

Comparing Three Methods of Measuring Skin Temperature during Exercise in a Hot, Humid Environment

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ABSTRACT

Exercise in a hot, humid environment substantially increases the physiological stress of exercise. Most of the techniques that are currently used to monitor changes in skin temperature have been in use for more than 20 years with little innovation. The purpose of the present study was two-fold: 1) to compare three techniques for measuring skin temperature (wired skin electrode, wireless temperature data logger, and thermal imaging) and 2) to compare and contrast these measures in men and women completing 45-min of cycling in a hot ($39\pm 2^{\circ}\text{C}$), humid ($45\pm 5\%$ RH) environment. The CPHS committee approved all procedures described in this report and subjects gave written consent to participate. Men ($N=14$) and women ($N=18$) completed all study requirements out of 45 subjects that were enrolled. Following a baseline screening session that included a measurement of body composition (whole body DXA scan) and an aerobic fitness test ($\text{VO}_{2\text{peak}}$), subjects were scheduled for an experimental exercise trial between 0500 and 0800. Subjects arrived to the laboratory and were tested for hydration using urine specific gravity and if dehydrated, they were provided water to drink before starting the exercise trial. Exercise consisted of 50-min of cycling. After 50-min, subjects were asked to continue cycling until their rectal core body temperature exceeded 39.3°C . The time they were able to exercise beyond 50-min was recorded and compared between individuals. Wired skin temperature was monitored using YSI400 banjo probes, wireless skin temperature was monitored using a data logging system (iButton), and thermal skin temperature was measured from images taken with a thermal camera (RAZR Max-IR). These skin measurements were made on the bicep and abdomen. All body temperatures were recorded at rest, every 10-min during exercise, and immediately following the end of exercise. Data was statistically analyzed using a 2 (gender: men & women) \times sensor method (wired, wireless, and thermal) \times time (0, 10, 20, 30, 40, 50, end) ANOVA with repeated measures on the 2nd and 3rd factors. Significance was set a $P<0.05$. Based on the data collected, all three methods of measuring skin temperature provided similar numbers. This relationship held for both men and women, although when comparing genders, the skin temperature of men seemed to be higher than that of women. Interpretation of these findings suggests that alternate means of measuring skin temperature may be used to accurately track men and women who are exercising in a hot, humid environment.