WHAT ELSE CAN I DO? NUTRITION FOR INJURY AND ILLNESS PREVENTION AND REHABILITATION

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Disclosures

In compliance with continuing education requirements, I have no financial or other associations with companies having a direct link and/or financial relationship that is related to the topic/content of this presentation to disclose.
Objectives

- Summarize recent research in the areas of Nutrition for Illness and Injury Prevention and Rehabilitation
- Assist athletes and teams by making practical nutrition recommendations to reduce incidence of upper respiratory tract infections
- Collaborate with sports dietitians to integrate nutrition into injury treatment plans
Where We are headed

- Nutrition interventions for minimizing chronic inflammation and Upper Respiratory Tract Infections
- Specific Injury Considerations
  - Concussions
  - Fractures
  - Muscle Health
  - Ligament Health
WHAT IS GOING ON AFTER EXERCISE?

Inflammatory Response

Immune Response
INFLAMMATION

- **Acute Post Exercise Inflammation**
  - Therapeutic Potential
- **Our goal**: Avoid low level chronic systemic inflammation
  - Caused by: chronic exhaustive exercise, stress, aging, lack of sleep, obesity
  - Associated with RA, HTN, Atherosclerosis, DM
  - Damages muscle proteins and impacts an athlete’s ability to train
IMMUNE RESPONSE

“Open Window” Theory = decreased post-exercise immune protection from bacteria and viruses

- Continuous long duration exercise 55-75% VO2 Max
- Especially without food intake

Collision 2015
OPEN WINDOW THEORY

- 10 Elite Male Cyclists
- 2 Hours of Cycling at 90% of second VT
- Blood Cells collected pre, immediately post, 2, 4, 8, and 24 hours post exercise
- Conclusion: “Suppression of total lymphocyte counts, NK cell counts, and neutrophil phagocytic function following exercise may be important in the increased rate of URI in response to regular intense endurance training”

Natural Killer Cells
- “First Line of Defense” against invading pathogens suppression.
- Implications in athletes developing URI.
- Particularly relevant in athletes completing multiple exercise sessions per day.

Kakanis 2010
NUTRITION INTERVENTIONS TO CONTROL INFLAMMATION AND SUPPORT IMMUNITY

- Fluid
- Carbohydrate During Exercise
- Dietary Fat
- Antioxidants
- Anthocyanins
- Probiotics
- Protein and Energy
- Prebiotics
- Mediterranean Inspired
<table>
<thead>
<tr>
<th>Dehydration</th>
<th>Hydration</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Associated with increased stress hormone response</td>
<td>• Higher saliva flow rate and greater availability of salivary antimicrobial proteins (SIgA, lysozyme, alpha-amylase)</td>
</tr>
<tr>
<td>• Lower saliva flow rate</td>
<td></td>
</tr>
</tbody>
</table>
Carbohydrate

- Consuming carbohydrate during prolonged exercise can minimize some aspects of exercise-induced immunosuppression.
- Carbohydrate intake of up to 60 g per hour during heavy exertion helps reduce immune inflammatory responses (Walsh 2011).
DIETARY FAT

Diets high in trans fats increase the release of pro-inflammatory cytokines and increase risk of cardiovascular disease (Harvey 2008)

Increased Omega 3 concentrations in the blood are associated with decreased levels of pro-inflammatory markers and higher levels of anti-inflammatory markers (Ferrucci 2006)
FOOD SPOTLIGHT

SALMON

- Omega-3
  - Healthy fat that contributes to brain, joint and heart health
- Vitamin B12
  - Important for nerve health and red blood cell formation
- Vitamin D
  - Helps Calcium absorb into bones
  - Important for cell growth, neuromuscular and immune function
- Protein
  - Building and repairing muscles and other tissues in the body
  - Makes hormones, enzymes and antibodies
  - 6oz Salmon = 34g protein

HOW TO EAT IT

- Cook: Grill, bake, or pan sear
- Season with: olive oil, lemon, garlic, herbs
- Side Dishes: brown rice and veggies

FUN LITTLE FACT:
Wild salmon is pink because of the carotenoids (natural redish-orange chemicals) in the crustacean and fish that it eats.
ANTIOXIDANTS

Exercise-induced oxidative stress may be associated with:
- muscle fatigue
- muscle damage
- decreased in performance

Increase in ROS signals important physiological adaptations

Excessive intakes of antioxidant supplements may impede exercise adaptations to training

Athletes should aim for 9 to 13 servings of fruits and vegetables a day

Gomez–Cabrera 2008
Collision 2015
ANTHOCYANINS

- Tart cherry juice reduces
  - inflammation
  - oxidative stress
  - some symptoms of muscle damage during exercise
- Consumption of cherry juice before and after eccentric exercise significantly reduced strength loss to only 4% compared with 22% using a placebo

Connolly 2006
Regular consumption of probiotics can modify the population of the gut microflora and influence immune function (Carvalho 2013)

Study on endurance athletes during winter training showed that daily use of a probiotic drink for 16 days reduced the incidence of URTIs, resulting in fewer days overall with illness, as well as reduced symptom severity (Cox 2010)
Prebiotics: non-digestible food ingredients that stimulate the growth and/or activity of healthy bacteria in the digestive system to promote health.

Fermented in the GI tract by the microflora resulting in the production of short chain fatty acids which are well known for their anti-inflammatory functions.
MEDITERRANEAN DIET

- High consumption of
  - whole grain breads and cereals
  - fruits
  - vegetables
  - legumes
  - nuts and seeds
  - olives
  - olive oil as principal source of added fat
  - fish and seafood
- Moderate consumption of
  - eggs
  - Poultry
  - dairy products (cheese and yogurt)
  - alcohol (mainly wine during meals)
- Low consumption of
  - red meat

- High intake of the n-3 fatty acids EPA and DHA, which decrease several markers of inflammation
- Lower intracellular oxidative stress by decreasing levels of ROS (Marin 2013)
- Statistically significant inverse associations with almost all inflammatory biomarkers
RESEARCH LOOKS PROMISING...

QUERCITIN  CATECHINS  COCOA
CURCUMIN  CINNAMON  GINGER

Collision 2015
Increase Intake of Omega-3 fatty acids (EPA, DHA, and ALA)

**Food**
- Salmon, Mackerel, Tuna, O3 Eggs, Walnuts, Flaxseed

**Consider Bioavailable Supplement**
- Fish and cod liver oils > Flax or Algae

**Early Nutrition** (first 24 hours)
- Adequate Calories and Protein
- Nausea and Decreased Appetite
- Bland, Familiar Foods
- Bananas, rice, applesauce, and toast

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**Concussed athletes should consume the following amount of protein each day:**

<table>
<thead>
<tr>
<th>Body Weight (lbs.)</th>
<th>Protein Needs (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 lbs.</td>
<td>46.68 g</td>
</tr>
<tr>
<td>150 lbs.</td>
<td>68.102 g</td>
</tr>
<tr>
<td>200 lbs.</td>
<td>91.136 g</td>
</tr>
<tr>
<td>250 lbs.</td>
<td>114.171 g</td>
</tr>
<tr>
<td>300 lbs.</td>
<td>136.205 g</td>
</tr>
</tbody>
</table>

**Food Based Protein Sources**

<table>
<thead>
<tr>
<th>Grams of Protein</th>
<th>Food Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10 g</td>
<td>1c Milk</td>
</tr>
<tr>
<td></td>
<td>1oz Cheese</td>
</tr>
<tr>
<td>10-20 g</td>
<td>12 fl oz Pale MIlk</td>
</tr>
<tr>
<td></td>
<td>1c Green peas</td>
</tr>
<tr>
<td></td>
<td>2T Nut butter</td>
</tr>
<tr>
<td>20-30 g</td>
<td>3 Scrambled eggs</td>
</tr>
<tr>
<td></td>
<td>12 fl oz Core Power</td>
</tr>
<tr>
<td></td>
<td>12 fl oz Gatorade Recovery</td>
</tr>
<tr>
<td></td>
<td>1c Greek yogurt</td>
</tr>
<tr>
<td></td>
<td>1c Cottage cheese</td>
</tr>
<tr>
<td>≥30 g</td>
<td>4oz Lean meats (Turkey, chicken, sirloin, pork loin, fish)</td>
</tr>
</tbody>
</table>
Effect of Docosahexaenoic Acid on a Biomarker of Head Trauma in American Football

- Effect of DHA supplement vs placebo on serum neurofilament light (NFL), a biomarker of axonal injury
- 81 NCAA D1 Football Players
- 8 Serum NFL Measurements:
  - Baseline
  - Pre-season (2)
  - Non conference (2)
  - Conference play (3)

Oliver 2016
DHA SUPPLEMENTATION
CONSIDERATIONS

- Research Limitations
  - Oliver:
    - # of starters completing season-long study
    - Serum NFL measurement without # of Head Impacts
  - Optimal Dose?
  - Funding
    - Majority uses rodent models
- Purity
- Safety
- NCAA distribution rules/regs
Nutrition for Fractures and Bone Health

**Performance Nutrition**

**Consuming Adequate Calories:**
- Maintaining adequate caloric intake in athletes is essential for bone maintenance. Restricting calories may lead to undernutrition and increase risk for stress fractures.

**Consuming Adequate Protein:**
- Bone collagen synthesis responds to increased amino acid levels so it is important for athletes to be eating adequate protein in order to maintain strong bones.

**Athletes at higher risk for fracture:**
- Anorexic females
- Athletes with restrictive eating patterns or diagnosed eating disorder
- Athletes with a history of bone related injuries
- Athletes with a noted diet deficiency of nutrients of concern
- Athletes with a serum vitamin D levels below optimal

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<table>
<thead>
<tr>
<th>Nutrient of Concern</th>
<th>Importance to Athletes</th>
<th>Consume All of the Following to Meet Daily Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Needs increase for heavy workout due to increased amount of excertion</td>
<td>1/2 cup Milk, 1 cup Nogurt, 1/2 cup Kale, 4 oz Salmon, 1 oz Cheese, 1/2 cup Broccoli</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Low levels may hinder athletic performance, decrease muscle strength, and increase risk for injuries</td>
<td>1 oz Salmon, 1 oz Milk, 1 large egg</td>
</tr>
<tr>
<td>Vitamin K2</td>
<td>Allows osteoclasts to draw calcium into bones in order to a strong bone matrix</td>
<td>1/2 cup Collard greens, 1 cup Spinach, 1/2 cup Kale, 1/2 cup Broccoli</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Phosphorus is used to make ATP, which is critical for energy production</td>
<td>1/2 cup Cheese, 1 oz Poultry, 1/4 cup Almonds, 1/2 cup Kale</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Urinary and sweat magnesium losses may be exacerbated in heat/humidity</td>
<td>1/2 cup Almonds, 1/2 cup Broccoli, 1/2 cup Milk, 3 large eggs, 1/2 cup Brian Flakes, 1 cup Lean bread, 1/2 cup Carrots</td>
</tr>
</tbody>
</table>

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**Adequate Calories and Protein**

- Crutching requires 2-3 times as many calories as walking

**Post-Op Considerations**

- Medication Side Effects (Nausea, Constipation, Decreased Gut Bacteria)

**Micronutrients of Focus**

- Vitamin D
- Magnesium
- Calcium
Other Keys for Fracture HEALING

- Optimize Vitamin D Status
- Optimize Calcium (↑) and Phosphorus (↓) Intake

Czeczelewski 2013
Tailor Nutrition to Meet Rehab/Training Situation and goals

Adequate Calories and Protein
- Crutching requires 2-3 times as many calories as walking

Post-Op Considerations
- Medication Side Effects (Nausea, Constipation, Decreased Gut Bacteria)
MAXIMIZE REPAIR AND ADAPTATION

- Consider pre-fuel carbohydrate and fluid needs
- 15-40g protein ASAP after training
- Repeat protein dose every 3-5 hours throughout the day
- Protein rich snack before bed

110# Ironman Finisher
ASAP: 55g Carb + 20g Pro
8 oz Chocolate Milk + Banana
1-2 hrs later: Meal with 4 eggs
MAXIMIZE MPS WITH LEUCINE

- Amino Acid metabolized directly by the muscle
- Stimulates Muscle Protein Synthesis ("Anabolic Trigger")
- Particularly important when injured tissue is resistant to anabolic stimuli

FIGURE 3.4 The "leucine trigger" hypothesis. After consumption of whey protein (which is higher in leucine content than soy or casein), there is a rapid increase in plasma leucine concentration, and this increase corresponds to the extent of stimulation of muscle protein synthesis.
<table>
<thead>
<tr>
<th>Food (serving size)</th>
<th>Leucine (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottage Cheese (1 cup)</td>
<td>2.9</td>
</tr>
<tr>
<td>Turkey Breast (3.5 oz)</td>
<td>2.4</td>
</tr>
<tr>
<td>Chicken Breast (3.5 oz)</td>
<td>2.3</td>
</tr>
<tr>
<td>Wild Salmon (3.5 oz)</td>
<td>2.0</td>
</tr>
<tr>
<td>Canned Tuna (3.5 oz)</td>
<td>2.0</td>
</tr>
<tr>
<td>Haddock (3.5 oz)</td>
<td>1.9</td>
</tr>
<tr>
<td>Beef “Loin” Cuts (3.5 oz)</td>
<td>1.9</td>
</tr>
<tr>
<td>Skim Milk (1 cup)</td>
<td>0.8</td>
</tr>
<tr>
<td>EAS Whey Isolate</td>
<td>0.5</td>
</tr>
<tr>
<td>Muscle Milk Whey</td>
<td>3.0</td>
</tr>
<tr>
<td>Yogurt (1 cup)</td>
<td>1.4</td>
</tr>
<tr>
<td>Red Kidney Beans (1 cup)</td>
<td>1.3</td>
</tr>
<tr>
<td>Lentils (1 cup)</td>
<td>1.3</td>
</tr>
<tr>
<td>Mozzarella Cheese (1 oz)</td>
<td>0.67</td>
</tr>
</tbody>
</table>
Nutrition for Tendon and Ligament Health

**Assessing Risk**
- Female athletes participating in cutting and jumping sports are 4-6 times more likely to tear their ACL than male counterparts.
- Knee laxity in women varies according to menstrual cycle:
  - Days 10-14: greatest laxity (highest estrogen levels)
- Strength, power, and speed are dependent on stiff tendons and ligaments.
  - This is better for performance but makes these tissues more prone to injury.
- Meeting adequate protein and copper needs during times of increased laxity may prove beneficial in injury prevention.

<table>
<thead>
<tr>
<th>Nutrients of Concern</th>
<th>Health Benefits</th>
<th>How to Meet Your Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>Will not increase tendon collagen synthesis, but is important for maintenance of muscle mass.</td>
<td>20g Protein/meal:  • 3 oz Chicken -or-  • 1 c Greek yogurt -or-  • 3 large eggs</td>
</tr>
<tr>
<td>Copper</td>
<td>Could prevent developed laxity.</td>
<td>900mg/day:  • 1 oz Cashews -and-  • 1 c Kale</td>
</tr>
<tr>
<td>Collagen + Vitamin C</td>
<td>Collagen is the primary protein type in tendons and ligaments. Vitamin C plays a vital role in collagen synthesis.</td>
<td>2-5g Gelatin/day. -consumed with- At least 75-90mg/day of Vitamin C:  • 1 Kiwi -and-  • ¾ c Strawberries -or-  6-8 fl apple or grape juice</td>
</tr>
</tbody>
</table>

**Collagen Boosting Juice Recipe:**
- 2-5 g gelatin (powder or as jello)
- 6-8 fl oz apple or grape juice (aim for 100% Daily Value of Vitamin C)
- Mix or shake together.
- Drink 30-60 minutes before training. (Baar 2015)

**Prevention?**
- Adequate protein and copper needs during times of increased laxity (Day 10-14 of menstruation)

**Post Op Considerations**
- Nausea, Constipation, Gut Health, Crutches, Ability to Obtain Fuel

**Pre-rehab/training Gelatin + Vitamin C**
VITAMIN C ENRICHED GELATIN AND COLLAGEN SYNTHESIS

- 8 male subjects
- Effect of Vitamin C Enriched Gelatin vs Placebo on blood amino acid content
- Impact of drawn blood on collagen content of engineered ligaments
- Impact of Gelatin vs Placebo on Blood Marker of Collagen Synthesis
WRAPPING IT UP

Athletic Trainers can and should integrate nutrition into their illness and injury prevention and rehabilitation programs in order to achieve the best possible outcomes

- Handouts
  - http://www.scandpg.org/sports-nutrition/sports-nutrition-fact-sheets/
- Collaborate with a Sports Dietitian
  - http://www.scandpg.org/search-rd/
- Keep an eye on emerging research
  - Twitter: @SCANdpg, @CPSDA, @FuelUpNU
REFERENCES


Carvalho BM, Saad MJ. Influence of gut microbiota on subclinical inflammation and insulin resistance. Mediators Inflamm 2013;2013:986734.


