Assessments of Cardiovascular Functions of Firefighters on A Very Long (72-hour) Shift: A Field Feasibility Study

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Background – HAWKS study

Many firefighters do additional 24-hour shifts beyond their standard 24-hour shifts, which generally result in consecutive 24-hour shifts (e.g., 72-hour work). We observed in our research of firefighters in Southern California that they work on average thirteen 24-hour shifts per month. Moreover, a substantial number of firefighters, 56%, worked 72 consecutive hours, while 22% worked 96 consecutive hours at least one time per month. However, little is known about the impact of consecutive 24-hour shifts on the cardiovascular functions of firefighters. Also, there have been no standard field methods for assessing the cardiovascular changes that result from consecutive 24-hour shifts.

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Objective

The study aims to test the feasibility of 5 direct and indirect ambulatory parameters of cardiovascular functions in firefighters on a very long (72-hour) shift.

- **Heart Rate**
- **Beat-to-Beat (R-R Interval) Heart Rate Variability**
- **Blood Pressure**
- **Salivary Cortisol**
- **Salivary C-Reactive Protein (CRP)**

7 Firefighters

- Had at least one Wellness and Fitness (WEFIT) exam at UCI-COH clinic.
- Scheduled for a 72-hour shift in the coming months.
- 5 non-hypertensive and 2 hypertensive (under treatment) firefighters.

Ambulatory Measures On a 24-hour Shift

- Measures on two 24-hour periods (1st 24-hour and 3rd 24-hour shifts of three consecutive 24-hour shifts). A 24-hour shift of the firefighters starts at 8:00 AM and ends at 8:00 AM of the next day.

For each 24-hour period,

- **Heart Rate** (with a Polar S810 heart rate monitor for 24 hours including sleep time).
- **Beat-to-Beat (RR Interval) Heart Rate Variability** (with a Polar S810 heart rate monitor for 24 hours including sleep time).
- **Blood Pressure** (with an Omron HEM-670 wrist blood pressure monitor in a sitting position at a fire station, every 30 minutes from 8:00 AM to bedtime).
- **Salivary Cortisol** (with Salimetric salivary cortisol kits at 8:00 AM, 10:00 AM, 8:00 PM, 10:00 PM or bedtime, awaking, and 30 minutes after awaking).
- **Salivary C-Reactive Protein (CRP)** (with Salimetric salivary cortisol kits at the same time as in salivary cortisol).
- **A diary** for assessing subjective ratings of fatigue and stress on a 100 mm visual analog scale (VAS) at the sampling times of salivary measures and collecting information on exercise, sleep, diet, and number of calls including night calls. Administrative call records were additionally collected.

Conclusions and Implications

- The five ambulatory parameters have great potential for being further developed as biomarkers of cardiovascular functions in firefighters on consecutive 24-hour shifts.

- We observed in the group of firefighters that as expected, self-rated stress and mental fatigue, heart rate, systolic and diastolic blood pressure increased (Table 1), while a frequency-domain measure of decreased heart rate variability (Low Frequency/High Frequency Power Ratio in Table 1) increased from the 1st 24-hour shift to the 3rd 24-hour shift, indicating an increased sympathetic nervous system over parasympathetic nervous system. However, contrary to our expectations the average of salivary CRP decreased during the period, though its diurnal pattern was much flatter during the same period (in fact, the averages of saliva CRP at 10.00 AM increased during the period. CRP is supposed to be the lowest at mid-day). The sample size is too small to make definitive conclusions.

- A larger field study is needed to examine a day-by-day change in the cardiovascular parameters in firefighters working a long (> 48 hours) shift and more importantly find effect modifiers (see Figure 1). Contact: Dr. BongKyoo Choi (b.choi@uci.edu).