

Validity of a Novel Sensor for Noninvasive Measurement of Core Body Temperature in Humans during Exercise

COLIN ATKINS, GRACE HANDLER, CASANDRA MENDEZ, ALVIN MOLINA, LAURYN OUTLAW, MATTHEW G. BECKER, & MATTHEW M. SCHUBERT

Metabolism & Applied Physiology Laboratory; Department of Kinesiology; California State University, San Marcos; San Marcos, CA

Category: Professional

ABSTRACT

The measurement of core body temperature during exercise can be useful for athletic performance and the prevention of heat-related illness. Non-invasive sensors have been developed for the measurement of core body temperature, but more data on their validity and reliability is needed before they can be recommended for widespread adoption. **PURPOSE:** The purpose of the present study was to evaluate a noninvasive core temperature sensor (T_{Core}) during exercise compared to an ingestible thermistor (T_{Pill}). **METHODS:** Twenty men and women (25 ± 4 years) participated in this study. Participants completed 20 minutes of exercise at 60% age-predicted max heart rate, 20 minutes at 70%, and 20 minutes at 80% while wearing warm clothing. During exercise, heart rate, core temperature, RPE, and thermal comfort were collected every 5 minutes. Pre/post exercise changes in body mass and urine specific gravity were conducted to ensure stable fluid levels. Mean differences were compared via a paired t -test, core temperature during exercise using a time*device repeated measures ANOVA, and agreement assessed with Bland-Altman and correlation analysis. **RESULTS:** Participants lost -0.47 ± 0.42 % body mass during exercise. USG did not change in response to exercise (Pre: 1.009 ± 0.005 vs Post: 1.009 ± 0.006 ; $p = 0.93$). Devices were well correlated ($r = 0.90$, 95% Confidence Interval: $0.74 - 0.97$; $p < 0.0001$). Mean core temperature during exercise was slightly but significantly lower as measured by the T_{Core} compared to T_{Pill} (Mean difference = -0.3°C , 95% CI: -0.57 to -0.03 ; $p = 0.028$). Exercise created a main effect of time on core temperature ($p < 0.0001$), with a significant interaction across time between devices ($p < 0.0001$). Specifically, core temperature was lower for T_{Core} from 15-55 minutes of exercise compared to T_{Pill} . Mean \pm SD of bias was $-0.3^{\circ}\text{C} \pm 0.16$, with 95% limits of agreement of -0.61°C to 0.03°C . **CONCLUSION:** Results of the present investigation revealed that the CORE device tended to underestimate core body temperature during indoor exercise of increasing intensity. However, the margin of error was relatively small, and few participants exceeded 39°C . Future studies should conduct field validity tests of the CORE device and should also include measures of skin temperature to facilitate further comparisons.