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Atlantic Health System

Sideline Emergencies: Exertional Heat Illness- Prevention and Treatment Updates

AOSSM: 2019 Sports Medicine & Football - Youth to the NFL

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JETS

ATLANTIC HEALTH SYSTEM

DISCLOSURE

Neither I, (Damion Martins, MD), nor any family member(s), author(s), have any relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation.

Learning Objectives

- ❑ Describe the pathophysiology of Exertional Heat Illness
- ❑ Identify signs and symptoms of Exertional Heat Stroke
- ❑ Understand urgent on the field management and treatment of Heat Illness
- ❑ Understand current evidence for prevention and treatment of Exertional Heat Stroke

Overview

- Heat Illness
  - Diagnosis
  - Pathophysiology
  - Risk Factors
  - Evaluation / Treatment
- Hydration
  - NCAA / NFL data
  - IV vs PO data

McNair video

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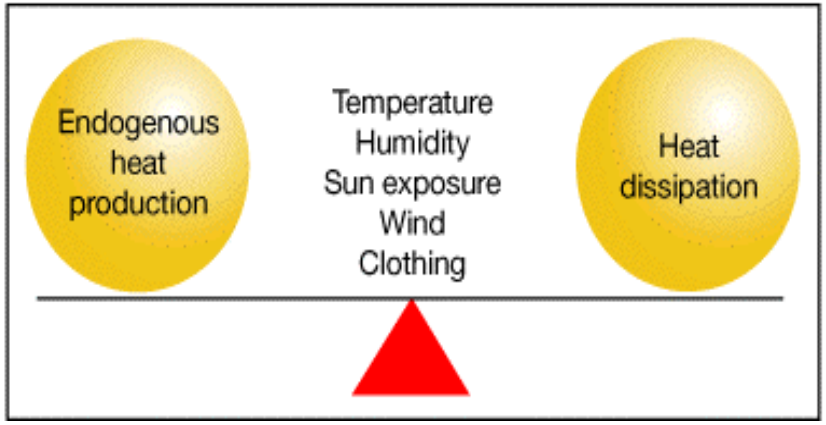
Thermoregulation

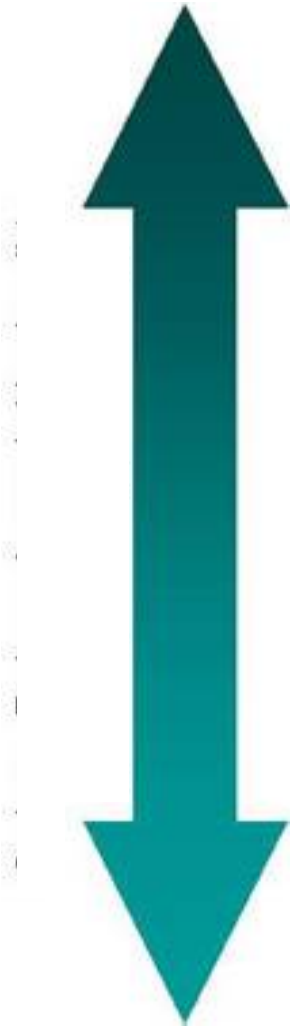
- Production
  - basal metabolism
  - exercise



- Dissipation
  - conduction
  - radiation
  - convection
  - evaporation

Sandor RP. *Phys SportsMed.* 1997;25(6):35-40.

Heat Illness Spectrum



- Heat Illness
- Heat Injury
- Heat Stroke

Exertional Heat Illness (EHI)

- Heat edema
  - initial days of heat exposure
  - self-limited, mild swelling of hands / feet
- Heat cramps or Exercise Associated Muscle Cramps (EAMCs)
  - skeletal muscle cramping during or after exercise
  - usually abdominal and extremities
- Heat syncope
  - orthostatic dizziness or sudden changes in posture in the heat
- Heat exhaustion
  - orthostatic changes and dehydration
  - inability to effectively exercise in the heat
  - NO lab evidence of organ dysfunction

NATA Position Statement. Exertional Heat Illness. *Journal of Athletic Training.* 2015.

Burke et al. *Appl Physiol.* 1993;75:1019-1023.

Exertional Heat Illness (EHI)

- Heat injury
  - exhaustion with lab evidence of organ dysfunction
  - organ and tissue injury due to high body temperature
  - core body (RECTAL) temperature >40.5C (105F)
  - mental status changes (confusion → delirium)

- Heat stroke
  - heat injury with neuropsychiatric impairment
  - core (RECTAL) temp >40.5C (105F)
  - medical emergency (coma, seizure, death)

- Rhabdomyolysis
  - CPK > 5,000 (>10x upper limit) with muscle tenderness
  - myoglubinuria with Cr > 2.0

NATA Position Statement. Exertional Heat Illness. *Journal of Athletic Training.* 2015.

Shapiro et al. *Med Sci Sports Exerc.* 1990;22:4-14.

Drugs Reported to Predispose to Heat Stroke

- Alpha agonist
- Amphetamines
- Anticholinergics
- Antihypertensives
- Antihistamines
- Anti-Parkinsonian agents
- β- blockers
- Calcium channel blockers
- Cocaine
- Diuretics
- Ethanol
- Heroin
- Inhaled anesthetics
- Laxatives
- LSD
- MAO inhibitors
- Nicotine
- PCP
- Phonothiathines
- Sympathomimetics
- Thyroid agents
- TCA's

Exertional Heat Injury (EHI)

- Predisposing factors
  - ambient temp >33° C
  - obesity (BMI >27) ***(Level B)***
  - dehydration (elevated urine specific gravity, Osm) ***(Level B)***
  - lack of acclimatization ***(Level C)***

- Incidence
  - most common heat related disorder in active population
  - military recruits: 13 per 10,000
  - runners: 14 per 10,000

Armstrong et al. *ACSM position stand:EHI*: **Med Sci Sports Exerc., *pp*556-572, 2007.**

Exertional Heat Injury (EHI)

- Treatment (SORT C)
  - shade, remove excess clothing
  - supine position, elevate legs above heart
  - use fans or ice towels
  - monitor vitals and CNS
  - oral Hydration preferred
  - IV hydration (NS or D5W) if abnormal vitals, neuro changes or unable to tolerate oral hydration

- Return to Play
  - may return to practice within 24-48
  - check urine volume and color to determine hydration level

NATA Position Statement. Exertional Heat Illness. *Journal of Athletic Training.* 2015.

ACSM Position Statement. EHI During Competition and Training. *Med Sci Sports Exerc.* 2007.

Exertional Heat Stroke (EHS)

- Etiology
  - hyperthermia (core temp > 40.5C or 105F)
  - associated with CNS and multi-organ failure

- Predisposing factors
  - WBGT > 82
  - strenuous exercise (VO_2 >75%) for longer than 1 hr
  - obesity (BMI >28), low fitness level (VO_{2max} <40), previous EHS history ***(Level B)***
  - sleep deprivation, sunburn, viral illness, diarrhea, medications ***(Level B)***
  - lack of acclimatization ***(Level C)***

- Pathophysiology
  - internal organ temp rises above thermal threshold (> 40.5C)
  - cell membrane is damaged and energy systems disrupted
  - duration of temperature elevation NOT peak temp determines degree of injury

ACSM Position Statement. **EHI During Competition and Training.** *Med Sci Sports Exerc.* **2007.**

Exertional Heat Stroke (EHS)

- Incidence
  - football: 1 in 350,000
  - marathons: 1-20 per 10,000

- Treatment
  - medical emergency
  - goal core body temperature <38.9C (***SORT B***)
  - cold water immersion provides fastest cooling and lowest mortality ***(Level A)***
  - ice water towels and ice packs provide effective but slower cooling ***(Level C)***
  - VS and rectal temperature monitoring q5-10 minutes (***SORT B***)

- Return to Play
  - NO evidence based recommendations
  - may return to practice after they reestablish heat tolerance ***(Level B)***

NATA Position Statement. Exertional Heat Illness. *Journal of Athletic Training.* 2015.

ACSM Position Statement. EHI During Competition and Training. *Med Sci Sports Exerc.* 2007.

Signs & Symptoms

Early

- ❑ Weakness
- ❑ Fatigue
- ❑ Dizziness/Lightheadedness
- ❑ Impaired coordination
- ❑ Headache
- ❑ Thirst
- ❑ Slowed mentation
- ❑ Muscle cramps
- ❑ Nausea / vomiting / diarrhea

Progressive

- ❑ Faintness
- ❑ Visual changes
- ❑ Ataxic gait
- ❑ Delirium
- ❑ Hypotension
- ❑ Hyperventilation
- ❑ Obtundation
- ❑ Collapse/ LOC
- ❑ Coma
- ❑ Death

NATA Position Statement. Exertional Heat Illness. *Journal of Athletic Training.* 2015.

ACSM Position Stand. *Med Sci Sports Exerc.* 1996;28:i-vii.

Differential Diagnosis- EHI

- Neuro
  - mTBI
  - CVA (Pontine or midbrain)
  - Seizure
- Cardio-Pulmonary
  - MI / arrhythmia
  - asthma
- Endocrine
  - thyroid
  - adrenal
- Drug effect
- Infections
  - meningitis
  - CAP
  - myocarditis
  - sepsis
  - viral / rickettsial disease
  - malaria
- Electrolytes
  - hyponatremia
  - hypoglycemia

Exertional Heat Illness- Field Treatment

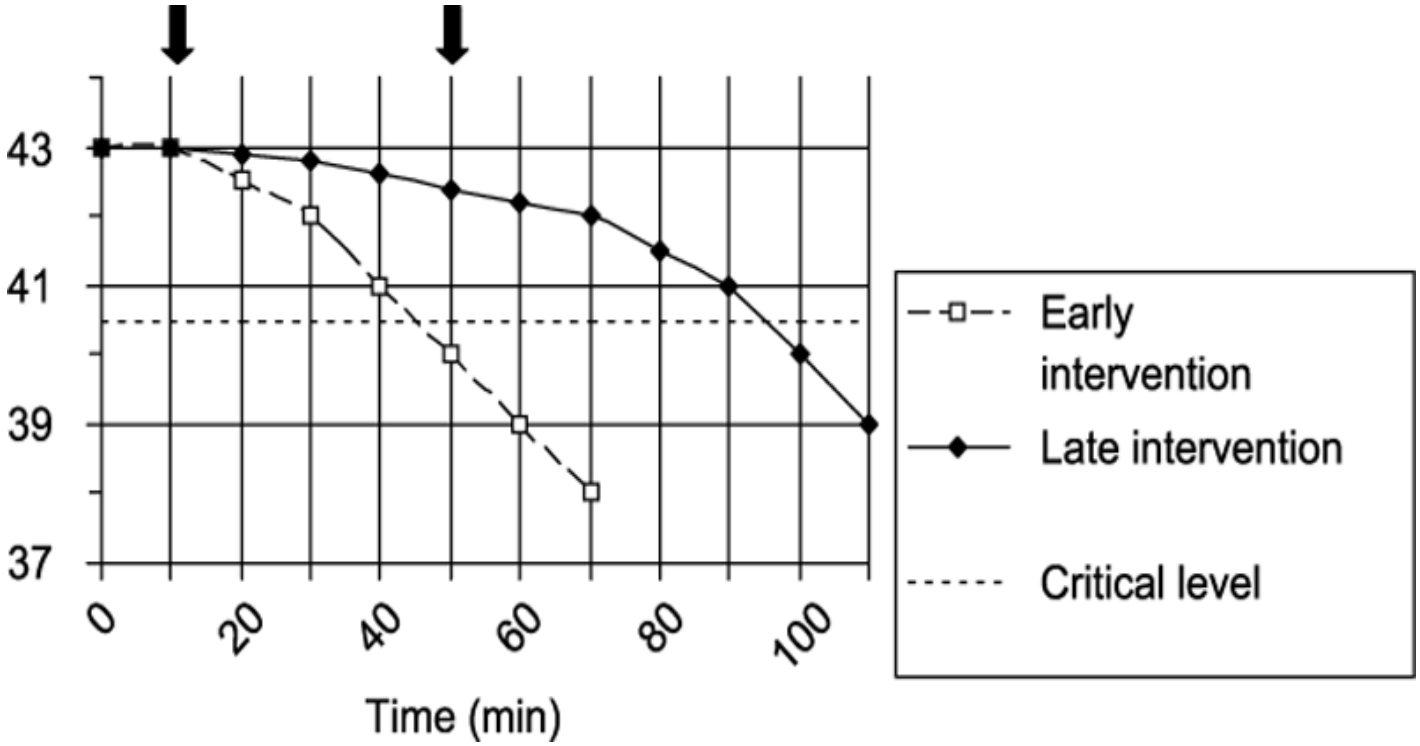
- Monitor ABC's
- Remove clothes and place on side
- Cooling:
  - ice packs to neck, groin and axilla
  - move to shaded area
- Transport to "cool room" facility

Clinical "Cool Room"

- Patient placed in ice water filled tubs
  - 0.25° F/min versus 0.1° F/min for misters
- Continuous rectal probe monitoring
- VS q5min
- Neuro evaluation by MD
- IV fluids ?

Weiner JS, Khogali M. *Lancet* 1980; 1(8176):507-9.

Clinical "Cool Room"



ACSM Position Statement. EHI During Competition and Training. *Med Sci Sports Exerc.* 2007.

Treatment Course in "Cool Room"

- Monitor VS and mental status
- Clinical response to cooling
  - even 110° F will cool rapidly (within 30 min)
  - if prolonged temp elevation think fever and other causes
  - remove patient from ice bath when temp ≤ 102° F
- Response to IVF
  - fluids until urine output
  - watch for signs of pulmonary edema

EHS Treatment Algorithm

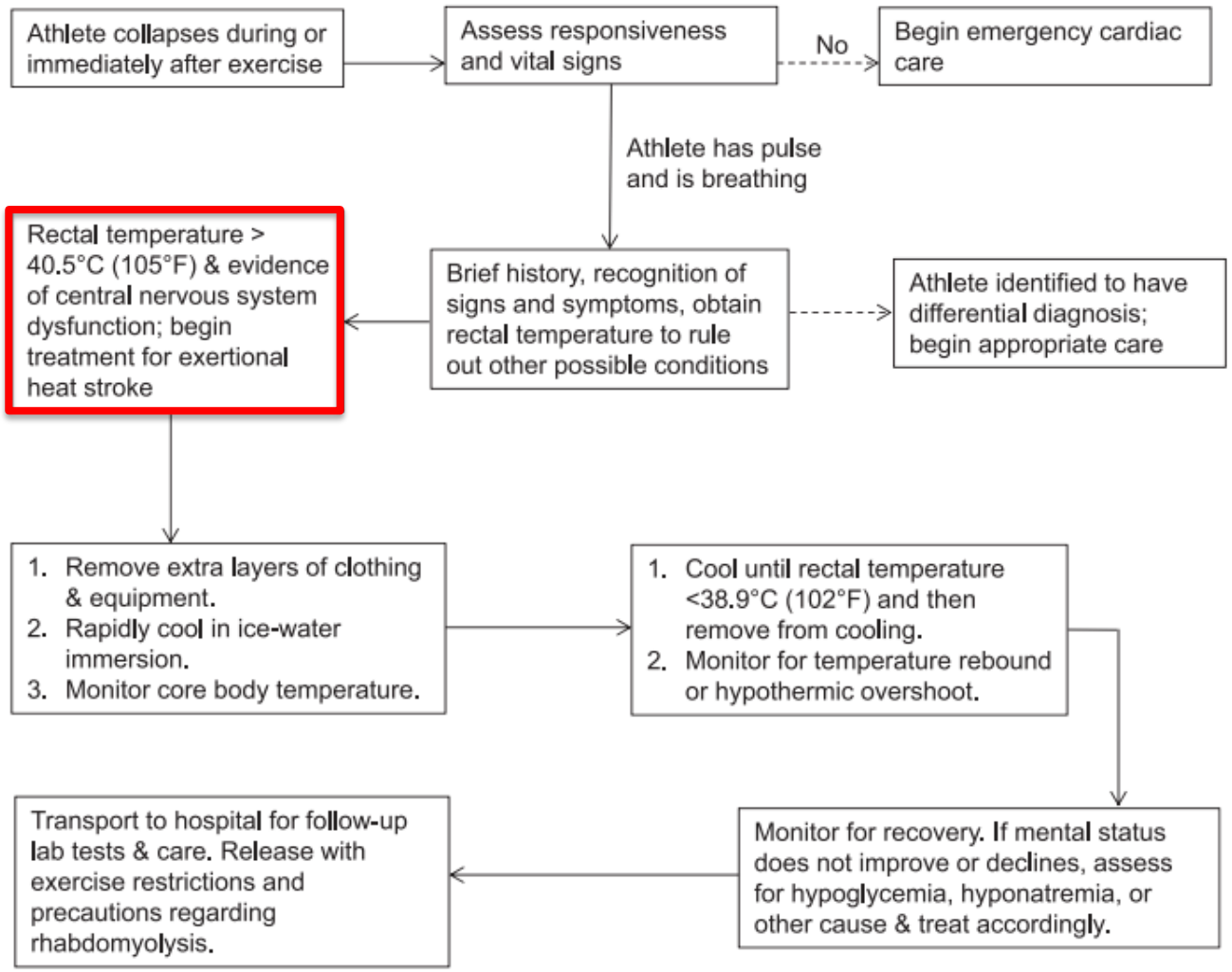
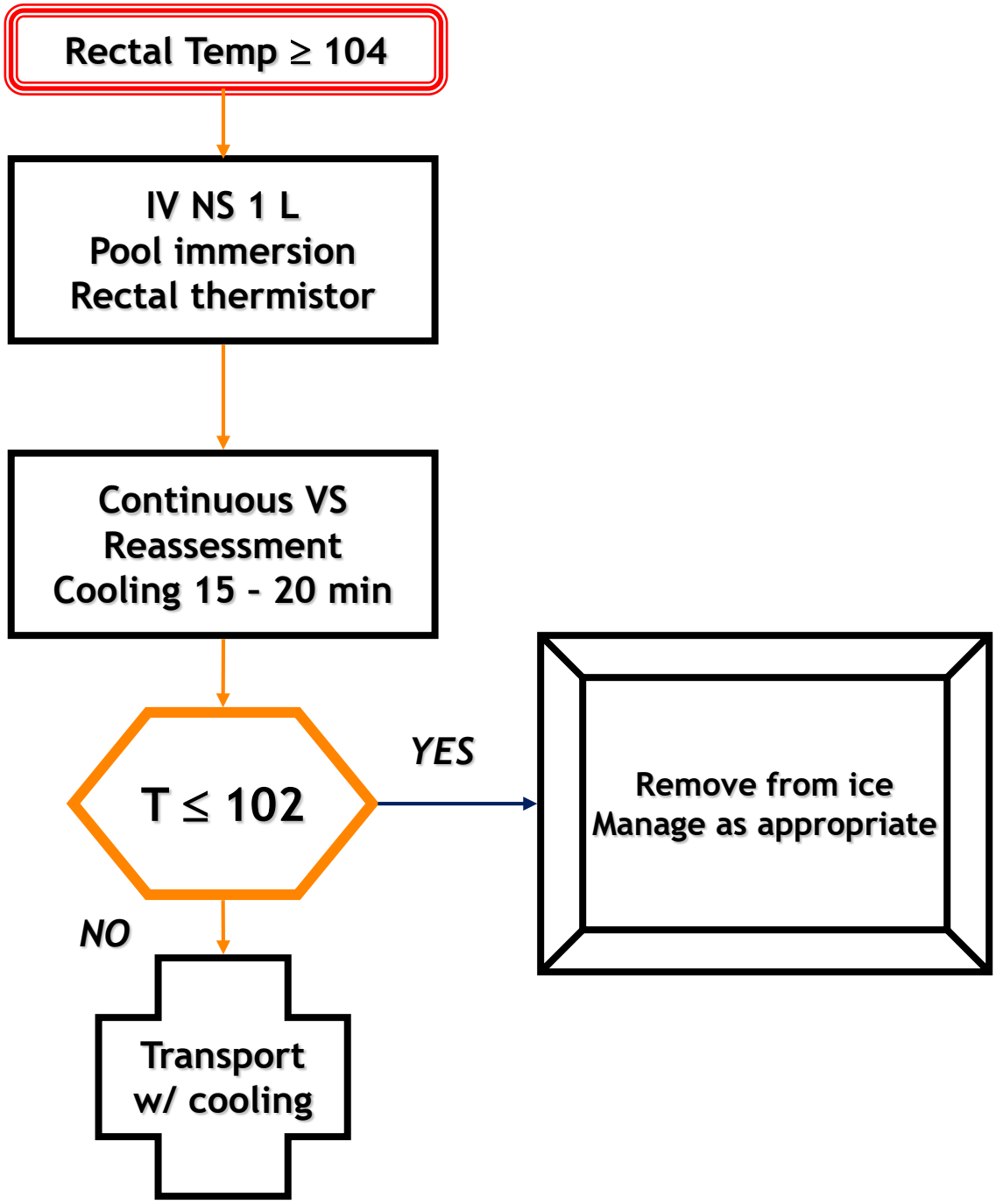


Figure 3. Algorithm for treatment of exertional heat stroke.

NATA Position Statement. **Exertional Heat Illness.** *Journal of Athletic Training.* **2015.**



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O'Connor et al. Managing Emergencies in Mass Participation Events: Medical Triage and Algorithms; 2001 MCMS.

Summary of the Evidence- Prevention

- **Pre-participation medical screening** (SORT C)
  - -Risk stratification
- **Heat acclimatization** (SORT B)
  - -7 to 14 days
- **Hydration** (SORT B)
  - -Prevent body mass loss >2%
- **Emergency Action Plan** (EAP) (SORT C)
- **Appropriate resources**
  - -Cold-water immersion (SORT B)
  - -Rectal temperature (SORT A)
- **Sleep, nutrition** (SORT C)
- **Work-to-rest ratio at practice** (SORT B)

Summary of the Evidence- Treatment

EHIs	Treatment	SORT
Exercise-Associated Muscle Cramps (EAMCs)	-Cease exercise -Provide sodium-containing beverages	B
Heat Syncope	-Supine with leg elevation	C
Exertional Heat Exhaustion (EHE)	-Cease exercise -Remove from heat -Elevate legs -Provide fluids	C
Exertional Heat Stroke (EHS)	-Immediate whole-body cold water-immersion -Goal core body temperature <38.9C	B

Exertional Heat Stroke- RTP Guidelines

- Refrain from exercise for minimum 7 days
- Follow-up physical exam and lab work in 1wk
- Need to be symptomatic & normal labs before return to activity
- Begin exercise in cool environment while gradual increasing duration, intensity and heat exposure for 2 wks
- If RTP difficult then consider heat tolerance test
- Clear athlete in 2-4wks if heat tolerance exists

NATA Position Statement. Exertional Heat Illness. *Journal of Athletic Training.* 2015.

ACSM Position Statement. EHI During Competition and Training. *Med Sci Sports Exerc.* 2007.

Heat Illness / Hyponatremia

References

Casa et al. Intravenous versus Oral Rehydration: Physiological, Performance, and Legal Considerations. *Current Sports Medicine Reports. 2008;supplemental-S49*

NATA Position Statement. Exertional Heat Illness. Journal of Athletic Training. 2015.

ACSM Position Statement. Exertional Heat Illness During Competition and Training. *Med Sci Sports Exerc.* 2007

ACSM Position Statement. Exercise and Fluid Replacement. *Med Sci Sports Exerc.* 2007

Consensus Statement: Exercise-Associated Hyponatremia. *Clinical Journal of Sports Med* 2005; 15:206-211.

Kenefick et al. *Med Sci Sports Exerc.* 2006; 38(12):2125-31.

Kulka T, Kenney W. *Phys Sportmed* 2002; 30 (7):29-39.

Noakes et al. *IMMDA* Advisory Statement on Guidelines for Fluid Replacement During Marathon Running*; 2002*.

Reibe, D et al. *Med Sci Sports Exerc.* 1997; 29(1):117-146

NJSIAA Heat Participation Policy

Schools must follow the statewide policy when conducting **outdoor practices and contests in all sports**. The policy shall follow modified guidelines of the American College of Sports Medicine in regard to :

- ❑ scheduling of practices during times of various Wet Bulb Globe Temperature (WBGT) levels
- ❑ ratio of workout time to time allotted for rest and hydration during times of various WBGT levels
- ❑ WBGT levels which will result in practice(s) or contest(s) being modified or terminated
- ❑ An **instrument scientifically approved to measure WBGT must be utilized at each practice** and readings should be taken on the practice site a minimum of every hour, beginning 30 minutes before the beginning of practice or contest. All readings should be recorded or data logged

NJSIAA Heat Participation Policy

WBGT READING	Flag	Risk for Heat Illness	ACTIVITY GUIDELINES AND REST BREAK GUIDELINES
Under 80.0°F	Green	Very Low	Normal activities – Provide at least three separate rest breaks each hour of minimum duration of 3 minutes each during workout.
80.0 F – 85.0°F	Yellow	Low	Use discretion for intense or prolonged exercise; watch at-risk players carefully; Provide at least three separate rest breaks each hour with a minimum duration of 4 minutes each.
85.1 F – 88.0°F	Orange	Moderate	Maximum practice time is 2 hours, For Football, Lacrosse and Field Hockey: All helmets and shoulder pads must be removed for practice and conditioning activities. If the WBGT rises to this level **during** practice, football players may continue to work out wearing football pants without changing into shorts. For All Sports: provide at least four separate rest breaks each hour with a minimum duration of 4 minutes each.
88.1 F – 90°F	Red	High	Maximum length of practice is 1 hour. For Football, Lacrosse and Field Hockey: No protective equipment may be worn during practice and there may be no conditioning activities. For All Sports: there must be 20 minutes of rest breaks distributed throughout the hour of practice.
Over 90°F	Black	Very High	NO OUTDOOR WORKOUTS. Delay practice until a cooler WBGT level is reached.

Overview

- Heat Illness
  - Diagnosis
  - Pathophysiology
  - Risk Factors
  - Evaluation / Treatment
- Hydration
  - NCAA / NFL data
  - IV vs PO data

Journal of Athletic Training 2009;44(6):624–629

www.nata.org/jat

original research

Estimation of Prepractice Hydration Status of National Collegiate Athletic Association Division I Athletes

Stella L. Volpe, PhD, RD, LDN, FACSM*; Kristen A. Poule, BS†; Erica G. Bland, BSN*

*University of Pennsylvania, Philadelphia, PA; †University of Massachusetts, Amherst, MA

- 66% of D1 athletes are hypohydrated
- More men (47%) were hypohydrated than women (28%)

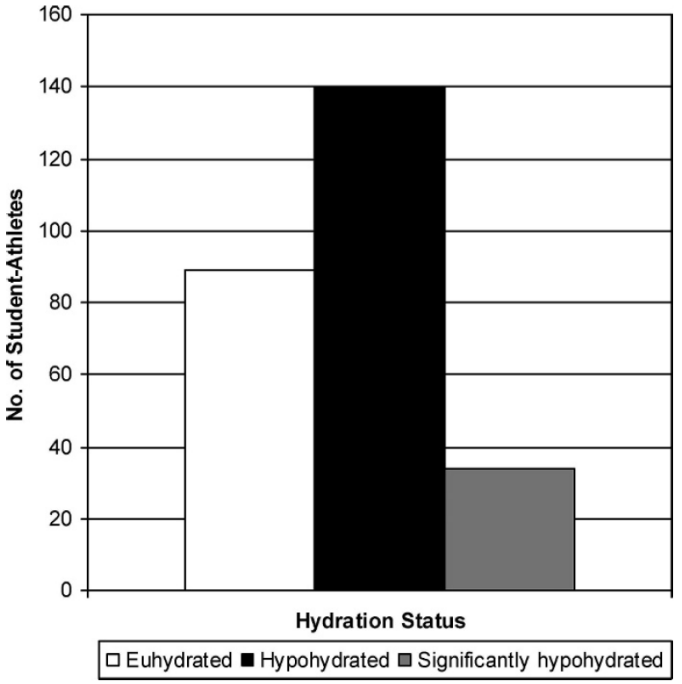

Figure. Prepractice hydration status of collegiate athletes. Euhydrated indicates a urine specific gravity of less than 1.020; hypohydrated, from 1.020 to 1.029; and significantly hypohydrated, more than or equal to 1.030.

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Sensitivity and specificity of clinical signs for assessment of dehydration in endurance athletes

J McGarvey,[1] J Thompson,[2] C Hanna,[1] T D Noakes,[3] J Stewart,[4] D Speedy[1]

Table 2 Presence or absence of measured variables in runners with and without weight loss ⩾3% (absolute number (percentage of total subjects)) and validity to detect this level of dehydration

		⩾3% weight loss (%)	<3% weight loss (%)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Decreased skin turgor	Yes	53 (9)	50 (8)	(25)	(87)	(51)	(69)
	No	155 (26)	348 (57)				
Sensation of thirst	Yes	147 (24)	235 (39)	(71)	(41)	(38)	(73)
	No	61 (10)	163 (27)				
Sunken eyes	Yes	94 (16)	148 (24)	(45)	(63)	(39)	(69)
	No	114 (19)	250 (41)				
Unable to spit	Yes	4 (1)	6 (1)	(2)	(98)	(40)	(66)
	No	204 (34)	392 (65)				
Dry membranes	Yes	139 (23)	283 (47)	(67)	(29)	(33)	(63)
	No	69 (11)	115 (19)				

Br J Sports Med 2010;**44**:716–719. doi:716 10.1136/bjsm.2008.053249

Hydration Markers

Measure	Practicality	Validity (Acute vs. Chronic changes)	EUH Cut-Off
TBW	Low	Acute and Chronic	<2%
Plasma Osmolality	Medium	Acute and Chronic	<290 mOsmol
Urine Specific Gravity	High	Chronic	<1.020 g·mL^{-1}
Urine Osmolality	High	Chronic	<700 mOsmol
Body Weight	High	Acute and Chronic*	<1%

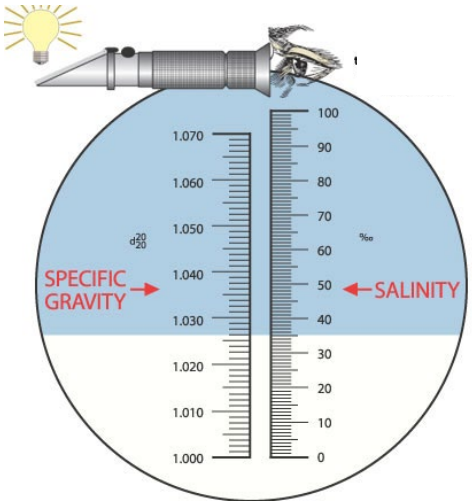
EUH = euhydration; * = potentially confounded by changes in body composition during very prolonged assessment periods.

Barrow MW, Clark KA. *Am Fam Physician.* 1998; 58(3): 749-59.

Hydration Assessment

- Body weight can be used to detect sweat loss and fluid needs *(Level A)*
  - AM post void, 3 consecutive measures as baseline
  - 1 kg of mass loss = 1 L of sweat loss

- Usg< 1.020, Uosm< 700 = Euhydrated *(Level B)*
  - Refractometer
  - Reagent Strips



Player		SPECIFIC GRAVITY											Actual Value
OL													
	OL	1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
	OL	1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
		1.010	1.015	1.020		1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0222
			1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0053
		1.010	1.015		1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0187
	OL	1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
	OL	1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
			1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0009
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
	RB	1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
	WR	1.010	1.015	1.020	1.021		1.025	1.026	1.027	1.028	1.029	1.030	1.0229
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
	WR		1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0066
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.026	1.028	1.029	1.030	
		1.010	1.015		1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0191
	TE	1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
			1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	1.0031
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	
		1.010	1.015	1.020	1.021	1.023	1.025	1.026	1.027	1.028	1.029	1.030	

[Primary Care]

Intravenous Fluid Use in Athletes

Gordon V. Givan, MD,* and Jason J. Diehl, MD†‡

Clinical Recommendations

SORT: Strength of Recommendation Taxonomy
A: consistent, good-quality patient-oriented evidence
B: inconsistent or limited-quality patient-oriented evidence
C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
1. Current evidence does not support the routine use of IV fluids for rehydration for otherwise healthy athletes that can tolerate oral fluids.[2,9,11,16,25,33,34,40,43,53]	B
2. Volume expanders may be beneficial in the prevention of dehydration and associated performance decline for selected endurance athletes.[14,15,30,31,38,41,42,44,52,74]	B
3. The use of IV fluids for prehydration may be beneficial for exercise-associated muscle cramp prevention in a subset of fluid sensitive athletes.[1,2,6,19,20,22,23,47]	C

Givan et al. *Sports Health: A Multidisciplinary Approach* 2012 4: 333