Sudden Cardiac Death in Athletes

Jonathan Meyer, MD, FACC

Is Sudden Cardiac Day a New Problem?

No

Pheidippedes was a Greek Herald, who collapsed suddenly after running 25 miles from Marathon to Athens to announce the Greek victory over Persia in the Battle of Marathon

Painting of Pheidippides as he gave word of the Greek victory over Persia at the Battle of Marathon to the people of Athens. — Luc-Olivier Merson (1869)

What is Sudden Cardiac Death (SCD)?

Sudden, unexpected loss of cardiac function resulting in cardiac arrest.

Vast majority from ventricular arrhythmia

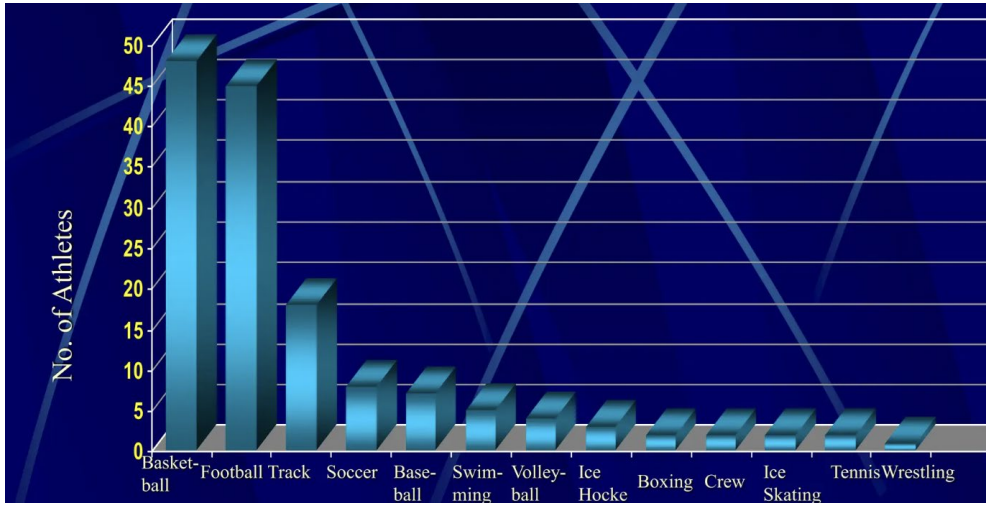
Largest cause of natural death in the USA

How Common is Sudden Cardiac Death in Athletes?

High school and college aged women -> 1 in 769,000

High school and college aged men -> 1 in 133,000

Males older than 40 -> 1 in 15,000



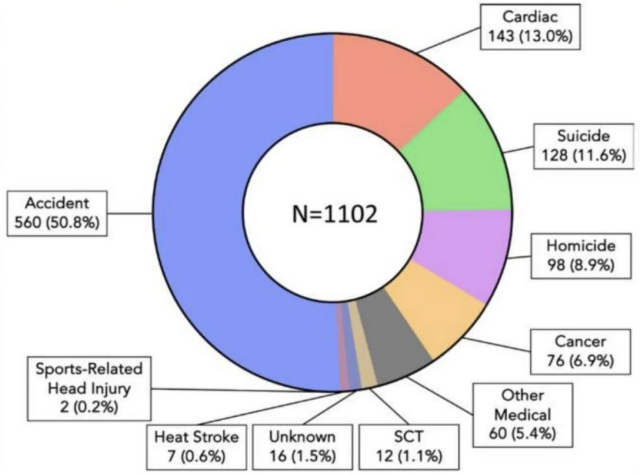
Maron BJ, et al. JAMA. 2000.

Why do Competitive Sports Increase the Risk of Cardiac Death?

Extreme and unpredictable environmental conditions such as decrease circulating blood volume, changes in electrolyte composition, and hydration in setting of increased cardiac demand.

This can result in electrical instability, and in those with underlying abnormalities, can cause arrhythmias resulting in cardiac failure.

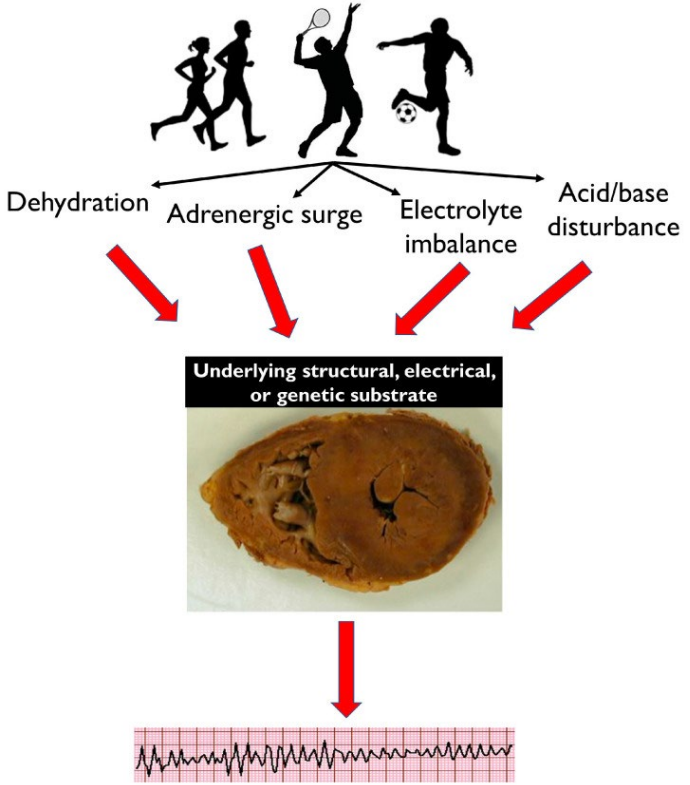
For athletes with Marfan syndrome, a congenital weakening in the walls of the aorta, increased stress, particularly when “bearing down” can cause arterial wall thinning, dilation, and potential rupture.



Circulation. 2024;149:80–90

What leads to Sudden Cardiac Death with exertion?

Several factors increase stress on the heart, and in individuals at risk, can lead to unstable electrical arrhythmia.



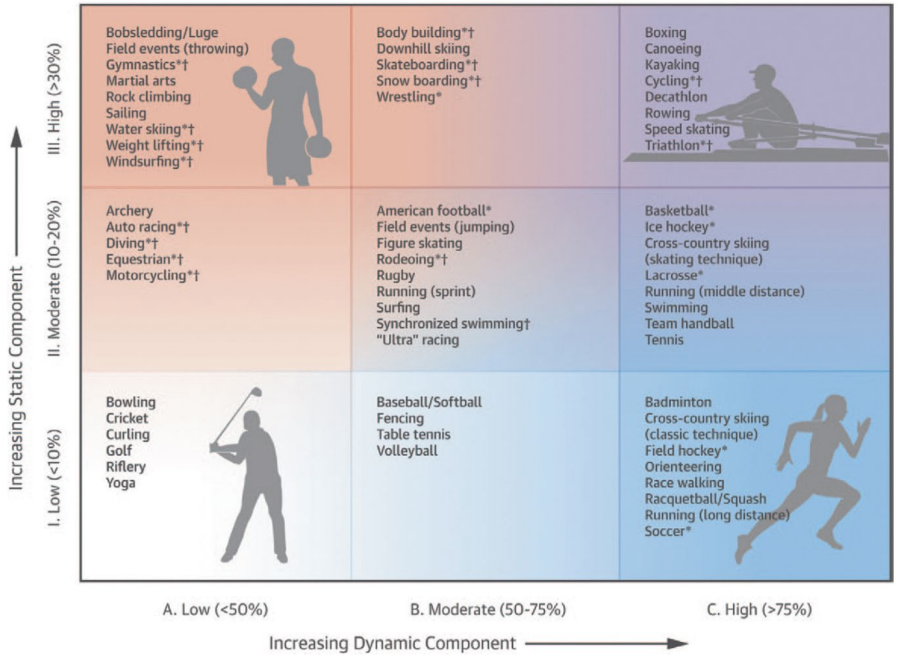
J Cardiovasc Dev Dis. 2023 Feb; 10(2): 68.

Which Sports are at Highest Risk?

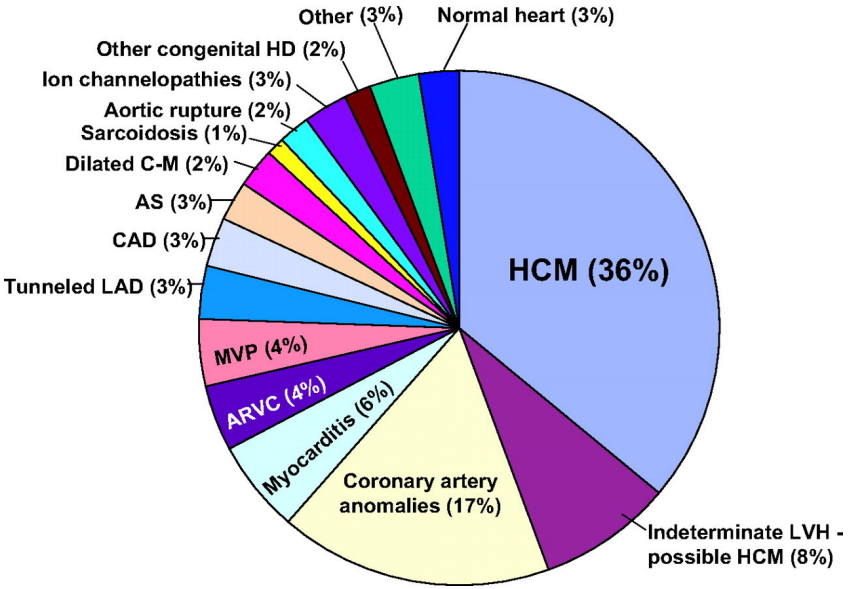
Sports that have the highest increase in cardiac output (Dynamic component) as well as those that have the highest voluntary contraction, increasing blood pressure load (Static component) are those at highest risk.

Must also consider environmental risks, where loss of consciousness could result in injury.

FIGURE Classification of Sports



What Causes Sudden Cardiac Death in the Young (<35)?



Structural Heart Abnormalities

- Hypertrophic Cardiomyopathy (most common, causing about ⅓ of SCD in the US)
- Anomalous Coronary Arteries
- Arrhythmogenic Cardiomyopathy
- Aortic Syndromes (Marfan's syndrome)

Inherited Arrhythmia Syndromes

- Long QT
- Short QT
- Brugada

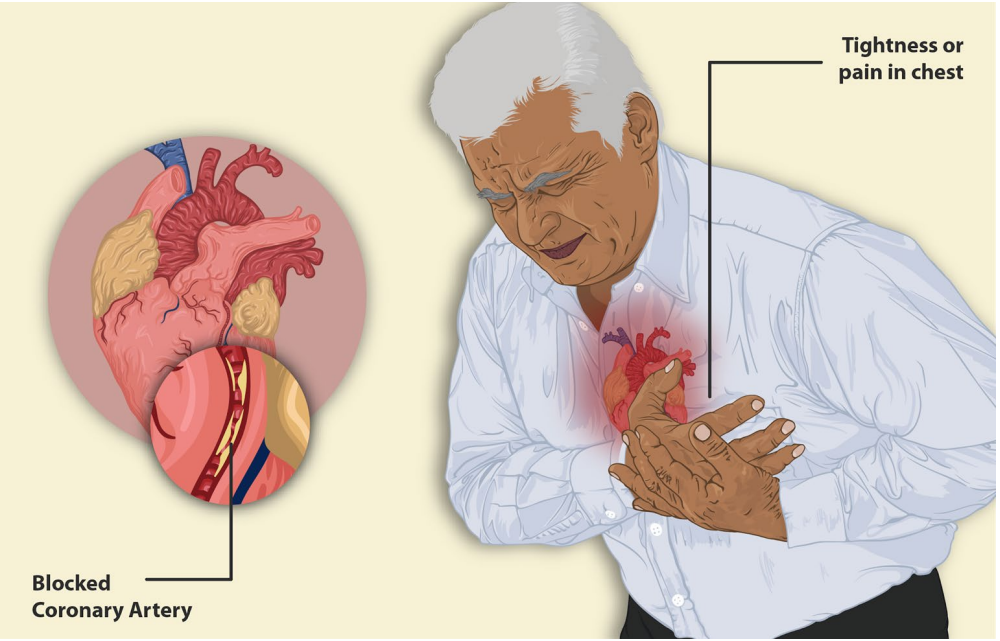
Drugs

- Ephedrine
- Anabolic Steroids
- Cocaine & other stimulants

Commotio Cordis

What causes SCD in Athletes over 35?

Coronary Artery Disease



How do we screen Young Athletes for Cardiac Disease?

14 point questionnaire and detailed physical examination

AHA Recommendations (10)*	PPE-4 (21)
Medical History†	
Personal History	**Heart Health Questions About You**
1. Chest pain/discomfort/tightness/pressure related to exertion	6. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?
2. Unexplained syncope/near syncope‡	5. Have you ever passed out or nearly passed out *during* or *after* exercise?
3. Excessive and unexplained dyspnea/fatigue or palpitations, associated with exercise	12. Do you get more tired or short of breath more quickly than your friends during exercise? 10. Do you get lightheaded or feel more short of breath than expected during exercise? 7. Does your heart ever race or skip beats (irregular beats) during exercise?
4. Prior recognition of a heart murmur 5. Elevated systemic blood pressure	8. Has a doctor ever told you that you have any heart problems? If so, check all that apply: ▫ High blood pressure ▫ A heart murmur ▫ High cholesterol ▫ A heart infection ▫ Kawasaki disease Other: _____
6. Prior restriction from sports	1. Has a doctor ever denied or restricted your participation in sports for any reason?
7. Prior testing for heart disease, ordered by a physician	9. Has a doctor ever ordered a test for your heart? (For example, ECG/EKG, echocardiogram) 11. **Have you ever had an unexplained seizure?**

Family History	Heart Health Questions About Your Family
8. Premature death (sudden and unexpected or otherwise) before 50 yrs of age attributable to heart disease in ≥1 relative	13. Has any family member or relative died of heart problems or had an unexpected death before age 50 yrs (including drowning, unexplained car accident, or sudden infant death syndrome)?
9. **Disability from heart disease in a close relative <50 yrs of age**	
10. Hypertrophic or dilated cardiomyopathy, long QT syndrome or other ion channelopathies, Marfan syndrome, or clinically significant arrhythmias; specific knowledge of genetic cardiac condition in family member	14. Does anyone in your family have hypertrophic cardiomyopathy, Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy, long QT syndrome, short QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia? 15. **Does anyone in your family have a heart problem, pacemaker, or implanted defibrillator?** 16. **Has anyone in your family had unexplained fainting, unexplained seizures, or near drowning?**

EXAMINATION		
Height: Weight:		
BP: / (/) Pulse: Vision: R 20/ L 20/ Corrected: ☐ Y ☐ N		
COVID-19 VACCINE		
Previously received COVID-19 vaccine: ☐ Y ☐ N Administered COVID-19 vaccine at this visit: ☐ Y ☐ N If yes: ☐ First dose ☐ Second dose ☐ Third dose ☐ Booster date(s) _____		
MEDICAL	**NORMAL**	**ABNORMAL FINDINGS**
Appearance • Marfan stigmata (kyphoscoliosis, high-arched palate, pectus excavatum, arachnodactyly, hyperlaxity, myopia, mitral valve prolapse [MVP], and aortic insufficiency)		
Eyes, ears, nose, and throat • Pupils equal • Hearing		
Lymph nodes		
Heart[a] • Murmurs (auscultation standing, auscultation supine, and ± Valsalva maneuver)		
Lungs		
Abdomen		
Skin • Herpes simplex virus (HSV), lesions suggestive of methicillin-resistant *Staphylococcus aureus* (MRSA), or tinea corporis		
Neurological		
MUSCULOSKELETAL	**NORMAL**	**ABNORMAL FINDINGS**
Neck		
Back		
Shoulder and arm		
Elbow and forearm		
Wrist, hand, and fingers		
Hip and thigh		
Knee		
Leg and ankle		
Foot and toes		
Functional • Double-leg squat test, single-leg squat test, and box drop or step drop test		

Is the rate of Sudden Cardiac Death increasing?

No, a recent study of the NCAA shows that incidence of cardiac causes of sudden death are DECREASING over the past 20 years at a rate about a 29% decrease every 5 years.

Overall rate was 1 in 63, 682 athlete years

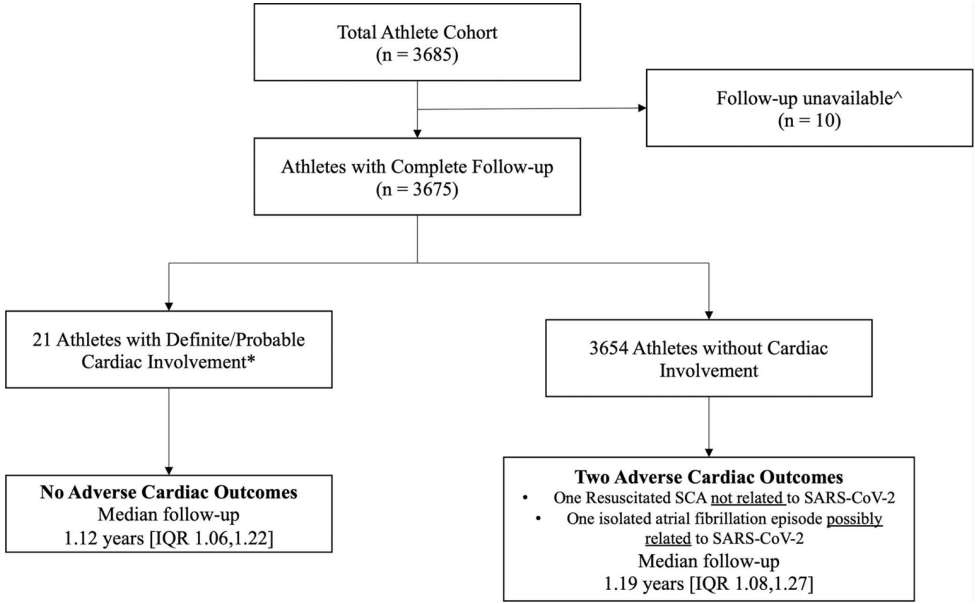
Rates were highest in basketball players at a rate of 1 in 8188 athlete years

Is COVID-19 increasing the Rate of Sudden Cardiac Death?

No

Despite causing cardiac involvement (0.6% of athletes positive for Covid), protocols in place removing athletes from competition successfully prevented adverse cardiac involvement.

It did require players to be out of sport for an average of 86 days.



Is Covid Vaccination increasing the Rate of Sudden Cardiac Death?

No

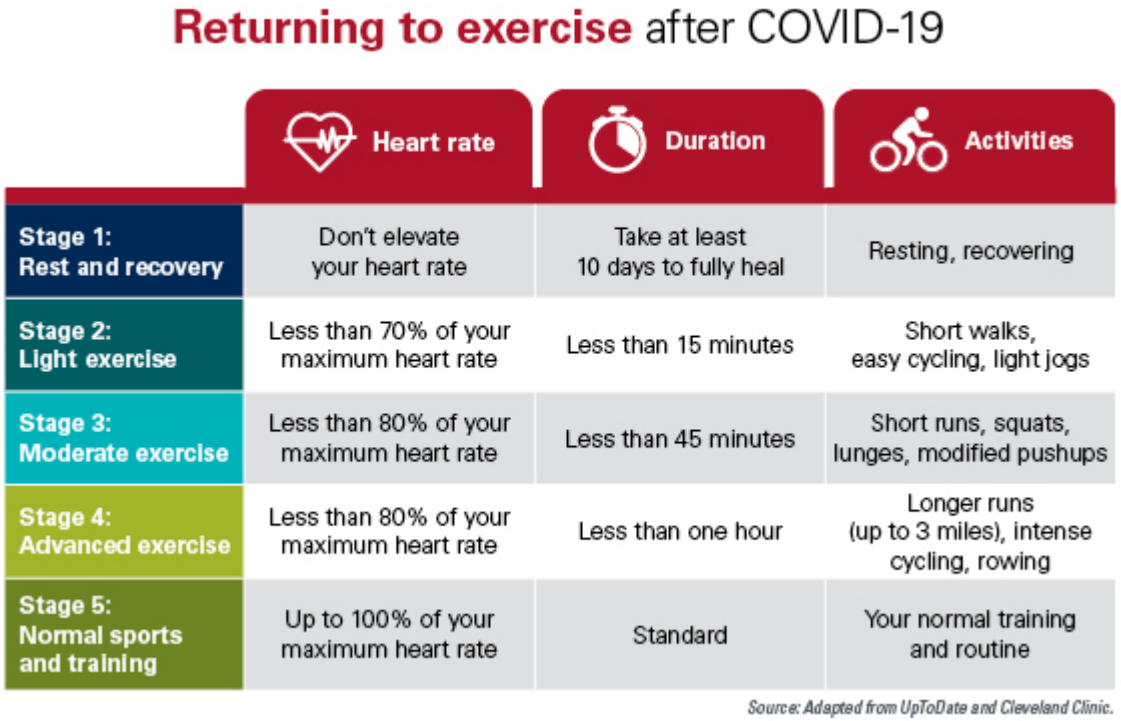
While the mRNA Covid vaccines have shown increases in rates of myocarditis, there have been no cases resulting in the sudden cardiac death in an athlete.

Estimates of myocarditis following vaccine administration is about 2 in 100,000, and highest among young men at about 11 in 100,000.

When is it Safe to Return to Sport Following COVID?

Young athletes with cardiac symptoms following covid infection should be fully evaluated by a cardiologist.

Those with evidence of cardiac involvement should not return to sport until all signs of inflammation are resolved.



How Do We Treat Cardiac Arrest?

CPR and AED

All sports facilities should have a properly inspected and maintained AED and an adult trained in CPR and use of an AED

Is participating in Athletics Dangerous?

No, not if proper screening is performed

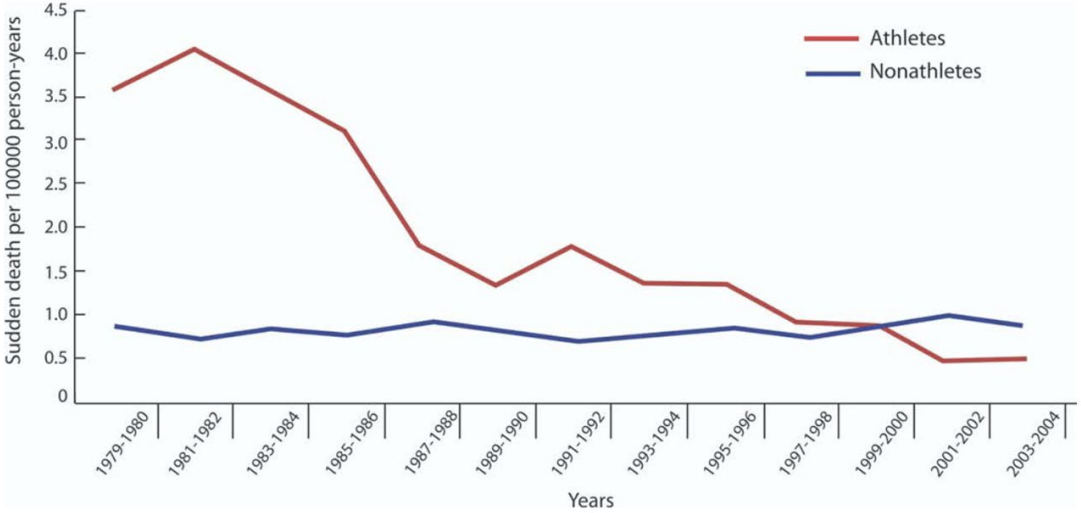


Figure 3 **Annual Incidence Rates of Sudden Cardiac Death Among Screened Competitive Athletes and Unscreened Nonathletes in the Veneto Region of Italy From 1979 to 2004**

Modified from Corrado et al. (23).

Questions?