1

Contemporary Sports Cardiology: "*What's Past is Prologue*"

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Founding Director of Sports Cardiology, Emory
Immediate Past-Chair, ACC Sports & Exercise Cardiology Council
MHIF Grand Rounds
May 11, 2026

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Disclosures

- Athletic/League Affiliations:

- Research Funding:
  - National Institutes of Health (NHLBI: R01HL162712 (current), K23HL128795 (past))
  - Atlanta Track Club
  - National Football League Player's Association

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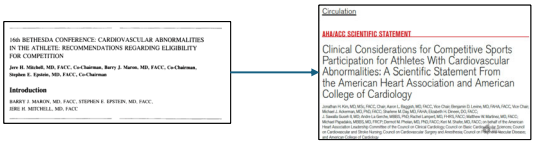
Objectives

1. Laying the Foundation: Historical Perspectives 
2. Sudden Cardiac Death in Athletes: Progress and Perspectives 
3. The New Guidelines! Roadmap from the Past to Present to the Future



4. Sports Cardiologist as a 'Team Cardiologist'

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Birth of ‘Sports Cardiology’?

COMPENDIUM ON CARDIOPULMONARY DISEASE AND EXERCISE: MOLECULAR TO CLINICAL MECHANISMS

Athlete's Heart Revisited: Historical, Clinical, and Molecular Perspectives

Paishiun Nelson Hsieh, Siman Shen, Marius I. Chukwurah, Timothy W. Churchill, Katie M. Stewart, Eugene H. Chung, Rory B. Weiner, Haobo Li,* James Sawalla Guseh*

Circulation Research

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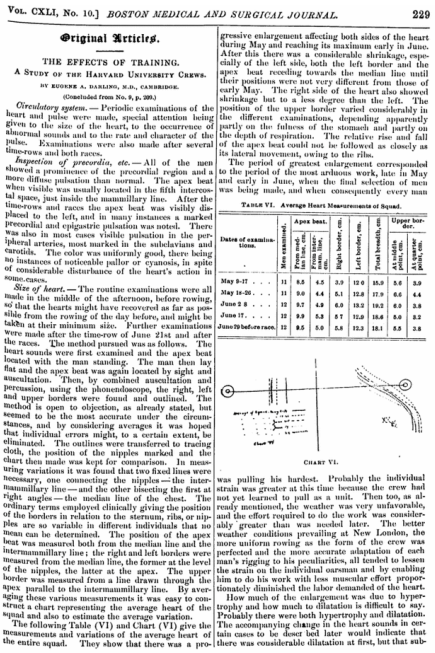
The NEW ENGLAND JOURNAL of MEDICINE



VOL. CXLI, No. 10.] BOSTON MEDICAL AND SURGICAL JOURNAL. 229

Original Articles.

THE EFFECTS OF TRAINING.
A STUDY OF THE HARVARD UNIVERSITY CREWS.
BY EUGENE A. DARLING, M.D., CAMBRIDGE.
(Concluded from No. 8, p. 200.)

Circulatory system. — Periodic examinations of the heart and pulse were made, special attention being given to the size of the heart, to the occurrence of abnormal sounds and to the rate and character of the pulse. Examinations were also made after several time-rows and both races.

Inspection of precordia, etc. — All of the men showed a prominence of the precordial region and a more diffuse pulsation than normal. The apex beat when visible was usually located in the fifth intercostal space, just inside the mammillary line. After the time-rows and races the apex beat was visibly displaced to the left, and in many instances a marked precordial and epigastric pulsation was noted. There was also in most cases visible pulsation in the peripheral arteries, most marked in the subclavians and carotids. The color was uniformly good, there being no instances of noticeable pallor or cyanosis, in spite of considerable disturbance of the heart's action in some cases.

Size of heart. — The routine examinations were all made in the middle of the afternoon, before rowing, so that the hearts might have recovered as far as possible from the rowing of the day before, and might be taken at their minimum size. Further examinations were made after the time-row of June 21st and after the races. The method pursued was as follows. The heart sounds were first examined and the apex beat located with the man standing. The man then lay flat and the apex beat was again located by sight and auscultation. Then, by combined auscultation and percussion, using the phonendoscope, the right, left and upper borders were found and outlined. The method is open to objection, as already stated, but seemed to be the most accurate under the circumstances, and by considering averages it was hoped that individual errors might, to a certain extent, be eliminated. The outlines were transferred to tracing cloth, the position of the nipples marked and the chart then made was kept for comparison. In measuring variations it was found that two fixed lines were necessary, one connecting the nipples — the intermammillary line — and the other bisecting the first at right angles — the median line of the chest. The ordinary terms employed clinically giving the position of the borders in relation to the sternum, ribs, or nipples are so variable in different individuals that no mean can be determined. The position of the apex beat was measured both from the median line and the intermammillary line; the right and left borders were measured from the median line, the former at the level of the nipples, the latter at the apex. The upper border was measured from a line drawn through the apex parallel to the intermammillary line. By averaging these various measurements it was easy to construct a chart representing the average heart of the squad and also to estimate the average variation.

The following Table (VI) and Chart (VI) give the measurements and variations of the average heart of the entire squad. They show that there was a progressive enlargement affecting both sides of the heart during May and reaching its maximum early in June. After this there was a considerable shrinkage, especially of the left side, both the left border and the apex beat receding towards the median line until their positions were not very different from those of early May. The right side of the heart also showed shrinkage but to a less degree than the left. The position of the upper border varied considerably in the different examinations, depending apparently partly on the fulness of the stomach and partly on the depth of respiration. The relative rise and fall of the apex beat could not be followed as closely as its lateral movement, owing to the ribs.

The period of greatest enlargement corresponded to the period of the most arduous work, late in May and early in June, when the final selection of men was being made, and when consequently every man

TABLE VI. Average Heart Measurements of Squad.

Dates of examinations.	Men examined.	Apex beat.		Upper border.	
		Distance from median line, cm.	Distance from nipple line, cm.	Right border, cm.	Left border, cm.	Total breadth, cm.	At middle point, cm.	At superior point, cm.
May 9-17 . . .	11	8.5	4.5	3.9	12.6	16.5	3.6	3.9
May 18-20 . . .	11	9.0	4.4	5.1	12.8	17.9	3.5	4.4
June 2 8 . . .	12	9.7	4.9	6.0	13.2	19.2	3.3	3.8
June 17. . . .	12	9.9	5.3	5.7	12.9	18.6	3.0	3.2
June 20 before race.	12	9.5	5.0	5.8	12.3	18.1	3.5	3.8

CHART VI.

was pulling his hardest. Probably the individual strain was greater at this time because the crew had not yet learned to pull as a unit. Then too, as already mentioned, the weather was very unfavorable, and the effort required to do the work was considerably greater than was needed later. The better weather conditions prevailing at New London, the more uniform rowing as the form of the crew was perfected and the more accurate adaptation of each man's rigging to his peculiarities, all tended to lessen the strain on the individual oarsman and by enabling him to do his work with less muscular effort proportionately diminished the labor demanded of the heart.

How much of the enlargement was due to hypertrophy and how much to dilatation is difficult to say. Probably there were both hypertrophy and dilatation. The accompanying change in the heart sounds in certain cases to be described later would indicate that there was considerable dilatation at first, but that sub-

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‘Sports Cardiology’ as a Field

- 1st International Congress of Sports Cardiology Rome, 1978
- 1st Sports Cardiology Society, 1981
- EAPC, Sports Section, 2005

JACC

CONFERENCE REPORT

Protecting the Heart of the American Athlete

Proceedings of the American College of Cardiology Sports and Exercise Cardiology Think Tank
October 18, 2012, Washington, DC

Writing Committee Members	Christine E. Lawless, MD, FACC, FACSM	Mark S. Link, MD, FACC
	Chad Asplund, MD, FACSM	Matthew W. Martinez, MD, FACC
	Irfan M. Asif, MD	G. Paul Matherne, MD, FACC
	Ron Courson, ATC, PT	Brian Olshansky, MD, FACC
	Michael S. Emery, MD, FACC	William O. Roberts, MD, MS, FACSM
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	Richard J. Kovacs, MD, FACC	Victoria L. Vetter, MD, MPH, FACC
	Silvana M. Lawrence, MD, PhD, FACC	Robert A. Vogel, MD, FACC
	Benjamin D. Levine, MD, FACC, FACSM	Jim Whitehead

2014

STATE-OF-THE-ART PAPERS

Sports and Exercise Cardiology in the United States

Cardiovascular Specialists as Members of the Athlete Healthcare Team

Christine E. Lawless, MD,*† Brian Olshansky, MD,‡ Reginald L. Washington, MD,§ Aaron L. Baggish, MD,‖ Curt J. Daniels, MD,¶ Silvana M. Lawrence, MD, PhD,# Renee M. Sullivan, MD,** Richard J. Kovacs, MD,†† Alfred A. Bove, MD, PhD‡‡

Chicago, Illinois; Lincoln, Nebraska; Iowa City, Iowa; Denver, Colorado; Boston, Massachusetts; Columbus, Ohio; Houston, Texas; Columbia, Missouri; Indianapolis, Indiana; and Philadelphia, Pennsylvania

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JACC

2017

THE PRESENT AND FUTURE

STATE-OF-THE-ART REVIEW

Sports Cardiology

Core Curriculum for Providing Cardiovascular Care to Competitive Athletes and Highly Active People

Aaron L. Baggish, MD,[a] Robert W. Battle, MD,[b] James G. Beckerman, MD,[c] Alfred A. Bove, MD, PhD,[d] Rachel J. Lampert, MD,[e] Benjamin D. Levine, MD,[f] Mark S. Link, MD,[f] Matthew W. Martinez, MD,[g] Silvana M. Molossi, MD, PhD,[h] Jack Salerno, MD,[i] Meagan M. Wasfy, MD,[a] Rory B. Weiner, MD,[a] Michael S. Emery, MD,[j] for the ACC's Sports and Exercise Council Leadership Group

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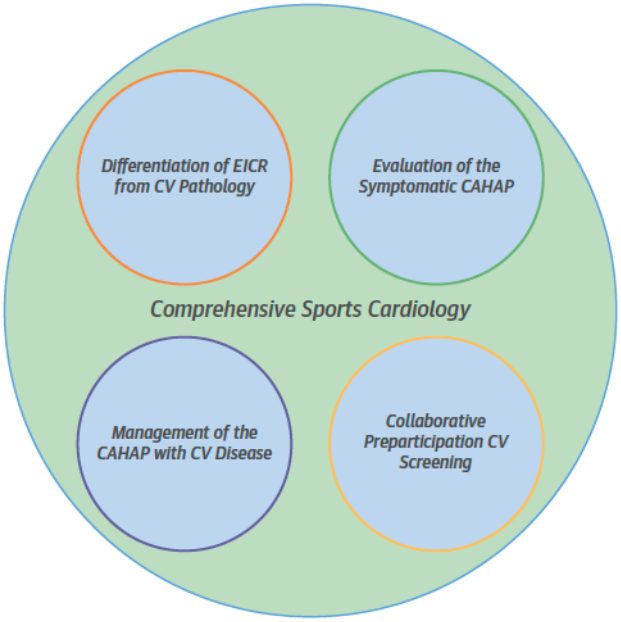
CENTRAL ILLUSTRATION Overview of Fundamental Core Competencies in Sports Cardiology



Baggish, A.L. et al. J Am Coll Cardiol. 2017;70(15):1902–18.

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JACC STATE-OF-THE-ART REVIEW

The Cardiovascular Care of the Pediatric Athlete

Peter N. Dean, MD,[a] Julie A. Brothers, MD,[b] Kristin Burns, MD,[c] Jonathan B. Edelson, MD,[b] Susan Etheridge, MD,[d] Dermot M. Phelan, MD, PhD,[e] Keri Shafer, MD,[f] Chris Snyder, MD,[g] Silvana Molossi, MD, PhD,[h] Alfred Danielian, MD,[i] Eli M. Friedman, MD,[j] Jeff Hsu, MD, PhD,[k] Mustafa Husaini, MD,[l] Eugene H. Chung, MD, MPH,[m] Matthew W. Martinez, MD,[n] Aaron L. Baggish, MD,[o] Benjamin D. Levine, MD,[p,q] Jonathan H. Kim, MD, MSc,[r] the American College of Cardiology Sports & Exercise Cardiology Council

JAMA Cardiology | Review

Racial Disparities in Sports Cardiology
A Review

Sheela Krishnan, MD; James Sawalla Guseh, MD; Merije Chukumerije, MD; Aubrey J. Grant, MD; Peter N. Dean, MD; Jeffrey J. Hsu, MD, PhD; Mustafa Husaini, MD, MBA; Dermot M. Phelan, MD, PhD; Ankit B. Shah, MD, MPH; Katie Stewart, CNP; Meagan M. Wasfy, MD, MPH; Quinn Capers IV, MD; Utibe R. Essien, MD, MPH; Amber E. Johnson, MD, MSc, MBA; Benjamin D. Levine, MD; Jonathan H. Kim, MD, MSc; for the American College of Cardiology Sports & Exercise Leadership Council

A contemporary review of sudden cardiac arrest and death in competitive and recreational athletes

Jonathan H Kim*, Matthew W Martinez, J Sawalla Guseh, Sheela Krishnan, Belinda Gray, Kimberly G Harmon, Michael Papadakis, Dermot M Phelan, Katie Stewart, Benjamin D Levine, Aaron L Baggish*, on behalf of the American College of Cardiology Sports & Exercise Leadership Council

EMORY HEART & VASCULAR CENTER

SCIENTIFIC STATEMENT

Clinical Considerations for Competitive Sports Participation for Athletes With Cardiovascular Abnormalities

A Scientific Statement From the American Heart Association and American College of Cardiology

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Aaron L. Baggish, MD, FACC, *Vice Chair*
Benjamin D. Levine, MD, FAHA, FACC, *Vice Chair*
Michael J. Ackerman, MD, PhD, FACC
Sharlene M. Day, MD, FAHA
Elizabeth H. Dineen, DO, FACC
J. Sawalla Guseh II, MD
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Rachel Lampert, MD, FHRS, FACC
Matthew W. Martinez, MD, FACC
Michael Papadakis, MBBS, MD, FRCP
Dermot M. Phelan, MD, PhD, FACC
Keri M. Shafer, MD, FACC
on behalf of the American Heart Association Leadership Committee of the Council on Clinical Cardiology, Council on Basic Cardiovascular Sciences, Council on Cardiovascular and Stroke Nursing, Council on Cardiovascular Surgery and Anesthesia, Council on Peripheral Vascular Disease, American College of Cardiology

Exercise-Induced Cardiovascular Adaptations and Approach to Exercise and Cardiovascular Disease

JACC State-of-the-Art Review

Matthew W. Martinez, MD,[a] Jonathan H. Kim, MD, MSc,[b] Ankit B. Shah, MD, MPH,[c] Dermot Phelan, MD, PhD,[d] Michael S. Emery, MD, MS,[e] Meagan M. Wasfy, MD, MPH,[f] Antonio B. Fernandez, MD,[g] T. Jared Bunch, MD,[h] Peter Dean, MD,[i] Alfred Danielian, MD,[i] Sheela Krishnan, MD,[k] Aaron L. Baggish, MD,[f] Thijs M.H. Eijsvogels, PhD,[l] Eugene H. Chung, MD, MSc,[m,*] Benjamin D. Levine, MD[n,*]

JAMA Cardiology | Special Communication

Coronavirus Disease 2019 and the Athletic Heart
Emerging Perspectives on Pathology, Risks, and Return to Play

Jonathan H, Kim, MD, MSc; Benjamin D, Levine, MD; Dermot Phelan, MD, PhD; Michael S, Emery, MD, MS; Mathew W. Martinez, MD; Eugene H. Chung, MD, MSc; Paul D. Thompson, MD; Aaron L. Baggish, MD

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A Timeline for Historical (U.S.) Context

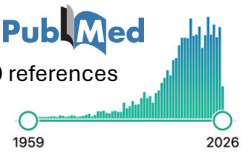
"It isn't a major public health issue..."
"You'd have to examine probably 250,000 athletes to detect one case."

The Washington Post August 1, 1988

WHEN ATHLETES DIE YOUNG

By Don Colburn

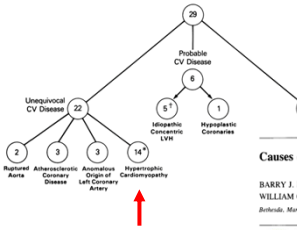
PubMed 3,269 references



1959 — Death of Robert Pollard 1988 — 1990 — 1993 — 2021 — 2023

ORIGINAL ARTICLES
Sudden Death in Young Athletes

Circulation 1980



Causes of Sudden Death in Competitive Athletes

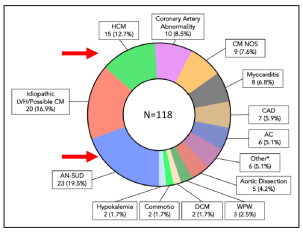
BARRY J. MARON, MD, FACC, STEPHEN E. EPSTEIN, MD, FACC, WILLIAM C. ROBERTS, MD, FACC

Bethesda, Maryland

JACC 1986

Sudden Cardiac Death in National Collegiate Athletic Association Athletes: A 20-Year Study

Circulation 2023



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Sudden Cardiac Death in National Collegiate Athletic Association Athletes: A 20-Year Study

Bradley J. Petek, MD; Timothy W. Churchill, MD; Nathaniel Moulson, MD; Stephanie A. Kliethermes, PhD; Aaron L. Baggish, MD; Jonathan A. Drezner, MD; Manesh R. Patel, MD; Michael J. Ackerman, MD, PhD; Kristen L. Kucera, PhD, MSPH, LAT, AT; David M. Siebert, MD; Lauren Salerno, BA; Monica Zigman Suchsland, MPH; Irfan M. Asif, MD; Joseph J. Maleszewski, MD; Kimberly G. Harmon, MD

Circulation

Table 2. Incidence of Sudden Cardiac Death, by Demographic Characteristics

Characteristics	Sudden cardiac death cases, n (%)	Incidence rate, athlete-years	95% CI
Total	143 (100)	1:63 682	1:54 065–1:75 010
Sex			
Male	119 (83)	1:43 348	1:36 228–1:51 867
Female	24 (17)	1:164 504	1:110 552–1:244 787
Race			
White	84 (59)	1:74 581	1:60 247–1:92 326
Black	53 (37)	1:26 704	1:20 417–1:34 925

- Database of all NCAA deaths 2002-2022
- Most common medical cause of death was CV
- Males higher risk vs. females
- Black athletes at higher risk vs. White athletes (1:26,704 AY vs. 1:74,581 AY)
- Men's basketball at highest risk (1:7,696 AY)

Petek BJ. *Circulation* 2023.

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Circulation

AHA PRESIDENTIAL ADVISORY

Call to Action: Structural Racism as a Fundamental Driver of Health Disparities

A Presidential Advisory From the American Heart Association

Keith Churchwell, MD, FAHA, Chair
Mitchell S.V. Elkind, MD, MS, FAHA
Regina M. Benjamin, MD, MBA
April P. Carson, PhD, MSPH, FAHA
Edward K. Chang, BS
Willie Lawrence, MD, FAHA
Andrew Mills, MPH
Tanya M. Odom, EdM
Carlos J. Rodriguez, MD, MPH, FAHA
Fatima Rodriguez, MD, MPH, FAHA
Eduardo Sanchez, MD, MPH
Anjail Z. Sharrief, MD, MPH, FAHA
Mario Sims, PhD, MS, FAHA
Olajide Williams, MD, MS
On behalf of the American Heart Association

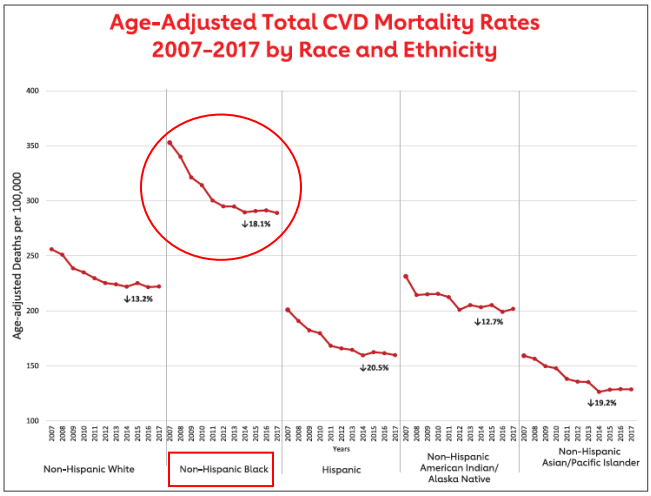

Figure 1. Age-adjusted total cardiovascular disease mortality rates, 2007 to 2017 by race and ethnicity.[22]
Downward arrows indicate a decrease in age-adjusted deaths from cardiovascular disease over the 10-year period shown.

Churchwell K. *Circulation* 2020.

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Circulation

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Olajide Williams, MD, MS
On behalf of the American Heart Association

terpersonal racism.[Race is a social construct and primarily based on phenotype, ethnicity, and other indicators of social differentiation that result in varying access to power and social and economic resources.[7,8]]

health conditions. However, race and ethnicity are sometimes improperly presumed to reflect biological or genetic differences, further contributing to the limited interrogation and conceptualization of structural racism in empirical research on health and mental and physical well-being.[79] In addition, although race and ethnicity can descriptively associate with poorer outcomes, future research needs to capture inherent unmeasured factors. Considering the

Churchwell K. *Circulation* 2020.

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Reckoning with race in sports cardiology: a call to action

Aubrey Grant,[1] Sheela Krishan,[2] Merije Chukumerije,[3] James Sawalla Guseh,[1] Jonathan H Kim [4]

BJSM

JAMA Cardiology | Review

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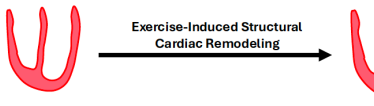


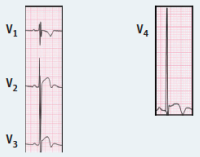
Left ventricular hypertrophy
- Left ventricular dilation
- Right ventricular dilation
- Increased left ventricular concentricity (wall thickness)

Normal athletic ECG findings:
- Increased QRS voltage
- Early repolarization
- Sinus bradycardia
- T-wave inversions V_1 through V_3 (≤16 y of age)
- Incomplete right bundle branch block
- First-degree AV block and Mobitz type 1 second-degree AV block
- Ectopic atrial or junctional rhythm
- **ST-segment elevation followed by T-wave inversion in V_1 through V_4 in Black athletes**

Borderline athletic ECG findings:
- Left/right axis deviation
- Left/right atrial enlargement
- Complete right bundle branch block

Abnormal athletic ECG findings:
- T-wave inversions and ST-segment depressions
- Pathologic Q waves
- Left bundle branch block/QRS ≥140 ms
- WPW, Brugada type 1, prolonged QT
- Sinus bradycardia <30 bpm
- PR interval ≥400 ms
- High-grade AV block
- Atrial/ventricular tachyarrhythmias

ECG repolarization variant: J-point elevation with convex ST-segment elevation and T-wave inversions in V_1 through V_4



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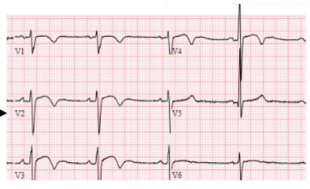
Prevalence and Outcomes of Competitive Athletes From the United States With Electrocardiographic Athletic Anterior Early Repolarization

Austin J. Rim, MD,[a] Paishiun Nelson Hsieh, MD, PhD,[b] Parth Patel, MD,[a] Melroy D'Souza, MD,[a] Neeya Patel, BA,[a] Sanchitha Rajesh,[a] Sophia Wolmer, MPHIL,[a] Heather DiGregorio, MLA,[a] Rayan El Chami,[a] Mekensie Jackson, MS,[a] James T. Miller, MS,[a] Zain Zaidi,[a] Yi-An Ko, PhD,[a] Eugene H. Chung, MD, MPH,[b] Timothy W. Churchill, MD,[b] Eli Friedman, MD,[c] J. Sawalla Guseh, MD,[b] Matthew W. Martinez, MD,[d] Aaron L. Baggish, MD,[e] Jonathan H. Kim, MD, MSc[a]

JACC Advances

N=6,177 Competitive Athletes 15-25 years-old



Screening ECG

Athlete Anterior Early Repolarization Pattern
- Overall Prevalence: 0.76%
- Prevalence Black Athletes: 1.91%
- Prevalence Non-Black Athletes: 0.48%
- No Adverse Cardiovascular Events Over 177 Athlete-Years
- No Diagnosed Structural Cardiac Pathology*

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JAMA Cardiology | Review

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Figure 2. Principles for Eliminating Racial Disparities in Sports Cardiology

Race-conscious awareness
- If proven a normal ECG finding, athletic anterior repolarization should be generalized to all athletes, irrespective of race
- Eliminate race as a clinical diagnostic/therapeutic variable in clinical algorithms
- When encountering concentric LVH, assess environmental influences like hypertension, considering factors beyond race

Clinical inclusivity
- Diversify the sports medicine and sports cardiology workforce and other health teams in sports medicine
- Include diverse groups in research studies, as these lay the foundation for generalizable clinical algorithms
- A proven lifesaving device, ensure AED access in all athletic arenas, especially in underserved communities

Research-driven practice refinement
- Allocate more federal and foundation funding to explore racial disparities in athlete cardiac outcomes
- Broaden studies on cardiac phenotypic variation to understand healthy variation
- Avoid pathologizing groups. Instead, define and study the full spectrum of human variation

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Roadmap Linking the Past to Contemporary Sports Cardiology…

Circulation

Circulation

AHA/ACC SCIENTIFIC STATEMENT

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on behalf of the American Heart Association Leadership Committee of the Council on Clinical Cardiology, Council on Basic Cardiovascular Sciences, Council on Cardiovascular and Stroke Nursing, Council on Cardiovascular Surgery and Anesthesia, Council on Peripheral Vascular Disease, American College of Cardiology

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CASE #1 (**2015**)

- 23-year-old professional American-style football player
- Skill position player, smaller NCAA school, non-Division-1
- Non-NFL Combine invite
- Asymptomatic with normal family history
- UDRFA attempts to sign…pending mandated screening ECG

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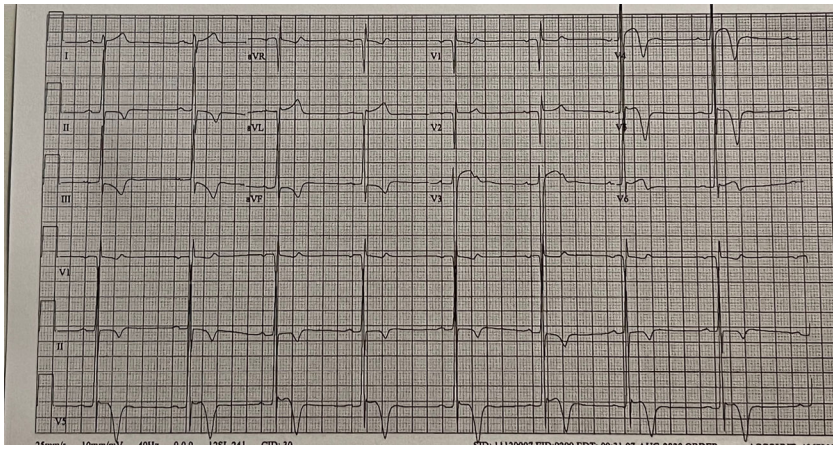
CASE #1



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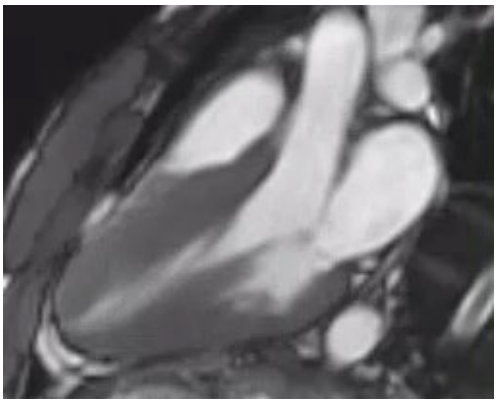
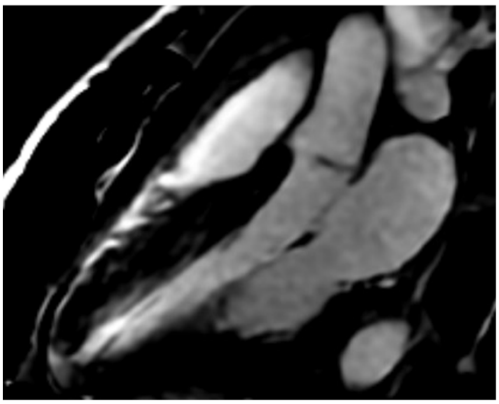
CASE #1





20

CASE #1

Let's 'get with the guidelines'…!

AHA/ACC SCIENTIFIC STATEMENT

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Task Force 3: Hypertrophic Cardiomyopathy, Arrhythmogenic Right Ventricular Car… Car…

2. Athletes with a probable or unequivocal clinical expression and diagnosis of HCM (ie, with the disease phenotype of LV hypertrophy) should not participate in most competitive sports, with the exception of those of low intensity (class IA sports) (see "Classification of Sport" [22]). This recommendation is independent of age, sex, magnitude of LV hypertrophy, particular sarcomere mutation, presence or absence of LV outflow obstruction (at rest or with physiological exercise), absence of prior cardiac symptoms, presence or absence of late gadolinium enhancement (fibrosis) on CMR, and whether major interventions such as surgical myectomy or alcohol ablation have been performed previously *(Class III; Level of Evidence C)*.

Maron BJ. *Circulation* 2015.

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CASE #2 (**2016**)

- 19-year-old collegiate American-style football player
- Defensive back
- Asymptomatic with normal family history
- Family opted for a routine 'athlete health CV screen' inclusive of ECG and trans-thoracic echocardiography

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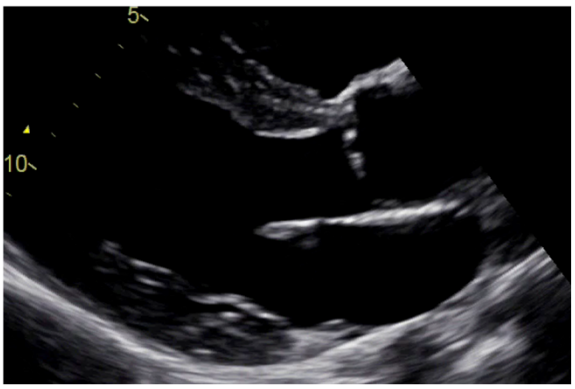
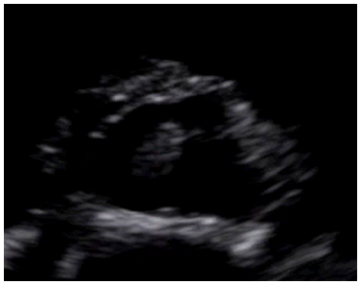
CASE #2





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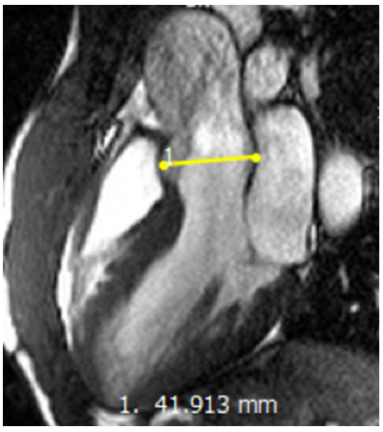
CASE #2



SUMMARY
- Bicuspid aortic valve
- No aortic stenosis or regurgitation
- Maximum diameter of the aortic root (coronary sinus) is 42 x 43 mm

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CASE #2

Let's 'get with the guidelines'...!

Bicuspid Aortic Valves

Bicuspid aortic valve is present in 1% to 2% of the population[1,2] and is the marker of connective tissue abnormalities that affect both the aortic valve and aorta. That patients with bicuspid aortic valves are at increased risk for AS and AR is well known, but these patients are also at increased risk for aortic enlargement and aortic dissection, although the absolute risk for these events is quite small,[1,12] and it is not known whether restriction of physical activity limits the risk or the rate of aortic enlargement or dissection.

Braverman AC. *Circulation* 2015.
Bonow RO. *Circulation* 2015.

For athletes with a BAV and a mild to moderately dilated aorta (score 2–3.5 or aortic root or ascending aortic diameters measuring 40–42 mm in men or 36–39 mm in women) and no features of associated connective tissue disorder or familial TAA syndrome, participation in low and moderate static and dynamic competitive sports with a low likelihood of significant bodily contact (classes IA, IB, IC, IIA, IIB, and IIC) may be considered. For these athletes, avoidance of intense weight training should be considered *(Class IIb; Level of Evidence C)*.

For athletes with a BAV and a dilated aorta measuring 43 to 45 mm, participation in low-intensity competitive sports (class IA) with a low likelihood of bodily contact may be considered *(Class IIb; Level of Evidence C)*.

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OUTDATED!!

1. Shift in Philosophical Approach
2. Data / Scientific Advances

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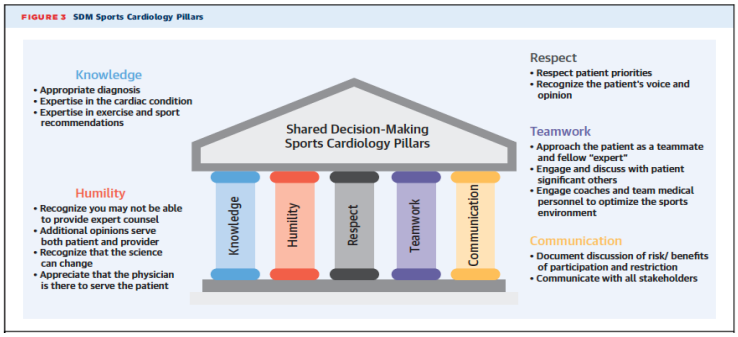
The medical care of competitive athletes: the role of the physician and individual assumption of risk

BENJAMIN D. LEVINE and JAMES STRAY-GUNDERSEN
Institute for Exercise and Environmental Medicine, Presbyterian Hospital of Dallas, The Baylor/UT Southwestern Sports Science Laboratory, and The University of Texas Southwestern Medical Center at Dallas

1. Shared Decision-Making is an *Ethical Imperative*



Martinez MW, Kim JH, et al. *J Am Coll Cardiol* 2021

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Jonathan H. Kim, MD, MSc
Emory University School of Medicine, Emory Clinical Cardiovascular Research Institute, Atlanta, Georgia.

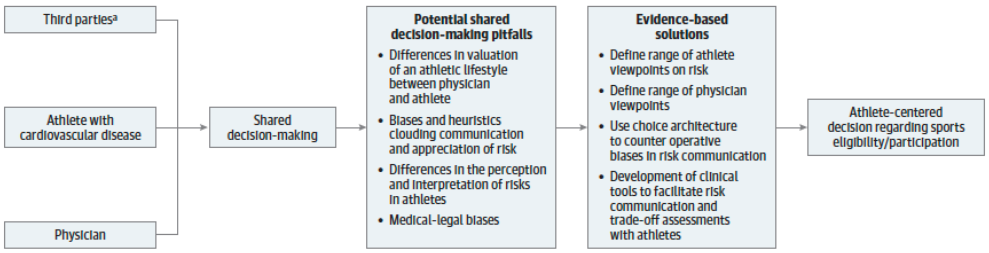
Neal W. Dickert, MD, PhD
Emory University School of Medicine, Emory University Center for Ethics, Emory Clinical Cardiovascular Research Institute, Atlanta, Georgia.

VIEWPOINT

Athletes With Cardiovascular Disease and Competitive Sports Eligibility
Progress and Challenges Ahead

JAMA Cardiology

Figure. Key Conceptual Pitfalls and Proposed Evidence-Based Solutions in Achieving a Balanced Athlete-Centered, Shared Decision-making Outcome



[a] Third parties are specific to competitively sanctioned athletes and represented by governing sporting leagues or organizations, universities, agents, or other family members.

Kim JH. *JAMA Cardiol* 2022.

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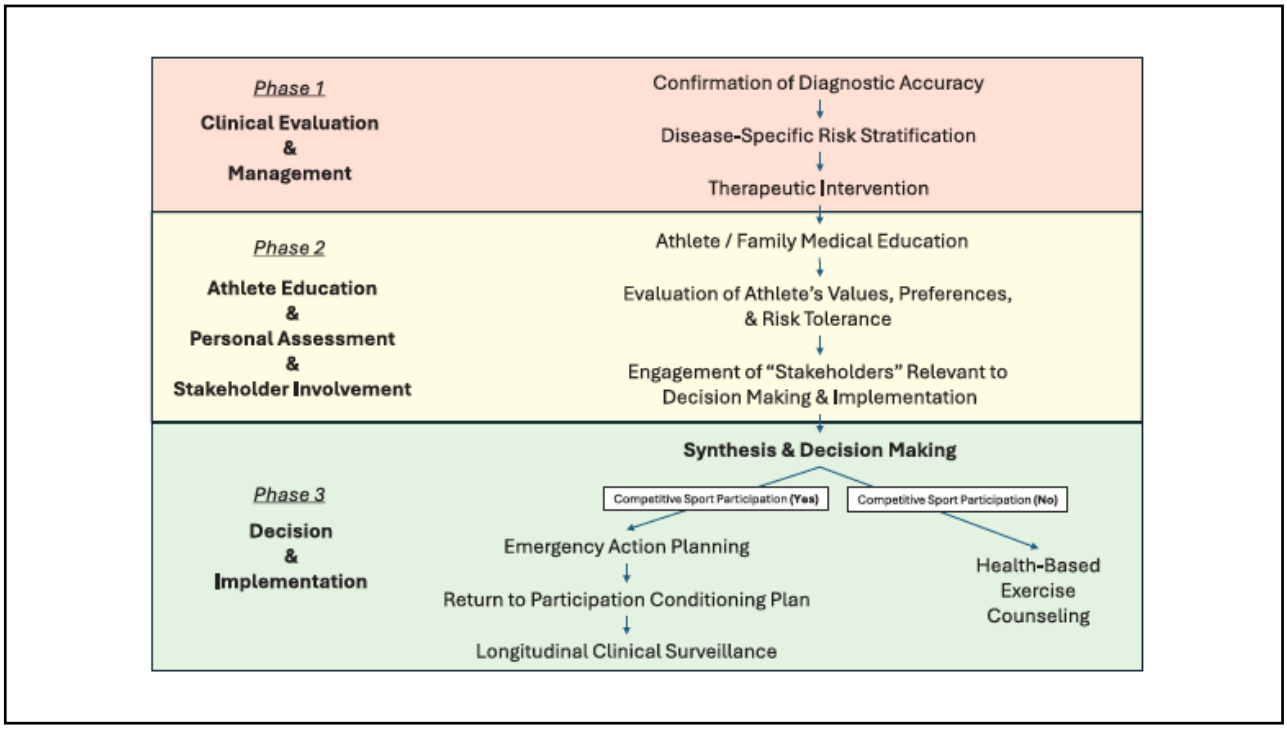

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Return-to-Play for Athletes With Long QT Syndrome or Genetic Heart Diseases Predisposing to Sudden Death

Kathryn E. Tobert, BA,[a] J. Martijn Bos, MD, PhD,[a,b,c] Ramin Garmany, BS,[a,d] Michael J. Ackerman, MD, PhD[a,b,c]

2. Scientific Advances Understanding the Safety of Competitive Sports with Heart Disease

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Return-to-Play for Elite Athletes With Genetic Heart Diseases Predisposing to Sudden Cardiac Death

Katherine A. Martinez,[a,e] J. Martijn Bos, MD, PhD,[a,b,c,e] Aaron L. Baggish, MD,[d,e] Dermot M. Phelan, MD, PhD,[f] Kathryn E. Tobert, BS,[a] Darrel B. Newman,[b] Erica Scherer,[f] Bradley J. Petek, MD,[d,g] Michael J. Ackerman, MD, PhD,[a,b,c] Matthew W. Martinez, MD[b]

JAMA Cardiology

JAMA Cardiology | Original Investigation

Vigorous Exercise in Patients With Hypertrophic Cardiomyopathy

Rachel Lampert, MD; Michael J. Ackerman, MD, PhD; Bradley S. Marino, MD; Matthew Burg, PhD; Barbara Ainsworth, PhD, MPH; Lisa Salberg; Maria Teresa Tome Esteban, MD, PhD; Carolyn Y. Ho, MD; Roselle Abraham, MD; Seshadri Balaji, MBBS, PhD; Cheryl Barth, BS; Charles I. Berul, MD; Martijn Bos, MD; David Cannom, MD; Lubna Choudhury, MD; Maryann Concannon, MSW; Robert Cooper, MD; Richard J. Czosek, MD; Anne M. Dubin, MD; James Dziura, PhD; Benjamin Eidem, MD; Michael S. Emery, MD; N. A. Mark Estes, MD; Susan P. Etheridge, MD; Jeffrey B. Geske, MD; Belinda Gray, MBBS, PhD; Kevin Hall, MD; Kimberly G. Harmon, MD; Cynthia A. James, PhD; Ashwin K. Lal, MD; Ian H. Law, MD; Fangyong Li, MS; Mark S. Link, MD; William J. Mckenna, MD; Silvana Molossi, MD, PhD; Brian Olshansky, MD; Steven R. Ommen, MD; Elizabeth V. Saarel, MD; Sara Saberi, MD, MS; Laura Simone, MS; Gordon Tomaselli, MD; James S. Ware, MD; Douglas P. Zipes, MD; Sharlene M. Day, MD; for the LIVE Consortium

Circulation

Safety of Sports for Athletes With Implantable Cardioverter-Defibrillators

Long-Term Results of a Prospective Multinational Registry

Rachel Lampert, MD; Brian Olshansky, MD; Hein Heidbuchel, MD, PhD; Christine Lawless, MD; Elizabeth Saarel, MD; Michael Ackerman, MD; Hugh Calkins, MD; N.A. Mark Estes, MD; Mark S. Link, MD; Barry J. Maron, MD; Frank Marcus, MD; Melvin Scheinman, MD; Bruce L. Wilkoff, MD; Douglas P. Zipes, MD; Charles I. Berul, MD; Alan Cheng, MD; Luc Jordaens, MD, PhD; Ian Law, MD; Michele Loomis, APRN; Rik Willems, MD, PhD; Cheryl Barth, BS; Karin Broos, BA; Cynthia Brandt, MD; James Dziura, PhD; Fangyong Li, MS; Laura Simone, BA; Katleen Vandenberghe, PhD; David Cannom, MD

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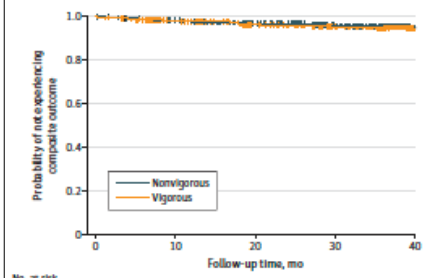
Figure 1. Kaplan-Meier Survival Curve for Freedom From Composite End Point (Death, Cardiac Arrest, Appropriate Implantable Cardioverter Defibrillator Shock, or Arrhythmic Syncope) by Exercise Group



No. at risk			
Nonvigorous	961	852	262
Vigorous	699	608	193

Vigorous and nonvigorous groups did not differ in freedom from composite end point.

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Lampert R. *JAMA Cardiol* 2023

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Return-to-Play for Elite Athletes With Genetic Heart Diseases Predisposing to Sudden Cardiac Death

Katherine A. Martinez,[1,*] J. Martijn Bos, MD, PhD,[2,3,*] Aaron L. Baggish, MD,[4,*] Dermot M. Phelan, MD, PhD,[5] Kathryn E. Tobert, BS,[6] Darrel B. Newman,[1] Erica Scherer,[7] Bradley J. Petek, MD,[7,8] Michael J. Ackerman, MD, PhD,[2,3,*] Matthew W. Martinez, MD[1]

JACC JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

TABLE 2 Evaluation of RTP

Evaluation of RTP	
Highest level of play	
Division I	50 (66)
Professional	26 (34)
Reason for diagnosis	
Abnormal cardiac evaluation	40 (53)
Syncope	9 (12)
Family history	7 (9)
Unrelated event	4 (5)
(Non)sustained VT	3 (4)
Cardiac arrest	6 (8)
Other symptoms	7 (9)
Initially disqualified	55 (72)
Chose to stop playing postdiagnosis	3 (4)
Remain disqualified	4 (5)
Follow-up	
Treatments while playing	
Pharmacological	34 (45)
ICD	24 (32)
Primary	16 (67)
Secondary	8 (33)
LCSD	6 (8)
BCEs	3 (4)

Values are n (%).
BCE = breakthrough cardiac event; ICD = implantable cardioverter-defibrillator; LCSD = left cardiac sympathetic denervation; RTP = return to play; VT = ventricular tachycardia.

TABLE 3 BCE Details

	Patient 1	Patient 2	Patient 3
Sex	Male	Male	Male
Diagnosis	HCM	LQTS	HCM
Reason for diagnosis	Cardiac arrest	Syncope	Syncope
Sport and level	Basketball	Hockey	Hockey
Age at diagnosis	20	21	22
Age at RTP	21	21	23
Symptoms before diagnosis	Yes	Yes	Yes
	Cardiac arrest	Syncope	Syncope
Initially disqualified	Yes	No	Yes
Treatment	ICD, beta blocker	Beta blocker	Beta blocker
BCE	ICD shock	Syncope	Syncope
Age at BCE, y	22	24	24
Circumstances of BCE	While moving furniture	While coming off the bench and making mac and cheese	While working out

BCE = breakthrough cardiac event; HCM = hypertrophic cardiomyopathy; ICD = implantable cardioverter-defibrillator; LQTS = long QT syndrome; RTP = return to play.

Martinez KA. *J Am Coll Cardiol* 2023.

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More Landscapes Have Changed Since 2015....

- Other sports-specific guidelines (*2017 International ECG Criteria for Athletes*, *2024 HRS Arrhythmias in Athletes*) and non-sports guidelines (HCM) that are not consistent with 2015 recommendations
- COVID-19 Pandemic
- Standard of care at expert sports cardiology centers opposes much of the old 2015 consensus recommendations...
- ...which has led to inequitable outcomes for athletes unable to receive guidance at high-level centers

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SECTION I: SPORTS CLASSIFICATIONS

SECTION II: THE PREPARTICIPATION CARDIAC EVALUATION

* SECTION III: ETHICAL ASPECTS OF COMPETITIVE SPORTS ELIGIBILITY

SECTION IV: CARDIOMYOPATHIES

SECTION V: MYOCARDITIS/ PERICARDITIS, VALVULAR HEART DISEASE, AND OTHER ACQUIRED CARDIOVASCULAR CONDITIONS

SECTION VI: CONGENITAL HEART DISEASE

SECTION VII: AORTOPATHY (INCLUDING BICUSPID AORTIC VALVE) AND SPONTANEOUS CORONARY ARTERY DISSECTION

SECTION VIII: ARRHYTHMIAS, DEVICES, AND ECG ABNORMALITIES

SECTION IX: CARDIAC CHANNELOPATHIES

* SECTION X: MASTERS ATHLETES

* SECTION XI: ADDITIONAL CARDIAC CONDITIONS AND CONSIDERATIONS

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2015 2025

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AHA/ACC SCIENTIFIC STATEMENT

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Preamble, Principles, and General Considerations

A Scientific Statement From the American Heart Association and American College of Cardiology

Barry J. Maron, MD, FACC, *Co-Chair** Douglas P. Zipes, MD, FAHA, MACC, *Co-Chair*† Richard J. Kovacs, MD, FAHA, FACC, *Co-Chair**

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SCIENTIFIC STATEMENT

Clinical Considerations for Competitive Sports Participation for Athletes With Cardiovascular Abnormalities

A Scientific Statement From the American Heart Association and American College of Cardiology

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on behalf of the American Heart Association Leadership Committee of the Council on Clinical Cardiology, Council on Basic Cardiovascular Sciences, Council on Cardiovascular and Stroke Nursing, Council on Cardiovascular Surgery and Anesthesia, Council on Peripheral Vascular Disease, American College of Cardiology

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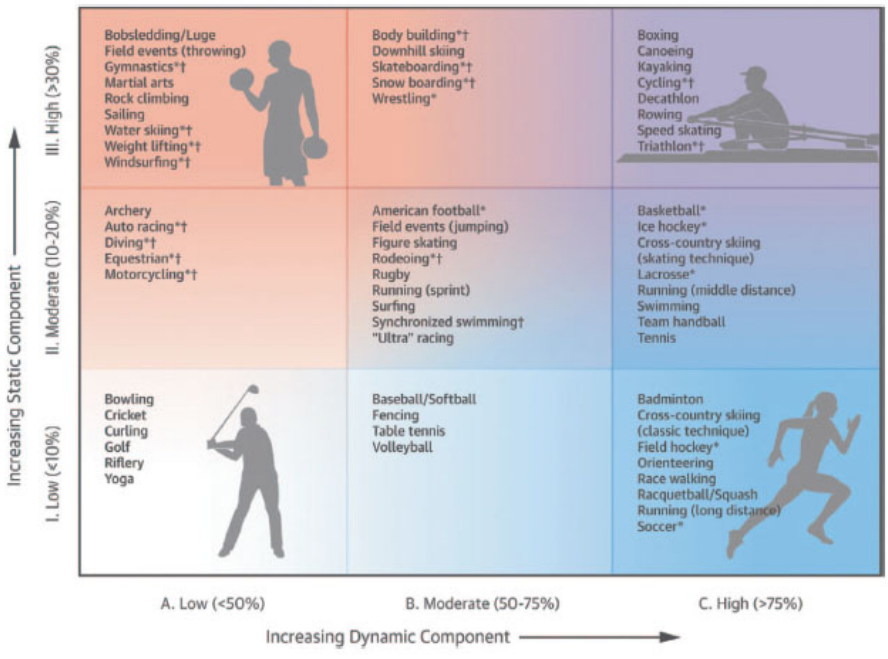
Up to 2015



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2025

FIGURE 1 Updated Competitive Sports Participation Classification Schema Presented as a Continuum of Competitive Sports Participation Based on Relative Strength and Endurance Intensities

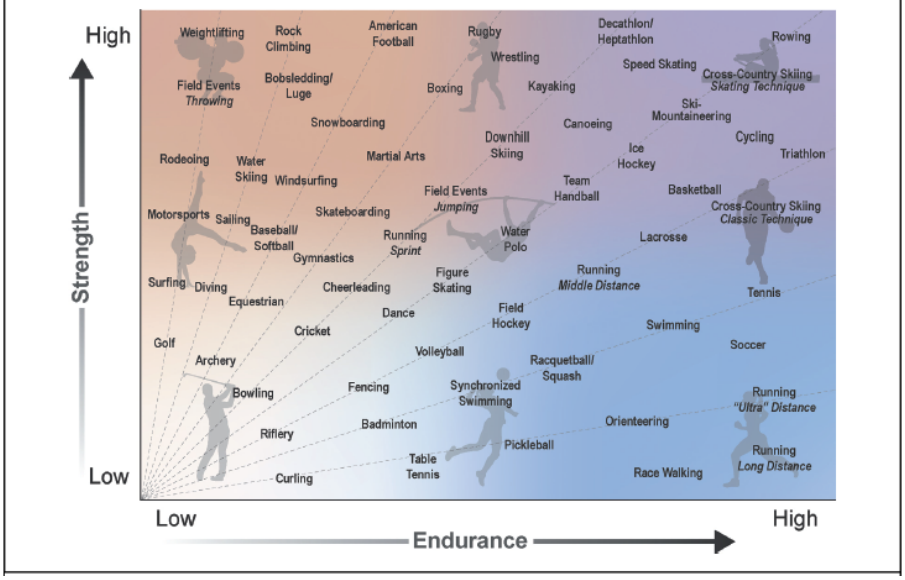

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Table 3. Competitive Sport–Specific Risks and Participation Considerations Related to Bodily Collision, Bodily Impact, and Projectile Impact

Bodily collisions or impacts are not expected or occur at low velocity	Bodily collisions or impacts occur unpredictably at moderate velocity	Bodily impacts occur unpredictably but at high velocity	Bodily collisions occur routinely and at moderate to high velocity
Athletes receiving full anticoagulation, partial anticoagulation, or aspirin monotherapy can participate in these competitive sports.	• After SDM, these competitive sports may be reasonable for athletes receiving full anticoagulation or partial anticoagulation. • Athletes receiving aspirin monotherapy can participate in these competitive sports.	• Risks associated with these competitive sports generally outweigh benefits for athletes receiving full anticoagulation. • Risks associated with these competitive sports may outweigh benefits for athletes receiving partial anticoagulation; SDM recommended. • Athletes receiving aspirin monotherapy can participate in these competitive sports.	• Risks associated with these competitive sports generally outweigh benefits for athletes receiving full anticoagulation. • Risks associated with these competitive sports may outweigh benefits for athletes receiving partial anticoagulation; SDM recommended. • Athletes receiving aspirin monotherapy can participate in these competitive sports.
Archery	Baseball/softball*	Downhill skiing	American football
Badminton	Cricket*	Cycling	Boxing
Bowling	Basketball	Triathlon (cycling portion)	Ice hockey*
Curling	Fencing	Motorsports	Lacrosse*
Cross-country skiing	Racquetball/squash*	Rodeoing	Martial arts
Dance	Cheerleading	Speed skating	Rugby
Golf	Gymnastics	Skateboarding	Wrestling
Orienteering	Figure skating	Snowboarding	
Pickleball	Soccer*	Bobsled/luge	
Race walking	Field hockey*	Rock climbing	
Riflery	Team handball*	Kayaking/canoeing	
Rowing	Diving	Equestrian	
Distance running/track & field	Surfing		
Sailing	Water skiing		
Swimming	Windsurfing		
Table tennis	Track & field (pole vault)		
Tennis			
Volleyball			
Weightlifting			

Colors correspond to low (green), moderate (yellow), or high (red) velocity. Collisions are defined as contact between ≥2 athletes occurring during competitive sport. Impacts are defined as contact between an athlete and a fixed or stationary object during competitive sport. Full anticoagulation is defined as a medical regimen including warfarin or direct thrombin inhibitors. Partial anticoagulation is defined as a medical regimen including dual antiplatelet therapy. SDM indicates shared decision-making.
*Denotes competitive sports in which injury from high-velocity projectiles (ie, balls, pucks) may pose risk of serious bleeding independent of bodily collision or impact.

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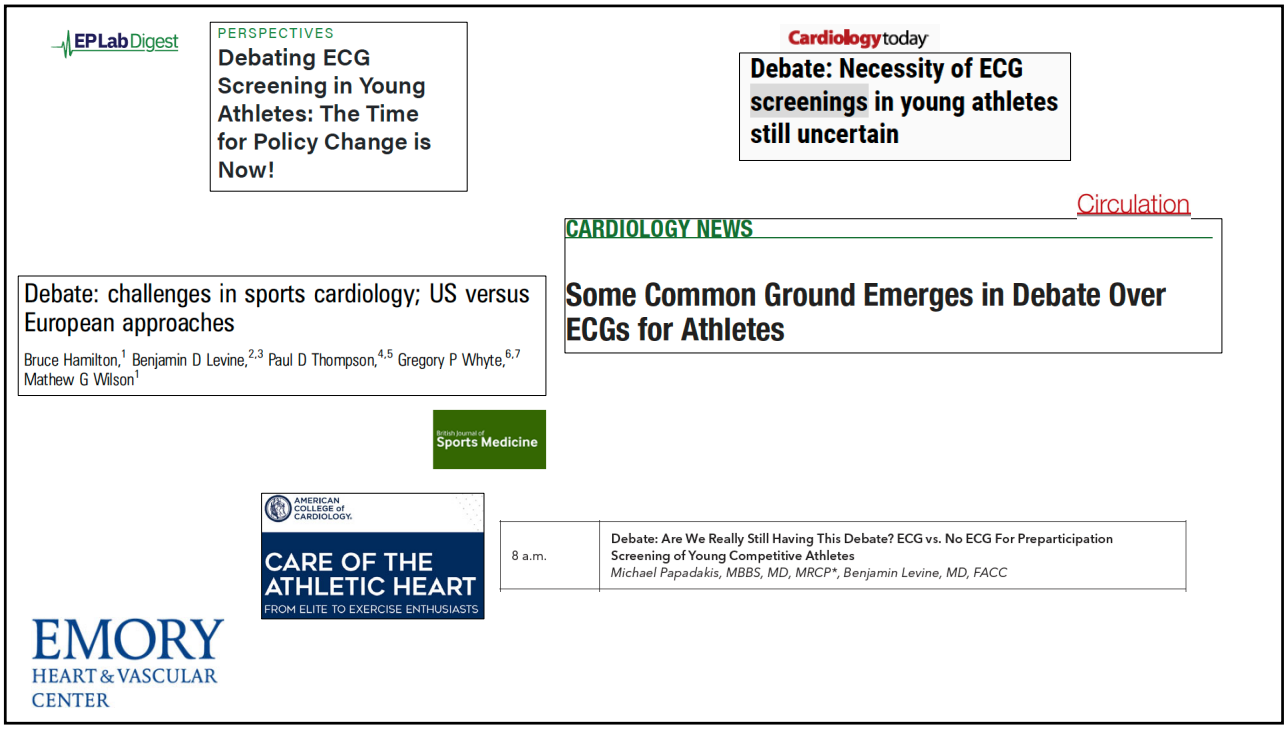

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SECTION II: THE PREPARTICIPATION CARDIAC EVALUATION

The inclusion of a resting 12-lead ECG is reasonable as it improves detection of underlying cardiac conditions in asymptomatic competitive athletes compared with medical history and physical examination alone.

- Implementation of screening ECGs requires appropriate expertise in interpretation & equitable downstream clinical resources for athletes found to have abnormal ECGs
- No data to suggest additional screening tests (e.g. echo) improves outcomes or incremental value
- Emphasis on effective EAP

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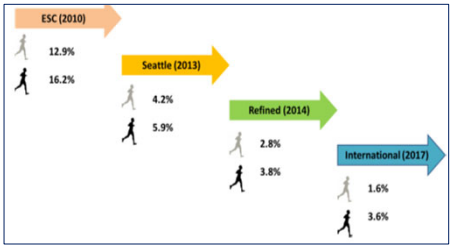
Accuracy of the 2017 international recommendations for clinicians who interpret adolescent athletes' ECGs: a cohort study of 11 168 British white and black soccer players

Aneil Malhotra ,[1] Harshil Dhutia,[1] Tee-Joo Yeo,[1,2] Gherardo Finocchiaro,[1] Sabiha Gati,[1,3] Paulo Bulleros,[1] Zephyr Fanton,[1] Efstathios Papatheodorou,[1] Chris Miles,[1] Tracey Keteepe-Arachi, Joyee Basu,[1] Gemma Parry-Williams,[1] Keerthi Prakash,[1] Belinda Gray,[1] Andrew D'Silva ,[1] Bode Ensam,[1] Elijah Behr,[1] Maite Tome,[1] Michael Papadakis,[1] Sanjay Sharma[1]

British Journal of Sports Medicine

- 11,168 soccer players
- 1.8% abnormal by International Criteria; 1.5% false positive (overall)



- 1.4% White vs. 3.3% Black false positive

Malhotra A. *Br J Sports Med* 2019.

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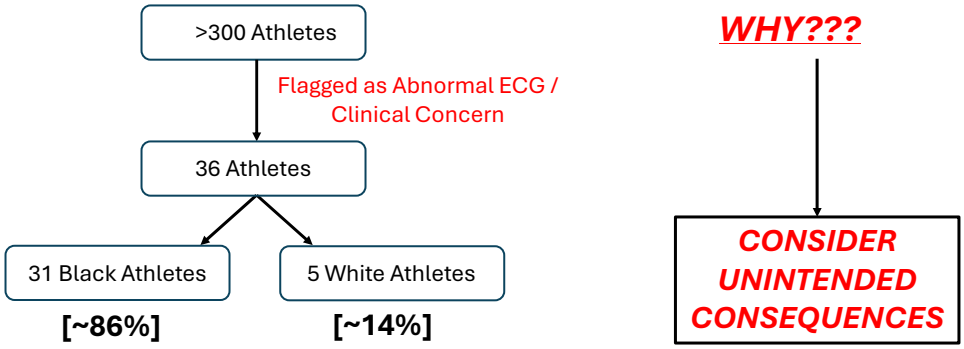
Real World Example…



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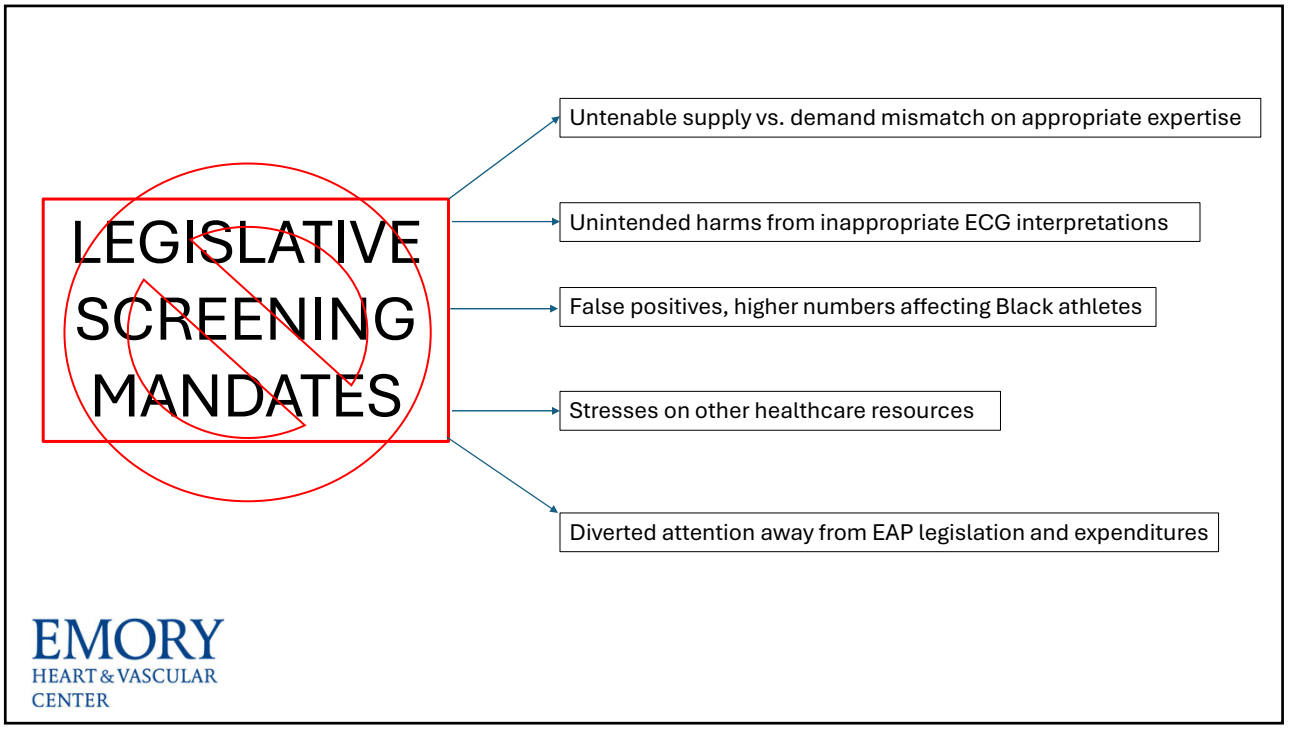
LEGISLATIVE SCREENING MANDATES
Untenable supply vs. demand mismatch on appropriate expertise
Unintended harms from inappropriate ECG interpretations
False positives, higher numbers affecting Black athletes
Stresses on other healthcare resources
Diverted attention away from EAP legislation and expenditures
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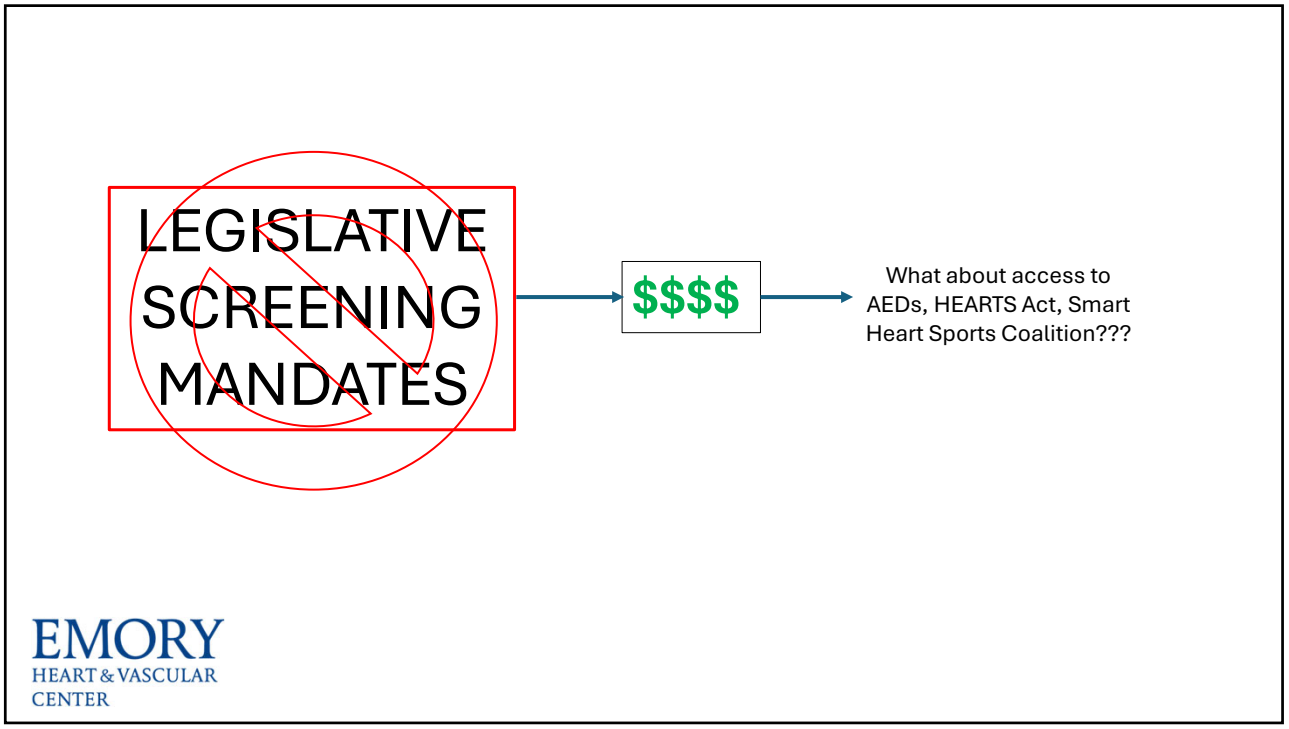
LEGISLATIVE SCREENING MANDATES
$$$$
What about access to AEDs, HEARTS Act, Smart Heart Sports Coalition???
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SOCIETAL STATEMENT

Opposing Legislative Mandates for ECG Screening in Competitive Athletes: A Report of the American College of Cardiology Solution Set Oversight Committee

Writing Committee

Jonathan H. Kim, MD, MSc, FACC, *Chair*
Aaron L. Baggish, MD, FACC
Doriane Coleman, JD
Elizabeth H. Dineen, DO, FACC
Kimberly G. Harmon, MD
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Benjamin D. Levine, MD, FACC
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Opposition of Electrocardiographic Screening Mandates

- In the United States, legislation mandating screening ECGs for competitive athletes should not be pursued. Such legislation would likely lead to more harm than benefit and would place an unsustainable burden on the healthcare system. The rationale for this position is based on the following tenets:
  - Accurate interpretation of ECGs in competitive athletes requires expertise in the use of contemporary athlete-specific electrocardiographic criteria. Legal mandates would generate an untenable "supply versus demand" shortage of appropriately trained medical professionals to interpret the high volume of screening ECGs.
  - In the absence of athlete ECG interpretation expertise, the number of inaccurately interpreted ECGs would likely be unacceptably high. Both false-positive and false-negative interpretation of ECGs would risk harms for the competitive athlete including adverse health outcomes (eg, missed cardiac diagnoses), psychological duress (eg, inappropriate sports disqualifications, significant time spent away from training, or both), and financial strain on families (eg, lack of health insurance or high deductibles).
  - Appropriately interpreted athletic ECGs are associated with false-positive rates ranging from ~2% to 15%. Although incompletely understood, rates of false-positive testing are associated with race, ethnicity, or both. Accordingly, legislation mandating screening ECGs is likely to place the highest burden of unintended harm on Black athletes and athletes from underserved neighborhoods, including rural areas, and low socioeconomic status backgrounds.
  - The clinical management of competitive athletes with abnormal screening ECGs requires considerable healthcare resources including a referral to a sports cardiologist or pediatric cardiologist, cardiac imaging, and additional diagnostic testing. Currently, the U.S. healthcare system is unable to provide these services at the scope that would be required following universal ECG mandates. This would also impact patients in the general population who would receive delayed or deferred care due to the influx of comparatively healthy competitive athletes.
  - Prevention of sudden cardiac death is fully dependent on the availability of both people trained in cardiopulmonary resuscitation and automated external defibrillators, which definitively reduces death among young competitive athletes. The current focus for legislation should be on secondary prevention and effective emergency action planning.

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SECTION IV: CARDIOMYOPATHIES

A uniform approach of restriction or disqualification from competitive sports participation should not be applied to competitive athletes with cardiomyopathies. Rather, SDM should be used to determine participation in competitive sports.

It is reasonable to consider competitive sports participation for competitive athletes with HCM after comprehensive expert assessment with SDM in which benefits and potential risks, including SCD, are discussed.

- HCM, DCM, ACM, LV Hypertrabeculation
- SDM should guide most competitive sports participation considerations

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Exercise Increases Age-Related Penetrance and Arrhythmic Risk in Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy–Associated Desmosomal Mutation Carriers

Cynthia A. James, ScM, PhD, Aditya Bhonsale, MD, Crystal Tichnell, MGC, Brittney Murray, MS, Stuart D. Russell, MD, Harikrishna Tandri, MD, Ryan J. Tedford, MD, Daniel P. Judge, MD, Hugh Calkins, MD

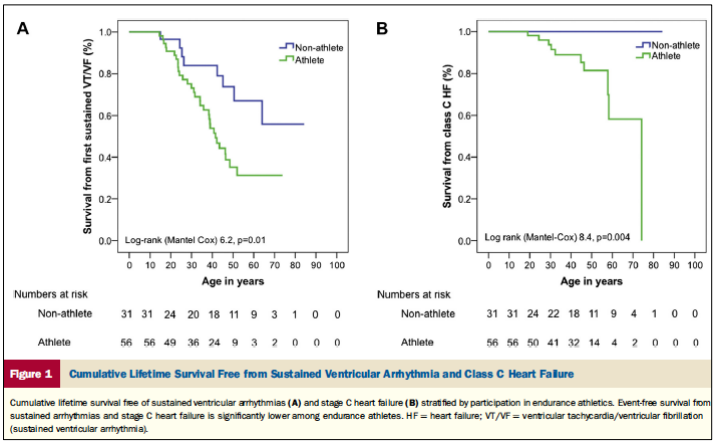

Figure 1 Cumulative Lifetime Survival Free from Sustained Ventricular Arrhythmia and Class C Heart Failure

Cumulative lifetime survival free of sustained ventricular arrhythmias **(A)** and stage C heart failure **(B)** stratified by participation in endurance athletics. Event-free survival from sustained arrhythmias and stage C heart failure is significantly lower among endurance athletes. HF = heart failure; VT/VF = ventricular tachycardia/ventricular fibrillation (sustained ventricular arrhythmia).

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James CA. *J Am Coll Cardiol* 2013.

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SECTION IV: CARDIOMYOPATHIES

Competitive athletes with a clinical diagnosis of *PKP2* ACM (ie, ACM attributable to a pathogenic or likely pathogenic variant in *PKP2*) should be advised that the risks of ventricular arrhythmias, structural disease progression, and SCD with continued endurance or higher-intensity competitive sports participation likely outweigh benefits.
Competitive athletes with non-*PKP2* ACM can consider competitive sports participation after comprehensive expert assessment with SDM in which benefits and potential risks, including SCD, are discussed. Although evidence of disease acceleration or increased arrhythmic risk is not established for non-*PKP2* ACM, these considerations should be individualized given the level of uncertainty.

- Emphasis on gene-specific mutations in ACM

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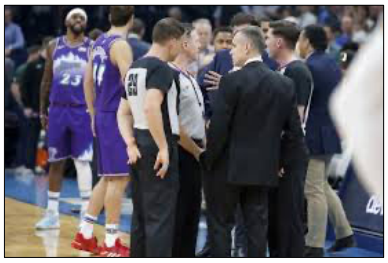
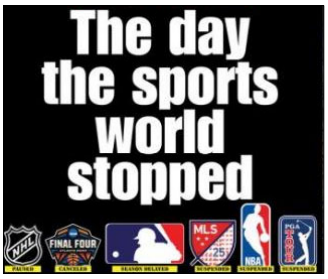
March 11th, 2020





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JAMA Cardiology | Original Investigation

Prevalence of Clinical and Subclinical Myocarditis in Competitive Athletes With Recent SARS-CoV-2 Infection
Results From the Big Ten COVID-19 Cardiac Registry

Curt J. Daniels, MD; Saurabh Rajpal, MBBS, MD; Joel T. Greenshields, MS; Geoffrey L. Rosenthal, MD; Eugene H. Chung, MD; Michael Terrin, MD; Jean Jeudy, MD; Scott E. Mattson, DO; Ian H. Law, MD; James Borchers, MD; Richard Kovacs, MD; Jeffrey Kovan, DO; Sami F. Rifat, MD; Jennifer Albrecht, PhD; Ana I. Bento, PhD; Lonnie Albers, MD; David Bernhardt, MD; Carly Day, MD; Suzanne Hecht, MD; Andrew Hipskind, MD; Jeffrey Mjaanes, MD; David Olson, MD; Yvette L. Rooks, MD; Emily C. Somers, PhD; Matthew S. Tong, DO; Jeffrey Wisinski, DO; Jason Womack, MD; Carrie Esopenko, PhD; Christopher J. Kratochvil, MD; Lawrence D. Rink, MD; for the Big Ten COVID-19 Cardiac Registry Investigators

RESULTS Representing 13 universities, cardiovascular testing was performed in 1597 athletes (964 men [60.4%]). Thirty-seven (including 27 men) were diagnosed with COVID-19 myocarditis (overall 2.3%; range per program, 0%-7.6%); 9 had clinical myocarditis and 28 had subclinical myocarditis. If cardiac testing was based on cardiac symptoms alone, only 5 athletes would have been detected (detected prevalence, 0.31%). Cardiac magnetic resonance imaging for all athletes yielded a 7.4-fold increase in detection of myocarditis (clinical and subclinical). Follow-up CMR imaging performed in 27 (73.0%) demonstrated resolution of T2 elevation in all (100%) and late gadolinium enhancement in 11 (40.7%).

Daniels CJ. JAMA Cardiol 2021

In follow-up, 27 of 37 athletes (73.0%) completed repeat CMR imaging with a range of 4 to 14 weeks (mean [SD], 9.4 [3.1] weeks) from initial COVID-19 test positivity. Two patterns emerged at CMR imaging follow-up. The first was complete resolution of both T2 mapping abnormalities and LGE in 11 of 27 athletes (40.7%; range between studies, 4-10 weeks with median [interquartile range] of 8 [3.5] weeks). The second was resolution of T2 mapping abnormalities but persistence of LGE in 16 of 27 athletes (59.3%; range between studies, 4-14 weeks with median [interquartile range] of 12 [4.3] weeks) (eFigure in Supplement 1).

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SECTION V: MYOCARDITIS/ PERICARDITIS, VALVULAR HEART DISEASE, AND OTHER ACQUIRED CARDIOVASCULAR CONDITIONS

Resumption of competitive sports participation for competitive athletes with myocarditis and preserved LV function can be considered 4 to 6 wk after complete resolution of symptoms if all the following criteria are met:

- There is resolution of inflammation or edema by CMR (T2 signal) or serum biomarkers (inflammation).
- Clinically relevant arrhythmias, including frequent or complex repetitive forms of ventricular arrhythmias, are absent on ambulatory ECG monitoring and exercise testing.

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SECTION VII: AORTOPATHY (INCLUDING BICUSPID AORTIC VALVE) AND SPONTANEOUS CORONARY ARTERY DISSECTION

Competitive sports participation for competitive athletes with BAV and mild to moderate thoracic aortic dilation (40–44 mm) and no additional risk factors for aortic dissection (as defined above) can be considered with SDM. Risk stratification should consider the degree of dilation relative to age, sex, and body size.

For competitive athletes with BAV and moderate to severe aortic dilation (≥45 mm), the risks likely outweigh the benefits of competitive sports participation. However, competitive sports participation can be considered in select cases with SDM, consultation with experts in aortic disease or sports cardiology, and longitudinal clinical surveillance.

Competitive sports participation for competitive athletes with HTADs whose aorta and branch vessels are normal in size can be considered with SDM, which should include the underlying condition and sport type. For such competitive athletes, the risks of competitive sports participation involving high-intensity strength physiology likely outweigh the benefits (see Section I, Figure 1).

Competitive sports participation for competitive athletes with unexplained mild to moderate thoracic aortic dilation (≥43–44 mm) can be considered with SDM, consultation with experts in aortic disease or sports cardiology, and longitudinal clinical surveillance.

The risks may outweigh the benefits of competitive sports participation for competitive athletes with unexplained moderate to severe thoracic aortic dilation (≥45 mm). Competitive sports participation can be considered in select cases with SDM, consultation with experts in aortic disease or sports cardiology, and longitudinal clinical surveillance.

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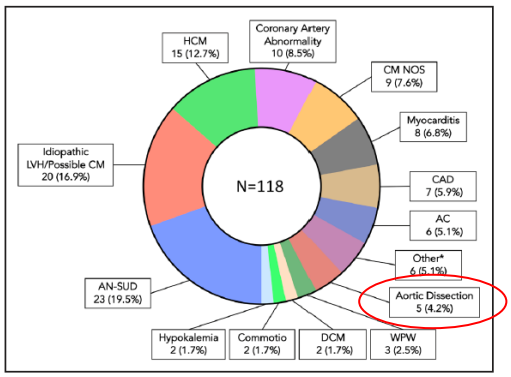
Sudden Cardiac Death in National Collegiate Athletic Association Athletes: A 20-Year Study

Bradley J. Petek, MD; Timothy W. Churchill, MD; Nathaniel Moulson, MD; Stephanie A. Kliethermes, PhD; Aaron L. Baggish, MD; Jonathan A. Drezner, MD; Manesh R. Patel, MD; Michael J. Ackerman, MD, PhD; Kristen L. Kucera, PhD, MSPH, LAT, AT; David M. Siebert, MD; Lauren Salerno, BA; Monica Zigman Suchsland, MPH; Irfan M. Asif, MD; Joseph J. Maleszewski, MD; Kimberly G. Harmon, MD

Circulation



European Journal of Preventive Cardiology

Sudden cardiac death secondary to acute aortic syndromes in young athletes in the United States

Bradley J. Petek[1], Nathaniel Moulson[2], Aaron L. Baggish[3,4], Stephanie A. Kliethermes[5], Joseph J. Maleszewski[6], Randi Delong[7], Kristen L. Kucera[7], Kimberly G. Harmon[8], Jonathan A. Drezner[8], and Timothy W. Churchill[9,10]*

- ~20 years
- 14/454 (SCA/D) cases (3%)
- 7/14 during exertion
- 2 Bicuspid cases
- 1/3 cases with autopsy description of aortic dimensions as 'normal'

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Annals of Internal Medicine | ARTICLE

Sudden Death in Young Adults: A 25-Year Review of Autopsies in Military Recruits

Robert E. Eckart, DO; Stephanie L. Scoville, DrPH; Charles L. Campbell, MD; Eric A. Shry, MD; Karl C. Stajduhar, MD; Robert N. Potter, DVM, MPH; Lisa A. Pearse, MD, MPH; and Renu Virmani, MD

Table 3. Non Dissections??? entifiable Cardiac Abnor 2001 ($n = 64$)

Cardiac Abnormality	Sudden Deaths, *n* (%)*
Cardiomyopathy	23 (36)
Myocarditis	13 (20)
Hypertrophic cardiomyopathy	8 (13)
Idiopathic dilated cardiomyopathy	1 (2)
Right ventricular dysplasia	1 (2)
Coronary artery pathology	39 (61)
Anomalous coronary artery	21 (33)
Atherosclerotic coronary artery disease	10 (16)
Coronary artery hypoplasia	3 (5)
Coronary aneurysm	2 (3)
Intramyocardial coronary bridge	2 (3)
Coronary dissection	1 (2)
Miscellaneous cardiac findings	2 (3)
Bicuspid aortic valvular stenosis	1 (2)
Embolic myocardial infarction	1 (2)

* Some numbers have been rounded.

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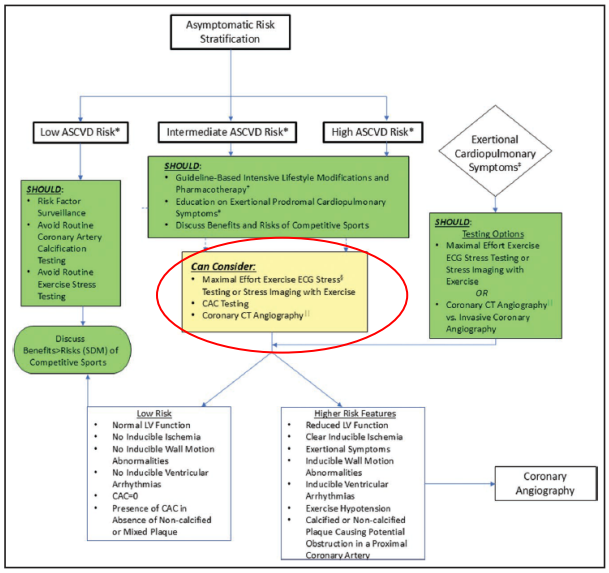
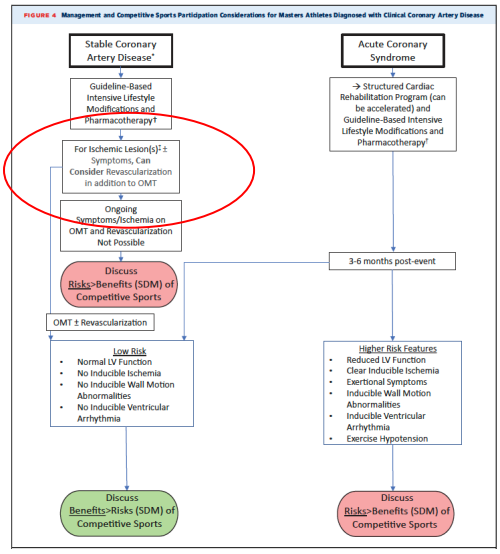
SECTION X: MASTERS ATHLETES





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The NEW ENGLAND JOURNAL of MEDICINE

Cardiac Arrest during Long-Distance Running Races

Jonathan H. Kim, M.D., Rajeev Malhotra, M.D., George Chiampas, D.O., Pierre d'Hemecourt, M.D., Chris Troyanos, A.T.C., John Cianca, M.D., Rex N. Smith, M.D., Thomas J. Wang, M.D., William O. Roberts, M.D., Paul D. Thompson, M.D., and Aaron L. Baggish, M.D., for the Race Associated Cardiac Arrest Event Registry (RACER) Study Group

	Age	Sex	Cause of Cardiac Arrest	Findings on Cardiac Catheterization	Echocardiographic Data
	yr				
Participants who survived					
1	48	Female	Nonischemic ventricular tachycardia	No coronary arterial luminal narrowing, normal left ventricular function (ejection fraction, 68%)	Normal left ventricular structure and function; septal thickness, 11 mm; posterior-wall thickness, 11 mm; left ventricular end-diastolic diameter, 52 mm; left ventricular ejection fraction, 60%
2	48	Male	Nonischemic ventricular tachycardia	No coronary arterial luminal narrowing, normal left ventricular function (ejection fraction 62%)	Mild left ventricular dilatation†; septal thickness, 11 mm; posterior wall thickness, 11 mm; left ventricular end-diastolic diameter, 59 mm; left ventricular ejection fraction, 66%
3	55	Male	Myocardial ischemia	95% mid-left anterior descending stenosis	Normal left ventricular morphology and function; septal thickness, 10 mm; posterior wall thickness, 11 mm; left ventricular end-diastolic diameter, 50 mm; left ventricular ejection fraction, 55%
4	60	Male	Myocardial ischemia	95% mid-left circumflex stenosis	Mild left ventricular dilatation; septal thickness, 11 mm; posterior wall thickness, 11 mm; left ventricular end-diastolic diameter, 57 mm; left ventricular ejection fraction, 50%
5	49	Male	Myocardial ischemia	95% distal right coronary-artery stenosis, 80% proximal right coronary-artery stenosis, 95% proximal left circumflex stenosis	Echocardiography not performed
6	47	Male	Myocardial ischemia	85% proximal left anterior descending stenosis	Mild left ventricular concentric hypertrophy; septal thickness, 12 mm; posterior wall thickness, 10 mm; left ventricular end-diastolic diameter, 49 mm; left ventricular ejection fraction, 50%
7	65	Male	Myocardial ischemia	90% mid-left anterior descending stenosis, 80% posterolateral-artery stenosis	Mild left ventricular concentric hypertrophy; septal thickness, 13 mm; posterior wall thickness, 11 mm; left ventricular end-diastolic diameter, 52 mm; left ventricular ejection fraction, 45%
8	53	Male	Unknown‡	Catheterization not performed	Mild left ventricular concentric hypertrophy; septal thickness, 13 mm; posterior wall thickness, 13 mm; left ventricular end-diastolic diameter, 51 mm; left ventricular ejection fraction, 65%

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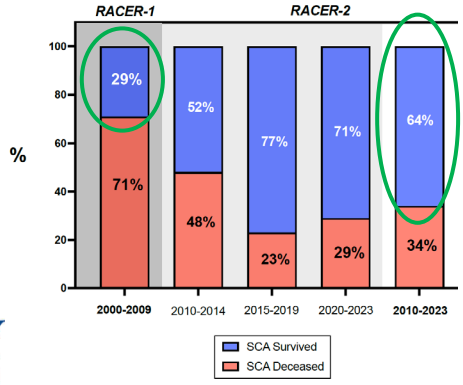
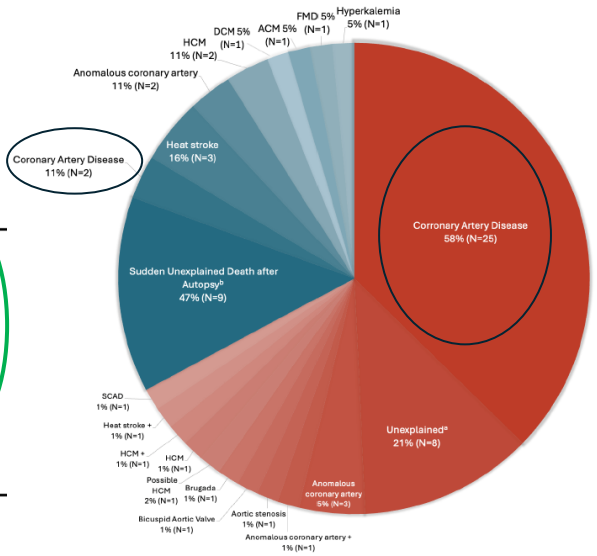
JAMA The Journal of the American Medical Association

JAMA | Original Investigation

Cardiac Arrest During Long-Distance Running Races

Jonathan H. Kim, MD, MSc; Austin J. Rim, MD; James T. Miller, MS; Mekensie Jackson, MS; Neeya Patel, BA; Sanchitha Rajesh; Yi-An Ko, PhD; Heather DiGregorio, MLA; George Chiampas, DO; David McGillivray, BS; Jay Holder, BA; Aaron L. Baggish, MD





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More Significant Changes! …Not Enough Time

SECTION VI: CONGENITAL HEART DISEASE

→ Coronary anomalies, Bridges?

SECTION IX: CARDIAC CHANNELOPATHIES

→ CPVT?

SECTION VIII: ARRHYTHMIAS, DEVICES, AND ECG ABNORMALITIES

→ Sudden cardiac arrest?

SECTION XI: ADDITIONAL CARDIAC CONDITIONS AND CONSIDERATIONS

→ PE, altitude, scuba, pregnancy?

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Uncertainties and The Future…

Journal of the American Heart Association

PROTOCOL

Rationale and Design of the ORCCA (Outcomes Registry for Cardiac Conditions in Athletes) Study

Nathaniel Moulson, MD*; Bradley J. Petek, MD*; Michael J. Ackerman, MD, PhD; Timothy W. Churchill, MD; Sharlene M. Day, MD; Jonathan H. Kim, MD, MSc; Stephanie A. Kliethermes, PhD; Rachel Lampert, MD; Benjamin D. Levine, MD; Matthew W. Martinez, MD; Manesh R. Patel, MD; Dermot Phelan, MD; Kimberly G. Harmon, MD; Aaron L. Baggish, MD; Jonathan A. Drezner, MD

ORCCA

OUTCOMES REGISTRY FOR CARDIAC CONDITIONS IN ATHLETES

JAMA Cardiology | Review

Racial Disparities in Sports Cardiology
A Review

Sheela Krishnan, MD; James Sawalla Guseh, MD; Mertije Chukumerije, MD; Aubrey J. Grant, MD; Peter N. Dean, MD; Jeffrey J. Hsu, MD, PhD; Mustafa Husaini, MD, MBA; Dermot M. Phelan, MD, PhD; Ankit B. Shah, MD, MPH; Katie Stewart, CNP; Meagan M. Wasfy, MD, MPH; Quinn Capers IV, MD; Utibe R. Essien, MD, MPH; Amber E. Johnson, MD, MSc, MBA; Benjamin D. Levine, MD; Jonathan H. Kim, MD, MSc; for the American College of Cardiology Sports & Exercise Leadership Council

Figure 2. Principles for Eliminating Racial Disparities in Sports Cardiology

Race-conscious awareness
- If proven a normal ECG finding, athletic anterior repolarization should be generalized to all athletes, irrespective of race
- Eliminate race as a clinical diagnostic/therapeutic variable in clinical algorithms
- When encountering concentric LVH, assess environmental influences like hypertension, considering factors beyond race

Clinical inclusivity
- Diversify the sports medicine and sports cardiology workforce and other health teams in sports medicine
- Include diverse groups in research studies, as these lay the foundation for generalizable clinical algorithms
- A proven lifesaving device, ensure AED access in all athletic arenas, especially in underserved communities

Research-driven practice refinement
- Allocate more federal and foundation funding to explore racial disparities in athlete cardiac outcomes
- Broaden studies on cardiac phenotypic variation to understand healthy variation
- Avoid pathologizing groups. Instead, define and study the full spectrum of human variation

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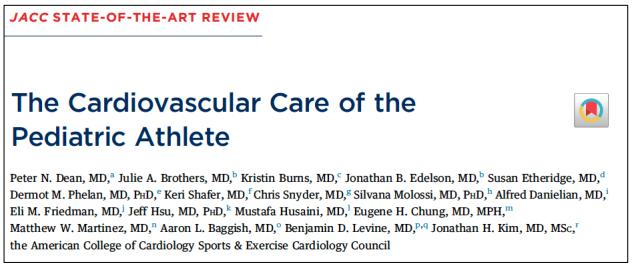
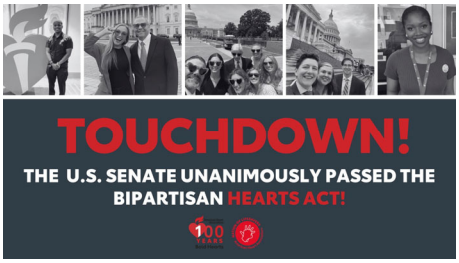
Uncertainties and The Future…


JACC STATE-OF-THE-ART REVIEW

The Cardiovascular Care of the Pediatric Athlete

Peter N. Dean, MD,[a] Julie A. Brothers, MD,[b] Kristin Burns, MD,[c] Jonathan B. Edelson, MD,[b] Susan Etheridge, MD,[d] Dermot M. Phelan, MD, PhD,[e] Keri Shafer, MD,[f] Chris Snyder, MD,[g] Silvana Molossi, MD, PhD,[h] Alfred Danielian, MD,[i] Eli M. Friedman, MD,[j] Jeff Hsu, MD, PhD,[k] Mustafa Husaini, MD,[l] Eugene H. Chung, MD, MPH,[m] Matthew W. Martinez, MD,[n] Aaron L. Baggish, MD,[o] Benjamin D. Levine, MD,[p,q] Jonathan H. Kim, MD, MSc,[r] the American College of Cardiology Sports & Exercise Cardiology Council

SMART HEART SPORTS COALITION



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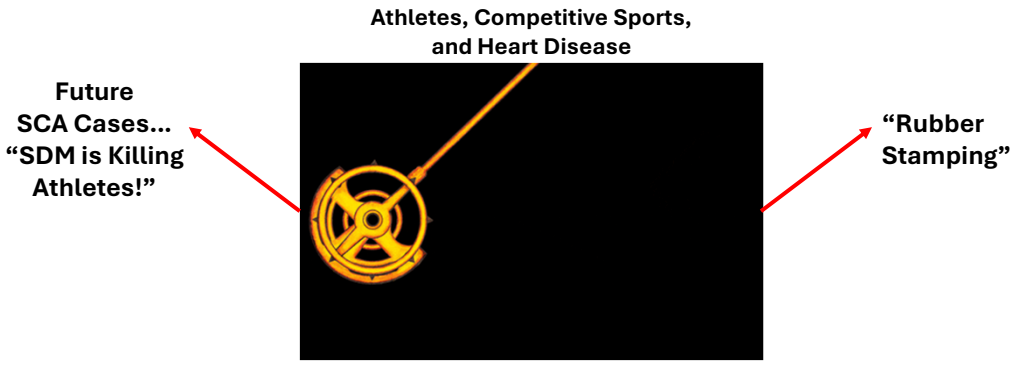
Lastly…A Simple Message of Caution…
Be Weary of the Pendulum



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Sports Cardiology and 'Relevance' in Sports Medicine

1985 → 2015-2025

16th BETHESDA CONFERENCE: CARDIOVASCULAR ABNORMALITIES IN THE ATHLETE: RECOMMENDATIONS REGARDING ELIGIBILITY FOR COMPETITION

Jere H. Mitchell, MD, FACC, Co-Chairman, Barry J. Maron, MD, FACC, Co-Chairman, Stephen E. Epstein, MD, FACC, Co-Chairman

Introduction

BARRY J. MARON, MD, FACC, STEPHEN E. EPSTEIN, MD, FACC, JERE H. MITCHELL, MD, FACC

→ **D/Q**

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1985 - ~2015

THE PRESENT AND FUTURE

STATE-OF-THE-ART REVIEW

Sports Cardiology

Core Curriculum for Providing Cardiovascular Care to Competitive Athletes and Highly Active People

Aaron L. Baggish, MD,[a] Robert W. Battle, MD,[b] James G. Beckerman, MD,[c] Alfred A. Bove, MD, PhD,[d] Rachel J. Lampert, MD,[e] Benjamin D. Levine, MD,[f] Mark S. Link, MD,[g] Matthew W. Martinez, MD,[g] Silvana M. Molossi, MD, PhD,[h] Jack Salerno, MD,[i] Meagan M. Wasfy, MD,[a] Rory B. Weiner, MD,[a] Michael S. Emery, MD,[i] for the ACC's Sports and Exercise Council Leadership Group

SCIENTIFIC STATEMENT

Clinical Considerations for Competitive Sports Participation for Athletes With Cardiovascular Abnormalities

A Scientific Statement From the American Heart Association and American College of Cardiology

Jonathan H. Kim, MD, MSc, FACC, *Chair*
Aaron L. Baggish, MD, FACC, *Vice Chair*
Benjamin D. Levine, MD, FAHA, FACC, *Vice Chair*
Michael J. Ackerman, MD, PhD, FACC
Sharlene M. Day, MD, FAHA
Elizabeth H. Dineen, DO, FACC
J. Sawalla Guseh II, MD
Andre La Gerche, MBBS, PhD
Rachel Lampert, MD, FHRS, FACC
Matthew W. Martinez, MD, FACC
Michael Papadakis, MBBS, MD, FRCP
Dermot M. Phelan, MD, PhD, FACC
Keri M. Shafer, MD, FACC
on behalf of the American Heart Association Leadership Committee of the Council on Clinical Cardiology, Council on Basic Cardiovascular Sciences, Council on Cardiovascular and Stroke Nursing, Council on Cardiovascular Surgery and Anesthesia, Council on Peripheral Vascular Disease, American College of Cardiology

2015 - Present

EMORY HEART & VASCULAR CENTER

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True Story – 2013 Atlanta Falcons Training Camp

Head Coach Mike Smith

Emory Cardiologist: "Hi. My name is Dr. X. I'm here to oversee the cardiac physicals this year. What's your name?"

Coach: "Hello. Nice to meet you as well. My name is Mike Smith."

Emory Cardiologist: "Nice to meet you, Mike. What position do you play?"

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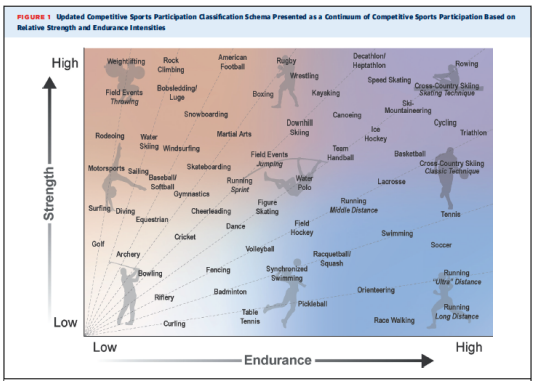

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Sports Cardiology as a Career Pathway

Guidance for Interested Cardiovascular Trainees

Eli M. Friedman, MD,[a] Aaron L. Baggish, MD,[b] Eugene H. Chung, MD,[c] Alfred Danielian, MD,[d] Elizabeth H. Dineen, DO,[e] J. Sawalla Guseh, MD,[c] Matthew W. Martinez, MD,[f] Caroline E. Murphy, MD,[g] Ankit B. Shah, MD,[h] Jonathan H. Kim, MD, MSc,[i] the ACC Council on Sports and Exercise Cardiology

JACC Advances

The 'Old Easy Days'...

1. Cardiology 'side hustle'
2. Free tickets to a game!
3. Sports swag!
4. Chance to see famous athletes once a year!
5. Broad brush medical D/Q's
6. No consideration of value within ortho/sports med; no business model

...To A New Era

1. Sports Cardiology is unique in sports medicine, nothing comparable
2. Teams/schools ARE dependent on this expertise
3. More emphasis on screening and science behind screening
4. With SDM and growth of field, cases ARE complex
5. Significant liability present
6. No ETA at present...CERTIFICATION is coming...
7. There must be investment in the right expertise

EMORY HEART & VASCULAR CENTER

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Summary

1. The history and growth of the field of sports cardiology is complicated, come with 'growing pains', but has evolved into a sub-specialty that numerous patients depend on and is now 'athlete-centered'

2. Uncertainties still exist in our understanding of sudden cardiac arrest/death in athletes, particularly reasons underlying disparities in outcomes

3. New guidelines for competitive sports considerations for athletes with heart conditions are available and grounded in shared decision-making

4. Investing in the right sports cardiology expertise is paramount for heath care organizations and within all of sports medicine

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Thank You!

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