

FIREFIGHTER INCIDENT REHABILITATION: INTERPRETING HEART RATE RESPONSES

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ABSTRACT

The primary objective of this observational study was to document the heart rate (HR) responses of firefighters during incident rehabilitation following firefighting activity in a high-rise building with a simulated fire on the 10th floor. Additionally, the study investigated potential factors, including firefighting workload, ambient temperature, firefighter movement, and individual characteristics, that may have affected HR during recovery. Firefighters ($n = 198$) were assigned to perform a simulation of fire suppression, search and rescue, or material support during one of six firefighting trials that involved different crew sizes and ascent modes, and were performed in different environmental conditions. After completing the simulated firefighting activity, firefighters reported to a rehabilitation area on the 8th floor. The rehabilitation area was staffed by firefighter/paramedics. HR was monitored continuously during simulated firefighting activity and a 15-minute rehabilitation period. Average HR during rehabilitation (HR_{mean}) was calculated and compared across trials. Simulated firefighting activity was performed in the summer in Virginia, USA, and ambient conditions varied among trials (mean \pm SD: $31 \pm 4^{\circ}\text{C}$; $46 \pm 15\%$ relative humidity; $32 \pm 4^{\circ}\text{C}$ heat index). Duration of simulated firefighting activity ranged from 12.0 to 20.3 minutes among trials (mean: 15.4 ± 5.2 minutes). Over all trials, mean peak HR during simulations was 173 ± 18 beats $\cdot\text{min}^{-1}$. Mean HR over all trials at entry into rehabilitation was 149 ± 24 beats $\cdot\text{min}^{-1}$. Following 15 minutes of recovery, mean HR over all trials

was 126 ± 23 beats $\cdot\text{min}^{-1}$. Exploratory analyses revealed that higher workload during firefighting (stair trials), higher ambient temperature ($\geq 30^{\circ}\text{C}$), greater movement during rehabilitation (≥ 0.1 g-force), higher age (≥ 45 years), and higher BMI (≥ 30.0 kg $\cdot\text{m}^{-2}$) were associated with higher HR responses during rehabilitation. During complex emergency operations, emergency medical service personnel will likely encounter considerable variability in HR responses upon initial evaluation and throughout rehabilitation. Following one bout of firefighting activity during a simulated fire scenario, HR decreased but remained elevated well above resting values following 15 minutes of rehabilitation. Based on current fire service recommendations, the majority of firefighters (88%) would not have been released from rehabilitation and eligible for reassignment after a 15-minute rehabilitation period following a brief bout of simulated firefighting activity.

Key words: medical monitoring, cardiac strain, firefighting

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