2021 PRIMARY CARE HAWAII CONFERENCE
Caring for the Active and Athletic Patient
August 9-13, 2021
Grand Hyatt Kauai, Kauai, Hawaii

Exertional Illness in Athletes and Warfighters: The Challenge of Prevention

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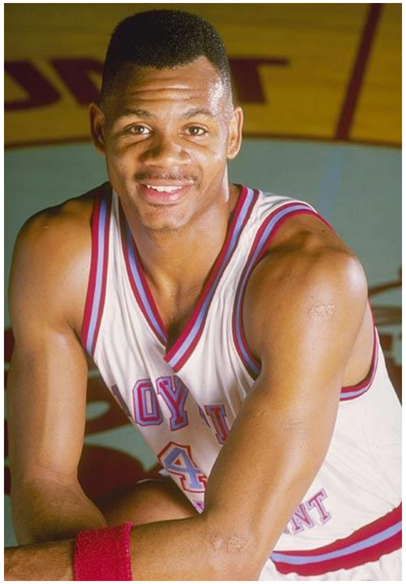
Disclosure Information

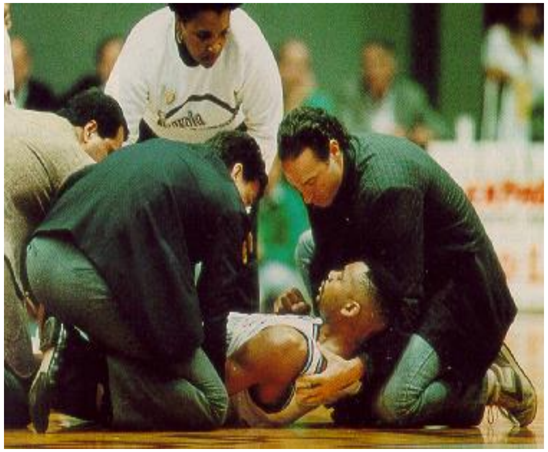
The information presented in this activity represents the opinions of the author and not those of the Department of Defense or the Uniformed Services University

Francis G. O'Connor, MD, MPH, has no financial interests or relationships to disclose.

Objectives

- **Review the principles of sports injury prevention.**
- **Identify common etiologies of collapse in athletes.**
- **Identify and Discuss prevention strategies for:**
  - **Exertional Sudden Cardiac Death**
  - **Exertional Heat Stroke**
  - **Exertional Collapse Associated with Sickle Cell Trait**

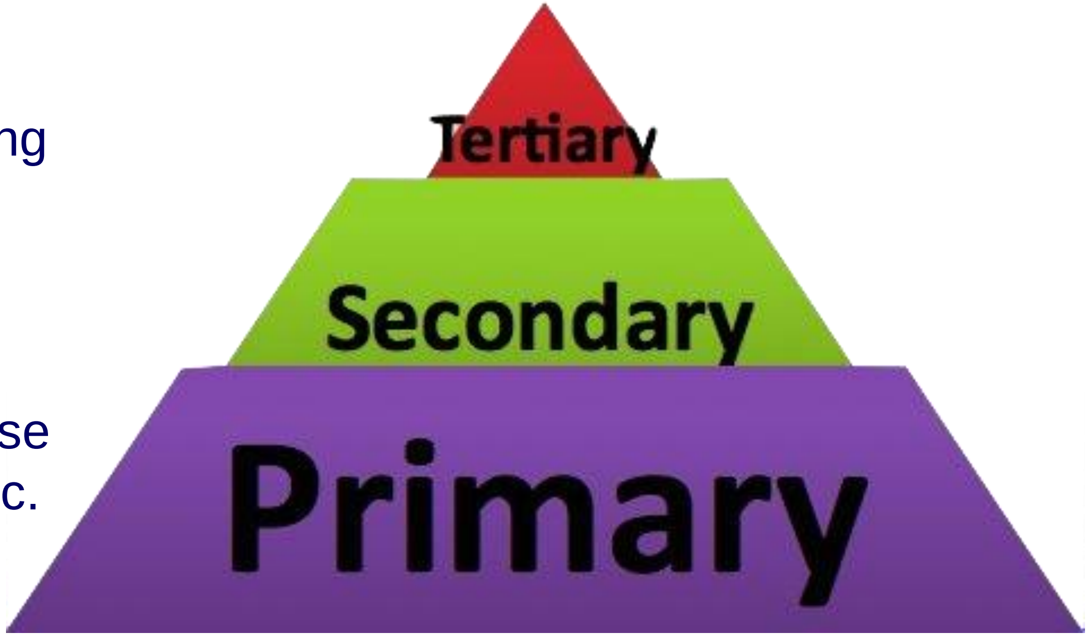




Exertional Injury and Illness: Prevention

Leavell's Prevention Levels

- **Primary**:
  - Keeps disease process from becoming established by eliminating causes or increasing resistance.
- **Secondary**:
  - Interrupts or detects the disease before it becomes symptomatic.
- **Tertiary**:
  - Limits the consequences of symptomatic disease.

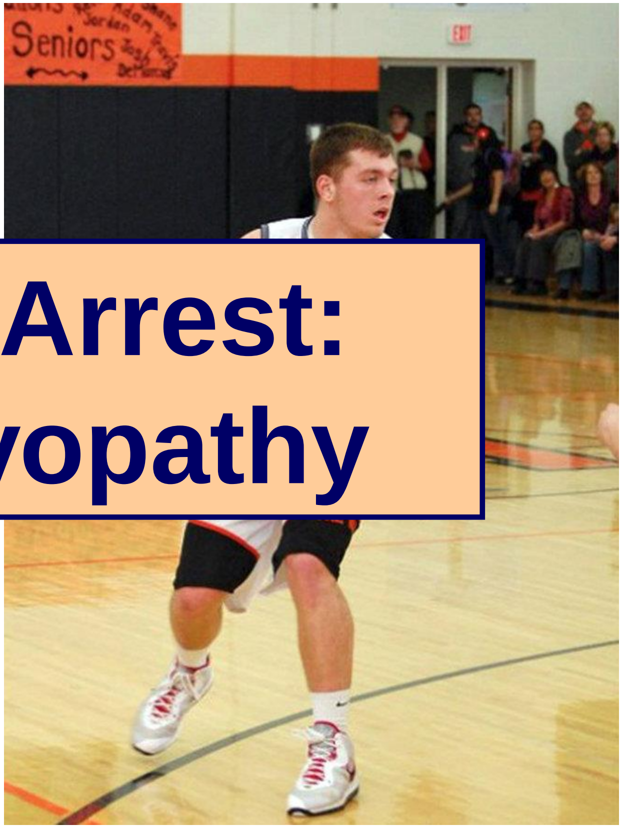


Leavell HR and Clark EG. Preventive Medicine for the Doctor in His Community. New York, NY: McGraw-Hill. 1965.

Wes Leonard – Basketball

- Fennville, Mich., March 3, 2011
- "He made the shot and then the game was over, we had won, every ... Tobi... Fenn... the s...
- "He did the team lineups where they all shake hands, the basketball team held him up, he **started walking, then collapsed**."

Sudden Cardiac Arrest: Dilated Cardiomyopathy



Epidemiology of Sudden Death in Young Athletes

- Sudden cardiac death in athletes is an **uncommon** event.
- Risk in young athletes is approximately 1:50,000 - 100,000/yr.
- Risk ranges from 1:15,000 to 1:50,000/yr In older athletes.

THE NATION'S NEWSPAPER 50 CENTS

USA TODAY

NO. 1 IN THE USA . . . FIRST IN DAILY READERS

WHEN IS AN AVERAGE KID NOT GOOD ENOUGH?

WHEN YOU'RE A BOOMER PARENT WHO BUYS BOOKS LIKE 'TOILET TRAINING IN A DAY'; CHILLING OUT, 1D

MEL BROOKS PUTS THE MERRY MEN IN ★★ 'TIGHTS' 8D

WEDNESDAY

20th Century Fox

TRACEY ULLMAN: Crone Latrine, 8D

Boston star Lewis collapses, dies at 27

By Jack Carey
USA TODAY

Boston Celtics captain Reggie Lewis, 27, who passed out during an NBA playoff game in April, died Tuesday night after collapsing while shooting baskets.

"It's a time of incredible grief," said Celtics executive Dave Gavitt late Tuesday.

After Lewis' April collapse, team doctor Arnold Scheller said he had a life-threatening heart ailment like the one that killed college basketball star Hank Gathers in 1990, and probably would not play again.

"You can die from this," Scheller said he told Lewis, a 1987 first-round draft pick.

But Lewis, against team wishes, sought a second opinion and was told he had a nerve condition that could be controlled.

Lewis arrived at Brandeis University at about 4 p.m. ET Tuesday and was shooting baskets, said Brandeis' Jack Molloy.

Witnesses said Lewis fell to the court about 5 p.m., was limp and shaking, stopped breathing and had no pulse.

Lewis "wasn't doing anything too strenuous," said Amir Weiss, who was at the gym.

Local paramedics said they found Lewis in complete cardiac arrest; he was pronounced dead at 7:30 p.m. ET at Waltham-Weston Hospital.

Celtics' president Red Auerbach, who is recovering from heart bypass surgery, called Lewis "a warm, kind, gentle and generous man."

He is survived by his wife, Donna Harris, and a son, Reggie Jr.

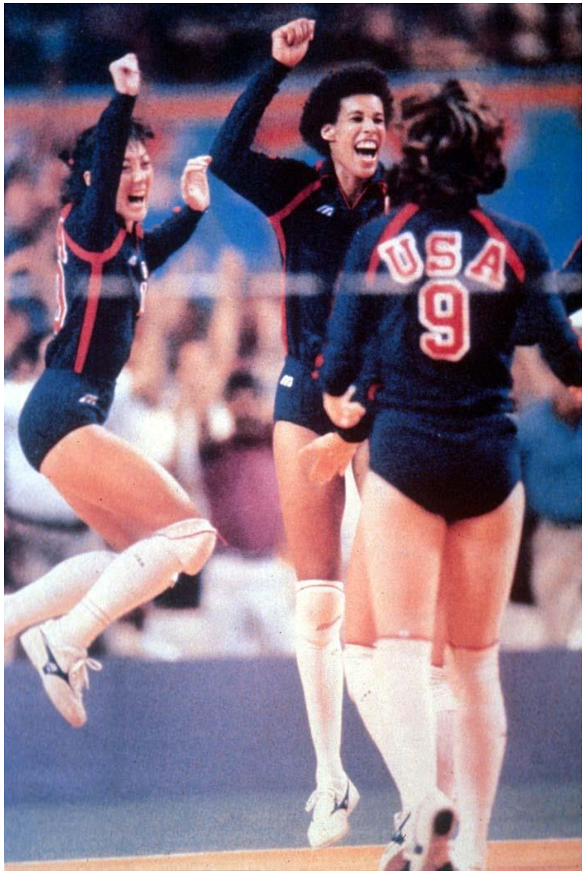
▶ 'Hearts are very heavy,' 1,9C

REGGIE LEWIS USA TODAY

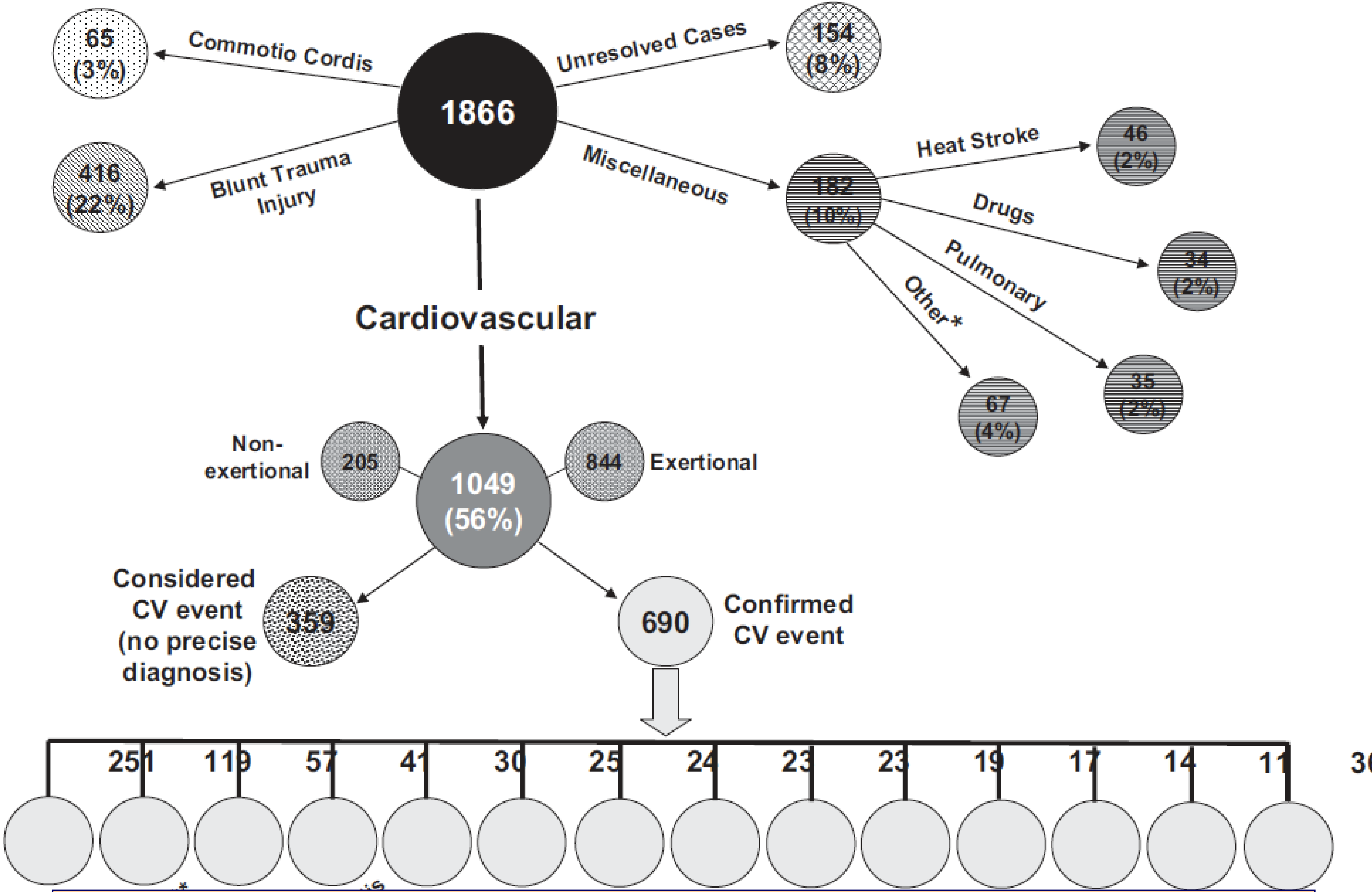
Sudden cardiac arrest is the leading cause of EXERTIONAL death in Young Athletes!

Epidemiology of Exertional Sudden Death

- Estimated death rates in **male athletes are 5X higher than in female** athletes.
- Estimated death rates in **college athletes are 2X higher than in high school** athletes.
- Non-cardiac deaths account for 22% of deaths.
- **Football and basketball** account for the majority of sudden deaths.
- **African Americans** appear to be at greater risk.



VanCamp SP et al: Nontraumatic sports deaths in high school and college athletes. MSSE 1992;24(3):279-80.



Maron BJ, et al: Sudden death in young athletes: Analysis of 1866 deaths in the United States, 1980 -2006. Circulation 2009;119:1085-1092.

Not so Fast!!

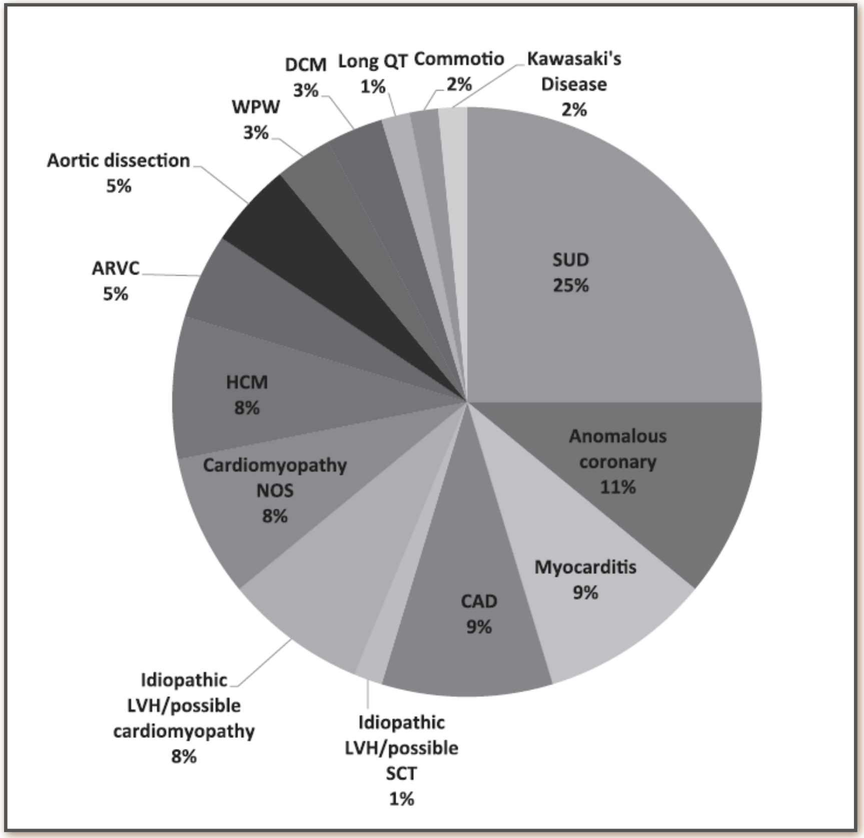
Table 3 Cause-Specific Findings in 902 Cases of Adjudicated Unanticipated Sudden Cardiac Death Stratified by Age <35 Years and ≥35 Years in a Cohort Undergoing Active Surveillance

Findings	<35 Yrs of Age (n = 298)	≥35 Yrs of Age (n = 604)	p Value
Sudden unexplained death	123 (41.3%)	64 (10.6%)	<0.001
Atherosclerotic disease	69 (23.2%)	442 (73.2%)	<0.001
Hypertrophic cardiomyopathy	38 (12.8%)	19 (3.1%)	<0.001
Myocarditis	17 (5.7%)	13 (2.2%)	0.009
Idiopathic dilated cardiomyopathy	14 (4.7%)	21 (3.5%)	0.478
Anomalous coronary artery	12 (4.0%)	1 (0.2%)	<0.001
Hypertensive cardiomyopathy	11 (3.7%)	15 (2.5%)	0.419
Arrhythmogenic RV dysplasia	4 (1.3%)	6 (1.0%)	0.737
Ischemic cardiomyopathy	2 (0.7%)	14 (2.3%)	0.135
Other*	8 (2.7%)	9 (1.5%)	—

Eckart RE et al, Department of Defense Cardiovascular Death Registry Group: Sudden death in young adults: an autopsy-based series of a population undergoing active surveillance. J Am Coll Cardiol. 2011 Sep 13;58(12):1254-61.

Sudden Unexplained Cardiac Death (SUD)

- The incidence of SCD in **Division 1 male basketball athletes was 1:5200 AY.**
- The most common findings at autopsy were a**utopsy-negative sudden unexplained death** in 16 (25%), and definitive evidence for hypertrophic cardiomyopathy was seen in 5 (8%).



Harmon KG et al: Incidence, Cause, and Comparative Frequency of Sudden Cardiac Death in National Collegiate Athletic Association Athletes: A Decade in Review. Circulation. 2015 Jul 7;132(1):10-9.

Primary Prevention

- **Universal Precautions**
  - Exercise Acclimatization
  - Environmental Acclimatization
  - Hydration/Workload Adjustments
- **Certified Athletic Trainer**
- **Certified Strength and Conditioning Coach**

Work/Rest and Water Consumption Table

Applies to average sized, heat-acclimated soldier wearing BDU, hot weather. (See TB MED 507 for further guidance.)

Easy Work	Moderate Work	Hard Work
• Weapon Maintenance • Walking Hard Surface at 2.5 mph, < 30 lb Load • Marksmanship Training • Drill and Ceremony • Manual of Arms	• Walking Loose Sand at 2.5 mph, No Load • Walking Hard Surface at 3.5 mph, < 40 lb Load • Calisthenics • Patrolling • Individual Movement Techniques, i.e., Low Crawl or High Crawl • Defensive Position Construction	• Walking Hard Surface at 3.5 mph, ≥ 40 lb Load • Walking Loose Sand at 2.5 mph with Load • Field Assaults

Heat Category	WBGT Index, F°	Easy Work		Moderate Work		Hard Work	
		Work/Rest (min)	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*
1	78° - 81.9°	NL	½	NL	¾	40/20 min	¾
2 (GREEN)	82° - 84.9°	NL	½	50/10 min	¾	30/30 min	1
3 (YELLOW)	85° - 87.9°	NL	¾	40/20 min	¾	30/30 min	1
4 (RED)	88° - 89.9°	NL	¾	30/30 min	¾	20/40 min	1
5 (BLACK)	> 90°	50/10 min	1	20/40 min	1	10/50 min	1

- The work/rest times and fluid replacement volumes will sustain performance and hydration for at least 4 hrs of work in the specified heat category. Fluid needs can vary based on individual differences (± ¼ qt/hr) and exposure to full sun or full shade (± ¼ qt/hr).
- **NL** = no limit to work time per hr.
- **Rest** = minimal physical activity (sitting or standing) accomplished in shade if possible.
- ***CAUTION: Hourly fluid intake should not exceed 1½ qts.***

  Daily fluid intake should not exceed 12 qts.
- If wearing body armor, add **5°F** to WBGT index in humid climates.
- If doing Easy Work and wearing NBC (MOPP 4) clothing, add **10°F** to WBGT index.
- If doing Moderate or Hard Work and wearing NBC (MOPP 4) clothing, add **20°F** to WBGT index.

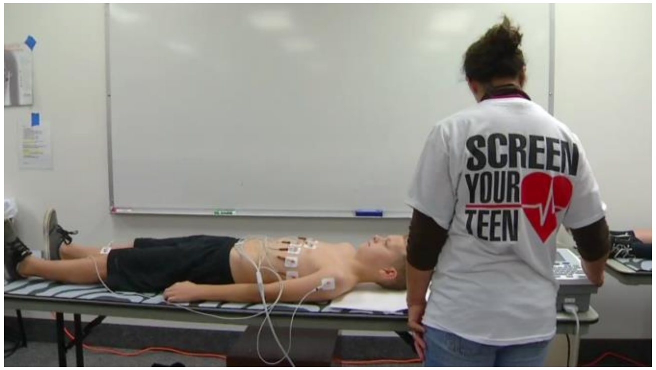
For additional copies, contact: U.S. Army Center for Health Promotion and Preventive Medicine Health Information Operations Division at (800) 222-9698 or CHPPM - Health Information Operations@apg.amedd.army. mil.
For electronic versions, see http://chppm-www.apgea.army.mil/heat. Local reproduction is authorized.
June 2004

CP-033-0404

Casa et al: The inter-association task force for preventing sudden death in secondary school athletics programs: best-practices recommendations. Journal Athletic Training 2013 Jul-Aug;48(4):546-53.

Secondary Prevention

- **The Preparticipation Examination**
- Consideration for Secondary Screening
  - Electrocardiography
  - Echocardiography
  - Consultation



14 Point History and Physical Examination

Table 1. The 14-Element AHA Recommendations for Preparticipation Cardiovascular Screening of Competitive Athletes

Medical history*

Personal history

1. Chest pain/discomfort/tightness/pressure related to exertion
2. Unexplained syncope/near-syncope†
3. Excessive and unexplained dyspnea/fatigue or palpitations, associated with exercise
4. Prior recognition of a heart murmur
5. Elevated systemic blood pressure
6. Prior restriction from participation in sports
7. Prior testing for the heart, ordered by a physician

Family history

8. Premature death (sudden and unexpected, or otherwise) before 50 y of age attributable to heart disease in ≥1 relative
9. Disability from heart disease in close relative <50 y 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 conditions in family members

Physical examination

11. Heart murmur‡
12. Femoral pulses to exclude aortic coarctation
13. Physical stigmata of Marfan syndrome
14. Brachial artery blood pressure (sitting position)§

AHA/ACC Scientific Statement

Assessment of the 12-Lead ECG as a Screening Test

"... there is INSUFFICIENT information...
to support the view that universal screening ECGs in asymptomatic young people ... is appropriate or possible on a national basis for the United States, in competitive athletes or in the general youthful population..."

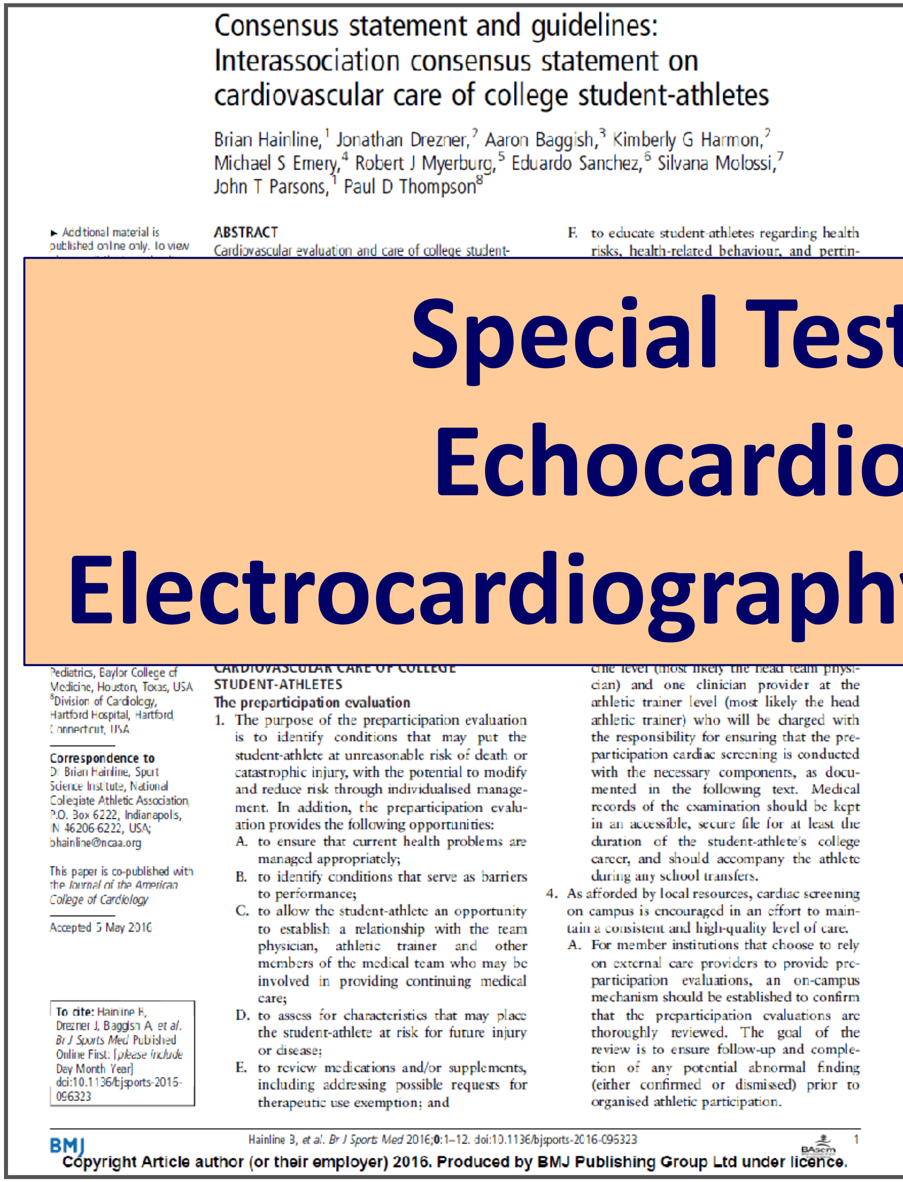
Paul Kligfield, MD, FAHA; Benjamin D. Levine, MD; Sami Viskin, MD;

However
"...individual quality controlled local, community, or student-related initiatives were, however, supported by the AHA if conducted properly and with adequate resources..."

Council on Epidemiology and Prevention, Council on Functional Genomics and Translational Biology, Council on Quality of Care and Outcomes Research, and American College of Cardiology

Maron BJ et al: Circulation.2014 Oct 7;130(15):1303-34

NCAA Guidance 2016


Consensus statement and guidelines:
Interassociation consensus statement on cardiovascular care of college student-athletes

Brian Hainline,[1] Jonathan Drezner,[2] Aaron Baggish,[3] Kimberly G Harmon,[2] Michael S Emery,[4] Robert J Myerburg,[5] Eduardo Sanchez,[6] Silvana Molossi,[7] John T Parsons,[1] Paul D Thompson[8]

► Additional material is published online only. To view

ABSTRACT
Cardiovascular evaluation and care of college student-

F. to educate student-athletes regarding health risks, health-related behaviour, and pertin-

Pediatrics, Baylor College of Medicine, Houston, Texas, USA
[8]Division of Cardiology, Hartford Hospital, Hartford, Connecticut, USA

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This paper is co-published with the *Journal of the American College of Cardiology*

Accepted 5 May 2016

To cite: Hainline B, Drezner J, Baggish A, *et al*. *Br J Sports Med* Published Online First: [*please include* Day Month Year] doi:10.1136/bjsports-2015-096323

CARDIOVASCULAR CARE OF COLLEGE STUDENT-ATHLETES

The preparticipation evaluation

1. The purpose of the preparticipation evaluation is to identify conditions that may put the student-athlete at unreasonable risk of death or catastrophic injury, with the potential to modify and reduce risk through individualised management. In addition, the preparticipation evaluation provides the following opportunities:
   A. to ensure that current health problems are managed appropriately;
   B. to identify conditions that serve as barriers to performance;
   C. to allow the student-athlete an opportunity to establish a relationship with the team physician, athletic trainer and other members of the medical team who may be involved in providing continuing medical care;
   D. to assess for characteristics that may place the student-athlete at risk for future injury or disease;
   E. to review medications and/or supplements, including addressing possible requests for therapeutic use exemption; and

the level (most likely the head team physician) and one clinician provider at the athletic trainer level (most likely the head athletic trainer) who will be charged with the responsibility for ensuring that the preparticipation cardiac screening is conducted with the necessary components, as documented in the following text. Medical records of the examination should be kept in an accessible, secure file for at least the duration of the student-athlete's college career, and should accompany the athlete during any school transfers.

4. As afforded by local resources, cardiac screening on campus is encouraged in an effort to maintain a consistent and high-quality level of care.
   A. For member institutions that choose to rely on external care providers to provide preparticipation evaluations, an on-campus mechanism should be established to confirm that the preparticipation evaluations are thoroughly reviewed. The goal of the review is to ensure follow-up and completion of any potential abnormal finding (either confirmed or dismissed) prior to organised athletic participation.

BMJ Hainline B, *et al*. *Br J Sports Med* 2016;**0**:1–12. doi:10.1136/bjsports-2016-096323 1

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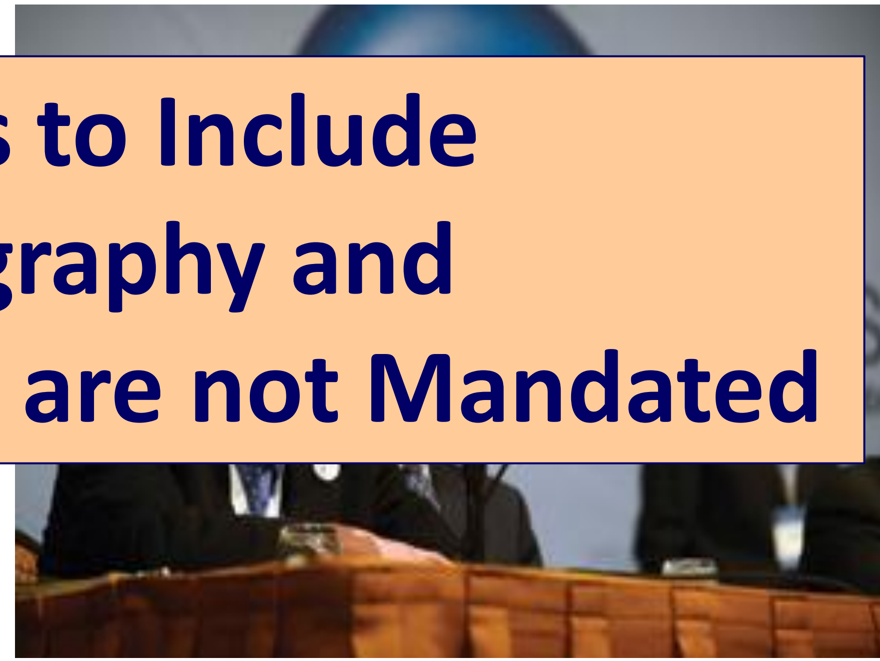

Special Tests to Include Echocardiography and Electrocardiography are not Mandated

Not all Athletes Carry the Same Risk!

AMSSM Position Statement on Cardiovascular Preparticipation Screening in Athletes: current evidence, knowledge gaps, recommendations and future directions

Jonathan A Drezner,[1] Francis G O'Connor,[2] Kimberly G Harmon,[1] Karl B Fields,[3] Chad A Asplund,[4] Irfan M Asif,[5] David E Price,[6] Robert J Dimeff,[7] David T Bernhardt,[8] William O Roberts[9]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2016-096781).

For numbered affiliations see end of article.

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JAD and FGO cochairs.

Accepted 30 August 2016

To cite: Drezner JA, O'Connor FG, Harmon KG, *et al. Br J Sports Med* Published Online First: [please include Day Month Year] doi:10.1136/bjsports-2016-096781

ABSTRACT
Cardiovascular screening in young athletes is widely recommended and routinely performed prior to participation in competitive sports. While there is general agreement that early detection of cardiac conditions at risk for sudden cardiac arrest and death (SCA/D) is an important objective, the optimal strategy for cardiovascular screening in athletes remains an issue of considerable debate. At the centre of the controversy is the addition of a resting ECG to the standard preparticipation evaluation using history and physical examination. The American Medical Society for Sports Medicine (AMSSM) formed a task force to address the current evidence and knowledge gaps regarding preparticipation cardiovascular screening in athletes from the perspective of a primary care sports medicine physician. The absence of definitive outcome-based evidence at this time precludes AMSSM from endorsing any single or universal cardiovascular screening strategy for all athletes, including legislative mandates. This statement presents a new paradigm to assist the individual physician in assessing the most appropriate cardiovascular screening strategy unique to their athlete population, community needs and resources. The decision to implement a cardiovascular screening programme, with or without the addition of ECG, necessitates careful consideration of the risk of SCA/D in the targeted population and the availability of cardiology resources and infrastructure. Importantly, it is the individual physician's assessment in the context of an emerging evidence base that the chosen model for early detection of cardiac disorders in the specific population provides greater benefit than harm. AMSSM is committed to advancing evidenced-based research and educational initiatives that will validate and promote the most efficacious strategies to foster safe sport participation and reduce SCA/D in athletes.

BACKGROUND
Cardiovascular screening in competitive athletes is recommended by most major medical organisations and sports governing bodies;[1–6] however, agreement on the most appropriate screening protocol remains a topic of considerable controversy. Within the primary care sports medicine and sports cardiology communities, this topic has created a highly charged debate specifically regarding the addition of a resting 12-lead ECG to the preparticipation history and physical examination. This polarised environment has limited a productive discussion of the current evidence, the identification of knowledge gaps and the development of research and educational priorities to improve the cardiovascular care of athletes.

AMSSM charge
The AMSSM Board of Directors appointed a task force to address the issues surrounding the cardiovascular screening of young competitive athletes (age 12–35) in the USA. The objective of the task force was to examine the current evidence and knowledge gaps relevant to cardiovascular screening in athletes and provide a framework for the AMSSM membership to assess screening recommendations and future research directions. This statement is unique in providing an assessment of cardiovascular screening from the perspective of a primary care sports medicine physician. While it may assist other healthcare professionals with cardiovascular screening in athletes, conclusions may not necessarily apply to physicians from other disciplines.

Writing group selection and process
The AMSSM President appointed cochairs (JAD and FGO) to assemble a task force to address the topic of cardiovascular preparticipation screening. The task force was carefully selected to include a balanced panel of primary care sports medicine physicians with demonstrated leadership and expertise in athlete cardiovascular screening to represent the different perspectives of cardiovascular preparticipation screening. This panel focused specifically on issues relevant to the potential addition of ECG to the preparticipation physical evaluation (PPE) and did not address the utility of other potential screening modalities, such as echocardiography.

A survey of the task force members was used to identify key discussion areas and generate an initial outline. The panel subsequently engaged in a series of conference calls, literature review and written communications to discuss and analyse specific areas relevant to cardiovascular screening in athletes, followed by an inperson meeting in Atlanta, Georgia, USA, on 21–22 February 2016. An Executive Summary from this panel is presented in box 1.

- The **differential risk** of SCA/D between **athletes and non-athletes is not fully understood** based on current epidemiologic evidence.
- **Athletes display a differential risk** for SCA/D based on age, sex, race, and sport.

The Sad Reality: Screening is a Challenge

- **METHODS:** From 1996 through 2016, **11,168 adolescent** athletes with a mean (±SD) age of 16.4±1.2 years (95% of whom were male) in the English Football cardiac screening program; health questionnaire, physical examination, electrocardiography, and echocardiography.
- **RESULTS:**
  - During screening, **42 athletes (0.38%) were found to have cardiac disorders** that are associated with sudden cardiac death.
  - After screening, there were **23 deaths** from any cause, of which **8 (35%) were sudden deaths attributed to cardiac disease. Cardiomyopathy accounted for 7 of 8** sudden cardiac deaths (88%).
  - **Six athletes (75%) with sudden cardiac death had had normal cardiac screening results.**
  - The mean time between screening and sudden cardiac death was 6.8 years.
  - On the basis of a total of 118,351 person-years, the incidence of sudden cardiac death among previously screened adolescent soccer players was 1 per 14,794 person-years (**6.8 per 100,000 athletes)**.

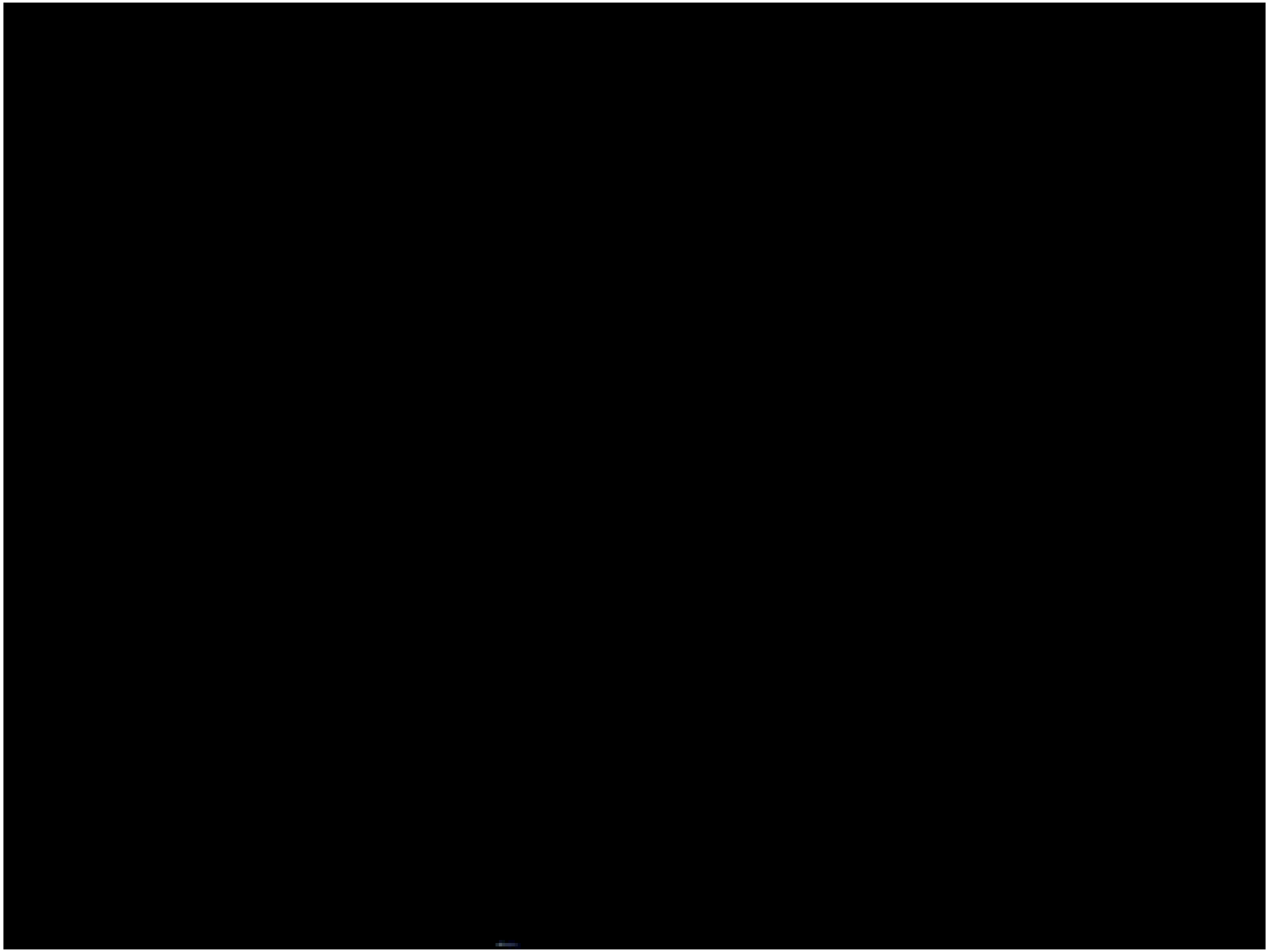
Malhotra A, Dhutia H, et al: Outcomes of Cardiac Screening in Adolescent Soccer Players. N Engl J Med. 2018 Aug 9;379(6):524-534.

Tertiary Prevention

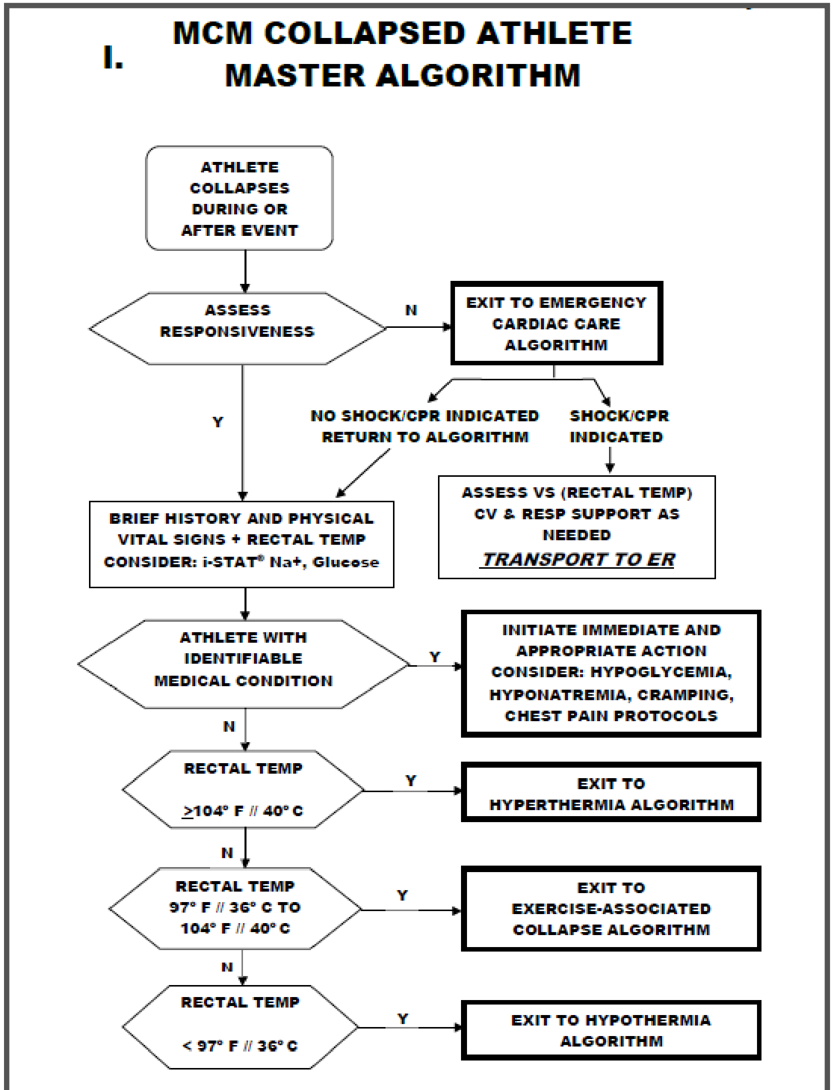
- Bystander CPR
- Access to Automated Defibrillators
- Execution of the Emergency Action Plan

Drezner JA, Rao AL, Heistand J, Bloomingdale MK, Harmon KG: Effectiveness of emergency response planning for sudden cardiac arrest in United States high schools with automated external defibrillators. Circulation. 2009 Aug 11;120(6):518-25.

Sudden Cardiac Arrest



Having a Plan that has been Practiced!

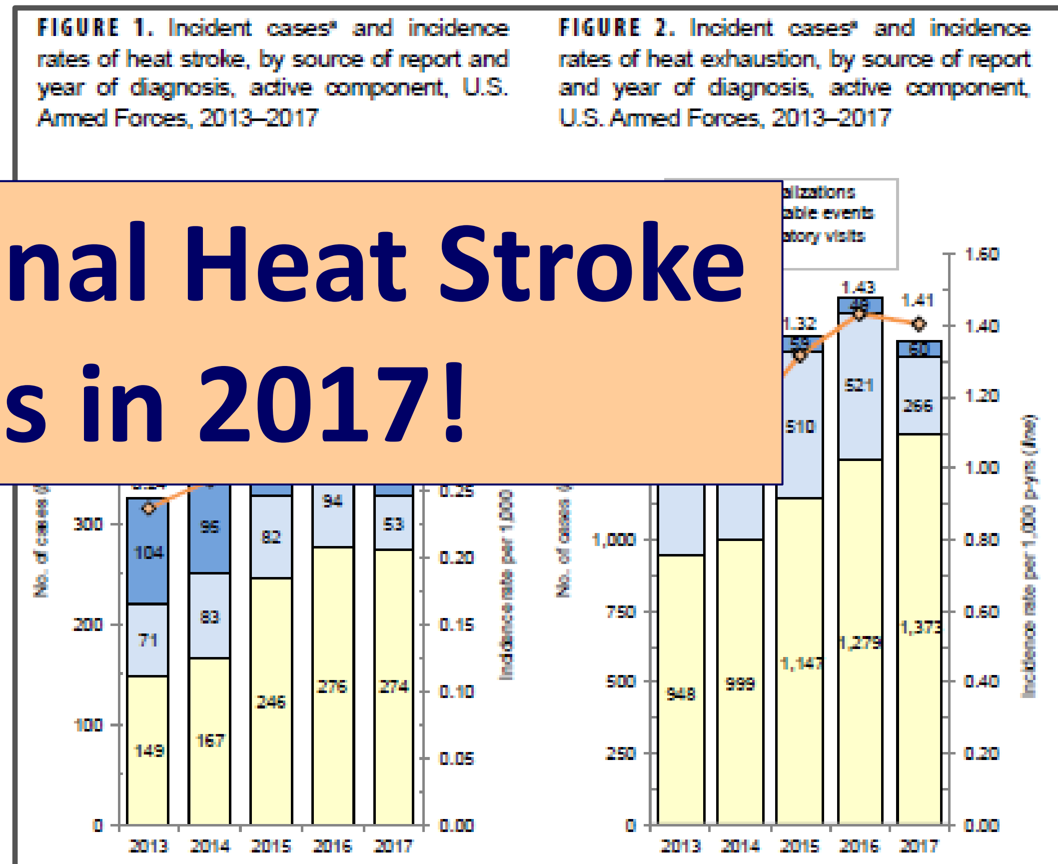


Korey Stringer – Football

- 1 August 2001, Mankato, MN
- Stringer and the Vikings practiced Tuesday in full gear on the hottest day o
The h
degrees
- Stringer vomited three times in practice and walked to an air-conditioned shelter. There he complained of dizziness and **became weak and began breathing heavily**.

Exertional Heat Stroke

Heat Stroke is Common in the Military!



464 Exertional Heat Stroke Events in 2017!

Exertional Heat Stroke in Football Players

- Since 1995, **54 reported football player fatalities** from exertional heat stroke (42 high school, 9 college, 2 professional, 1 sandlot).

Exertional Heat Stroke is Arguably the Most Common Cause of Preventable Non-traumatic Exertional Sudden Death in American Sports

- **The EHI rate in football (4.42 per 100,000 AEs) was 11.4 times that in all other sports combined.**

Kerr ZY, Casa DJ, Marshall SW, Comstock RD: Epidemiology of exertional heat illness among U.S. high school athletes. Am J Prev Med. 2013 Jan;44(1):8-14.

Why do Individuals Die from Heat Stroke?

- These **two items** were present in 100% of fatal cases:
  - 1) Physical effort unmatched to physical fitness
  - 2) **Absence of proper medical triage**

Rav Acha M: Fatal Exertional Heat Stroke: A Case Series, American Journal of Medical Sciences, 2004;328(2):84-87.

Risk Factors

- Age
- **Poor physical fitness**
- **Lack of acclimatization**
- **Obesity**
- Prolonged exertion
- Lack of sleep
- **Illness**
- Skin disease
- History of heat injury
- **Drug use e.g. ephedra**
- Use of **heavy equipment or clothing**

Gardner JW, Kark JA, Karnei K, Sanborn JS, et al. Risk factors predicting exertional heat illness in male Marine Corps recruits. Med Sci Sports Exerc. 1996; 28:939-944.

Obesity

- **Obese and overweight men were 3.2 times more likely ($p<0.01$) to sustain any heat illness than non-obese men during the first 90 days of service.**

Bedno SA et al: Exertional heat illness among overweight U.S. Army recruits in basic training. Aviat Space Environ Med. 2010 Feb;81(2):107-11.

Medications that Inhibit Thermoregulation

- Anticholinergics
- Antihistamines
- Tricyclics
- STIMULANTS
- Diuretics
- Antipsychotics
- ACE inhibitors,
- B-blockers
- Supplements

Primary Prevention

- Air Conditioning
- **Acclimatization**
- **Hydration/Exertion Tables**
- Modification of uniform/ training sites
  - Remove headgear when not on field
- Increase spacing and positioning resting athletes in shade whenever possible
  - Consider tentage next to training areas
- **Pre/Intra-Cooling**

Work/Rest and Water Consumption Table

Applies to average sized, heat-acclimated soldier wearing BDU, hot weather. (See TB MED 507 for further guidance.)

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- ***CAUTION: Hourly fluid intake should not exceed 1½ qts.***

  Daily fluid intake should not exceed 12 qts.
- If wearing body armor, add **5°F** to WBGT index in humid climates.
- If doing Easy Work and wearing NBC (MOPP 4) clothing, add **10°F** to WBGT index.
- If doing Moderate or Hard Work and wearing NBC (MOPP 4) clothing, add **20°F** to WBGT index.

For additional copies, contact: U.S. Army Center for Health Promotion and Preventive Medicine Health Information Operations Division at (800) 222-9698 or CHPPM - Health Information Operations@apg.amedd.army. mil.
For electronic versions, see http://chppm-www.apgea.army.mil/heat. Local reproduction is authorized.
June 2004

CP-033-0404

Work/Rest and Water Consumption Table

Applies to average sized, heat-acclimated soldier wearing BDU, hot weather. (See TB MED 507 for further guidance.)

Easy Work	Moderate Work	Hard Work
• Weapon Maintenance • Walking Hard Surface at 2.5 mph, < 30 lb Load • Marksmanship Training • Drill and Ceremony • Manual of Arms	• Walking Loose Sand at 2.5 mph, No Load • Walking Hard Surface at 3.5 mph, < 40 lb Load • Calisthenics • Patrolling • Individual Movement Techniques, i.e., Low Crawl or High Crawl • Defensive Position Construction	• Walking Hard Surface at 3.5 mph, ≥ 40 lb Load • Walking Loose Sand at 2.5 mph with Load • Field Assaults

Heat Category	WBGT Index, F°	Easy Work		Moderate Work		Hard Work	
		Work/Rest (min)	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*
1	78° - 81.9°	NL	½	NL	¾	40/20 min	¾
2 (GREEN)	82° - 84.9°	NL	½	50/10 min	¾	30/30 min	1
3 (YELLOW)	85° - 87.9°	NL	¾	40/20 min	¾	30/30 min	1
4 (RED)	88° - 89.9°	NL	¾	30/30 min	¾	20/40 min	1
5 (BLACK)	> 90°	50/10 min	1	20/40 min	1	10/50 min	1

- The work/rest times and fluid replacement volumes will sustain performance and hydration for at least 4 hrs of work in the specified heat category. Fluid needs can vary based on individual differences (± ¼ qt/hr) and exposure to full sun or full shade (± ¼ qt/hr).
- **NL** = no limit to work time per hr.
- **Rest** = minimal physical activity (sitting or standing) accomplished in shade if possible.
- ***CAUTION: Hourly fluid intake should not exceed 1½ qts.***

  Daily fluid intake should not exceed 12 qts.
- If wearing body armor, add **5°F** to WBGT index in humid climates.
- If doing Easy Work and wearing NBC (MOPP 4) clothing, add **10°F** to WBGT index.
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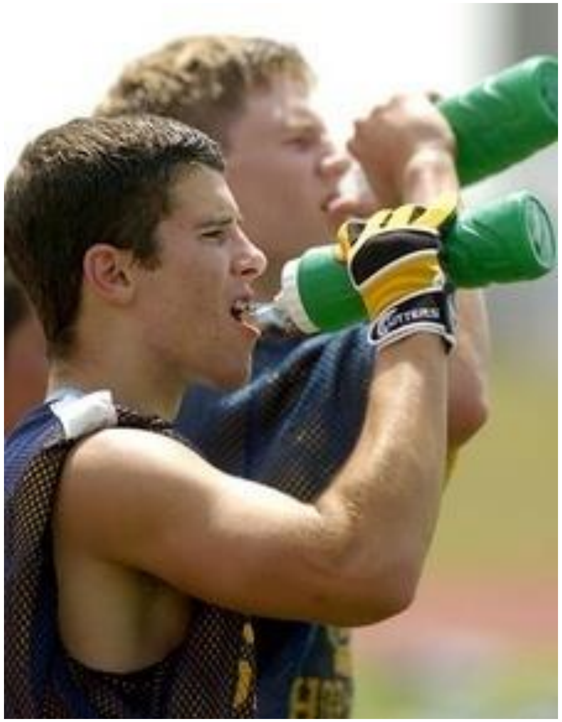
For electronic versions, see http://chppm-www.apgea.army.mil/heat. Local reproduction is authorized.
June 2004

CP-033-0404

NATA Guideline on Acclimatization

- **Days 1 through 5** of the heat-acclimatization period consist of the first 5 days of formal practice. During this time, athletes may not participate in more than **1 practice per day.**
- If a practice is interrupted by inclement weather or heat restrictions, the practice should recommence once conditions are deemed safe. Total practice time **should not exceed 3 hours in any 1 day**.
- A 1-hour maximum walk-through is permitted during days 1–5 of the heat-acclimatization period. However, a 3-hour recovery period should be inserted between the practice and walk-through (or vice versa).



Douglas J. Casa, PhD, ATC, FNATA, FACSM et al : Preseason Heat-Acclimatization Guidelines for Secondary School Athletics. Journal of Athletic Training 2009;44(3):332–333.

To Start or Not to Start?

CONCLUSIONS:

- **Marathons in northern latitudes (>40 degrees) held in "unexpectedly" hot conditions when the participants are not acclimatized and the start WBGT is >21 degrees C often end in either race cancellation or an MCI.**
- **The rate of unsuccessful marathon starters per 1000 marathon finishers plotted against start WBGT generates a curve that can be used to estimate a do not start level.**

Roberts WO.: Determining a “do not start” temperature for a marathon on the basis of adverse outcomes. Med Sci Sports Exerc. 2010 Feb;42(2):226-32.

Pre/Intra Event Cooling Strategies

Siegel R Laursen PB: Keeping your cool: possible mechanisms for enhanced exercise performance in the heat with internal cooling methods. Sports Med. 2012 Feb 1;42(2):89-98.

Secondary Prevention

- Detection of milder forms of heat illness
  - **Buddy System**
- Use of those **sentinel cases** to modify training to prevent additional cases
- Screening for poor food and fluid intake
- **Leveraging Heat Dumping**

Michael Macor / The Chronicle

Secondary Prevention

- **Heat Dumping**
  - Encourage cool showers and time in air conditioning between high exertion training
  - If athletes are staying in dorms for summer training- check to ensure air conditioning is functioning

Ice Sheets

Tertiary Prevention

- **Tertiary prevention** efforts focus on people already affected by disease and attempt to reduce resultant disability and restore functionality
- **Rapid cooling intervention** by first responders can reduce organ injury and prevent development of multi-organ dysfunction syndrome

It’s a Heat Attack!

IV. MCM HYPERTHERMIA ALGORITHM

RECTAL TEMP ≥ 104° F // 40° C
LOSS OF THERMOREGULATORY CONTROL
EVIDENCE OF ACUTE ORGAN DYSFUNCTION
(Altered mental status / inappropriate behavior)

↓

- RAPID EXTERNAL COOLING ❶
- IV NS 1-2 LITERS ❷ (OBTAIN BLOOD CHEMISTRY SAMPLES ❸)
- CORE TEMPERATURE MONITORING (Q 3 MIN RECTAL TEMPERATURE OR INDWELLING RECTAL THERMISTOR

↓

- CONTINUOUS VITAL SIGN REASSESSMENT
- CONTINUOUS COOLING INTERVENTIONS

↓

T ≤ 102° - 102.5°F // 39° C

↓

STOP COOLING TREATMENT
MONITOR FOR TEMPERATURE REBOUND
OR HYPOTHERMIC OVERSHOOT

↓

PERSISTENT MENTAL OBTUNDATION

Y → **ASSESS FOR HYPOGLYCEMIA, HYPONATREMIA OR OTHER ETIOLOGY FOR CNS ALTERATION & TREAT ACCORDINGLY ❸** → **TRANSPORT TO ER**

N ↓

SEVERE RHABDOMYOLYSIS EVIDENT ❹
NEED FOR ONGOING IV HYDRATION ❷

Y → **TRANSPORT TO ER**

N ↓

RELEASE WITH EXERCISE RESTRICTIONS &
PRECAUTIONS REGARDING RHABDOMYOLYSIS

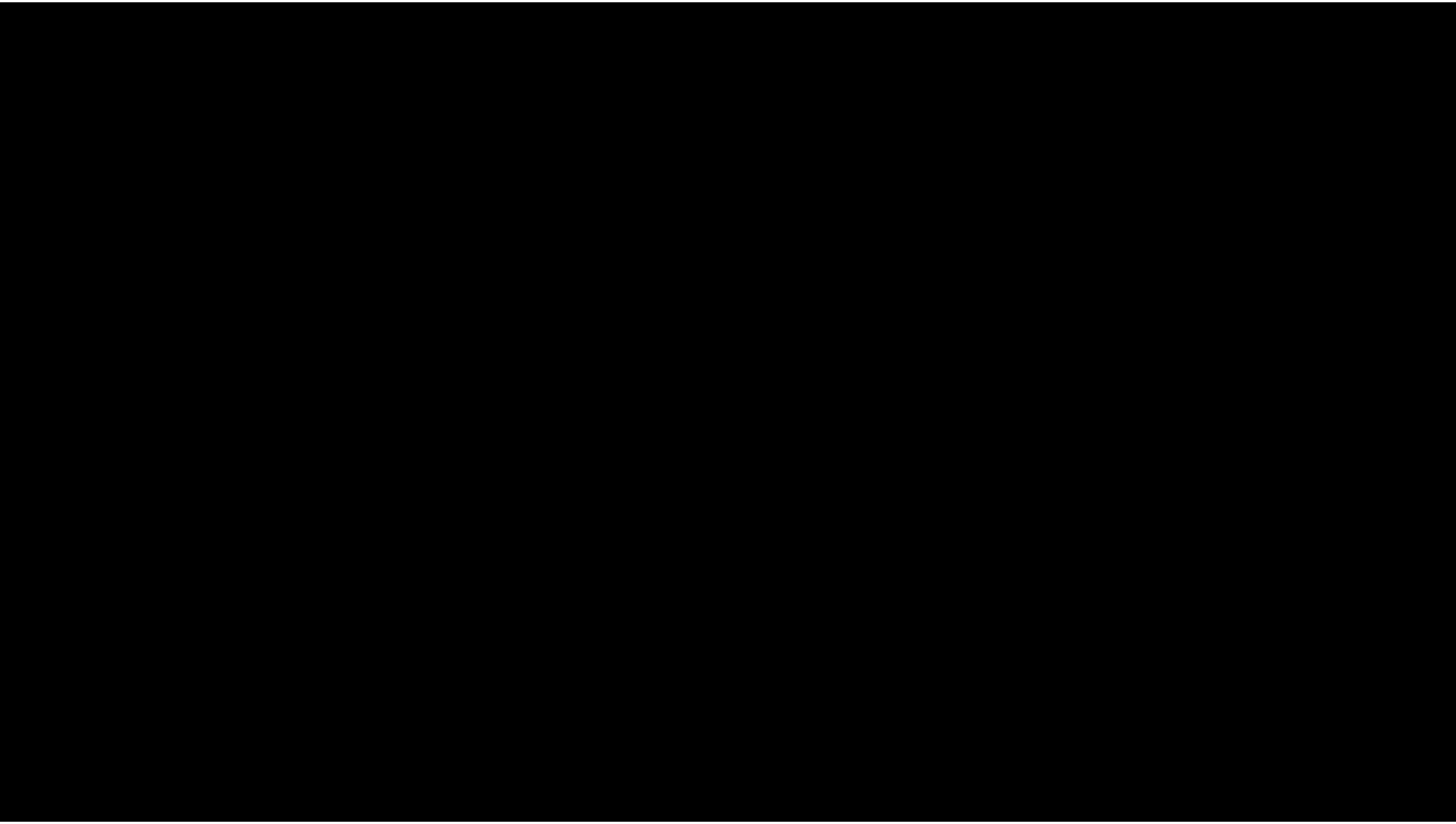
ALL TEMPERATURES ARE RECTAL!

❶ RAPID COOLING OPTIONS: ICE WATER BATH IMMERSION, WHOLE BODY ICE MASSAGE/PACKING WITH CONTINUOUS ICE WATER DOUSING &/OR ICE WATER-SOAKED SHEETS (REWETTED EVERY 3 MINUTES). FANS IF AVAILABLE. CONSIDER COOLED IV FLUIDS. STOP COOLING WHEN TEMPERATURE DROPS TO 102° F / 39° C OR BELOW.

❷ IVF: NS 2L BOLUS UNLESS SIGNS OF OVER-HYDRATION OR CHF (THEN NS @ KVO RATE); REASSESS ON-GOING IVF NEEDS FROM CLINICAL RESPONSE, URINE OUTPUT, AND LABS. COOLED FLUIDS FOR HEAT CASUALTY.

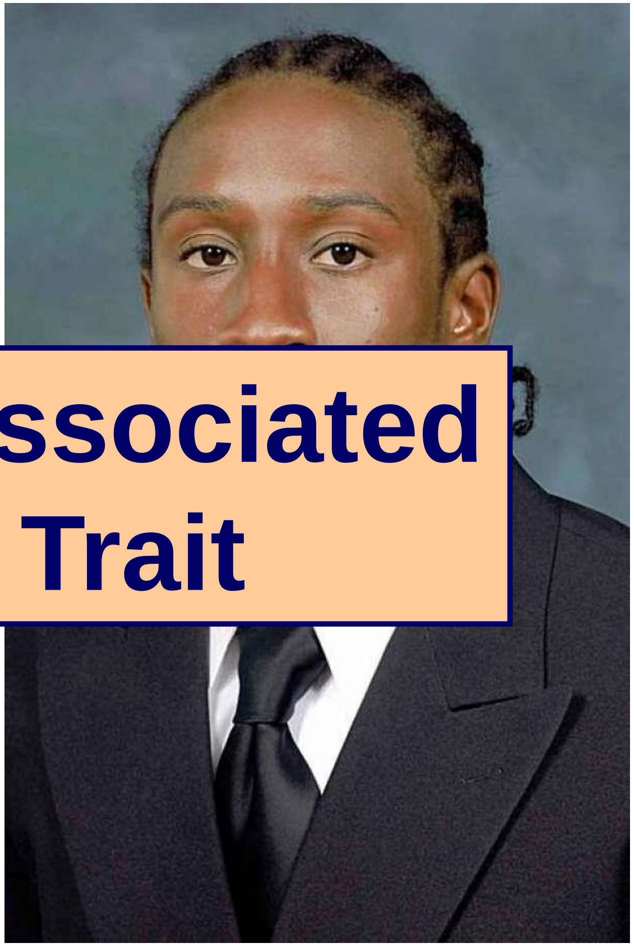
❸ IMMEDIATE Na, Gluc, K +/- Cr, BUN, Cl & Hct (e.g. i-Stat®); TREAT HYPOGLYCEMIA AND HYPONATREMIA PER PROTOCOLS.

❹ IF RHABDOMYOLYSIS SUSPECTED, NEED CK, BMP, AST, ALT, LDH, Uric Acid & UA w/ Micro IF AVAILABLE. ADD Ca^{++}, PO_4 & Mg FOR SEVERE RHABDO; IF NOT AVAILABLE, ALERT ER.



Dale Lloyd II - Football

- On Sept. 25, 2006, Dale Lloyd II, 19 collapsed on a field in Texas after overexertion in practice.
- Lloyd and his teammates ran 16 co… a … sh… heavily and **suffering muscle tightness in his legs.**
- As the workout progressed he had trouble standing. Later, he even had trouble just holding up his head and collapsed.



Exercise Collapse Associated with Sickle Cell Trait

SCT is Associated with Sudden Death

"Current cumulative evidence is convincing for associations with hematuria, renal papillary necrosis, hyposthenuria, splenic infarction, **exertional rhabdomyolysis, and exercise-related sudden death**."

Tsaras G: Complications associated with sickle cell trait: a brief narrative review. Am J Med.2009 Jun;122(6):507-12. Epub 2009 Apr 24.

Sickle Cell Trait and Sudden Death

- **Military**:
  - Study of >450,000 military recruits (1977-1981)
  - SST+ 30X risk sudden death: {RR 30 (11 – 84)}

Kark et al: Sickle-cell trait as a risk factor for sudden death in physical training NEJM 1987; 317:781.

- **Civilian**
  - NCAA SCT deaths 2004 to 2008 = 5.
  - SST +15X risk of sudden death.
  - **D1 football players alone: SCT African Americans (AA) have a AR of 1:805; or 37x risk relative to those without SCT.**

Harmon et al: Sickle Cell Trait Associated with a Relative Risk of Death of 37x in National Collegiate Athletic Association Football Athletes: A Database with 2 Million Athlete-Years as the Denominator. BJSM 2012; 46(3):158.

Is it Heat, Hydration or Intensity?

- "Excess" sudden deaths in SCT due to Exertional Heat Illness (EHI)
  - & Sudden Cardiac Death
  - & Acute, Fulminant Renal Failure

Dr. John Kark

Kark et al: Exercise and hemoglobin S. Semin Hematol. 1994 Jul;31(3):181-225.

Dr. Randy Eichner

"Heat is no more a trigger for exertional sickling than is altitude, asthma, heedless valor, or a reckless coach"

Current Sports Med Reports, 2010, 9(6):349

Warfighters with SCT Serve with Distinction!

- We found that SCT-positive service members **deployed more frequently**, for **greater lengths of time**, and **remained in service longer.**
- **No significant difference in crude mortality** ratio was discovered.

Singer DE, Chen L, Shao S, Goldsmith J, Byrne C, Niebuhr DW. The Association Between Sickle Cell Trait in U.S. Service Members with Deployment, Length of Service, and Mortality, 1992-2012. *Mil Med*. 2018;183(3-4):e213–e218.

Who is the Athlete or Warfighter at Risk? Can Genetic Studies Assist?

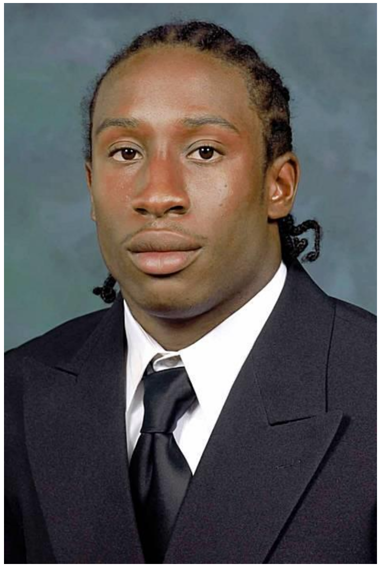
- Risk of sudden death is **1:3,000 (SCT+ Trainee)…but who is the 1 in 3,000?**
- “SCT has to be **reconsidered** as a single-hemoglobin gene mutation.
- This means that subjects with SCT are **similar for this gene, but may be different** for all other hemoglobin genes.
- …subjects with SCT may also be different with regard to all their remaining genes.”

BLUF: SCT Athletes may not all be the Same!

Abkowitz JL, O'Connor FG, Deuster PA, Thompson AA: Sickle cell trait and safe athletic participation: the way forward. Curr Sports Med Rep.2014 May-Jun;13(3):192-3

Primary Prevention

- The National Collegiate Athletic Association (NCAA) adopted a policy requiring Division I institutions to perform sickle cell trait testing for all incoming student athletes.
- Policy was partly in response to legal settlement with Dale Lloyd Case.
- But then….



American Society of Hematology

- Policy **Opposes Mandatory SCT Screening** for Athletic Participation
  - Recommends universal training interventions and additional research
- Believes NCAA Division I policy, as currently written and implemented, **has potential to harm student athletes and larger community of individuals with SCT**.

Statement on Screening for Sickle Cell Trait and Athletic Participation. (2012). ***ASH Policy*** **Retrieved January 2012, from http://www.hematology.org/advocacy/policy-statements/7704.aspx**

Guidance from the NCAA

In general, student-athletes with sickle cell trait should:

- **Set their own pace.**
- Engage in a slow and gradual preseason conditioning regimen to be prepared for sports-specific performance testing and the rigors of competitive intercollegiate athletics.
- Build up slowly while training (e.g., paced progressions).
- Use adequate rest and recovery between repetitions, especially during “gassers” and intense station or “mat” drills.
- Not be urged to perform all-out exertion of any kind beyond two to three minutes without a breather.
- **Be excused from performance tests such as serial sprints or timed mile runs, especially if these are not normal sport activities.**
- Stop activity immediately upon struggling or experiencing symptoms such as muscle pain, abnormal weakness, undue fatigue or breathlessness.
- Stay well hydrated at all times, especially in hot and humid conditions.
- Maintain proper asthma management.
- Refrain from extreme exercise during acute illness, if feeling ill, or while experiencing a fever.
- Access supplemental oxygen at altitude as needed.
- Seek prompt medical care when experiencing unusual distress.

Secondary Prevention

- Prohibit punitive exercise and conditioning sessions;
- **Recognize athletes who are struggling early on, so they can immediately be allowed to rest and not pushed past their physiologic limit;**
- Develop adequate emergency plans for all individuals responsible for athletes during training and conditioning.

Harmon KG, Drezner JA , Casa DJ: To screen or not to screen for sickle cell trait in American football? British Journal of Sports Medicine March 2012.

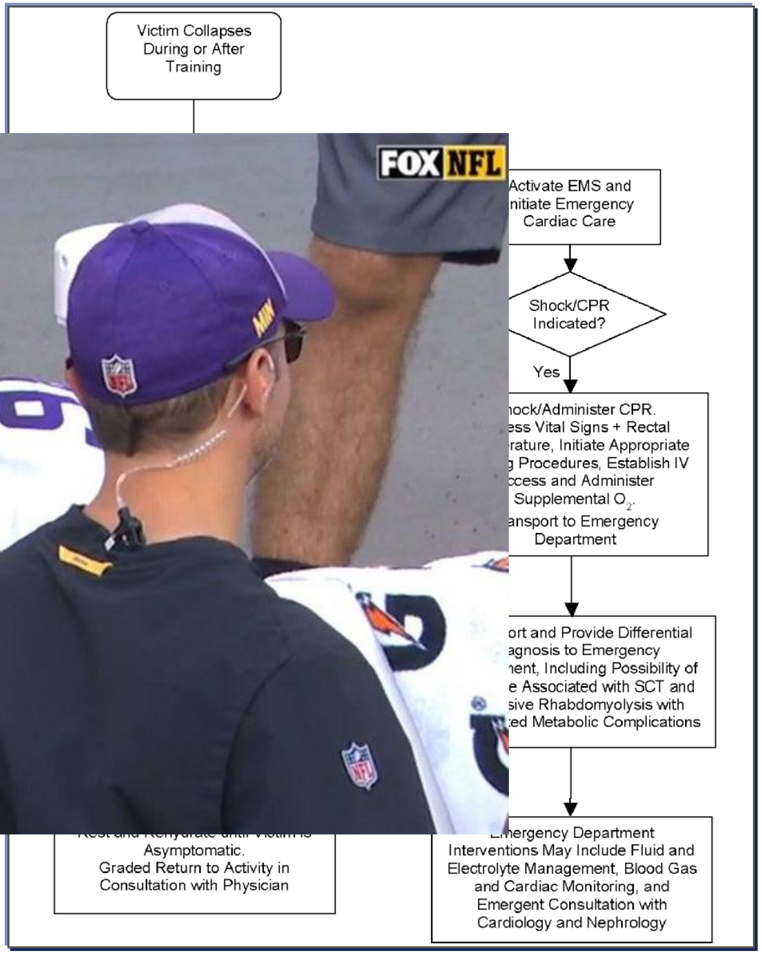
Secondary Prevention

- **Resting blood viscosity was greater in the SCT carriers than in the Control group.**
- The change in blood viscosity occurring in SCT carriers during soccer games was dependent on the experimental condition:
  - (1) in dehydration condition, blood viscosity rose over baseline;
  - (2) in hydration condition, blood viscosity decreased below resting level reaching Control values.
- This study demonstrated that **ad libitum hydration in exercising SCT carriers normalizes the blood hyperviscosity.**

Diaw M, Samb A, Diop S, Sall ND, Ba A, Cissé F, Connes P: Effects of hydration and water deprivation on blood viscosity during a soccer game in sickle cell trait carriers. Br J Sports Med.2012 Jun 9.

Tertiary Prevention

- **Warfighters**
  - Entry brief to ALL on inhe sud
- **Cadr**
  - Re war
- **Prov**
  - Education on common causes of ERD for all



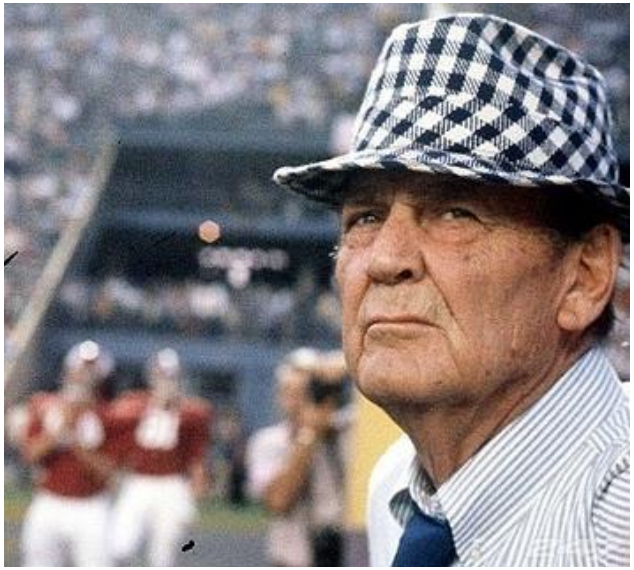
Exercise Collapse Associated with Sickle Cell Trait

AED and Oxygen in the Hands of the Medic

Summary

- **In the End, the Critical Variable is….**

Leadership



Confirming Recent Literature

Nontraumatic Exertional Fatalities in Football Players, Part 2

Excess in Conditioning Kills

Barry P. Boden,*[†] MD, Ken M. Fine,[†] MD, Tiahna A. Spencer,[†] MD, Ilan Breit,[†] PA-C, and Scott A. Anderson,[‡] BA, ATC

Investigation performed at The Orthopaedic Center, Centers for Advanced Orthopaedics, Rockville, Maryland, USA

Background: The incidence of nontraumatic fatalities in high school (HS) and National Collegiate Athletic Association (NCAA) football players has continued at a constant rate since the 1960s.

Purpose: To describe the causes of nontraumatic fatalities in HS and NCAA football players and provide prevention strategies.

Study Design: Descriptive epidemiology study.

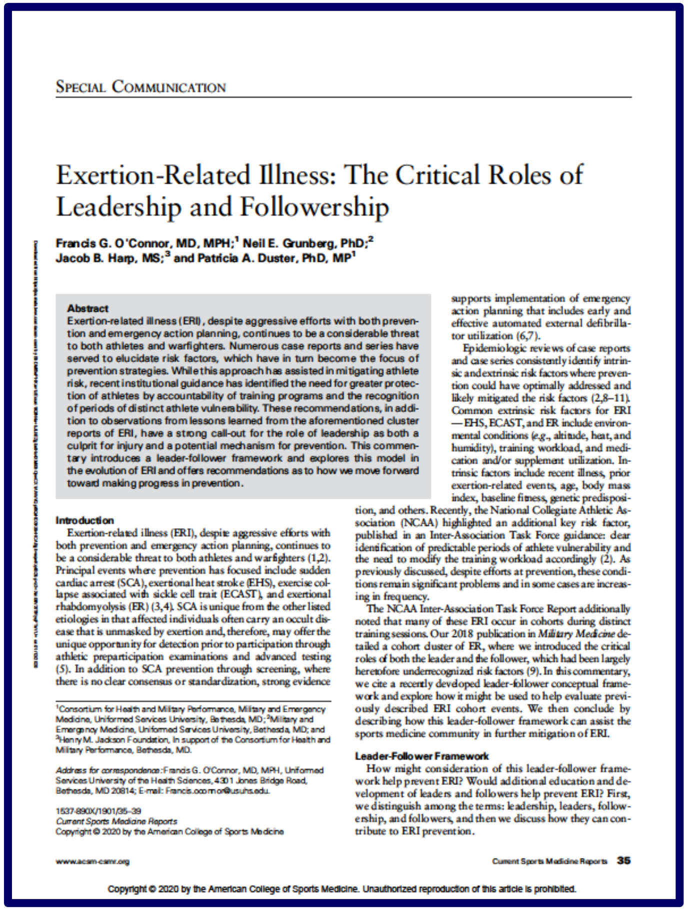
Methods: We reviewed 187 fatalities in HS and NCAA nontraumatic football players catalogued by the National Registry of Catastrophic Sports Injuries during a 20-year period between July 1998 and June 2018.

Results: The majority (n = 162; 86.6%) of fatalities occurred during a practice or conditioning session. Most fatalities, when timing was known, (n = 126; 70.6%) occurred outside of the regular playing season, with the highest incidence in the August preseason (n = 64; 34.2%). All documented conditioning sessions were supervised by a coach (n = 92) or strength and conditioning coach (n = 40). The exercise regimen at the time of the fatality involved high-intensity aerobic training in 94.7%. Punishment was identified as the intent in 36 fatalities. The average body mass index of the athletes was 32.6 kg/m^2. For athletes who died due to exertional heat stroke, the average body mass index was 36.4 kg/m^2, and 97.1% were linemen.

Conclusion: Most nontraumatic fatalities in HS and NCAA football players occurred during coach-supervised conditioning sessions. The primary cause of exertion-related fatalities was high-intensity aerobic workouts that might have been intended as punishment and/or excess repetitions. Exertion-related fatalities are potentially preventable by applying standards in workout design, holding coaches accountable, and ensuring compliance with the athlete's health and current welfare policies.

Boden BP, Fine KM, Breit I, Lentz W, Anderson SA. Nontraumatic Exertional Fatalities in Football Players, Part 1: Epidemiology and Effectiveness of National Collegiate Athletic Association Bylaws. *Orthop J Sports Med*. 2020;8(8):2325967120942490.

Leadership Followership Model



Special Communication

Exertion-Related Illness: The Critical Roles of Leadership and Followership

Francis G. O'Connor, MD, MPH;[1] Neil E. Grunberg, PhD;[2] Jacob B. Harp, MS;[3] and Patricia A. Duster, PhD, MP[1]

Abstract
Exertion-related illness (ERI), despite aggressive efforts with both prevention and emergency action planning, continues to be a considerable threat to both athletes and warfighters. Numerous case reports and series have served to elucidate risk factors, which have in turn become the focus of prevention strategies. While this approach has assisted in mitigating athlete risk, recent institutional guidance has identified the need for greater protection of athletes by accountability of training programs and the recognition of periods of distinct athlete vulnerability. These recommendations, in addition to observations from lessons learned from the aforementioned cluster reports of ERI, have a strong call-out for the role of leadership as both a culprit for injury and a potential mechanism for prevention. This commentary introduces a leader-follower framework and explores this model in the evolution of ERI and offers recommendations as to how we move forward toward making progress in prevention.

Introduction

Exertion-related illness (ERI), despite aggressive efforts with both prevention and emergency action planning, continues to be a considerable threat to both athletes and warfighters (1,2). Principal events where prevention has focused include sudden cardiac arrest (SCA), exertional heat stroke (EHS), exercise collapse associated with sickle cell trait (ECAST), and exertional rhabdomyolysis (ER) (3,4). SCA is unique from the other listed etiologies in that affected individuals often carry an occult disease that is unmasked by exertion and, therefore, may offer the unique opportunity for detection prior to participation through athletic preparticipation examinations and advanced testing (5). In addition to SCA prevention through screening, where there is no clear consensus or standardization, strong evidence supports implementation of emergency action planning that includes early and effective automated external defibrillator utilization (6,7).

Epidemiologic reviews of case reports and case series consistently identify intrinsic and extrinsic risk factors where prevention could have optimally addressed and likely mitigated the risk factors (2,8–11). Common extrinsic risk factors for ERI —EHS, ECAST, and ER include environmental conditions (*e.g.*, altitude, heat, and humidity), training workload, and medication and/or supplement utilization. Intrinsic factors include recent illness, prior exertion-related events, age, body mass index, baseline fitness, genetic predisposition, and others. Recently, the National Collegiate Athletic Association (NCAA) highlighted an additional key risk factor, published in an Inter-Association Task Force guidance: clear identification of predictable periods of athlete vulnerability and the need to modify the training workload accordingly (2). As previously discussed, despite efforts at prevention, these conditions remain significant problems and in some cases are increasing in frequency.

The NCAA Inter-Association Task Force Report additionally noted that many of these ERI occur in cohorts during distinct training sessions. Our 2018 publication in *Military Medicine* detailed a cohort cluster of ER, where we introduced the critical roles of both the leader and the follower, which had been largely heretofore underrecognized risk factors (9). In this commentary, we cite a recently developed leader-follower conceptual framework and explore how it might be used to help evaluate previously described ERI cohort events. We then conclude by describing how this leader-follower framework can assist the sports medicine community in further mitigation of ERI.

Leader-Follower Framework

How might consideration of this leader-follower framework help prevent ERI? Would additional education and development of leaders and followers help prevent ERI? First, we distinguish among the terms: leadership, leaders, followership, and followers, and then we discuss how they can contribute to ERI prevention.

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1537-890X/1901/35–39
Current Sports Medicine Reports

O'Connor FG, Grunberg NE, Harp JB, Deuster PA. Exertion-Related Illness: The Critical Roles of Leadership and Followership. *Curr Sports Med Rep*. 2020;19(1):35–39.

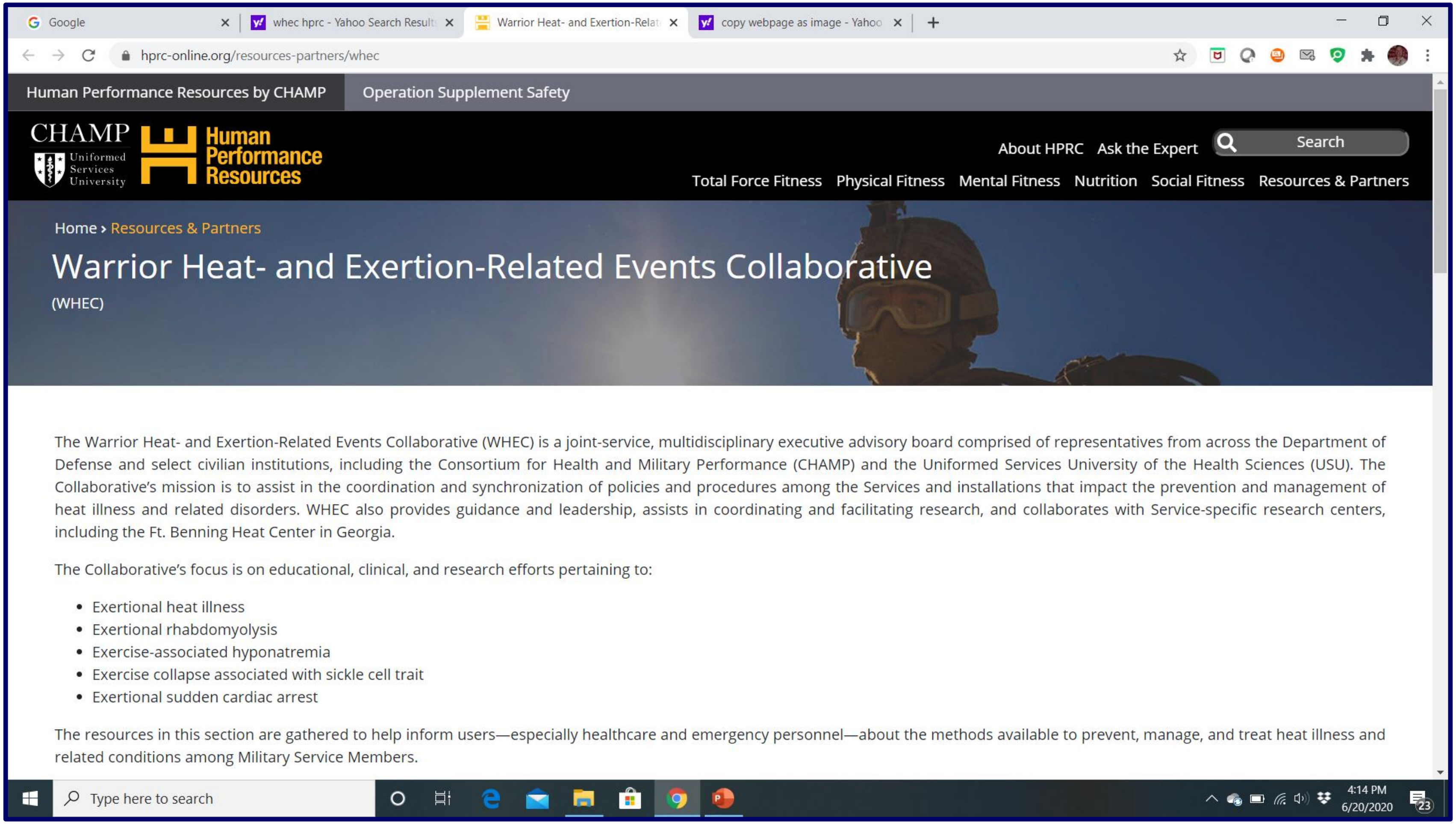




Prevention | **Field Care** | **Evacuation** | **Advanced Care** | **Return to Duty**

Optimizing Readiness:
Education, Clinical Care Research, Leadership

Warrior Heat and Exertion Related Collaborative



https://www.hprc-online.org/resources-partners/whec

For Further Information

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