TACSM Abstract

A Comparison of Temperatures Inside Protective Headgear With Indicators of Physiological Strain and Core Temperatures During Exercise in a Hot Environment

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ABSTRACT

Introduction: Non-invasive temperature monitoring with a sensor mounted inside protective headgear such as a football or military helmet or a construction hardhat may be an effective method of detecting temperatures that are indicative of increased risk of heat illness. Hothead Technologies has developed a system for providing temperature information to medical personnel responsible for the health of the individual. **Purpose:** The purposes of this study were to establish the relationship between in-hardhat temperature (Tih) readings, markers of physiological strain and perceptual responses, and to determine the differences between the in-helmet temperature readings and core temperature (Tc) as measured by rectal (Tre) and esophageal (Tes) probes. **Methods:** Thirty males (age, 24.57 ± 4.32 years; height 180.51 ±7.06 cm; body mass, 81.06 ±9.35 kg; percent body fat, 13.76 ±5.11; VO$_2$max, 46.84 ± 7.10 mL/Kg/min) completed two experimental trials separated by a minimum of one week: a continuous submaximal exercise (CSE) condition and a series of high intensity 30-second sprints (HIE) with a one-minute rest period between each sprint. Exercise in both conditions was carried out in a 36° C environment with a relative humidity of 40% while wearing a standard construction hardhat with a sensor mounted in the forehead area of the head strap, and continued until one of the following two criteria was met: the subject voluntarily terminated the session, or the subject's Tc reached 39.5^{o}C. Temperatures, heart rate, cardiorespiratory, and perceptual responses were monitored throughout, and balance error scoring system (BESS) and mental function tests were conducted before and after exercise. A physiological strain index (PSI) was calculated from Tc and HR.

Results:

Table 1. Temperature Responses (^{o} C), BESS results and PSI (mean + SD)									
Condition	**Post Tih**	**Post Tre**	**Post Tes**	**BESS Firm Pre**	**BESS Firm Post**	**BESS Foam Pre**	**BESS Foam Post**	**PSI Tre**	**PSI Tes**
CSE	38.77 ±0.42	38.90 ±0.49	39.38 ±0.37	2.73 ±2.41	7.17 ±3.81	11.33 ±4.38	15.50 ±4.78	9.18 ±1.11	10.04 ±1.05
CV	1.08%	1.26%	0.93%						
HIE	38.76 ±0.37	38.91 ±0.47	39.15 ±0.49	3.67 ±2.59	7.37 ±4.10	10.80 ±3.46	15.53 ±5.55	9.29 ±0.99	9.86 ±1.02
CV	0.95%	1.21%	1.26%						

CV- Calculated from final temp. **Conclusion:** The general agreement between the Tih and other temperature measures along with the consistency as indicated by the low coefficient of variation in the recordings of the Tih sensors at the point of termination suggest that this device may have application as a warning system for impending heat-related problems.