



# THE STRESS OF FIREFIGHTING

## IMPLICATIONS FOR LONG-TERM HEALTH OUTCOMES

**Dr Luana Main**  
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Government of South Australia  
Department of Environment,  
Water and Natural Resources



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# STRESS



Stressor      Assessment      Outcome



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# STRESS RESPONSE


CARDIOVASCULAR RESPONSE

- ↑ HR & BP
- ↑ BREATHING RATE

HORMONAL RESPONSE

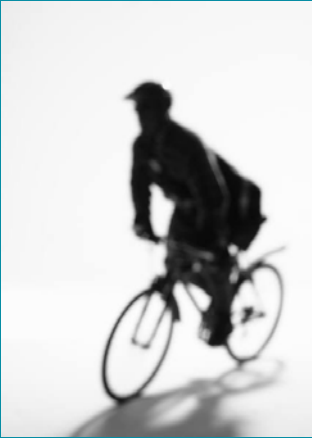
- ↑ CATECHOLAMINES
- ↑ CORTICOSTEROIDS

↑ ANXIETY / IRRITABILITY




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# STRESS RESPONSE



## Inflammatory Cytokines

- Acute phase response
- Pro and anti-inflammatory
- Impact:
  - Central nervous system
  - Physical symptoms
  - Auto-immune/ inflammatory diseases



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## SO WHAT?



- Long term health implications

- CVD
- Depression
- PTSD
- Post viral / chronic fatigue
- ...

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## EXPOSURE

- Intermittent physical work <sup>1-2</sup>
- Heat <sup>3-4</sup>
- Smoky <sup>5</sup>
- Dust and pollutants <sup>6</sup>
- Toxic chemicals <sup>7</sup>
- Excessive noise <sup>8</sup>
- Inadequate recovery <sup>9</sup>
- Sleep disruptions <sup>10</sup>
- Psychological stress <sup>11</sup>



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## AIMS

- 1) investigate whether an inflammatory response was mounted following a day of wildfire suppression tasks
- 2) investigate the effect of a repeated day of wildfire suppression tasks on the same inflammatory markers

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## METHODS

12 male firefighters (29 ± 11 yr)

2 consecutive days of live-fire prescribed burn operations in Ngarkat National Park, SA

Standard PPC was worn throughout as per agency guidelines

Approval for the project was obtained from the Deakin Ethics committee for Human Research

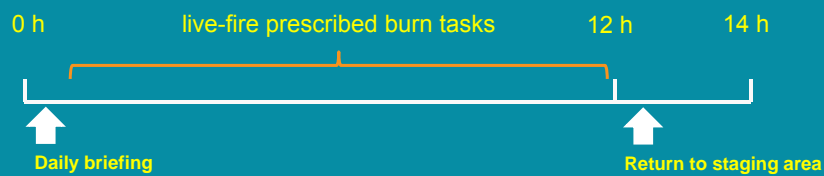
Informed written consent was obtained prior to commencement

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# METHODS

- Blood samples – antecubital vein (10 mL)



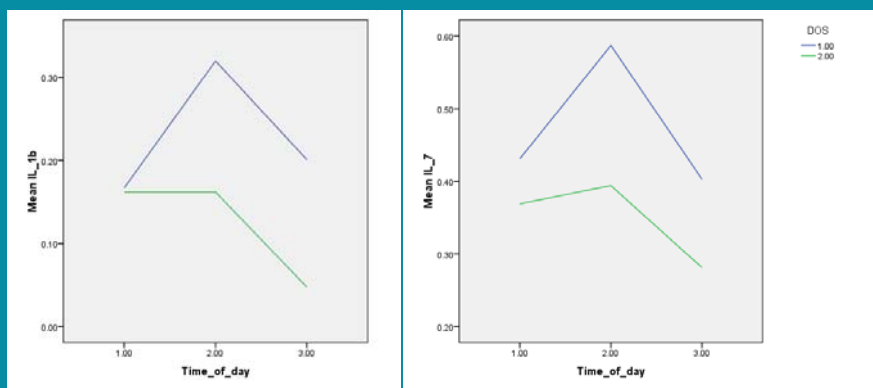
- Selection of cytokines analysed:

IL-1 $\beta$ , IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12p70, IL-13, IFN $\gamma$ , GM-CSF, & TNF $\alpha$



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# RESULTS



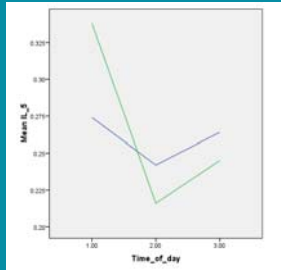
IL-1 $\beta$  = important mediator of stress response

IL-7 = key role in modulating the immune response

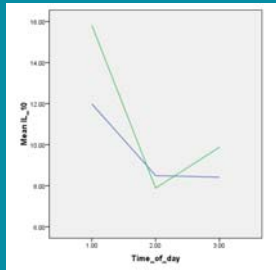


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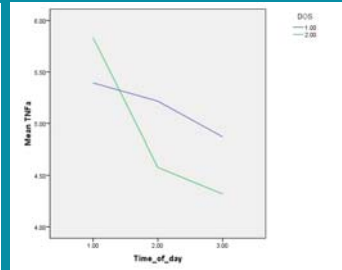
# RESULTS



IL-5 = anti-inflammatory coordination of white-blood cells



IL-10 = anti-inflammatory modulates the inflammatory response

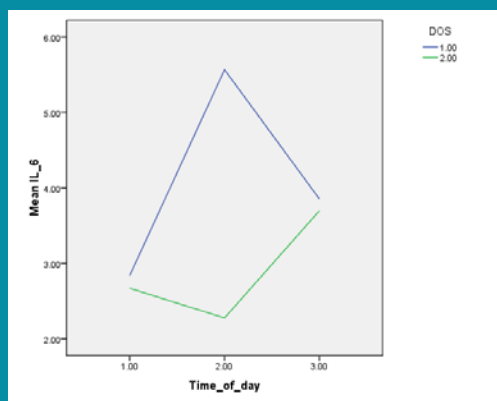


TNFα = together with IL-1B & IL-6 associated with the acute-phase response



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# RESULTS



- Day 1: increase of 96%
- Day 2: decrease of 15%



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## NEXT STEPS



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## KEY TAKE HOME POINTS

- Wildfire suppression = inflammatory response
- The impact of different stressors needs to be investigated further
- The impact of repeated days needs to be investigated further
- Need to optimise and ensure adequate recovery time between shifts
- Reducing the risk of mal-adaptation of our stress response
- Safeguarding the long term health of our personnel



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## “TO PROTECT LIVES AND PROPERTY”



bushfire CRC

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## REFERENCES

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UNIVERSITY AUSTRALIA

## RESULTS – WITHIN DAY

|                               | Day 1 |        | Day 2 |        |
|-------------------------------|-------|--------|-------|--------|
|                               | 0-12h | 12-14h | 0-12h | 12-14h |
| <b>IL-1<math>\beta</math></b> | 88%   | -37%   | 0%    | -69%   |
| IL-4                          | 10%   | -17%   | 16%   | -19%   |
| <b>IL-5</b>                   | -11%  | 8%     | -35%  | 14%    |
| IL-6                          | 96%   | -31%   | -15%  | 62%    |
| <b>IL-7</b>                   | 37%   | -32%   | 5%    | -28%   |
| IL-8                          | -2%   | -6%    | -10%  | 32%    |
| <b>IL-10</b>                  | -29%  | -1%    | -50%  | 25%    |
| IL-13                         | 17%   | -7%    | -18%  | -6%    |
| <b>TNF<math>\alpha</math></b> | -3%   | -7%    | -21%  | -6%    |



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## RESULTS – BETWEEN DAYS

|              | Day 1 |        | Day 2 |        |
|--------------|-------|--------|-------|--------|
|              | 0-12h | 12-14h | 0-12h | 12-14h |
| IL-1 $\beta$ | 88%   | -37%   | 0%    | -69%   |
| IL-4         | 10%   | -17%   | 16%   | -19%   |
| IL-5         | -11%  | 8%     | -35%  | 14%    |
| IL-6         | 96%   | -31%   | -15%  | 62%    |
| IL-7         | 37%   | -32%   | 5%    | -28%   |
| IL-8         | -2%   | -6%    | -10%  | 32%    |
| IL-10        | -29%  | -1%    | -50%  | 25%    |
| IL-13        | 17%   | -7%    | -18%  | -6%    |
| TNF $\alpha$ | -3%   | -7%    | -21%  | -6%    |

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## AWAKE, SMOKY AND HOT


- Student: Alex Wolkow
- Stressor/s:
  - Physical work, long work hours & extended wakefulness
- Aim: to investigate the interactions of intense, intermittent physical labour, long working hours and sleep deprivation on firefighters health.
- Justification:
  - Known mood disturbances, behavioural changes and altered immune function.
  - The interactive and cumulative effect of these stressors on a firefighters health and wellbeing is poorly understood.




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## AWAKE, SMOKY AND HOT




- **Stressor:** Exposure to smoke
- **Aim:** to examine the impact of working in smoky conditions on inflammatory markers
- **Justification:**
  - To date there are no reliable laboratory markers for carbon monoxide poisoning
  - Short term exposure to carbon monoxide is associated with an acute inflammatory response
  - Further research is required to assess if there is an accumulation effect




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## AWAKE, SMOKY AND HOT



- **Student:** Sarah Jefferies
- **Stressor/s:**
  - Physical work in the heat
- **Aim:** to examine the impact of working in the heat on inflammatory markers
- **Justification:**
  - Significant elevations in plasma pro-inflammatory cytokine levels in heat stroke patients upon hospitalisation.
  - There is still the inability to predict, diagnose and treat the aetiology of heat stroke
  - The acute-phase response may be involved in the pathology of heat stroke



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