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Sudden Cardiac Death (SCD) in Young Athletes – A Review of Current Guidelines and Key Studies

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Abstract

Background: Sudden cardiac death (SCD) in young athletes is a rare but catastrophic event that exerts a profound impact on the medical community, athletic organizations, and society. While regular physical activity provides robust cardiovascular benefits, vigorous exertion can act as a trigger for fatal arrhythmias in individuals with underlying and often clinically silent structural or electrical cardiac abnormalities.

Aim: The objective of this study is to synthesize current epidemiological data, explore the pathophysiological etiologies of SCD in young athletes, evaluate ongoing debates regarding screening modalities, and outline the contemporary clinical framework—emphasizing the shift toward Shared Decision-Making (SDM) and robust secondary emergency prevention.

Material and methods: This comprehensive narrative review synthesizes data from modern prospective investigations utilizing mandatory reporting systems, such as the National Collegiate Athletic Association (NCAA) databases and the US Registry for Sudden Death in Athletes (USRSDA), as well as a comparative analysis of the latest international guidelines (HRS 2024, ACC/AHA 2025).

Results: The incidence of SCD is highly variable across subpopulations, demonstrating significant disparities based on sex, race, and sporting discipline, with the highest risk identified in Black male basketball players,. Key etiologies include structural conditions like HCM and ACM, autopsy-negative findings (AN-SUD) linked to channelopathies, and mechanical triggers such as commotio cordis,,. Furthermore, the evolution of ECG interpretation criteria has improved specificity, reducing false-positive rates to between 1.3% and 3%.

Conclusions: There is a paradigm shift away from paternalistic disqualification toward Shared Decision-Making (SDM), allowing many athletes to safely return to play while emphasizing the rigorous implementation of Emergency Action Plans (EAPs) and rapid access to automated external defibrillators (AEDs) as the most effective survival interventions.

Key words: sudden cardiac death, athletes, sports cardiology, ECG, shared decision-making.

1. Introduction

The sudden death of a young, seemingly healthy athlete is a highly visible tragedy that highlights the complex intersection of sports physiology and cardiovascular pathology. The phenomenon is characterized by the "exercise paradox": while habitual, moderate physical activity significantly reduces long-term cardiovascular and all-cause mortality, acute bouts of vigorous exertion can transiently increase the risk of sudden cardiac arrest (SCA) and SCD in individuals harboring occult cardiovascular disease (Lampert et al., 2024; Melnyk et al., 2024).

Historically, athletes diagnosed with cardiovascular conditions were uniformly disqualified from competitive sports to prevent SCD. However, modern sports cardiology has evolved rapidly, driven by advanced imaging, refined electrocardiographic criteria, and large-scale observational registries (Lampert et al., 2024). The objective of this comprehensive review is to synthesize the current epidemiological data, explore the pathophysiological etiologies of SCD in young athletes, evaluate ongoing debates regarding screening modalities, and outline the contemporary clinical framework—emphasizing the shift toward Shared Decision-Making (SDM) and robust secondary emergency prevention (Lampert et al., 2024; Sivalokanathan & Chokshi, 2025).

Research Objective. To evaluate the current clinical framework for SCD prevention and the efficacy of modern screening modalities.

Research Problems. What are the primary causes of SCD in young athletes, and how effective are current preparticipation screening protocols?

Research Hypotheses. Modern ECG interpretation criteria and the shift toward Shared Decision-Making significantly improve athlete safety and participation outcomes.

2. Research materials and methods

2.1 Procedure / Instruments. Research materials and methods The methodology for this comprehensive narrative review involved a structured search of major medical databases, including PubMed, Scopus, and Google Scholar, covering literature published up to March 2026. The primary objective was to synthesize current evidence on the incidence, etiology, and prevention of sudden cardiac death (SCD) in young athletes, with a particular focus on the latest clinical practice updates.

The search strategy employed combinations of the following keywords: "sudden cardiac death," "sports cardiology," "athlete screening," "shared decision-making," "hypertrophic cardiomyopathy," and "emergency action plans".

To ensure the highest clinical relevance, the inclusion criteria prioritized:

- **Recent Guidelines:** Direct analysis of the 2024 HRS Expert Consensus Statement and the 2025 ACC/AHA Scientific Statements regarding sports participation.
- **High-Quality Evidence:** Large-scale prospective investigations from the National Collegiate Athletic Association (NCAA) databases and the US Registry for Sudden Death in Athletes (USRSDA).
- **Language:** English and Polish peer-reviewed publications.

The collected data were qualitatively synthesized to contrast historical management strategies with the current paradigm shift toward shared decision-making and individualized risk assessment. To ensure the rigor of the analyzed incidence tracking, the review incorporated standardized reporting tools, including the International Criteria for Reporting Study Quality for Sudden Cardiac Arrest/Death (IQ-SCA/D)

2.2. Data collection and analysis / Statistical analysis. Data were synthesized by comparing incidence rates (expressed in athlete-years), pathophysiological etiologies (structural vs. electrical), and the efficacy of various screening modalities

3. Epidemiology and Demographic Risk Stratification

Accurately determining the incidence of SCD in young athletes has been a pervasive methodological challenge. Early estimates, heavily reliant on passive media tracking and insurance claims, dramatically underestimated the risk, suggesting rates between 1 in 200,000 to 1 in 300,000 athlete-years (Asif et al., 2017). However, modern prospective investigations utilizing mandatory reporting systems, such as the National Collegiate Athletic Association (NCAA) databases and the US Registry for Sudden Death in Athletes (USRSDA), have revealed that the incidence is significantly higher (Asif et al., 2017).

Current rigorous estimates place the overall incidence of SCD in high school athletes between 1 in 50,000 and 1 in 80,000 athlete-years, while college-aged athletes face an estimated risk of approximately 1 in 50,000 athlete-years (Lampert et al., 2024). A recent systematic review and meta-analysis of low risk-of-bias studies found an incidence rate of 1.91 per 100,000 athlete-years among young competitive athletes aged 14 to 25 years (Lear et al., 2022)**.**

Crucially, epidemiological data demonstrate that SCD risk is not uniformly distributed; it is heavily influenced by demographic factors and the specific physiological demands of the sport:

- **Sex Disparities:** Male athletes face a dramatically higher risk than female athletes. Across multiple registries, the incidence in males is reported to be 3 to 10 times higher than in females, with male incidence rates reaching up to 1 in 37,790 athlete-years (Lampert et al., 2024**;** Lear et al., 2022)**.**
- **Racial Disparities:** Black athletes exhibit a disproportionately elevated risk, with an incidence of SCD up to 5 times greater than that of their White counterparts (Lampert et al., 2024**;** Lear et al., 2022).
- **Sport-Specific Risk:** Sports characterized by high dynamic and static demands—particularly basketball, American football, and soccer—account for the vast majority of SCD events. NCAA Division I Black male basketball players represent the highest-risk cohort identified to date, demonstrating an astonishing SCD incidence of 1 in

5,200 athlete-years, or roughly 1 in 1,300 over a four-year collegiate career (Lampert et al., 2024).

In contrast to young athletes, SCD in "Masters athletes" (individuals over 35 years of age) occurs at much higher absolute rates and is overwhelmingly driven by acquired atherosclerotic coronary artery disease (CAD) (Lampert et al., 2024; Kim et al., 2025). Conclusions of epidemiology and demographic risk stratification of SCD are presented in Table 1.

Table 1. Epidemiology and Demographic Risk Stratification of SCD

Category	**Risk Characteristic / Incidence**
Overall Incidence	1.91 per 100,000 athlete-years.
Sex Disparities	Males: 3 to 10 times higher risk than females.
Racial Disparities	Black athletes: up to 5 times greater risk than White athletes.
High-Risk Sports	Basketball, American football, and soccer.
Highest Risk Cohort	NCAA Division I Black male basketball players: 1 in 5,200 athlete-years

4. Etiology and Pathophysiological Mechanisms

The underlying pathologies responsible for SCD in athletes under the age of 35 encompass a diverse spectrum of structural anomalies, primary electrical channelopathies, and environmental triggers.

4.1 Structural Heart Diseases

- **Hypertrophic Cardiomyopathy (HCM):** Historically considered the leading cause of SCD in US athletes, HCM is an inherited sarcomeric disorder characterized by unexplained left ventricular hypertrophy and myocardial disarray (Lampert et al. 2024; Wheeler, 2010). The structural derangement serves as an arrhythmogenic substrate, predisposing the athlete to ventricular fibrillation during sympathetic surges.
- **Arrhythmogenic Cardiomyopathy (ACM / ARVC):** Particularly prevalent in European cohorts, ACM involves the progressive replacement of right (and often left) ventricular myocardium with fibrofatty tissue (Lampert et al., 2024).

Vigorous endurance exercise acts not only as a trigger for arrhythmias but actively accelerates the phenotypic progression and structural deterioration of the disease in individuals with desmosomal mutations (e.g., *PKP2*) (Lampert et al., 2024)

- **Congenital Coronary Artery Anomalies (AOCA):** Anomalous origin of a coronary artery, particularly when coursing between the aorta and the pulmonary trunk, accounts for 12% to 20% of SCD events (Lampert et al., 2024). During peak exertion, the expansion of the great vessels can compress the anomalous artery, leading to acute demand ischemia and fatal ventricular arrhythmias.

4.2 Non-Structural and Genetic Arrhythmia Syndromes

Recent autopsy series utilizing multidisciplinary expert panels have revealed a paradigm shift: Autopsy-Negative Sudden Unexplained Death (AN-SUD), also known as Sudden Arrhythmic Death Syndrome (SADS), is now recognized as the most common post-mortem finding in many athletic cohorts, representing up to 25-32% of cases (Lampert et al., 2024; Melnyk et al., 2024**;** Kim et al., 2025).These structurally normal hearts harbor occult primary electrical disorders, predominantly ion channelopathies (Lampert et al., 2024). Notable conditions include Long QT Syndrome (LQTS), where exercise (and specifically swimming in LQT1) triggers lethal arrhythmias; Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT), which causes bidirectional ventricular tachycardia under intense adrenergic stress; and Brugada Syndrome, which is frequently exacerbated by hyperthermia (Lampert et al., 2024). Furthermore, Wolff-Parkinson-White (WPW) syndrome, characterized by an accessory electrical pathway, can precipitate sudden death if atrial fibrillation conducts rapidly to the ventricles, triggering ventricular fibrillation (Lampert et al., 2024).

4.3 Mechanical Triggers: Commotio Cordis

Commotio cordis is a highly specific, mechanically induced lethal arrhythmia caused by blunt, non-penetrating trauma to the precordium. It accounts for a significant portion of SCD in young athletes, predominantly in sports involving dense projectiles like baseball, lacrosse, and ice hockey Lampert et al., 2024; Doerer et al., 2007).The pathophysiology requires precise, unfortunate timing: the impact must occur directly over the cardiac silhouette during a narrow 10 to 30-millisecond vulnerable window of repolarization, just prior to the peak of the T-wave (Doerer et al., 2007). At a cellular level, the impact stretches the myocardium, activating mechano-sensitive K+ATP channels that induce inhomogeneous repolarization and initiate ventricular fibrillation (Lampert et al., 2024). Historically, commercially available chest protectors failed to prevent commotio cordis (Lampert et al., 2024). Recently, the National Operating Committee on Standards for Athletic Equipment (NOCSAE) developed the ND200 performance standard, utilizing a mechanical surrogate to drastically reduce the transmission of impact force to the chest, offering the first scientifically validated primary prevention against this event (Lampert et al., 2024; Dau et al., 2024).

Conclusions of major etiologies of SCD in athletes under 35 Years are presented in Table 2.

Table 2. Major Etiologies of SCD in Athletes <35 Years

Type of Cause	**Condition / Mechanism**	**Clinical Key Notes**
Structural	Hypertrophic Cardiomyopathy (HCM)	Historically the leading cause in the US; involves myocardial disarray.
	Arrhythmogenic Cardiomyopathy (ACM)	Progressive fibrofatty replacement; exercise accelerates disease progression.
	Coronary Artery Anomalies (AOCA)	Accounts for 12% to 20% of SCD events; causes demand ischemia.
Electrical (AN-SUD)	Channelopathies (e.g., LQTS, CPVT)	25–32% of cases; hearts appear structurally normal during autopsy.
Mechanical	Commotio cordis	Lethal arrhythmia caused by blunt, non-penetrating trauma to the chest.

4.4. Acquired Inflammatory Conditions: Myocarditis

While genetic and structural anomalies dominate the etiology of SCD, **myocarditis** remains a significant acquired cause, accounting for a notable percentage of sudden deaths in young athletic cohorts (Maron et al., 2015). Myocarditis is characterized by inflammation of the myocardium, most commonly triggered by viral infections, including enteroviruses, adenovirus, and more recently, SARS-CoV-2 (Pelliccia et al., 2021).

The "exercise paradox" is particularly lethal in the acute phase of myocarditis. Physical exertion during active inflammation can accelerate viral replication, exacerbate the inflammatory response, and create a highly unstable arrhythmogenic substrate through myocardial scarring and edema (Maron et al., 2015; Pelliccia et al., 2021).

Key Clinical Considerations for Athletes:

- **Diagnosis:** Modern diagnosis relies heavily on Cardiac Magnetic Resonance (CMR) imaging, utilizing the "Lake Louise Criteria" to identify edema and late gadolinium enhancement (LGE) (Eichhorn et al., 2020) .
- **Return to Play (RTP):** According to the 2024 HRS and 2025 ACC/AHA guidelines, athletes diagnosed with myocarditis should be restricted from competitive sports for a period of 3 to 6 months (Maron et al., 2015; Pelliccia et al., 2021; Sivalokanathan & Chokshi, 2025) .
- **Re-evaluation:** Before returning to play, athletes must undergo comprehensive re-evaluation, including exercise stress testing, 24-hour Holter monitoring, and assessment of ventricular function (Pelliccia et al., 2021) . The presence of persistent LGE on MRI is now recognized as a critical marker for long-term arrhythmic risk (Eichhorn et al., 2020) .

5. Primary Prevention: The Preparticipation Screening (PPS) Debate

The optimal strategy for primary prevention through preparticipation screening (PPS) remains the most intensely debated topic in sports cardiology. The fundamental divide centers on the mandatory inclusion of a resting 12-lead electrocardiogram (ECG).

5.1 The Transatlantic Divide: AHA vs. ESC

The American Approach (AHA/ACC): The American Heart Association continues to advocate for a targeted 14-point history and physical examination, reserving the ECG only for athletes who demonstrate abnormal primary findings (Lampert et al., 2024). The AHA's reluctance to mandate universal ECG screening is rooted in concerns regarding the cost of implementation across millions of athletes, the logistical lack of trained interpreting physicians, and the psychological and financial burdens of false-positive results.

The European and International Approach (ESC/IOC): Conversely, the European Society of Cardiology and the International Olympic Committee strongly endorse universal 12-lead ECG screening (Lampert et al., 2024; Melnyk et al., 2024). This recommendation is heavily influenced by a landmark prospective study in Italy, which demonstrated that implementing mandatory ECG screening led to an 89% reduction in the incidence of SCD in young athletes by successfully identifying and managing silent cardiomyopathies and channelopathies (Lampert et al., 2024).

5.2 The Polish and Central European Perspective

In the Polish context, the approach to preparticipation screening aligns closely with the European model (ESC). Current national regulations mandate periodic medical examinations for children and young athletes (up to 23 years of age) competing in organized sports. Unlike the American model, the Polish protocol includes a mandatory resting 12-lead ECG as a baseline requirement, alongside a physical examination and medical history. This systematic approach ensures that high-risk electrical and structural abnormalities are identified early in a population where sports participation is widespread, reflecting a commitment to the "safety-first" principle prevalent in European sports medicine (Lampert et al., 2024; Melnyk et al., 2024).

5.3 The Evolution of ECG Interpretation Criteria

A major historical limitation of ECG screening was the inability to differentiate pathological abnormalities from the benign, physiological electrical remodeling associated with "athlete's heart" (e.g., sinus bradycardia, early repolarization, isolated voltage criteria for left ventricular hypertrophy). Early guidelines yielded false-positive rates exceeding 10% (Lampert et al., 2024).To address this, international experts iteratively refined the standards—from the 2010 ESC criteria, to the Seattle Criteria, and finally to the 2017 International Criteria for ECG Interpretation in Athletes (Lampert et al., 2024; Petek et al., 2023). These modern criteria correctly categorize physiological adaptations as normal, drastically improving specificity and reducing false-positive rates to between 1.3% and 3% in most demographics, without compromising sensitivity (Lampert et al., 2024; Petek et al., 2023).

5.4 Cost-Effectiveness

Studies evaluating the cost-effectiveness of ECG screening demonstrate significant utility when modern criteria are applied. A prominent decision-analysis model by Wheeler et al. demonstrated that adding an ECG to the history and physical examination saves 2.06 life-years per 1,000 athletes. The incremental cost was only $89 per athlete, yielding a highly favorable cost-effectiveness ratio of $42,900 per life-year saved, well below traditional public health willingness-to-pay thresholds (Wheeler et al., 2010)

6. Contemporary Management: The Shift to Shared Decision-Making (SDM)

Perhaps the most significant evolution in sports cardiology is the abandonment of universal, paternalistic disqualification policies. The 2024 HRS Expert Consensus Statement and the 2025 ACC/AHA Guidelines cement a paradigm shift toward Shared Decision-Making (SDM) (Lampert et al., 2024; Sivalokanathan & Chokshi, 2025).

6.1 Principles of SDM

SDM is a collaborative framework that integrates the best available clinical evidence, disease-specific risk stratification, and the unique values, goals, and risk tolerance of the athlete and their family. Recognizing the immense physical and psychological harm caused by sudden disqualification, clinicians now partner with athletes to optimize medical therapy, implement specific emergency action plans, and facilitate a return to play (RTP) whenever feasible (Lampert et al., 2024; Sivalokanathan & Chokshi, 2025).

6.2 Evolving Evidence for Return to Play (RTP)

Recent registry data heavily support the safety of SDM: Hypertrophic Cardiomyopathy (HCM):

- The landmark LIVE-HCM study prospectively compared individuals with HCM engaging in vigorous exercise against those performing non-vigorous exercise. The study found that 4.7% of vigorous exercisers and 4.6% of non-vigorous exercisers reached a composite clinical endpoint, proving that vigorous exercise was not associated with a higher rate of ventricular arrhythmias or death in risk-stratified patients (Lampert et al., 2024). Consequently, 2024 HRS and 2025 ACC/AHA guidelines now state that sports participation is reasonable for selected HCM patients (Lampert et al., 2024; Kim et al., 2025).

- **Implantable Cardioverter-Defibrillators (ICDs)**: Historically, athletes with ICDs were restricted from all competitive sports out of fear of device failure, lead fracture, or lethal arrhythmias during exertion. The prospective Multinational ICD Sports Safety Registry (led by Lampert et al.) followed 440 athletes participating in organized sports. The study reported zero tachyarrhythmic deaths, zero resuscitated arrests, and no structural damage to devices during sports, establishing that RTP for athletes with ICDs is highly safe when guided by SDM and appropriate device programming (e.g., programming high rate cutoffs to prevent inappropriate shocks) (Lampert et al., 2024).
- **Long QT Syndrome (LQTS)**: Athletes with LQTS managed at expert centers with prophylactic beta-blockers and hydration protocols exhibit exceptionally low event rates (0.003 to 1.16 events per 100 athlete-years) (Lampert et al., 2024). Thus, under expert care, RTP is broadly permissible, though specific environmental modifications (e.g., prohibiting unobserved swimming in LQT1) remain critical (Lampert et al., 2024).
- **Arrhythmogenic Cardiomyopathy (ACM)**: ACM remains an exception where caution is heavily emphasized. Because vigorous endurance exercise directly causes myocardial structural degradation and accelerates disease penetrance in individuals with desmosomal mutations, current guidelines explicitly warn that high-intensity endurance sports are potentially harmful, and restriction is generally recommended (Lampert et al., 2024).

7. Secondary Prevention: Emergency Preparedness and Response

Given the inherent limitations of primary screening—where early-stage diseases or occult channelopathies may escape detection—secondary prevention is the ultimate, fail-safe mechanism against SCD (Lampert et al. 2024), Scarneo-Miller et al., 2024). Time to defibrillation is the single most critical determinant of survival; for every minute CPR and defibrillation are delayed, survival decreases by 7% to 10% (Dau et al., 2024).

To mitigate this, athletic venues must implement comprehensive Emergency Action Plans (EAPs). EAPs are venue-specific, written protocols that coordinate the immediate actions of athletic trainers, coaches, and emergency medical services (EMS). Key tenets of an effective EAP include:

- **Immediate Recognition:** Responders must be trained to assume SCA in any athlete who collapses suddenly and is unresponsive. Misinterpreting agonal gasping or myoclonic seizure-like jerking as a neurological event fatally delays care (Dau et al., 2024)
- **Early Defibrillation:** Universal access to AEDs within a 3-minute response window is mandatory (Scarneo-Miller et al., 2024). When an AED is applied promptly by trained onsite personnel, survival rates for athletes suffering SCA can reach 85% to 89% (Lampert et al., 2024; Del Rios et al., 2025).
- **Regular Rehearsal:** EAPs must be rehearsed and simulated at least annually by all stakeholders (coaches, school nurses, and medical staff) to ensure a coordinated response (Lampert et al. 2024; Scarneo-Miller et al., 2024)**.** Alarmingly, a comprehensive evaluation of US secondary schools found that fewer than 10% were fully compliant with best-practice EAP rehearsal guidelines (Scarneo-Miller et al., 2024; Chidester et al., 2025) .

8. Conclusions

Sudden cardiac death in young athletes is a devastating outcome predominantly driven by underlying structural cardiomyopathies, primary electrical channelopathies, and mechanical triggers like commotio cordis (Lampert et al., 2024). While the absolute incidence is low, epidemiological data clearly identify high-risk cohorts, particularly male and Black athletes engaging in high-intensity team sports (Lampert et al., 2024). The medical approach to athlete health has undergone a massive transformation in recent years. Advancements in ECG interpretation criteria have vastly improved the diagnostic accuracy of preparticipation screening, making it a highly cost-effective tool (Lampert et al., 2024; Wheeler et al., 2010). Furthermore, the modern era of sports cardiology is defined by the integration of Shared Decision-Making, replacing paternalistic disqualification with nuanced risk stratification and personalized care (Lampert et al., 2024; Sivalokanathan & Chokshi, 2025). Combined with the rigorous implementation of Emergency Action Plans and rapid AED deployment, the medical community can safely keep athletes in the game while providing an unparalleled safety net (Scarneo-Miller et al., 2024).

9. Future Directions

Despite significant advancements, several critical gaps remain that must dictate the future trajectory of sports cardiology research and policy. To transition from reactive management to proactive prevention, the following areas require urgent attention:

- **Data Standardization and Registries**: The current literature is often limited by inconsistent definitions of sudden cardiac arrest (SCA) and death (SCD), alongside fragmented reporting across different sports organizations. The widespread adoption of standardized tools, such as the IQ-SCA/D (International Criteria for Reporting Study Quality for Sudden Cardiac Arrest/Death), is necessary to improve the methodological rigor of future incidence tracking (Lampert et al., 2024; Lear et al., 2022). Comprehensive, international mandatory registries must be funded to capture asymptomatic, aborted, and fatal events accurately.
- **Technological Integration:** The integration of artificial intelligence (AI) and deep learning in ECG interpretation holds immense promise for mass screening (Lampert et al., 2024). AI-enhanced algorithms have already demonstrated the potential to further reduce false-positive rates and assist non-experts in identifying subtle pathological patterns (Petek et al., 2023). Furthermore, the role of wearable technologies and smartwatches in the long-term monitoring of athletes with diagnosed arrhythmias (e.g., Long QT Syndrome) remains an area ripe for clinical validation (Lampert et al., 2024; Sivalokanathan & Chokshi, 2025).
- **Addressing Disparities**: Future studies must address the persistent demographic disparities in cardiac care and SCD outcomes. Specifically, more research is needed to elucidate the biological and socioeconomic factors contributing to the higher SCD incidence among Black male athletes (Lampert et al., 2024; Lear et al., 2022). Additionally, longitudinal studies are required to establish optimal, evidence-based screening protocols for pediatric and adolescent athletes, whose cardiovascular systems are undergoing rapid physiological maturation (Kim et al., 2025; Sivalokanathan & Chokshi, 2025).
- **Refining the Shared Decision-Making Framework:** while the shift toward Shared Decision-Making (SDM) is a landmark development in the 2024-2025 guidelines, its long-term impact on athlete psychology and clinical outcomes must be rigorously evaluated. Future research should focus on developing decision-aid tools that help clinicians, athletes,

and families navigate the complexities of "acceptable risk" in competitive sports (Lampert et al., 2024; Sivalokanathan & Chokshi, 2025).

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Anna Żmigrodzka: Conceptualization, Project Administration, Supervision, Writing – Review & Editing.

Agnieszka Przepióra: Methodology, Literature Search, and Comparative Analysis of epidemiological data from the NCAA and USRSDA registries.

Maria Orłowska: Investigation and Synthesis of literature regarding structural heart diseases, specifically HCM and ACM.

Jana Kozłowska: Investigation and Data Curation regarding non-structural syndromes, AN-SUD, and channelopathies.

Maria Sanocka: Investigation and Writing – Original Draft Preparation for the section on mechanical triggers and commotio cordis.

Aleksandra Wielogórska: Formal Analysis and Comparison of Preparticipation Screening (PPS) strategies (the "Transatlantic Divide").

Karolina Trojnar: Investigation and Synthesis of the evolution of ECG interpretation criteria and international standards.

Klaudia Goławska: Formal Analysis and Visualization, including the development of comparative tables for screening and RTP protocols.

Agnieszka Kamińska: Literature Search and Synthesis regarding the clinical framework of Shared Decision-Making (SDM) and athlete-centered care.

Anna Kwiatkowska: Investigation and Writing – Original Draft Preparation for sections on secondary prevention, Emergency Action Plans (EAPs), and AED implementation.

Joanna Falana: Formal Analysis of future research directions, including AI integration in ECG and addressing racial disparities in sports cardiology.

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