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Ability of WBGT Indices to Discriminate
Between Sustainable and Unsustainable Heat Stress Exposures

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Objectives

Heat stress assessment through wet bulb globe temperature (WBGT) was designed to limit exposures to those that could be sustained for an 8-h day. The exposure limit was based on limited data from Lind in the 1960s. The results from two progressive heat stress studies provided the opportunity to determine the ability of the current WBGT-based occupational exposure limits (OELs) to discriminate between Sustainable and Unsustainable heat exposures.

Methods

The progressive heat stress studies included 176 matched pairs of Sustainable and Unsustainable exposures over a range of relative humidities and metabolic rates using about 29 participants. To assess the ability of an existing WBGT-based OEL, the exposure metric was the difference between the observed WBGT and the OEL's WBGT limit adjusted for metabolic rate. Because there were matched cases and controls, conditional logistic regression models were used to fit the binary outcome with a continuous predictor. The ability of the current WBGT-based OEL to accurately discriminate Sustainable vs Unsustainable was assessed using a receiver operating characteristic (ROC). The ROC curve graphically displays the predictive accuracy of the logistic regression model and the area under the curve (AUC) is a measure of the overall ability to discriminate between Sustainable and Unsustainable.

Results

The current WBGT-based OEL has a sensitivity of 1.00 and a specificity of 0.07. The conditional logistic regression model found that the odds of being Unsustainable increased 4 times per 1 °C-WBGT of difference above the OEL (C.I. 2.75 – 5.54). The ROC curve had an AUC of 0.95 (C.I. 0.92 – 0.97). By increasing the threshold to a point where the probability of an Unsustainable exposure was 5% (p=0.05), the threshold increase was 2.7 °C-WBGT, and sensitivity was 0.98 (C.I. 0.95 – 1.00) and specificity was 0.42 (C.I. 0.34 – 0.49).

Conclusion

Current TLV has a high sensitivity, meaning that the exposed working population is protected. Nevertheless, its specificity is very low, which is translated in a high percentage of false positive cases. The specificity can be increased substantially with little loss of sensitivity by increasing the exposure threshold by 2.7 °C-WBGT.