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Original Research

Perceptual Responses While Wearing an American Football Uniform in the Heat

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Abstract

Context: The protective equipment worn during American football has been shown to increase thermal strain; however, the perception of this increased heat has not been examined.

Objective: To evaluate perceptual responses of American football players while wearing different uniforms during exercise in the heat and to evaluate how these responses may be used to monitor athlete safety.

Design: Randomized controlled trial.

Setting: Human Performance Laboratory.

Patients or Other Participants: Ten men with more than 3 years of competitive experience as football linemen (age = 23.8 ± 1.3 years, height = 183.9 ± 1.8 cm, mass = 117.4 ± 3.5 kg, body fat = 30.1% ± 1.7%) participated.

Intervention(s): On 3 occasions in hot, humid (33°C, 48%–49% relative humidity) environmental conditions, participants completed 10 minutes of strenuous repetitive box lifting (RBL), 10 minutes of seated rest, and up to 60 minutes of treadmill walking. At each trial, they wore a different uniform condition: control (CON) clothing comprising shorts, socks, and sneakers; partial (PART) National Football League (NFL) uniform comprising the uniform without helmet or shoulder pads; or full (FULL) NFL uniform. Exercise, meals, and hydration status were controlled.

Main Outcome Measure(s): Rectal temperature (T_{re}), skin temperature (T_{sk}), rating of perceived exertion (RPE), thermal perception (THM), perception of thirst (TST),

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and perception of muscle pain (MPN) were obtained for time points matched across trials.

Results: Nineteen of the 30 trials ended before 60 minutes of treadmill walking as a result of participant exhaustion. Mean treadmill time was longer for the CON condition (51.7 ± 13.4 minutes) than for the PART (43.1 ± 15.6 minutes; $t_9 = 3.092$, $P = .01$) or the FULL (36.2 ± 13.2 minutes; $t_9 = 4.393$, $P = .002$) conditions. Neck and forearm T_{sk} increased between the initial time point and the end of exercise in the PART ($33.6 \pm 0.9^\circ\text{C}$ and $35.0 \pm 0.6^\circ\text{C}$, respectively; $F_{2,18} = 9.034$, $P < .001$) and the FULL ($33.4 \pm 0.9^\circ\text{C}$ and $35.2 \pm 0.6^\circ\text{C}$, respectively; $F_{2,18} = 21.011$, $P = .002$) conditions. Rate of T_{re} rise was greater in the FULL ($0.042 \pm 0.010^\circ\text{C}/\text{min}$) than in the PART ($0.034 \pm 0.006^\circ\text{C}/\text{min}$) condition ($F_{2,27} = 10.69$, $P = .04$). We found a relationship at the post-RBL and final time points between RPE and THM ($r = 0.75$, $P < .001$ and $r = 0.59$, $P < .001$, respectively), RPE and TST ($r = 0.76$, $P < .001$ and $r = 0.61$, $P < .001$, respectively), and RPE and MPN ($r = 0.63$, $P < .001$ and $r = 0.64$, $P < .001$, respectively). The RPE was greater at the end of exercise in the PART (17 ± 2) and FULL (18 ± 1) conditions than in the CON (15 ± 3) condition ($F_{2,18} = 7.403$, $P = .005$).

Conclusions: Although no differences in perceptual scales existed between the PART and FULL conditions, the T_{sk} and rate of T_{re} increase differed, indicating that football athletes find it difficult to perceptually rate exercise conditions as potentially dangerous hyperthermia develops. In addition, correlations between the perceptual scales further defined perceptual responses during exercise in the heat.

Keywords: [rectal temperature](#), [rating of perceived exertion](#), [thermal perception](#), [thirst perception](#), [muscle pain perception](#)

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