OCCUPATIONAL ACCLIMATISATION TO HOT HEAVY WORK IN AUSTRALIAN BUSHFIRE FIGHTERS

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Generally, people who work in hot jobs are assumed to acclimatise to their work conditions. This report documents improvements in physiological heat tolerance acquired during fire fighting operations by a group of five male Australian bushfire fighters of age (mean and range) 25 (21-29) y and body mass 68.7 (63.1-79.1) kg. This 'natural acclimatisation' occurred over a period of 17 days in the summer. On seven of these days, at intervals varying from 3 consecutive days to 5 days apart, the firefighters worked to suppress large scale experimental forest fires. Fire suppression involved prolonged periods of strenuous work constructing fireline with hand tools. The work conditions in the seven fires were: work duration, 93 (42-190) min; air temperature, 30.6 (27.3-34.7)°C; mean radiant temperature, 71.9 (45.0-91.1)°C; water vapour pressure, 18.8 (16.7-22.2) mb; WBGT Index, 29.0 (24.3-34.4)°C; energy expenditure, 485 (439-616) w; estimated required evaporation (Ereq), 1,120 (1,018-1,347) g/h. The firefighter's work responses averaged for each individual for the seven fires were (mean and range): heart rate, 153 (143-162) b min^{-1}; rectal temperature, 38.2 (37.9-38.6)°C; thigh skin temperature, 35.1 (33.5-35.9)°C; sweat rate, 1,175 (971-1,418) g/h. The evidence for acclimatisation is based on changes in the firefighters' responses between two occasions at about midday when they constructed fireline in the absence of fire; once before the 17 day period (Day 0, NF1), and again at the end of the period (Day 18, NF2). The work conditions and firefighters' responses in NF1 and NF2 are shown in the Table. Work heart rates, rectal temperatures, and thigh skin temperatures were all significantly lower, and sweat rates were also 10% lower in NF2 than in NF1. Increases (drifts) in heart rates and rectal temperatures with work time were less in NF2 than in NF1. Thigh skin temperatures increased with work time in NF1 but they decreased with work time in NF2. Rates of production of fireline were similar in NF1 and NF2.

Variables	NF1	NF2	NF2-NF1	***P***
Work conditions (n=2)				
Work duration min	151	141	-10	n.a.
Air temperature °C	33.1	32.0	-1.1	n.a.
Water vapour pressure mb	19.7	13.3	-6.4	n.a.
WBGT index °C	28.1	26.6	-1.5	n.a.
Energy expenditure w (n=5)	500	545	45	0.08
Required evaporation (Ereq) g h^{-1} (n=5)	921	974	53	0.13
Firefighters' work responses (n=5)				
Heart rate b min^{-1}	163	139	-24	0.008
Rectal temperature °C	38.48	38.12	-0.36	0.009
Thigh skin temperature °C	35.3	34.1	-1.2	0.001
Sweat rate g h^{-1}	1,105	989	-116	0.033
Perceived exertion (RPE)	14.4	14.7	0.3	0.67

n.a. = not applicable

Conclusion: Seven exposures to fire suppression during a period of 17 days induced physiological adaptations characteristic of heat acclimatisation. Rather than increasing their work intensity with this acclimatisation these firefighters maintained their habitual work performance but enjoyed lower levels of physiological strain.

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