

Top Sports Nutrition Concerns Seen in Adolescent Sports Medicine

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CHOC RD's in Practice: Pediatric Sports Nutrition

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Pediatric Sports Medicine Essentials for Office Evaluation



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Disclosures



- I do receive royalties for SLACK Publications from my textbook

Goals and Objectives

- Case-based presentation
 - Identification and management tips for the anemic athlete
 - Compare and contrast the roles of water vs. sports beverages
 - Explore strategies for athletes suffering from Female Athlete Triad and/or Relative Energy Deficit
 - Review contributions of protein and creatine to recovery
- Practical recommendations
- Whole food based to maximize collateral benefits

Case One

**SHOULD I TAKE EXTRA IRON TO
BOOST MY PERFORMANCE?**

Role of Iron in Oxygen Transport

- **Hemoglobin**- transports oxygen in blood
- **Myoglobin**- accepts, stores, and releases oxygen in muscle
- About 70% of body iron in hemoglobin or myoglobin



Iron Storage

- **Ferritin:** intracellular protein that stores iron
 - Acute Phase Reactant
 - Levels may rapidly fluctuate due to stressors



Anemia

- Decreased **hematocrit** (amount of red cells in blood) and/or hemoglobin able to transport oxygen
- **Results in decreased aerobic performance**
 - Fatigue
 - Poor recovery
 - Slower race times



Causes of Anemia in Athletes

- Gastrointestinal Losses
- Foot Strike Hemolysis
- Larger Bruises, Contusions or Hematomas
- Menstrual Losses
- Athletic Pseudo-Anemia
- Excessive Sweat Losses (pretty rare)
- Insufficient Iron Intake

Gastrointestinal Losses

- **Non-steroidal Anti-inflammatory Use**
- Reflux esophagitis
 - Cyclists and runners
- Higher **reticulocyte count**
- **Occult blood positive stools**



Foot Strike Hemolysis

- Break down of red cells due to impact of foot with ground
 - Distance Runners
- **Peripheral Smear:** fragmented, irregular cells
- **Mean Corpuscular Volume (MCV):** higher due to larger immature cells released into blood



Larger Bruises, Contusions or Hematomas

- Acute trauma
- Relatively rapid decrease in hematocrit/hemoglobin
- Serial measurements recommended



Menstrual Losses

- Heavier menstrual flow
- Higher number of days of menstrual flow
- Actual trend toward longer or absent menstrual cycles in active female athletes



Athletic Pseudo-Anemia

- Increased plasma volume relative to increase in red cell counts
 - Less viscosity allows more efficient red cell transport
- **Red Blood Cell Counts (RBC), Red Cell Sizes (MCV/MHCH) and Ferritin all normal**



Insufficient Iron Intake

Hematocrit and Hemoglobin	Low
Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC)	Low
Total Iron Binding Capacity (TIBC)	High
Iron Saturation	Low
Ferritin	Low

Little doubt in professional literature that classic iron deficiency anemia can contribute to diminished aerobic performance, and that supplementing iron stores is indicated

Where It Gets Interesting....

**NORMAL RED CELL COUNTS AND IRON STORES,
SHOULD I STILL TAKE EXTRA IRON?**

OR EVEN BETTER,

**SHOULD ALL ENDURANCE ATHLETES TAKE EXTRA
IRON?**

Hereditary Hemochromatosis

- Excessive Iron Affinity
- Increased Iron Deposition
 - Early organ damage
 - Bronze color to skin
- Tends to run in families
- More common and presents sooner in males
 - Menstration in females delays clinical onset



Hereditary Hemochromatosis

Screening and Confirmation

- Screen:
 - Iron (Transferrin) Saturation
 - >45% in males
 - >45-50% in females
 - (high serum ferritin higher risk factor)
 - Many suggest screen any male before iron supplementation
- Confirm:
 - Blood genetic testing for C282Y and H63D mutations



Normal red cells, normal ferritin

Prevailing thought is that supplemental iron intake is **not** needed and may actually have risks (organ damage, higher risk of liver cancer) that outweigh any benefits to performance.

Now, Where It Gets Really Interesting

ROLE OF IRON SUPPLEMENTATION WITH

LOW FERRITIN AND NORMAL OR LOW

NORMAL HEMATOCRIT/HEMOGLOBIN

Things to Consider

Unique Demands of Endurance Athletes

- Athletic individuals have different oxygen transport and muscle function demands.
- What many of us consider as "normal" hemoglobin values for less active individuals may not be so acceptable for intense endurance or team sports athletes.
- Many athletes may strive for hemoglobin levels at least 2-3 points above the lowest range of normal.

Things to Consider

The Perplexing Role of Ferritin

- Ferritin levels can be influenced by illness or even total body inflammation, so often sick or over-trained and under-performing athletes mistakenly appear to be "doing better" with iron intake based solely on higher ferritin levels.
- If you "trust" ferritin, then deciding on acceptable levels is yet another concern. In many athletes, keeping levels in the 20-30 range is a challenge during period of heavier training or competition.

Is There Something Better Than Ferritin?

- **Soluble Transferrin Receptor:** may be more accurate in measuring iron stores
 - **Not an acute phase reactant**



Bottom Line?

- The results of a recent meta-analysis lend additional support that iron supplementation for low iron stores without frank anemia can improve iron status and aerobic capacity.
 - Burden R, Br J Sports Med 2015;49:21
- Higher doses of iron supplementation over a shorter period of time were suggested to be more effective than smaller doses over longer periods with effect on iron stores to be diminished with a treatment period over 80 days.
- Optimal dosing amounts, protocols, and routes (oral versus injected) require more study.

Food Sources of Iron

- Best Absorbed: Red meat, Red fish, Dark poultry, Veal
 - Also supply protein and creatine
- Leafy Green Vegetables, Raisins, Nuts
 - Need almost astronomical amounts for sufficient effect
- Vitamin C enhances absorption
- Cooking with Cast Iron pan/skillet



US RDA for Elemental Iron

Age (Years)	Daily Dose of Elemental Iron
3-8	10 mg/day
8-13	8 mg/day
>13 years	
MALES	11 mg/day
FEMALES	15 mg/day

Liquid or Pill Iron Supplement Doses

Ferrous Sulfate, Ferrous Gluconate, Ferrous Fumarate, Ferrous bis-glycinate chelate

- 3-6 mg **elemental iron**/kg/day
 - Liquid forms contain 20% elemental iron
 - Dried forms (monohydrate) have 30-33%
 - BID to TID
 - Many recommend nightly dosing for GI upset
 - Compliance is major issue
 - Recommend taking until next scheduled blood draw (2-3 months)

Liquid or Pill Iron Supplements

Ferrous Sulfate, Ferrous Gluconate, Ferrous Fumarate, Ferrous bis-glycinate chelate

- Indications
 - Insufficient Food Intake
 - Vegetarian/Vegan
 - Prolonged Insufficiency
 - Ferritin <20
- Issues
 - Liquid: Staining of teeth
 - Use a straw
 - Constipation
 - Stool softener is a must
 - Ferrous fumarate may be better tolerated
 - Ferrous bis-glycinate chelate requires lower dosing, may be better tolerated



Goals

- Increase Hemoglobin by at least 1 point
- Increase Ferritin over 20
- Reduce impact of side effects



Unique Challenges

- Iron Supplementation not an overnight success
 - Takes at least 100 days to increase red cell production
- Anti-inflammatory diet may increase absorption
 - Less processed carbohydrates/foods
 - Increased ginger, tumeric, berries/cherries, omega-3 fatty acids



Role of Intramuscular or Intravenous Iron?

- Few studies in elite athletes
- Failed diet and oral supplementation
- Risks:
 - Anaphylaxis
 - Skin/muscle necrosis
 - Iron toxicity
- Certain IM/IV administrations may be banned for elite athletes



Why Isn't it Working?

- Confirm Diagnosis
- Eliminate other causes of anemia
- Discuss compliance
- Absorption Issues
 - Carbonation
 - Concurrent Calcium intake
 - Equivocal data if Helicobacter infection reduces iron absorption



Other Things to Consider

- Other causes of fatigue/underperformance
 - Emotional/physical overtraining and burnout
 - Insufficient sleep
 - Less than 8.5 hours a night in high school population
 - Relative energy availability concerns
 - Insufficient overall intake for level of physical demand



The Fluid Battle

WATER VS. SPORTS BEVERAGES

Indications for Sports Beverages

American Academy of Pediatrics Councils on Sports Medicine and Fitness and Nutrition

<http://pediatrics.aappublications.org/content/early/2011/05/25/peds.2011-0965.full.pdf>

- Sports drinks have a specific limited function
 - More rapid replenishment of carbohydrates and/or electrolytes in **combination with water** during prolonged sports
- Concerns over excessive sugar intake
 - Dental Erosion
 - Caloric Intake
 - Carbohydrate/sugar load
 - Weight Issues



Pre-Activity

- The Winner: **WATER**
- **WHY?**
 - Inexpensive, readily accessible and low-calorie option
 - Cold water better absorbed
 - For kids who won't drink water and prefer a flavored beverage, then sports drinks right before exercise are a sensible option.



Guidelines for Pre-Exercise Hydration

<http://www.acsm.org/docs/brochures/selecting-and-effectively-using-hydration-for-fitness.pdf>

- Drink 16-20 fluid ounces of water or sports beverage at least four hours before exercise.
- Drink 8-12 fluid ounces of water 10-15 minutes before exercise.



Other Pre-Exercise Hydration Thoughts

- Dehydration can affect quality of exercise, ability to maintain body temperature, and may lead to early fatigue and cramping.
- Keep an eye on body weight, especially in hot or humid environments, and in multiple exercise sessions with short recovery periods.
- More than 2% weight loss from regular weight suggests dehydration and requires adequate fluid intake (usually with water)



During Activity

- The winner: **Kinda Depends**
- **WHY?**
 - For most exercise *under an hour*, water is a very sensible
 - If the exercise *over an hour*, water is still a solid selection, but there is increased role for sports beverages to help replace carbohydrates and electrolytes
 - For those *salty sweaters* (white salt rings on headgear and uniforms, sweat has a distinct salt taste), sports beverages can help replace those sweat salt losses.



Maintaining Fluid Balance

“depending on tolerance”

Exercising for less than 60 minutes	Drink 3-8 fluid ounces of water every 15- 20 minutes depending on tolerance
Exercising greater than 60 minutes	Drink 3-8 fluid ounces of a sports beverage or water (5-8 percent carbohydrate with electrolytes) every 15-20 minutes depending on tolerance

Risks of Over-Hydration

- Excessive water ingestion without adequate salt intake can lead to low serum sodium levels (hyponatremia) with risks of seizures, brain swelling and even death.
- Thus, many authorities recommend against rigid or forced consumption of water especially during ultra-endurance events such as marathons or triathlons.



Post-Activity

- The Winner: **Neither**
- **WHY?**
 - Cannot go wrong with water or measured amounts (again to reduce sugar/calorie burden) of sports drinks
 - **But** if the ultimate goal is optimizing immediate (first 30 minutes) recovery including rehydration....



Chocolate Milk

- Adequate fluids for rehydration, but also scientifically supported ratios of carbohydrate to protein that enhance muscle repair and recovery
- Delivers calcium and Vitamin D especially with indoor sport athletes that have reduced opportunity for Vitamin D absorption
- Almond, rice or soy-based chocolate milk can be used for those who don't tolerate or are allergic to cow's milk.
- Usually isn't much objection to the sweet taste.



Tart Cherry Juice

Kuehl K, [Med Sport Sci.](#) 2012;59:86-93

- Provides necessary fluid intake with collateral benefits of anti-inflammatory properties that could reduce both immediate and delayed muscle soreness and stiffness
- Might actually be able to reduce perceived need for non-steroidal anti-inflammatory medications after exercise



Guidelines for Use

- One 8-12 ounce serving of chocolate milk or tart cherry juice within 30 minutes of completing activity.
- Can use similar amount of sports beverage
- Measure weight after activity- for every one pound of weight loss, recommend consumption of 16-24 ounces of fluid, of which water should be the primary component.



SPEAKING ABOUT ENERGY ISSUES

**RELATIVE ENERGY DEFICIT (REDS) AND
FEMALE ATHLETE TRIAD ISSUES**

What is the Female Athlete Triad?

Berz and McCambridge, Pediatric Sports Medicine: Essentials for Office Evaluation (Koutures and Wong, eds). SLACK, 2013

- Menstrual Function
 - Primary Amenorrhea
 - No period after age 15
 - Secondary Amenorrhea
 - Absence of menses for 3 cycles or 6 months after established normal cycles
- Bone Mineral Density
 - Stress Injuries
- Energy Availability
 - **Disordered Eating**



How about **Relative Energy Deficiency?**

Br J Sports Med 2014;48:491-497 doi:10.1136/bjsports-2014-093502

- “inadequacy of energy to support the range of body functions involved in optimal health and performance”
- Involves males
- Considered a syndrome that impairs physiologic and/or psychologic function



Who is at risk?

- Weight class athletes
- Disciplines that favor leanness
- Activities with subjective scoring



Why Athletes Will Get Referred....

- Amenorrhea
- Bone Stress Injuries
 - More than one
 - Higher risk stress fractures
 - Complicated healing
- Under-performance
- Injured athletes
 - Fear of weight gain while inactive
- Family discord or history of abuse



Particular Food-based Behaviors

- Restrictive Diet
 - Inadequate caloric intake
 - Ignorance rather than disease
- Pre-occupation with weight or food
- Won't eat in front of teammates
- Meticulous counting of calories or fat grams
- Regimented “extra” exercise
- Use of laxatives or diuretics



Team-Based Collaborative Evaluation

- Follow Height, Weight and BMI
- Calculate Energy Availability
 - 3 Day Food and Activity Diary
 - Accelerometer
- Consider EKG in syncope/presyncope or bradycardia
- Consider DEXA scan
 - Persistent amenorrhea > 6 months
 - Multiple or high risk stress fractures
- Psychological Support



Goals and Outcomes

- Evidence suggests that keeping BMI >28%ile contributes to regular menstrual function
 - Golden NH, Carlson JL. The Pathophysiology of Amenorrhea in the Adolescent. *Annals of the New York Academy of Sciences* 2008 Jun; 1135:163-178.
- Modify activity levels to “match” energy intake
- Liberalize activity as energy intake levels increase



Elements of a Treatment Contract

Berz and McCambridge, In Pediatric Sports Medicine: Essentials for Office Evaluation, Koutures and Wong eds, SLACK 2013

- **Frequency of follow-up appointments:** Usually once per week until weight stabilizes
- **Frequency of labs:** Initial visit and then every 6 -8 weeks until steady weight gain is established
- **Names of practitioners who will evaluate the athlete:** Nutritionist, Psychologist, Physician
- **Expected weight gain per week:** 0.5 to 1 lb
- **Minimum acceptable weight:** < 85% of expected weight for height/age is DSM IV TR criteria for AN
- **Goal Body Mass Index (BMI):** < 18.5 or < 5th percentile on a growth chart considered underweight
- Weight at which the athlete must stop physical activity or that requires hospitalization
- Statement that failure to comply will result in restriction from sport
- Statement that the athlete's family may be contacted as necessary if condition worsens
- All initial labs and screening tests must be completed in certain time frame-usually 1-2 weeks.

Evaluation of Abnormalities Using a Serum Metabolic Panel

Berz and McCambridge in Pediatric Sports Medicine- Essentials for Office Evaluation, Koutures and Wong eds, SLACK 2013

Glucose	Decreased in poor nutrition, increased in insulin deficiency
Sodium	Decreased with increased water intake or laxative use
Potassium	Decreased in vomiting, laxative or diuretic use, refeeding syndrome
Chloride	Decreased in vomiting, increased with laxative use
Bicarbonate	Increased in vomiting, decreased in laxative use
BUN	Increased in dehydration
Creatinine	Increased in dehydration or renal dysfunction, falsely elevated due to low muscle mass
Calcium	Decreased or normal in poor nutrition with bone breakdown
Phosphate	Decreased in poor nutrition or refeeding
Magnesium	Decreased in poor nutrition, laxative use, refeeding syndrome
Total protein/Albumin	Increased in early malnutrition due to muscle breakdown
Aspartate aminotransaminase (AST)	Increased in liver dysfunction
Alanine aminotransaminase (ALT)	
Amylase	increased in vomiting and pancreatitis
Lipase	Increased in pancreatitis

Mechanisms for Modifying Behavior

- Shift obsession from calories to portions
- Create concrete changes
 - Adding 100 kcal/week
 - Adding avoided food group
- Address underlying issues
 - Family/individual therapy
 - Medications



Contraindications for Participation

- BMI < 17
- Weight that goes down 2 lines on growth chart
- Failure to meet targeting weight gain goals
- Hospitalization
 - dehydration
 - severe/symptomatic bradycardia
 - electrolyte abnormalities



Protein and Creatine

**I WANT TO GET BIGGER AND
STRONGER!**

Protein

- Made up of amino acids
- Can assist in building muscle when combined with resistance training
- Common types
 - Whey
 - Casein
- Big fan of **Whole Food based sources**
- **Supplements no better than food sources**



What are Protein Requirements?

- USA RDA
 - 0.8 gm/kg/day (adult)
- Endurance Athletes
 - 1.2-1.4 gm/kg/day
- Strength Athletes
 - 1.2-1.7 gm/kg/day



Amount is Usually Not the Issue

- “Standard American Diet”
 - Most males get sufficient amounts of protein
 - Excessive protein tends to be excreted in the urine
- Who might not get adequate amount?
 - Restricted/limited/no animal based food product intake
 - Malabsorption



Timing of Protein Intake

- Best: within 30 minutes **after** finishing athletic activity
 - Up to 30 grams
 - Simultaneous ingestion of carbohydrate may enhance absorption
- Some evidence suggests another protein load **2 hours after exercise**



Chocolate Milk

- 4:1 gram ratio of carbohydrate to protein
- Collateral benefits
 - Calcium (300 mg/8 oz)
 - Vitamin D (100 IU)
 - Sodium (150 mg)
 - Potassium (425 mg)
 - Tastes good
 - Relatively inexpensive
 - Easy to obtain



Evidence Supporting Chocolate Milk

- Consuming chocolate milk immediately after exercise and again at 2 h post-exercise appears to be optimal for exercise recovery and may attenuate indices of muscle damage
 - Pritchett K, Med Sports Sci 2012; 59:127-134
- Chocolate milk may be as effective as or superior to (commercial recovery beverages) in promoting recovery
 - Spaccarotella K, J Strength Cond Res 2011 Nov;25(11):3198-204
- The effects of consumption of MILK after endurance exercise on muscle protein fractional signal rate, signaling molecules of skeletal muscle protein turnover, leucine kinetics, and performance measures suggest unique benefits of milk compared with a CHO-only beverage
 - Lunn W, Med Sci Sports Exerc 2012 Apr;44(4):682-91

Other Easy to Access Food-based Protein Sources

- Yogurt
 - Especially Greek Yogurt
- Peanut or Almond Butter
- Nuts and seeds
 - Trail mix
- Cruciferous Vegetables
 - Broccoli, Cauliflower, Carrots



How About Protein Drinks, Shakes and Powders?

- Benefits
 - Condensed delivery
 - Taste good
 - Appealing
 - Collateral elements
- Potential Downsides
 - Cost
 - Overload on urinary system
 - Dependence
 - Unwanted collateral elements
 - Bridge to other supplements?

Creatine Monohydrate

- Phosphate donor
 - ATP resynthesis from ADP
 - Primary energy source for short-duration (10 second) anaerobic high-intensity exercise
 - Terjung, Med Sci Sports Exerc. 2000; 32(3):706-717
- Use to enhance muscle hypertrophy and recovery
 - Med Sci Sports Exerc. 2009; 41(3):709-731



Food Sources of Creatine

- Wild Game
- Domestic Meats
 - Free Range richer than Commercially Prepared
- Wild Caught Fish
- Milk (rather small amount)
- Cranberries (rather small amount)



Why Supplement?

- Supplementation can increase muscle phosphocreatine stores by 20%
 - Smith, Contemporary Pediatrics 2009;26(2):36-46
- Common Forms
 - Liquid
 - Powder



Potential Creatine Side Effects

- Gastrointestinal Discomfort
- Diarrhea
- Weight Gain
- Muscle Cramping
- Muscle Strains
- Renal Dysfunction



Opinions on Creatine

- Most US-based national sports medicine medical bodies do not recommend creatine supplementation in athletes < 18 y/o
 - American Academy of Pediatrics
 - American College of Sports Medicine

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Our Present and Future Athletes Thank You!

