

Intermittent Cold and Dry Air Underneath Football Shoulder Pads as a Method to Assist in Temperature Homeostasis: Evaluation of Efficacy

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INTRODUCTION

The dangers of heat illness and the need for prevention were brought to the forefront of the nation's attention following the death of 5 athletes between 2001 and 2004. Football players are at a particular risk for heat related illnesses because they perform in ambient conditions that exceed normal body temperature while their ability to thermoregulate is impeded by the insulating effects of the protective padding, gloves and helmets they wear. When clothed in a standard football uniform, the athlete's body surface area available for sweat evaporation is reduced by 50%.^{1,2} We investigated whether the use of football shoulder pads made with air channels assist in maintaining temperature homeostasis during and after exercise. As a result of circulating cool dry air underneath the shoulder pads between and after periods of intense physical activity, we hypothesized that there would be a decrease in core body temperature and other physiological and subjective measures of heat stress.

METHODS

After IRB approval, 15 consenting volunteers [(age: 22.3 yrs. \pm 3.6); (weight: 92.5 kg \pm 15.3)] participated in two testing sessions wearing shoulder pads, shorts, and a helmet: 1) Control - no air blown under the shoulder pads; and 2) COOL - cool dry air blown under the shoulder pads during the rest periods and recovery session. Testing sessions consisted of three cycles of treadmill jogging/sprinting (alternating between 55% VO₂ maximum for 2 minutes and 90% VO₂ maximum for 30 seconds; for a total of 15-minutes) with 10-minute intermittent rest periods, followed by a 20-minute recovery session (Figure 1). Core body temperature (ingested sensor), heart rate, visual analog thirst scale (VATS), rate of perceived exertion (RPE), thermal sensation scale (TSS), and fluid intake were assessed as participants completed the discontinuous exercise program. In order to better simulate the playing environment of football players, the testing room was kept at a mean heat index of 33.4°C (92.1°F).



Figure 1. A. Shoulder pads with vertical air flow channels. B. Cooling system in use during a football game. C. Test subject running on the treadmill.

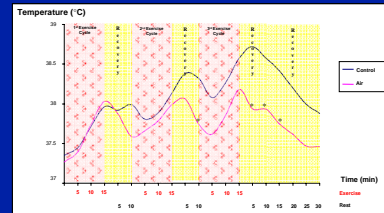


Figure 2. Core temperature differences significant* at p<0.05.

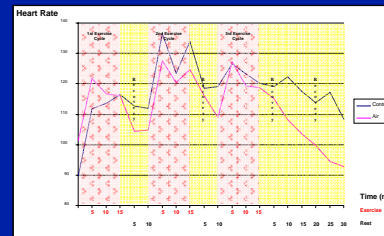


Figure 3. The COOL condition had significantly lower heart rates at each time point that did not intersect (p<0.05).

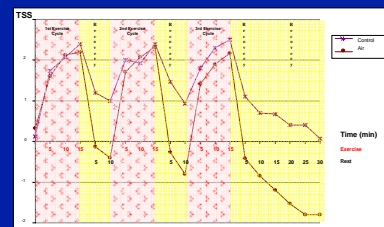


Figure 4. The COOL condition had significantly lower TSS scores during all recovery sessions (p<0.05).

RESULTS

Core body temperature and heart rate were recorded every 20 seconds during the testing sessions. Significant differences in core body temperature between Control and COOL were noted at 10 minutes post second cycle of exercise and during 5, 10, and 15 minutes of recovery (Figure 2). Significant interactions were noted in heart rate between control and COOL after the three 10 minute rest sessions. The COOL condition had significantly lower heart rate at each of the time points that did not intersect (Figure 3). Significant differences for the VATS were noted following the third session of exercise. RPE resulted in a significant difference only immediately after the first exercise cycle. TSS resulted in significant differences during all resting sessions. During the COOL session, participants reported feeling cooler on the TSS as compared to their control session (Figure 4). No significant difference was noted for fluid intake between the testing conditions [Control: 1364.8ml \pm 760.3; COOL: 1288.1 ml \pm 693.4].

DISCUSSION & CONCLUSION

The cool, dry air used during the COOL sessions decreased the core body temperature of the research participants at specific time points leading to a positive impact on other measured parameters. The results suggest that the use of cool, dry air can potentially help decrease the risk of heat related illnesses in football players.

REFERENCES

1. Lee-Chiong Jr TL, Stitt JT. Heatstroke and other heat related illness: the maladies of summer. *Postgrad Med.* 1995; 98(1): 26-36.
2. McCullough EA, Kennedy, WL. Thermal Insulation and Evaporative Resistance of Football Uniforms. *Medicine & Science in Sports & Exercise.* 35(5):832-837, 2003.