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Original Research

Response of Thermocouples Interfaced to Electrothermometers When Immersed in 5 Water Bath Temperatures

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Abstract

Context: Thermocouples and electrothermometers are used in therapeutic modality research. Until recently, researchers assumed that these instruments were valid and reliable.

Objective: To examine 3 different thermocouple types in 5°C, 15°C, 18.4°C, 25°C, and 35°C water baths.

Design: Randomized controlled trial.

Setting: Therapeutic modality laboratory.

Intervention(s): Eighteen thermocouple leads were inserted through the wall of a foamed polystyrene cooler. The cooler was filled with water. Six thermocouples (2 of each model) were plugged into the 6 channels of the Datalogger and 6 randomly selected channels in the 2 Iso-Thermexes. A mercury thermometer was immersed into the water and was read every 10 seconds for 4 minutes during each of 6 trials. The entire process was repeated for each of 5 water bath temperatures (5°C, 15°C, 18.4°C, 25°C, 35°C).

Main Outcome Measure(s): Temperature and absolute temperature differences among 3 thermocouple types (IT-21, IT-18, PT-6) and 3 electrothermometers (Datalogger, Iso-Thermex calibrated from -50°C to 50°C, Iso-Thermex calibrated from -20°C to 80°C).

Results: Validity and reliability were dependent on thermocouple type, electrothermometer, and water bath temperature ($P < .001$; modified Levene $P < .05$). Statistically, the IT-18 and PT-6 thermocouples were not reliable in each electrothermometer; however, these differences were not practically different from each other. The PT-6 thermocouples were more valid than the IT-18s, and both thermocouple types were more valid than the IT-21s, regardless of water bath temperature ($P < .001$).

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Conclusions: The validity and reliability of thermocouples interfaced to an electrothermometer under experimental conditions should be tested before data collection. We also recommend that investigators report the validity, the reliability, and the calculated uncertainty (validity + reliability) of their temperature measurements for therapeutic modalities research. With this information, investigators and clinicians will be better able to interpret and compare results and conclusions.

Keywords: [reliability](#), [validity](#), [uncertainty](#)

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