The Influence of Wildland Fire Operations on Adipose Tissue, Skeletal Muscle and Blood Lipids

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Where I come from...?

- Georgia
- Mississippi
- Tennessee
- ALASKA!
- Arkansas
- Copenhagen
Hot Times in Alaska
Wildfire property damage could reach $65 billion in Northern California

by Jill Disis  @jdisis

October 11, 2017: 11:09 AM ET
Danger to Civilians
Threat to Infrastructure
73 Type 2 EFF crews
Many Alaska Native

What about occupational resilience and metabolic risk factors in Alaska Wildland Firefighters?
According to Dr. Brian Sharkey in his book, “Fitness and Work Capacity - 2nd edition”:

“Our studies have shown that muscular fitness is highly related to performance of the tasks involved in wildland firefighting. Firefighters with more strength and muscular endurance are better able to carry the loads and use the tools than those with lower levels.”
15 Year Comparison:

Brent Ruby: UMT

4,182 kcals/day
(2719-6260 kcals/day)
(1.8-3.6 x BMR)

4,556 kcals/day
(2946-6083 kcals/day)
(1.7-3.5 x BMR)

Total energy expenditure during arduous
Stressors and Potential Consequences

- Energy expenditure
- Physical/Mental Fatigue
- Sleep deprivation
- Reduced appetite
- Environmental stress

  ➡️

- Loss of skeletal muscle
- Loss of bone density
- Increased injury/death
Do WFF’s preserve their muscle over the season?

Three Fairbanks WFF crews over the 2017 Fire Season
- Skeletal muscle via MRI and DEXA
- Metabolic measurements including liver and blood lipids
Surprisingly.. they maintain muscle

**Total Lean Body Mass**

Pre-Season: 40

Post-Season: 50

\( P = 0.04 \)

**Mid-Thigh Muscle Area**

Pre-Season: 0

Post-Season: 100

\( P = 0.04 \)

**Total Fat Mass**

Pre-Season: 0

Post-Season: 5

\( P = 0.08 \)
Increase in Intrahepatic Lipid
Connected to Increase in Blood Lipids

**VLDL-cholesterol**

- Pre-Season: 0-30 mg/dL
- Post-Season: 10-40 mg/dL

P=0.01

**LDL Cholesterol**

- Pre-Season: 50-150 mg/dL
- Post-Season: 70-200 mg/dL

P=0.01

**Total Cholesterol**

- Pre-Season: 100-200 mg/dL
- Post-Season: 150-250 mg/dL

P=0.01

**Triglycerides**

- Pre-Season: 50-150 mg/dL
- Post-Season: 100-250 mg/dL

P=0.01
Metabolic Demands of Hiking in Wildland Firefighting, 2017

Table 3. Mean heart rate, core temperature, and predicted relative oxygen consumption values while hiking. Data are shown as mean ± STD.

<table>
<thead>
<tr>
<th>Hike Type</th>
<th>Crew Type (# of min observed)</th>
<th>Heart Rate (bpm)</th>
<th>Core Temperature (°C)</th>
<th>Oxygen Consumption – All Hiking (ml/kg/min)</th>
<th>Oxygen Consumption – Uphill Hiking Only (ml/kg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingress</td>
<td>All (n=1489)</td>
<td>128 ± 29</td>
<td>37.5 ± 0.5</td>
<td>21.5 ± 12.3</td>
<td>25.8 ± 11.7</td>
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<td>IHC (n=951)</td>
<td>130 ± 28</td>
<td>37.5 ± 0.6</td>
<td>22.4 ± 12.0</td>
<td>26.7 ± 11.4</td>
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<td>Type II (n=538)</td>
<td>125 ± 30</td>
<td>37.4 ± 0.4</td>
<td>19.8 ± 12.2</td>
<td>24.1 ± 12.0</td>
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<tr>
<td>Shift</td>
<td>All (n=2455)</td>
<td>127 ± 23</td>
<td>37.7 ± 0.5†</td>
<td>19.1 ± 12.3†</td>
<td>22.9 ± 12.9†</td>
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<td>IHC (n=1282)</td>
<td>126 ± 24</td>
<td>37.6 ± 0.5</td>
<td>19.0 ± 12.0</td>
<td>23.1 ± 12.2</td>
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<td>Type II (n=1173)</td>
<td>129 ± 23</td>
<td>37.8 ± 0.5</td>
<td>19.2 ± 12.5</td>
<td>22.7 ± 13.5</td>
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<td>Egress</td>
<td>All (n=1217)</td>
<td>120 ± 21†</td>
<td>37.6 ± 0.4†</td>
<td>19.0 ± 11.8†</td>
<td>25.3 ± 12.1</td>
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<td>IHC (n=731)</td>
<td>119 ± 23</td>
<td>37.6 ± 0.4</td>
<td>19.2 ± 11.3</td>
<td>24.6 ± 11.1</td>
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<td>Type II (n=486)</td>
<td>121 ± 19</td>
<td>37.8 ± 0.4</td>
<td>18.8 ± 12.4</td>
<td>26.4 ± 13.4</td>
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<tr>
<td>Training</td>
<td>All (n=968)</td>
<td>150 ± 27†</td>
<td>38.1 ± 0.9†</td>
<td>34.2 ± 14.5†</td>
<td>37.4 ± 12.5†</td>
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<td>IHC (n=919)</td>
<td>152 ± 26</td>
<td>38.1 ± 0.9</td>
<td>34.3 ± 14.4</td>
<td>37.6 ± 12.3</td>
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<td>Type II (n=49)</td>
<td>123 ± 35</td>
<td>37.2 ± 0.4</td>
<td>29.5 ± 15.3</td>
<td>30.4 ± 15.0</td>
</tr>
</tbody>
</table>

Pre-season training appears more aggressive?

Sol et al., Wilderness Environmental Medicine, 2017
Potential Causes

- Detraining effect
- Stress
- Diet
- Sleep Deprivation
- Smoke Exposure
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