Heat Acclimatization and Heat Illness Prevention – For Safety *and* Performance

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NFHS SMAC Position Statements and Recommendations for Mitigating the Risk For Exertional Heat Illness

National Federation of State High School Associations

Heat Acclimatization and Heat Illness Prevention Position Statement

National Federation of State High School Associations (NFHS)
Sports Medicine Advisory Committee (SMAC)

Exertional Heatstroke (EHS) is the leading cause of preventable death in high school athletics. Students participating in high-intensity, long-duration or repeated same-day sports practices and training activities during the summer months or other hot-weather days are at greatest risk. Football has received the most attention because of the number and severity of exertional heat illnesses. Notably, the National Center for Catastrophic Sports Injury Research reports that **35 high school football players died of EHS between 1995 and 2010.** EHS also results in thousands of emergency room visits and hospitalizations throughout the nation each year.

This NFHS Sports Medicine Advisory Committee (SMAC) position statement is the companion piece to the NFHS's online course "A Guide to Heat Acclimatization and Heat Illness Prevention." **This position statement provides an outline of "Fundamentals" and should be used as a guiding document by member state associations.** Further and more detailed information can be found within the NFHS on-line course, the 4th Edition of the NFHS Sports Medicine Handbook, the NFHS SMAC "Position Statement and Recommendations for Hydration to Minimize the Risk for Dehydration and Heat Illness" and the resources listed below.

Following the recommended guidelines in this position statement and "A Guide to Heat Acclimatization and Heat Illness Prevention" can reduce the risk and incidence of EHS and the resulting deaths and injuries in high school athletics. The NFHS recognizes that various states and regions of the country have unique climates and variable resources, and that there is no "one-size-fits-all" optimal acclimatization plan. However, the NFHS and the NFHS SMAC strongly encourage member state associations to incorporate all of the "Fundamentals" into any heat acclimatization plan to improve athlete safety. In addition, **"A Guide to Heat Acclimatization and Heat Illness Prevention" should be required viewing for all coaches.**

Heat Acclimatization and Safety Priorities:

- Recognize that EHS is the leading preventable cause of death among high school athletes.
- Know the importance of a formal pre-season heat acclimatization plan.
- Know the importance of having and implementing a specific hydration plan, keeping your athletes well-hydrated, and encouraging and providing ample opportunities for regular fluid replacement.
- Know the importance of appropriately modifying activities in relation to the environmental heat stress and contributing individual risk factors (e.g., illness, obesity) to keep your athletes safe and performing well.
- Know the importance for all members of the coaching staff to closely monitor all athletes during practice and training in the heat, and recognize the signs and symptoms of developing heat illnesses.

National Federation of State High School Associations

POSITION STATEMENT AND RECOMMENDATIONS FOR HYDRATION TO MINIMIZE THE RISK FOR DEHYDRATION AND HEAT ILLNESS

National Federation of State High School Associations (NFHS)
Sports Medicine Advisory Committee (SMAC)

DEHYDRATION, ITS EFFECTS ON PERFORMANCE, AND ITS RELATIONSHIP TO HEAT ILLNESS:

- Appropriate hydration before, during, and after physical activity is an important ingredient to healthy and successful sports participation.
- Weight loss during exercise and other physical activity represents primarily a loss of body water. A loss of just 1 to 2% of body weight (1.5 to 3 pounds for a 150-pound athlete) can negatively impact performance. A loss of 3% or more of body weight can significantly increase the risk for exertional heat-related illness. If an athlete is already dehydrated prior to beginning activity, these effects will occur even sooner.
- Athletes should be weighed (in shorts and T-shirt) before and after warm or hot weather practice sessions and contests to assess their hydration status.
- Athletes with high body fat percentages can become significantly dehydrated and over-heat faster than athletes with lower body fat percentages while working out under the same environmental conditions.
- Athletes have different sweating rates and some lose much more salt through their sweat than others. "Salty sweaters" will often have noticeable salt stains on clothing after workouts, and often have a higher risk of developing exertional muscle cramps.
- Poor heat acclimatization/fitness levels can greatly contribute to an athlete's heat intolerance and heat illness risk.
- Certain medications, or fever, can negatively affect an athlete's hydration status and temperature regulation, increasing the risk for heat illness.
- Environmental temperature and humidity each independently contribute to dehydration and heat illness risk.
- Clothing that is dark or bulky, as well as protective equipment (such as helmets, shoulder pads, and other padding and coverings), can increase body temperature, sweat loss and subsequent dehydration and heat illness risk.

Why the Statements & Guidelines?

- Ongoing incidents of heat illness, injury, or death
  - First 1-3 days
- Why?
  - Too hard, too long, too much uniform, TOO SOON!

Exertional Heatstroke

- Leading cause of preventable death in high school athletics
- 40 high school football players died of EHS between 1995 and 2010
- Thousands of ED visits & hospitalizations each year (CDC MMWR)

Physiological Effects of the Heat

- ↑ Core Body Temperature
- ↑ Fluid/Electrolyte Loss
- ↑ Carbohydrate Use
- ↓ Time to Fatigue
- ↓ Performance
- ↑ Clinical Risk
  - Heat cramps
  - Heat exhaustion
  - Heat stroke
    - Exertional Collapse or Death

Fundamental 1: Physical Exertion & Training – Slowly & Progressively

- Begin with shorter, less intense activities & sessions
- Minimize and progressively introduce protective gear
- Allow adaptation
- Emphasize instruction over conditioning, especially at the start
- Cannot “condition” an athlete in 2-3 weeks

Heat Acclimatization

Table 4. Physiologic Responses After Heat Acclimatization Relative to Nonacclimatized State

Physiologic Variable	After Acclimatization (10–14 Days' Exposure)
Heart rate	Decreases[46,145]
Stroke volume	Increases[145,147]
Body-core temperature	Decreases[145]
Skin temperature	Decreases[152]
Sweat output/rate	Increases[46,47,149]
Onset of sweat	Earlier in training[46,145]
Evaporation of sweat	Increases[47,152]
Salt in sweat	Decreases[9,50]
Work output	Increases[46,50]
Subjective discomfort (rating of perceived exertion [RPE])	Decreases[50,145]
Fatigue	Decreases[50]
Capacity for work	Increases[46,50]
Mental disturbance	Decreases[50]
Syncopal response	Decreases[9,50]
Extracellular fluid volume	Increases[50]
Plasma volume	Increases[50,150]

Fundamental 2: Consider level of conditioning & medical status

- Current or recent illness
  - GI distress (vomiting and/or diarrhea)
  - Fever
- Medications that affect hydration or thermoregulation
  - Treat ADHD (Ritalin) or enhance performance
    - ↑ metabolic rate and hyperthermia

Fundamental 3: Adjust intensity, rest breaks, and uniform with increasing heat stress

Temperature (°F)

Relative Humidity (%)	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

- Tolerance to physical activity decreases
- Exertional heat illness risk increases
- Adjust practices for safety *and* performance
- Monitor <u>all</u> players more closely

Fundamental 4: Adequate Hydration is Essential for All Activities

- Proper hydration is integral to heat safety
- Athletes can still dangerously overheat, even when adequately hydrated

Sweat Fluid Losses & Recovery

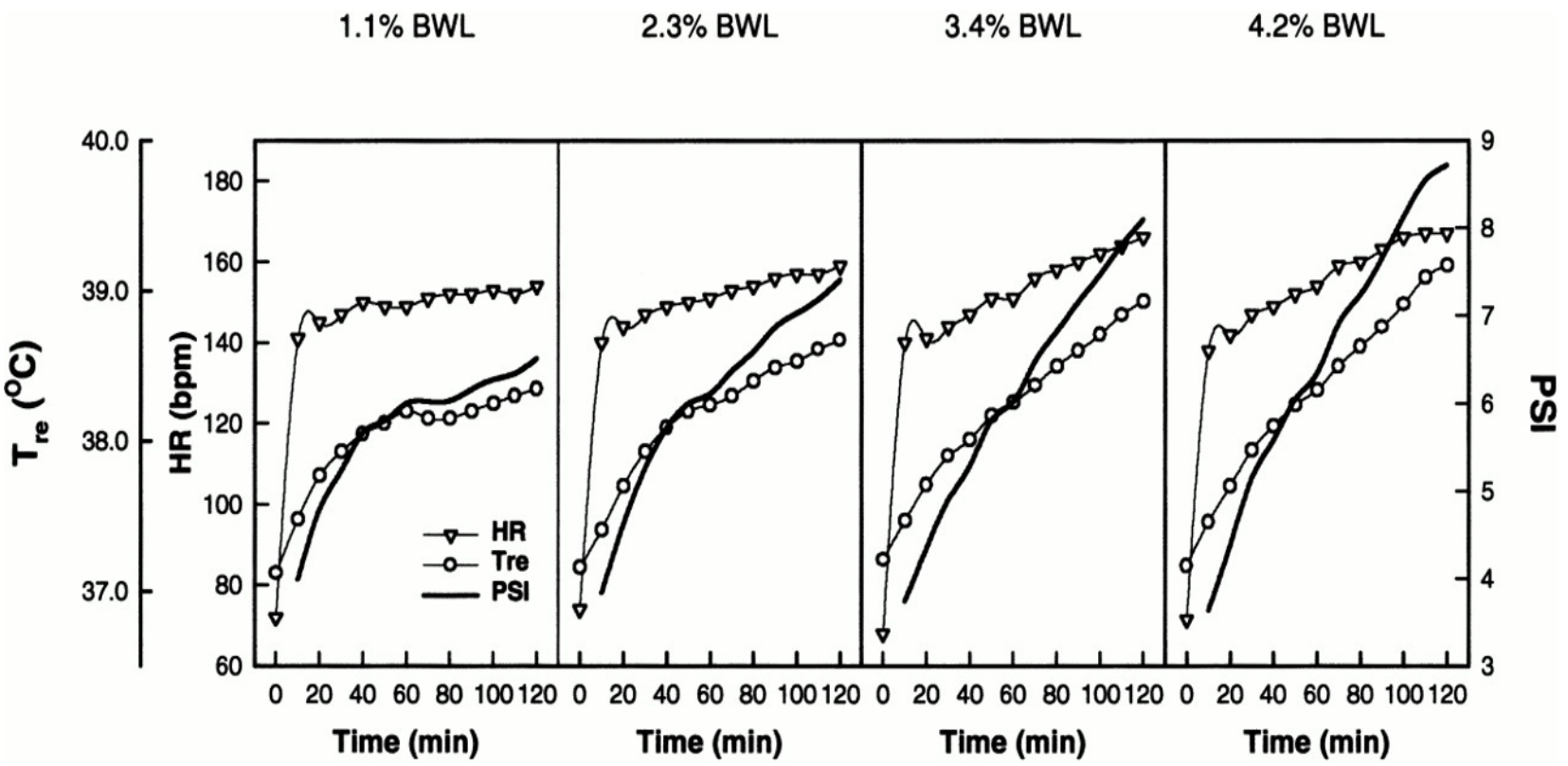
- Sweating Rate
  - –0.5 - 3.0^{+} L/hr
  - –18 – 106^{+} oz/hr

- Fluid Intake
  - –1.0 - 2.0 L/hr
  - – 35 - 70 oz/hr

Evaluation of different levels of hydration…

Moran, DS et al.

***Am. J. Physiol.* 275: R854-R860, 1998**



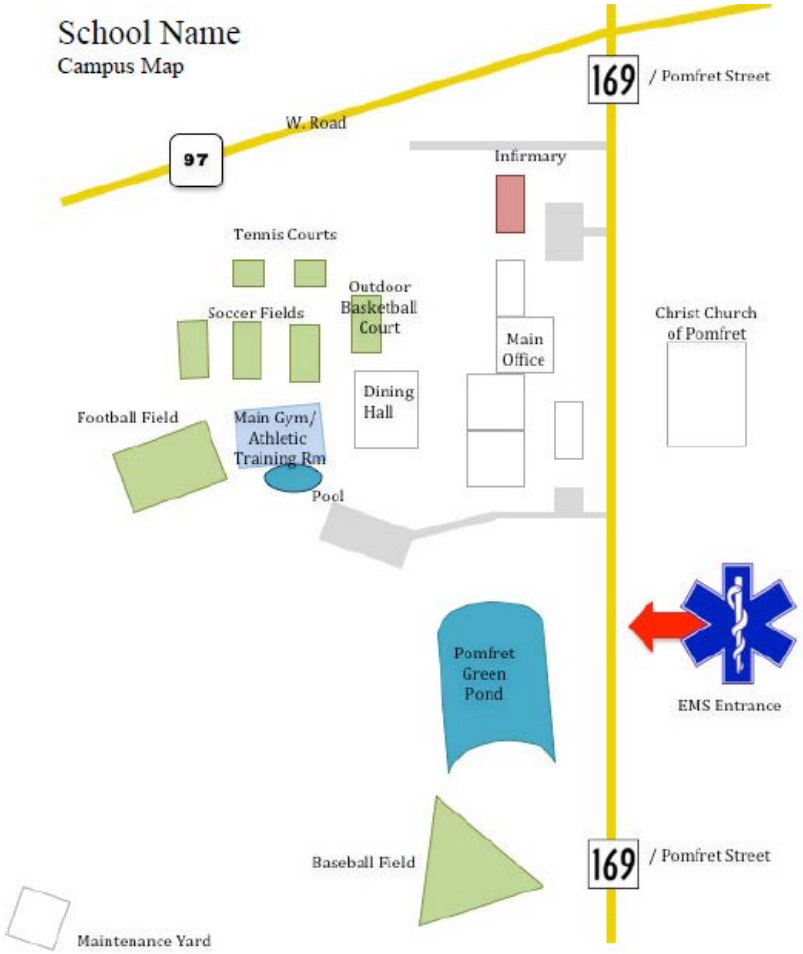
Fundamental 5: Recognize early signs of distress *and respond*!

- Athletes show signs of struggling
- Teammates are often the first to recognize
- Promptly adjust activity and treat if necessary
  - First aid should not be delayed
- Most serious problems can be averted

Fundamental 6: Stop Immediately & Activate EMS for Serious EHI

- Clumsiness, stumbling, collapse, remarkable behavioral changes or other CNS problems
- Immediately Stop!!!
- Activate EMS
- Immediate on-site rapid cooling

Fundamental 7: Emergency Action Plan – In Place & Practiced

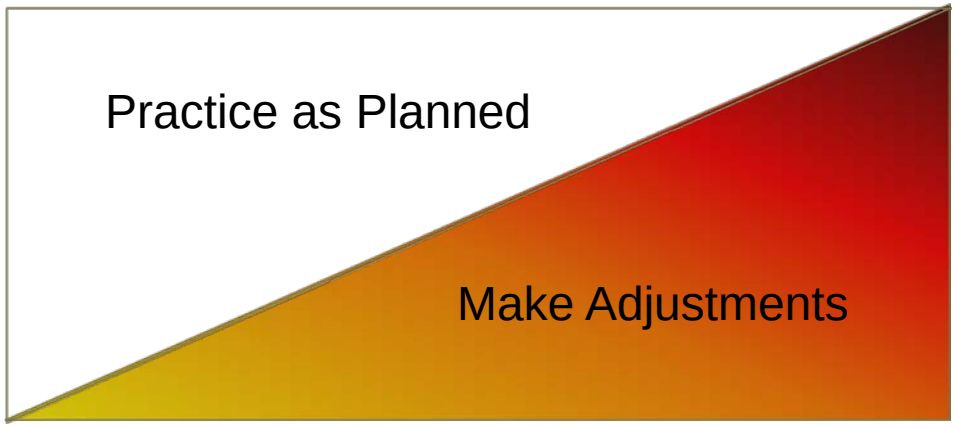


- Emergency Personnel
- Emergency Communication
- Emergency Equipment
- Roles of First Responder
- Venue Directions with a Map
- Emergency Action Plan Checklist for Non-Medical Emergencies

- **Risk Factors**
  - Heat/Humidity
  - Poor preparation
  - Excessive physical exertion; insufficient recovery between bouts
  - Poor hydration; limited access/opportunity
  - Multiple same-day sessions; not enough recovery between each
  - Uniform/Protective gear
  - Clinical Risk
    - Illness; Medications
    - Sickle Cell Trait

- **Actions**
  - Regular/sufficient fluids
  - Acclimatization
    - Heat/Humidity
    - Intensity
    - Duration
    - Uniform configurations
  - Modify Activity
    - Decrease workload
    - Increase rest period duration & frequency
    - Cancel; Move indoors
  - ↑ Rest/Recovery time
  - Limit participation
  - ↑Monitoring; EAP

Another Way to Look at It



Heat Illness Risk

- High heat and/or humidity
- Unacclimatized to:
  - Environment
  - Intensity, Duration and Uniform
- Second session of the day
- Overweight or unfit
- Clinical status or condition or medication affecting thermoregulation
- …

ACSM Consensus Statement

SPECIAL COMMUNICATIONS
Roundtable Consensus Statement

Youth Football: Heat Stress and Injury Risk

EXPERT PANEL

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INTRODUCTION

From 1995 to 2001, 21 young football players reportedly died from heat stroke in the United States (68). Since that time, the media has highlighted a number of similar incidents, as well as other heat-related problems with young players on the football field, such as exertional collapse. Despite the recognized benefits of sufficient fluid intake and precautionary measures to optimize performance and reduce the risk of heat illness, heat- and dehydration-related problems persist on the football field—particularly in preseason practice.

This roundtable highlighted football-specific empirical data and practices that directly relate to heat stress effects and heat injury risk in youth football. The presentations underscored the operational issues and factors related to heat injury risk and prevention in this age group, with a specific emphasis on preseason practice. Discussions related to general physiological, clinical, and behavioral aspects of hydration, temperature regulation, and heat strain and the clinical management of heat injury were intentionally limited so the informational outcomes of this roundtable could be readily integrated into practical and effective guidelines and strategies to reduce the risk of heat injury for youth football athletes.

Recent published and unpublished on-field observations and survey-based information give new insight to fluid balance and core temperature responses during preseason practice, as well as how selected youth programs are managing environmental challenges and attempting to prevent on-field heat-related injuries. These new data, along with previous on-field observations and other published football-specific studies and reports, provided the bases for discussions during the roundtable.

FLUID LOSSES AND HYDRATION STATUS

As with adult athletes, maintaining fluid balance can be difficult for young football players, especially in hot and humid conditions. Intensity and duration of practice, scheduling of fluid breaks, uniform configurations, and number of sessions per day are also key factors in tempering or exacerbating this challenge. Unfortunately, specific data and insight regarding fluid loss and intake patterns in young football players during practice or games are very limited.

Stover et al. (89) observed moderate rates of sweating (<1 L·h^{-1}) and small body weight deficits (about 1%) in high school players during preseason practice. These measures were slightly lower than losses described in collegiate players training in similar moderate (wet bulb globe temperature [WBGT] 25°C) environmental conditions (87). In another recent on-field examination of high school players during two successive days of preseason football training in much hotter and more humid conditions (33°C, 56% relative humidity), Bergeron et al. (unpublished findings) noted similar pre- to postpractice body weight deficits of nearly 1%, despite each player consuming about 2 L of water during the daily 2-h practice sessions. Moreover, greater sweat fluid losses led to greater body weight deficits. This is not surprising, as athletes often do not match sweat loss with fluid intake during exercise in the heat (10,14). Bergeron et al. also noted that the 10 players presented with elevated urine specific gravities on day 1, suggesting that they were not well-hydrated at the start of practice. Notably, the same players had even higher urine specific gravities at the start of practice on day 2, suggesting that their recovery fluid intake to restore sweat fluid losses from the previous day

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- Acclimatization
  - Environment
  - Intensity
  - Uniform/Protective Gear
- Hydration
- Practice Modification
- Monitoring/Cooling
- Clinical Support and Education

Preseason Practice Guidelines

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www.nata.org/jat

consensus statement

Preseason Heat-Acclimatization Guidelines for Secondary School Athletics

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A proper heat-acclimatization plan in secondary school athletic programs is essential to minimize the risk of exertional heat illness during the preseason practice period. Gradually increasing athletes' exposure to the duration and intensity of physical activity and to the environment minimizes exertional heat-illness risk while improving athletic performance. Progressive acclimatization is especially important during the initial 3 to 5 days of summer practices. When an athlete undergoes a proper heat-acclimatization program, physiologic function, exercise heat tolerance, and exercise performance are all enhanced.[1–6] In contrast, athletes who are not exposed to a proper heat-acclimatization program face measurable increased risks for exertional heat illness.

For these reasons, the Inter-Association Task Force for Preseason Secondary School Athletics, in conjunction with the National Athletic Trainers' Association's Secondary School Athletic Trainers' Committee, recommends that these "Preseason Heat-Acclimatization Guidelines for Secondary School Athletics" be implemented by all secondary school athletic programs. These guidelines should be used for all preseason conditioning, training, and practice activities in a warm or hot environment, whether these activities are conducted indoors or outdoors. When athletic programs implement these guidelines, the health and safety of the athletes are primary. However, the recommendations outlined here are only minimum standards, based on the best heat-acclimatization evidence available. Following these guidelines provides all secondary school athletes an opportunity to train safely and effectively during the preseason practice period.

DEFINITIONS

Before participating in the preseason practice period, all student-athletes should undergo a preparticipation medical examination administered by a physician (MD or DO) or as required/approved by state law. The examination can identify predisposing factors related to a number of safety concerns, including the identification of youths at particular risk for exertional heat illness.

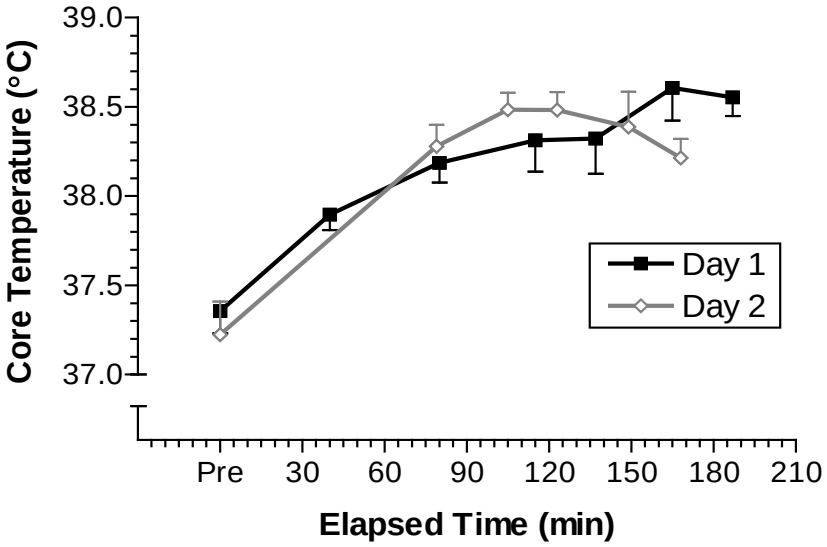
The *heat-acclimatization period* is defined as the initial 14 consecutive days of preseason practice for all student-athletes. The goal of the acclimatization period is to enhance exercise heat tolerance and the ability to exercise safely and effectively in warm to hot conditions. This period should begin on the first day of practice or conditioning before the regular season. Any practices or conditioning conducted before this time should not be considered a part of the heat-acclimatization period. Regardless of the conditioning program and conditioning status leading up to the first formal practice, all student-athletes (including those who arrive at preseason practice after the first day of practice) should follow the 14-day heat-acclimatization plan. During the preseason heat-acclimatization period, if practice occurs on 6 consecutive days, student-athletes should have 1 day of complete rest (no conditioning, walk-throughs, practices, etc).

Days on which athletes do not practice due to a scheduled rest day, injury, or illness do not count toward the heat-acclimatization period. For example, an athlete who sits out the third and fourth days of practice during this time (eg, Wednesday and Thursday) will resume practice as if on day 3 of the heat-acclimatization period when returning to play on Friday.

A *practice* is defined as the period of time a participant engages in a coach-supervised, school-approved, sport- or conditioning-related physical activity. Each individual practice should last no more than 3 hours. Warm-up, stretching, and cool-down activities are included as part of the 3-hour practice time. Regardless of ambient tempera-

Doing it Right

Core Body Temperature



- **Day 1**
  - **32.5 ± 1.7° C**
  - **58.0 ± 5.0% rh**
- **Day 2**
  - **34.0 ± 1.0° C**
  - **53.8 ± 3.0% rh**
- **Hazy & sunny**

Musculoskeletal Injury Risk

- Fatigue
  - Loss of biomechanical control & stability
- Muscle Strains
- Torn Ligaments
- Stress Fractures
- Mild to Severe Rhabdomyolysis
  - Life threatening
  - Recent cases highlighted in the media

Facing Changes

Coaches Feedback

- Few (if any) heat-related problems
- Less time lost to all injuries (including heat)
- Still adequately prepared

Key Points: Performance & Safety

- Progressive acclimatization is critical
- Often begin practice measurably dehydrated
  - ↑ CV & thermal strain
- Full hydration
  - Water *and* sodium
- Multiple sessions
  - Insufficient recovery
- Monitoring & Planning

A Guide to Heat Acclimatization & Heat Illness Prevention

Higher risk for heat illness:

- High intensity outdoor sports in hot & humid weather

35 high school football players died of exertional heat stroke between1995 and 2010.

TRANSCRIPT | RESOURCES

Heat illness is the leading cause of preventable death in high school athletics. Students participating in high-intensity outdoor sports during the summer months are at the greatest risk. Football has received the most attention due to the number and severity of heat illnesses. In fact the National Center for Catastrophic Sports Injury Research reports that 35 high school football players died of heat stroke between 1995 and 2010.

Thank you!