Relevance of Work Intensity in Hot Environments: Duration of Continuous Work Until Critical Core Temperature

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ABSTRACT

Background:
Work in hot environment causes thermal strain and increases health risks, especially during physically demanding work. While research on thermal strain has traditionally focused on the effects of environmental temperature, this study examines how work intensity influences core body temperature (Tc) and cardiovascular responses to work in the heat. The aim of this study was to investigate how long continuous work can be sustained in hot environments at different levels of work intensity. The study examined whether recovery brakes are dependent on task intensity, underscoring its role in thermal strain.

Methods:
Fourteen healthy volunteers completed three work bouts separated by two rest intervals. Constant power cycling exercise was performed at moderate and heavy intensities (33% and 50% of VO2max, respectively) at ambient temperatures of 20, 30, and 40 °C (35% relative humidity). Exercise continued until Tc exceeded 38.0 °C or plateaued. Thermal and cardiovascular responses were assessed using an ingestible temperature capsule and two-lead ECG.

Results:
The 38.0 °C Tc threshold was reached faster during heavy than moderate work (26.0 ± 1.1 vs 41.0 ± 1.8 min, averaged across all ambient temperatures), demonstrating a strong effect of work intensity on thermal strain. No significant differences in Tc rise time were observed between work intensities at 20 °C, whereas at higher temperatures heavy work resulted in significantly shorter work bouts than moderate work.

Core temperature and heart rate responses further indicated cumulative thermal strain during heavy work, particularly at 40 °C. This was reflected in progressively faster increases in Tc, longer recovery times across successive work bouts, and higher cardiovascular strain during later bouts at both intensities.

Conclusion:

These findings indicate that work intensity is a critical determinant of thermal strain, as the 38.0 °C Tc limit was exceeded under 25 minutes during heavy work in hot conditions. The results suggest that current work-rest guidelines may substantially overestimate safe exposure durations in hot environments.