

A Game Plan for Heat Stress

Policy Recommendations for High School Sports

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CONTENTS

Introduction	1
HSAAs' Role in Mitigating Heat Exposure	2
Policy Recommendations	2
Recommendation 1: Environmental Heat Monitoring	2
Recommendation 2: Activity Modification Guidelines	3
Recommendation 3: Venue-Specific Heat Protocols	4
Recommendation 4: Universal Application of Heat Policies	5
Recommendation 5: Investment and Implementation	5
Conclusion	6
References	7

Introduction

High school athletic associations (HSAAs) bear the responsibility of ensuring the health and safety of student-athletes, an increasingly urgent task in light of climate change and rising temperatures. Exertional heat illness poses a significant risk to student-athletes. The Korey Stringer Institute (KSI) [regularly evaluates](#) each state's high school sport safety protocols (KSI 2023). These evaluations reveal considerable disparities in policies across states. Our recommendations build on KSI's research and aim to provide a comprehensive strategy to manage heat stress, targeting improvements in measurements, guidelines, plans, universal application, and funding.

Five Key Recommendations

- (1) Environmental Heat Monitoring:** The most accurate way to evaluate heat stress is to implement on-site heat monitoring using a handheld (or tripod-mountable) device to measure environmental conditions. An appropriate heat stress monitor measures wet bulb globe temperature (WBGT). Training should be provided to staff for correct measurement and use in activity modification.
- (2) Activity Modification Guidelines:** Provide athletic trainers, coaches, and student-athletes with detailed, sport-specific guidelines based on heat stress levels that outline safe practices for hydration, work-to-rest ratios, clothing, practice length limitations, equipment use, and heat acclimatization. Ensure that all stakeholders thoroughly understand the guidelines and how to implement at their facility. For examples, see [GHSA n.d.](#); [Cooper et al. 2020](#); [NCHSAA n.d.](#); [OSHA 2017](#); [Jacklitsch et al. 2016](#); and [Hosokawa et al. 2019](#).
- (3) Venue-Specific Heat Protocols:** Each school should incorporate detailed heat safety plans within venue-specific emergency action plans to account for unique environmental conditions of a given location. These plans are most effective when paired with regular drills simulating emergency situations and school-wide education and training, and should be reviewed annually.

- (4) **Universal Application of Heat Policies:** To ensure comprehensive protection of student-athletes from heat-related health risks, apply heat policies to both indoor and outdoor sports and extracurricular activities.
- (5) **Investment and Implementation:** Explore funding opportunities (such as through the [National Federation of State High School Associations](#)) to facilitate the purchase of necessary resources such as WBGT meters. Consider a system for coaches to log WBGT measurements, with incentives for compliance, and promote consistent communication to support adherence to policies.

The goal of these policy recommendations is to create a safer environment for all high school athletes by mitigating the risk of heat-related illnesses. Implementing robust environmental heat measurements, thorough activity modification guidelines, and venue-specific heat action plans across all sports and venues will significantly reduce heat-related illnesses in high school athletes. While primarily targeting high school athletics, these principles can also be applied to other youth physical activities such as elementary and middle school sports, marching bands, camps, and park activities.

HSAAs' Role in Mitigating Heat Exposure

HSAAs have a vital role to play in safeguarding the health and well-being of student-athletes. One key area is the prevention and management of exertional heat illness, which can have serious—even fatal—consequences. Heat stress presents a significant risk to student-athletes, and this risk is growing with the increasing frequency of extreme temperatures caused by climate change. Existing state policies exhibit considerable variance. Although several HSAAs require using heat stress indices such as wet bulb globe temperature (WBGT), many either simply recommend WBGT or only include policies based on more rudimentary metrics, such as the Heat Index. Furthermore, most HSAAs lack enforcement mechanisms to ensure policy compliance. A coordinated, efficacious approach is therefore vital for the protection of young athletes.

POLICY RECOMMENDATIONS

As part of an ongoing commitment to safeguard student-athletes from heat-related illnesses, HSAAs should consider the following policy recommendations.

Recommendation 1: Environmental Heat Monitoring

Accurate assessment of environmental conditions is crucial for evaluating heat stress at a given time and location. This can be achieved by (1) on-site measurement using a scientific instrument and (2) use of a robust index that suits the local climate, since what works in one region may not work in another. WBGT is a comprehensive heat stress measure, especially useful in humid climates. Unlike the Heat Index, which only takes into account humidity and air temperature, WBGT incorporates multiple variables such as air temperature, humidity, wind speed, and radiation (e.g., sunlight).

Despite the increasing popularity of mobile apps offering temperature readings, their dependence on data from the nearest weather stations can lead to significant inaccuracies resulting from local variations in conditions. **Consequently, on-site measurement is crucial.** HSAs should provide clear guidelines for on-site heat stress measurements, including where and how to take measurements, identifying shaded areas, and the frequency of readings. Training for staff on measurement accuracy and proper interpretation of index values is also recommended. One source for additional information and guidance on measuring environmental heat stress can be found in the work by [Hosokawa et al \(2021\)](#).

Recommendation 2: Activity Modification Guidelines

Activity modification guidelines serve as a practical translation of environmental heat monitoring into actions that directly mitigate exposure of student-athletes to excessive heat. This includes establishing thresholds above which activities should be modified or even halted, according to the intensity of exertion, equipment used, and duration of the activity. The establishment of such thresholds should be based on robust research from within a specific region (and climate) linking heat stress index readings to specific health outcomes. One example of this can be found in Georgia ([Cooper et al. 2020](#)).

In addition to determining when activity should be halted, modifications to activities should encompass the following:

- **Work-to-Rest Ratios:** An important aspect of these guidelines should include varying ratios of work to rest based on heat stress index readings. Breaks should be required to be in shaded (for outdoor sports) or air-conditioned (for indoor sports) areas and unlimited opportunities for hydration should be provided during these breaks.
- **Hydration:** Adequate hydration is critical to prevent heat-related illnesses. Mandated hydration breaks should be woven into activity schedules, especially during hot weather. Providing access to water and/or sports drinks should be mandatory. Athletes should also be encouraged to hydrate before and after practices and games. Weigh-ins of athletes should be strongly considered, before and after practice, to track hydration levels.
- **Clothing and Equipment:** Guidelines should also consider the types of clothing and equipment worn during periods of high heat stress. Uniforms that are light in color and breathable should be recommended and the use of heavy or full-body equipment should be limited. Specific and clear requirements for each environmental heat stress level should be included.
- **Heat Acclimatization:** Athletes need time to acclimate to hot conditions. As such, the start of sports seasons or training camps, often during late summer, should include a heat-acclimatization period. This may involve gradually increasing the duration and intensity of training sessions over one to two weeks without wearing equipment, allowing athletes to adjust to the heat gradually. Two sources for guidance on heat acclimatization protocols are the [National Federation of State High School Associations \(NFSA 2022\)](#) and [Adams et al. \(2021\)](#).

- **Specific Guidelines for Different Sports:** Different sports have varying levels of exertion and equipment use. Therefore, sport-specific modifications should be developed. For instance, football, with its heavy protective gear, might require more conservative guidelines than cross country running.

Implementation of these guidelines should be made mandatory to effectively protect student-athletes from heat-related illnesses. Furthermore, it's essential that all involved parties—athletes, coaches, referees, and even spectators—understand these guidelines to ensure their correct application. Education programs and resources must be readily available to increase awareness and understanding.

Recommendation 3: Venue-Specific Heat Protocols

Schools should be required to have a detailed heat action plan. The overarching components of such a plan that include details of the prevention, recognition, and treatment of heat-related illnesses can be outlined for all sports in a single document, such as an existing school-wide emergency action plan. Accuracy of this information is critical, with clear policies regarding exertional heat stroke treatment specifying “cool first, transport second.” Robust information is provided in the National Athletic Trainers’ Association Position Statement: Exertional Heat Illnesses (Casa et al. 2015). Additionally, it is also critical to account for venue-specific factors that affect levels of heat stress and the ability to provide adequate shaded breaks and additional emergency cooling solutions such as cold-water immersion tubs. These details should be incorporated into existing venue-specific emergency action plans.

Understanding the unique characteristic of each venue is critical, as environmental conditions can differ considerably across small distances (for instance, the length of one or two football fields). Several factors can influence temperature, humidity, and airflow at a particular location:

- Natural elements such as the percentage of the surrounding field/area that is forested, and local sources of humidity like nearby bodies of water or swampy wetland areas.
- The influence of topography—for instance, fields located at the bottom of a hill may experience reduced airflow.
- The type of surface, with tennis courts, asphalt, and artificial turf often generating more ground-level heat than grass fields.

Understanding these factors can aid in determining optimal practice or play times for each location. Locations identified as “hot spots” may benefit from interventions such as large fans to enhance airflow or shade structures to block the sun. The effectiveness of these interventions should be verified using scientific meters.

A WBGT meter could be used to monitor all potential venues (e.g., grass or artificial turf fields, tennis courts, etc.) for 30 minutes on a hot and sunny day. These measurements could then be compared to establish a general baseline for heat levels at each location. Schools should also have a basic understanding of weather conditions, as recent heavy rain and resulting wetter soil could increase local humidity levels.

In addition to identifying and monitoring environmental factors, schools should regularly conduct drills simulating emergency situations. This ensures that the protocol will be effectively executed when needed. It's also critical that the heat safety plan includes the education and training of coaches, trainers, and athletes on heat stress implications and mitigation strategies.

Recommendation 4: Universal Application of Heat Policies

The requirement for robust heat stress monitoring should apply to all sports, both indoor and outdoor. Even indoor environments such as gymnasiums can pose heat risks if not adequately air conditioned. By applying these guidelines universally, HSAsAs can ensure all student-athletes are equally protected from heat-related health risks. Furthermore, applying these guidelines to extracurricular activities such as marching band and cheerleading will safeguard an even larger population of students from heat-related illnesses.

For indoor environments that may not have efficient air conditioning or none at all, HSAsAs should mandate measures to aid cooling, such as strategically placing fans to circulate air. It's also important to measure the WBGT in these indoor spaces when fans are operational to assess their effectiveness in reducing heat stress.

States such as Georgia, Indiana, Minnesota, North Carolina, and South Carolina have robust guidelines based on WBGT that have been successful in preventing heat-related illnesses and could serve as examples for other states. These states have mandated the use of WBGT and have had comprehensive policies in place for years, demonstrating the feasibility and effectiveness of such strategies.

Lastly, regulations for activity modifications or practice cancellations during heat events should extend to the games themselves. If athletes have not been acclimated to the most thermally stressful conditions during practice, this may increase their risk during games held under these dangerous conditions. The logistics and other implications of game cancellations often pose challenges, but these could be mitigated by enforcing more stringent safety measures during games. These could include having more professionally trained medical staff on hand to treat heat illnesses immediately and effectively (such as by requiring ice immersion tubs be on-site), implementing more frequent breaks during the game, or even rescheduling games to take advantage of cooler, shaded conditions when possible.

Recommendation 5: Investment and Implementation

Despite the potential costs, such as the purchase of WBGT meters and emergency cooling solutions, these strategies provide invaluable benefits to student health. In addition, these investments can often be funded by grants. For example, the North Carolina High School Athletic Association was able to purchase WBGT meters for all of their member schools thanks to a grant from the National Federation of State High School Associations.¹ Such funding opportunities could be explored by other states to help mitigate the costs.

Development of comprehensive policies is an important first step, but enforcement is also critical to ensure effective implementation. HSAsAs could consider incentives to encourage compliance,

¹ J. Fonseca, personal communication with author.

and consistent communication to support adherence to policies. Additionally, HSAAs could also consider a system for coaches or athletic trainers to log the WBGT during their practice timeframe via a web portal or a mobile application. In times of particularly high heat stress, more stringent reporting requirements could be implemented to ensure safety. This system could include automated warnings to schools when extreme heat conditions are forecast, with penalties for noncompliance, such as disqualification from games or playoffs if conditions and associated modifications to practices/games are not documented.

It is crucial to emphasize that these policies should be **mandatory** rather than merely recommended. Making such policies compulsory will ensure uniformity in heat stress management, providing a safer environment for athletes across all high schools. This will help to prevent heat-related illnesses and ensure the health and safety of all student-athletes, a priority for any athletic program.

CONCLUSION

The goal of these policy recommendations is to create a safer environment for high school athletes by reducing the risk of heat-related illnesses. By implementing policies regarding robust environmental heat measurement, thorough activity modification guidelines, venue-specific heat action plans, and, ultimately, applying all of these to every sport and venue, HSAAs will make a significant step toward preventing heat illnesses in high school athletes.

Emerging applications enabling easy monitoring of individual athletes' physiological conditions could augment heat safety measures in the future. Integrating this personalized data with environmental heat stress monitoring and logged practice intensity could help more effectively identify at-risk athletes.

While these recommendations are primarily geared toward high school athletics, the principles could be applied to other settings involving youth physical activities, such as high school marching bands, elementary and middle school sports, youth camps, and parks and recreation activities. By promoting these safety measures beyond the realm of high school athletics, more young people can be protected from the risks of heat-related illnesses.

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Review

This report was reviewed by experts in the fields of climatology, sports medicine, and kinesiology:

- Andrew Grundstein, Professor, Department of Geography, University of Georgia
- Janna Fonseca, Director of Health, Safety & Wellness, North Carolina High School Athletic Association
- Earl Cooper, Professor, Department of Kinesiology, University of Georgia

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Heat Policy Innovation Hub

The [Heat Policy Innovation Hub](#) at Duke University's Nicholas Institute for Energy, Environment & Sustainability brings together scientists and communities to develop and deploy innovative policy solutions that reduce the impacts of extreme heat on human health and well-being. The hub is the first program in the United States dedicated to cross-disciplinary innovation on extreme heat policy and practice, tapping into Duke University's globally recognized expertise in medicine, healthcare, public policy, engineering, the environment, and ministry.

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