



Pre-competition screening for cardiovascular disorders among athletes at the Bali provincial national sports week: a cross-sectional study



I Gusti Ngurah Putra Eka Santosa^{1*}, I Nyoman Wiryawan²,
Ida Bagus Yorky Brahmantya³, I Gusti Ngurah Rama Arya Diyva⁴,
Made Jodi Arta Wiguna⁴

ABSTRACT

Sudden Cardiac Death (SCD) remains a significant risk among competitive athletes, who, despite being perceived as paragons of physical health, may harbor subclinical cardiovascular abnormalities that manifest fatally under peak exertion. This cross-sectional epidemiological study conducted pre-competition cardiovascular screenings on 95 athletes from the Bali Provincial contingent preparing for the National Sports Week on February 14, 2024, with the objective of determining the prevalence of cardiovascular disorders and identifying individuals requiring specialized clinical management. The three-stage screening protocol employed the 14-point American Heart Association checklist for structured clinical history and hereditary risk assessment, a comprehensive physical examination incorporating vital sign monitoring and cardiac auscultation, and 12-lead electrocardiography (ECG) interpreted by two independent cardiologists under a pre-established consensus protocol. Among the 95 participants (54.7% male; 71.6% aged 20–30 years), hypertension was identified in 8.4% of athletes. Rhythm analysis of 85 evaluable ECG recordings revealed normal sinus rhythm in 51.8%, sinus bradycardia in 40.0%, sinus arrhythmia in 7.1%, and atrial rhythm in 1.2%. Detailed ECG analysis of 15 athletes with significant findings identified Incomplete Right Bundle Branch Block (IRBBB) in 60.0%, Left Posterior Fascicular Block (LPFB) in 20.0%, Left Ventricular Hypertrophy (LVH) in 13.3%, and Premature Ventricular Contraction (PVC) Bigeminy in 6.7%. A total of 20 athletes (21.1%) were referred for specialized cardiology consultation. These findings demonstrate that a structured, multi-stage pre-participation screening protocol is effective in uncovering both physiological cardiac adaptations and potentially pathological conditions in elite athletes, underscoring the necessity of institutionalizing such programs as a standard pre-competition safety measure in Indonesian sports governance.

Keywords: athlete, cardiovascular, electrocardiography, screening, sport.

Cite This Article: Santosa, I.G.N.P.E., Putra, I.P.N.A., Wiryawan, I.N., Brahmantya, I.B.Y., Diyva, I.G.N.R.A., Wiguna, M.J.A. 2026. Pre-competition screening for cardiovascular disorders among athletes at the Bali provincial national sports week: a cross-sectional study. *Journal of Ethnomedicine and Medical Wellness* 2(2): 37-41

¹Physiology Division, Biomedic Department, Faculty of Medicine, Universitas Mahasarwati Denpasar, Indonesia

²Cardiovascular Department, Prof. Dr. I.G.N.G Ngoerah Central General Hospital, Denpasar, Indonesia

³Medical Education Unit, Faculty of Medicine, Universitas Mahasarwati Denpasar, Indonesia

⁴Bachelor of Medicine Program, Faculty of Medicine, Universitas Mahasarwati Denpasar, Indonesia

*Corresponding author:

I Gusti Ngurah Putra Eka Santosa;
Physiology Division, Biomedic Department, Faculty of Medicine, Universitas Mahasarwati Denpasar, Indonesia;

ekasantosa@unmas.ac.id

Received: 2026-04-26

Accepted: 2026-06-22

Published: 2026-07-08

INTRODUCTION

Intensive physical exertion among competitive athletes inherently elevates the risk of Sudden Cardiac Death (SCD), which remains the primary cause of non-traumatic mortality within this demographic.^{1,2} While athletes are traditionally viewed as the quintessence of health, a subset of this population may harbor subclinical cardiovascular abnormalities that manifest as fatal incidents during peak performance or training.³ Therefore, early detection through systematic pre-participation cardiovascular screening serves as an indispensable preventive measure to safeguard athlete longevity.⁴

Robust evidence demonstrates that screening protocols combining clinical history, physical assessment, and 12-lead electrocardiography (ECG) are highly effective in identifying conditions like hypertrophic cardiomyopathy and channelopathies—the primary drivers of SCD in young competitors.^{2,5} Large-scale data further support this approach, showing a significant decrease in sudden cardiac arrest rates when these systematic screenings are implemented.^{2,4} By identifying at-risk individuals, medical professionals can facilitate timely clinical management and provide evidence-based recommendations regarding sports participation to prevent catastrophic outcomes.¹

Despite robust international evidence, systematic pre-participation cardiovascular screening remains incompletely implemented in many low- and middle-income countries, including Indonesia. Within the context of high-stakes multi-sport events such as the Indonesian National Sports Week, the premier domestic multi-sport competition, athletes are subjected to intensive physical demands comparable to professional competition, yet standardized cardiovascular safety protocols remain underdeveloped. Epidemiological data on the prevalence of cardiovascular disorders among Indonesian competitive athletes are scarce, representing a significant gap in the national sports medicine evidence

base. Addressing this gap is essential for informing policy decisions regarding mandatory pre-competition health assessments and for directing clinical resources toward at-risk individuals.

Accordingly, this cross-sectional epidemiological study aimed to determine the prevalence of cardiovascular disorders, including hypertension and ECG abnormalities, among athletes from the Bali Provincial contingent preparing for the National Sports Week, using a rigorous three-stage screening protocol aligned with AHA guidelines. Secondary objectives included characterizing the demographic and sport-specific distribution of cardiovascular findings and quantifying the proportion of athletes requiring specialist cardiology referral, thereby contributing to the evidence base for the institutionalization of pre-competition cardiovascular screening in Indonesia.

METHODS

Study Design and Setting

This study employed a descriptive cross-sectional epidemiological design to characterize the prevalence of cardiovascular disorders among competitive athletes. The screening was conducted on February 14, 2024, at the Indonesian National Sports Committee (*Komite Olahraga Nasional Indonesia/KONI*) office in Bali Province, Indonesia. The activity was carried out in collaboration with the Indonesian Heart Association (*Perhimpunan Dokter Spesialis Kardiovaskular Indonesia/PERKI*) Bali Branch, ensuring the availability of specialist cardiology expertise for both ECG interpretation and immediate clinical decision-making. All participants provided informed consent prior to enrolment.

Study Population and Sampling

The target population comprised of all athletes from the Bali Provincial contingent officially registered to compete in the National Sports Week (Pekan Olahraga Nasional/PON). The study recruited participants through a total sampling approach, enrolling all athletes who were physically present at the KONI Bali office on the designated screening

date and who voluntarily provided written informed consent. A total of 95 athletes were enrolled, representing 12 competitive sporting disciplines: athletics, handball, dance sport, judo, karate, rock climbing, swimming, surfing, sepak takraw, tennis, boxing, and weightlifting. Athletes were excluded if they declined to participate, were absent on the screening date, or were unable to complete any component of the three-stage protocol.

Screening Protocol

The cardiovascular screening was conducted in three sequential, standardized stages, consistent with current international recommendations for pre-participation cardiovascular evaluation.⁶

Stage 1: Structured Clinical Interview

Each participant underwent a structured clinical interview administered by a trained physician, utilizing the 14-point cardiovascular history checklist developed by the American Heart Association (AHA) and the American College of Cardiology (ACC).¹² This validated checklist systematically assessed the following domains: (a) personal history of exertional chest pain or discomfort, unexplained syncope or near-syncope, exercise-induced excessive dyspnea or fatigue disproportionate to the degree of exertion, previously detected cardiac murmur, and elevated systemic blood pressure; and (b) family history of premature death (sudden or otherwise) before age 50 years attributable to cardiac disease in one or more relatives, disability from heart disease in a close relative under 50 years of age, and specific knowledge of any of the following conditions in family members: hypertrophic or dilated cardiomyopathy, long QT syndrome, Marfan syndrome, or clinically important tachyarrhythmias. Any positive response on one or more items was documented and used to guide the clinical examination and interpretation of objective findings.

Stage 2: Physical Examination

A systematic physical examination was performed by a physician for each participant, encompassing blood pressure and heart rate measurement using a

calibrated aneroid sphygmomanometer, body weight and height measurement for body mass index calculation, visual inspection for stigmata of Marfan syndrome (tall stature, arm span exceeding height, arachnodactyly, high-arched palate, lens subluxation, and mitral valve prolapse), auscultation of the heart at four standard precordial positions, and peripheral vascular assessment. Blood pressure was classified in accordance with the Eighth Joint National Committee (JNC 8) guidelines, defining hypertension as a systolic blood pressure ≥ 140 mmHg or a diastolic blood pressure ≥ 90 mmHg on two consecutive measurements taken five minutes apart.¹² Athletes with elevated readings at initial measurement were re-evaluated in the seated position after five minutes of rest, and hypertension was confirmed only when both measurements exceeded the defined threshold.

Stage 3: 12-Lead Electrocardiography

Resting 12-lead electrocardiograms (ECGs) were recorded for all participants using a standardized ECG machine (25 mm/s paper speed, 10 mm/mV calibration) by trained medical personnel. Participants were positioned supine and instructed to remain motionless and breathe normally during acquisition. All ECGs were printed and independently reviewed by two board-certified cardiologists who were blinded to each other's interpretations. ECG findings were classified according to the 2017 International Criteria for ECG Interpretation in Athletes as: (i) normal training-related findings (e.g., sinus bradycardia, sinus arrhythmia, first-degree atrioventricular block, incomplete right bundle branch block, isolated voltage criteria for LVH, and early repolarization); (ii) borderline findings (e.g., left axis deviation, right bundle branch block, right ventricular hypertrophy by voltage, prolonged QT interval); or (iii) abnormal findings warranting further evaluation (e.g., T-wave inversions, ST-segment depression, pathological Q waves, ventricular arrhythmias, ventricular pre-excitation).⁹ Any interpretive discrepancy between the two cardiologists was resolved through a structured consensus meeting involving a third senior cardiologist, whose adjudication was considered definitive.

Referral Pathway

Athletes with one or more of the following were classified as requiring specialized cardiology referral: (a) confirmed hypertension; (b) abnormal or borderline ECG findings as defined by the 2017 International Criteria; (c) positive clinical history items suggestive of hereditary or structural cardiac disease; or (d) significant physical examination findings such as pathological murmurs or Marfan stigmata. All referred athletes received written documentation of their findings and were expeditiously directed to the cardiovascular outpatient clinic of Prof. Dr. I.G.N.G Ngoerah Central General Hospital, Denpasar, for comprehensive evaluation including echocardiography and, where indicated, Holter monitoring and exercise stress testing.

Data Management and Statistical Analysis

All data were recorded on standardized case report forms and subsequently entered a structured electronic database. Data were analyzed using descriptive statistics. Categorical variables, including sex, age group, sport discipline, regional origin, blood pressure classification, heart rhythm, and ECG findings, are presented as absolute frequencies and percentages. Continuous variables are summarized as means \pm standard deviations (SD) or medians with interquartile ranges (IQR) as appropriate, depending on the normality of distribution. No inferential statistical comparisons were performed, as the study objective was descriptive epidemiological characterization of cardiovascular disorders in the study population. All analyses were performed using SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

A cohort of 95 athletes across diverse sporting disciplines participated in the screening program, with the demographic profile predominantly comprising males (54.7%, $n = 52$) and individuals aged 20–30 years (71.6%, $n = 68$), primarily representing the regions of Badung and Denpasar (26.3% each). Clinical assessments revealed that 8.4% ($n = 8$) of the participants presented with

hypertension. 10 athletes were unable to attend the ECG examination; therefore, ECG data is available for only 85 athletes. Heart rhythm analysis of 85 evaluable cases identified normal sinus rhythm in 51.8%, sinus bradycardia in 40.0%, and sinus arrhythmia in 7.1% of the athletes. Detailed 12-lead ECG of 15 athletes with significant findings further identified Incomplete Right Bundle Branch Block (IRBBB) in 60.0%, Left Posterior Fascicular Block (LPFB) in 20.0%, Left Ventricular Hypertrophy (LVH) in 13.3%, and Premature Ventricular Contraction (PVC) Bigeminy in 6.7%. By synthesizing these multi-stage findings, the program identified 21.1% of the total cohort ($n = 20$) as being at cardiovascular risk, necessitating immediate referral for specialized cardiological evaluation. These outcomes demonstrate that systematic screening can uncover a high prevalence of both benign physiological adaptations and potentially pathological conditions in elite athletes, highlighting the critical need for evidence-based risk stratification in sports medicine.

DISCUSSION

This cross-sectional epidemiological study identified a substantial and clinically meaningful burden of cardiovascular abnormalities among competitive athletes preparing for the Bali Provincial National Sports Week. The finding that one fifth of screened athletes met criteria for cardiological referral is among the most consequential outcomes of this investigation, underscoring the paradox inherent in elite athletic populations: peak physical performance does not preclude the coexistence of potentially life-threatening cardiac pathology. This referral rate is consistent with the broader epidemiological literature on pre-participation screening in community-level and national competition settings, which consistently demonstrates that a significant proportion of athletes harbor asymptomatic cardiovascular abnormalities detectable only through systematic, multi-modal evaluation.² The high proportion of athletes in the 20–30-year age group (71.6%) further contextualizes these findings, as this demographic represents the peak years

Table 1. Athletes characteristics

Characteristics	N	%
Sex		
Male	52	54.7
Female	43	45.3
Age Range		
10-20 years old	14	14.7
20-30 years old	68	71.6
30-40 years old	13	13.7
Sports		
Athletics	9	9.5
Handball	5	5.3
Dance Sport	13	13.7
Judo	15	15.8
Karate	12	12.6
Rock Climbing	10	10.5
Swimming	5	5.3
Surfing	6	6.3
Sepak Takraw	2	2.1
Tennis	2	2.1
Boxing	11	11.6
Weightlifting	2	2.1
Regional origin		
Badung	25	26.3
Denpasar	25	26.3
Tabanan	10	10.5
Jembrana	2	2.1
Gianyar	9	9.5
Bangli	8	8.4
Karangasem	8	8.4
Klungkung	8	8.4
Blood pressure classification		
Normal	87	91.6
High	8	8.4
Heart rhythm (n = 85)		
Normal Sinus Rhythm	44	51.8
Sinus Bradycardia	34	40.0
Sinus Arrhythmia	6	7.1
Atrial Rhythm	1	1.2
Electrocardiogram results (n = 15)		
Incomplete Right Bundle Branch Block	9	60.0
Left Posterior Fascicular Block	3	20.0
Left Ventricular Hypertrophy	2	13.3
PVC Bigeminy	1	6.7

PVC, premature ventricular contraction.

of competitive athletic participation and, paradoxically, the period during which heritable cardiomyopathies and primary arrhythmic disorders are most likely to

manifest under the physiological stress of intense competition.³

The ECG findings in this cohort warrant careful and nuanced interpretation in the context of exercise-induced cardiac adaptation. Sinus bradycardia, observed in 40% of evaluable athletes, is among the most common and well-characterized physiological ECG variants in trained athletes, reflecting enhanced parasympathetic tone and reduced intrinsic sinus node firing rate that develop as adaptive responses to sustained aerobic conditioning. Similarly, sinus arrhythmia, present in 7.1% of this cohort, represents a benign manifestation of respiratory-phase-dependent variation in autonomic modulation of the sinoatrial node. These findings collectively illustrate the “athlete’s heart” phenomenon and should not in isolation prompt clinical concern.¹ In contrast, the pathological ECG findings identified in 15 athletes demand considerably greater clinical scrutiny. IRBBB detected in 60% of athletes with significant ECG findings, is a common conduction variant that, while frequently a benign finding in otherwise healthy young individuals,⁷ may in certain contexts represent an early marker of right heart structural abnormality. LPFB found in 20% of athletes with notable ECG findings, is an uncommon conduction abnormality that frequently co-occurs with structural cardiac disease,⁸ and warrants echocardiographic evaluation to exclude underlying organic pathology. Of clinical significance is the identification of LVH by ECG criteria in 13.3% of athletes with notable findings. The critical diagnostic challenge with LVH in athletes lies in differentiating the physiological concentric hypertrophy associated with resistance training from the pathological asymmetric septal hypertrophy characteristic of hypertrophic cardiomyopathy,⁹ the most common cardiovascular cause of SCD in young American athletes.^{10,11} Finally, the detection PVC Bigeminy in 6.7% of athletes with significant findings represents a clinically important ventricular arrhythmia that, particularly when arising from the right ventricular outflow tract or in the context of structural heart disease, carries an elevated risk of degeneration into malignant ventricular arrhythmias under exercise-induced

sympatho-adrenergic stimulation.¹² In aggregate, these ECG findings reinforce the indispensability of cardiologist-led interpretation of athlete ECGs, which, as demonstrated in this study, allows for appropriate risk stratification beyond the diagnostic capacity of unassisted history-taking or physical examination alone.⁵

The hypertension prevalence of 8.4% observed in this cohort warrants epidemiological attention. While elevated blood pressure is generally expected to be less prevalent in physically active populations than in sedentary age-matched controls, the detection of Stage 1 or higher hypertension in nearly one in twelve athletes underscores that athletic participation alone does not confer universal protection against cardiovascular risk factors. In younger athletes, secondary causes of hypertension, including renal disease, endocrine disorders, and performance-enhancing substance use, should be excluded through appropriate clinical evaluation, as these may have direct implications for both sports eligibility and long-term cardiovascular health.

The methodological strengths of the present study include its use of a validated, internationally recognized screening framework (the AHA 14-point checklist), independent dual-cardiologist ECG interpretation with a pre-specified consensus resolution mechanism to minimize observer bias, and the comprehensive multi-stage design that integrates subjective history with objective clinical and electrophysiological data. The multi-sport composition of the cohort further enhances the generalizability of findings across diverse competitive disciplines represented in the Indonesian national sports ecosystem.

Several limitations of this study must be acknowledged. First, the inherent design limitation of a cross-sectional study precludes the establishment of causal relationships and provides only a single temporal snapshot of cardiovascular status, which may not capture dynamic or episodic cardiac phenomena. Second, the sample was drawn exclusively from Bali Province, limiting extrapolation to the broader Indonesian athletic population. Third, universal echocardiography was not performed as part of the screening

protocol, which constrains the ability to definitively distinguish physiological from pathological hypertrophy and may have led to an underestimation of structural cardiac abnormalities. Fourth, the discrepancy between the total sample size ($n = 95$) and the number of evaluable ECG rhythm interpretations ($n = 85$) suggests incomplete data capture for a subset of participants, potentially introducing selection bias into the electrophysiological findings. Future investigations should address these limitations through prospective longitudinal designs, multi-provincial sampling, and universal echocardiography. Notwithstanding these limitations, the present study provides a valuable epidemiological baseline and constitutes the strongest available evidence supporting the systematic implementation of pre-competition cardiovascular screening for Indonesian national-level athletes. Sports governing bodies, including the National Sports Committee of Indonesia, are strongly encouraged to adopt and institutionalize standardized cardiovascular screening protocols as a mandatory component of pre-competition clearance procedures, thereby fulfilling their duty of care toward the nation’s competitive athletes.

CONCLUSION

The cardiovascular screening program for 95 National Sports Week athletes in Bali Province successfully identified a significant subset of individuals with latent cardiovascular risks requiring specialized medical intervention. Clinical findings, including hypertension and diverse ECG abnormalities, validate the utility of this multi-stage approach in uncovering conditions that may otherwise remain asymptomatic in athletes. These results demonstrate that a standardized protocol combining history-taking with objective diagnostic tools effectively bridges the gap between general athletic participation and the identification of potentially life-threatening pathologies. Consequently, the systematic and routine integration of cardiovascular screening into pre-competition protocols is essential to mitigate the risk of SCD and fundamentally safeguard the long-term well-being of high-performance athletes.

CONFLICT OF INTEREST

All authors declared that there is no conflict of interest regarding this article.

FUNDING

This article is self-funded by authors.

ETHICS APPROVAL

Not applied.

AUTHOR'S CONTRIBUTION

All authors contributed equally in the writing process of this article.

REFERENCES

1. Maron BJ, Thompson PD, Ackerman MJ, Balady G, Berger S, Cohen D, et al. Recommendations and Considerations Related to Preparticipation Screening for Cardiovascular Abnormalities in Competitive Athletes: 2007 Update: A Scientific Statement From the American Heart Association Council on Nutrition, Physical Activity, and Metabolism: *Endorsed by the American College of Cardiology Foundation*. *Circulation*. 2007;115(12):1643–55. doi:10.1161/CIRCULATIONAHA.107.181423
2. Sarto P, Zorzi A, Merlo L, Vessella T, Pegoraro C, Giorgiano F, et al. Value of screening for the risk of sudden cardiac death in young competitive athletes. *Eur Heart J*. 2023;44(12):1084–92. doi:10.1093/eurheartj/ehad017
3. Panhuyzen-Goedkoop N, Verbeek A, Goedkoop R, Malekzadeh A, Wilde A, Peters R. Quality of athlete screening for high-risk cardiovascular conditions—A systematic review. *Scand J Med Sci Sports*. 2023;33(11):2094–109.
4. Wren C. Cardiovascular pre-participation screening of young competitive athletes for prevention of sudden death: proposal for a common European protocol. *Eur Heart J*. 2005;26(17):1804–1804. doi:10.1093/eurheartj/ehi379
5. Williams E, Pelto H, Toresdahl B, Prutkin J, Owens D, Salerno J. Performance of the American Heart Association (AHA) 14-Point Evaluation Versus Electrocardiography for the Cardiovascular Screening of High School Athletes: A Prospective Study. *J Am Heart Assoc*. 2019;8(14):e012235.
6. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report From the Panel Members Appointed to the Eighth Joint National Committee (JNC 8). *JAMA*. 2014;311(5):507. doi:10.1001/jama.2013.284427
7. Dodulík J, Plášek J, Vrtal J, Václavík J. Incomplete Right Bundle Branch Block: A Narrative Review of Clinical Relevance, Diagnostic Pitfalls, and Prognostic Implications. *Cardiol Ther*. 2025;14(4):495–512. doi:10.1007/s40119-025-00429-1
8. Calò L, Crescenzi C, Romeo F, Panattoni G, Toto F, Canestrelli S, et al. When the conduction disturbance expresses a cardiomyopathy. *Eur Heart J Suppl*. 2025;27(Supplement_3):iii40–5. doi:10.1093/eurheartjsupp/suaf014
9. Augustine DX, Howard L. Left Ventricular Hypertrophy in Athletes: Differentiating Physiology From Pathology. *Curr Treat Options Cardiovasc Med*. 2018;20(12):96. doi:10.1007/s11936-018-0691-2 PubMed PMID: 30367318.
10. Maron BJ, Pelliccia A, Spirito P. Cardiac Disease in Young Trained Athletes. *Circulation*. 1995;91(5). doi:https://doi.org/10.1161/01.CIR.91.5.1596
11. Malhotra A, Sharma S. Hypertrophic Cardiomyopathy in Athletes. *Eur Cardiol Rev*. 2017;12(2):80–2. doi:10.15420/ocr.2017:12:1 PubMed PMID: 30416558; PubMed Central PMCID: PMC6223355.
12. Lee V, Perera D, Lambiase P. Prognostic significance of exercise-induced premature ventricular complexes: a systematic review and meta-analysis of observational studies. *Heart Asia*. 2017;9(1):14–24. doi:10.1136/heartasia-2016-010854 PubMed PMID: 28123456; PubMed Central PMCID: PMC5237717.



This work is licensed under a Creative Commons Attribution