



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

**KATIE KNAPPENBERGER MS, RD, CSSD, ATC
COORDINATOR OF PERFORMANCE NUTRITION
NORTHWESTERN UNIVERSITY**

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

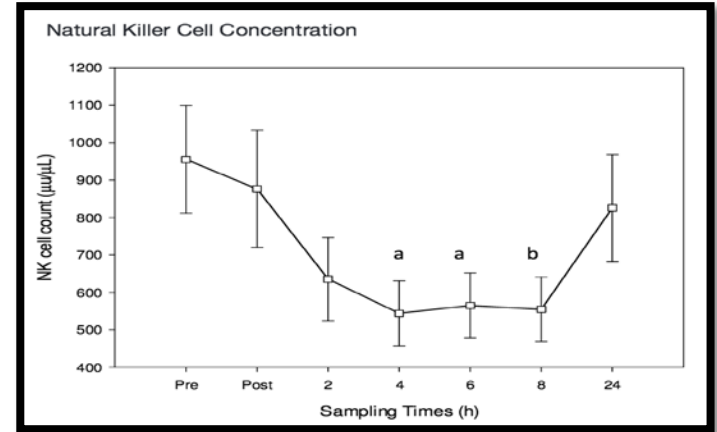
IMMUNE RESPONSE

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

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

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.

NUTRITION INTERVENTIONS TO CONTROL INFLAMMATION AND SUPPORT IMMUNITY

Fluid

Carbohydrate
During Exercise

Dietary Fat

Antioxidants

Anthocyanins

Probiotics

Protein and
Energy

Prebiotics

Mediterranean
Inspired

FLUID

Dehydration

- Associated with increased stress hormone response
- Lower saliva flow rate

Hydration

- Higher saliva flow rate and greater availability of salivary antimicrobial proteins (SIgA, lysozyme, alpha-amylase)

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)



FOODSPOTLIGHT

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

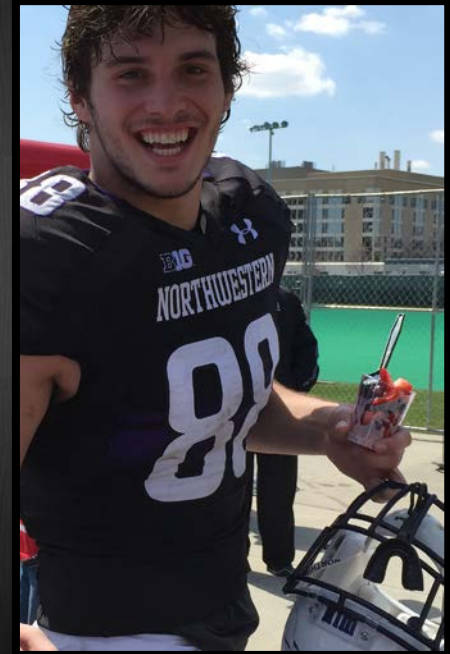
FUN LITTLE FACT:

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

PERFORMANCE
NUTRITION

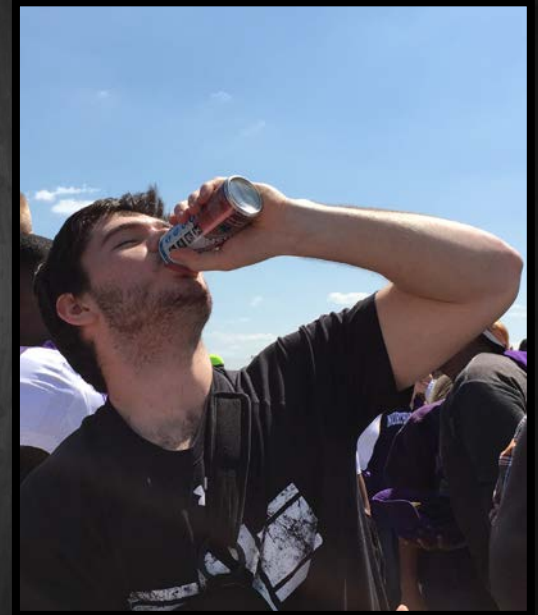
ANTIOXIDANTS

- 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



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



PROBIOTICS

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 URIs, resulting in fewer days overall with illness, as well as reduced symptom severity (Cox 2010)



PREBIOTICS

- **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

NUTRITION INTERVENTION DURING INJURY REHABILITATION

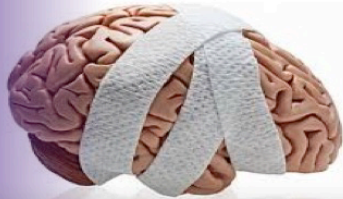
Concussions

Fractures

Muscle
Health

Tendon
Health

Nutrition for Concussion Recovery



PERFORMANCE NUTRITION

Dietary Changes Post-Concussion

- Increase intake of Omega-3 fatty acids (EPA, DHA, and ALA) to aid with recovery.
 - It is especially important to increase EPA and DHA which can be found in food and supplement form.
 - If supplementing, re-esterified triglyceride fish oil, fish body oil, and cod liver oil have the highest bioavailability of EPA and DHA.
- Provide early nutrition within the first 24 hours.
 - At least *half* the amount of calories the athlete would consume on a regular basis.
 - Do not restrict protein or calories during this time.
- If nauseous, consume a bland diet comprised of familiar foods
 - Examples include: Bananas, rice, applesauce, and toast.

Treatment Plan:

- Some research suggests that Omega-3 doses higher than the AI may be beneficial for prevention and/or healing of concussion injuries.
- Consult with a sports dietitian to determine if higher doses or supplementation of Omega-3s should be part of your nutrition plan.

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

Body Weight (lbs.)	Protein Needs (g)
100 lbs.	46-68 g
150 lbs.	68-102 g
200 lbs.	91-136 g
250 lbs.	114-171 g
300 lbs.	136-205 g

Food Based Protein Sources

Grams of Protein	Food Sources
<10 g	1c Milk 1oz Cheese
10-20 g	12 fl oz FairLife Milk 1c Green peas 2T Nut butter
20-30 g	3 Scrambled eggs 12 fl oz Core Power 12 fl oz Gatorade Recovery 1c Greek yogurt 1c Cottage cheese
≥30 g	4oz Lean meats (Turkey, chicken, sirloin, pork loin, fish)

Christina Weidman RDN, LDN

Katie Knappenberger MS, RD, CSSD, ATC

Charlotte Vance MS, RD, CSSC

Copyright © 2016 by Northwestern University Performance Nutrition

May be Reproduced for Educational Purposes Only

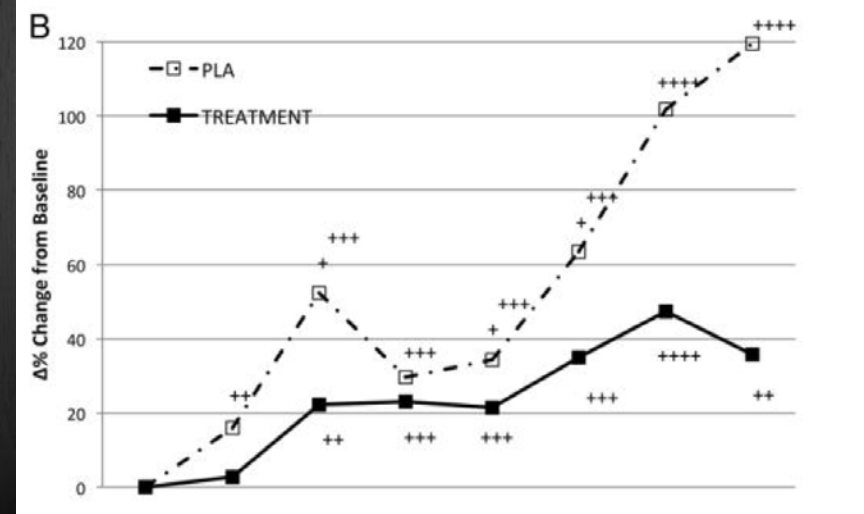
Northwestern Performance Dietitians are members of the Sports, Cardiovascular and Wellness dietetic practice group (SCAN). Please visit the SCAN website www.scandpg.org to find a registered dietitian / certified specialist in sports dietetics in your area.



- 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

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)

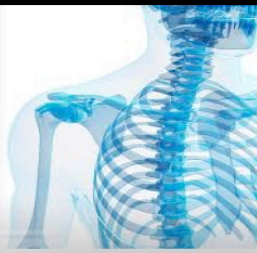


DHA SUPPLEMENTATION CONSIDERATIONS

- ▣ 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 fracture.

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:

- Amenorrheic 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

Those with a history of stress fractures, frequent illness, bone and joint injury, skeletal weakness or pain, or signs of overtraining syndrome should meet with a Registered Dietitian for individualized meal planning.

Nutrient of Concern	Importance to Athletes	Consume All of the Following to Meet Daily Needs
Calcium	Needs increase for heavy sweaters due to increased amount of excretion	8oz Milk 6oz Yogurt 1/2c Kale 4oz Salmon 1oz Cheese 1/2c Broccoli
Vitamin D	Low levels may hinder athletic performance, decrease muscle strength, and increase risk for injuries	3oz Salmon 8oz Milk 1 Large egg
Vitamin K2	Allows osteocalcin to draw calcium into bones in order to a strong bone matrix	1/2c Collard greens 1c Spinach 1c Kale 1/2c Turnip greens
Phosphorus	Phosphorus is used to make ATP, which is critical for energy production	1.5oz Cheese 3oz Poultry 1/4c Almonds 1/2c Edamame
Magnesium	Urinary and sweat magnesium losses may be exacerbated in heat/humidity	1/2 c Almonds 1/2c Broccoli 8oz Milk 3 Large eggs 1/2c Bran Flakes 4oz Lean beef 4 Large carrots 1/4c Cashews

Christina Weidman RDN, LDN
Katie Knappenberger MS, RD, CSSD, ATC
Charlotte Vance MS, RD, CSCS

Copyright © 2016 by Northwestern University Performance Nutrition
May be Reproduced for Educational Purposes Only

Northwestern Performance Dietitians are members of the Sports, Cardiovascular and Wellness dietetic practice group (SCAN). Please visit the SCAN website www.scandpg.org to find a registered dietitian / certified specialist in sports dietetics in your area.

- 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

Other Keys for Fracture HEALING

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

MEAN VALUES (±SD) OF DAILY PROTEIN AND MINERAL INTAKES BY ADOLESCENT FEMALE SWIMMERS AND CONTROLS

Variable	Swimmers (n = 20)			Controls (n = 20)			Years	Groups	Y. x Gr.
	2008	2009	2010	2008	2009	2010			
Energy intake (kcal)	2227 ± 470	2513 ± 531	2604 ± 548	2047 ± 406	2355 ± 459	2489 ± 435	***		
Protein (g)	70.7 ± 16.8 [^]	71.6 ± 17.6 [^]	73.4 ± 18.9 [^]	63.8 ± 13.9 [^]	71.7 ± 13.6 [^]	69.8 ± 16.0 [^]			**
Calcium (mg)	527 ± 201 [^]	770 ± 258 [^]	649 ± 247 [^]	414 ± 197 [^]	751 ± 357	746 ± 304			***
Phosphorus (mg)	1193 ± 266 [^]	1170 ± 246 [^]	1302 ± 268 [^]	1016 ± 264 [^]	1268 ± 217 [^]	1169 ± 272 [^]			***
Ca:P	2.45 ± 0.84 [^]	1.66 ± 0.67 [^]	2.17 ± 0.68 [^]	2.82 ± 0.99 [^]	1.94 ± 0.68	1.73 ± 0.56			***
Ca:Protein	7.6 ± 2.9 [^]	11.2 ± 4.5 [^]	8.8 ± 3.4 [^]	6.4 ± 2.5 [^]	10.4 ± 4.0	10.7 ± 3.9			***

Nutrition for Muscle Strain

PERFORMANCE NUTRITION

Nutritional strategy is similar to the protocol for increasing lean muscle mass.

- Provide protein at optimal times to help support growing tissues.
- Consume protein source immediately to 30 mins after a workout/rehab session.

What Puts Athletes at a Higher Risk?

- To optimize performance in elite sports, athletes must maximize the stiffness of the musculoskeletal system.
 - Greater musculoskeletal stiffness leads to better performance.
- However, when tendons are stiffer than the muscle is strong, the protective effect of the tendon is lost and the muscle ruptures.

Nutrient of Concern	Benefit to Athletes	Meeting the Requirements
Protein	Supports adaptation, repair, and remodeling	100lbs: 55–90g pro/day 150lbs: 82–136g pro/day 200lbs: 109–182g pro/day 250lbs: 136–227g pro/day 300lbs: 164–273g pro/day
Phosphatidic Acid (PA)	Can improve muscle mass and maximize strength	Increase the following foods in your diet: <ul style="list-style-type: none">• Cabbage• Tomatoes• Peas• Cucumber• Celery
Phosphatidylserine (PS)	Decreases stress markers during intense training cycles	300mg/day: <ul style="list-style-type: none">• 3.5oz Dark meat chicken -and-• 3.5oz Tuna
Carbohydrates	Replenishes glycogen stores to have energy for upcoming workouts	50g Carbs/Refuel: <ul style="list-style-type: none">• 1.5c Oatmeal• 1 Large banana and 8oz chocolate milk• 8oz yogurt and 1c berries• 1 Clif bar and 1 clementine

Christina Weidman RDN, LDN
Katie Knappenberger MS, RD, CSSD, ATC
Charlotte Vance MS, RD, CSCS

Copyright © 2016 by Northwestern University Performance Nutrition

Northwestern Performance Dietitians are members of the Sports, Cardiovascular and Wellness dietetic practice group (SCAN). Please visit the SCAN website www.scandpg.org to find a registered dietitian / certified specialist in sports dietetics in your area.



- 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

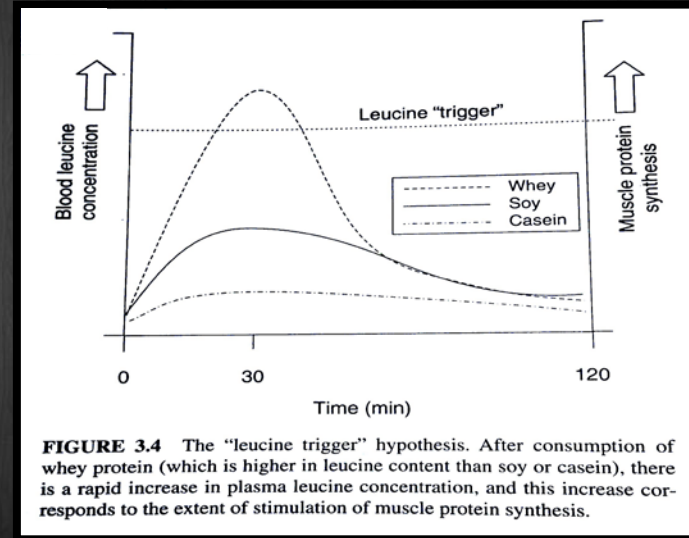
- Consider pre-fuel carbohydrate and fluid needs
- 15-40g protein ASAP after training
- Repeat protein dose every 3-5 hours throughout the day
- Protein rich snack before bed



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



MAXIMIZE MPS WITH LEUCINE

**Aim for 2.5
grams in post
exercise
meal/snack**

Food (serving size)	Leucine (grams)
Cottage Cheese (1 cup)	2.9
Turkey Breast (3.5 oz)	2.4
Chicken Breast (3.5 oz)	2.3
Wild Salmon (3.5 oz)	2.0
Canned Tuna (3.5 oz)	2.0
Haddock (3.5 oz)	1.9
Beef “Loin” Cuts (3.5 oz)	1.9
Skim Milk (1 cup)	.8
EAS Whey Isolate	0.5
Muscle Milk Whey	3.0
Yogurt (1 cup)	1.4
Red Kidney Beans (1 cup)	1.3
Lentils (1 cup)	1.3
Mozzarella Cheese (1 oz)	.67

Nutrition for Tendon and Ligament Health

PERFORMANCE NUTRITION

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.

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)

Nutrients of Concern	Health Benefits	How to Meet Your Goal
Protein	Will not increase tendon collagen synthesis, but is important for maintenance of muscle mass.	20g Protein/meal: <ul style="list-style-type: none">• 3oz Chicken-or-• 1c Greek yogurt-or-• 3 Large eggs
Copper	Could prevent developed laxity.	900mcg/day: <ul style="list-style-type: none">• 1oz Cashews-and-• 1c Kale
Collagen + Vitamin C	Collagen is the primary protein type in tendons and ligaments. Vitamin C plays a vital role in collagen synthesis.	2-5g Gelatin/day: <ul style="list-style-type: none">-consumed with-At least 75-90mg/day of Vitamin C:<ul style="list-style-type: none">• 1 Kiwi-and-• ½c Strawberries-or-6-8 fl apple or grape juice

Christina Weidman RDN, LDN
Katie Knappenberger MS, RD, CSSD, ATC
Charlotte Vance MS, RD, CSCS

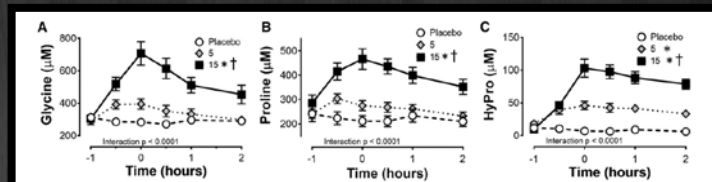
Copyright © 2016 by Northwestern University Performance Nutrition
May be Reproduced for Educational Purposes Only

Northwestern Performance Dietitians are members of the Sports, Cardiovascular and Wellness dietetic practice group (SCAN). Please visit the SCAN website www.scandpg.org to find a registered dietitian / certified specialist in sports dietetics in your area.

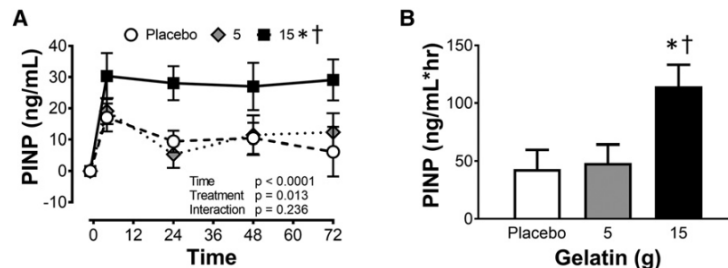
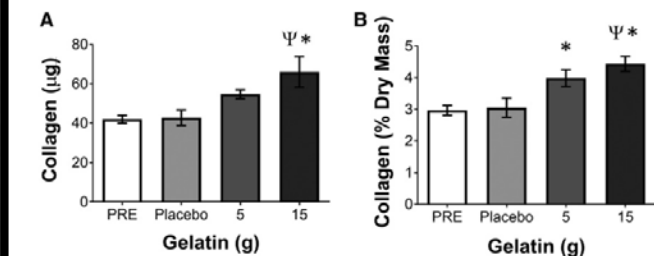
- Prevention?
 - Adequate protein and copper needs during times of increased laxity (Day 10-14 of menstruation)
- Post Op Considerations
 - Nausea, Constipation, Gut Health, Crutches, Ability to Obtain Fuel
- Pre-rehab/training Gelatin + Vitamin C

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



SHAW ET AL.



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.nata.org/practice-patient-care/health-issues/nutrition>
- <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

- Bishop NC, Blannin AK, Armstrong E, Rickman M, Gleeson M. Carbohydrate and fluid intake affect the saliva flow rate and IgA response to cycling. *Med Sci Sports Exerc* 2000;32:2046-2051
- Burke, Louise, Vicki Deakin, and Bethanie Allanson. *Clinical Sports Nutrition*. 5th ed. N.p.: McGraw-Hill Education, 2015. Print.
- Collison, Sharon. *Nutritional Strategies to Decrease Inflammation and Enhance Immunity for the Athlete*. 2015. My Sports Dietitian. Web.
- Connolly, D. A. J. "Efficacy of a Tart Cherry Juice Blend in Preventing the Symptoms of Muscle Damage * Commentary 1 * Commentary 2." *British Journal of Sports Medicine* 40.8 (2006): 679-83. Web.
- Carvalho BM, Saad MJ. Influence of gut microbiota on subclinical inflammation and insulin resistance. *Mediators Inflamm* 2013;2013:986734.
- Cox AJ, Pyne DB, Saunders PU et al Oral administration of the probiotic *Lactobacillus fermentum* VRI-003 and mucosal immunity in endurance athletes. *British J of Sports Med* 2010;44:222-6.
- Czezelewski, Jan, Barbara Dąygo-Åcka, and Ewa Czezelewska. "Intakes Of Selected Nutrients, Bone Mineralisation And Density Of Adolescent Female Swimmers Over A Three-Year Period." *Biology of Sport* 30.1 (2013): 17-20. Web.
- Ferrucci L, Cherubini A, Bandinelli S. Relationship of plasma polyunsaturated fatty acids to circulating inflammatory markers. *J Clin Endocrinol Metab*. 2006;91(2):439–46.
- Harvey KA, Arnold T, Rasool T, Antalis C, Miller SJ, Siddiqui RA. Trans-fatty acids induce pro-inflammatory responses and endothelial cell dysfunction. *Br J Nutr* 2008;99(4):723-731.
- Kakanis, M., J. Peake, S. Hooper, B. Gray, and S. Marshall-Gradisnik. "The Open Window of Susceptibility to Infection after Acute Exercise in Healthy Young Male Elite Athletes." *Journal of Science and Medicine in Sport* 13 (2010) Web.
- Marín C, Yubero-Serrano EM, López-Miranda J, Pérez-Jiménez F. Endothelial Aging Associated with Oxidative Stress Can Be Modulated by a Healthy Mediterranean Diet. *Int. J. Mol. Sci*. 2013;14:8869-8889
- Oliver, Jonathan M., Margaret T. Jones, K. Michele Kirk, David A. Gable, Justin T. Repshas, Torie A. Johnson, Ulf AndrÅsson, Niklas Norgren, Kaj Blennow, and Henrik Zetterberg. "Effect of Docosahexaenoic Acid on a Biomarker of Head Trauma in American Football." *Medicine & Science in Sports & Exercise* 48.6 (2016): 974-82. Web.
- Rosenbloom, Christine, and Ellen Coleman. *Sports Nutrition: A Practice Manual for Professionals*. Chicago, IL: Academy of Nutrition and Dietetics, 2012. Print.
- Shaw3, Gregory, Ann Lee-Barthel5, Megan LR Ross34, and And Bing Wang7. "Gregory Shaw." *The American Journal of Clinical Nutrition*. N.p., n.d. Web. 24 Feb. 2017.
- Walsh NP, Gleeson M, Pyne DB, Nieman DC, Dhabhar FS, Shephard RJ, Oliver SJ, Berman S, Kajeniene A. Position statement. Part two: Maintaining immune health. *Exerc Immunol Rev*. 2011;17:64-103.