THE ROLE OF GLOBAL RADIATION MEASURED BY A LIGHT SENSOR ON HEAT STRESS ASSESSMENT

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The Wet Bulb Globe Temperature (WBGT), developed in 1957 by Yaglou and Minard and considered to be as the most common heat stress index, is in use by the US army and has also been adapted by the World Health Organization (WHO). The WBGT is calculated from ambient temperature (T_a), wet bulb temperature (T_w), and black globe temperature (T_g). The T_g is usually measured by a thermometer surrounded by a 6" blackened sphere, and quantifies the global radiation component of the thermal load. However, measuring T_g is cumbersome in many circumstances for two main reasons. First, T_g measurement requires about 30 min for the instrument to reach equilibrium. Second, the blackened sphere is of a relatively big size (6"). Therefore, measuring T_g becomes inconvenient and simply not practical, especially in transient situations. The purpose of this study was to evaluate a new relatively small (5 mm) light sensor for measuring solar radiation for use in heat stress assessment. Global radiation was using from three instruments: black globe (T_g), Pyranometer (P), and light (L) sensor, in Israel for 25 days, from 09:00 am until 17:00 pm during September - October. Analysis of the daily collected data from these three instruments revealed, in spite of the different units, the same pattern for P and L during each day, where T_g was slower in its response and lagged behind P and L in its values. Therefore, we constructed a new model, which converted and predicted the L data measured in mv for P values measured in $W \bullet m^{-2}$ as follows: $P=-13.81+0.619L-0.00012278L^2$; $W \bullet m^{-2}$. The analyzed data contained 771 measurements and the correlation coefficient between P and L were very high ($R^2=0.933$, $P<0.001$). Therefore, we concluded that the L sensor has the potential to measure global radiation. However, more studies should be done for further validation. This conclusion is very encouraging since there are already existing micro-sensors for measuring T_a and relative humidity (RH) in use. In this study, we explored the possibility of developing a new heat stress index based only on fast response environmental micro-sensors (e.g., T_a, RH, and L) that can be assembled into a small portable device.

Yaglou, C.P. and Minard, D. (1957) Control of heat casualties at military training centers. Arch. Indus. Health 16, 302-305.

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