



Heat Related Illness : an Emergency in the Making

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OMED 2017

The Body's furnace



- Energy can neither be created nor destroyed
- Muscle contraction is directly related to and limited to muscle blood flow
- This “energy” that is delivered is transformed into phosphates, mechanical contraction work, and HEAT
- Heat production is the result of muscle work, and during recovery if all is not used, the excess “energy” must be dissipated or else core temp increases

Role of Thermoregulation

- Because of the constant flux of energy, the core body temp is transient
- With out the internal regulation that takes place, even at rest, the core body temp would increase **1 degree C every 5 minutes**
 - Thus with exercise this ratio is increased further
- Mechanisms of Heat Loss
 - Non-evaporative- **Conductive** (transfer heat to colder object), **Convection** (result of fluid-ie heat loss through peripheral blood flow), and Radiation.
 - **Evaporative** – through sweat and respiratory moisture; is indirectly related to humidity (**higher humidity/temp, less ability to cool with evaporation**)

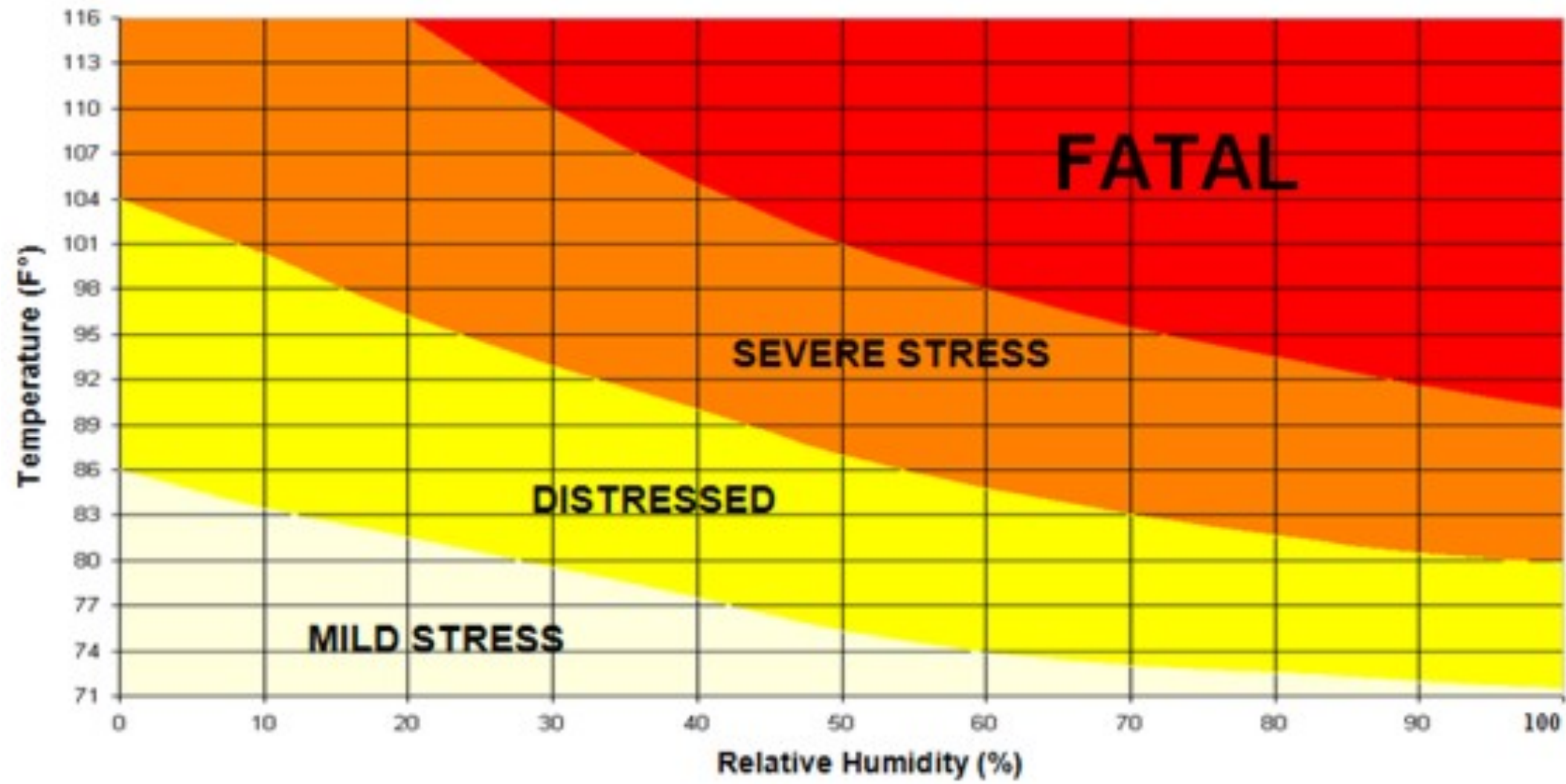
Epidemiology

- Deaths from Exertional Heat Illness were higher from 2009-2015, with an average of 9200 cases seen among high school athletes
- Sport most affected- Football
- Among collegiate athletes from 2003-2014, only 1 death was seen from Exertional Heat Illness
 - This most likely attributed to the better acclimatization programs today.

Risk Factors

- Age- young vs old
- Strenuous exercise in high ambient temp/humidity
- Lack of acclimatization
- Poor physical fitness
- Obesity
- Dehydration- almost a natural situation in athletes
- Congenital disorders-anhidrosis, sickle cell trait
- Drugs/supplements
 - Antihistamines, decongestants, amphetamines, stimulants, Betablockers

HEAT INDEX CHART



Types of Heat Illness

- Exercise associated muscle cramps (heat cramps)
- Exercise associated collapse (heat syncope)
- Heat exhaustion
- Exertional heat stroke
- These may all occur at the same time



Exercise Associated Muscle Cramps (Heat Cramps)

- Signs/sx- Severe, spreading muscle spasm/tightening seen during or after intense exercise
 - Larger limbs affected more---hamstrings/ quads
- Etiology- “salt loss, fluid loss, and muscle fatigue”
- Predisposing factors- lack of conditioning, sickle cell trait , wellness
- Treatment- Rest and cooling, ice massage, oral rehydration-water vs electrolyte supplementation
 - If no improvement after 45min- consider IVs, but check vitals first, possible use of IV diazepam, if suspect malignant hyperthermia-IV dantrolene
- Complications-impending heat exhaustion, rhabdomyolysis



Exercise Associated Collapse (Heat syncope)

- Signs/sx- syncope or lightheadedness seen at end of endurance exercise (running usually)
- Etiology- “orthostatic”, athlete is peripherally vasodilated at end of exercise, causing pooling of blood in lower limbs
- Predisposing factors- sudden end of exercise without cool down, dehydration, lack of acclimation
- Treatment- Assess ABCs, Vital Signs; lie down and elevate legs (trendelenberg position), cool down asap , orally rehydrate
 - Should resolve after 30min
- Complications- impending heat exhaustion



Heat exhaustion



- Most Common heat-related illness
- Signs- **elevated RECTAL temp >104 F**, decreased cardiac output(tachy, orthostatic), profuse sweating, **mild mental status** change (mild confusion, mood change)
- Sx- fatigue, headache, N/V, “goose bumps”
- Etiology- Failure to compensate for increase work load- combo of exertional heat stress and dehydration
- Predisposing factors- dehydration and poor acclimation
- Treatment- Assess ABCs, Vital Signs, rest in cool shaded environment, pool, or AC (need rapid cooling), Trendelenburg positioning, Oral rehydration, if decrease MS-IVFs (5% dextrose in NS) but check BMP first
 - If sx don’t resolve within 2-3hrs transfer, must monitor closely
- Complications- no long term sequelae, but increase risk for future occurrences

Exertional heat stroke

- Medical Emergency!!
- Signs- **Rectal temp above 104 F, with profound change in Mental Status,** impaired cardiac output, diminished ability to cool (no sweating), feeling of impending doom!!
- Sx- similar to heat exhaustion- dizziness, fatigue, N/V
- Etiology- TOTAL thermoregulatory failure
- Predisposing factors- recent illness, lack of acclimation, dehydration, previous problems
- Treatment- Assess ABCs, remove from hot environment, remove clothing, Vital Signs, monitor rectal temp every 5-10min, Immediate COOLING with cold water emersion , place IV line-check BMP (Na), bolus IVFs as needed to maintain BP, Vasopressors if needed, transfer to medical facility for closer monitoring. Always treat while transferring.
 - Don't hesitate to cool while waiting for IV line
 - Monitor temp until cooled to 102 F

Exertional Heat Stroke

- Complications
 - CNS- upwards of 20% have permanent problems
 - Rhabdomyolysis
 - Acute Renal Failure
 - DIC – disseminated intravascular coagulation
 - Liver Damage
 - Myocardial Injury- arrhythmias, MI, cardiac arrest
 - Pulmonary Injury- pulmonary edema moderate to severe
 - Metabolic abnormalities- hypoK, hyperK, hyperNa, hypoNa, hypoCa, hyperPhos
 - Then those seen with DIC and liver injury, etc..
- Morbidity/mortality- correlate to time elapsed between core temp elevation and initiation of cooling, can be as high as 10%

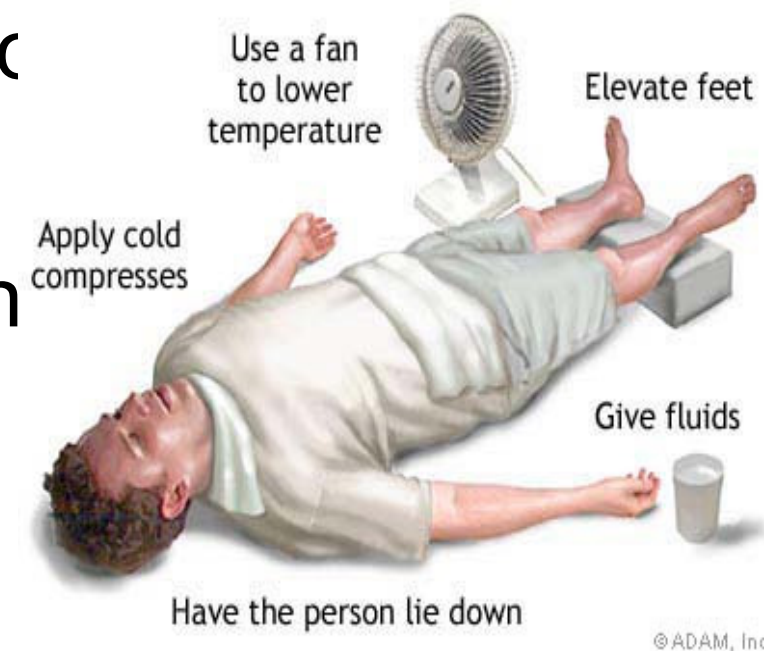


Return to Play-after heat stroke

- Needs at least 7-14 days of asymptomatic rest after release from medical care
- F/u evaluation including repeat blood work showing return to normal function
- Once cleared, begin exercise in cool environment and gradually increase intensity and duration and level of heat exposure over a 2 wk period
- If no problems, athlete may return to normal activity after 2-4wks of training
- Potential of re-injury by heat stroke increases tremendously (as high as 30-40 %) and remains high for up to a year after initial injury

Modes of Cooling

- Ice water immersion- best if available, small pool
- Wet patient down with cool spray or wet cloth
- Utilize large fan to help speed evaporative
- Ice bags on head, in axilla/groin
- Always remove from hot environment and treat while transporting





Prevention



- Obviously proper condition, fluid hydration, and heat acclimation
- Acclimation to exercise in heat takes 7-14 days, some studies from The Lancet say 5-7 days. PIAA requirement
 - Preseason conditioning programs-strength, endurance, and sport specific exercises
- Reschedule activities to cooler time of day or cancel
- Proper clothing and color of clothing
- Prevent dehydration- encourage COLD WATER intake before, during, and after, why cold??, and why water??, and how much??
 - For every 1lb loss during exercise needs to replace with 16 oz water

Programs in Place for Prevention



- PIAA—In effect, but only applies to football
 - During the heat acclimatization process football players are permitted to wear helmets and shoulder pads the first five days, 5-3-5-3-5 hrs.
 - On the third day full protective equipment is permitted but no full contact until acclimation is complete.
 - Contact is not permitted during the first 5 days of heat acclimatization -must be consecutive days. No more than 5-3-5-3-5
 - And it must be followed by a break of at least two hours
 - And football teams are limited to a maximum of 5 hours of practice a day regardless of the length of each session and minimum of 3 hours. New player must do the same before playing is permitted.

Programs in Place for Prevention

- NCAA
 - During the **first five days** of the heat-acclimatization process, **athletes may not participate in more than one practice per day**
 - If a practice is interrupted by inclement weather or heat restrictions, the practice should recommence once conditions are deemed safe, but total practice time should not exceed **three hours per day**
 - A **one-hour maximum walk-through** is permitted **during the first five days** of the heat-acclimatization period; however, a **three-hour recovery period** should be inserted between the practice and walk-through (or vice versa)
 - During the **first two days** of the heat-acclimatization period, in sports requiring helmets or shoulder pads, a **helmet should** be the only protective equipment permitted (goalies, as in the case of field hockey and related sports, should not wear full protective gear or perform activities that would require protective equipment). During days three through five, only helmets and shoulder pads should be worn
 - **Beginning on day six, all protective equipment may be worn and full contact may begin**
 - Beginning no earlier than the **sixth day and continuing through the 14th day, double-practice days must be followed by a single-practice day**
 - On single-practice days, one walk-through is permitted, but it must be separated from the practice by at least three hours of continuous rest
 - When a double-practice day is followed by a rest day, another double-practice day is permitted after the rest day.
 - On a double-practice day, neither practices **duration should exceed three hours total, and student-athletes should not participate in more than five total hours of practice**
 - Warm-up, stretching, cool-down, walkthrough, conditioning and weight-room activities are included as part of the practice time
 - The **two practices should be separated by at least three continuous hours in a cool environment**
 - Because the risk of exertional heat illnesses during the pre-season heat-acclimatization period is high, the consensus statement strongly recommends that an **athletic trainer be on site before, during, and after all practices. All athletes must be weighed before and after practices and their weight must be recorded and reviewed before the next practice.**

References

- Netters Sports Medicine
- Up To Date
- PIAA.com
- NCAA.com
- Google images
- Team Physician Handbook

