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## Secondary School Activity Modifications Based on Pre-Event WBGT Readings

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# Secondary School Activity Modifications Based on Pre-Event WBGT Readings

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## Background

Wet Bulb Globe Temperature (WBGT) is considered best practice to monitor heat stress for sports.<sup>1,2</sup> Many state athletic associations develop heat illness guidelines for schools to follow to reduce the risk of heat illness in athletes.<sup>3,4</sup> The purpose of this study was to observe which activity modifications were made based on pre-event WBGT readings.

## Methods

- Cohort design.
- Athletic trainers (ATs) recorded daily pre-event WBGT (pWBGT) readings during activity using Kestral 5400 devices (Figure 1) during August and September 2023.
- WBGT data and specific activity modifications were submitted electronically daily if outdoor activities were scheduled.
- All data was collected in WBGT geographic region 2. Activity modification frequencies were reported based on pWBGT reading.
- ATs who provided data worked in Nebraska and modification compliance was determined based on Nebraska State Activities Association (NSAA) Heat Modification Guidelines (Figure 2).

## NSAA Wet Bulb Globe Thermometer (WBGT) Heat Modification Guidelines

The NSAA Board of Directors approved the Wet Bulb Globe Thermometer (WBGT) as the recommended measurement practice and device for measuring acceptable heat / humidity levels for practices and contests. The use of WBGT is recommended throughout the calendar year when the ambient temperature is above 80 degrees.

Region 1	Region 2	Activity Guidelines
< 76.1	< 79.7	NORMAL ACTIVITIES 3 SEPARATE - 3 TO 5 MINUTE REST / WATER BREAKS PER HOUR
76.2 - 81	79.8 - 84.6	USE DISCRETION FOR INTENSE / PROLONGED PRACTICE 3 SEPARATE - 4 TO 6 MINUTE REST / WATER BREAKS PER HOUR MONITOR AT-RISK ATHLETES CLOSELY COLD WATER IMMERSION AVAILABLE
81.1 - 84	84.7 - 87.6	MAXIMUM PRACTICE TIME IS 2 HOURS HELMETS AND SHOULDER PADS ONLY REMOVE HELMETS AND SHOULDER PADS IF CONDITIONING (FOOTBALL) 4 SEPARATE - 4 TO 6 MINUTE REST / WATER BREAKS PER HOUR MONITOR AT-RISK ATHLETES CLOSELY COLD WATER IMMERSION AVAILABLE
84.1 - 86.1	87.7 - 89.7	MAXIMUM PRACTICE TIME IS 1 HOUR HELMETS AND SHOULDERS PADS PROHIBITED (FOOTBALL) NO CONDITIONING 4 SEPARATE - 5 TO 7 MINUTE REST / WATER BREAKS PER HOUR MONITOR AT-RISK ATHLETES CLOSELY COLD WATER IMMERSION AVAILABLE
> 86.1	> 89.7	NO OUTDOOR ACTIVITIES CANCEL OR DELAY OUTDOOR PRACTICES / CONTESTS UNTIL LOWER WBGT IS RECORDED

Additional Information: PARTICIPANTS SHOULD ALWAYS HAVE UNRESTRICTED ACCESS TO WATER / FLUIDS  
 WBGT SHOULD BE MEASURED EVERY 30 MINUTES  
 INDIVIDUAL REACTIONS TO HEAT WILL VARY PER ATHLETE  
 SCHOOLS SHOULD HAVE AN EXERTIONAL HEAT ILLNESS EMERGENCY ACTION PLAN  
 AT RISK ATHLETES SHOULD ALWAYS BE MONITORED CLOSELY

WBGT is an all-inclusive measure of the heat stress in direct sunlight, which takes into account ambient temperature, humidity, sun angle, wind speed, cloud cover (solar radiation)

**Figure 2.** Nebraska State Activities Association WBGT Activity Guidelines

## Results

- Thirty-eight high school ATs participated in the study, recording a total of 504 unique data entries (mean pWBGT: 78.94 +/- 6.72).
- Thirty-four (6.7%) total pWBGT readings were reported in the “black” range. Green was the most frequent pWBGT category recorded (55.2%), followed by Yellow (28.3%), Black (6.7%), Orange (6.3%), and finally Red (2.0%) (Figure 3).
- Modifications recommended by ATs were followed by coaches/administrators 90.7% of the time.
- When pWBGT readings were in the black range, activities were only cancelled 38.2% of the time, however, activity location was modified 88.2% of the time.
- Cold water immersion was available 84.2% of the times it was recommended based on pWBGT readings.
- Outdoor activities had cold drinking water (100%), cold sports drink (35.9%), access to a shaded area (75.1%), ice towels (26.1%), misting stations (12.9%), and easy access to air-conditioned facilities (90.6%).

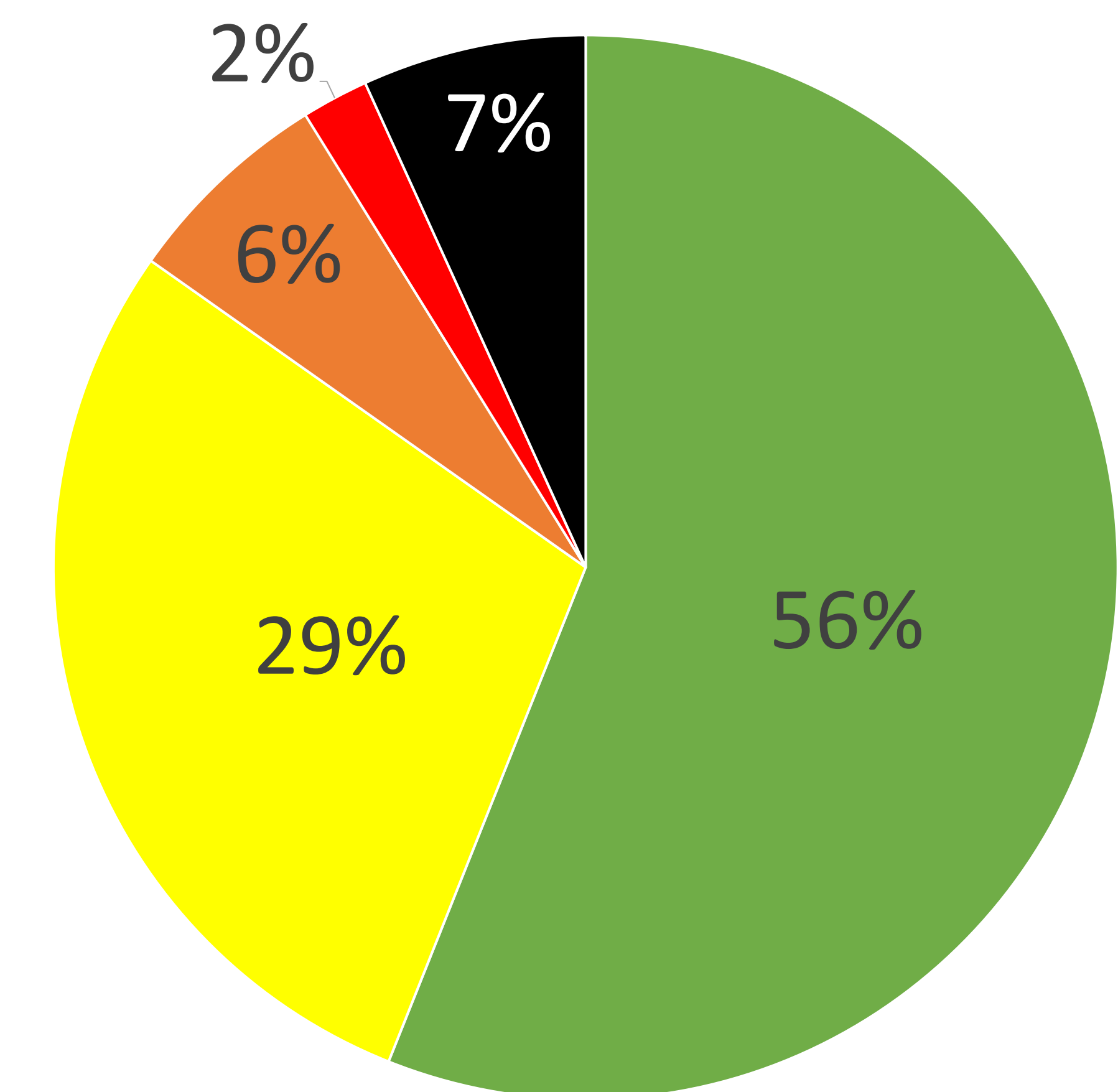
## Discussion

Despite WBGT guidelines suggesting to cancel outdoor activities when WBGT readings are in the black category, many schools elected to move activities indoors. Many of the events where a black WBGT was measured occurred outside of the initial 10-14 day acclimatization period. Coaches and administrators followed the modification recommendations in most instances.

## Conclusions

Many schools demonstrate compliance with activity modifications based on WBGT readings, physicians should work with ATs, coaches, and administrators to develop an institution-specific written heat policy to follow state athletic association and/or national guidelines.

Fall 2023 WBGT Reading Frequency



**Figure 3.** Percentage breakdown of Pre-Event WBGT readings based on a total of 504 data entries

## References

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2. Grundstein A, Cooper E. Comparison of WBGTs over different surfaces within an athletic complex. *Medicina*. 2020;56(6):313.
3. Kerr ZY, Marshall SW, Comstock RD, Casa DJ. Implementing exertional heat illness prevention strategies in US high school football. *Medicine and science in sports and exercise*. 2014;46(1):124-130.
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**Figure 1.** The Kestral 5400 and the Zelus phone application that provide location specific WBGT readings