Time Limit for Personal Cooling with Ice-Based Systems

This is a simple (back of the envelop) estimation of the time limit when wearing an ice-based personal cooling system. It does not apply to supplied air systems or those that do not use water ice as the heat sink. Use only as guidance. There is no explicit or implicit warranty.

Step 1. Compute the Amount of Ice [kg] -- IW

Weigh or measure the water in liters.

If in a gel formulation, multiply by 0.9 to determine the ice (versus starch/filler)

Step 2. Estimate Cooling Efficiency -- Eff

For an Ice Vest: Eff = 0.5

For a tube suit configuration: Eff = 0.8

Step 3. Estimate Average Metabolic Rate -- MR [kcal/hr]

MR [kcal/h] = M [W] / 1.16

Step 4. Estimate the Cooling Time -- t_{cool}

t_{cool} [min] = 60 [min/hr] * 80 [kcal/kg] * Eff * IW [kg] / MR [kcal/hr]

Step 5. Estimate Time Limit -- t_{limit}

t_{limit} [min] = t_{cool} + 15 min

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