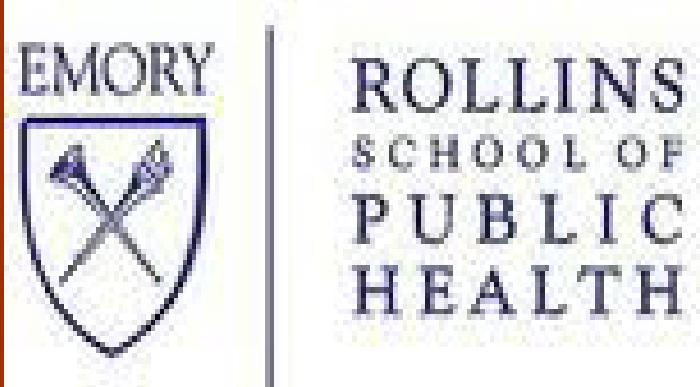


# Surveillance for Heat-Related Illness Among Student Athletes in Georgia

## Sheila Bashirian, Shalonda Freeman, Stephanie Joseph, Heather Peebles



### Introduction and Background

Heat illness is often associated with morbidity and mortality among student athletes (1). Heat illness is classified by degree of symptom severity: heat edema, heat rash, heat syncope, heat cramps, heat exhaustion and heat stroke. Heat stroke is the most severe heat illness and can be fatal. The third most common cause of US high school exercise-related mortality is heat stroke (2). While heat stroke is usually associated with dehydration, heat cramps is caused by electrolyte, especially sodium, depletion.

Table I. Risk Factors for Heat Illness (3)

- Prepubescent age
- Obesity
- Lack of fitness
- Dehydration
- Lack of acclimatization
- Prior history of heat illness
- Sleep deprivation
- Medications (antidepressants, diuretics, antihypertensive, antihistamines)
- Stimulants (caffeine, Ma Huang, ephedra, pseudoephedrine)
- Alcohol consumption
- Sweat gland dysfunction
- Sunburn
- Upper respiratory illness, acute gastroenteritis within 1 week of strenuous exercise

Table II. Criteria for Diagnosis of Heat Illness (4)

Condition	Core Temperature °F (°C)	Associated Symptoms	Associated Signs
Heat Edema	Normal	None	Mild edema in dependent areas (ankles, feet, hands)
Heat Rash	Normal	Pruritic rash	Papulovesicular skin eruption over clothed areas
Heat Syncope	Normal	Dizziness, generalized weakness	Loss of postural control, rapid mental status recovery once supine
Heat Cramps	Normal or Elevated but <104°F (40°C)	Painful muscle contractions (calf, quadriceps, abdominal)	Affected muscles may feel firm to palpation
Heat Exhaustion	98.6°F - 104°F (37°C - 40°C)	Dizziness, malaise, fatigue, N/V, headache	Flushed, profuse sweating, cold clammy skin, normal mental status
Heat Stroke	>104°F (40°C)	Possible history of heat exhaustion symptoms before mental status change	Hot skin with or without sweating, CNS disturbance (confusion, ataxia, irritability, coma)

### Context and Objectives:

State: GA  
 Surveillance objective: Heat illness incidence  
 Target population: Student athletes  
 Initial year budget levels:  
 • Level 1: \$250,000  
 • Level 2: \$500,000  
 • Level 3: \$1,000,000

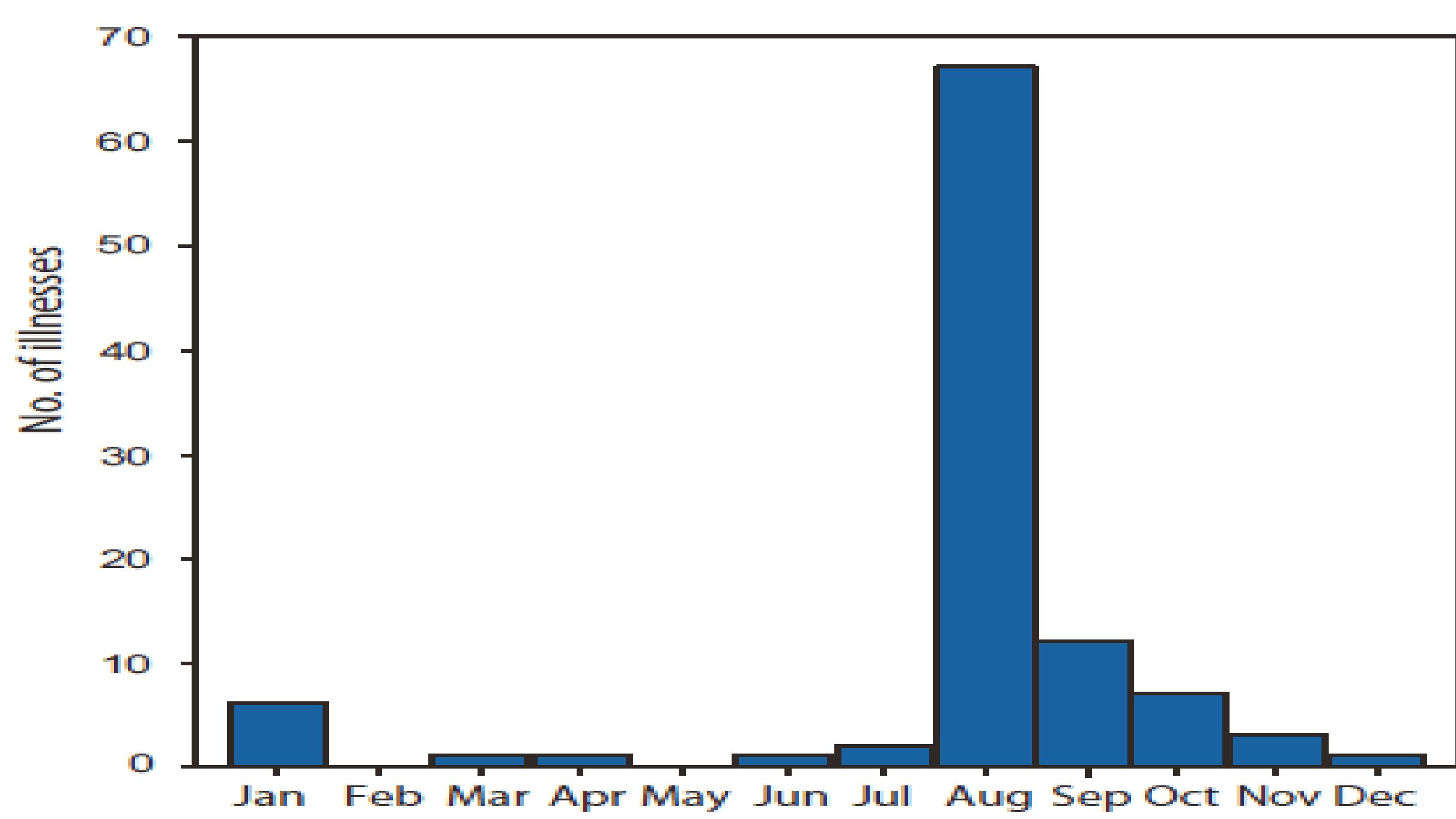
### Methods

- Pubmed searches: 1. school sports injury surveillance and 2. "heat stress disorders" and "athlete"
- Google search: "school sports injury surveillance"
- Survey of ICD-9 codes related to heat illness (identified 992 and its subsection)
- Based on literature and web searches, development of 3 levels of surveillance programs, each at different escalating cost levels.
- A risk-based approach was used to develop the surveillance systems. The population at highest risk for heat illness was targeted, as was the highest risk sport, and highest risk time period.
- The merits of each surveillance system were assessed in terms of cost, usefulness, sustainability and simplicity.

### Findings

#### Epidemiology

FIGURE. Number (n = 101\*) of time-loss heat illnesses among high school athletes, by month — National High School Sports-Related Injury Surveillance Study, United States, 2005–2009 (1).



\* Excludes 17 cases with missing dates.

† Defined as dehydration or heat exhaustion/heat stroke that 1) resulted from participation in a school-sanctioned practice or competition, 2) was assessed by a medical professional (with or without treatment), and 3) resulted in ≥1 days of time loss from athletic activity.

§ Data based on reports from a 100-school sample.

#### Surveillance Case Definition: Heat Illness

##### Case definition:

Students age 5-18 years old experiencing one or more of the following:

- Heat edema – mild swelling in ankles, feet or hands
- Heat cramps – painful muscle contractions
- Heat syncope – brief loss of consciousness (fainting) or dizziness and generalized weakness
- Heat exhaustion – the inability to continue physical activity due to fatigue, mild confusion, nausea, vomiting or syncope
- Heat stroke – malfunction or failure of internal organ system, pronounced mental status changes (altered consciousness, coma, convulsions, disorientation, irrational behavior), fatigue, nausea or vomiting

##### Case classification:

**Confirmed cases:** Must match the case definition and the following criteria:

1. Participated in a school or recreation league sponsored practice or competition
2. Assessed by a medical profession (with or without treatment)
3. Resulted in any amount of time loss from athletic activity

**Probable cases:** Must match the case definition and meet criteria 1 and 2 above.

#### Proposed Surveillance Options

##### Level 1: \$250,000

Overview: Review data from the national high school sports related injury surveillance study to identify reports of heat illness which meet the case definition, and which occur 1.) only for the sport of football (since it is the highest-risk sport (5)) and 2.) during the time periods of August and September (since these are the months during which most heat illnesses occur (5,6))

Data source: National High School Sports Related Injury Surveillance Study

##### Strengths:

- Existing data source is easy to access and therefore cost effective.
- Studies also have stable funding and are therefore sustainable.

##### Weaknesses:

- Only NATA (National Athletic Trainers Association) certified trainers are asked to participate in the survey. This covers only ~42% of schools in the US (low representativeness).
- Not all sports are covered, so data will underestimate the total number of cases in Georgia
- Does not capture very young students (younger than high school age) or college-age students (low representativeness).

• Football data is only recorded for boys/men and not women (not representative of both genders)

##### Level 2: \$500,000

Overview: Level 1 activities plus: Review data from the NCAA injury surveillance program to identify reports of heat illness which meet the case definition, and which occur 1.) only for the sport of football (since it is the highest-risk sport (5)) and 2.) during the time periods of August and September. Also review insurance claims and medical records for ICD-9 codes (992) related to heat illness during the time periods of August and September.

Data sources: 1.) National high school sports related injury surveillance study

2.) NCAA injury surveillance program 3.) Medical records and insurance claims (ICD-9 codes)

##### Strengths:

- Same as Level 1, plus the following:
- Review of ICD-9 codes will capture data for elementary school age children (thereby increasing representativeness)

##### Weaknesses:

- Same as level 1 for the high school survey data source plus the following:
- Football data is only recorded for boys/men and not women (not representative of both genders)
- Not all sports are covered, so will underestimate the total number of cases in Georgia,
- Does not capture students younger than high school age (low representativeness)
- Review of medical records is labor intensive and expensive and may only be able to identify age and gender, but not which sport or if injury occurred during sports (not necessarily representative of athletes).

### Findings

#### Level 3: \$1,000,000

Overview: Level 2 activities (excluding ICD-9 code review) plus the development of a statewide surveillance survey for elementary/middle school, which is based on the National High School Sports Related Injury Surveillance Study

Data sources: 1.) National High School Sports Related Injury Surveillance Study  
 2.) NCAA injury surveillance program 3.) New Georgia elementary school surveillance study

##### Strengths:

- Creation of the new system would allow quality data to be captured for the younger students (increased representativeness).
- In terms of simplicity, since this could be modeled after the existing high school study, it would be fairly straightforward (simplicity).
- Since the new survey is modeled after the existing survey, it may be more likely to be sustained, as the same funding partners may be open to funding this venture as well (sustainability).
- Using multiple data sources helps ensure that a broad net is cast (increased sensitivity).
- Other strengths as listed in Level 2 (excluding those related to ICD-9 review).

##### Weaknesses:

- Implementing the new study and gathering data will have an extensive requirement of both time and resources. Because this option is so labor intensive, it is costly and may not be sustainable (high cost, questionable sustainability).
- Distinguishing heat-illness medical records and insurance claims from other records is a tedious process. The data is not obtained from a centralized location and is not streamlined. (complex, not simple).
- Funding for a new survey study may be difficult to sustain (questionable sustainability).
- Other weaknesses as outlined in level 2 (excluding those related to ICD-9 review).

### Stakeholders

Professional Associations	Manufacturers of sports equipment and clothing	Therapy professionals (speech, occupational and physical)
American Football Coaches Association	Producers of sports drinks	<b>Team/School Stakeholders</b>
National Collegiate Athletic Association	Manufacturers of sports enhancers (drugs, supplements etc)	Coaches
The National Association of State High School Associations	Athletic trainers	School administrators
National Athletic Trainers Association	Pharmaceutical companies (Rx drugs can increase risk)	Teachers/Instructors
American College of Sports Medicine	Rules committees	Team physicians
American Academy of Pediatrics, Committee on Sports Medicine and Fitness	EMS	School organizations (PTO, Booster Club, Alumni etc.)
<b>Local Stakeholders</b>	Local physicians	Personal Stakeholders
	Hospitals	Parents/Guardians
	Sub-acute care facilities	Student athletes
	Long-term care facilities	Team members
<b>National Stakeholders</b>		

### Recommendations

- Implement Level 3. Although this is the costliest option, it is also the one with the most useful data because it captures athlete-specific information for all three age groups (elementary school age, high school age and college age). We particularly liked this option because it provided the ability to capture data for the highest risk group (very young students playing football). It may also be the easiest to sustain since the partners who fund the high school survey may be likely to expand to funding the elementary school survey. Since it is based on an existing system, it also ensures simplicity.
- Increase public awareness. Coordinate with injury prevention groups, community recreation centers and schools to promote awareness of the heat illness problem and increase student, parent, instructor and coach education. Also educate clinicians about correct classification and reporting of heat illnesses.

### Summary and Conclusions

- Heat illness is based on a spectrum of symptoms ranging from heat related cramps to heat stroke.
- The incidence of heat illness among student athletes is currently underestimated because existing surveillance systems monitor all sports injuries that occur among collegiate and high school athletes.
- In 2002, NATA published heat illness prevention guidelines for all levels of football.
- Because of recent high profile heat related deaths, there is increased focus on athletes and heat illness.
- Georgia school-aged athletes are at higher risk for heat related illness due to higher humidity.
- Implementation of a statewide surveillance system will provide data for all school athletes on a continuous basis, enhancing sensitivity.
- Starting the statewide structure will be challenging but once established, the system would be able to continue without much maintenance adding to its sustainability.

### References

1. Centers for Disease Control and Prevention (CDC) (2010) Heat illness among high school athletes ... United States, 2005-2009. *MMWR Morb Mortal Wkly Rep*, Vol 59: No 32 1009-1013.
2. Martin TJ and Martin JS. (2002) Special issues and concerns for the high school- and college-aged athletes. *The Pediatric Clinics of North America*, Vol 49: 533-552.
3. Coris EE, Ramirez AM, Van Durme DJ. (2004) Heat illness in athletes: the dangerous combination of heat, humidity and exercise. *Sports Medicine*, Vol 34: No 1 9-16.
4. Howe, A.S., Boden, B.P. (2007) Heat-Related Illness in Athletes. *American Journal of Sports Medicine*, Vol 35: No 8 1384-1395.
5. Centers for Disease Control and Prevention (CDC) (2006) Sports Related Injuries Among High School Athletes-United States, 2005-06 School Year. *MMWR Morb Mortal Wkly Rep*, Vol 55: No 38 1037-1040.
6. Cooper ER, Ferrara MS, Broglie SP. (2006) Exertional heat illness and environmental conditions during a single football season in the southeast. *J Athl Train*, Vol 41: 332-336.