Thermophysiological and Subjective Impacts of Two Different Respirator Ambient Air-Cooling Options during Mild Hyperthermia

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Microclimate cooling of chemical biological (CB) protective ensembles has been investigated as a solution to lessen thermal physiological stress and attenuate personal discomfort. However, conditioned air or water microclimate cooling systems are not logistically practical in the field for many end users. Torso and face cooling with ambient air, which has been shown to lower thermal strain for subjects exercising in the heat with CB ensembles, may be a more viable microclimate cooling option. This investigation assessed the thermophysiological and subjective impacts of different respirator ambient air-cooling options while wearing CB protective equipment in a warm environment (32 °C, 50-60% RH). Ten volunteers participated in 90-min heat exposure trials with and without respirator (Control) wear and performed computer-generated tasks while seated. Ambient air-cooling was provided to full-facepiece, air-purifying respirators (APRs) modified to blow air onto the forehead (FHC) or to the forehead and into the breathing zone (BZC) of the respirator. Ambient air was supplied by a miniature axial fan at a rate of 45 $L \bullet min^{-1}$. An unmodified APR (no cooling (NC)) wear trial was also completed. Body temperatures were highest and subjective comfort ratings were lowest for the NC condition. Both the FHC and BZC ambient air-cooling conditions reduced facial skin temperatures, reduced the rise in core temperatures, and led to better subjective ratings of comfort and thermal sensation compared to the NC configuration during heat exposure under resting conditions. These findings suggest that ambient air-cooling of the face under mild hyperthermia reduced the thermophysiological strain and perceived discomfort of APR wear.