Physiological Stress Responses to a Live-Fire Training Evolution in Career Firefighters

MATTHEW J. MCALLISTER[1], DREW E. GONZALEZ[2], STEVEN E. MARTIN[2,3]

[1]Metabolic & Applied Physiology Laboratory, Department of Health & Human Performance, Texas State University, San Marcos, TX; [2]Tactical Athlete Research Unit, Department of Kinesiology & Sports Management, Texas A&M University, College Station, TX; [3]Huffines Sports Medicine Institute, Department of Kinesiology and Sport Management, Texas A&M University, College Station, TX

Introduction

Firefighters have a physically demanding job that exposes them to many specific and unique stressors, which contribute to cardiovascular disease (CVD) risk (i.e., cardiovascular strain, inflammation, and oxidative stress) or even mortality. At present, the literature lacks data evaluating these physiological stress responses amongst firefighters in any realistic or simulated scenarios, such as a live-fire training evolution (LFTE). **Given the elevated risk of premature mortality, there is a critical need to better understand the physiological stress responses to a LFTE.** This information could aid in developing nutritional, training, and other various interventions to mitigate stress load and reduce the incidence of CVD among this population.

PURPOSE: **To assess the physiological stress response to an LFTE among firefighters.**

Figure 2: Summary of Physiological Responses to Firefighting

→ **Cardiovascular** (Increased HR and BP, Decreased Stroke Volume)

→ **Hematological** (Decreased Plasma Volume, Hemoconcentration)

→ **Thermoregulatory** (Elevated Core Temperature, Dehydration)

→ **Respiratory** (Increased Breathing Rate and Oxygen Consumption)

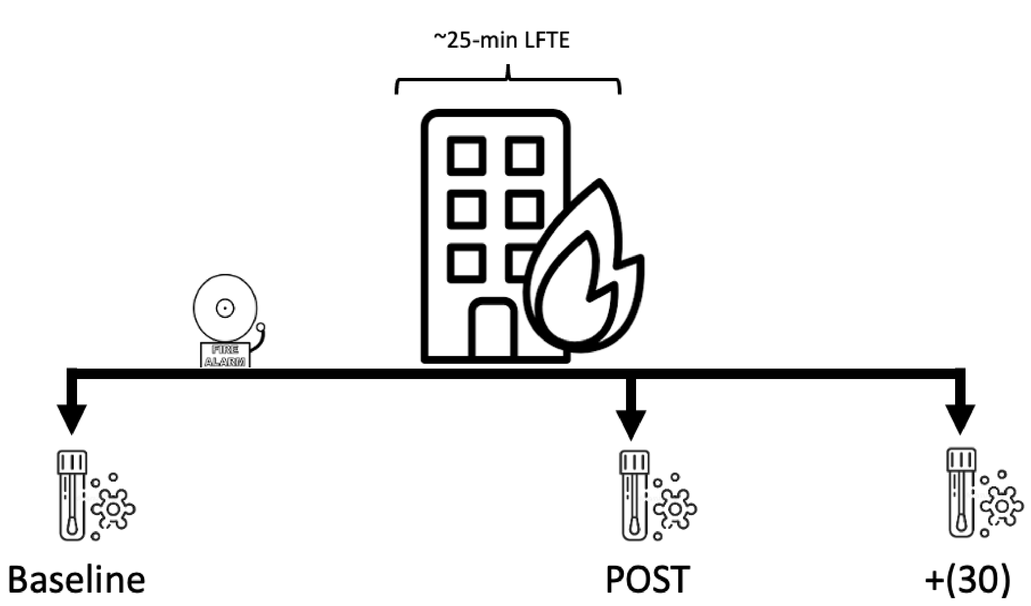
→ **Metabolic** (High Oxygen Cost, Increased Lactate, Fatigue)

→ **Immune/Endocrine** (Increased Leukocytes and Hormones)

→ **Nervous** (Sympathetic Surge and Increased Adrenaline)

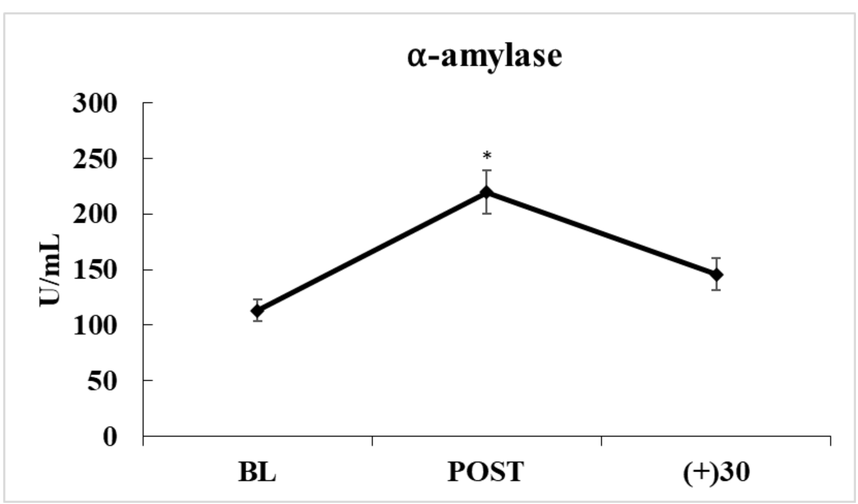
→ **Muscular** (Increased Oxygen Use and Heat Production)

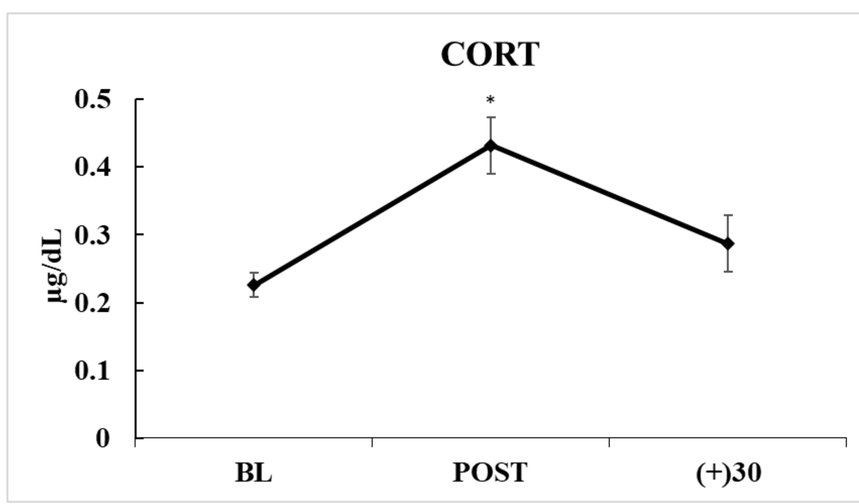
Methods

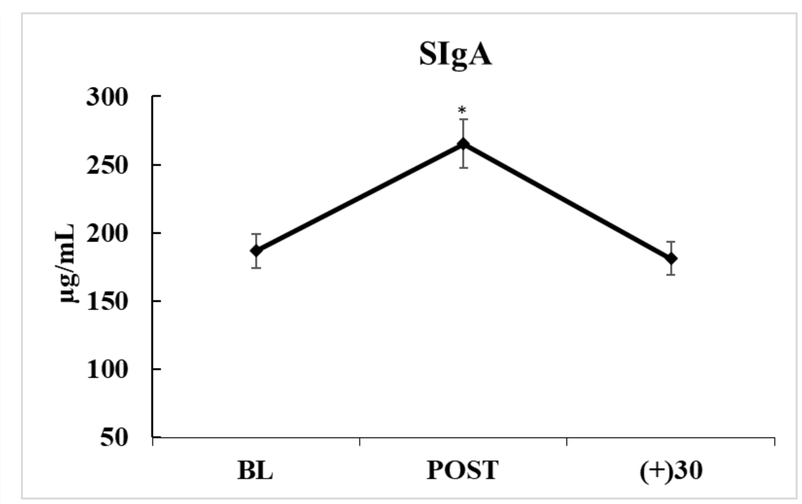


Seventy-six (n = 76) career firefighters completed an LFTE. Salivary samples were collected pre, post, and 30-min post the LFTE, and analyzed the following stress markers: α-amylase (AA), secretory immunoglobulin-A (SIgA), and cortisol (CORT). One-way repeated measures analysis of variance was used to assess changes over time. Fisher's LSD and Cohen's d effect size calculations were used for post hoc analysis.

Results







Significant main effects for time were found for AA, SIgA, and CORT ($p<0.001$). Fisher's LSD post hoc analysis found AA, SIgA, and CORT concentrations were all significantly elevated post LFTE compared to pre ($p<0.0001$) and 30-min post ($p<0.0001$). Medium to large effect sizes were noted for AA, SIgA, and CORT with respect to changes pre to immediately post-LFTE (d = 0.83, 0.61, and 0.77, respectively).

Conclusion

While many studies have shown increased inflammation and oxidative stress, as well as adverse cardiovascular and metabolic responses to firefighting activities, these data provide insight into the physiological *stress* placed upon a firefighter engaging in fire-suppressive evolutions.