Outline

• Introduction
• DoD Injury Prevention & Human Performance Research Initiative
• Nutrition Research Key Findings
• Next Steps
• Questions
State of the Science  11,500 sq. ft.
Neuromuscular Research Lab (NMRL)
Musculoskeletal/Biomechanical Profiling

Physiological/Metabolic & Nutritional Profiling
The Consistent Message - “Broken”

Years as an SOF Operator

Operational Value

Injuries and Performance

Injuries

Physical Performance
University of Pittsburgh
Human Performance Research Objectives

• Establish reliable, valid, scientific mission-specific human performance testing, training, and nutrition protocols to:
  – Minimize the number and severity of operator/soldier injuries.
  – Maximize performance and combat readiness.
  – Enhance career longevity and quality of life following service.
Terminology

- Air Force Special Operations Command - AFSOC
- Naval Special Warfare - NSW or SEAL
- United States Army Special Operations Command - USASOC
- Special Warfare Combatant-Craft Crewmen - SWCC or SBT-22
- 101st Airborne Division (Air Assault) - 101st
- SEAL Qualification Training - SQT
- SWCC Crewman Qualification Training - CQT
- Special Operations Forces - SOF
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Nutrition Specific Aims

• Assess the nutrient intake, diet quality, and dietary supplement habits of the SOF.

• Evaluate usual diet and eating habits
  – Relative to fueling & recovery for daily physical training
  – Relative to mission specific operations (task & demand)

• Determine suboptimal nutrition and physical training characteristics related to:
  – Physical performance
  – Body composition
  – Injury
  – Health & Performance over time
Evaluation of Dietary Intake Relative to Fueling Demand of Daily PT
## UPITT-MED Screenshots

### Physical Training Questions

**Exercise/Physical Activity**

Check all of the following activities that you have performed regularly during the past three months:

- [ ] Walking/Hiking/Marching While Carrying Load
- [ ] Walking/Hiking/Marching Without Carrying Load
- [ ] Bicycling
- [ ] Vigorous sports involving running
- [ ] Circuit Training
- [ ] Running
- [ ] Moderate Sports
- [ ] Weight Training
- [ ] Calisthenics
- [ ] Other
Running:

On average, how many sessions per week?

On average, how many miles per session?

Average duration per session (in minutes)

What was the average weight of the load?

Average power output:
**Carbohydrate (CHO) to Meet Muscle Fuel Needs of Daily Physical Training**

<table>
<thead>
<tr>
<th>Exercise Volume</th>
<th>SOF N=850 (% of Operators)</th>
<th>CHO Recommendations</th>
<th>% Met CHO Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (&lt;10 hour/week)</td>
<td>6 (0.1%)</td>
<td>3-5 g CHO/kg bw/day</td>
<td>83%</td>
</tr>
<tr>
<td>Moderate (10-≤25 hour/week)</td>
<td>29 (3.4%)</td>
<td>5 g CHO/kg bw/day</td>
<td>10%</td>
</tr>
<tr>
<td>High (≥25 hour/week)</td>
<td>813 (95.6%)</td>
<td>6-10 g CHO/kg bw/day</td>
<td>12%</td>
</tr>
</tbody>
</table>

International Physical Activity Questionnaire www.ipaq.ki.se
Fuel Utilization at Different Exercise Intensities

- Rest
- 50
- 75
- 95

% of VO2\textsubscript{max}

Percent

Carbohydrate
Fat
Protein
Daily Carbohydrate Intake (g/kg BW)

Goal for daily high volume physical training to muscle fuel needs >6 g Carb
Daily Protein Intake (g/kg BW)

Goal: 1.2 - 2.0 g/kg: Moderate amounts high quality protein spread throughout the day and following strenuous PT.
Calories from Fat

Goal: 20-30% of total calories; 1.0-2.0 g fat/kg
Evaluation of Dietary Intake Relative to mission specific operations

Full Mission Profile (FMP)

Glacier

Mountain Patrol (MP)
AFSOC FMP Glacier Training

- Data was collected
  - 9 Subjects
  - 23rd Special Tactic Squadron
    - Pararescue Jumpers
    - Combat Controllers
  - 9-day training evolution in Anchorage Alaska and Matanuska Glacier Park
- Demographic Data
  - Mean wt: 92.3 kg
  - Body fat%: 14.2
  - Load Carriage 28.6 kg
## Glacier FMP Training Activities

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glacier Safety Training</td>
<td>Climber Rope Training</td>
<td>Rope Crevasse Rescue Systems</td>
<td>Glacier FMP</td>
</tr>
<tr>
<td>- Walking in crampons on glacier</td>
<td>- Traversing glacier</td>
<td>- Rope pulling</td>
<td>- Casualty lift/carry/drag</td>
</tr>
<tr>
<td>- Anchoring and ice axe climbing</td>
<td>- Rappelling</td>
<td>- Crevasse climb/rappel</td>
<td>- Rope</td>
</tr>
<tr>
<td></td>
<td>- Climbing</td>
<td>- Crevasse casualty rescue</td>
<td>- climb/rappel/pulling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Ascending mountain peak to recover patient</td>
</tr>
</tbody>
</table>

- Rappelling
- Traverse glacier climbing
- Crevasse climb/rappel
- Crevasse casualty rescue
- Casualty lift/carry/drag
- Rope climbing
- Ascending mountain peak to recover patient
Total Energy Expenditure (TEE) compared to Energy Intake (EI)

<table>
<thead>
<tr>
<th>Kcals per Kg</th>
<th>50</th>
<th>55</th>
<th>55</th>
<th>24</th>
<th>70</th>
<th>45</th>
<th>57</th>
<th>46</th>
<th>51</th>
<th>39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>Mean 1 2 3 4 5 6 7 8 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bar chart showing the comparison of TEE and EI for subjects with different Kcals per Kg.
Bridging the Energy Gap

Results from DLW Study
- Energy deficit -1550 kcals
- Body weight loss -2.2%
- CHO intake 4.1 g/kg
- Protein intake 1.4 g/kg
- Fat intake 1.6 g/kg

Energy to meet Demand
- Provide additional kcals
  - ~50 kcals/kg
  - Increase CHO 7 g/kg
  - Increase Protein 1.7 g
  - Keep fat intake the same
  - Monitor fluid intake
**SQT Alaska Demand Analysis**

**Mountain Patrol**
- Mountain Climb
- Land-bridge traverse
- Set up camp for night

**River Crossing**
- Solo, bipod, tripod and wedge crossings
- Zip-line Crossing
- Tactical Float
- ~ 4 hour
# Energy Intake Relative to Physical Demand

<table>
<thead>
<tr>
<th>TDEE (kcal)</th>
<th>Energy Intake (kcal)</th>
<th>Δ Energy (kcal)</th>
<th>Time Mod- High Intensity (mins)</th>
<th>CHO (g/kg)</th>
<th>Pro (g/kg)</th>
<th>Fat (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain Patrol</td>
<td>5010 ± 411</td>
<td>2289 ± 636</td>
<td>2722</td>
<td>313</td>
<td>3.1</td>
<td>1.2</td>
</tr>
<tr>
<td>River Crossing</td>
<td>3530 ± 181</td>
<td>2854 ± 614</td>
<td>676</td>
<td>97</td>
<td>3.4</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Bridging the Energy Gap

Results from MP T & D

- Energy deficit -2722 kcals /day
- Body weight loss: N/A
- CHO intake 3.1 g/kg
- Protein intake 1.3 g/kg
- Fat intake 1.4 g/kg

Energy to meet Demand

- Provide additional kcals
  - ~60 kcals/kg
  - Increase CHO 9 g/kg
  - Increase Protein 1.8 g
  - Increase Fat 1.8 g
Consequences of Inadequate Energy Intake

- Early onset fatigue
- Lower power output
- Decrease mental alertness & concentration
- Decrease strength & endurance capacity
- Prolonged recovery from injury or illness
- Decreased energy to perform consecutive training or deployment missions
### Nutrient Timing of MP

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
<th>Meal</th>
<th>EI (kcal)</th>
<th>CHO (g)</th>
<th>Pro (g)</th>
<th>Fat (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meal</td>
<td>7-9 am</td>
<td>Breakfast</td>
<td>637 ± 352</td>
<td>72 ± 43</td>
<td>28 ± 14</td>
<td>27 ± 18</td>
</tr>
<tr>
<td>Snack</td>
<td>10:45</td>
<td>Snack</td>
<td>54 ± 116*</td>
<td>9 ± 20</td>
<td>3 ± 7</td>
<td>1 ± 1</td>
</tr>
<tr>
<td>Hiking Ankle-Knee deep snow</td>
<td>11:45-1800 (374 mins)</td>
<td>Lunch</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Snack</td>
<td>1800</td>
<td>Dinner</td>
<td>1197 ± 480</td>
<td>146 ± 73</td>
<td>50 ± 21</td>
<td>45 ± 27</td>
</tr>
<tr>
<td>Snack</td>
<td>1900-2400</td>
<td>Snack</td>
<td>44 ± 117</td>
<td>8 ± 21</td>
<td>2 ± 6</td>
<td>0.5 ± 1</td>
</tr>
<tr>
<td>TOTAL EI</td>
<td></td>
<td></td>
<td>2289 ± 430</td>
<td>261 ± 52</td>
<td>97 ± 18</td>
<td>96 ± 17</td>
</tr>
</tbody>
</table>

*Only 2 subjects consumed a snack pre-MP activity
^Only 3 subjects consumed Protein or Candy Bars
Using Nutrient Timing

Results from MP T & D
• 28% calories Breakfast
  – Only 72 g CHO
• Only 2/10 subjects consumed am snack prior to MP evolution
• During 6.3 hour intermittent high intensity MP, 1 fluid break, no lunch, small snack 3 subjects
• Recovery delayed and insufficient to replace lost fuel

Nutrient Timing Strategies
• Increase CHO at breakfast & am Snack
• Schedule lunch and regular fluid/snack breaks
• During intermittent high intensity long duration activity provide 30-60 g CHO
• Recovery replace fluids and fuels used during MP
**Physical Training**
Individual Military training on base

Mission specific Tactical Training Evolutions

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**Operator/Soldier Diet**
Low Energy Intake (Tactical evolutions)
Low Daily CHO intake
High fat, saturated fat intake
<50 % DRI/MDRI for certain vitamins, minerals
Low fluid intake
Inadequate meal/snack pattern

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**CONSEQUENCES**
Suboptimal Fueling & Delayed Recovery

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**Fatigue**
### Diet Quality: Healthy Eating Index

**USDA’s Center for Nutrition Policy and Promotion**

<table>
<thead>
<tr>
<th>HEI-2010' COMPONENT</th>
<th>MAXIMUM</th>
<th>STANDARD FOR MAXIMUM SCORE</th>
<th>STANDARD FOR MINIMUM SCORE OF ZERO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADEQUACY (higher score indicates higher consumption)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fruit²</td>
<td>5</td>
<td>≥ 0.8 cup equiv. / 1,000kcal¹⁰</td>
<td>No fruit</td>
</tr>
<tr>
<td>Whole Fruit³</td>
<td>5</td>
<td>≥ 0.4 cup equiv. / 1,000kcal</td>
<td>No whole fruit</td>
</tr>
<tr>
<td>Total Vegetables⁴</td>
<td>5</td>
<td>≥ 1.1 cup equiv. / 1,000kcal</td>
<td>No vegetables</td>
</tr>
<tr>
<td>Greens and Beans⁴</td>
<td>5</td>
<td>≥ 0.2 cup equiv. / 1,000kcal</td>
<td>No dark-green vegetables, beans, or peas</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>10</td>
<td>≥ 1.5 cup equiv. / 1,000kcal</td>
<td>No whole grains</td>
</tr>
<tr>
<td>Dairy⁵</td>
<td>10</td>
<td>≥ 1.3 cup equiv. / 1,000kcal</td>
<td>No dairy</td>
</tr>
<tr>
<td>Total Protein Foods⁶</td>
<td>5</td>
<td>≥ 2.5 ounce equiv. / 1,000kcal</td>
<td>No protein foods</td>
</tr>
<tr>
<td>Seafood and Plant Proteins⁵⁷</td>
<td>5</td>
<td>≥ 0.8 ounce equiv. / 1,000kcal</td>
<td>No seafood or plant proteins</td>
</tr>
<tr>
<td>Fatty Acids⁸</td>
<td>10</td>
<td>(PUFAs + MUFAs) / SFAs ≥ 2.5</td>
<td>(PUFAs + MUFAs) / SFAs ≤ 1.2</td>
</tr>
<tr>
<td><strong>MODERATION (higher score indicates lower consumption)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refined Grains</td>
<td>10</td>
<td>≤ 1.8 ounce equiv. / 1,000kcal</td>
<td>≥ 4.3 ounce equiv. / 1,000kcal</td>
</tr>
<tr>
<td>Sodium</td>
<td>10</td>
<td>≤ 1.1 gram / 1,000kcal</td>
<td>≥ 2.0 grams / 1,000kcal</td>
</tr>
<tr>
<td>Empty Calories⁹</td>
<td>20</td>
<td>≤ 19% of energy</td>
<td>≥ 50% of energy</td>
</tr>
</tbody>
</table>
Healthy Eating Index (HEI)

Goal: 100 = Perfect Score

<table>
<thead>
<tr>
<th></th>
<th>SOF</th>
<th>NSW</th>
<th>SQT</th>
<th>USASOC</th>
<th>AFSOC</th>
<th>SBT22</th>
<th>CQT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI</td>
<td>54.5</td>
<td>55.7</td>
<td>56.3</td>
<td>57.4</td>
<td>53.9</td>
<td>53.3</td>
<td>50.2</td>
</tr>
</tbody>
</table>
# Healthy Eating Index (HEI)

<table>
<thead>
<tr>
<th>HEI Component</th>
<th>Score (Mean ± SD)</th>
<th>Max Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adequacy (higher score, higher consumption)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Vegetable</td>
<td>3.08 ± 1.55</td>
<td>5</td>
</tr>
<tr>
<td>Green and Bean</td>
<td>2.07 ± 2.23</td>
<td>5</td>
</tr>
<tr>
<td>Total Fruit</td>
<td>2.36 ± 2.01</td>
<td>5</td>
</tr>
<tr>
<td>Whole Fruit</td>
<td>2.43 ± 2.21</td>
<td>5</td>
</tr>
<tr>
<td>Whole Grain</td>
<td>3.31 ± 3.48</td>
<td>10</td>
</tr>
<tr>
<td>Total Dairy</td>
<td>5.99 ± 3.20</td>
<td>10</td>
</tr>
<tr>
<td>Total Protein</td>
<td>4.67 ± 0.83</td>
<td>5</td>
</tr>
<tr>
<td>Seafood and Plant Protein</td>
<td>2.52 ± 2.23</td>
<td>5</td>
</tr>
<tr>
<td>Fatty Acids</td>
<td>4.45 ± 3.47</td>
<td>10</td>
</tr>
<tr>
<td><strong>Foods in Moderation (higher score, lower consumption)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>2.69 ± 3.08</td>
<td>10</td>
</tr>
<tr>
<td>Refined Grains</td>
<td>7.48 ± 3.12</td>
<td>10</td>
</tr>
<tr>
<td>Empty Calories</td>
<td>13.42 ± 5.58</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td>54.48 ± 14.75</td>
<td>100</td>
</tr>
</tbody>
</table>
Suboptimal Nutrition Characteristics

- Inadequate daily CHO intake
  - Under-fueling, delayed recovery, low energy, early onset fatigue
  - Dietary supplements to energize
    - Energy drinks, nicotine, caffeine, nitric oxide
- Higher fat/saturated fat diets
  - Lower consumption of MUFA and Omega-3 FAs
- Lower nutrient density of diet
  - Low intake fruits, vegetables, dairy and whole grains
Suboptimal Nutrition Characteristics

- Sporadic meal/snack pattern
  - Skip meals
  - Insufficient fueling/fluid before, during and after long duration training evolutions
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Dietary Factors Promote Inflammation

- Refined starches and sugars
- Saturated and trans fat
- Low fiber
- Low omega-3 and high omega 6 fatty acids
- Low intake of fruits, vegetables – antioxidants

What contributes to a “Pro Inflammatory” Lifestyle?

- Smoking
- Heavy alcohol use
- All kinds of Stress
- Insufficient exercise
- Overtraining
- Poor sleep quality
- Exposure to environmental toxins
**SOF Lifestyle**

- Intense periods of PT
- Sleep Deprivation
- Exposure to environmental extremes
- Physical & Psychological Stress
- Perceived physical harm
- Poor diets and heavy ETOH use
  - Fruit/vegetable intake
  - Whole grains
  - High saturated fat, low Omega-3 Fas
  - Low fiber
  - Empty Calorie Foods
  - Fast food consumption

Diment, BC et al. 2012 Eur J Appl Physio 112:1411-1418
Anti-Inflammatory Diet

- Carbohydrates to meet muscle fuel demands
- Fruits fresh and dried
- Nuts: quality, protein, hazelnuts, pecans, etc.
- Legumes
- Whole grains, sprouted grains
- Fatty Fish: Salmon, anchovy, sardines, mackerel, tuna, halibut
- Olive oil
- Cheese, Yogurt
- Eggs
- Replace lost fluids to promote adequate hydration
- Lean meat: Turkey, chicken, duck
- Herbs: parsley, rosemary, oregano, thyme, capsacin, garlic, ginger, tumeric
Proposed Diet Intervention

Sports Nutrition Diet

Where the 2 Shall Meet!

Anti Inflammatory Diet
“What we eat and drink, affects our day to day stamina, long term health, weight, body composition, exercise and recovery time. Nutrition is the ultimate ergogenic aid and if you are serious about physical performance and injury prevention it should be a core part of your training regimen”.
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