



## Grant Information Summary:

# Body Temperature, Stress Hormone, and Perceptual Responses of Adolescents During High School Preseason Football Practices

### Practical Significance Statement

**U**se of appropriate practice guidelines and ensuring heat acclimatization prior to preseason football activity can help keep body temperatures within safe levels. Once environmental conditions are accounted for they can have a strong relationship with thermoregulatory responses.

### Study Background

American football is the most common sport played by high school males. There have been 31 heat-related deaths in high school and collegiate football since 1995. In 2003, the NCAA instituted regulations for collegiate football teams to follow. Unfortunately, high school governing bodies have not implemented regulations similar to the NCAA. During puberty, alterations in body composition, sweat variables, hormonal responses, exercise

efficiency, cardiac function, skin blood flow, and pulmonary function occur resulting in a change in exercise heat tolerance. Factors that affect body temperature, hydration status, and other thermoregulatory responses are of concern in football due to possibilities of exertional heat stroke. At this time, no actual data representing on-field core body temperature responses in high school football players exists.

## Objective

The purpose of this work was to observe natural thermoregulatory responses of adolescent high school football players during formal preseason football practices under varying environmental conditions.

## Design And Setting

An observational research design was used in this study where practices were observed outside in August. Days 1-5 consisted of one practice; days 6-8, two practices; and days 9-10, one practice. The average maximum WBGT during these days was  $23\pm 4^{\circ}\text{C}$ .

## Subjects

Twenty-five heat-acclimatized male football players (age  $15.0\pm 1.0$  yrs,  $4.0\pm 1.0$  Tanner Stage, height  $180.0\pm 8.0$  cm,  $81.4\pm 15.8$  kg,  $12\pm 5\%$  fat) were observed in this study.

## Measurements

An ingestible telemetric sensor measured body temperature ( $T_{\text{GI}}$ ) throughout all practices. The ratio of saliva testosterone and cortisol concentrations (T/C) in the AM and PM estimated stress state during these portions of the day. A thermal sensation and an environmental symptoms questionnaire (ESQ) were collected before, during, and/or after practice. Results were compared overall for all subjects as well as by specific age groups (younger; 14-15y,  $n=13$ ) and (older; 16-17y,  $n=12$ ).

## Results

A significant increase ( $P<0.001$ ) from minimum ( $37.6\pm 0.1^{\circ}\text{C}$ ) to maximum ( $38.7\pm 0.3^{\circ}\text{C}$ )  $T_{\text{GI}}$  within practice occurred. There were differences of maximum  $T_{\text{GI}}$  across days ( $P<0.001$ ) where day 7 demonstrated a lower value than all other days. Body temperatures remained below  $40^{\circ}\text{C}$  across all days. Maximum  $T_{\text{GI}}$  was not different ( $P=0.299$ ) between younger ( $38.7\pm 0.2^{\circ}\text{C}$ ) and older ( $38.6\pm 0.2^{\circ}\text{C}$ ) adolescents. Moreover, maximum  $T_{\text{GI}}$  revealed a strong correlation with maximum WBGT ( $r=0.774$ ,  $P=0.009$ ). Differences in T/C in the morning (AM) ( $P=0.007$ ) and afternoon (PM) ( $P<0.001$ ) values across days were found. Maximum thermal sensation had a strong relationship with maximum WBGT ( $r=0.918$ ,  $P<0.001$ ) and  $T_{\text{GI}}$  ( $r=0.839$ ,  $P=0.002$ ). Lastly, post ESQ scores were generally the greatest on days 1 and 2 ( $P<0.001$ ).

## Conclusions

Body temperature responses remained under  $40^{\circ}\text{C}$  possibly due to safe practice guidelines and previously established heat-acclimatization in the athletes. Likely due to the heat-acclimatization,  $T_{\text{GI}}$  had the strongest relationship with environmental conditions across all days. The results observed with the T/C responses may be attributed to safe training level stress, environmental conditions, or pubertal changes.

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Susan Walker Yeargin, BS, James Madison University; MS, University of Florida; PhD Kinesiology, University of Connecticut, May 2007. Dr. Yeargin currently serves as a laboratory instructor for the athletic training education program and research assistant for exercise physiology. Dr. Yeargin's research interests include studying the heat and hydration issues in a youth sport population.

## Publication & Presentation List

Yeargin SW, Casa DJ, McDermott BP, Lopez RM, Ganio MS, Lee EC, Vingen J, Hatfield D, Stearns RL, Chow SB, Warchol MD, Blowers JA, Armstrong LE, Anderson JM, Maresh CM. Body temperature, perceptual, and hormonal responses of adolescents during preseason high school football practices. NATA Annual Meeting & Clinical Symposium. Anaheim, CA 2007.

## Printing by:

Ellington Printery, Ellington, CT

## Funded by NFL Charities



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