, and peripheral artery disease, were collected.

2.2 | Recording device

We use the AliveCor™ device to screen AF. The device consists of a battery-powered pair of electrodes linked to a smartphone-based application using ultrasonic audio. The result of the recording is a single-lead ECG; which was matched to lead 1 of a standard 12-lead surface ECG. A specific algorithm built in the device can identify AF. It interpreted the recordings as sinus rhythm, AF, unclassified, no analysis, and unreadable. As it was the first large scale study in Indonesia using AliveCor™ we confirmed the diagnosis by a cardiologist blinded to the results of AliveCor™ interpretation.

2.3 | Statistical analysis

SPSS 21.0 (Chicago, IL, USA) statistical package program used for data analysis. Continuous variables were expressed as mean ± standard deviation, and categorical data were recorded as percentages. ROC analysis was used to analyze the sensitivity and specificity of AliveCor™.

3 | RESULTS

A total of 9773 patients across eight major cities in Indonesia participated in this study. The characteristics of the participating subjects are shown in Table 1. The mean age was 44.6 ± 14.9 years-old (yo), with women as the majority (54.5%). Based on medical history, most patients had no history of heart failure (93.8%), hypertension (78.1%), diabetes (93.6%), stroke (98.1%), coronary artery disease (89.4%), peripheral artery disease (99.8%), and AF (98.5%).

A total of 310 patients (3.2%) were diagnosed as having AF by AliveCor™, while SR was classified in 8458 patients (86.5%) and others in 10.3%. The AF patients were older (51.1 ± 14.7 vs. 44.4 ± 14.8 yo, $p < .001$), owing higher AF risk factors such as heart failure, hypertension, diabetes mellitus, coronary artery disease and history of AF compare to that without AF. The history of stroke was more obvious in patients with- compare to that without AF (5.8% vs. 1.8% respectively, $p < .001$). The age quartile prevalence of AF patients are presented in Figure 1. In the quartile 1 (aged of <32 yo), quartile 2 (aged of 32-45 yo), quartile 3 (aged of 46-56 yo), and quartile 4 (aged of >56 yo) prevalence of AF were 1.8%, 2.4%, 3.9%, and 4.8% respectively.

The accuracy of AliveCor™ diagnosis on AF was confirm by the cardiologists. Using the exact tracings, cardiologists diagnosed AF in 343 patients (3.5%), SR in 90.8% of patients, and others in 5.7% of patients (Table 2). The Kappa agreement between AF interpreted by AliveCor™ and AF interpreted by cardiologist was 0.852. The sensitivity and specificity of AliveCor™ to diagnose AF were 82.9% and 99.7%, respectively.

The CHA_2DS_2VASc score of AF subjects are presented in Figure 2. The AF subjects are classified into low risk (score of 0–1), or high risk (score of 2 or more). The majority of subjects are having low risk for stroke or systemic thromboembolism (56%) which most of them are having score of 1 (36%).

4 | DISCUSSION

The present study is the first to describe the prevalence of AF in Indonesia across 8 regions on a large scale using a smartphone-based device. Based on this study, the group of patients diagnosed

TABLE 1 Clinical characteristic.

Clinical characteristics	All subjects $n=9773$	With AF $n=310$	Without AF $n=9463$	p-value
Age (year)		51.1 ± 14.7	44.4 ± 14.8	
Quartile 1, *n* (%)		45 (0.46)	2519 (25.78)	
Quartile 2, *n* (%)	44.6 ± 14.9	58 (0.59)	2367 (24.22)	<.001[a]
Quartile 3, *n* (%)		96 (0.98)	2357 (24.12)	
Quartile 4, *n* (%)		111 (1.14)	2220 (22.72)	
Sex				
Males, *n* (%)	4451 (45.5)	155 (50.0)	4296 (45.4)	.081[b]
Females, *n* (%)	5322 (54.5)	155 (50.0)	5167 (54.6)	.081[b]
Heart Failure, *n* (%)	604 (6.2)	71 (22.9)	533 (5.6)	<.001[b] *
Hypertension, *n* (%)	2144 (21.9)	99 (31.9)	2045 (21.6)	<.001[b] *
Diabetes, *n* (%)	630 (6.4)	42 (13.5)	588 (6.2)	<.001[b] *
Stroke, *n* (%)	187 (1.9)	18 (5.8)	169 (1.8)	<.001[b] *
Coronary artery disease, *n* (%)	1033 (10.6)	62 (20.0)	971 (10.3)	<.001[b] *
Peripheral artery disease, *n* (%)	20 (0.2)	2 (0.6)	18 (0.2)	.669[b]
Known history of AF, *n* (%)	143 (1.5)	92 (29.7)	51 (0.5)	<.001[b] *

Note: *p-value <.05.

Abbreviation: AF, atrial fibrillation.

[a]Mann–Whitney Test.

[b]Z proportions Test.

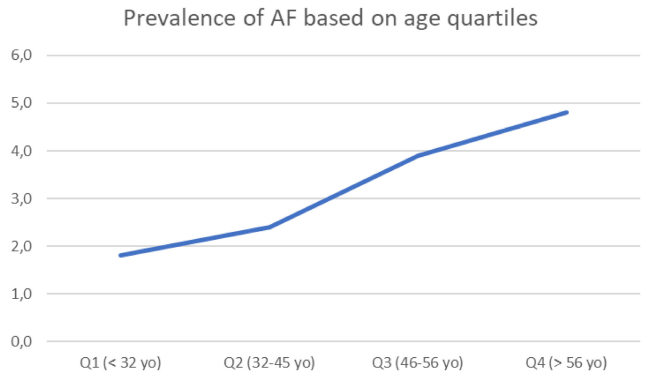

FIGURE 1 The prevalence of AF based on age quartiles. There is trend of increasing AF prevalence by increasing age. Q1, Quartile 1, Q2, Quartile 2, Q3, Quartile 3, Q4, Quartile 4, yo, Years-old.

TABLE 2 Diagnostic results of AliveCor™ and Cardiologist.

Diagnosis	AliveCor™ *n* (%)	Cardiologist *n* (%)
AF	310 (3.2)	343 (3.5)
Non-AF/unclassified	954 (9.8)	508 (5.2)
Unreadable/uninterpretable/ no analysis	51 (0.5)	49 (0.5)
Sinus rhythm	8458 (86.5)	8872 (90.8)
Total	9773 (100)	9773 (100)

Abbreviation: AF, atrial fibrillation.

with AF by AliveCor™ was 322 (3.3%) subjects which has excellent agreement with that was diagnosed by a cardiologist at 343 subjects (3.5%). Similar study in single hospital of Ethiopia 3000 costumers or visitors of hospital (median 31 years of age; 65% men) were screened. AF was detected in 13 (0.43%) individuals (median 50 years of age; $n=7$ men). AF prevalence was higher for older age groups, with ≥70 years of age reaching 6.67% ($n=3$ of 45). This study used same device brand with our study.[10] In 2000, the Hokkaido Atrial Fibrillation Study Group reported that the prevalence of AF was 14% in 19,825 patients who visited the cardiovascular clinics of the 13 hospitals in Hokkaido, Japan.[11] Based on gross national income (GNI) per capita data, the World Bank classifies economies for analytical purposes into four income groups: low, lower-middle, upper-middle, and high income. Indonesia belongs to upper-middle-while Ethiopia belongs to lower-income countries.[12] The risk factors of AF such as hypertension, diabetes mellitus, coronary artery disease, obesity and heart failure were more prominent in developed countries like Japan and less common in lower income countries like Ethiopia.[13] The prevalence of AF in Indonesia is then expected to be higher than Ethiopia but not as high as developed countries such as Japan. In addition, lower-income countries are more dealing with infectious disease as compare to non-infectious disease in higher-income countries. The last epidemiology study that presenting data of AF prevalence in Indonesia was conducted more than three decades ago,[14] so that our simple data in this study is an important update. Another local study conducted in National Cardiovascular Center at Jakarta Indonesia reported that the incidence of AF in hospitalized patients increased every year, such as 7.1% in 2010, 9.0% in 2011, 9.3% in 2012, and 9.8% in 2013.[15]

The mean age of AF patients diagnosed in our population was 51.15 ± 14.68 years old. It is relatively younger compare to developed countries. More than 70% of AF patients in Western Europe, Australia and North America were aged >65 years.[16] However, it was

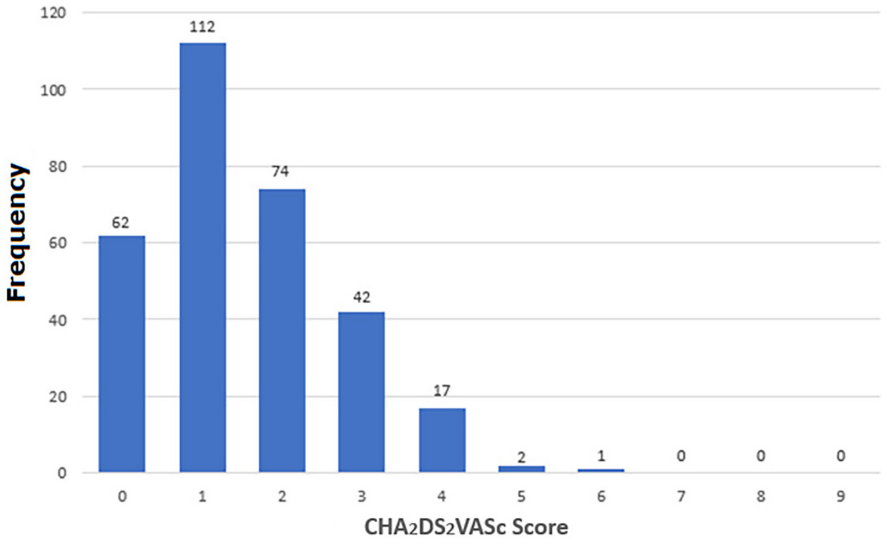

FIGURE 2 CHA_2DS_2VASc score distribution among AF patients.

similar to other developing countries; the mean age of AF patients was 57 ± 16 years in the Gulf-SAFE registry from Arabic population,[17] 41 ± 13 years in an Ethiopian study,[18] <65 years in 43% of the South Korean population detected with AF[16] and <50 years in 38% of patients from one South-African hospital.[19] AF has wide heterogeneity in terms of comorbidities and age. Although AF is often seen in the elderly, some can also occur in young people with no comorbidity.

Based on gender, the majority of AF in our population were males, although it was a slight difference compare to females. Globally, more incident cases of AF occurred in males [1.59 million (95% uncertainty interval [UI] 1.35–1.82)] over females [1.46 million (95% UI 1.24–1.68)], with a higher age-standardized incidence rate of AF was observed in males [42.5 (95% UI 36.3–49.0)] than in females [34.2 (95% UI 29.1–39.4)]. Similar results were also found for prevalent cases of AF.[13] Morphologically, there are differences between AF in women and men. Left atrial fibrotic remodeling causes disruption of the electrical impulses of the atrial cells that contributes to the incidence of AF. Research reports that women have a higher rate of fibrotic remodeling than men.[20]

In this study, most patients did not have risk factors such as a history of heart failure, hypertension, diabetes, stroke, coronary artery disease, peripheral arterial disease, and a history of AF. Younger age of our AF patient may possibly associate with less-established risk factors. The sub-analysis of the RELY AF registry show that almost all patients presenting to the emergency department without traditionally defined AF risk factors have less-established or borderline risk factors upon closer examination. These patients without traditional risk factors have seemingly less severe AF with predominantly paroxysmal episodes, less AF persistence, and a low 1-year risk of death, stroke, and heart failure hospitalizations. Nevertheless, their risk of AF-related re-hospitalization is high.[21]

The CHA_2DS_2VASc score in our AF subjects almost equally distributed as low risk (score of 0–1) and high risk (score of ≥2) for stroke or systemic thromboembolism. McIntire and Linz classified male patient with CHA_2DS_2VASc score of ≥2 or female with score of ≥3 as high risk; male score of 1 or female score of 2 as low risk; and male with score of 0 or female with score of 1 as minimal risk.[22] We classified our AF subjects into more strict classification such as low and high risk based on the need to be anticoagulated. High risk subject defined as them who their CHA_2DS_2VASC score reach the indication for oral anticoagulant therapy. Determining the low-risk group is essential as they have very low risk of thromboembolic event hence no anticoagulation needed. In Taiwanese population the CHA_2DS_2VASc scoring system performed better than the ATRIA scoring system in predicting ischemic stroke among non-anticoagulated AF patients. The score of 0 could clearly identify truly low-risk subjects with 1-year event rates of 1.06, whereas those defined using the ATRIA score were not actually low-risk patients.[23] Similar study in Korea showed the incidence rates of ischemic stroke were 0.24 in low-risk (CHA_2DS_2VASc score 0 for man or 1 for woman).[24]

This study has several advantages, including the relatively large number of samples. In addition, this study is the first to describe the characteristics of AF in Indonesia on a large scale using a smartphone-based method. The percentage of AF diagnoses made by AliveCor™ and cardiologists were similar.

5 | LIMITATIONS

This is a cross-sectional study conducted in 8 major cities in Indonesia which may not reflect the actual diverse ethnic population that this country has. Furthermore, in depth investigation regarding the risk factor and comorbidities in AF was not performed. We only used a simple questionnaire that could bring an undetected disease that the subject had.

6 | CONCLUSION

In this study, the prevalence of AF based on tertiary hospital survey in Indonesia about 3.2%. In our population, AF patients are younger and most of them did not report traditional risk factors. Based on

CHA_2DS_2VASc score, most of AF patient are low risk for stroke and systemic thromboembolism.

AUTHOR CONTRIBUTIONS

Conceptualization: YY; *methodology*: YY, AIS; *software*: AIS, MM; *validation*: YY, SBR, DAH, DYH; *writing original draft preparation*: AIS, YY; *writing—review and editing*: YY; *supervision*: YY, FB, BH, AFC, CA, MI, AET, HER, HH, AAL, DT, IY, EM, RJ, AR, PSA and MA. All authors have read and agreed to the approved version of the manuscript.

AFFILIATIONS

[1]National Cardiovascular Center Harapan Kita, Jakarta and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia
[2]Mitra Keluarga Hospital Bekasi Timur, West Java, Bekasi, Indonesia
[3]Bina Waluya Cardiac Hospital, Jakarta, Indonesia
[4]Siloam Hospital, Kebun Jeruk, Jakarta, Indonesia
[5]Pasar Rebo District Hospital, East Jakarta, Indonesia
[6]Hasan Sadikin Hospital, Bandung, and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Padjadjaran, Bandung, Indonesia
[7]Mohammad Hoesin Hospital, Palembang, Indonesia
[8]M Djamil Hospital, Padang, West Sumatera and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Andalas, Padang, Indonesia
[9]Eka Hospital, Pekanbaru, Indonesia
[10]Siloam Hospital Karawaci, Tangerang, Indonesia
[11]Eka Hospital, Bumi Serpong Damai, Pekanbaru, Indonesia
[12]Sardjito Hospital, Yogyakarta, and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Gajah Mada, Yogyakarta, Indonesia
[13]Sutomo District Hospital, Surabaya, and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Airlangga, East Java, Indonesia
[14]Saiful Anwar Hospital, Malang, and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Brawijaya, Malang, Indonesia
[15]IGNG Ngoerah Hospital, Denpasar, Bali, and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Udayana, Bali, Indonesia
[16]Wahidin Sudirohusodo Hospital, Makassar, South Sulawesi, and Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Hasanuddin, Makassar, Indonesia

ACKNOWLEDGMENTS

The authors would like to especially thank Salsabila Maulaa Putri for providing necessary analysis and support to optimize and complete this study.

FUNDING INFORMATION

This research received funding from Universitas Indonesia with grant no. PENG-001/UN2.RST/PPM.00.00/2023.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The data is not publicly available. The corresponding author Yoga Yuniadi (yogay136@gmail.com) can be contacted to request permission to view the data.

ETHICS STATEMENT

The study was approved by the Institutional Review Board of National Cardiovascular Center Harapan Kita (No: KET-973/UN2.F1/ETIK/PPM.00.02/2022 on 12 September 2022). This study was conformed to the principles drafted in the Declaration of Helsinki.

CONSENT

Not applicable.

ORCID

Sunu B. Raharjo https://orcid.org/0000-0001-5749-8231
Dony Y. Hermanto https://orcid.org/0000-0002-6540-6103
Chaerul Ahmad https://orcid.org/0000-0002-6542-0941
Mohammad Iqbal https://orcid.org/0000-0003-1343-8207
Alexander E. Tondas https://orcid.org/0000-0002-2317-5212

REFERENCES

1. Morady F, Zipes PD. Fibrillation: Clinical Features, Mechanisms, and Management. In: P. D. Zipes, P. Libby, R. O. Bonow, L. D. Mann and G. F. Tomaselli, eds. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 11 ed. Philadelphia: Elsevier; 2018(38): 730–52.
2. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al. Heart disease and stroke statistics-2019 update: a report from the American Heart Association. Circulation. 2019;139:e56–e528.
3. Wong CX, Brown A, Tse HF, Albert CM, Kalman JM, Marwick TH, et al. Epidemiology of atrial fibrillation: the Australian and Asia-Pacific perspective. Heart Lung Circ. 2017;26:870–9.
4. Hindricks G, Potpara T, Dagres N, Arbelo E, Bax JJ, Blomström-Lundqvist C, et al. 2020 ESC guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): the task force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) developed with the special contribution of the European heart rhythm association (EHRA) of the ESC. Eur Heart J. 2021;42:373–498.
5. Svendsen JH, Diederichsen SZ, Højberg S, Krieger DW, Graff C, Kronborg C, et al. Implantable loop recorder detection of atrial fibrillation to prevent stroke (the LOOP study): a randomized controlled trial. Lancet. 2021;398:1507–16.
6. Sanna T, Diener H-C, Passman RS, Di Lazzaro V, Bernstein RA, Morillo CA, et al. Cryptogenic stroke and underlying atrial fibrillation. N Engl J Med. 2014;370:2478–86.
7. Bray JJH, Lloyd EF, Adenwalla F, Kelly S, Wareham K, Halcox JPJ. Single-lead ECGs (AliveCor) are a feasible, cost-effective and safer alternative to 12-lead ECGs in community diagnosis and monitoring of atrial fibrillation. BMJ Open Qual. 2021;10(1):e001270.
8. Wegner FK, Kochhäuser S, Ellermann C, Lange PS, Frommeyer G, Leitz P, et al. Prospective blinded evaluation of the smartphone-based AliveCor Kardia ECG monitor for atrial fibrillation detection: the PEAK-AF study. Eur J Intern Med. 2020;73:72–5.
9. Hall A, Mitchell ARJ, Wood L, Holland C. Effectiveness of a single lead AliveCor electrocardiogram application for the screening of atrial fibrillation: a systematic review. Medicine. 2020;99:e21388.
10. Pitman BM, Chew SH, Wong CX, Jaghoori A, Iwai S, Lyrtzis E, et al. Prevalence and risk factors for atrial fibrillation in a semi-rural sub-Saharan African population: the hEart oF Ethiopia: focus on atrial fibrillation (TEFF-AF) study. Heart Rhythm. 2022;O2(3):839–46.
11. Tomita F, Kohya T, Sakurai M, Kaji T, Yokoshiki H, Sato M, et al. Prevalence and clinical characteristics of patients with atrial fibrillation: analysis of 20,000 cases in Japan. Jpn Circ J. 2000;64:653–8.

12. The World Bank World Development Indicators database. World Bank. 2024. Available at http://data.worldbank.org/data-catalog/world-development-indicators
13. Dai H, Zhang Q, Abu Much A, Maor E, Segev A, Beinart R, et al. Global, regional, and national prevalence, incidence, mortality, and risk factors for atrial fibrillation, 1990–2017: results from the global burden of disease study 2017. Eur Heart J - Quality of Care and Clinical Outcomes. 2021;7:574–82.
14. Boedhi-Darmojo R, Setianto B, Sutedjo KD, Kusmana D, Andradi A, Supari F, et al. A study of baseline risk factors for coronary heart disease: results of population screening in a developing country. Rev Epidemiol Sante Publique. 1990;38(5–6):487–91.
15. Yuniadi Y, Hanafy DA, Raharjo SB, Tondas AE, Maharani E, Hermanto DY, et al. 2014 Indonesian heart association guidelines of Management of Atrial Fibrillation. J Kardiol Indones. 2014;35:102–33.
16. Rahman F, Kwan GF, Benjamin EJ. Global epidemiology of atrial fibrillation. Nat Rev Cardiol. 2014;11:639–54.
17. Zubaid M, Rashed WA, Alsheikh-Ali AA, Almahmeed W, Shehab A, Sulaiman K, et al. Gulf survey of atrial fibrillation events (gulf SAFE). Circ Cardiovasc Qual Outcomes. 2011;4:477–82.
18. Maru M. Atrial fibrillation and embolic complications. East Afr Med J. 1997;74:3–5.
19. Sliwa K, Carrington MJ, Klug E, Opie L, Lee G, Ball J, et al. Predisposing factors and incidence of newly diagnosed atrial fibrillation in an urban African community: insights from the heart of Soweto study. Heart. 2010;96:1878–82.
20. Pothineni NV, Vallurupalli S. Gender and AF: differences and disparities. US Cardiol Rev. 2018;12:103–6.
21. Kloosterman M, Oldgren J, Conen D, Wong JA, Connolly SJ, Avezum A, et al. Characteristics and outcomes of atrial fibrillation in patients without traditional risk factors: a RE-LY AF registry analysis. Europace. 2020;22:870–7.
22. McIntyre WF, Linz D. Atrial fibrillation and stroke: who is low risk and what are we going to do about it? Eur Heart J. 2022;43:3539–41.
23. Chao TF, Liu CJ, Wang KL, Lin YJ, Chang SL, Lo LW, et al. Using the CHA2DS2-VASc score for refining stroke risk stratification in 'low-risk' Asian patients with atrial fibrillation. J Am Coll Cardiol. 2014;64:1658–65.
24. Kim T-H, Yang P-S, Kim D, Yu HT, Uhm J-S, Kim J-Y, et al. CHA2DS2-VASc score for identifying truly low-risk atrial fibrillation for stroke: a Korean nationwide cohort study. Stroke. 2017;48:2984–90.

How to cite this article: Yuniadi Y, Supit AI, Hanafy DA, Raharjo SB, Hermanto DY, Basalamah F, et al. Prevalence of atrial fibrillation based on tertiary hospital survey in Indonesia: A smartphone-based diagnosis. J Arrhythmia. 2024;40:1102–1107. https://doi.org/10.1002/joa3.13137