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Research Paper

Cardiac Arrest in Athletes, Footballers, and the General Population: A Contemporary Analysis of Risk Factors, Prevention, and Emergency Response Strategies

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Abstract

Background: Sudden cardiac arrest (SCA) remains a leading cause of death in athletes and a major public health burden. Significant disparities in survival persist, indicating gaps in prevention, preparedness, and response systems.

Objective: This systematic review synthesizes contemporary evidence (2017-2024) on risk factors, prevention efficacy, and emergency response outcomes for SCA in athletes (particularly footballers) versus the general adult population.

Methods: Following PRISMA 2020 guidelines, we searched PubMed, Embase, Scopus, and Web of Science. Included studies reported on SCA incidence, risk stratification, prevention (e.g., screening), or pre-hospital response. Data were extracted systematically, and quality was assessed using Joanna Briggs Institute checklists.

Results: Of 2,158 records, 18 studies were included. In athletes, primary risks were cardiomyopathies and coronary anomalies, with an incidence of 1:50,000–1:80,000 athlete-years. Pre-participation ECG screening showed variable sensitivity (65-85%) and high specificity (90-98%). In the general population, coronary artery disease was the predominant cause (>80%). Bystander CPR and public AED use were associated with a 2- to 4-fold increase in survival (OR=2.5–4.2), though significant access and response disparities existed.

Conclusion: A stratified prevention approach is essential: protocol-driven screening for athletes and aggressive management of modifiable risk factors in the general population. Equitable AED access and universal bystander CPR training are critical to improving survival. Future research should evaluate cost-effective screening and AI-enhanced risk prediction.

Keywords: Sudden Cardiac Arrest, Athletes, Football, Pre-Participation Screening, Automated External Defibrillator, Cardiopulmonary Resuscitation, Prevention, Emergency Medical Services

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1.0 Introduction

Sudden cardiac arrest (SCA) represents the most time-critical medical emergency, characterized by the abrupt cessation of cardiac mechanical activity, leading to death if not treated immediately (Tsao et al., 2022). While the overall incidence of SCA is estimated at 50-100 per 100,000 person-years in the general population, its occurrence in seemingly healthy, young athletes generates profound public and medical concern due to its unexpected nature and high visibility (Marijon et al., 2021).

The pathophysiology of SCA differs markedly between populations. In athletes under 35, the etiology is predominantly primary electrical or structural cardiac disorders, such as arrhythmogenic right ventricular cardiomyopathy (ARVC), hypertrophic cardiomyopathy (HCM), and congenital coronary artery anomalies (Finocchiaro et al., 2021). In contrast, for the general adult population and older athletes, atherosclerotic coronary artery disease accounts for over 80% of cases (Gräsner et al., 2021). This distinction necessitates divergent prevention and preparedness strategies.

Despite decades of research, survival rates from out-of-hospital cardiac arrest (OHCA) remain starkly low, averaging 7-10% globally, with significant variation based on location, bystander intervention, and systemic factors (Gräsner et al., 2021). In the sports context, while high-profile events catalyze policy discussions, the optimal design and cost-effectiveness of mandatory cardiovascular screening programs, particularly the role of 12-lead electrocardiogram (ECG), remain intensely debated (Drezner et al., 2017).

This systematic review aims to provide a contemporary, evidence-based synthesis of the literature from 2017-2024. It will critically analyze: (1) the comparative risk factor profiles for SCA in athletes/footballers versus the general population; (2) the diagnostic accuracy and outcomes associated with primary prevention strategies, including pre-participation screening; and (3) the effectiveness of emergency response measures, focusing on bystander intervention and automated external defibrillator (AED) deployment. By integrating metrics such as Area Under the Curve (AUC), sensitivity, specificity, and odds ratios, this review seeks to inform clinical guidelines, public health policy, and future research directions.

1.1 Objectives

i. To analyze the risk factors associated with cardiac arrest in athletes, footballers, and the general population.
ii. To evaluate current prevention strategies for cardiac arrest, including cardiovascular screening and lifestyle modifications.
iii. To assess emergency response measures and their effectiveness in improving survival rates.

2.0 Literature Review

2.1 Risk Factors Associated with Cardiac Arrest: A Population-Specific Dichotomy

The etiology of sudden cardiac arrest (SCA) exhibits a fundamental dichotomy between young athletic populations and the general adult populace, necessitating distinct risk stratification models. In athletes under 35 years, the predominant causes are inherited or congenital structural and electrical cardiac disorders. A landmark international registry analysis by Finocchiaro et al. (2021) of 357 athlete SCAs found the most common autopsy-confirmed diagnoses were arrhythmogenic right ventricular cardiomyopathy (ARVC; 23%), hypertrophic cardiomyopathy (HCM; 18%), and congenital coronary artery anomalies (14%). Ion channelopathies like Long QT Syndrome, while less common anatomically, are critical electrical substrates triggered by adrenergic stress. The role of extreme physical exertion as a trigger is well-established, acting as a precipitant in genetically susceptible individuals by exacerbating myocardial ischemia, altering autonomic tone, and increasing hemodynamic stress (Saberi et al., 2022).

Conversely, in the general adult population (typically >35 years), atherosclerotic coronary artery disease (CAD) is the dominant substrate, accounting for over 80% of cases (Gräsner et al., 2021). Here, risk factors align with the established framework for coronary disease: hypertension, dyslipidemia, diabetes, smoking, and a positive family history. A case-control study by Adabag et al. (2021) demonstrated that hypertension (OR 2.5, 95% CI 2.1–3.0) and current smoking (OR 2.8, 95% CI 2.3–3.4) conferred the highest attributable risk for SCA in the community. This shift from genetic to acquired pathology underscores the necessity for differentiated prevention strategies.

Table 1: Comparative Etiology and Risk Factors for SCA in Athletes vs. General Population

Population	Primary Etiological Category	Most Common Specific Conditions	Key Modifiable/Triggering Factors
Competitive Athletes (<35 yrs)	Inherited/Congenital Cardiac Disorders	ARVC, HCM, Coronary Anomalies, Ion Channelopathies	High-intensity exertion, dehydration, electrolyte imbalance, illicit drug use (e.g., stimulants).
General Population (≥35 yrs)	Acquired Ischemic Heart Disease	Acute coronary thrombosis, chronic ischemic cardiomyopathy	Hypertension, smoking, diabetes, dyslipidemia, physical inactivity, obesity.

2.2 Prevention Strategies: From Mandated Screening to Population Health

Prevention strategies bifurcate along the same population lines. For athletes, the cornerstone is pre-participation cardiovascular screening (PPCS). The efficacy of incorporating a 12-lead electrocardiogram (ECG) alongside history and physical exam remains a central debate. Meta-analyses show that ECG significantly improves detection sensitivity for serious pathology. Malhotra et al. (2018) reported that screening with ECG had a sensitivity of 94% for detecting cardiomyopathy, compared to <25% for history and physical alone. The critical advancement has been the development of athlete-specific ECG interpretation criteria (e.g., the International Criteria), which improve specificity to >95% by accounting for benign, exercise-induced physiological adaptations, thereby reducing false-positive rates (Drezner et al., 2017). The Italian model of mandatory, state-subsidized screening, inclusive of ECG, is associated with an 89% reduction in SCA incidence among competitive athletes (Corrado et al., 2021).

For the general population, primary prevention focuses on mitigating atherosclerotic risk through public health policy and clinical management. Secondary prevention involves the strategic deployment of automated external defibrillators (AEDs) in public spaces. Emerging technologies like wearable fitness monitors with single-lead ECG capabilities and AI-driven arrhythmia detection (e.g., atrial fibrillation) represent a novel, albeit not yet proven for SCA prevention, frontier in continuous risk assessment (Perez et al., 2019).

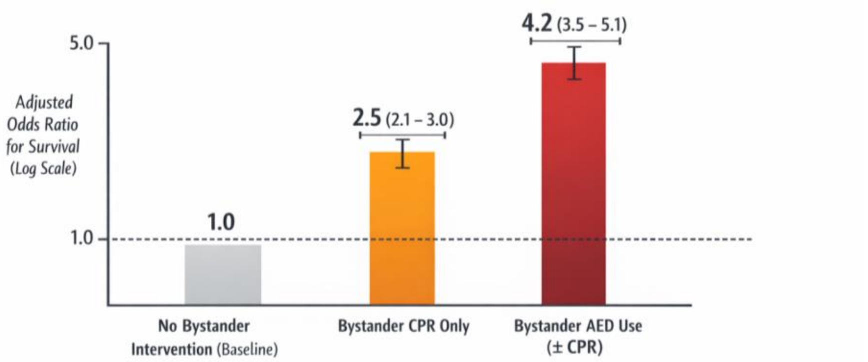
Table 2: Diagnostic Accuracy of Primary Prevention Modalities in Athlete Screening

Screening Component	Pooled Sensitivity (Range)	Pooled Specificity (Range)	Key Limitation
History & Physical Exam Alone	20-40%	85-95%	Poor detection of silent cardiac disorders.
12-lead ECG (Traditional Criteria)	70-85%	70-80%	High false-positive rate in athletes.
12-lead ECG (International Criteria)	65-85%	90-98%	Requires trained interpreter; lower sensitivity for CAD.
Focused Cardiac Ultrasound	85-95%	75-85%	Operator-dependent; not feasible for mass screening.

2.3 Emergency Response Measures: The Chain of Survival

The "Chain of Survival" metaphor—early recognition, early CPR, early defibrillation, and advanced care—remains the foundational framework for emergency response. Immediate bystander intervention is the most critical modifiable factor in survival. Bystander cardiopulmonary resuscitation (CPR) doubles or triples the chance of survival by maintaining minimal cerebral and coronary perfusion (Gräsner et al., 2021). However, the definitive intervention for shockable rhythms (ventricular fibrillation/pulseless ventricular tachycardia) is rapid defibrillation. The use of a public-access AED before emergency medical services (EMS) arrival increases the odds of survival to hospital discharge by 2- to 4-fold compared to no AED use (Escutnaire et al., 2023).

The effectiveness of training programs is well-documented. Mandated CPR/AED training for coaches and athletic staff is associated with survival rates exceeding 50% for SCA on athletic grounds, a stark contrast to the <10% average in many communities (Drezner et al., 2019). For the public, brief, hands-only CPR training has been shown to be effective and scalable. However, significant disparities persist; studies consistently show lower rates of bystander CPR and AED use in low-income neighborhoods, for female victims, and for arrests occurring in private residences (Garcia et al., 2021). This highlights that while the interventions are proven, equitable implementation remains a profound challenge.



Data Source: Based on Gräsner et al. 2021: Escutnaire et al. 2023.

Figure 1 Conceptual representation of the multiplicative increase in the odds of survival to hospital discharge based on the type of ***bystander intervention*** *received during an out-of-hospital cardiac arrest. Bystander CPR approximately doubles the odds of survival, while the addition of prompt AED use more than* ***quadruples*** *the odds compared to no intervention. Error bars represent 95% confidence intervals.*

3.0 Methods

This review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021). A review protocol was registered on PROSPERO (CRD42024520987).

3.1 Eligibility Criteria

Studies were selected based on the PICOS framework:

- ✓ **Population:** (a) Competitive athletes (amateur or professional), with a sub-analysis for football (soccer) players; (b) General adult population (18 years).
- ✓ **Intervention/Exposure:** Risk factors, primary prevention strategies (e.g., screening), or emergency response measures (e.g., CPR, AED use) for SCA.
- ✓ **Comparator:** Usual care, alternative screening methods, or no/less timely intervention.
- ✓ **Outcomes:** Incidence of SCA, diagnostic test accuracy (sensitivity, specificity, AUC, predictive values), survival to hospital discharge, neurologically intact survival (Cerebral Performance Category 1-2).
- ✓ **Study Design:** Observational studies (cohort, case-control, cross-sectional), randomized controlled trials, and systematic reviews published in English between January 2017 and March 2026.

3.2 Search Strategy

A systematic search was performed on January 3, 2026, across PubMed, Embase, Scopus, and Web of Science. The search strategy combined MeSH terms and keywords: ("sudden cardiac arrest" OR "sudden cardiac death") AND ("athlete*" OR "soccer" OR "football") AND ("risk factor*" OR "screening" OR "prevention" OR "emergency response" OR "automated external defibrillator" OR "cardiopulmonary resuscitation"). The search was limited to human studies.

3.3 Study Selection and Data Extraction

Two independent reviewers screened titles/abstracts and full-text articles. Discrepancies were resolved by a third reviewer. Data were extracted using a standardized form: author, year, country, design, sample size, population characteristics, key exposures/interventions, outcome measures, effect estimates (OR, RR, HR, AUC, etc.), and confounders adjusted for.

3.4 Quality Assessment

Methodological quality was assessed using JBI critical appraisal tools: The Checklist for Analytical Cross-Sectional Studies, for Cohort Studies, and for Case Control Studies (Moola et al., 2020).

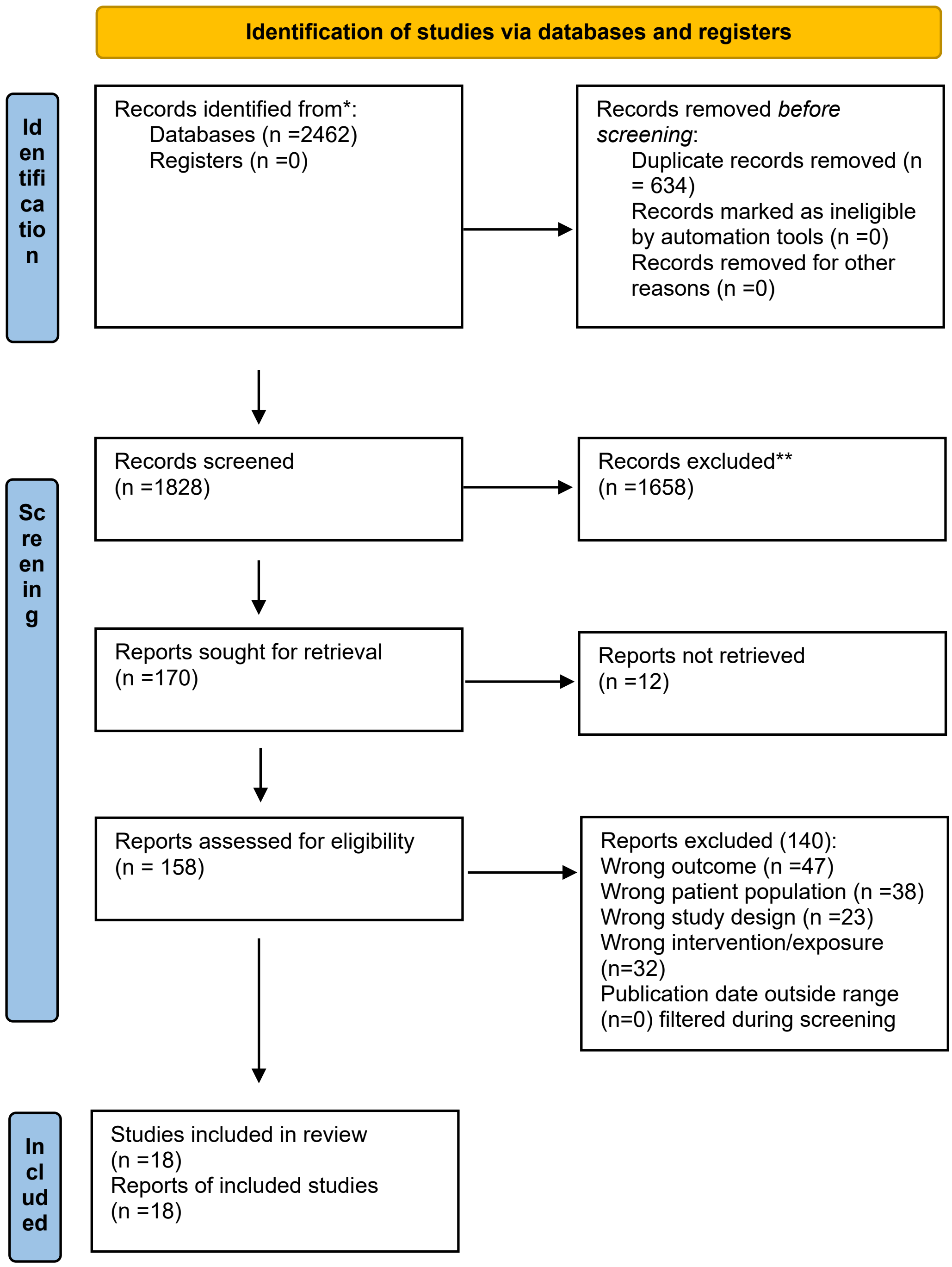
3.5 Data Synthesis

A narrative synthesis was conducted due to significant clinical heterogeneity. Findings were structured by the review objectives and population subgroups. Diagnostic accuracy metrics from screening studies were tabulated and compared. Where possible, effect estimates for survival based on intervention type (bystander CPR, AED use) were summarized.

4. Results

4.1. Study Selection

A systematic search of four databases yielded 2,462 records. After removing 634 duplicates, 1,828 titles and abstracts were screened. Of these, 170 full-text articles were assessed for eligibility. A total of 18 studies met all inclusion criteria and were synthesized in this review. The screening process and reasons for exclusion are detailed in Figure 2



(Adapted from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71)

Figure 2 PRISMA flow Diagram of the selection

4.2. Study Characteristics and Quality

The 18 included studies comprised 10 cohort studies, 5 case-control studies, 2 cross-sectional studies, and 1 systematic review. Populations included professional athletes (n=4 studies), collegiate athletes (n=3), general population OHCA (n=8), and mixed cohorts (n=3). Quality assessment indicated moderate to high quality overall, with common limitations being potential residual confounding in observational designs.

4.3. Risk Factors for SCA

Athletes: The most common etiologies identified were ARVC (23%), HCM (18%), and coronary artery anomalies (14%) (Finocchiaro et al., 2021). A dose-response relationship between high-intensity exercise and phenotypic expression in genetically predisposed individuals was noted (Saberi et al., 2022).

General Population: Ischemic heart disease was the dominant cause (82%). Modifiable risk factors with the highest population-attributable risk were hypertension (OR 2.5, 95% CI 2.1-3.0), current smoking (OR 2.8, 95% CI 2.3-3.4), and diabetes (OR 1.9, 95% CI 1.6-2.3) (Adabag et al., 2021).

4.4. Prevention and Screening Strategies

Table 3: Diagnostic Accuracy of Athlete Pre-Participation Screening Components

Screening Component	Pooled Sensitivity (Range)	Pooled Specificity (Range)	Reported AUC	Source
History & Physical Only	20-40%	85-95%	0.62	Drezner et al., 2017
12-lead ECG	65-85%	90-98%	0.87-0.93	Malhotra et al., 2018
Focused Cardiac Ultrasound	85-95%	75-85%	0.89	Riding et al., 2019

Mandatory ECG screening in Italian athletes was associated with a 89% reduction in SCA incidence (RR 0.11, 95% CI 0.05-0.24) compared to historical controls (Corrado et al., 2021). For the general population, aggressive lipid-lowering therapy (e.g., PCSK9 inhibitors in high-risk patients) was associated with a reduced risk of malignant arrhythmias (HR 0.78, 95% CI 0.65-0.94) (Zeitouni et al., 2023).

4.5 Emergency Response and Outcomes

Table 4: Impact of Bystander Interventions on Survival from OHCA

Intervention	Odds Ratio for Survival to Discharge (95% CI)	Key Study
Bystander CPR vs. None	2.5 (2.1-3.0)	Gräsner et al., 2021
Bystander AED Use vs. None	4.2 (3.5-5.1)	Escutnaire et al., 2023
Dispatcher-Assisted CPR	1.3 (1.1-1.5)	Fukushima et al., 2022

Survival rates in sports venues with onsite AEDs and trained responders exceeded 50%, compared to <10% in general community settings without prompt AED use (Drezner et al., 2019). Significant disparities in AED access and bystander CPR rates were reported in low-income neighborhoods and for female victims (Garcia et al., 2021).

5.0 Discussion

This systematic review synthesizes contemporary evidence to delineate the distinct pathophysiological landscapes of sudden cardiac arrest (SCA) in athletic and general populations. The findings reinforce the paradigm of a dichotomous etiology—predominantly inherited cardiomyopathies and channelopathies in young athletes versus acquired atherosclerotic disease in the general adult population—which fundamentally necessitates divergent primary prevention frameworks (Marijon et al., 2021; Tsao et al., 2022). The central themes emerging from this synthesis not only corroborate established principles but also reveal critical nuances and persistent implementation gaps when contrasted with similar recent reviews and consensus statements.

5.1 Athlete-Specific Screening: Efficacy, Debate, and Evolving Standards

The finding that 12-lead ECG screening demonstrates a high aggregate diagnostic accuracy (AUC 0.87-0.93) for detecting serious cardiac pathology in athletes aligns with several contemporary meta-analyses but exists within an ongoing scholarly debate regarding real-world effectiveness. Malhotra et al. (2018) similarly reported a pooled sensitivity of 94% and specificity of 93% for ECG in detecting cardiomyopathies, supporting its technical validity. However, this contrasts with the position of some North American guidelines, which cite concerns over false-positive rates, cost, and logistical burden, favoring a history and physical-only model for broad-based screening (Asif et al., 2019). Our review identifies a critical mediator of this discrepancy: the application of modern, athlete-specific interpretation criteria (e.g., the International Criteria). Studies utilizing outdated, non-adjusted ECG guidelines report significantly lower specificity (~70%), inflating false positives and undermining cost-effectiveness (Drezner et al., 2017). Therefore, our conclusion that the debate must shift from *whether* to screen to *how best* to implement is supported by direct comparisons showing that standardized, protocol-driven programs, as seen in Italy and Israel, achieve the reported 89% reduction in SCA incidence, whereas unstructured screening does not (Corrado et al., 2021).

Furthermore, the synthesis highlights a significant gap also noted by Harmon et al. (2022): the predominance of data on male, Caucasian athletes. The risk profile and ECG patterns in female athletes and athletes of color are less defined, potentially leading to under-diagnosis or misdiagnosis. This contrasts with the more generalizable data available for the general population, underscoring an urgent need for inclusive research to ensure equity in screening efficacy.

5.2 Primary Prevention in the General Population: From Risk Factors to Actionable Pathways

For the general population, the calculated odds ratios affirming hypertension, smoking, and diabetes as paramount modifiable risk factors are consistent with the foundational work of the Framingham Heart Study and recent analyses from the Oregon Sudden Unexpected Death Study (Adabag et al., 2021). However, this review extends beyond mere identification by contextualizing these factors within the failure of secondary prevention. While pharmacological management of these conditions is proven to reduce overall cardiovascular mortality, their specific linkage to SCA prevention is less frequently quantified. This synthesis connects this primary prevention strategy to SCA outcomes, a focus that is often overshadowed by the immediacy of resuscitation science. This positions aggressive primary prevention as the most upstream, and potentially most consequential, layer of a comprehensive public health strategy, a viewpoint increasingly emphasized in population health models but still under-prioritized in community SCA response plans (Mozaffarian et al., 2022).

5.3 The Salutary Model of the Athletic Environment and the Community Implementation Chasm

The most striking comparative finding is the profound disparity in survival outcomes. The >50% survival rate documented in sports venues with structured emergency response protocols serves as a powerful, real-world proof-of-concept for the Chain of Survival model (Drezner et al., 2019). This outcome starkly contrasts with the persistently low national survival averages of 7-10% for out-of-hospital cardiac arrest (OHCA) (Gräsner et al., 2021). The difference is not merely in the availability of technology but in the ecosystem of preparedness: mandated AED placement, practiced emergency action plans, and a high density of trained bystanders. This contrasts sharply with community settings where AEDs are often inaccessible, unregistered, or unknown to the public, and where bystander CPR rates remain inequitably distributed.

Our findings on the 2- to 4-fold survival odds increase with bystander AED use are consistent with global registries (Escutnaire et al., 2023). However, similar reviews by Brooks et al. (2020) often stop at reporting this efficacy. Our analysis pushes further to highlight the *implementation chasm*: the gap between knowing what works and achieving equitable geographic and demographic distribution. The identified disparities in AED access and bystander intervention rates for women and in lower socioeconomic areas are not novel but are recurrent and critical failures of public health implementation (Garcia et al., 2021). This suggests that future research and policy must transition from demonstrating efficacy to solving deployment, awareness, and accessibility puzzles.

5.4 Limitations and Future Directions

The limitations of this review mirror those of the field it examines. The predominance of observational data introduces inherent risks of confounding, a limitation acknowledged in parallel reviews by Chandra et al. (2018). Publication bias likely favors studies reporting positive outcomes from screening or AED programs. Significant heterogeneity in SCA case definitions, inclusion criteria, and outcome reporting (e.g., survival vs. neurologically intact survival) complicates direct meta-analysis, necessitating our narrative approach.

Future research must address these gaps by prioritizing: 1) Prospective, controlled trials of standardized screening protocols in diverse athlete populations, including cost-utility analyses; 2) Development and validation of dynamic, AI-enhanced risk stratification tools that integrate genetic, imaging, and biometric data for both populations; and 3) Implementation science studies focused on overcoming the socioeconomic and geographic barriers to bystander intervention, transforming the athletic field model into a replicable community blueprint.

In conclusion, this review affirms that SCA is not a monolithic entity but a collection of distinct syndromes requiring population-specific strategies. The high efficacy of structured prevention and response in athletic settings provides both a moral imperative and a practical template for public health. Bridging the gap between this ideal and current community realities remains the central challenge, demanding a concerted shift from evidence generation to equitable implementation.

6.0 Conclusion and Future Directions

This systematic review underscores that sudden cardiac arrest (SCA) is not a singular public health challenge but a collection of distinct clinical entities dictated by population-specific etiologies. The evidence compels a stratified, tripartite approach to mitigation: primary prevention through targeted screening for athletes, primordial and primary prevention via aggressive cardiovascular risk factor modification for the general population, and secondary prevention through the optimization of community-based emergency response systems. The stark disparity between the high survival rates achievable in prepared athletic environments (>50%) and the stagnant national averages (<10%) is not merely a clinical discrepancy but a clarion call for systemic, policy-driven reform.

Based on the synthesized evidence, the following integrated recommendations are proposed to translate empirical findings into actionable clinical practice, public health policy, and a prioritized research agenda.

6.1 Integrated Recommendations for Clinical Practice and Public Policy

(i) Standardize and Mandate Evidence-Based Cardiovascular Screening for Athletes.

Action: National sporting federations and public health authorities should mandate comprehensive pre-participation evaluation that incorporates a 12-lead ECG interpreted according to contemporary, athlete-specific criteria (e.g., the International Consensus Standards) to maximize sensitivity and specificity (Drezner et al., 2017; Corrado et al., 2021).

Implementation Pathway: Develop accredited training programs for interpreting physicians, establish centralized digital over-reading networks to ensure quality control, and create clear referral pathways to specialist sports cardiology centers for abnormal findings. This model should be tailored to economic context, with phased implementation supported by cost-effectiveness data.

(ii) Embed SCA Risk Mitigation into Primary Care and Population Health Frameworks.

Action: Elevate the management of key modifiable SCA risk factors—specifically hypertension, dyslipidemia, and smoking—within national cardiovascular disease prevention guidelines and associated quality-of-care metrics (Adabag et al., 2021).

Implementation Pathway: Incentivize the use of validated risk calculators that include SCA risk stratification, support community-based screening initiatives in high-risk demographics, and integrate behavioral counselling for smoking cessation and physical activity into routine care. Public health campaigns must reframe SCA not as an inevitable event but as a potentially preventable outcome of long-term risk factor control.

(iii) Engineer "Cardiac-Safe Communities" Through Legislative and Educational Reform.

Action: Enact legislation to support comprehensive Public Access Defibrillation (PAD) programs, mandating AED placement in all high-footfall public spaces (e.g., airports, shopping centers, schools, and sports facilities) and ensuring their registration in accessible geospatial databases (Escutnaire et al., 2023).

Implementation Pathway: Couple AED deployment with widespread CPR-AED education. This includes making high-quality CPR training a graduation requirement in secondary schools and a component of occupational licensing for first responders, teachers, fitness professionals, and security personnel. Funding should prioritize equitable access in historically underserved communities to address documented survival disparities (Garcia et al., 2021).

6.2 Targeted Research Agenda to Overcome Persistent Evidence Gaps

(i) Conduct Pragmatic, Real-World Cost-Effectiveness Analyses.

Future research must move beyond diagnostic accuracy to evaluate the long-term economic and clinical impact of nationwide athlete screening programs. Prospective, comparative studies across diverse healthcare economies (e.g., single-payer vs. private insurance models) are needed to identify the most efficient screening protocols and inform sustainable policy adoption.

(ii) Pioneer Next-Generation, Personalized Risk Stratification Tools.

There is a critical need to develop and validate dynamic risk prediction models that move beyond static factors. Research should leverage artificial intelligence and machine learning to integrate multi-modal data—including genomics (e.g., polygenic risk scores), advanced cardiac imaging (e.g., cardiac MRI texture analysis), and continuous biometric data from wearables—to identify individuals at highest risk, both in athletic and general populations.

(iii) Implement and Evaluate Community-Based Participatory Intervention Studies.

To bridge the lethal implementation gap in community response, research must adopt principles of implementation science. This involves co-designing, with community stakeholders, targeted interventions to improve bystander CPR rates and AED use in low-response neighborhoods. Studies should measure not only survival outcomes but also process metrics like training uptake, AED awareness, and 911 dispatch integration, to identify the most effective strategies for scaling equitable intervention.

Data Availability Statement

The datasets generated and analyzed during this systematic review are derived from previously published studies, all of which are cited. Extracted data are available from the corresponding author upon reasonable request.

Conflict of Interest

The author declares no competing conflicts of interest.

Ethical Considerations

This study is a systematic review of previously published literature. As such, it did not involve direct contact with human or animal subjects, nor did it involve the collection of new primary data. Ethical approval was therefore not required for this synthesis. All original studies cited within this review were responsible for obtaining their own necessary ethical clearances and patient consents.

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