

Heat Illness in Young Athletes

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The logo features the word "SMART" in large, bold, blue capital letters. To the left of the "S" is a stylized graphic of a hand with fingers pointing upwards. To the right of "SMART" is the word "SERIES" in smaller, blue capital letters, oriented vertically.



Financial Disclosure

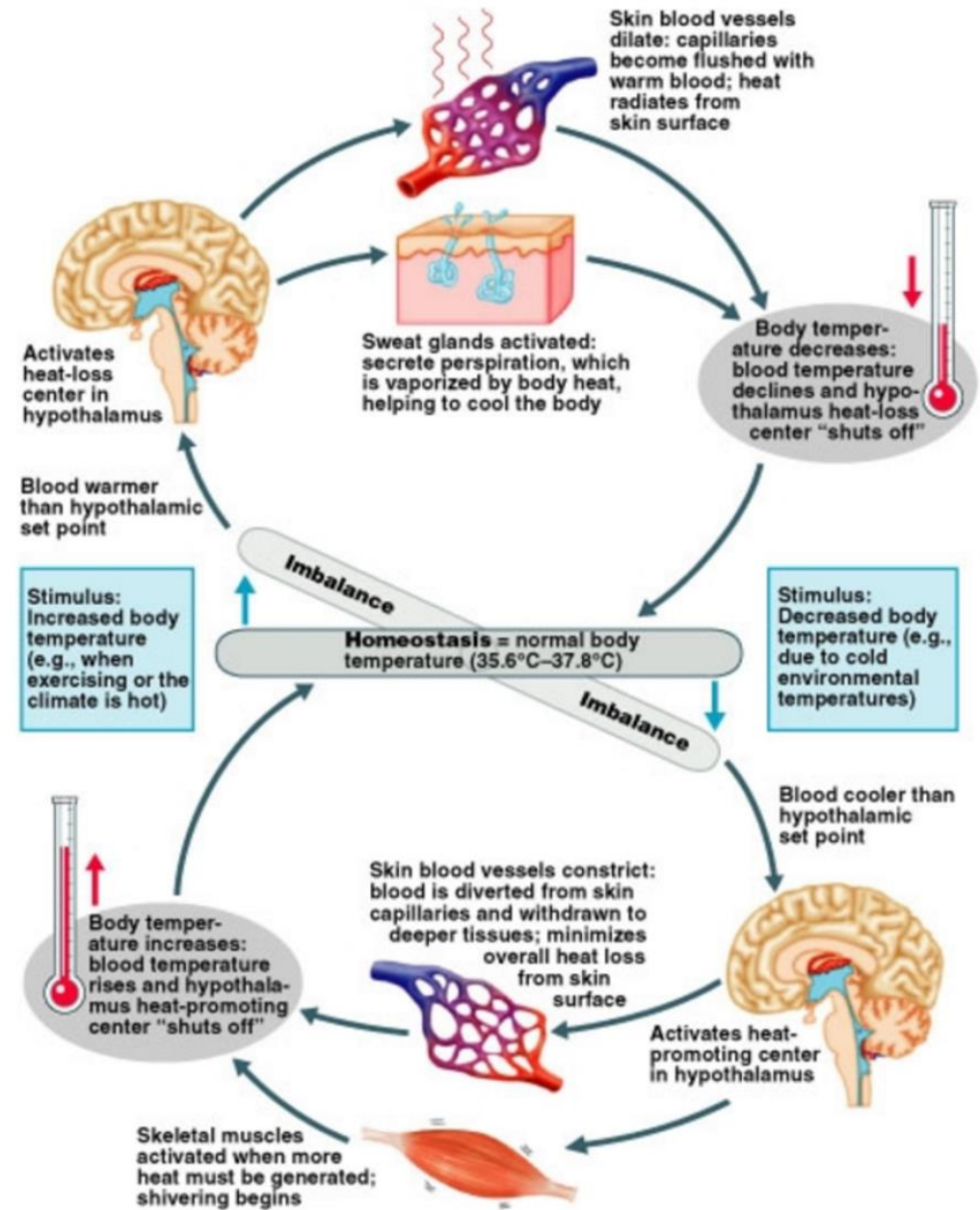
- I have no relevant financial disclosures



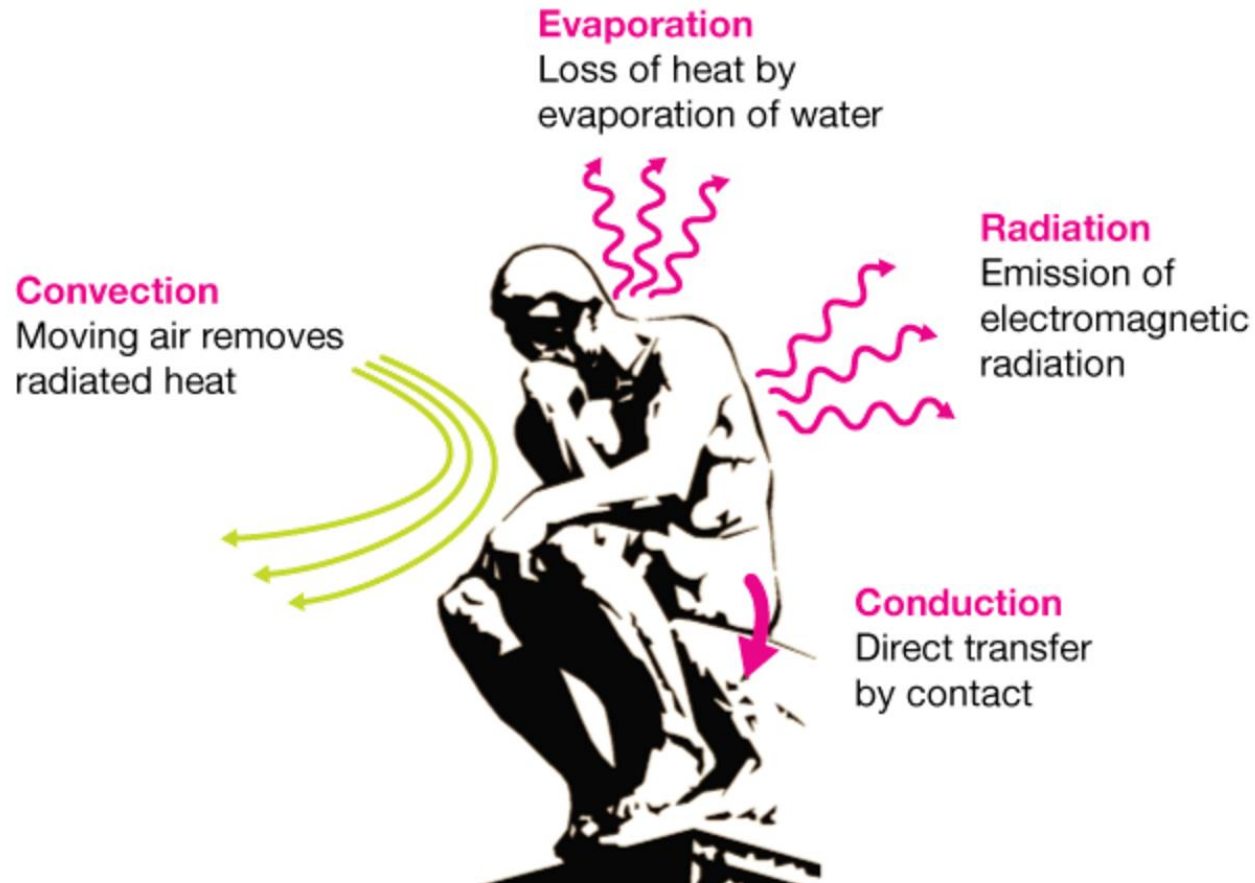
Objectives

- Describe the condition known as exertional heat illness
- Discuss risk factors for exertional heat illness
- Discuss treatment and prevention strategies for exertional heat illness

Thermoregulation



Heat Loss



Epidemiology

- 9,000 HS athletes annually
- Most in August
- 2/3 medical presence
 - 95% athletic trainer

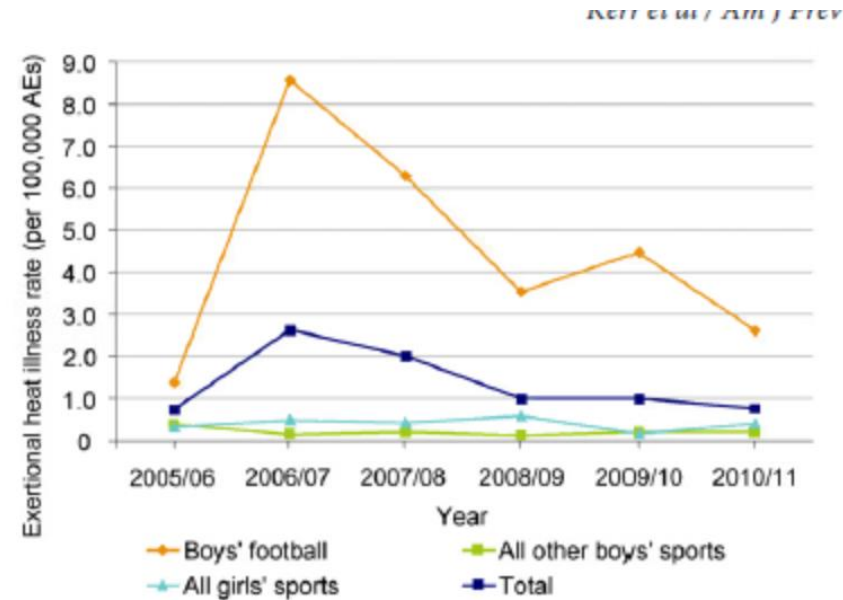


Figure 1. Rates of exertional heat illness among U.S. high school athletes, by year

Note: Data are from the High School Sports-Related Injury Surveillance System, U.S., 2005/2006–2010/2011. AE is defined as one athlete participating in one athletic practice or competition.

AE, athlete exposure

Table 1 EHI Rates in High School Sports, by Sport and Event Type, 2012/2013–2016/2017 Academic Years

Sport	Counts			EHI rates per 10,000 AE (95% CI)		
	Competition	Practice	Total	Competition	Practice	Total
Boys' basketball	0	1	1	0.00	0.01 (0.00 to 0.02)	0.01 (0.00 to 0.02)
Boys' cross country	6	3	9	0.52 (0.10 to 0.93)	0.05 (0.00 to 0.11)	0.13 (0.04 to 0.21)
Boys' American football	44	172	216	0.61 (0.43 to 0.79)	0.50 (0.43 to 0.58)	0.52 (0.45 to 0.59)
Boys' soccer	3	4	7	0.07 (0.00 to 0.14)	0.04 (0.00 to 0.08)	0.05 (0.01 to 0.08)
Boys' track	1	2	3	0.04 (0.00 to 0.11)	0.02 (0.00 to 0.04)	0.02 (0.00 to 0.04)
Boys' wrestling	1	2	3	0.03 (0.00 to 0.09)	0.02 (0.00 to 0.05)	0.02 (0.00 to 0.05)
Girls' basketball	2	0	2	0.05 (0.00 to 0.11)	0.00	0.01 (0.00 to 0.03)
Girls' cross country	12	5	17	1.18 (0.51 to 1.84)	0.10 (0.01 to 0.18)	0.28 (0.15 to 0.41)
Girls' field hockey	2	13	15	0.16 (0.00 to 0.39)	0.50 (0.23 to 0.77)	0.39 (0.19 to 0.59)
Girls' lacrosse	2	1	3	0.14 (0.00 to 0.33)	0.03 (0.00 to 0.09)	0.06 (0.00 to 0.14)
Girls' soccer	8	6	14	0.20 (0.06 to 0.34)	0.07 (0.01 to 0.12)	0.11 (0.05 to 0.17)
Girls' track	0	2	2	0.00	0.02 (0.00 to 0.05)	0.02 (0.00 to 0.04)
Girls' volleyball	0	4	4	0.00	0.04 (0.00 to 0.09)	0.03 (0.00 to 0.06)
Cheerleading ^a	3	1	4	0.09 (0.00 to 0.19)	0.01 (0.00 to 0.03)	0.03 (0.00 to 0.06)
Overall total ^b	84	216	300	0.14 (0.11 to 0.17)	0.13 (0.11 to 0.14)	0.13 (0.11 to 0.14)

Abbreviations: AE, athlete exposure; CI, confidence interval; EHI, exertional heat illness.

^aCheerleading performance data are included in competitions. ^bThe following sports had 0 EHI events reported but were included in the overall total: boys' baseball, ice hockey, lacrosse, and swimming; and girls' softball and swimming.

Table 2 Characteristics of EHI in High School Sports, by Sport and Census Region, 2012/2013–2016/2017 Academic Years

Characteristic	n	% within total (n = 300)	% within American football (n = 216)
Total number of EHI events	300	100.0	N/A
Total number of EHI events in American football	216	72.0	100.0
Total number of EHI events in American football practices	172	57.3	79.6
Total number of EHI events in American football practices in the preseason	133	44.3	61.6
Total number of EHI events in American football practices in the preseason with a registered air temperature $\geq 90^{\circ}\text{F}$	87	29.0	40.3
Total number of EHI events in American football practices in the preseason with a registered air temperature $\geq 90^{\circ}\text{F}$ and occurring ≥ 1 h into practice	62	20.7	28.7
Total number of EHI events in American football practices in the preseason with a registered air temperature $\geq 90^{\circ}\text{F}$ and occurring ≥ 2 h into practice	23	7.7	10.6

Abbreviations: EHI, exertional heat illness; N/A, not applicable.

Table 3 EHI Rates in High School Sports, by US Census Region and Event Type, 2012/2013–2016/2017 Academic Years

	US census region, n				EHI rates per 10,000 AE (95% CI)		South versus all other US census regions' IRR (95% CI)
	Midwest	Northeast	South	West	South US census region	All other US census regions	
All sports							
Total	45	39	182	34	0.23 (0.20 to 0.26)	0.08 (0.06 to 0.09)	2.96 (2.35 to 3.74)
Competition ^a	18	9	49	8	0.08 (0.06 to 0.10)	0.03 (0.02 to 0.04)	2.64 (1.71 to 4.07)
Practice	27	30	133	26	0.68 (0.56 to 0.79)	0.21 (0.16 to 0.25)	3.26 (2.48 to 4.29)
American football only							
Total	31	22	133	30	0.80 (0.67 to 0.94)	0.33 (0.26 to 0.41)	2.41 (1.83 to 3.17)
Competition	9	5	23	7	0.85 (0.50 to 1.19)	0.47 (0.27 to 0.67)	1.80 (0.997 to 3.25)
Practice	22	17	110	23	0.80 (0.65 to 0.95)	0.30 (0.23 to 0.38)	2.62 (1.92 to 3.57)

Abbreviations: AE, athlete exposure; CI, confidence interval; EHI, exertional heat illness; IRR, injury rate ratio.

^aCheerleading performance data are included in competitions.

Table 4 Distribution of EHI Types in High School Sports, by Sport and US Census Region, 2012/2013–2016/2017 School Years

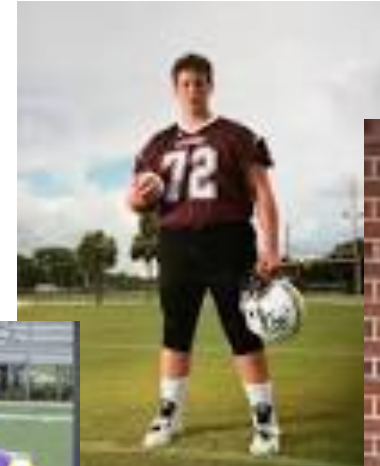
Type of EHI	Total, n (%)	Sport, n (%)		US census region, n (%)			
		American football	All other sports	All sports		American football only	
				South US census region	All other US census regions	South US census region	All other US census regions
Exercise-associated muscle cramps ^a	56 (18.7)	44 (20.4)	12 (14.3)	37 (20.3)	19 (16.1)	30 (22.6)	14 (16.9)
Heat exhaustion	173 (57.7)	132 (61.1)	41 (48.8)	110 (60.4)	63 (53.4)	85 (63.9)	47 (56.6)
Heat syncope	36 (12.0)	20 (9.3)	16 (19.0)	21 (11.5)	15 (12.7)	9 (6.8)	11 (13.3)
Heat stroke	5 (1.7)	3 (1.4)	2 (2.4)	3 (1.6)	2 (1.7)	3 (2.3)	0
Other/missing	30 (10.0)	17 (7.9)	13 (15.5)	11 (6.0)	19 (16.1)	6 (4.5)	11 (13.3)
Total	300 (100.0)	216 (100.0)	84 (100.0)	182 (100.0)	118 (100.0)	133 (100.0)	83 (100.0)

Abbreviations: EHI, exertional heat illness; RIO, Reporting Information Online.

^aHigh school RIO used the variable name “heat-related cramps,” but the current terminology for such a diagnosis is “exercise-associated muscle cramps.”

Deaths

- Leading cause of preventable death in HS athletes
- 35 HS FB players died between 1995-2010
- Summer 2011: 6 deaths
- 2005-2009: More sport-related EHS deaths in same period in 35 yrs.



Exertional Heat Illness (EHI)

Exercise-Associated Muscle Cramps (EAMC)

- Sudden vs progressive, involuntary, painful muscle contractions
 - Contributing factors:
 - Dehydration
 - Electrolyte imbalances
 - Altered neuromuscular control
 - Fatigue

Exertional Heat Syncope

- Fainting/dizziness



EHI

Exertional Heat Exhaustion

- Fatigue/weakness
- Fainting/collapse
- Dizzy/lightheaded
- Headache
- Nausea/vomiting
- Low BP
- Clammy skin
- Temp $<104^{\circ}\text{F}$ (40°C)

Exertional Heat stroke

- CNS dysfunction
- Temp $>104^{\circ}\text{F}$ (40°C)
- +/- sweating



Treatment

EAMC

- Rest
- Passive stretching
- Fluids
- +/- electrolytes

Heat Syncope

- Shade
- Elevate legs
- Cool skin
- Rehydrate
- Monitor

Treatment

Heat Exhaustion

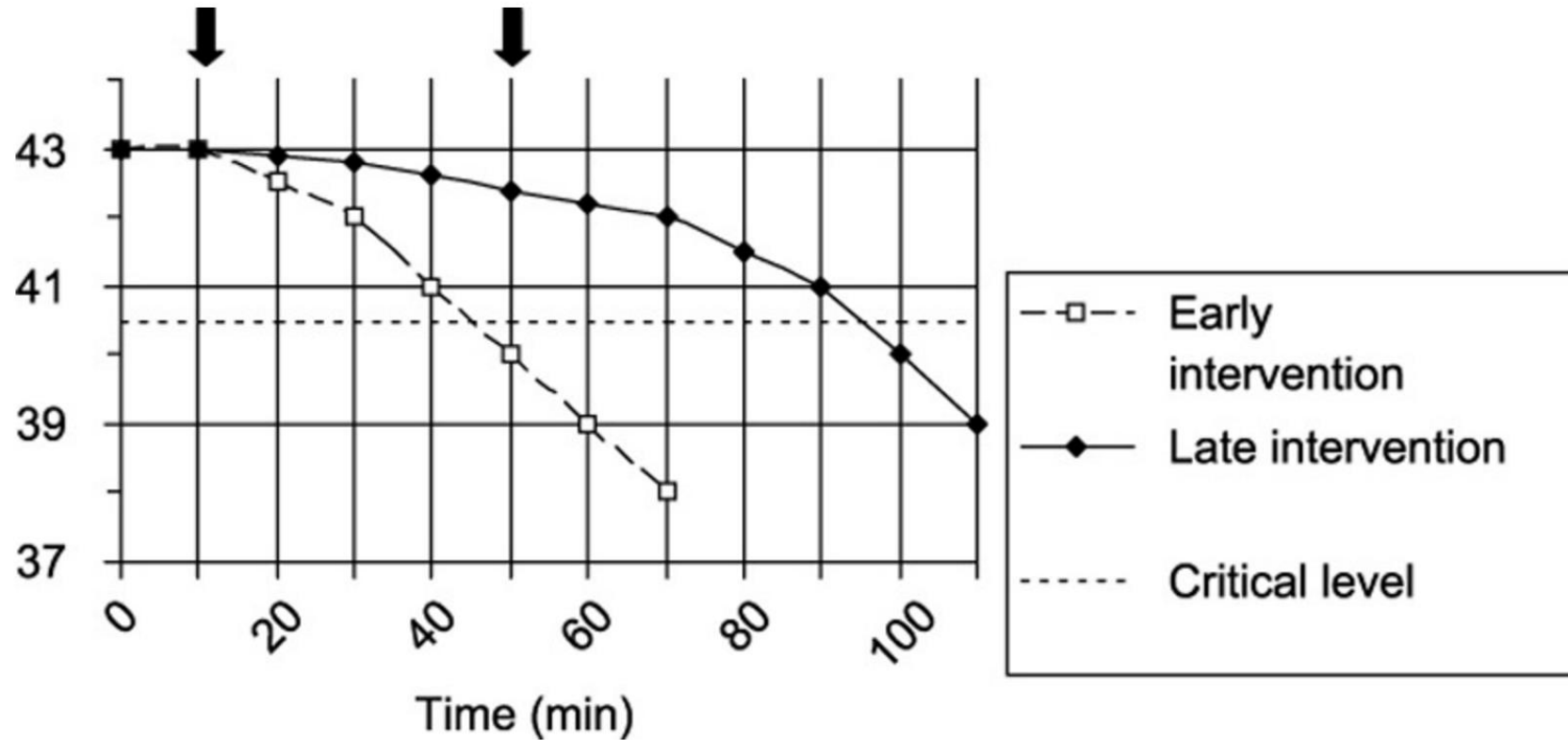
- Remove equipment/clothing
- Move to shaded/cool area
- Elevate legs
- Cool – ice towels, fans, cold water
- Rehydrate
- Monitor (including temp)
- If worsening or not improving in 30 mins → EMS

Heat Stroke

- Rapid cooling
 - Ice water immersion
 - Ice towels/cold water
- Monitor temp and vitals
 - Continuous vs. q 5-10 mins
 - Remove when temp $\leq 102^{\circ}\text{F}$
- **COOL BEFORE TRANSPORT!**



Cooling Curves



Return to Play

EAMC/Exertional Heat Syncope

- May return once symptoms resolve
- Monitor

Heat Exhaustion

- No same-day return
- May return at 24-48 hours
- Gradual increase in activity
- Monitor closely

Return to Play

Exertional Heat Stroke

- No exercise for at least 7 days
- Re-eval by physician 1 week after EHS for exam, +/- labs, +/- imaging
- When cleared for activity:
 - Start in cool environment
 - Gradually increase intensity, duration and heat exposure over 2 weeks*
 - Monitor
- Full clearance once heat tolerance is demonstrated (~2-4 weeks)



Athlete Risk

- Obesity
- Dehydration
- Electrolyte imbalances
- Poor conditioning
- Inadequate acclimatization
- Clothing/equipment
- Illness
- Medications
 - Stimulants
 - Anti-cholinergic meds
 - Sympathomimetics
 - Diuretics
- Sickle Cell Trait
- Prior EHI

WIAA Heat Policy

- Heat and humidity (heat index)
 - 30 mins prior, 60 mins after
 - Digital psychrometer
- HI <95°F
 - Ample water
 - Water breaks q 30 mins (optional)
 - Ice towels
- HI \geq 95°F – 99°F
 - Same
 - Equipment removed when possible
 - Less time outside, later/earlier practice
 - Recheck temp/humidity q 30 mins
- HI >99°F – 104°F
 - Same
 - Mandatory water breaks q 30 mins (10 mins)
 - Eliminate equipment if possible
 - If equipment needed for safety, suspend play
- HI >104°F
 - Stop all outside activity
 - Stop inside activity if inadequate cooling



SMART
SERIES

 Children's
Wisconsin

NWS Heat Index

Temperature (°F)

Relative Humidity (%)	Temperature (°F)															
	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										



Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution

Extreme Caution

Danger

Extreme Danger

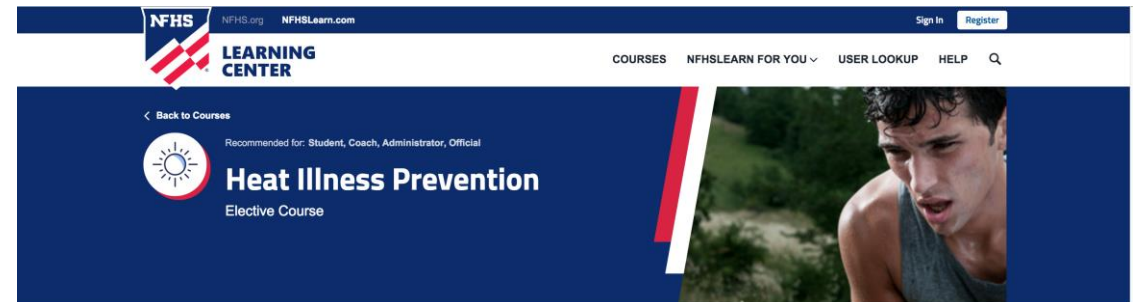


Acclimatization



Prevention

- PPE screening
- Acclimatization
- Avoid exercise during illness/fever
- Education/training/planning
- Available medical staff
- Ice tub/towels available
- Maximize recovery periods
- Hydrate (+/- electrolytes)



References

