Work patterns of tanker-based bushfire suppression by Australian volunteer firefighters in south-east Australia.

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Background

In Australia,

- Annual bushfire threat.
- Rural fire agencies suppress fires from fire tankers.
- 221,000 volunteers (McLennan et al., 2004)
- No published data on work demands or physiological responses during tanker-based bushfire suppression.
- No evidence base for fitness, hydration, nutrition, or recovery requirements for safe & effective tanker-based bushfire suppression.
Objective

• Describe firefighters work patterns during tanker-based bushfire suppression.
  • Work intensity.
  • Duration of work efforts within a shift.
  • ‘work : rest’ patterns.

Deliverable to fire agencies

• Advanced knowledge and understanding of fireground stress (stimulus) on the firefighter.
  • Documenting specific fireground stressors e.g. work intensity & duration.
Methods

- 6 fire incidents (5 VIC, 1 NSW).
- Researcher ‘call-out’ from CFA HQ
- Firefighters recruited at staging area prior to deployment.
  - Verbal consent
- Non-intrusive monitoring of work intensity.

- Work Intensity:
  - Heart rate
  - Physical (work) activity
  - Movement Speed & distance travelled
Participants

• 38 volunteers: 33 men & 5 women.
• 36 CFA VIC, 2 RFS NSW.
• Age: $37.5 \pm 2.1$ yr (18 - 67 years).
• Years of service: $11.2 \pm 2.1$ yr (1 - 35 yr).
• Height: $174.4 \pm 1.9$ cm (155.5 - 188.4 cm).
• Weight: $76.1 \pm 2.4$ kg (54 - 92 kg).
• BMI: $25.1 \pm 0.8$ kg·m$^{-2}$ (18.2 - 30.4 kg·m$^{-2}$).
Walking distance & speed.

Shift length: $10.5 \pm 0.6 \text{ hr}$
Time on foot: $7.8 \pm 1.8 \text{ hr}$
Total distance: $16 \pm 5.5 \text{ km}$
Average speed: $2.1 \pm 1.0 \text{ km} \cdot \text{hr}^{-1}$
Heart Rate

Average: 101.2 ± 12.6 beats·min⁻¹
55.4 ± 6.1% HR max

Peak: 169.8 ± 17.8 beats·min⁻¹
93.4 ± 2.1% HR max

ACSM Intensity Domains

- Light (30 - 49% HR max)
- Moderate (50 - 69% HR max)
- Hard (70 - 89% HR max)
- Very Hard (> 90% HR max)
Physical (work) activity

- Sedentary: < 100 counts·min⁻¹
- Light: 100 – 1499 counts·min⁻¹
- Moderate: > 1500 counts·min⁻¹

Count: sum of trunk movements (any direction) in one minute

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Sedentary (%)</th>
<th>Light (%)</th>
<th>Moderate (%)</th>
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<tbody>
<tr>
<td>0 - 2 hr</td>
<td>40.0</td>
<td>60.0</td>
<td>0</td>
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<td>2 - 4 hr</td>
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<td>4 - 6 hr</td>
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<td>6 - 8 hr</td>
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<td>8 - 10 hr</td>
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<tr>
<td>10 - 12 hr</td>
<td>40.0</td>
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0% 20% 40% 60% 80% 100% Percentage of time period

- Sedentary (< 100 counts·min⁻¹)
- Light (100 – 1499 counts·min⁻¹)
- Moderate (> 1500 counts·min⁻¹)
Physical (work) activity

- USA Handtool: Cuddy et al. (2007)
- Aust. Tanker-based

Activity (counts·min\(^{-1}\))

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<th>Time (hr)</th>
<th>Activity</th>
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Important considerations for fire agencies:

• Bushfire suppression comprises brief periods of intense work separated by long periods of low level labour / rest.

• Intense work bouts may put some firefighters at increased risk of cardiac event during a shift.
  • Pre-existing cardiovascular conditions
  • Normally sedentary

• Tanker-based bushfire suppression seems to accrue lower physical activity counts than US wildfire crews using handtools.
Future Directions

- Increase study sample
  - More diversity in participants

- Agency-based research
  - Data monitoring by agency personnel trained & overseen by researchers.

- Explore relationships between work intensity &
  - Age
  - Gender
  - BMI
  - Experience
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