

Wildland Firefighter Job Demands and Physiological Stress

Molly West, MPH

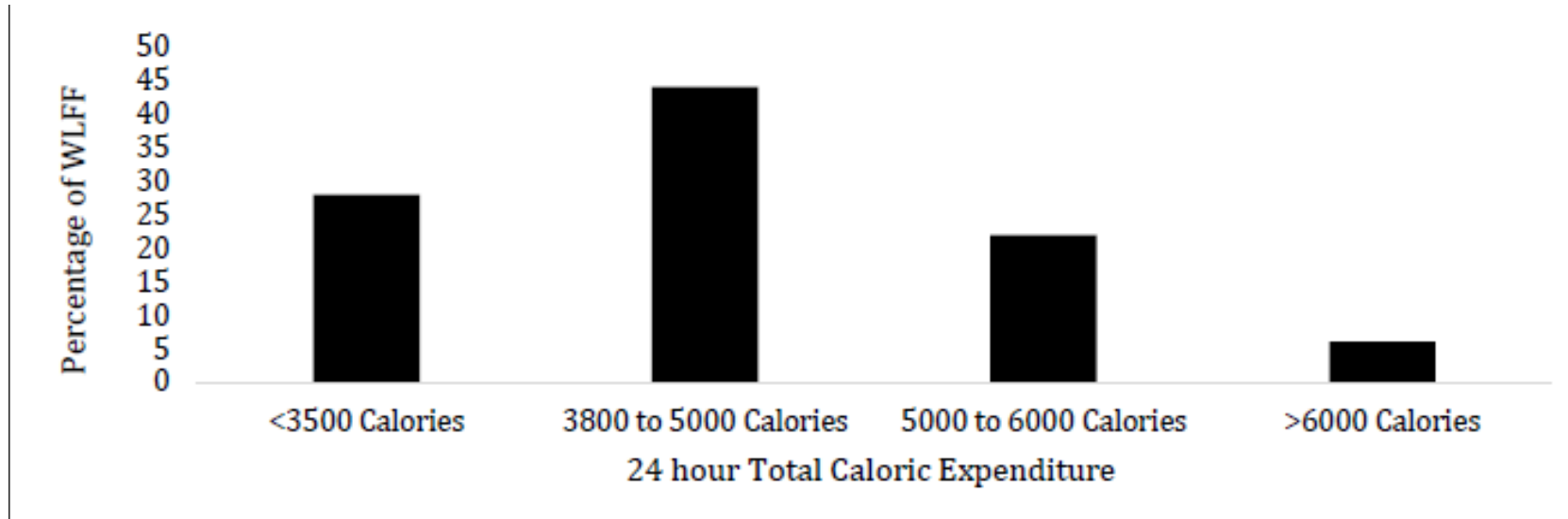
Skylar Brown, RN

Joe Sol, MS

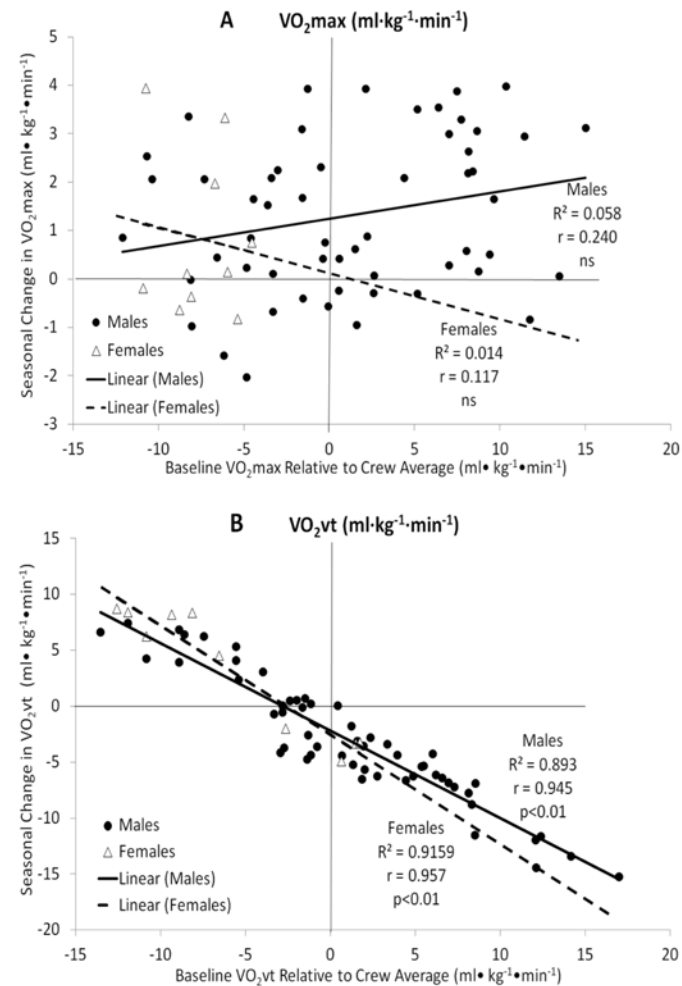
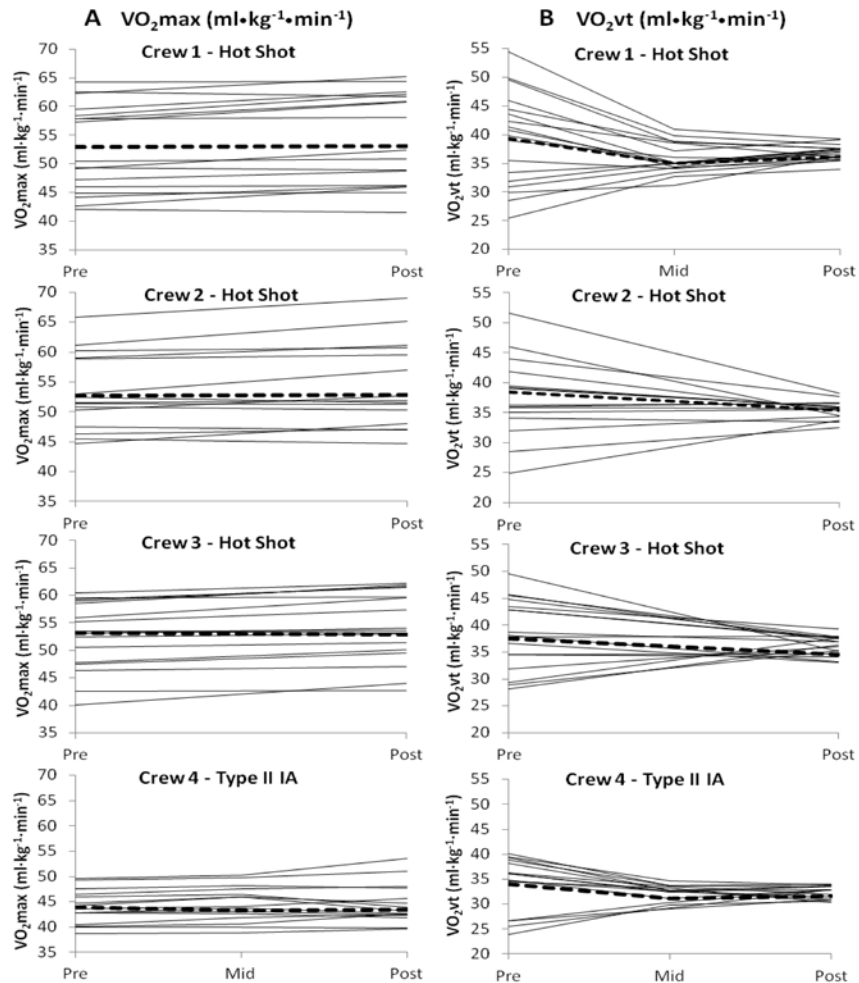
Joe Domitrovich, PhD



Caloric Demands



How does Fitness tie into this?



Seasonal changes in wildland firefighter fitness and body composition

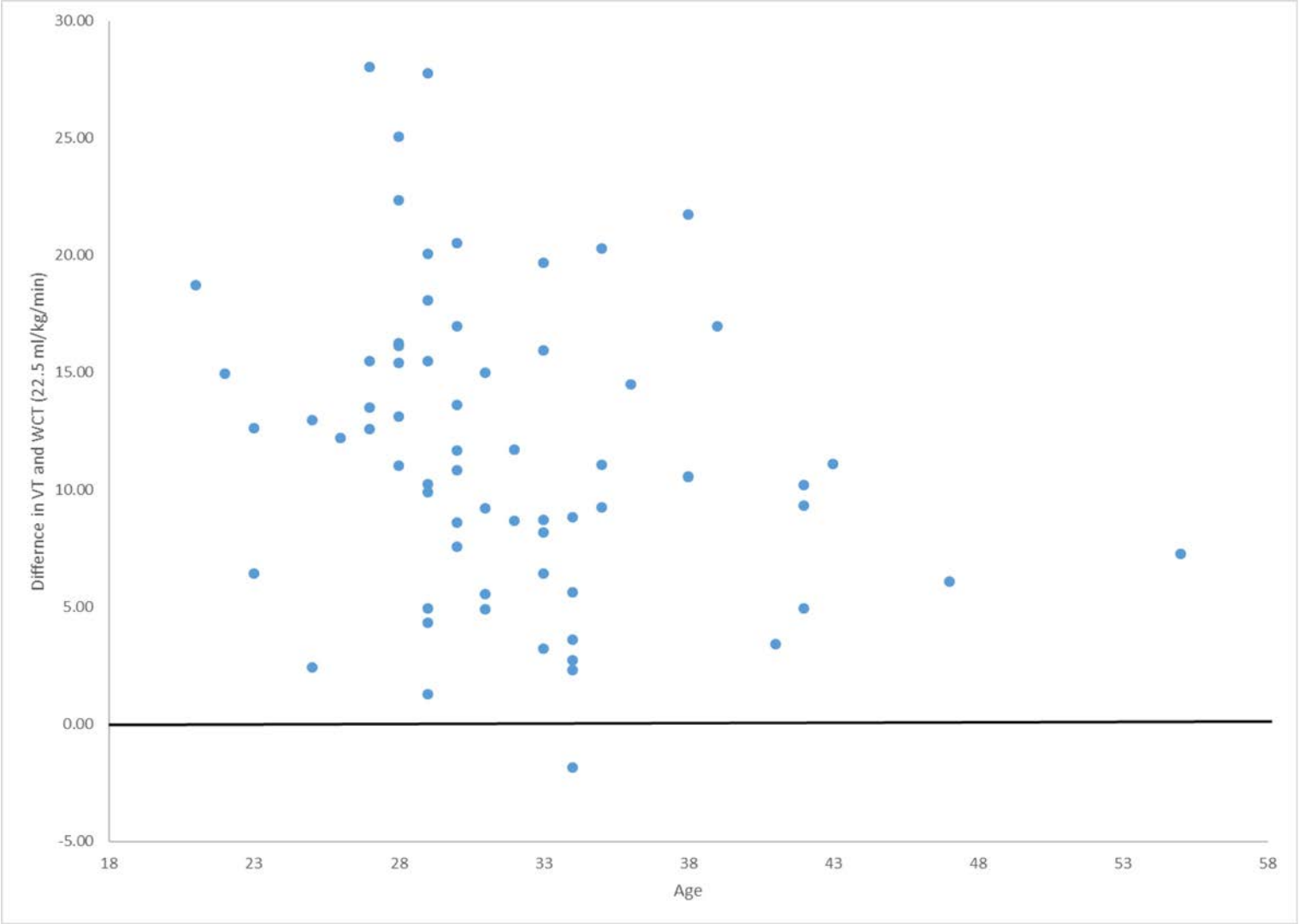
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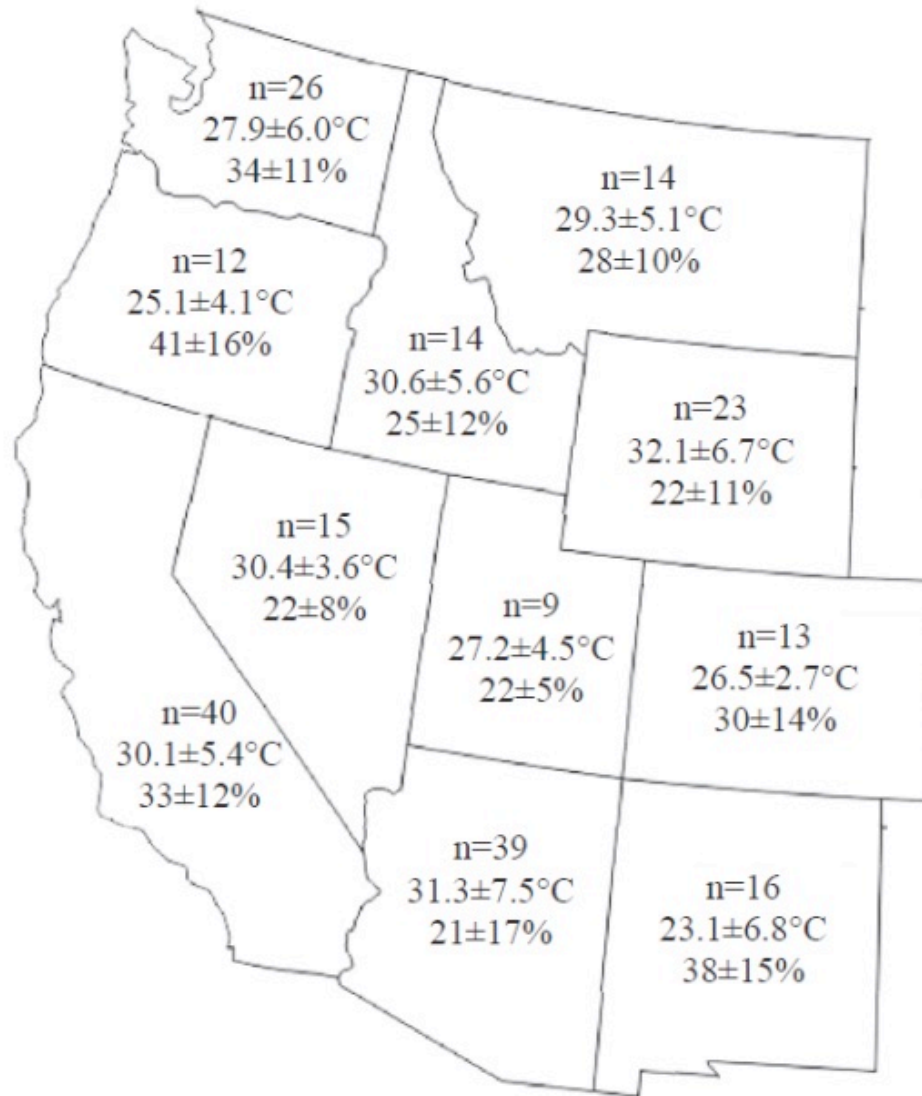


Title: Peak and Sustainable Aerobic Fitness of United States Smokejumper and Rappeller Wildland Firefighters

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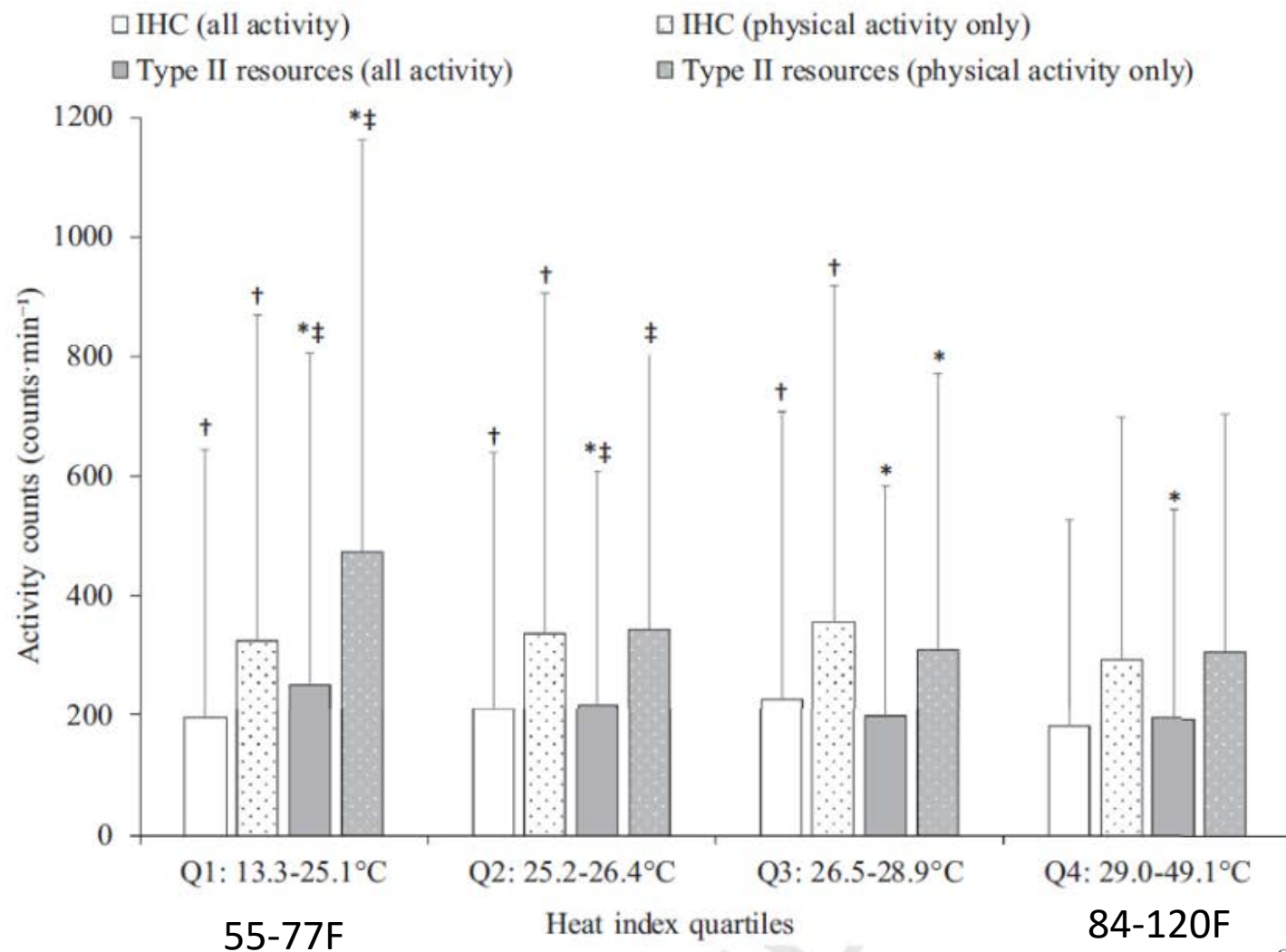


ORIGINAL RESEARCH

Evaluation of Environmental Conditions on Self-Selected Work and Heat Stress in Wildland Firefighting

Joseph A. Sol, MS¹; Molly R. West, MPH¹; Joseph W. Domitrovich, PhD¹; Brent C. Ruby, PhD²

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Job Tasks-Key to Physiological Stress!

Table 1 Wildland firefighter job tasks categorised into four groups based on activity level and percentage of total person-task observations in the data set in the Wildland Firefighter Heat Related Illness study, Western United States, 2013–2016

Sedentary activity	%	Light physical activity	%	Moderate physical activity	%	High physical activity	%
ICP Stationary	1.7	Handline Direct Pump	0.1	Mop Up	5.1	Handline Direct Scratch	0.7
ICP Other	0.2	Handline Indirect Pump	0.02	Cold Trailing	0.6	Handline Direct Sawyer	0.5
Briefing	6.7	Handline Indirect Dozer Boss	0.02	Improving Direct Line	0.2	Handline Direct Swamper	0.6
Driving	6.9	Holding Direct Line	1.3	Improving Indirect Line	1.1	Handline Direct Engine	0.1
Lunch Break	3.6	Holding Indirect Line	0.2	Felling Sawyer	0.6	Handline Direct Squad Leader	0.1
Rest Break	3.3	Holding Firefighter	0.7	Felling Swamper	0.6	Handline Direct Firefighter	0.2
Operational Break	19.5	Holding Squad Leader	0.2	Working with Aviation	0.1	Handline Indirect Scratch	0.4
Staging	0.9	Holding Engine	0.1	Scouting Hazard Trees	0.7	Handline Indirect Sawyer	0.6
Other	0.5	Suppression Holder	0.8	Grid the Black	1.5	Handline Indirect Swamper	1.2
Total	43.2	Engine Pump Operator	0.2	Grid the Green	0.6	Handline Indirect Squad Leader	0.3
		Holding Pump	0.1	Tool Up/Tool Down	8	Handline Indirect Firefighter	0.2
		RX Holder	0.2	Total	19	Line Preparation	0.5
		Refurb Tools	3.3			Initial Attack	0.1
		Structure Protection	1.1			RX Lighter	0.2
		Compound Work	1.4			Suppression Lighter	0.8
		Total	9.4			Physical Training	1.3
						Project Saw	0.6
						Project Stacking	0.7
						Hiking	19.2
						Medical	0.1
						Total	28.4

ORIGINAL RESEARCH

Risk for heat-related illness among wildland firefighters: job tasks and core body temperature change

Molly R West ,^{1,2} Sadie Costello,³ Joseph A Sol,² Joseph W Domitrovich²

Core Body Temp Rise

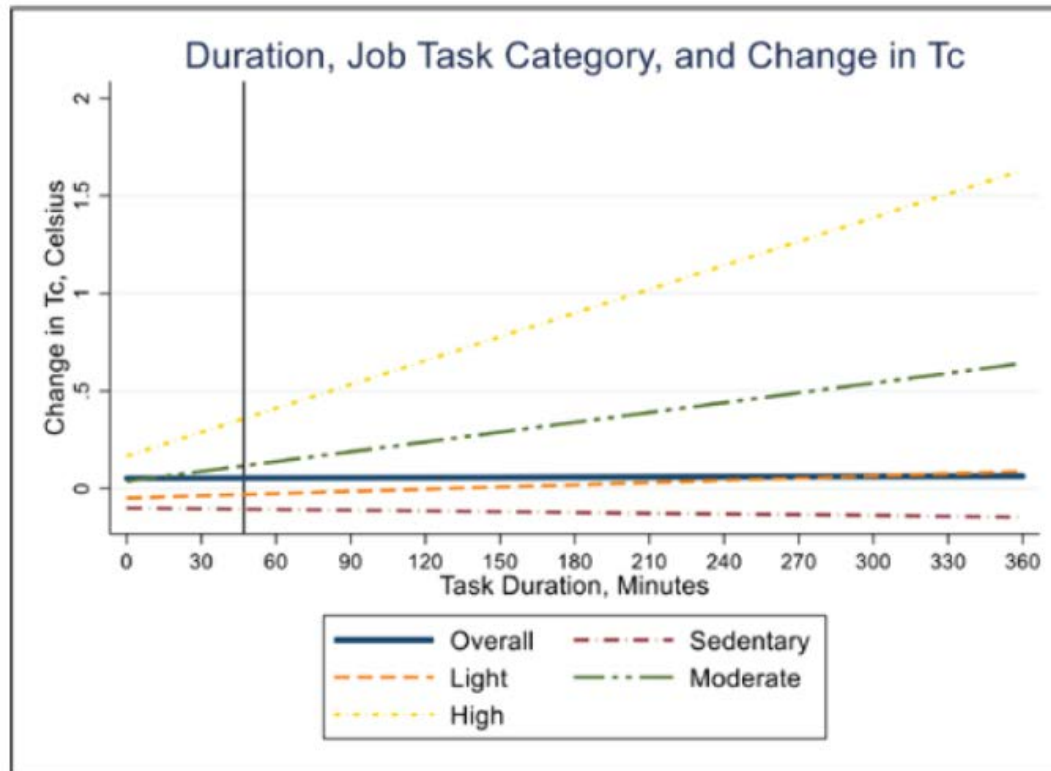


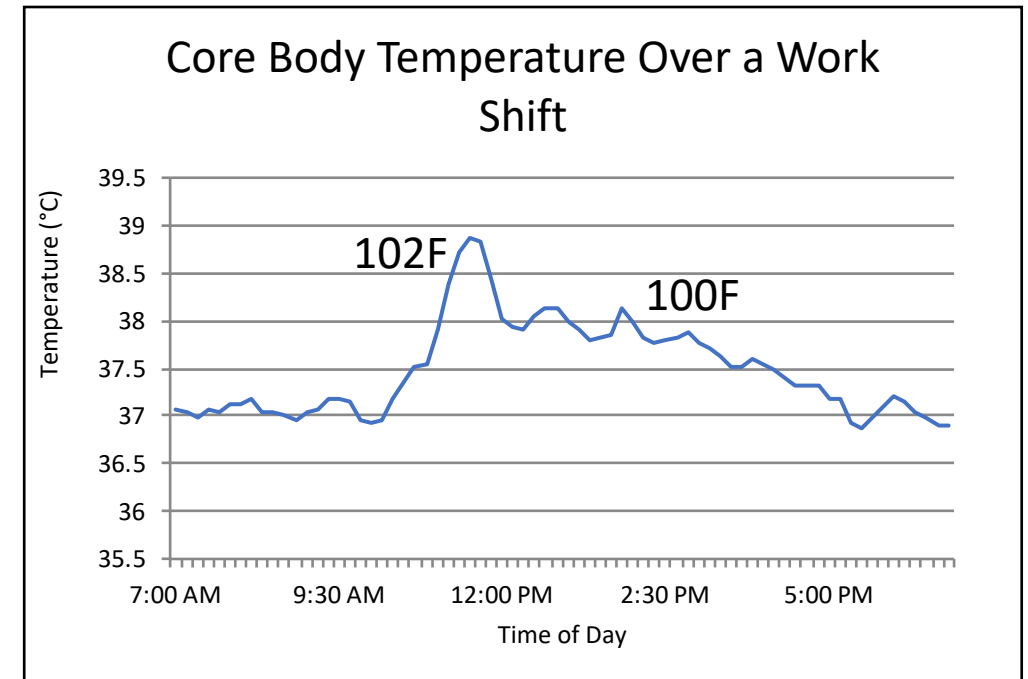
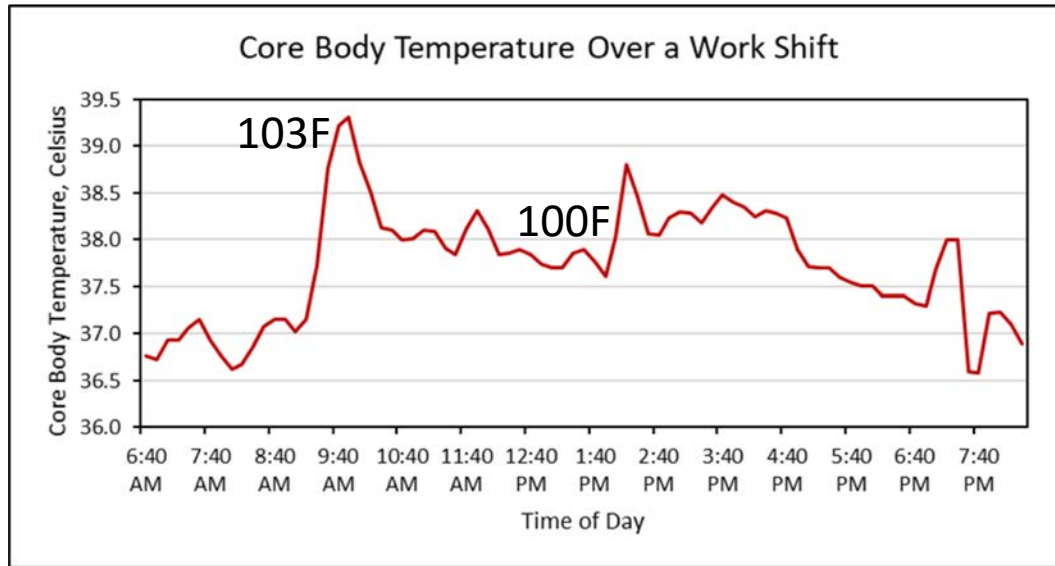
Figure 1 Predicted changes in core temperature (T_c) among wildland firefighters in the Heat Related Illness Study based on interaction of job task category (sedentary, light, moderate and high) and task duration in the generalised estimating equations model. Average task duration of 47 min denoted by vertical line.

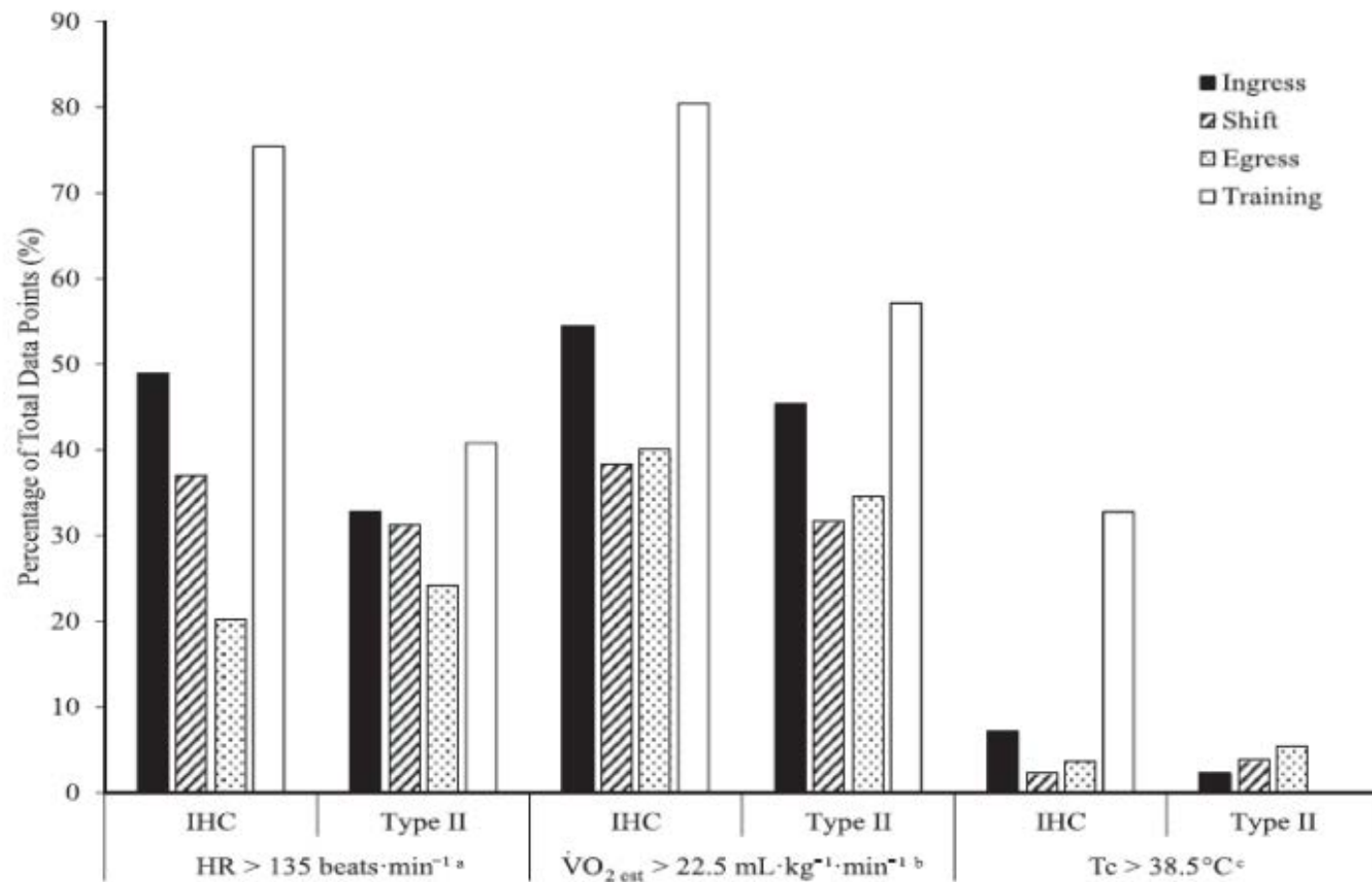
ORIGINAL RESEARCH

Risk for heat-related illness among wildland firefighters: job tasks and core body temperature change

Molly R West ,^{1,2} Sadie Costello,³ Joseph A Sol,² Joseph W Domitrovich²

Example of a shift





^a - 135 beats·min⁻¹ represents HR value associated with the ventilatory threshold of WLFFs⁴⁴.

^b - 22.5 mL·kg⁻¹·min⁻¹ represents the metabolic demand of the current WLFF Work Capacity Test⁷⁻⁹.

^c - 38.5°C represents the core temperature representative of the onset of risk for heat exhaustion⁴¹.

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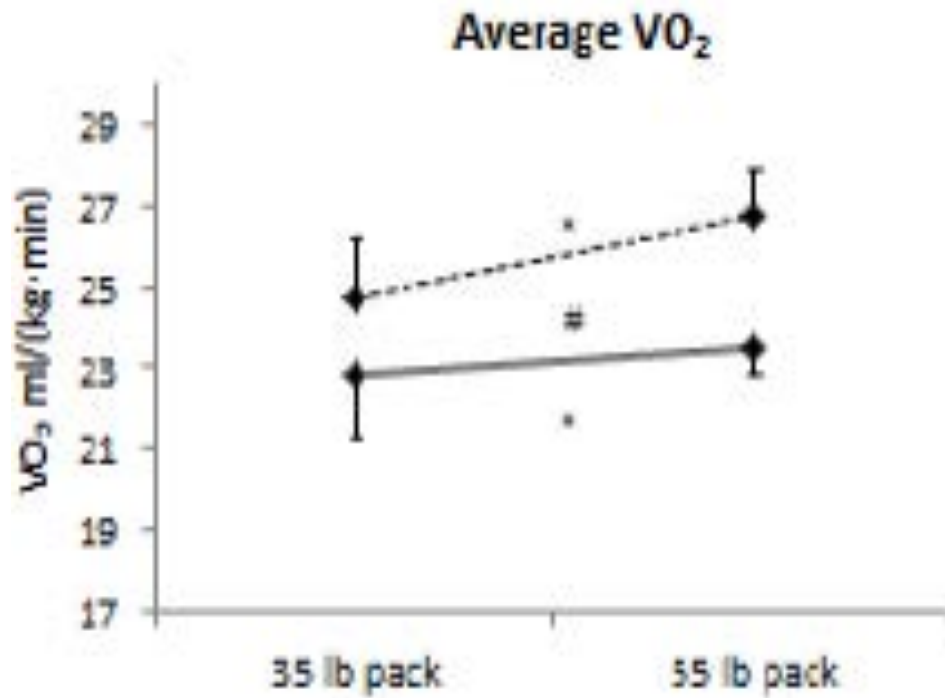
ORIGINAL RESEARCH

Metabolic Demand of Hiking in Wildland Firefighting

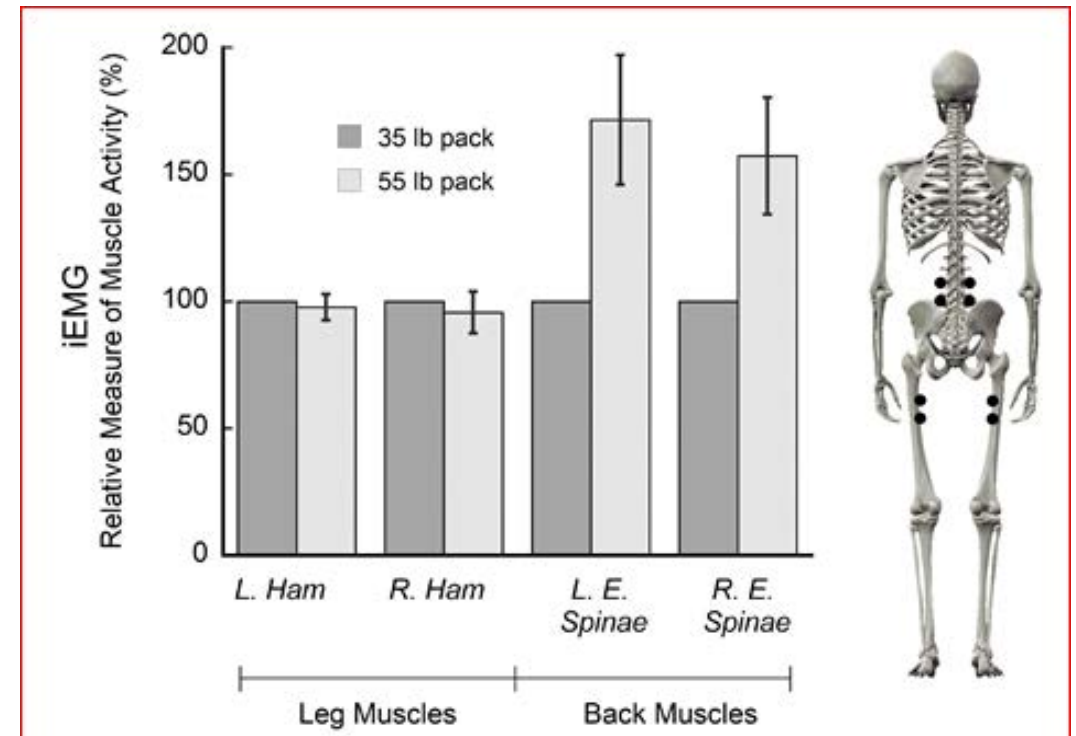
Joseph A. Sol, MS; Brent C. Ruby, PhD; Steven E. Gaskill, PhD; Charles L. Dumke, PhD; Joseph W. Domitrovich, PhD

From the United States Department of Agriculture, Forest Service, National Technology and Development Program, Missoula, MT (Mr Sol and Dr Domitrovich); the Montana Center for Work Physiology and Exercise Metabolism, University of Montana, Missoula, MT (Dr Ruby); and the Department of Health and Human Performance, University of Montana, Missoula, MT (Drs Gaskill and Dumke).

Pack/Gear Weight



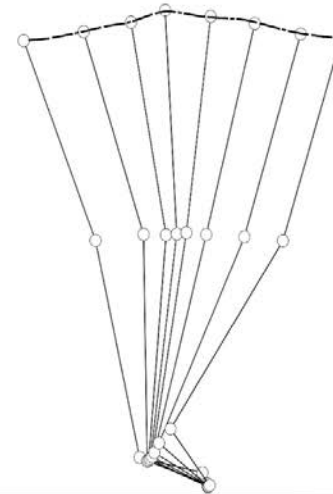
20% Increase in Workload with heavier pack



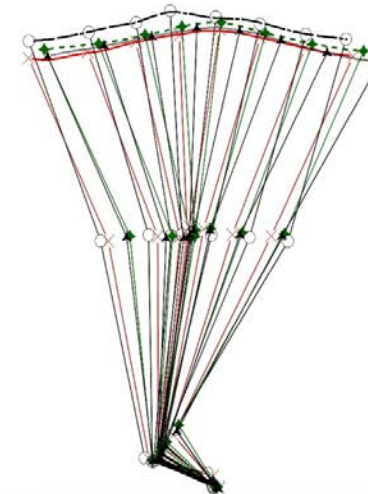
Pack Weight (this was with 85lbs)



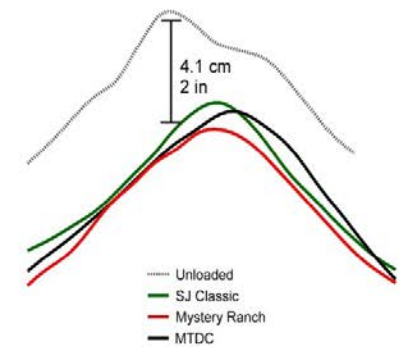
Unloaded Leg Movements



Unloaded vs Loaded [all conditions]



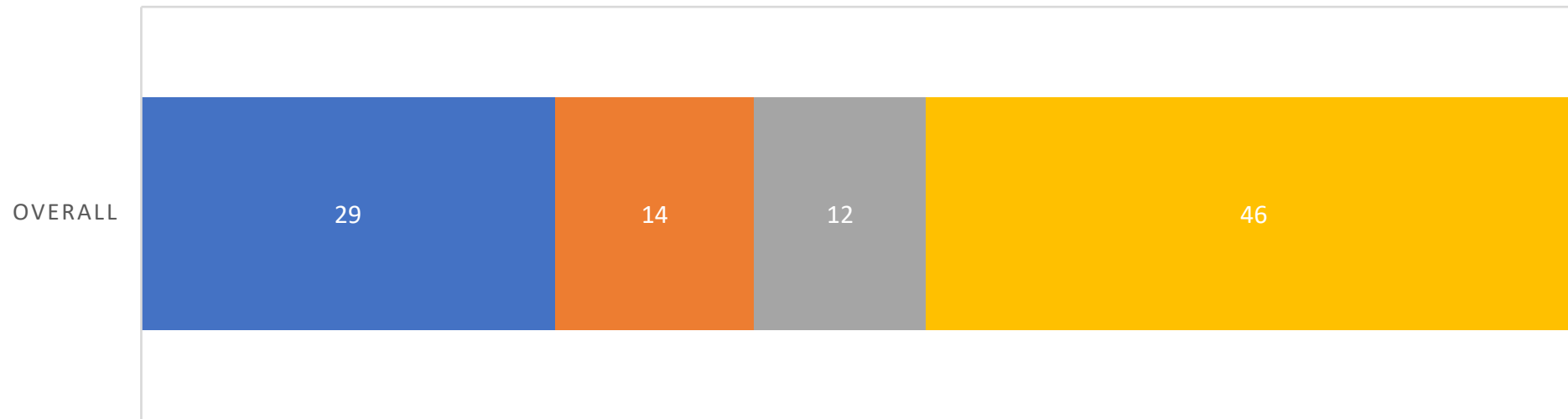
Magnification of the Hip [all conditions]



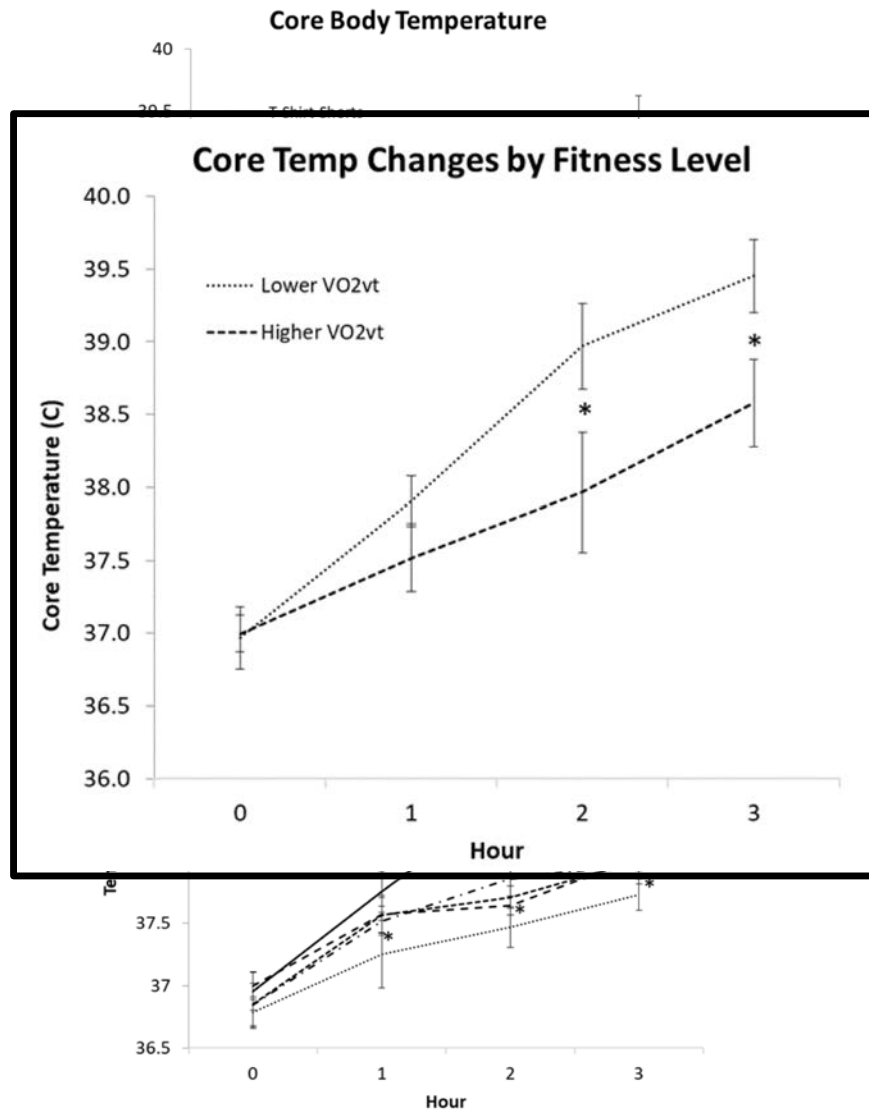
What ya got in that thing?

BREAKDOWN OF PACK WEIGHT PERCENT BY CATEGORY

■ Water ■ Empty Pack ■ Fire Shelter ■ Other



What about PPE?



Wildland fire uniforms configurations on physiological measures of exercise-heat stress

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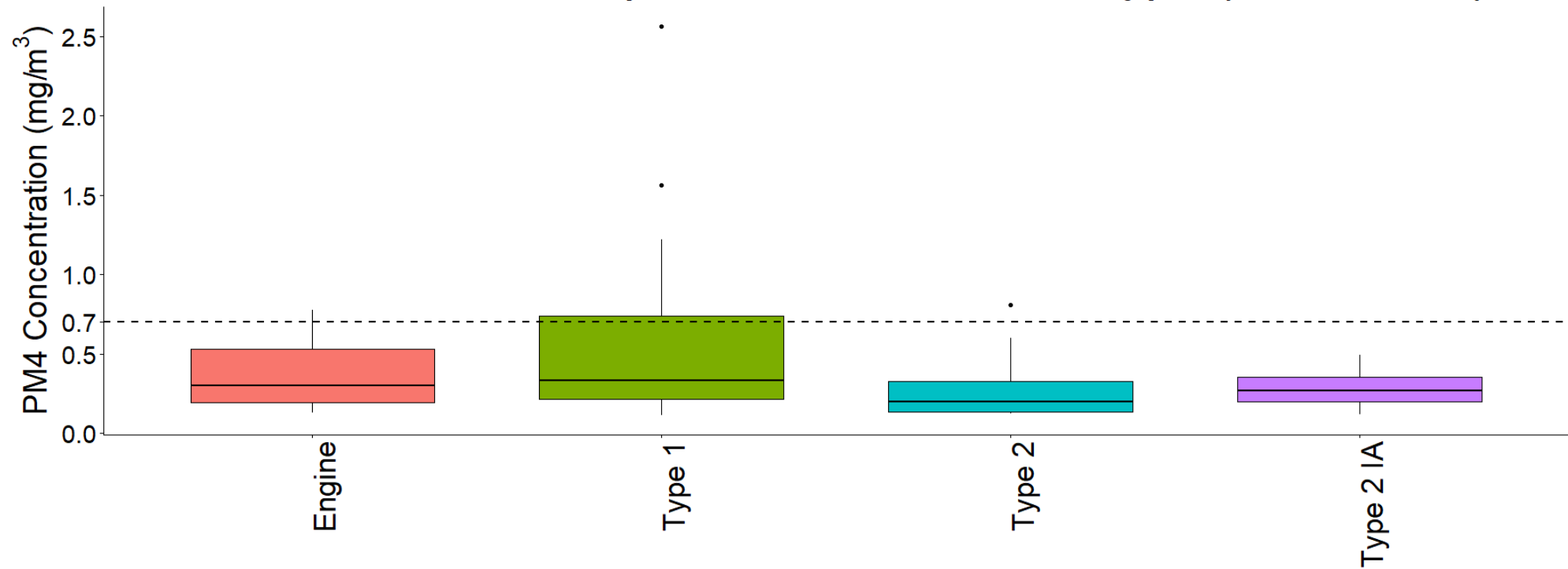
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Bring it all Together!

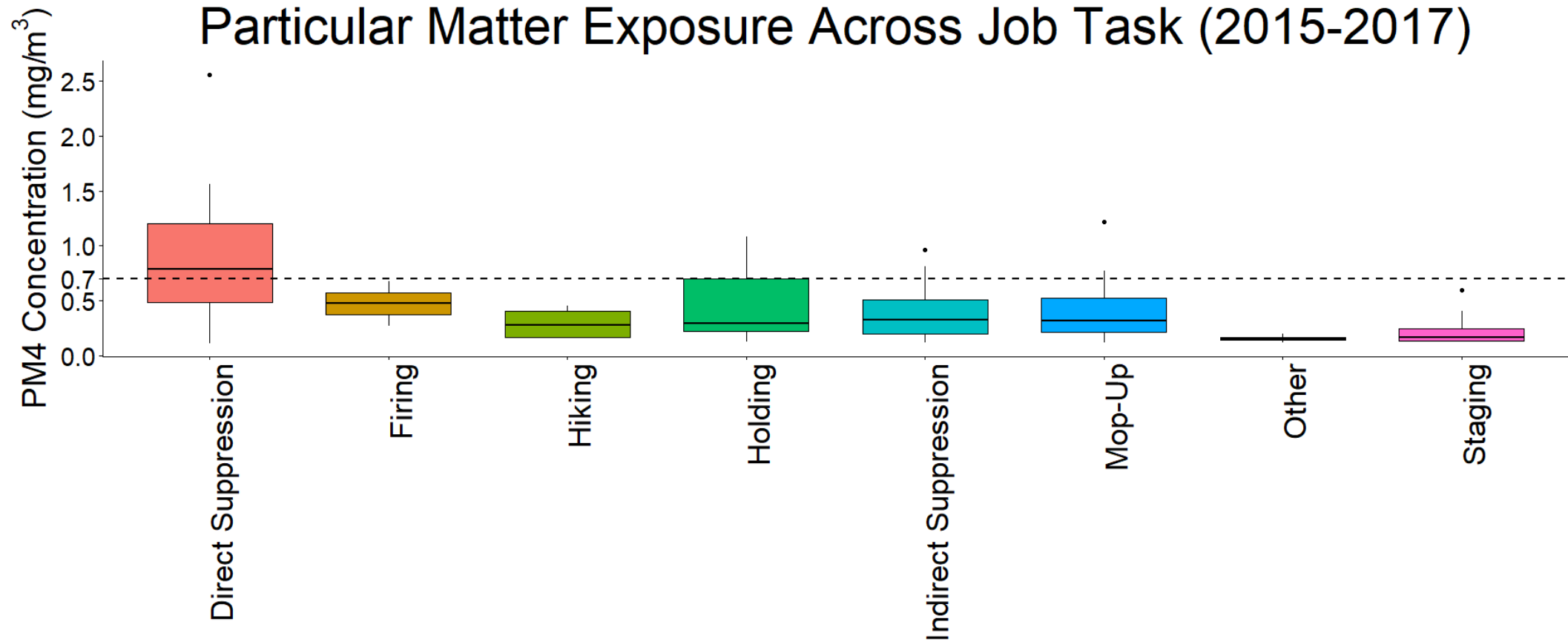
- 61% of firefighters had a core temp over 38 deg C (100.4)
 - Most of that was for over 30 mins in length
 - No subject had a heat injury
- Job Tasks and the Duration of those tasks matter!
 - Proper Work Rest
- Hydration is not a magic bullet!
- Hiking-20 to 40% of work shift
 - What is driving up the demand?
 - Weight!
 - About 58 lbs of equipment weight
 - 33% of body weight

Smoke Exposure

Particular Matter Exposure Across Crew Type (2015-2017)



Smoke (PM)



Smoke (CO)



Bring It All Together

- We did not see much decrease in smoke exposure after mitigations were put into place.
- We did see good identification of smoke level by firefighters
- Very dynamic conditions
 - Most “high” exposures were short term

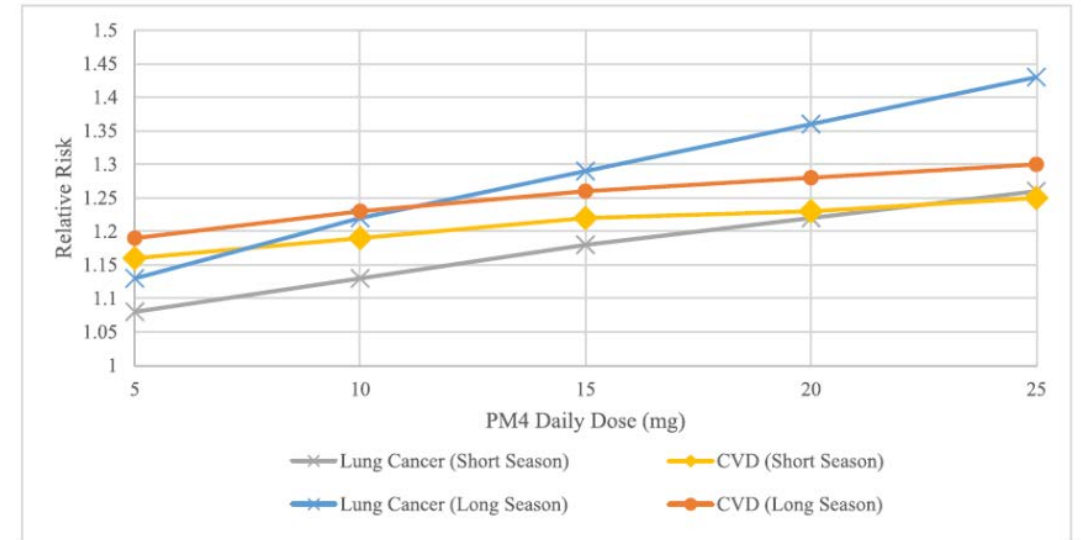


Fig. 1. Relative risk of lung cancer and cardiovascular disease across career length.

Questions/Comments/Thoughts

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