



## Information Brief: DoD Nutritional Research Activities

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14 November 2011

Nutritional Sustainment of Military Operational Health Program Review



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## Outline



- DoD Nutrition Research - Players
- Nutritional Physiology Research
- Ration Sustainment Test Program
- Dietary Supplements Research





## Who's Who of Nutrition Research



- Army – DoD Executive Agent Combat Feeding
  - **Combat Feeding Directorate, NSRDEC (1° for Ration Development)**
  - **USARIEM (1° for Nutritional Requirements)**
  - USUHS (Dr. Deuster; CHAMP)
  - SOCOM
- Broad Agency Announcements
  - Navy – Code 30
  - Air Force                      \$\$ to - DoD and University Laboratories
  - DARPA
  - MOMRP
- Congressional Special Interest (CSI)

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PENNINGTON BIOMEDICAL RESEARCH CENTER

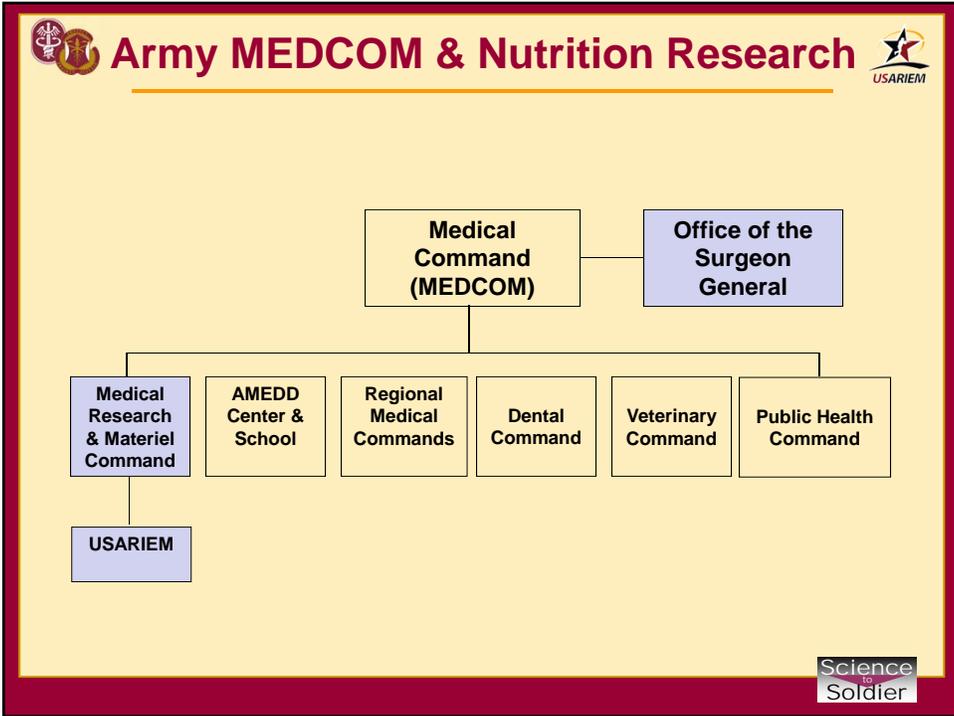
*promoting healthier lives through research and education in nutrition and preventive medicine*



- **Research faculty expert in nutrition, metabolism & obesity**
- **Analytic biochemistry labs and metabolic wards**
- **MRS & NMR**
- **Nutrient Databases**



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## USARIEM COMMANDER & STAFF

### Research Support Division



**Thermal & Mountain  
Medicine Division  
(TMMD)**



**Biophysics &  
Biomedical  
Modeling Division  
(BBMD)**



**Military Nutrition  
Division  
(MND)**



**Military Performance  
Division  
(MPD)**

**200 USARIEM PERSONNEL**

31% Military  
48% Civilian  
21% Contractor



## Military Nutrition Division Staff

### Principle Scientists

Andrew Young, Ph.D. Chief  
MAJ Aaron Crombie, Ph.D.  
CPT Steven Jackson, Ph.D.  
Harris Lieberman, Ph.D.  
James McClung, Ph.D.  
Scott Montain, Ph.D. Deputy  
CPT Stefan Pasiakos, Ph.D.  
Angus Scrimgeour, Ph.D.  
Tracey Smith, M.S., R.D.

### Dietitians and Nutritionists

Christina Carvey, M.S., R.D.  
Phil Karl, M.S., R.D.  
Laura Lutz, M.S., R.D.  
CPT Lee Margolis, M.S., R.D.  
Holly McClung, M.S., R.D.  
Susan McGraw, B.S.

### Administration

Douglas Dauphinee, B.S.  
SSG William Mills  
John Stuhl

### Research Technicians

Nancy Andersen, B.S.  
Michelle Condlin, M.A.  
Matthew Ely, M.S.  
SGT Matthew Dickson, B.S.  
SP4 David Gonzalez, B.S.  
SP4 Andrei Loban, M.S.  
Louis Marchitelli, M.S.  
Philip Niro, B.S.  
SP4 Hedrick Porrata, B.S., MD  
Lauren Thompson, B.S.  
SGT Bryan Wiley, B.S.

+ Three additional ORISE Post-Doctoral Fellows not assigned to Task B





## Military Nutrition Division



### Mission:

- Conducts research on nutritional issues affecting Warfighters
- Supports Army Surgeon General responsibilities as DoD executive agent for nutrition.
- Provides biomedical science basis for developing new rations (NSRDEC CFD), feeding plans/menus (JCCoE, AMEDD) & nutrition policies and programs (OTSG, OSD-HA) that satisfy nutritional requirements of Warfighters to attain/sustain readiness & performance throughout the deployment cycle.

### Core Capabilities:

- Basic to Applied Science (Cell Culture → Small Animal → Human)
- Nutritional physiology in the context of optimizing Warfighter fitness and performance
- Ration sustainment test program & dietary requirements for Warfighters
- Dietary supplements

Andrew J. Young, Ph.D., Division Chief,  
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## Fundamental Research Objectives



- Enhanced Warfighter Health, Performance & Resilience via Optimized Nutrition
  - Soldier fueling
  - Scientific basis for field feeding & combat ration systems
- Nutrition Requirements of Recovery, Reset & Medical Readiness
  - Nutritional countermeasures to offset physiological consequences (catabolic, inflammatory, immune) of heavy work & load carriage
  - Between missions –
    - In Theater
    - Training
  - Between deployments -





## Nutritional Physiology



- Energy Requirements
- Carbohydrate – Historical Work
- Protein & Amino Acid Metabolism During Energy Restriction
  - Is there advantage to providing additional protein?
  - Optimal dietary EAA requirements – muscle protein turnover, energy restriction & exercise

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## Protein and Exercise



**Phase I:** Moderate endurance-type exercise produced an increase proteolytic gene expression.

**Phase II:** Leucine supplementation during moderate endurance-type exercise suppressed proteolysis and enhanced muscle anabolism.



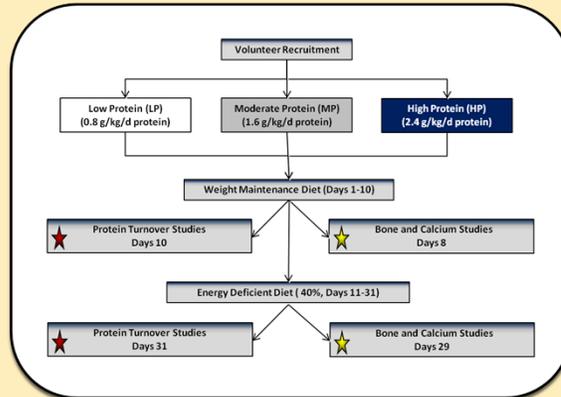
**Ration Optimization?**

**Can higher-protein diets protect musculoskeletal health during prolonged energy restriction ?**

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## Musculoskeletal Health: Approach



31-day Controlled trial at the USDA GFHNR

- Protein spanning Acceptable Macronutrient Distribution Range
- 40% Energy restriction (30% diet + 10% physical activity)

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## Protein Source and Bone: Approach



### Prolonged Energy Restriction in Rats

- **16-wk intervention:** To assess the role of chronic energy restriction on musculoskeletal health and glycemic regulation
- **Dietary intervention:** High and low protein, milk- and soy-based diets
- **Study status:** Institutional review in progress

#### Study Endpoints

- Bone mineralization and lean body mass
- Bone architecture and biomechanics
- Glucose homeostasis

#### Methodology

- DEXA and  $\mu$ CT
- Insulin challenge
- Basic molecular biology



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## Nutritional Physiology



- Mineral Nutrition
  - Fe supplementation in female recruits during Basic Combat Training
  - Fe-sensitive molecular regulation of body composition in rats
  - Zn deficiency & diarrhea, Kenya
  - Zn-signaling mechanisms of resilience to & recovery from mTBI (mechanical versus blast)
  - Sweating and impact on micro-nutrient DRIs
- Phytonutrients & Environmental
  - Suppression of oxidative stress from environmental toxicity using sulforaphane, isothiocyanates, & curcumin

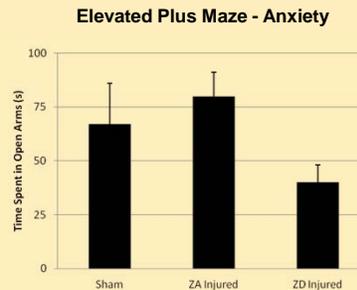
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## Zinc and Head Injury



- Head injury is a significant source of morbidity in theatre; zinc deficiency may reduce tolerance to head impact.
- mTBI was induced using a closed head-wound model.
- Behavioral tests to examine mTBI- and Zn-effects on learning, memory, anxiety and depression.
- LUMINEX to examine the effect of mTBI and diet on apoptotic protein expression; integrated GeLC-MS proteomics to identify Zn-responsive proteins following the mTBI.



Cope et al., *Physiol Behav*, 2011

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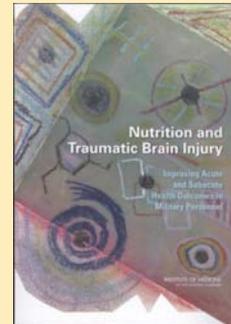


## Transitions



- Continue development of brain injury models to examine neuroprotective nutritional interventions.
- Nutritional intervention studies – preventive and treatment

MOMRP  
sponsored  
IOM study  
2010



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## Nutritional Physiology



- Probiotics
  - Shelf-stable - *L. reuteri* for gut health & diarrhea prevention
- Vitamin D
  - IMT – status
  - Ultraviolet (UV) intensity and incidence of bone injuries
  - RCT of Vitamin D & Calcium supplementation on biomarkers of nutritional status & bone health outcomes in USA & USAF recruits

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## Optimizing vitamin D status during initial military training: A randomized, double-blind, placebo-controlled trial.

PI: James P. McClung, Ph.D.

Org: USARIEM, Natick, MA



### Problem, Hypothesis and Military Relevance

- Vitamin D is an essential nutrient for optimizing calcium absorption and maintaining bone health.
- Vitamin D status may be suboptimal in female Soldiers at US Army basic combat training (BCT).
- Stress fracture may affect up to 20% of female Soldiers during BCT.
- Studies have demonstrated that vitamin D and calcium supplementation may prevent stress fracture in female Navy recruits, although the effects of supplementation on indicators of bone health, such as bone mineral density (BMD) and biochemical markers of bone turnover remain unknown in military personnel during training.

### Proposed Solution

- Randomized, double-blind, placebo-controlled trial of daily supplementation with 800 IU of vitamin D and 2000 mg of calcium.
- Multicenter longitudinal trial, to include female trainees at US Army BCT and US Air Force IMT.
- Trial will include iterations during both winter and summer months with both populations, anticipated sample size is 350 per iteration (final n = 1400).
- Endpoints include BMD, parathyroid hormone, bone health biomarkers, and the effects of vitamin D receptor polymorphisms on biochemical outcomes.



### Timeline and Cost

Activities	FY	11	12	13
IRB, Establish Contracts, 1 Iteration		1169162		
2 Iterations			1353175	
1 Iteration, Data Analysis/Reports				990287
<b>Estimated Budget</b>		<b>\$1169162</b>	<b>\$1353175</b>	<b>\$990287</b>



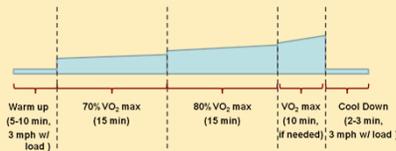
## Nutritional Physiology



- Essential Fatty Acids
  - mTBI – small animal blast studies
  - Super Chicken Study
    - Funding source
    - Does improved n-3:n-6 increase tolerance to physical stress?

### Fatiguing protocol with load

If 50 kg < BW < 60 kg, then 20kg load  
If BW 60 kg or greater then 25kg load



Strength, power & agility





## Nutritional Physiology



- Stress, Caloric Deprivation and Cognitive Function
  - SERE studies
  - Tyrosine
  - Energy depletion studies
- Behavior, Satiety and Warfighter Healthy Eating
  - Hormonal regulation of satiety
  - Promotion of healthy food choice and eating behavior in military DFACs
  - Health-associated implications of weight management disorders

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## Ration Sustainment Testing



- Nutritional Optimized First Strike Ration
  - ✓ ATO- lighten load & increase stamina
  - Transition to **Combat Feeding Directorate (CFD)**



- Performance Enhancing Ration Components
  - Nutrient delivery systems
  - Caffeinated ration components and COTS products

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## Ration Sustainment Testing



- Ration Nutrient Composition Analysis
  - Collaborative effort with CFD
  - Ration menu planning & storage studies
- Ration Consumer Acceptability
  - Support NSRDEC CFD's continuous ration improvement program)

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## Dietary Supplement Research



- DoD Center Alliance - USARIEM MND & USUHS
- Define Relationships Between DS Use and Health & Performance in Military Personnel
  - Surveys & epidemiological studies
  - Establish system to document adverse health effects of DS use
- Assess Health Safety of DS in Use by Military Personnel
  - Establish internationally recognized panel of SMEs
  - Implement Institute of Medicine's recommended safety review process
- Evaluate Suitability of Selected DS for DoD Use
  - Combat rations, DFACs, etc
  - Establish standards for consideration of DS
  - Evidence-based reviews by SMEs
  - Research testing in relevant operational environments

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## QUESTIONS?

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