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PREDICTING RECTAL TEMPERATURE RESONSE UNDER DIFFERENT COMBINATIONS OF ENVIRONMENTAL CLIMATE, SOLAR LOAD, WORK INTENSITY AND CLOTHING

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An earlier mathematical model to predict body core temperature (T_{re}), which was based on indoor laboratory studies (1) was found to be over estimating when data was compared to T_{re} measurments recorded under outdoor natural climate in shaded areas or open field exposed to direct solar radiation. Analyzing the discrepancy it was concluded that radiative heat transfer should be considered seperately for short wave radiation absorbed by the body (H_r) and long wave emission from the body to the atmosphere (Hl_{eff}). These two variables equal zero under controlled laboratory environment, when all serounding objects are at ambient temperature, but are meaningfull under outdoor conditions. Thus, the model was adjusted for outdoor use as follows:

$$T_{re} = 36.75+0.004\ (M-W_{ex}) + 0.0011\ H_c + 0.0025\ H_r - 0.0025\ Hl_{eff} + 0.8 \exp(0.0047\ (E_{req} - E_{max}));\ (^{o}C)$$

The two components of radiation were integrated into the model, also as part of E_{req}; all other components remained as determined by Givoni and Goldman (1).
H_r is calculated as: $H_r = 4.0\ (clo_o/clo)\ (\Delta MRT)$; (watt)
where: clo_o - insulation coefficient of air around a nude body; clo - insulation coefficient of clothing; MRT - mean radiant temperature. Hl_{eff} is calculated as:
$Hl_{eff} = 0.9\ \phi_B\ (clo_o/clo)\ Khc$; (watt)
where; ϕ_B - emitted flux density based on the Stephan-Boltzman law (watt); Khc - a constant dependent on metabolic rate (0.43 at rest; 0.57 at work). The validity and applicability of the model was tested under wide range of climatic conditions, solar load, work intensity, and clothing. Under outdoor conditions this model was found to predict T_{re} better than could be predicted by the original model, but since at indoor conditions H_r and Hl_{eff} equal zero the original model is still valid for laboratory studies.

(1) Givoni B. and Goldman R.F; J. Appl. Physiol. 32: 812, 1972.