Prevention of Sudden Cardiac Death in Athletes

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Sudden cardiac death (SCD)

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‘Natural death due to cardiac causes, heralded by abrupt loss of consciousness within 1 h of the onset of acute symptoms; pre-existing heart disease may have been known to be present, but the time and mode of death are unexpected’

Myerberg, 1997 A Textbook of Cardiovascular Medicine

Sudden cardiac death: An epidemic

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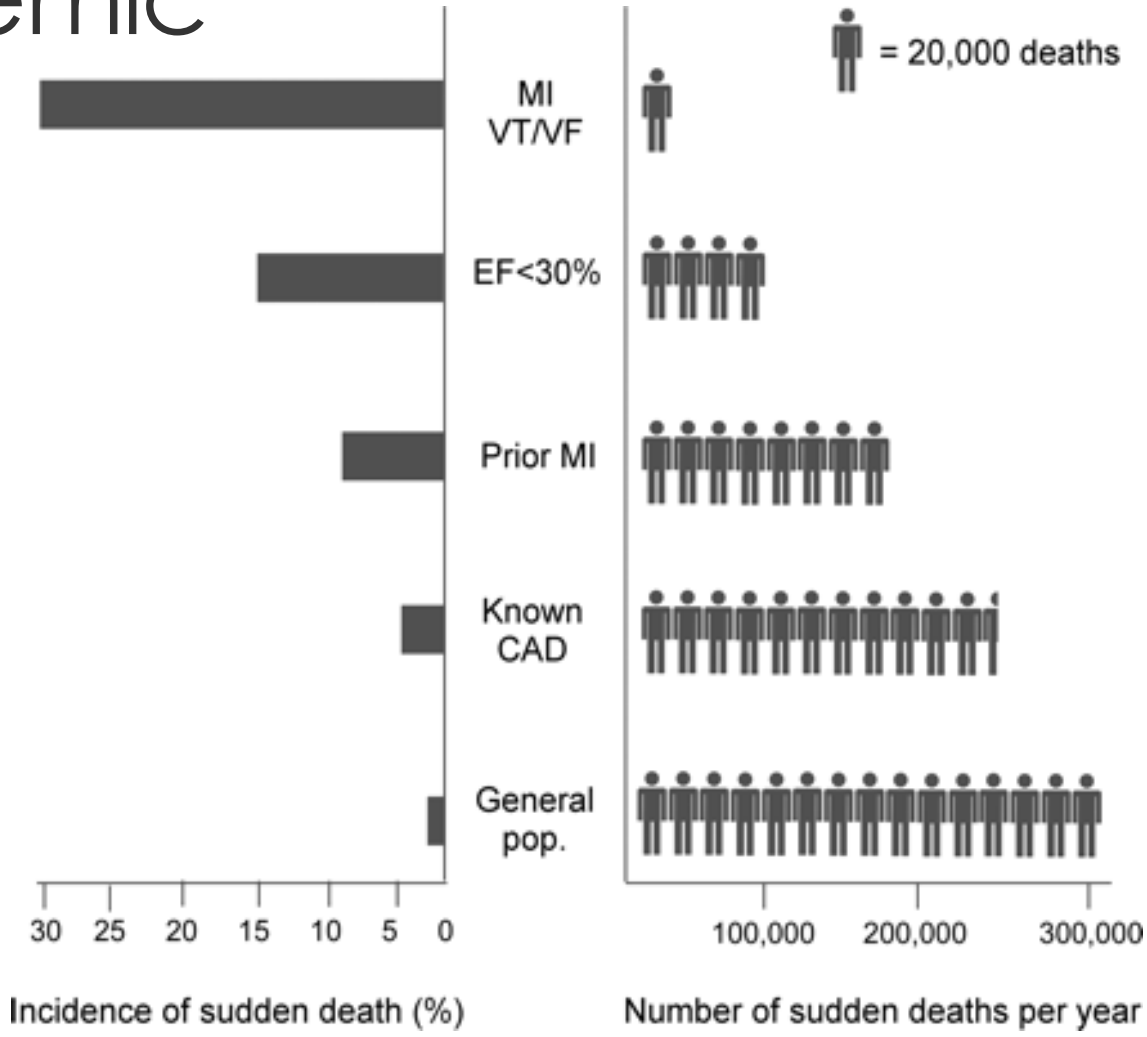

Noseworthy, P. A. et al. Circulation 2008;118:1854-1863

Circulation

American Heart Association
Learn and Live

Comparison of public-access defibrillation studies

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	Casinos[10]	Airlines[9]	Airports[7]	NCAA Division I Universities[11]	US High Schools
Cases of SCA, n	148	36	21	35	36
Immediate resuscitation rate, % (n/N)	48 (71/148)	36 (13/36)	52 (11/21)	54 (19/35)	64 (23/36)
Cases of VF/VT, n	105	15	18	21*	30*
Resuscitation rate if shock deployed, % (n/N)	63 (66/105)	87 (13/15)	61 (11/18)	71 (15/21)	67 (20/30)

Survival to discharge: 61% to 87%

Drezner, Circulation. 2009 Aug 11;120(6):518-25

Case

- 44 y.o. male Caucasian marathon runner
- Cardiac RFs: nil
- PMH: nil
- Meds: nil
- Non-drinker, non-smoker, vegetarian; machinist
- No family history of cardiac disease
- Completed multiple marathons, including the Boston Marathon
- Runs a minimum of 50 miles per week for 5 years

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Case: HPI

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- Running a marathon
- At mile 24 of 26, he suddenly collapses
- Found to be pulseless and apneic by a physician spectator; CPR initiated

- On arrival to hospital
  - Intubated, in ventricular fibrillation → cardioverted
  - 110/80, P = 100 irregular, T = 38.6
  - JVP not elevated, lungs clear, S4 noted
  - Cardiac markers, transaminases elevated
  - CXR: Normal
  - Swan-Ganz catheter inserted; PCWP = 6

Case (cont'd)

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- Stay complicated by significant ventricular ectopy requiring lidocaine and procainamide
- Suffered significant anoxic brain injury
- Died on Day 50 from *Pseudomonas* pneumonia
- Autopsy
  - Transmural myocardial infarction involving the anterior, septal, and lateral left ventricle
  - Left coronary artery system was large in diameter and was "widely patent" throughout its entirety
  - Right coronary artery had mild atherosclerosis

Fatal Myocardial Infarction in Marathon Racing

LAURENCE H. GREEN, M.D.; STAFFORD I. COHEN, M.D., F.A.C.P.; and GEORGE KURLAND, M.D.; Boston, Massachusetts

We believe that our study is the first documentation of a myocardial infarction in a trained athlete while running a marathon. In the presence of normal coronary arteries, the relation between exertion and infarction is unclear. Advocates of long-distance running for prevention or rehabilitation of ischemic heart disease should be aware of this potential complication.

Annals of Internal Medicine 84:704-706, 1976

‘The unexpected demise of an athlete is always a tragic event, which has a tremendous impact on the media, because it strikes down apparently healthy individuals…everyone wonders what intervention might have prevented sudden death.’

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Dr. Domenico Corrado, Cardiologist
University of Padua, Italy

Corrado, ESC, Paris 2011

Phidippides (530 BC - 490 BC)

Athenian herald: Professional-running courier

Ran 40km from Marathon to Athens to announce Greek victory over Persia

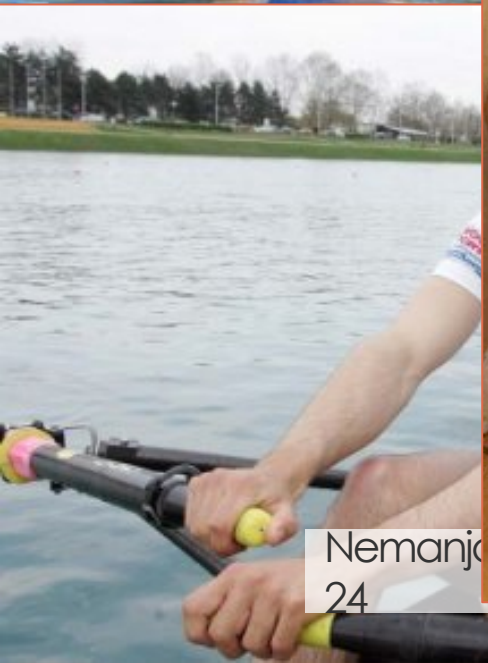
'Nikomen' – We have won

Collapses and dies

Luc-Olivier Merson, 1869

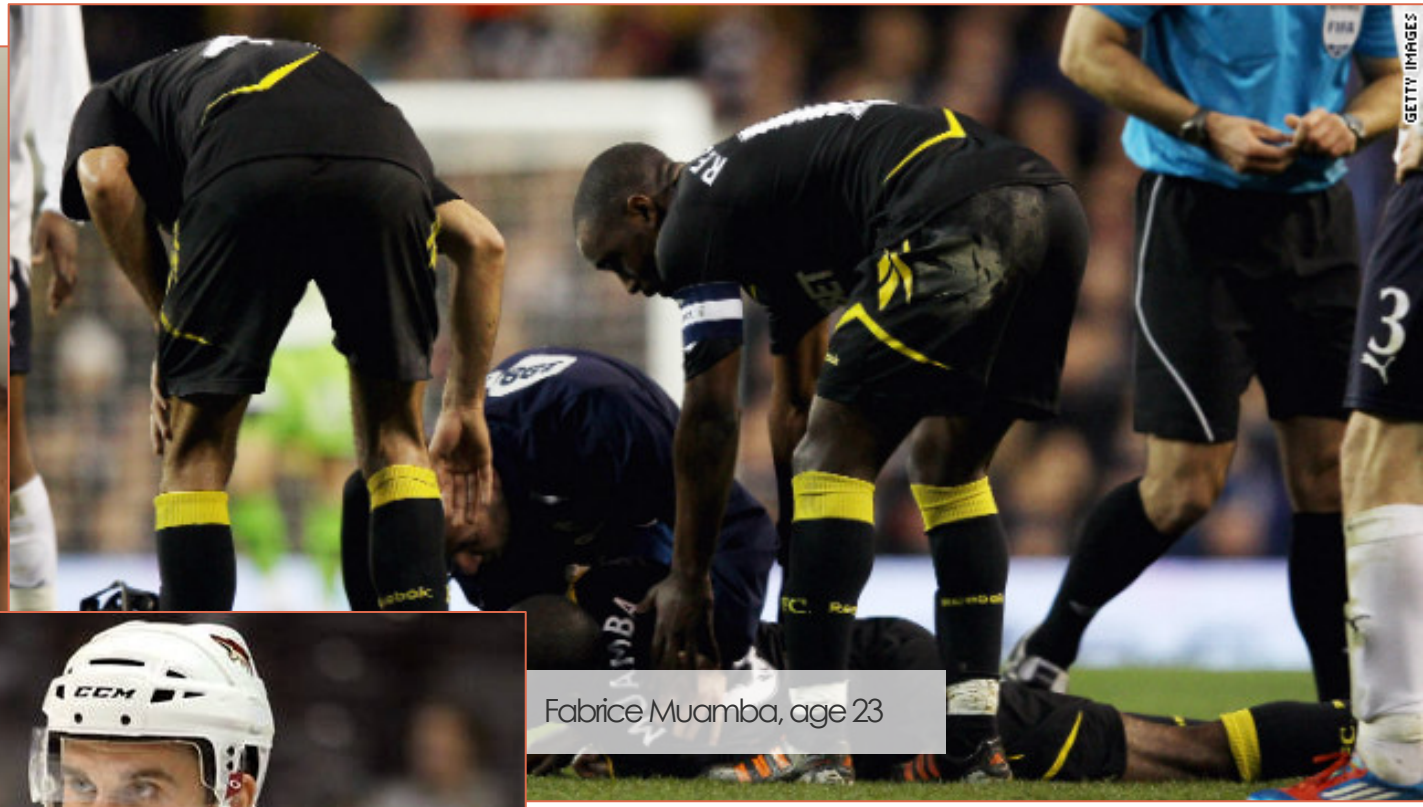
Alexa

Claire Squires, age 30

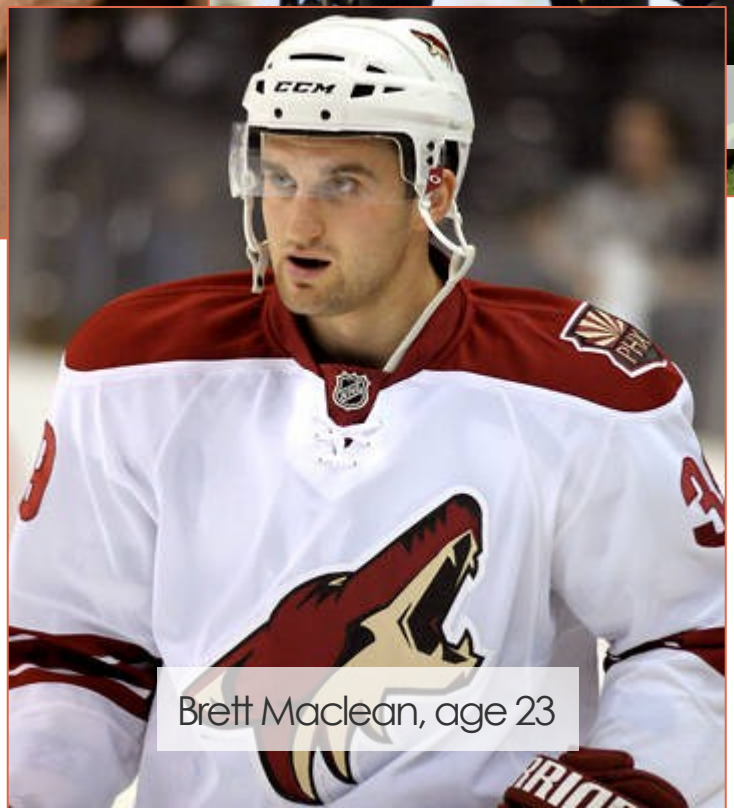


Nemanj
24

o Morosini, age 25



Fabrice Muamba, age 23



Brett Maclean, age 23

Objectives

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- Does exercise increase the risk of SCD and what etiologies account for SCD in athletes?
- Can we prevent sudden cardiac death in athletes?
- What restrictions should be placed upon individuals with cardiovascular disease?

SCD and exercise: Mechanis

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- Majority of deaths: Ventricular tachycardia (VT) or ventricular fibrillation (VF)
- Two mechanisms:
  - Prolonged physical training induces changes in cardiac structure (eg, chamber dilation and physiologic hypertrophy) that may create arrhythmic substrate
  - Immediate physiologic demands of intense athletics may trigger malignant arrhythmias and SCD in susceptible individuals with underlying cardiac abnormalities

Physiologic changes of exerc and potential sequelae

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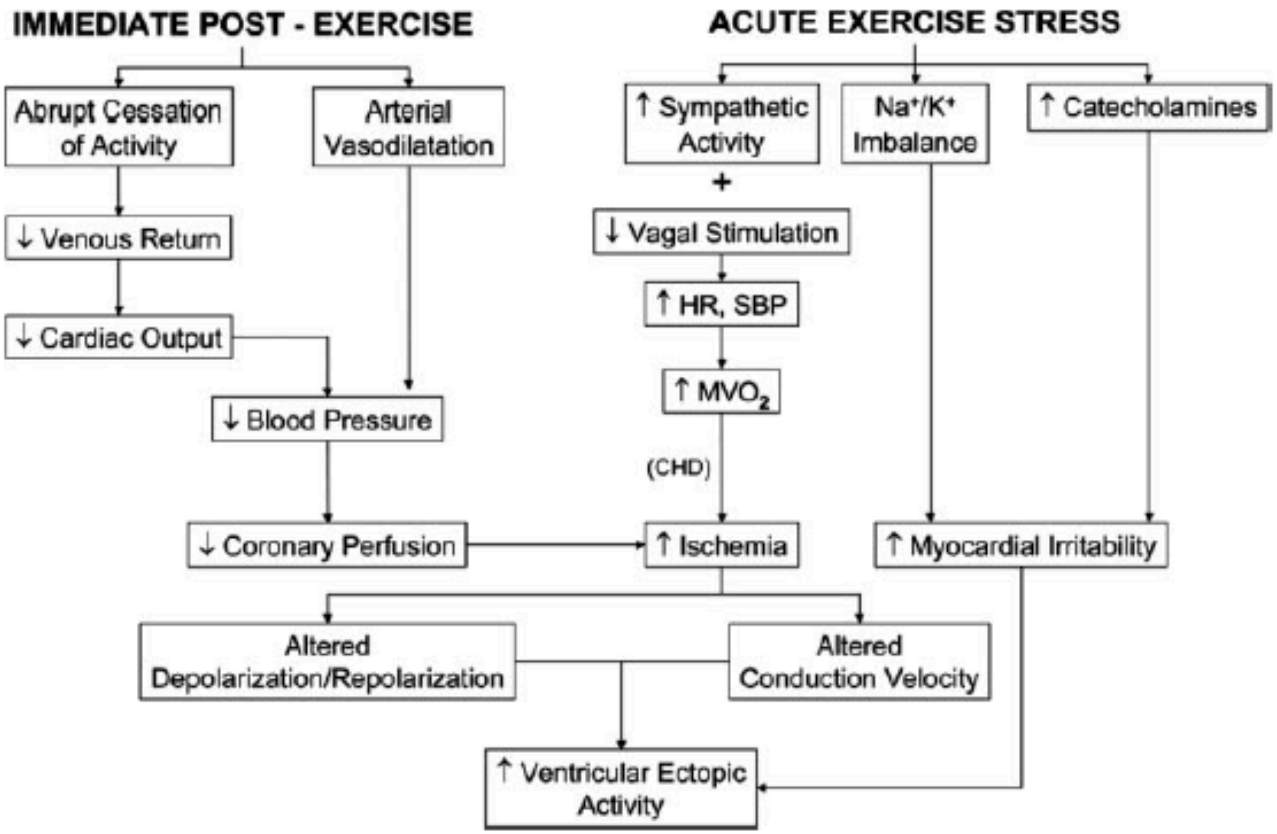

Thompson, Circulation. 2007 May 1;115(17):2358-68.

Risk of SCD: Age, Sport, Etiology

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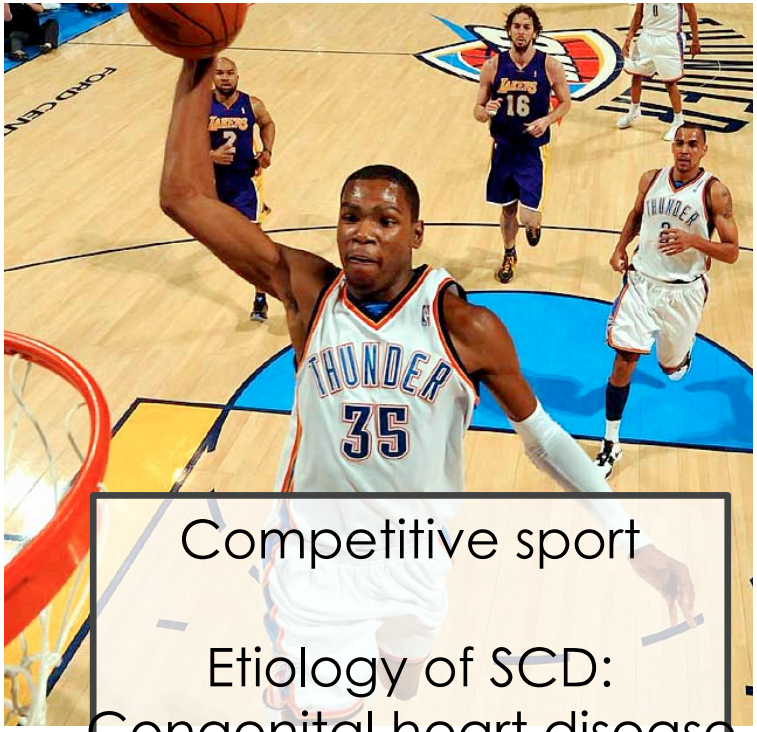
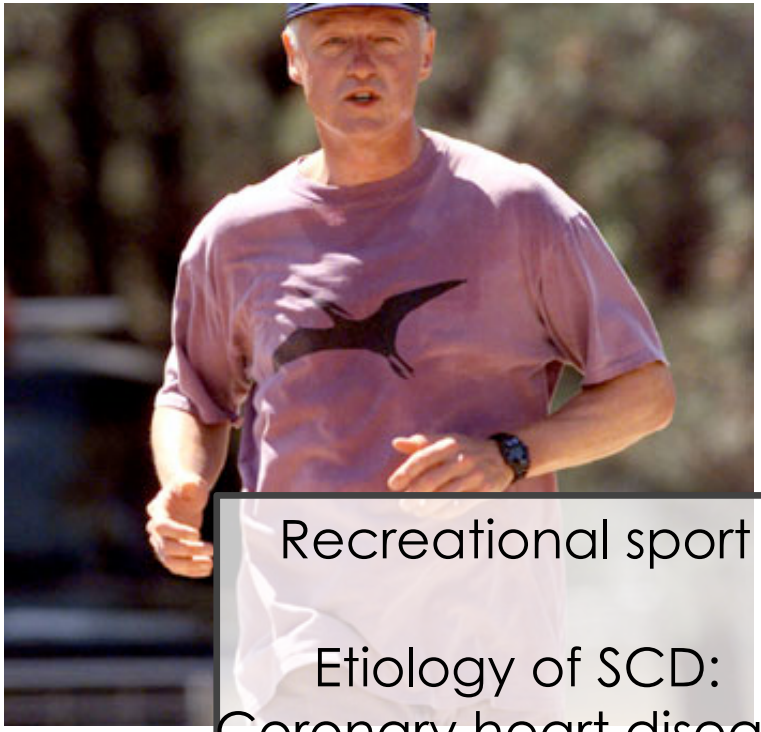
Kevin Durant, 23 y.o.
NBA scoring title x 3



Competitive sport

Etiology of SCD:
Congenital heart disease

Bill Clinton, 66 y.o.
CABG x 4, DES x 2



Recreational sport

Etiology of SCD:
Coronary heart disease

Classification of SCD by age and etiology

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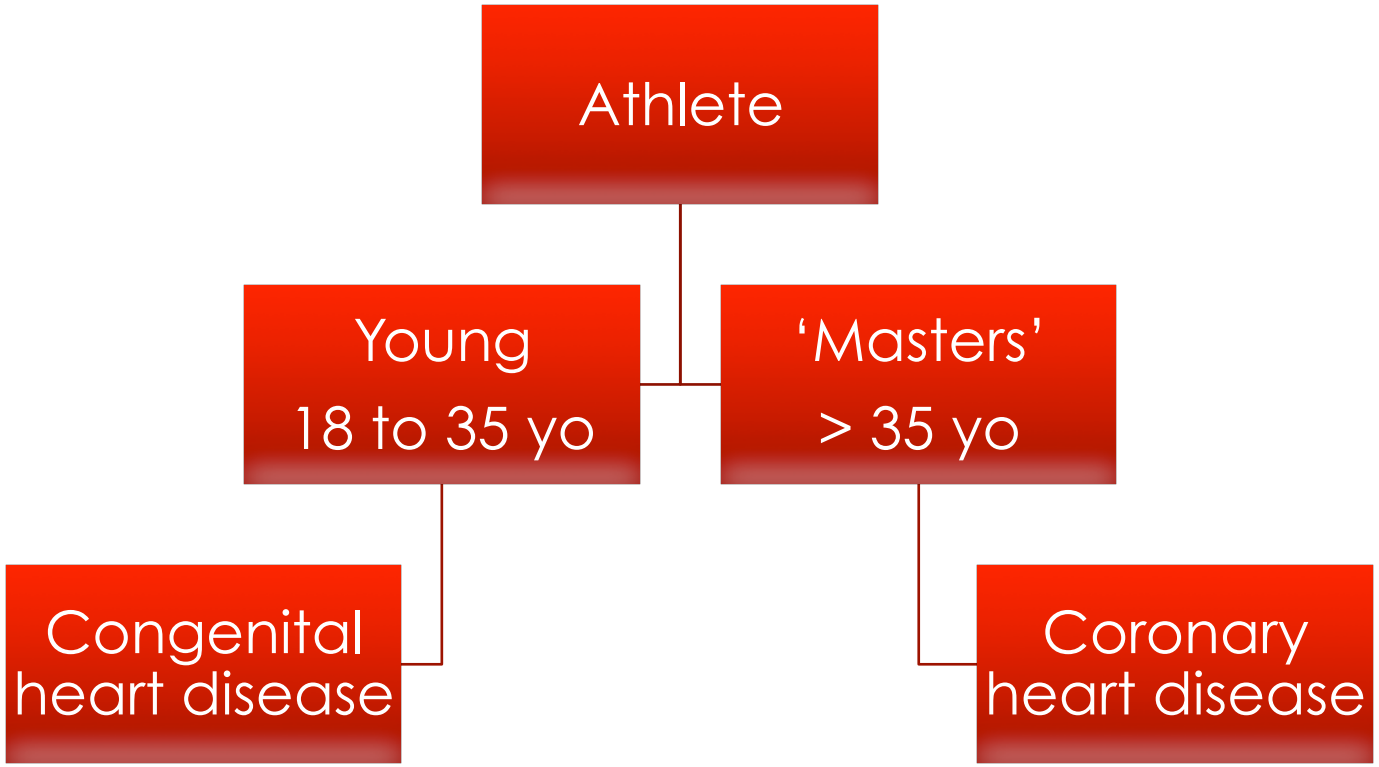
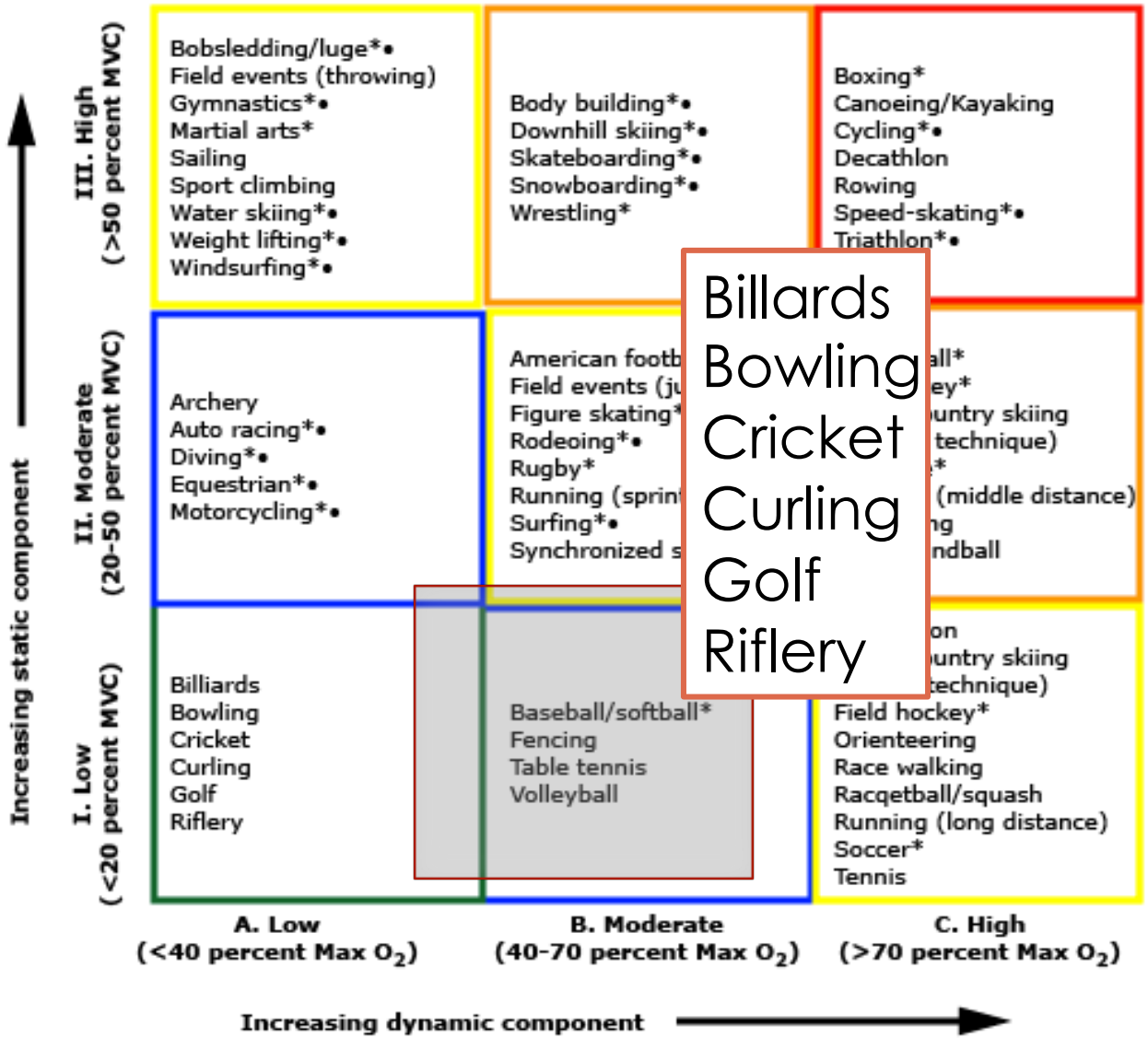


Classification of sports



Billards
Bowling
Cricket
Curling
Golf
Riflery

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J Am Coll Cardiol. 2005;45(8):136

Higher physical fitness associated with decreased all-cause mortality

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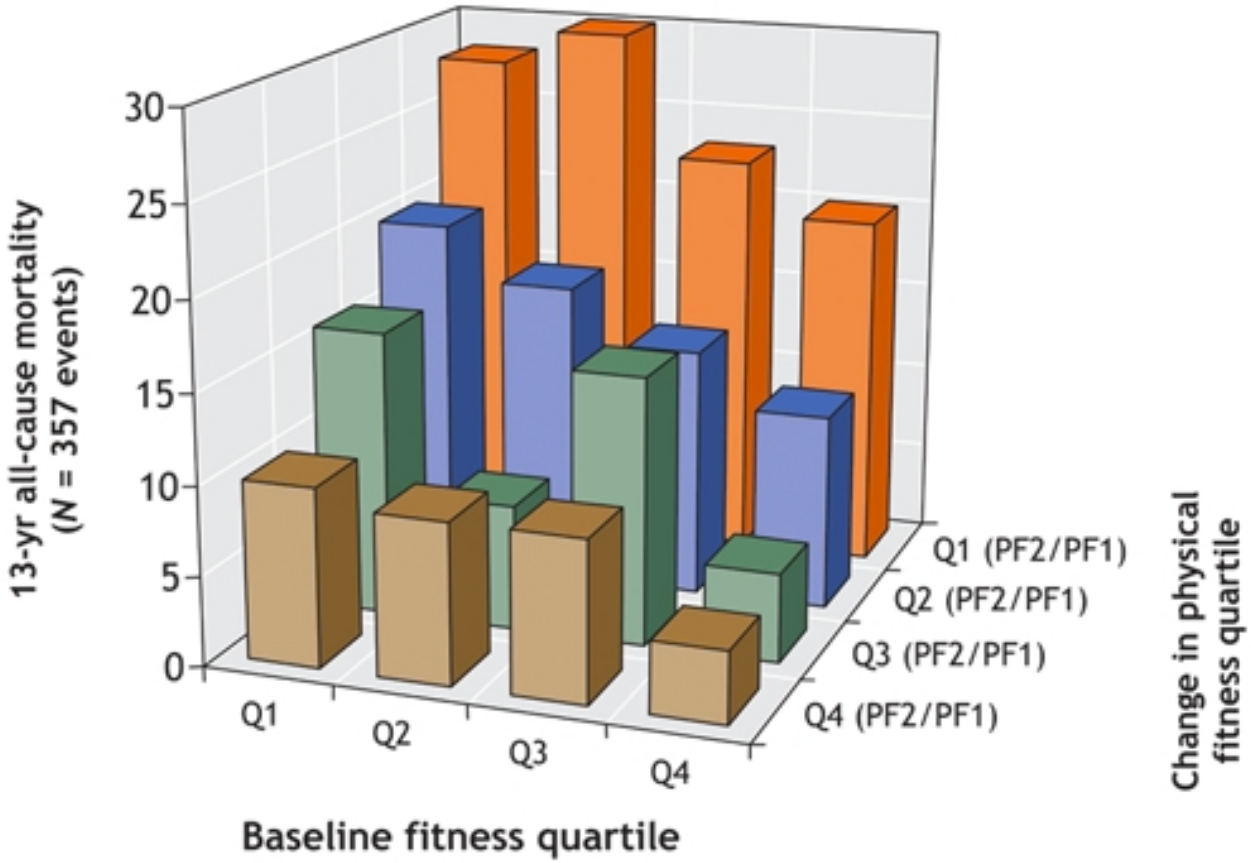

Warburton, CMAJ. 2006 Mar 14;174(6):801-9.

Does exercise increase the risk of SCD in athletes?

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- Small absolute increase in relative risk of SCD during exercise

- In the long-run, physical activity is protective

Etiology of SCD in young athletes

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- Structural
  - Hypertrophic cardiomyopathy
  - Arrhythmogenic right ventricular cardiomyopathy or dysplasia
  - Premature coronary atherosclerosis
  - Congenital anomalies of coronary arteries
- Myocarditis
- Aortic rupture
- Valvular disease
- Pre-excitation syndromes and conduction diseases
- Ion channel diseases
  - Brugada
  - Long QT syndrome
  - Catecholaminergic Polymorphic Ventricular Tachycardia

Etiologies of SCD

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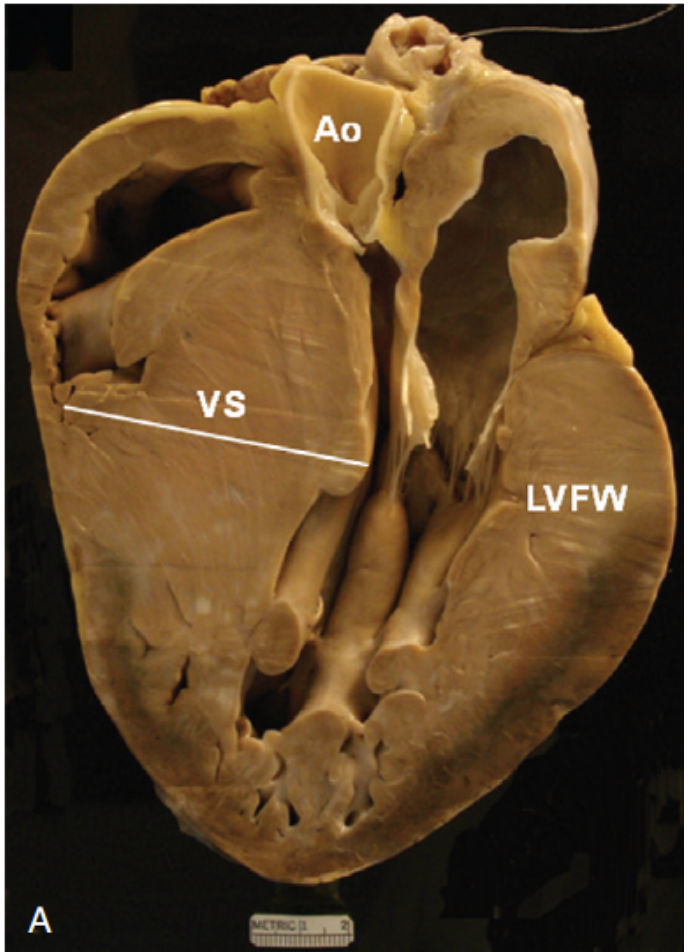
Hypertrophic cardiomyopathy



Arrhythmogenic right ventricular Dysplasia/Cardiomyopathy

Etiology of SCD in young athletes: American experience

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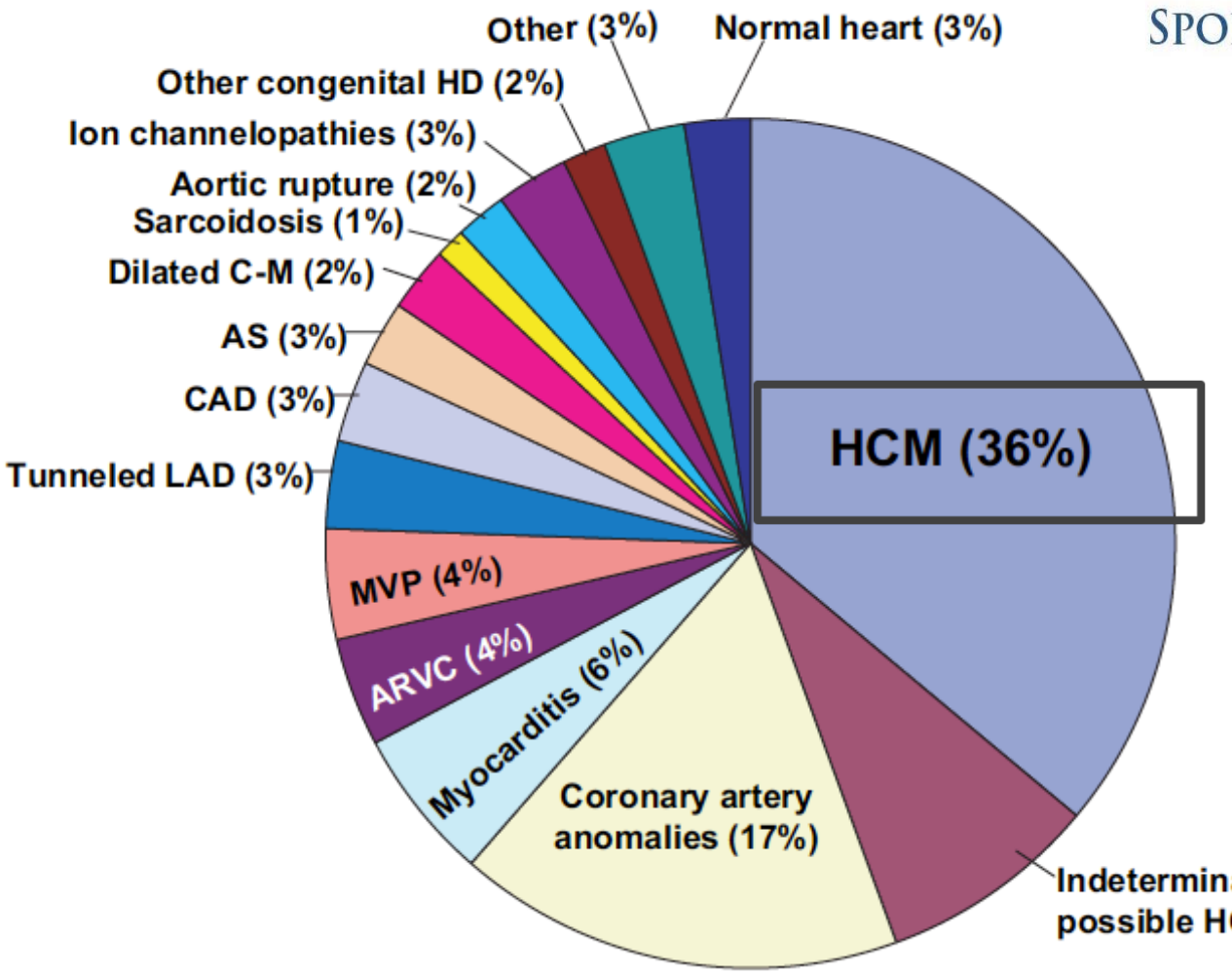

Maron, Circulation. 2007;115(12):1643

Etiology of SCD in young athletes: Italian experience

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Cause	Athletes (N=49)	Nonathletes (N=220)	Total (N=269)
	number (percent)		
Arrhythmogenic right ventricular cardiomyopathy	11 (22.4)	18 (8.2)*	29 (10.8)
Atherosclerotic coronary artery disease	9 (18.4)	36 (16.4)	45 (16.7)
Anomalous origin of coronary artery	6 (12.2)	1 (0.5)†	7 (2.6)
Disease of conduction system	4 (8.2)	20 (9.1)	24 (8.9)
Mitral-valve prolapse	5 (10.2)	21 (9.5)	26 (9.7)
Hypertrophic cardiomyopathy	1 (2.0)	16 (7.3)	17 (6.3)
Myocarditis	3 (6.1)	19 (8.6)	22 (8.2)
Myocardial bridge	2 (4.1)	5 (2.3)	7 (2.6)
Pulmonary thromboembolism	1 (2.0)	3 (1.4)	4 (1.5)
Dissecting aortic aneurysm	1 (2.0)	11 (5.0)	12 (4.5)
Dilated cardiomyopathy	1 (2.0)	9 (4.1)	10 (3.7)
Other	5 (10.2)	61 (27.7)	66 (24.5)

*P=0.008 for the comparison with the athletes.

†P<0.001 for the comparison with the athletes.

NEJM 1998 Aug 6;339(6):364-9.

Differing etiologies of SCD in young American and Italian athletes

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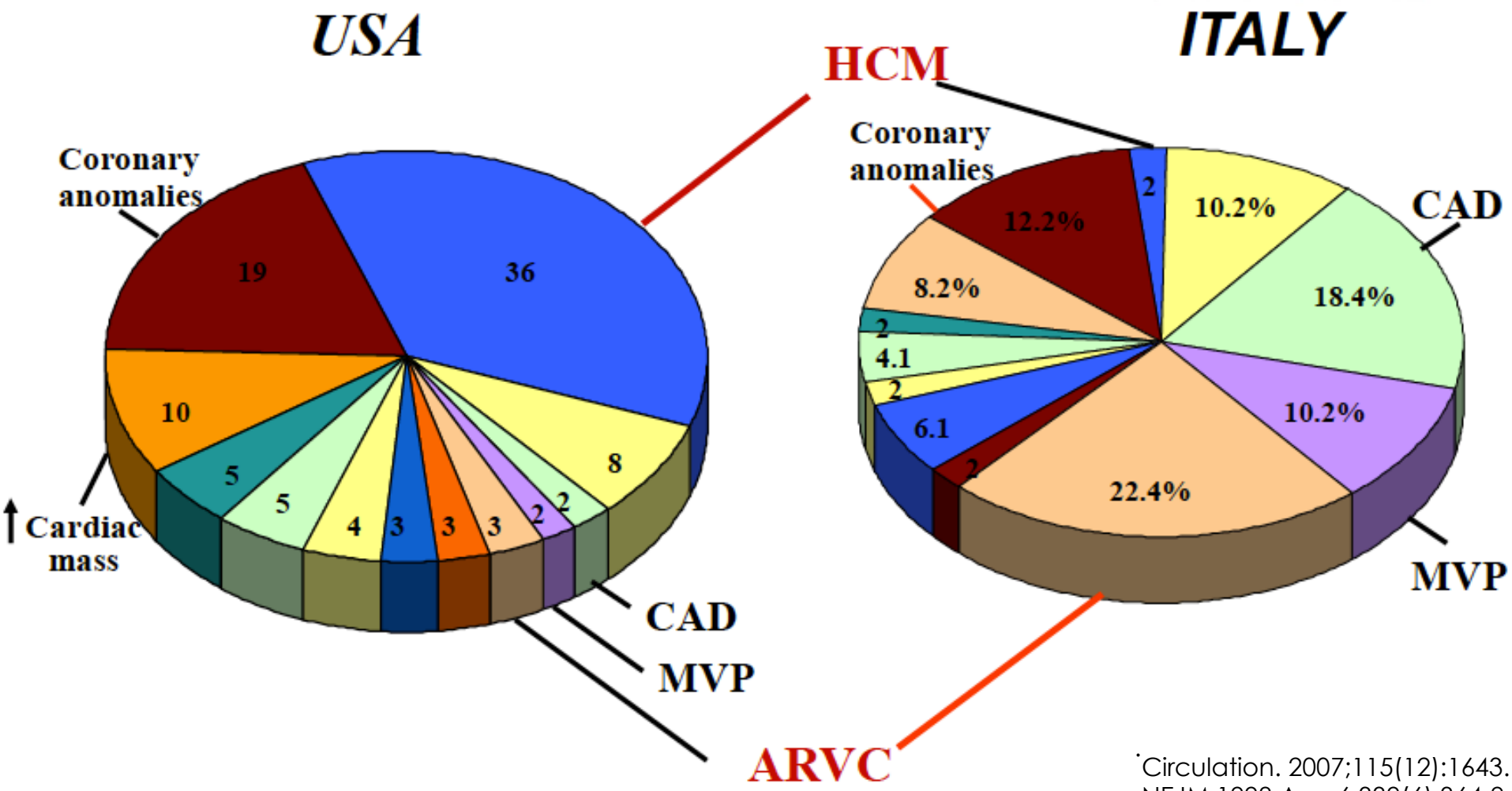

Circulation. 2007;115(12):1643.
NEJM 1998 Aug 6;339(6):364-9

Etiology of SCD in 'Masters' athletes: CAD

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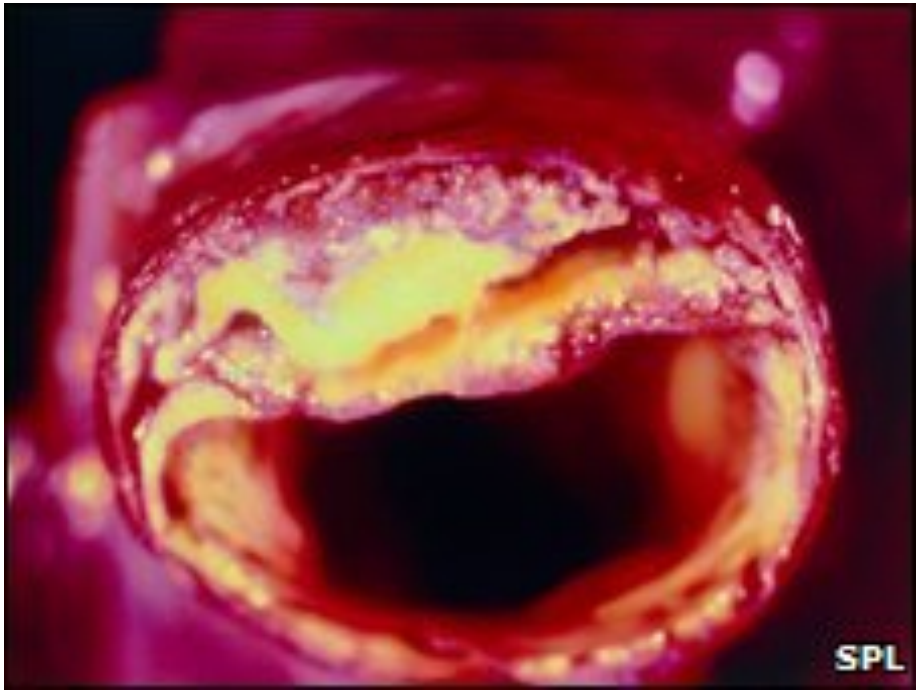

HCM vs. Athlete's Heart

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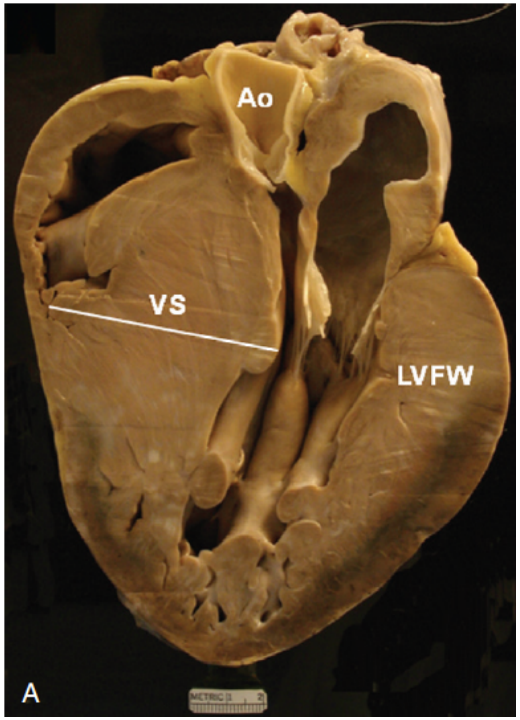

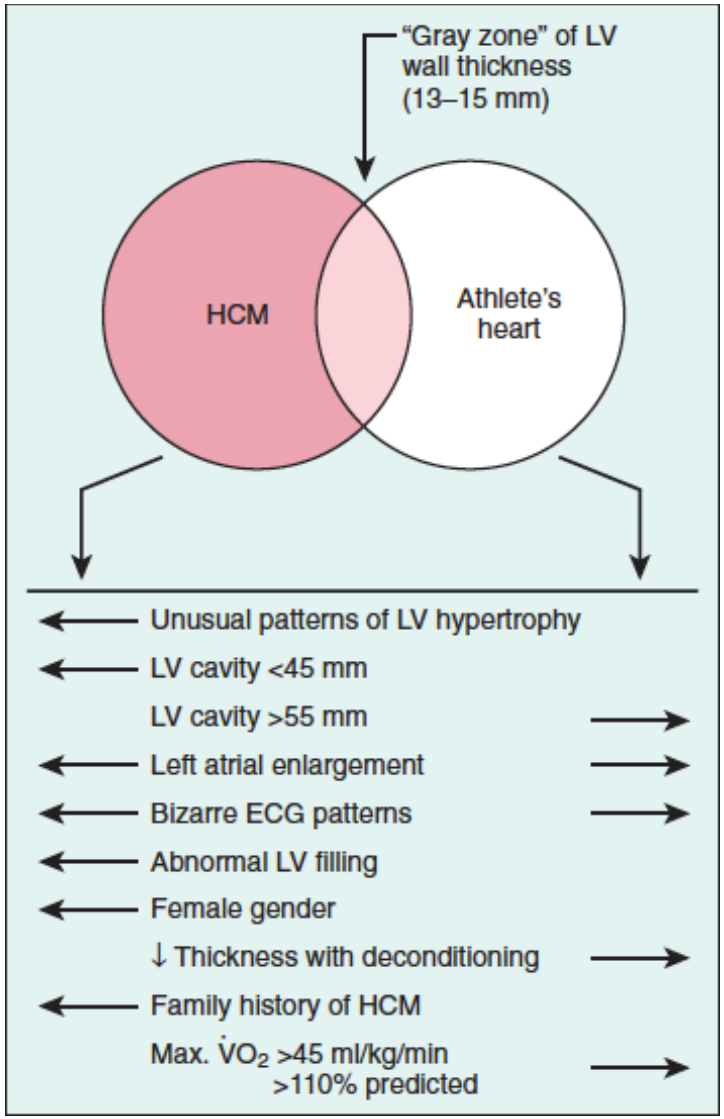

Braunwald, 2012

What restrictions should be placed upon individuals with cardiac disease?

Restriction from competitive sports: What do the experts agree upon?

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- Absolute restriction:
  - HCM
  - ARVC
  - Congenital coronary artery abnormalities (uncorrected)
- Partial restriction:
  - Myocarditis – for initial 6 months following diagnosis
  - MVP – class IA sports if
    - syncope/arrhythmia, family history of MVP/SCD, significant SVT or ventricular ectopy, moderate to severe MR, embolic event
  - LQTS – class IA sports
  - Brugada – class IA sports
  - CPVT – all have ICD, thus to class IA with minimal contact
- ICD: restrict to only recreational sports with no potential trauma allowed


Can we prevent SCD in athletes?

Can we prevent SCD in athletes?

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- Disagreement amongst experts in the field (ACC/AHA and ESC)
- No randomized trials comparing various screening methods
- The strongest data is from Italy, but this has not been reproducible
- Universal screening is likely not cost-effective in Canada
- History and physical examination is insensitive for the detection of cardiac abnormalities; the ECG adds sensitivity
- A significant proportion of SCD in 'Master's' athletes
- Evidence for AEDs

Case for Screening

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- First symptom exhibited by 60% of SCD in young athlete victims in the US is cardiac arrest
- Widespread belief that screening of young should exist - American Heart Association, International Olympic Committee, European Society of Cardiology
- Only Japan, Israel and Italy mandate screening

Two approaches to screening: American vs. Italian

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AHA/ACC

- Cardiovascular screening q 2 to 4 years for high school/ college athletes
- History and physical examination only

ESC/IOC/FIFA

- Systematic preparticipation screening of young competitive athletes
- History and physical examination, plus a 12-lead ECG

Canada……

- Fundamental lack of data in this area
- Screening isn't mandated
- No official recommendation exists
- British Columbia has a very unique and ethnically diverse population
- Must develop a data set before any screening recommendations can be made

Sports Cardiology B.C. Young Athletes Study

- "Prevalence of Cardiac Disease in British Columbia for Young Competitive Athletes - Screening Using ECG, Physical Exam and Personal and Family History Questionnaire"
- Will determine prevalence in a subset of our population
- Will use recommendations of AHA and ESC and compare and contrast efficiencies of screening methods

Future Study – "Masters" Population (>35)

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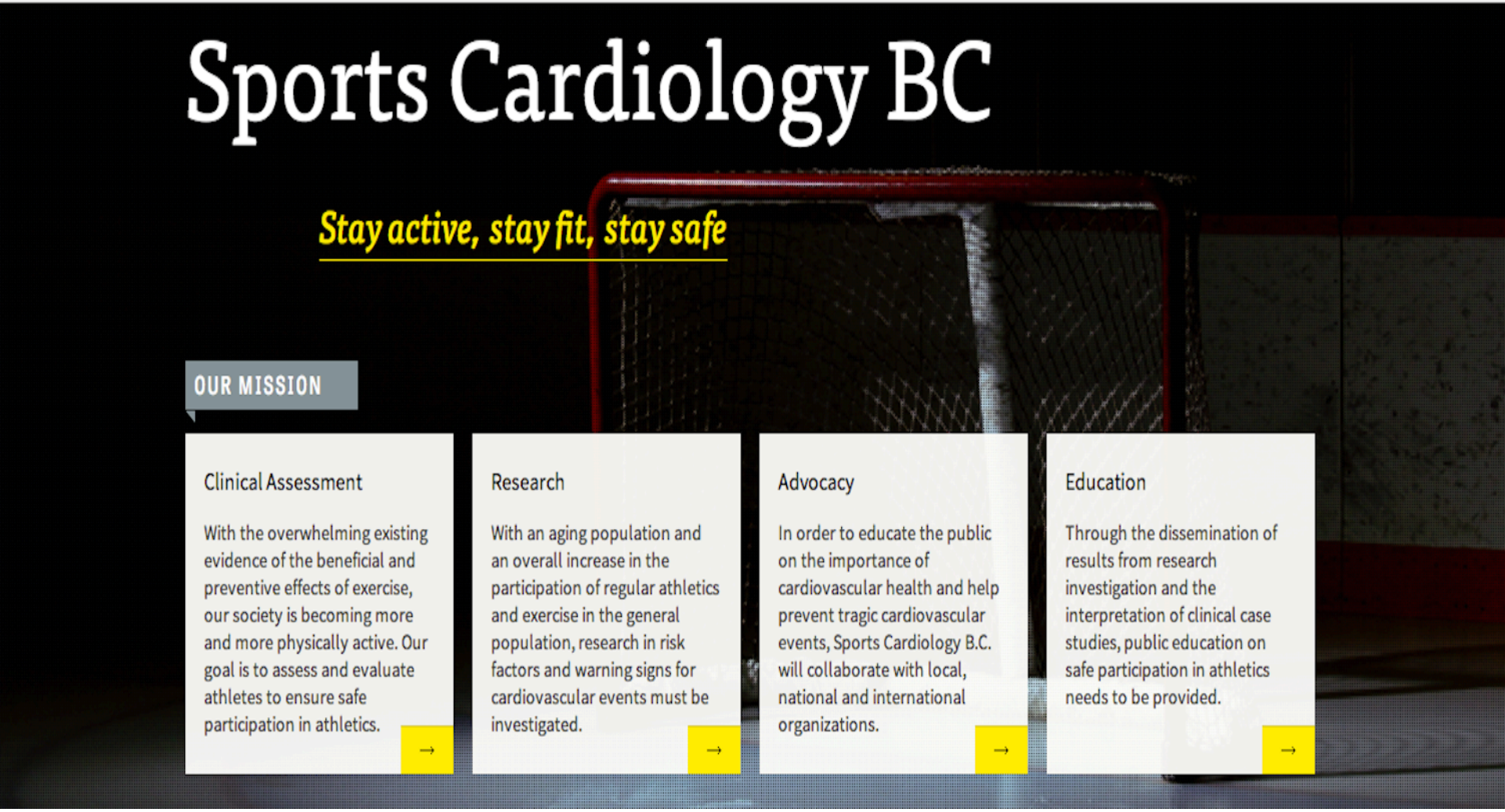
- Similar in nature – will conduct preliminary screening tests on large sample from across B.C.
- Goals are:
  - Determine prevalence of cardiovascular disease that can lead to cardiac events in this population
  - Determine prevalence of risk factors in this population
  - Compare and contrast efficiencies of different screening tests used

Sports Cardiology BC

Stay active, stay fit, stay safe



OUR MISSION

Clinical Assessment

With the overwhelming existing evidence of the beneficial and preventive effects of exercise, our society is becoming more and more physically active. Our goal is to assess and evaluate athletes to ensure safe participation in athletics.

→

Research

With an aging population and an overall increase in the participation of regular athletics and exercise in the general population, research in risk factors and warning signs for cardiovascular events must be investigated.

→

Advocacy

In order to educate the public on the importance of cardiovascular health and help prevent tragic cardiovascular events, Sports Cardiology B.C. will collaborate with local, national and international organizations.

→

Education

Through the dissemination of results from research investigation and the interpretation of clinical case studies, public education on safe participation in athletics needs to be provided.

→

Sports Cardiology B.C.

- Multidisciplinary medical team approach
- Goals of the program are outlined by the 4 pillars:
  - **Research, Clinical Assessment, Education and Advocacy**
- Clinical focus: Risk assessment and guidance in athletes with cardiac abnormalities, with a focus on Master's athletes with CHD
- Resource for medical community to educate and provide local perspective on controversial topics
- Research: Detection, prevention and treatment of cardiovascular disease, registry formation, risk factor and disease prevalence

Team

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- Dr. Saul Isserow
- Dr. Brett Heilbron
- Dr. Andrew Krahn
- Dr. Teresa Tsang
- Dr. Shubhayan Sanatani
- Dr. Jack Taunton
- Dr. Darren Warburton
- Dr. Kam Shojania
- Dr. Jimmy McKinney
- Dr. Anthony Della Siega
- Dr. Rick Leather
- Dr. Kevin Pistawka
- Dr. Mike Wilkinson
- Dr. Janet McKeown
- Dr. Rich Vandegriend
- Dr. Michael Luong
- Dr. Christopher Fordyce
- Mr. Faisal Aziz

VGH UBC hospital foundation
ensuring excellence

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Questions?

www.sportscardiologybc.org