

Changes in Salivary IGA during arduous wildfire suppression relative to work shift length

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Basic Summary

Salivary IgA, a saliva protein that is related to decreases in immune function, along with a simple step test to evaluate HR response to a standardized submaximal workload, are inversely related to each. Both the Salivary IgA and the step test provide good indicators of fatigue. Wildland firefighters, based on these data, were fatigued demonstrated reductions in immune function by the end of long work shifts, but recovered by the following morning. These data suggest that there may be effective, yet simple quantifiable methods to monitor both short and long term fatigue during extended work shifts and duty cycles. Further work remains to be completed before recommendations can be made in this area.



Abstract:

PURPOSE: The purpose of this study was to compare the reduction in salivary IgA in response to a 14 and 21 hour work shift. **METHODS:** Seventeen (15M, 2F) wildland firefighters (WLFF) from two Interagency Hotshot crews served as subjects. Subject groups were studied in response to a short or long work shift (13.9±0.7 and 21.4±0.3 hrs). Work shift energy expenditure (EE) was estimated using the method established by Heil (MSSE 33(5):s168, 2001). Unstimulated saliva (4 min) was collected prior to work at 0530 and immediately post shift. Salivary IgA secretion rate (mg·min⁻¹) was calculated from an ELISA assay procedure. **RESULTS:** Work shift EE was significantly higher (p<0.05) for the long work shift (4101±578 and 3322±478 kcals for the long and short work shift, respectively).

Crew (work shift hrs)	Pre	Post	Next AM
13.9±.7 hr (n=6)	76.9±23.1	14.0±8.0*	82.4±55.9
21.4±.3 hr (n=11)	54.1±30.3	24.7±26.5*	40.3±29.5†

Values are salivary IgA (mg·min⁻¹), * p<0.05 vs. pre, †p<0.05 vs. the 13.9 hr work shift group

Salivary IgA was significantly decreased post work shift yet returned to pre shift values by the following AM in both groups. The 14 hr work shift group showed a recovery in sIgA (AM values at days 5 and 6 were 85.8±40.5 and 67.4±32.0 mg·min⁻¹, respectively). In contrast, the 21 hr work shift group showed suppressed values for sIgA six days after the extended shift (27.3±13.3 mg·min⁻¹). **CONCLUSIONS:** These data indicate that the sIgA secretion rate is significantly depressed following a single day of wildfire suppression. Work shift EE and/or duration may impair recovery and increase the risk for upper respiratory infection during extended operations.

Introduction

Recently our laboratory has demonstrated that the tee associated with wildfire suppression may exceed 6000 kcal/day (26.4 MJ/day) resulting from consistent work outputs and extended work shifts (Ruby et. Al, 2002). Forest fire suppression involves arduous work (average = 7.5 kcal/min) for prolonged periods (12 to 24 hours) in difficult environmental conditions (heat, altitude, smoke).

The job routinely includes packing heavy loads, building fireline with hand tools, and emergency responses, often under arduous and dangerous field conditions. Firefighters perform their duties while wearing personal protective gear that balances the needs for protection, performance, and mobility. In busy fire seasons, firefighters may work as many as 21 days without relief, with meals provided by field rations, a remote fire camp, or an organized camp with full field kitchen. When combined with pre and post-season work on prescribed fires, firefighters may log over 100 days of work in a season and over 1000 hours of overtime.



There is also an element of real danger as demonstrated by the 1994 Storm King Mountain fire in Glenwood Springs, CO, where 14 firefighters were killed. An additional 4 firefighters were killed during the 2001 fire season in Washington state.

Medical units in large fire camps treat a number of injuries and medical emergencies. Although the work predictably leads to numerous cases of dehydration, upper respiratory tract irritation and infection is the most common complaint during extended wildfire assignments.

Previous research has associated extended work with a suppression in the salivary protein salivary immunoglobulin A (slgA) in response to running (Neiman, et. Al, 2002) and physical training (Gleeson, 2000). Previous research has also demonstrated that dietary intervention (supplemental liquid carbohydrate) may attenuate immunosuppression as measured by slgA (Bishop et. Al, 2000).

Purpose

The purpose of this study was to determine the transitory changes in the secretion rate of slgA ($\mu\text{g}\cdot\text{min}^{-1}$) in response to arduous wildfire suppression efforts. As a secondary purpose, the HR response to a standardized work bout was also evaluated to determine its association with fatigue.

Methodology

- Subjects included 17 wildland firefighters (n=15m, 2F) recruited from two hot shot crews in the northern rockies. Subjects were studied prior to and after two work shift intervals (14 hours (n=6) and 21 hours (n=11) of constant work).
- Unstimulated saliva was collected for 4 min at 0530 and again post shift. The frozen saliva samples were analyzed using an Elisa Assay by technicians at Loma Linda University.
- Work shift EE was estimated from CSA activity monitors using the method established by Heil (MME 33(5):s168, 2001).
- HR index was established from a 1-min step test (20.3 cm step, 120 steps/min) as the sum of resting (5 min seated rest), 0, 30 and 60 seconds post exercise.



Results

Figure 1 shows that Salivary IgA values are sensitive to extreme working conditions. There was a global suppression of sIgA in response to the extended workshifts.

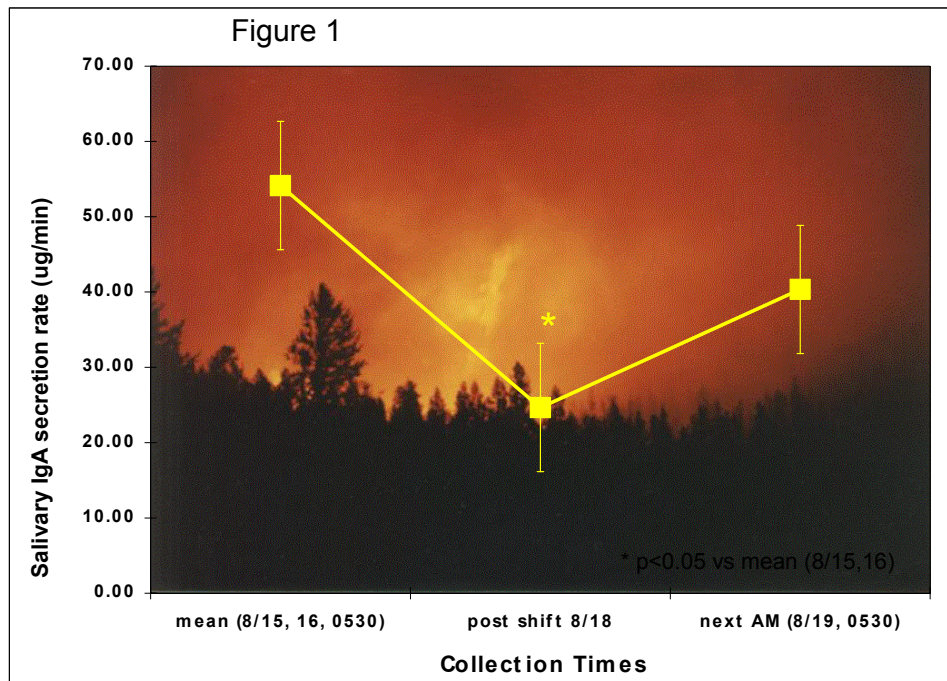
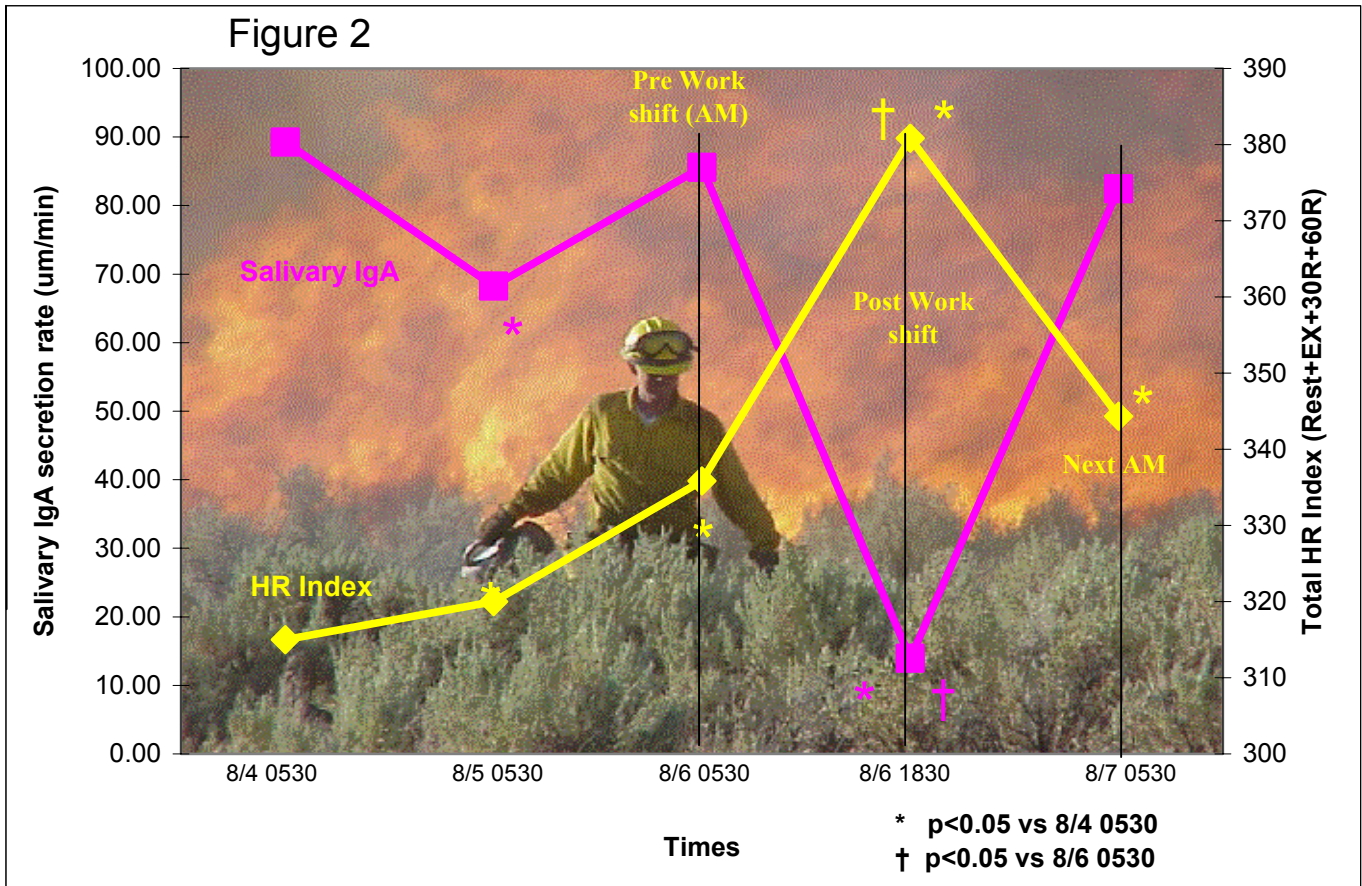


Figure 2 shows that the HR index demonstrated an inverse relationship with the suppression in sIgA and may serve as an early warning against overwork and a suppression of immune function during field observations.



Conclusions:

- Both salivary IgA and the submaximal HR index test can be used as effective markers of fatigue.
- Additional research should focus on strategies to return workers to optimal health and limit the risk of URTI on the fireline.
 - These strategies may include supplemental nutritional techniques (including the timing of ingestion, i.e. post shift), adequate hydration, optimal work:rest cycle issues, and shift length recommendations.



References

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