Back Pain
Lifting Tasks are Associated With Injuries During the Early Portion of a Deployment to Afghanistan

Roy et al 2012 Military Med

• Stryker Brigade Combat Team survey
• Men n = 243 21.4% were injured
• Women n = 17 58.8% were injured
• Low-back (15.4%), shoulder (14.5%), knee (12.8%)
• Dismounted patrolling (heavy loads) and lifting were reported to account for 36% of injuries
• Female sex was found to be a risk factor for injury in their study
• Survey, n = 531 males and 57 females
• 45% reported injury during deployment
• Women: less physical labor and lighter loads
• Still at more risk for injury than men
Risk Factors from several studies:

– Female gender, white race
– Low levels of aerobic fitness before BCT
– Cigarette smoking before BCT
– Endocrine dysfunction
– Repetitive mechanical forces
– Abrupt increase in duration, intensity, or frequency activity/training without adequate rest
– Low muscle strength and endurance (Quad, Hips, Legs, Core)
– Sports
– Marching on uneven terrain or in poor light
– Obstacle courses, especially jumping off, running on them
Risk Factors (AIT, BCT, OCS) 
Army, Marines, AF

Women
- Less running before BCT
- Slower run time
- Smoking
- Fewer Push-ups
- High BMI
- Lowest Ranks (E1-4)
- CS and CSS compared to CA
- Height

Men
- Exercise level before BCT
- Slower run time
- Smoking
- Fewer Push-ups
- High and Low BMI
- Enlisted Ranks (E1-9)
- CSS
- High and Low flexibility
- Fewer Sit ups
- Age
Image: Female soldiers negotiate obstacles during the U.S. Army Special Operations Command’s cultural support program which prepares all-female Soldier teams to serve as enablers supporting Army special operations combat forces in and around secured objective areas. The Army is working to improve women’s health throughout the Army, thus contributing to force readiness. (Photo by Staff Sgt. Russell Klika, USAJFKSWCS. Source: Soldiers Magazine)
Cost of MI: Limited Duty

- At least $25,000,000 yearly
- Limited duty days 6-18 per injury
- Rates of limited duty are up to 10% higher in women
- Up to 60% of soldiers with MI cannot return to full duty immediately
- 42% of injured deployed soldiers had difficulty with occupational tasks
  - 17-19% had to be replaced completely

15% combat force lost
In one Basic Combat Training study, there was no longer a difference in injury rate between men and women when they controlled for run time. When women were compared to men with similar running speeds they were injured at the same rate.


## Injury Rates

<table>
<thead>
<tr>
<th>Women</th>
<th>Men</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>70%</td>
<td>65%</td>
<td>Marine Corps Basic Training</td>
</tr>
<tr>
<td>47%</td>
<td>29%</td>
<td>Army AIT</td>
</tr>
<tr>
<td>38%</td>
<td>16%</td>
<td>Army BCT</td>
</tr>
<tr>
<td>41%</td>
<td>17%</td>
<td>Army BCT</td>
</tr>
<tr>
<td>25%</td>
<td>14%</td>
<td>Army BCT</td>
</tr>
<tr>
<td>45%</td>
<td>29%</td>
<td>Army BCT</td>
</tr>
<tr>
<td>2%</td>
<td>1%</td>
<td>NTC</td>
</tr>
<tr>
<td>80%</td>
<td>60%</td>
<td>Marine OCS</td>
</tr>
<tr>
<td>61%</td>
<td>44%</td>
<td>Afghanistan 1yr Deployment</td>
</tr>
</tbody>
</table>
## Women vs. Men serving in Afghanistan

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>N</th>
<th>% Injured</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Armor</strong></td>
<td>0-4 hours</td>
<td>40</td>
<td>55.0%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥ 5 hours</td>
<td>14</td>
<td>85.7%</td>
<td>1.56 (1.02-2.23)</td>
</tr>
<tr>
<td><strong>Load Worn</strong></td>
<td>≤ 30 lbs</td>
<td>41</td>
<td>51.2%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥ 31 lbs</td>
<td>14</td>
<td>85.7%</td>
<td>1.67 (1.09-2.43)</td>
</tr>
<tr>
<td><strong>Ave Weight of Objects Lifted</strong></td>
<td>20-50 lbs</td>
<td>30</td>
<td>46.7%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥ 51 lbs</td>
<td>22</td>
<td>81.2%</td>
<td>1.75 (1.15-2.79)</td>
</tr>
<tr>
<td><strong>Times Objects Lifted/Day</strong></td>
<td>1-4 times</td>
<td>35</td>
<td>51.4%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥ 5 times</td>
<td>17</td>
<td>82.3%</td>
<td>1.6 (1.05-2.41)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>N</th>
<th>% Injured</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>≤ 29 years</td>
<td>393</td>
<td>76.0%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥ 30 years</td>
<td>125</td>
<td>24.0%</td>
<td>1.32 (1.07-1.61)</td>
</tr>
<tr>
<td><strong>Rank</strong></td>
<td>E1-4</td>
<td>288</td>
<td>55.0%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>E5-9</td>
<td>202</td>
<td>39.0%</td>
<td>1.34 (1.09-1.63)</td>
</tr>
<tr>
<td></td>
<td>Officer/Warrant</td>
<td>32</td>
<td>6.0%</td>
<td>1.22 (.78-1.72)</td>
</tr>
<tr>
<td><strong>Time Spent Standing</strong></td>
<td>0-8 hours</td>
<td>187</td>
<td>36.0%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;8 hours</td>
<td>337</td>
<td>64.0%</td>
<td>1.24 (1.01-1.55)</td>
</tr>
<tr>
<td><strong>Heaviest Load</strong></td>
<td>0-25 lbs</td>
<td>47</td>
<td>9.0%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>25-50 lbs</td>
<td>77</td>
<td>15.0%</td>
<td>1.41 (.84-2.45)</td>
</tr>
<tr>
<td></td>
<td>≥ 50 lbs</td>
<td>401</td>
<td>76.0%</td>
<td>1.69 (1.10-2.78)</td>
</tr>
<tr>
<td><strong>Days/Week Lifting Duties Performed</strong></td>
<td>1-4 days</td>
<td>278</td>
<td>53.0%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5-7 days</td>
<td>247</td>
<td>47.0%</td>
<td>1.27 (1.05-1.54)</td>
</tr>
</tbody>
</table>
Types of Injury at AF and Marine TNG

<table>
<thead>
<tr>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Force Academy</strong></td>
<td><strong>Air Force Academy</strong></td>
</tr>
<tr>
<td>1. Ankle Sprain</td>
<td>1. Ankle Sprain</td>
</tr>
<tr>
<td>2. UE Sprain</td>
<td>2. Back/neck Sprain</td>
</tr>
<tr>
<td>4. Patellar Tendonitis</td>
<td>4. Patellar Tendonitis</td>
</tr>
<tr>
<td>5. Hip Strain</td>
<td>5. Hip Strain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marine Corps Basic Training</th>
<th>Marine Corps Basic Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patellar Femoral Pain Syndrome</td>
<td>1. Iliotibial Band Syndrome</td>
</tr>
<tr>
<td>2. Ankle Sprain</td>
<td>2. Ankle Sprain</td>
</tr>
<tr>
<td>3. Iliotibial Band Syndrome</td>
<td>3. Achilles Tendonitis</td>
</tr>
</tbody>
</table>
Mechanisms of Injury

Knapik et al. studied U.S. Army wheel vehicle mechanics. Mil Med. Sep 2007;172(9):988-996

Women
- Physical Training
- Mechanical Work
- Airborne Operations
- Road Marching

Men
- Physical Training
- Mechanical Work
- Sports
- Airborne Operations
Running Shoes

INJURY REDUCTION EFFECTIVENESS OF SELECTING RUNNING SHOES BASED ON PLANTAR SHAPE. JOSEPH J. KNAPIK, J Strength Cond Res 23(3): 685-697, 2009

• Prospective study in BCT:
  – Experimental (E) : n = 1,079 men and 451 women selected motion control, stability, or cushioned shoes
  – Control (C) : n = 1,068 men and 464 women
  – Age, fitness, and smoking were obtained from a questionnaire and databases
  – Multivariate Cox regression controlling for other injury risk factors showed little difference in injury risk between the E and C groups among men (risk ratio (E/C) = 1.01; 95% confidence interval = 0.88-1.16; p=0.87) or women (risk ratio (E/C) = 1.07; 95% confidence interval = 0.91-1.25; p = 0.44).
  – Selecting shoes based on plantar shape had little influence on injury risk in BCT

  – Prospective study
  – Showed: assigning running shoes based on the shape of the plantar surface had little influence on injury risk in BMT even after controlling for other injury risk factors.
Running and Injuries

• Significantly lower weekly run mileage DOES NOT = significantly slower run times

BUT

• Significantly lower weekly run mileage DOES = significantly fewer injuries

<table>
<thead>
<tr>
<th>Gender</th>
<th>Miles Run over 9 weeks</th>
<th>Percent Injuries</th>
<th>2 Mile Run Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>34-44 miles</td>
<td>33%</td>
<td>14.9 min</td>
</tr>
<tr>
<td>Male</td>
<td>26-39 miles</td>
<td>21%</td>
<td>14.8 min</td>
</tr>
<tr>
<td>Female</td>
<td>34-44 miles</td>
<td>58%</td>
<td>18.0 min</td>
</tr>
<tr>
<td>Female</td>
<td>26-39 miles</td>
<td>46%</td>
<td>17.8 min</td>
</tr>
</tbody>
</table>
Prevention Strategies

• Educate leadership
• Targeting reduction in running mileage
• Gradually increase exercise stress (overloading)
  – Aerobic fitness
  – Muscle Strength and endurance
  – Power
  – Agility/proprioception
• Marching Progression
• Load progression
“Old school” Physical Training

Mobility

Strength

Endurance
But...Physical Requirements

Strength
Overcome resistance

Mobility
Movement proficiency

Endurance
Sustain activity
So...Program Added

Strength
Overcome resistance

Mobility
Movement proficiency

Endurance
Sustain activity
Physical Readiness Training (FM 7-22) Published Mar 2010

• Principles: progressive overload, regularity, specificity, precision, variety, and balance

• Specificity:
  – Physical requirements
  – Fitness components involved
  – Training activities to improve the military tasks.

• Injury-prevention features include reduced running mileage, exercise variety (cross-training), and gradual, progressive training
Screening Tests

- Horizontal leap
- Movement
- Stability
- Grip Strength
- Arch Height
- Balance
- Agility
- Body Comp
- 6 M Hop
- Sprint/RAST
- Body Comp
Physical Readiness Training

• In 3 military field studies, the overall adjusted risk of injury: 1.5-1.8 X > in soldiers performing traditional military PT programs when compared with groups using new PRT program.

• When compared with traditional military physical training programs, PRT consistently resulted in fewer injuries and in equal or greater improvements in fitness and military task performance.
A SYSTEMATIC REVIEW OF THE EFFECTS OF PHYSICAL TRAINING ON LOAD CARRIAGE PERFORMANCE

10 original research studies met the review criteria

Meta-analysis indicated that large training effects were apparent when:

- progressive resistance training was combined with aerobic training and
- when that training was conducted at least 3 times per week, over at least 4 weeks.

When progressive load-carriage exercise was part of the training program, at least 1x/wk, much larger training effects were evident
Future Impact

• # of women Veterans using VA is growing rapidly

• Since 2000, the # more than doubled, from nearly 160,000 in ‘00 to > than 354,000 in ‘12

• Based on the upward trend of women in all branches of service, the # of women Veterans—and female VA users—will keep climbing

• We need to increase surveillance and education