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Original Research

Thermoregulatory Responses and Hydration Practices in Heat-Acclimatized Adolescents During Preseason High School Football

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Abstract

Context: Previous researchers have not investigated the thermoregulatory responses to multiple consecutive days of American football in adolescents.

Objective: To examine the thermoregulatory and hydration responses of high school players during formal preseason football practices.

Design: Observational study.

Setting: Players practiced outdoors in late August once per day on days 1 through 5, twice per day on days 6 and 7, and once per day on days 8 through 10. Maximum wet bulb globe temperature averaged $23 \pm 4^\circ\text{C}$.

Patients or Other Participants: Twenty-five heat-acclimatized adolescent boys (age = 15 ± 1 years, height = 180 ± 8 cm, mass = 81.4 ± 15.8 kg, body fat = $12 \pm 5\%$, Tanner stage = 4 ± 1).

Main Outcome Measure(s): We observed participants within and across preseason practices of football. Measures included gastrointestinal temperature (T_{GI}), urine osmolality, sweat rate, forearm sweat composition, fluid consumption, testosterone to cortisol ratio, perceptual measures of thirst, perceptual measures of thermal sensation, a modified Environmental Symptoms Questionnaire, and

Volume 45, Issue 2
(March/April 2010)

[◀ Previous](#) [Next ▶](#)



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knowledge questionnaires assessing the participants' understanding of heat illnesses and hydration. Results were analyzed for differences across time and were compared between younger (14–15 years, $n = 13$) and older (16–17 years, $n = 12$) participants.

Results: Maximum daily T_{GI} values remained less than 40°C and were correlated with maximum wet bulb globe temperature ($r = 0.59$, $P = .009$). Average urine osmolality indicated that participants generally experienced minimal to moderate hypohydration before (881 ± 285 mOsmol/kg) and after (856 ± 259 mOsmol/kg) each practice as a result of replacing approximately two-thirds of their sweat losses during exercise but inadequately rehydrating between practices. Age did not affect most variables; however, sweat rate was lower in younger participants (0.6 ± 0.2 L/h) than in older participants (0.8 ± 0.1 L/h) ($F_{1,18} = 8.774$, $P = .008$).

Conclusions: Previously heat-acclimatized adolescent boys ($T_{GI} < 40^{\circ}\text{C}$) can safely complete the initial days of preseason football practice in moderate environmental conditions using well-designed practice guidelines. Adolescent boys replaced most sweat lost during practice but remained mildly hypohydrated throughout data collection, indicating inadequate hydration habits when they were not at practice.

Keywords: [fluid](#), [gastrointestinal temperature](#), [hormones](#), [sweat](#), [Tanner stage](#), [heat acclimatization](#)

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top ▲